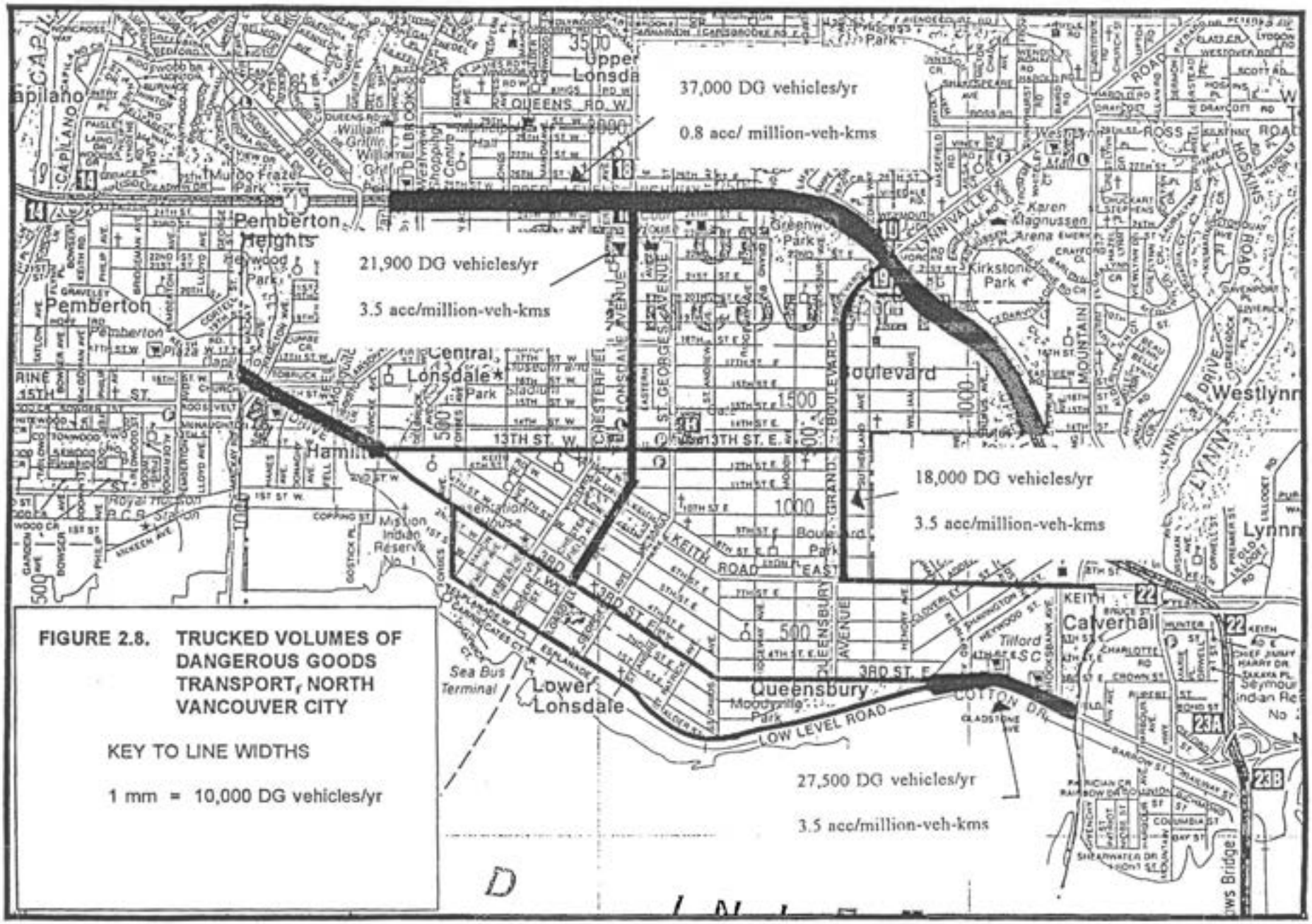

FIGURE 2.8. TRUCKED VOLUMES OF DANGEROUS GOODS TRANSPORT, NORTH VANCOUVER CITY

2.3.3 Road Accident Rates

Road accident rates represent the number of accidents on a given roadway divided by the number of vehicles that use that route. These rates are expressed in terms of the number of accidents per million vehicle-kilometres:

$$\text{Accident Rate} = \frac{\text{Number of Accidents}}{\text{Million Vehicle-Kms}}$$

Researchers recognize there are hundreds of factors that combine to determine the actual risk of dangerous goods transportation by road. Some of the factors related to the probability of a dangerous goods incident are listed below:

- Roadway types
- Number of lanes
- Number of intersections
- Roadway lighting
- Roadway visibility
- Road surface condition
- Traffic volume
- Traffic controls
- Terrain
- Vehicle speed
- Driver care
- Driver training
- Driver experience
- Vehicle condition
- Vehicle size
- Container type and size
- Time of day
- Time of year

One simplifying assumption is commonly applied to the method of estimating risks: Vehicles carrying dangerous goods are exposed to the same hazards as all other vehicles on the road. This assumption allows us to use available accident rates for all vehicles to represent accident probability involving dangerous goods vehicles.

Figure 2.9 presents common accident rates for a variety of road types found within Canada.

FIGURE 2.9. ACCIDENT RATES BY ROAD TYPE

ROADWAY TYPE	ACCIDENTS / MILLION VEHICLE-KM
Freeway / Expressway	0.8
Provincial Highways	1.2
Provincial Secondary Roads	1.5
Urban Arterials	3.5
Other Roadways	4.7

Source: LaMorte / Williams & Associates, 1987.

Applying these accident rates to North Vancouver roadways yields:

- 0.8 accident per million vehicle kilometres for the Upper Levels Highway
- 3.5 accidents per million vehicle kilometres for urban arterial streets like Marine Drive, Third Street, and Lonsdale Avenue

Accident rates for principal roadways in North Vancouver are indicated in Figure 2.8, shown previously.

2.4 RAIL TRANSPORT

The rail transport of dangerous goods on the North Shore is currently conducted by two railway companies:

- British Columbia Rail (B.C. Rail)
- Canadian National Rail (C.N. Rail)

The provincial carrier, B.C. Rail, enters the study area from the north, while the C.N. line crosses the Second Narrows from Burnaby in the south. Both rail firms interchange cars at the Mission Indian Reserve in North Vancouver. Only C.N. Rail operates the mainline that passes through the City of North Vancouver.

2.4.1 Rail Dangerous Goods Routes

The rail line transporting dangerous goods in North Vancouver is shown in Figure 2.10, as described below.

The C.N. Rail mainline, comprising a portion of the Yale Subdivision, enters the North Shore as it crosses the rail bridge at the Second Narrows. The line proceeds northwestward where it enters the City of North Vancouver as it crosses Lynn Creek. The main line then enters the C.N. Lynn Creek Yard, which extends from Brooksbank Avenue to Kennard Avenue, across the Low Level Highway from the Tilford Shopping Centre. Rail cars occasionally remain at this location for varying periods of time between pick up and delivery. In general, dangerous commodities are not permitted to remain in yards for more than 48 hours.

A connecting line continues along the waterfront, passing through a 500 m (1,500 ft) tunnel beneath Esplanade (from St. George Street to Rogers Avenue), to meet the B.C. Rail interchange yard between Bewicke Avenue and Forbes Avenue at Mosquito Creek (on the Mission Indian Reserve No. 1). The line continues through the District of North Vancouver to the B.C. Rail Terminal Yard, located just east of the First Narrows Bridge, near Vancouver Wharves.

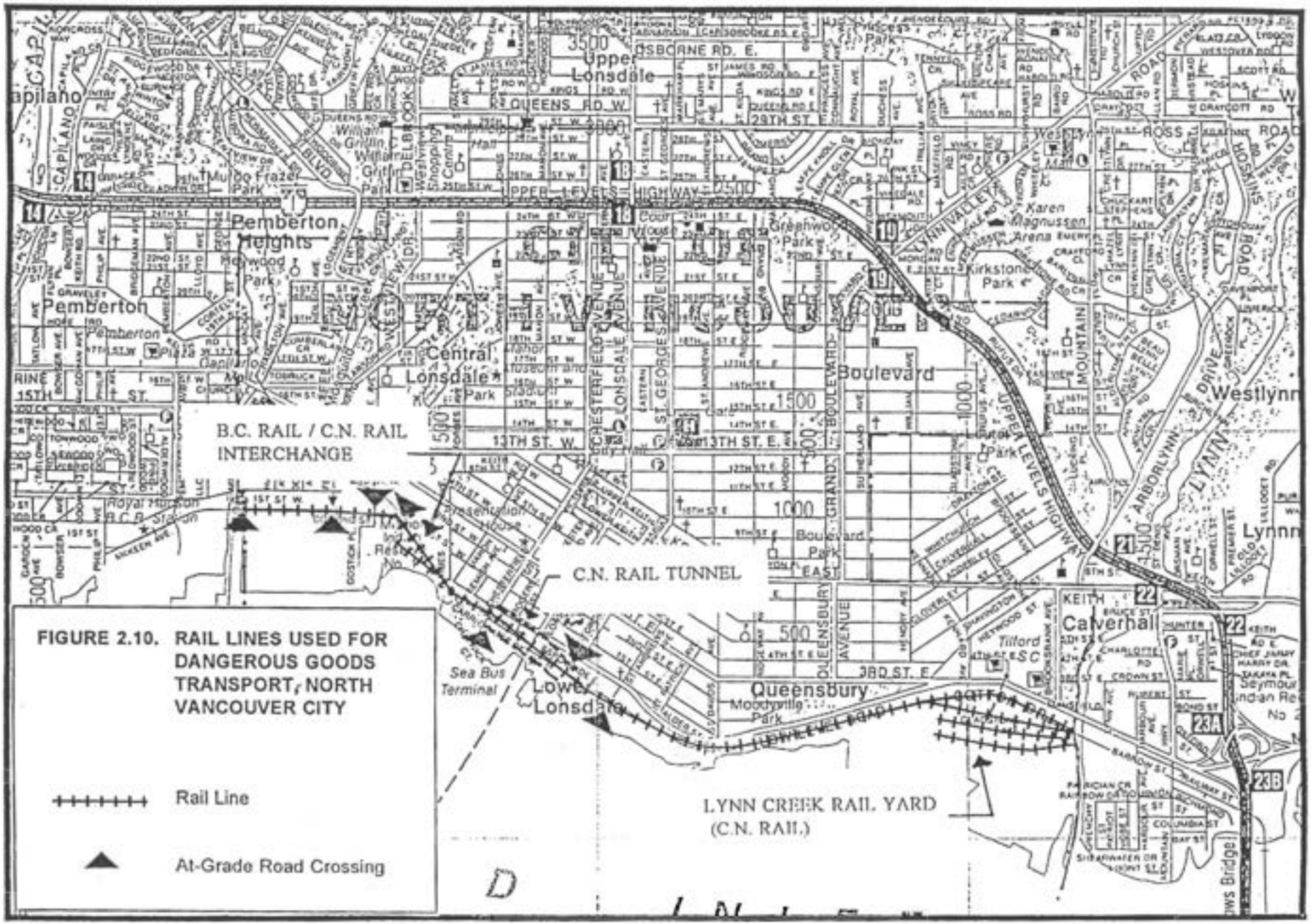

FIGURE 2.10. RAIL LINES USED FOR DANGEROUS GOODS TRANSPORT, NORTH VANCOUVER CITY

Along the 5.4 kms (3.3 mi) of track within the City of North Vancouver, the C.N. Rail line has 7 level crossings at the following roadway locations, listed from east to west:

1. St. Andrews Avenue
2. St. George Avenue
3. Chesterfield Avenue
4. Indian Avenue
5. Bewicke Avenue
6. Fell Avenue
7. MacKay Avenue

2.4.2 Rail Dangerous Goods Volumes

The TDG Study in 1987 found that 24 commodities represented nearly 95 percent of the total dangerous goods moved by rail throughout the Lower Mainland. Ten of these products were transported through the City of North Vancouver in 1986. The results of the TDG Study are summarized in Figure 2.11.

FIGURE 2.11. 1987 TDG STUDY RAIL NETWORK DATA (Car Movements per Year)

COMMODITY	Link 9: From South Rail Tunnel, Vancouver, to Lynn Creek Yard	Link 10: From Lynn Creek Yard to BC Rail Interchange
Sodium Hydroxide	5,075	472
Methanol	2,781	2,781
Ethylene Dichloride	1,958	-
Propane / L.P.G.	1,214	1,271
Chlorine	345	434
Sulphur Dioxide	42	35
Hydrogen Peroxide	28	32
Sulphuric Acid	28	-
Hydrochloric Acid	-	6
Sodium Chlorate	2	-
TOTAL	11,473	5,031

Source: Adapted from GVRD TDG Study, 1987

Sodium hydroxide and methanol shipments head the list in terms of the number of bulk rail cars travelling through the City of North Vancouver. More than 2,300 cars of extremely toxic gases, such as chlorine, ethylene dichloride and sulphur dioxide, were also transported within the community in 1986. The ten commodities researched by the TDG Study accounted for more than 16,000 car movements within city limits in 1986, for an average of 43 rail car movements per day.

2.4.3 Rail Accident Rates

A number of factors affect the probability of a rail accident, such as a rail crossing incident, collision or derailment. Such factors include (Sonntag, 1988):

- Auto Traffic at Crossings
- Condition of Rail Cars (rolling stock)
- Employee Supervision
- Employee Training
- Length of Train
- Pattern and Number of Rail Lines
- Rail Traffic
- Roadbed Condition
- Standard Operating Procedures
- Track Condition
- Train Speed

Rail firms record three types of accidents. First are derailments, where the wheels of a car leave the designated track. Often, derailments at low speeds leave the cars upright and cause no damage to the containers themselves. Derailments at faster speeds or where embankments are present may result in upset of the cars and a greater likelihood of container breach. Second are collisions, where one rail car or engine strikes another. These events can also cause container breach, especially when cars travel at greater speeds. The third accident type involves automobile vehicles where rail lines cross roadways. These crossing accidents can lead to derailment and breach of containers, again depending on the speeds involved.

Although trains and their cargoes are exposed to a number of hazards along any route, relatively few types of events have actually occurred in the past. Rail accidents throughout Canada have been steadily declining over the last ten years, due to improved track testing, maintenance programs, rolling stock, and better safety measures throughout the system (Transport Canada, 1990).

The most appropriate accident rate to apply to the C.N. Rail line through North Vancouver would be derived from the historical record for that line, tempered by recent improvements in the system. In the absence of such a figure at present, a rail accident rate used for the extensive Toronto rail study in 1987 was adopted for demonstration purposes. Throughout the Toronto region, which included many of the same rail conditions and operations found in North Vancouver, the accident rate was found to be 0.0196 accidents per million car-kilometres (Concord, 1987).

2.5 MARINE TRANSPORT

Marine shipments of dangerous goods in the vicinity of North Vancouver are governed in part by the Canadian Coast Guard and the Vancouver Port Corporation, a crown corporation operating under Transport Canada. In addition to waterway activity, the Vancouver Port Corporation also owns and controls a number of land parcels adjacent to Burrard Inlet, some of which are leased for industrial activity.

2.5.1 Marine Dangerous Goods Routes

The major components of the marine transport network for dangerous goods within the City of North Vancouver include marine terminals where dangerous goods are known to be trans-shipped and a transit route in Burrard Inlet.

The principal marine terminals within the City of North Vancouver used to transport dangerous goods are listed below and shown in Figure 2.12.

1. Cassiar Mining, at Pier 94, foot of St. Andrews Avenue (currently in receivership)

2. White Pass & Yukon Corporation, Pier 94, foot of St. Andrews Avenue

The majority of the marine traffic transiting Burrard Inlet consists of tug-barges and coastal tankers operating between Vancouver and other ports in B.C., Puget Sound, and Alaska (Sandwell, 1991).

Chemical tankers with total capacities varying from 7,500 to 40,000 DWT call at the Port 10 to 12 times per month. Petroleum tankers visit the Port of Vancouver once or twice a month. Refined product carriers range in capacity from 30,000 to 40,000 deadweight tonnes (DWT), and crude oil carriers range from 40,000 to 60,000 DWT. Liquefied petroleum gas cargo shipments in specialized foreign carriers no longer use the Port of Vancouver (Sandwell Swan Wooster, 1988).

Coastal vessels carry dedicated tanks, rail cars, and vehicle traffic along the coast of B.C. to Alaska and other U.S. ports. Railcar ferries operating out of the Port are designed to carry, on average, 25 standard railcars (Sandwell Swan Wooster, 1988).

Tugs and barges also operate along the coast. Barges carrying refined petroleum products range in size from 4,260 bbls. capacity and 100 feet in length to the largest U.S. barges of 116,000 bbls. capacity and 400 feet in length. Chemical barges range in size from about 1,800 DWT capacity and 200 feet length to about 5,000 DWT capacity and 270 foot length. Chemical barges carry caustic soda in hull tanks, sodium chlorate in hull and deck tanks, and chlorine in deck tanks (Sandwell Swan Wooster, 1988).

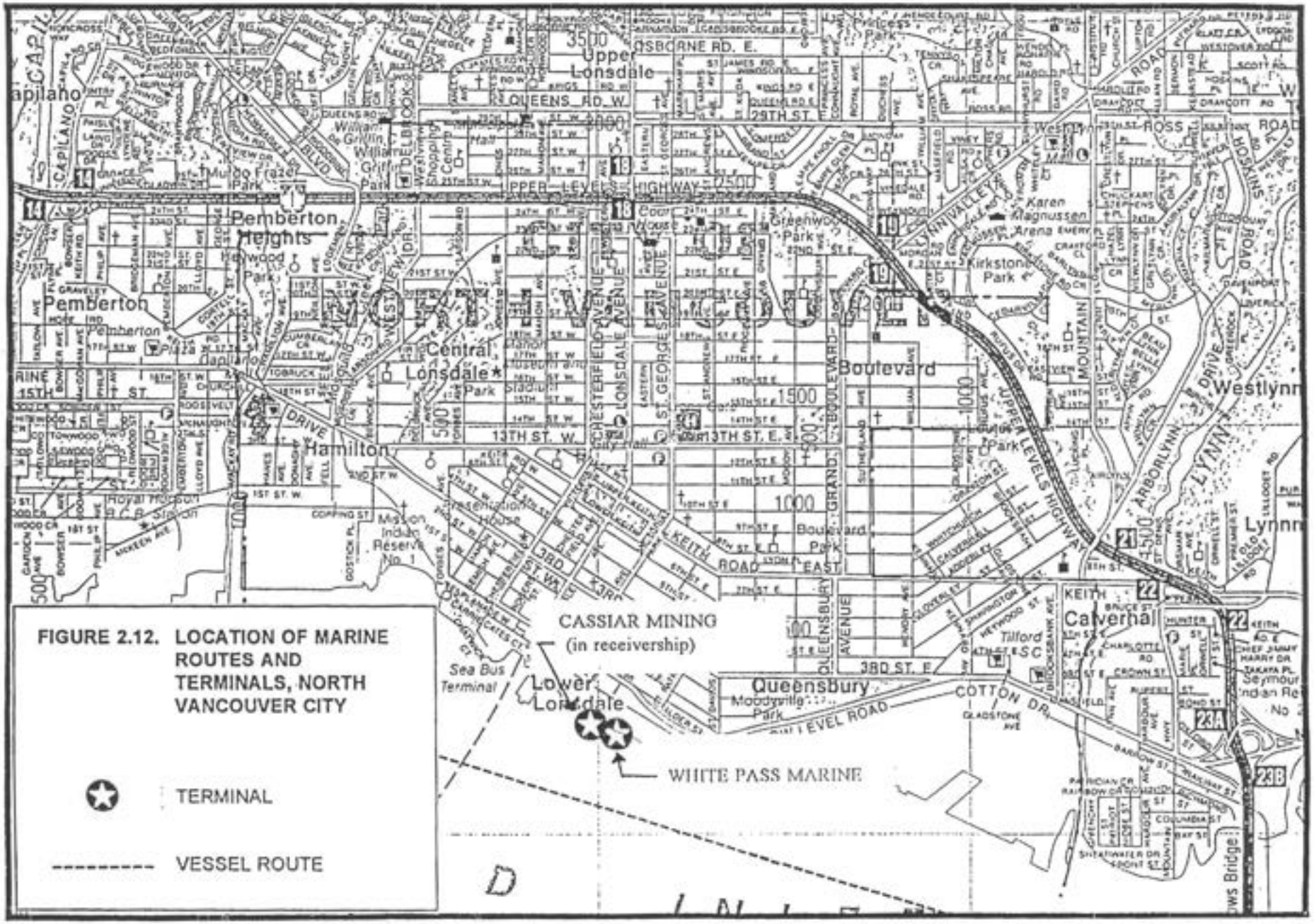

FIGURE 2.12. LOCATION OF MARINE ROUTES AND TERMINALS, NORTH VANCOUVER CITY

2.5.2 Marine Dangerous Goods Volumes

The Port of Vancouver is Canada's largest deepsea port, and among the largest in North America in terms of foreign tonnage handled.

The Cassiar Mining Corporation terminal at one time handled asbestos minerals, general cargo, fuels, and miscellaneous dangerous cargoes. Located at Pier 94, at the foot of St. Andrews Street, Cassiar operated two berths and a 55-tonne-capacity barge ramp. Cassiar is currently in receivership, and the future of this terminal is unknown at present, although the terminal may be leased to other parties to continue similar operations (Forbes, 1993).

The City's largest marine terminal is the White Pass & Yukon, located at Pier 94 at the foot of St. Andrews Avenue. White Pass currently ships every second Thursday, ferrying fuel and containers to Skagway, Alaska. Their 400-foot ship is part fuel tanker, part container carrier. In terms of dangerous goods, they carry about 75 full containers each year. Most of the product is cyanide brickets, packed in steel drums, and then packed in steel crates within containers. Trucks deliver the products to the Pier. A summary of the bulk dangerous goods passing through these two terminals in 1991 is presented in Figure 2.13.

FIGURE 2.13. DANGEROUS GOODS THROUGHPUT AT NORTH VANCOUVER TERMINALS, 1991

TERMINAL	DANGEROUS GOODS	METRIC TONNES
Cassiar Mining Corp.	Aviation Fuel	13,900
	Fuel Oil	80,400
	Gasoline	27,300
	Fertilizer	800
	Paint	200
	Sodium Cyanide	300
White Pass Marine	Fuel Oil	4,800
	Gasoline	2,300

Source: Vancouver Port Corporation, 1992.

All marine traffic transiting Burrard Inlet are required to report to the Vancouver Port Corporation detailed information on the types and quantities of dangerous goods destined for or received from a Port terminal, as well as information on the containment vessel, whether barge, tanker or container. Thus, the Port Corporation has an excellent record of the annual volumes of hazardous commodities within the harbour. Permit data do not record, however, goods that remain onboard during a port visit.

Figure 2.14 summarizes the volumes of bulk dangerous goods moving through the Port of Vancouver within the five years between 1985 and 1989.

FIGURE 2.14. BULK DANGEROUS GOODS MOVING THROUGH PORT OF VANCOUVER
(Tonnes per Year)

COMMODITY	1985	1986	1987	1988	1989
Crude Oil	195,921	439,922	646,051	1,024,692	804,817
Gasoline	1,353,084	1,424,247	1,466,294	1,207,048	1,062,910
Fuel Oil	1,723,634	1,642,659	2,041,998	1,910.633	1,862,819
Misc. Petroleum Products	311	32,295	1,012	589	491
Liquid Chemical Products	1,450,805	1,435,588	1,750,763	2,121,666	2,231,597
Oils, Fats, Waxes	225,934	171,680	266,975	151,165	63,764
Tallow	62,358	76,819	76,907	110,400	101,234
TOTAL	5,012,047	5,223,210	6,250,000	6,526,193	6,127,632

Sources: Sandwell, 1991; Port of Vancouver, 1991

With the crude oil carriers and product tankers, a number of specialty carriers move chemicals through the Port of Vancouver. According to the most recently available figures from the Vancouver Port Corporation, sodium hydroxide heads the list of top marine shipments of liquid chemicals through the Port by all vessel types. Figure 2.15 presents a summary of these shipments.

FIGURE 2.15. LIQUID CHEMICAL PRODUCTS THROUGH PORT OF VANCOUVER, 1991

COMMODITY	METRIC TONNES, 1991
Sodium Hydroxide (Caustic Soda)	1,008,000
Ethylene Dichloride	441,000
Methanol	399,000
Styrene Monomer	227,000
Sodium Chlorate Solution	188,000
Chlorine	49,000
TOTAL	2,312,000

Exclusive of Petroleum Products

Source: Vancouver Port Corporation, 1992

Gasoline, diesel and fuel oils are carried in "product tankers" designed for the transport of refined petroleum products. Segregated ballast tanks (so no product is discharged with the ballast) are required for product tankers greater than 30,000 DWT. Inert gas systems (to prevent the buildup of explosive atmospheres in the tanker) are required for all product carriers.

2.5.3 Marine Accident Rates

Sandwell recently conducted a study of tanker risks for the Vancouver Port Corporation and derived the accident rates shown in Figure 2.16.

FIGURE 2.16. TANKER ACCIDENT RATES (Accidents per 10,000 Port Calls)

Accident Type	Overall Tankers	Crude Tankers	Petroleum Tankers	Chemical Tankers	Coastal Tankers	Tanker Barges
Collisions	1.0	0.8	1.1	1.3	1.0	1.5
Groundings	4.0	3.4	4.0	4.8	3.8	1.0
Strikings	7.0	4.6	7.4	8.8	7.4	7.5
Fires/ Explosions	2.0	1.7	2.2	2.2	1.9	0.5
Structural Failures	0.5	0.6	0.5	0.5	0.4	1.5
TOTAL	14.5	11.0	15.1	17.5	14.4	12.0

Source: Adapted from Sandwell, 1991.

The probability of an accident involving a marine vessel in Burrard Inlet is greater than in English Bay or in the Strait of Georgia. During the 1987 Lower Mainland TDG Study, the Marine Subcommittee ranked the Burrard Inlet among the highest category of accident probability in the study area, considering such factors as (Sonntag, 1988):

- Tidal Patterns
- Congestion of Vessels
- Draft Restrictions
- Incidence of Fog
- Maneuverability
- Currents

Several persistent management problems in marine transportation have a strong influence on the likelihood of accidents. The States/British Columbia Oil Spill Task Force, after studying a number of pollution incidents concluded that significant shortfalls persisted in oil transportation management, including (States, 1990):

- Inadequate personnel training and qualifications
- Shortcomings in vessel design and integrity
- Insufficient traffic management
- Gaps in regulatory oversight
- Incomplete cost recovery opportunities

Although these conclusions were expressed with the oil transportation industry in mind, similar problems should be examined within the chemical shipping activity.

2.6 PIPELINE TRANSPORT

The transport of dangerous goods by pipeline is a frequently overlooked element of a community risk profile. Of several U.S. studies reviewed, few dealt with pipelines in any detail and many failed to acknowledge them at all.

We contacted the major natural gas distribution company operating on the North Shore, B.C. Gas, for information on the volumes and risks of this mode of transport. While they cooperated with our research, they cautioned that the movement of liquid or gaseous products through piping systems is so different from vehicle transport that comparisons are difficult.

2.6.1 Pipeline Routes

B.C. Gas carries natural gas to more than 40,000 customers on the North Shore through about 700 kms of distribution pipelines. Routes for the natural gas system are shown in Figure 2.17.

Natural gas is delivered to the North Shore by way of a new 24-inch trunk line across the Second Narrows Bridge. High pressure lines operating at 1,200 kPa (175 psi) transport the gas to a number of district regulator stations located throughout the North Shore, where pressure is reduced to about 400 kPa (60 psi).

Within the City of North Vancouver, B.C. Gas reports about 7.4 kms (4.6 mi) of high pressure pipeline. Four district regulator stations are maintained within or immediately adjacent to the City at the following locations:

1. Keith Road at Brooksbank Avenue (at border with North Vancouver District)
2. Keith Road at St. Andrews Avenue
3. Mahon Avenue at Ottawa Gardens
4. 29th Street at Jones Avenue (at border with North Vancouver District)

Smaller service pipes feed gas to above-ground meters outside buildings being served. In general, trunk and distribution lines follow the street systems throughout the urban and rural areas. Virtually all piping facilities are buried underground.

2.6.2 Pipeline Volumes

The B.C. Gas delivery system is designed to deliver a maximum of 126,00 cubic metres of gas per hour to the North Shore. Minimum load is typically 20 percent of this peak rate. Annual volumes depend on demand and fluctuate from year to year.

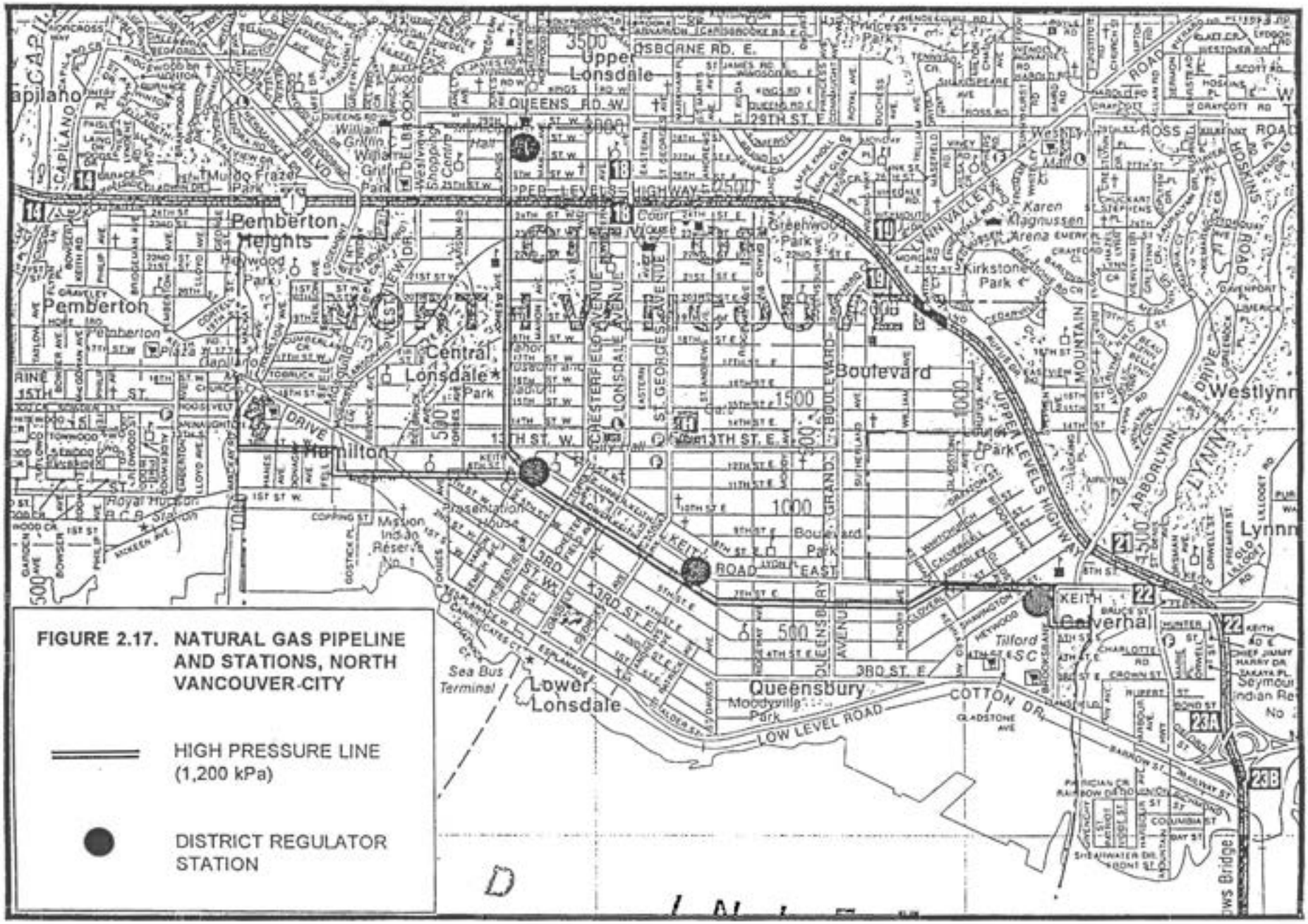

FIGURE 2.17. NATURAL GAS PIPELINE AND STATIONS, NORTH VANCOUVER CITY

HIGH PRESSURE LINE (1,200 kPa)

DISTRICT REGULATOR STATION

2.6.3 Pipeline Accident Rates

Accidents involving natural gas piping typically fall into three categories:

1. Third Party Damage. The rupture of an underground main or service piping generally correlates with excavation activity by a third party, that is, not employees of B.C. Gas. Although B.C. Gas has an active warning and prevention program to address excavation risks, about 100 such incidents occur each year throughout the Lower Mainland.

2. Underground Leakage. Leakage from underground pipe can occur where corrosion or mechanical joint problems exist. About 85 percent of such leaks are detected by sensitive equipment used by B.C. Gas to continually survey their distribution system. The remaining leaks are reported by the public or other agencies.

3. Impact Damage to Gas Meter. B.C. Gas protects above-ground meter sets that are vulnerable to vehicle traffic by installing large steel posts. Nevertheless, a small number of vehicle accidents lead to broken gas meters and leakage each year. Such events invariably require immediate evacuation of the local building or area.

The effects of an earthquake in the Lower Mainland on the pipeline system are difficult to predict without more information. The new 24-inch trunk line carrying natural gas to the North Shore across the Second Narrows Bridge contains a pressure-sensitive valve that would automatically halt product flow if activated.

B.C. Gas reports no deaths, injuries, or fires related to gas distribution incidents since the North Shore first received natural gas in 1956. Building fires, gas leakage within a building, and malfunctioning appliances have been noted as related to customer-owned premises and equipment.

The Netherlands Organization for Applied Scientific Research has adopted a universal accident frequency for all pipelines of 0.00001 pool fires or gas cloud explosions per 100 m of pipeline length per year (TNO, 1988).

Given a lack of other information the frequency may be appropriate

2.7 EMERGENCY PREPAREDNESS

Several risk models recognize the influence emergency preparedness can have on dangerous goods risk. Although a quick response does not affect accident probability, it has been known to reduce consequences in some instances. Through evacuation of those within zones of hazard, by containing spilled liquids, or by controlling the spread of fire, among other activities, emergency response crews have reduced the adverse effects of a large number of dangerous goods accidents.

In spite of the perceived benefits, accounting for emergency preparedness in a risk assessment remains a tenuous proposition. Several researchers have attempted to assign risk reduction factors given the presence of emergency plans, trained response crews, and appropriate equipment (Abkowitz, 1992; Alberta, 1986; LaMorte, 1987; TNO, 1988). A universally acceptable method, however, has yet to be proposed for direct use in risk calculations. In the absence of such a method, emergency preparedness can only be represented by qualitative descriptions.

2.7.1 Community Emergency Preparedness

The City of North Vancouver participates in the North Shore Emergency Program, sharing activities in accident prevention, preparedness, response and recovery with the Districts of North Vancouver and West Vancouver.

The North Vancouver City Fire Department offers the community's primary response capability for all types of dangerous goods incident. Emergency procedures for the City call for Fire Department response to all incidents where fuels or chemicals may impact the general population, although fire officers may not take full control of the situation in all cases. To accomplish their mission, the Fire Department has access to a full inventory of hazardous material response equipment.

City fire officers are provided dangerous goods response training through established educational programs. Four senior officers have completed training through the Association of American Railroads in Colorado, and several others have attended the Safety Training Centre at Maple Ridge, B.C. All firefighters have completed the first response level of the U.S. IFSTA training. Local industries, such as members of TRANSCAER, and C.N. Rail also offer training opportunities and participate in emergency exercises.

During emergency conditions, the North Vancouver City Fire Department will consult a variety of experts, including the federal CANUTEC program, C.N. Rail, Canadian Oxy, and Kelex in North Vancouver, depending on the nature of the incident. For road accidents, the Fire Department will identify the carrier and contact the shipper, where possible. Local weather and wind data sources include Environment Canada and the GVRD. Evacuation areas are usually determined with the assistance of the Transport Canada CANUTEC Guide, on-site experts, and occasionally through the CAMEO computer software program maintained by the Fire Department.

The North Vancouver City Fire Department notes that they are not permitted on the Mission Indian Reserve land for pre-planning and inventory of dangerous goods without invitation, but would respond to an incident on the reserve.

Community response to dangerous goods accidents may include the North Vancouver RCMP Detachment. RCMP constables conduct evacuation procedures, where necessary, under the direction of the commanding fire officers. Evacuation zones are determined by the Fire Department in all cases, after consulting reliable sources.

NORTH VANCOUVER CITY...

Members of the North Vancouver RCMP have received awareness training through the TRANSCAER Program and with the assistance of C.N. Rail. Officers have a basic knowledge of hazards and response procedures, and have access to the Canadian Police Information System, which can list commodity names and safety measures by product identification number (PIN). RCMP response teams have airpacks in the vehicles, but generally stay well away from an incident site until the product has been identified. Coordinating officers attend monthly North Shore emergency planning meetings and participate in periodic exercises.

The North Vancouver City Public Works Department responds to requests for assistance in dangerous goods incidents. Public Works may provide sand or gravel, build berms, provide heavy equipment, or supply absorbent booms, pillows or blankets. In most cases they work directly with the Fire Department.

Public Works crews do not receive formal training in dangerous goods response, although some employees have attended individual training sessions and seminars. Public Works personnel have access to standard respirators only, and do not gear-up in chemical suits or self-contained-breathing-apparatus. When waste disposal is needed, Public Works may store contaminated soils and wastes at their yard on ~~West 2nd Street~~. Public Works is loosely involved with the community emergency plan, and does not have a separate written plan.

2.7.2 Industry Emergency Preparedness

Although some fixed facilities within North Vancouver are known to have prepared pre-fire safety plans, it is difficult to estimate the total number of premises that specifically address emergency response to dangerous goods incidents. Information on emergency plans and Workplace Hazardous Materials Information System (WHMIS) is collected by the Fire Prevention Officer for businesses where fire safety plans are required.

B.C. occupational health and safety regulations require employers to plan for worker protection from chemical releases, including warning systems and first aid. The extent of compliance among North Vancouver City business and industry suspected of holding and handling dangerous goods has not been examined. Currently, emergency response plans are in place for some institutions, such as the Lion's Gate Hospital, and some industrial operations, such as Magnum Explosives.

Even where emergency plans have been prepared, however, the level of preparedness cannot be predicted. In a sample of 157 industry emergency response plans reviewed by the TDG Directorate of Transport Canada, 65 percent were found to be inadequate (Kittle, 1990).

Shippers and road transporters of certain high hazard dangerous goods are required by federal and provincial TDG regulations to prepare emergency response plans. Some of the more prominent carriers in the Lower Mainland, such as ICX and Trimac, are known to have plans, trained personnel, and response equipment. The extent of preparedness among other types of carriers, such as general freight haulers and couriers, is questionable. Although no statistics are available on emergency planning among all classes of road transporters, we suggest that emergency plans are the exception rather than the rule among road carriers.

Mention that plans should also be developed to include protection as well as workers. (Differentials)

NORTH VANCOUVER CITY...

Response to rail incidents within the boundaries of North Vancouver City would fall to C.N. Rail, which has trained crews and the appropriate heavy equipment at their Lynn Creek Yard. C.N. Rail has developed an emergency response plan and participates in planning exercises with the North Shore communities from time to time.

For marine accidents, the Vancouver Port Corporation (VPC) has an emergency plan with a scope from Pt. Atkins south to the U.S. border and all waters east, except the Fraser River. The plan covers all terminals and all types of incident. Although the VPC does not have a fire department (it contracts with local municipalities), it acts literally like a municipality, reviewing development plans and enforcing safety provisions. The VPC has its own police force of 40 personnel, with 9 boat crew and 3 boats. The Security force has prepared its own sub-plan.

Four VPC Harbour Masters have extensive training in dangerous goods, having completed emergency preparedness courses and Master mariner courses. VPC clean-up equipment is minimal, including absorbants, pads, small quantities of first response equipment and 1,000 ft of boom. The VPC relies on Burrard Clean to provide environmental protection following a spill. Focusing on oil spills, the stockpile of response equipment immediately available to the Port of Vancouver is presented in Figure 2.18.

To respond to natural gas pipeline incidents, B.C. Gas has prepared an emergency plan, communications procedures, trained crews, and specialized equipment. Distribution shut-off valves provided for emergency isolation in a serious event are inspected and maintained annually. Radio-equipped crews are available during workdays, and emergency crews are on stand-by around the clock. Emergency crews are given annual refresher training, covering such topics as analysis of leakage situation, live gas leakage repairs, and fire fighting techniques. B.C. Gas also provides training to local fire and police departments to assist in coordinating a response to a natural gas incident.

Overall statement on response capability?

FIGURE 2.18. BOOMS AND SKIMMERS AVAILABLE TO THE PORT OF VANCOUVER

Burrard Clean		
Boom	1,920 m 1,829 m 610 m 304 m	0.8 m Versatech Zoom Boom 0.5 m Inshore Boom 0.6 m Harbour Boom 0.6 m River Boom
Skimmers	1 1 1 2 2 1	12.8 m Bennett Mark 6D Skimmer 15.2 m Marco Class VIIB Skimmer Oil Mop Mark 9DP Morris Industry MI-2 Skimmer Komara Mini Skimmers Scavenger Skimmer
Canadian Coast Guard		
Boom	1,000 m 1,220 m 308 m 305 m 500 m	0.9 m Bennett Boom 0.6 m Inshore Boom 0.5 m Versatech Boom 0.4 River Boom 0.8 m Vikoma SeaPack
Skimmers	1 2 1 1 1 2	Slicklicker Komara Mini Skimmers Morris Industry MI 30 Skimmer Semi-Portable Oil Mop Portable Oil Mop GT-185 Skimmers
Vancouver Port Corporation		
Boom	305 m	0.5 m Inshore Boom
Clean Sound		
Main Skimmers	3	JBF Skimmers

Source: Sandwell, 1991.

2.8 CONCLUSIONS

Because of the tentative and incomplete nature of the data presented above, few conclusions can be drawn with confidence. Yet, the purpose of this early assessment is, in part, to identify what we know and what further information is required. This section offers a limited view of the risks presented by dangerous goods to the community as a whole, identifies a few locations that deserve further attention, and lists the data required to complete a risk assessment for the City of North Vancouver.

2.8.1 Overall Level of Risk

Although no universally acceptable measure of community risk yet exists, the overall level of risk from dangerous goods in the City of North Vancouver can be placed in some perspective through the following observations.

- There are no primary chemical producers within the municipal boundaries, and the total number of about 270 fixed facilities presumed to contain dangerous goods is considered average for the business and industrial base within the community.

- Road transport of bulk commodities is largely limited to through traffic using the Upper Levels Highway. Estimates predict at least 6,000 dangerous goods vehicles per year, or 20 trucks per day, and some methods suggest much more. Although data are lacking, a significant number of trucks may use urban arterials within the City, such as Marine Drive, Lonsdale Avenue, and Low Level Road, especially in the vicinity of the waterfront. Road traffic has historically shown the highest accident rate among all transport modes.

- A relatively large number of hazardous shipments travel by rail through the community, accounting for an average of about 45 cars per day. In some locations, yard and mainline operations bring bulk tank cars of such hazardous chemicals as chlorine, ethylene dichloride, and sulphur dioxide within a hundred meters of high-rise office buildings, commercial centres, and residences. Although rail incidents are rare, and the release of product from modern tank cars even more so, the proximity of these high volume hazardous materials to densely populated areas in North Vancouver indicate severe consequences should an accident occur.

- The total tonnage of fuels and liquid chemicals shipped past North Vancouver by marine traffic in English Bay far outweighs the combined dangerous goods by other modes. Marine accidents seldom occur and the prospect of community impact must be considered a very low probability.

One comparison of overall community risks in available literature comes from the 1988 TDG Study for the Lower Mainland. Based on limited research and incomplete data, the TDG Study attempted to compare and rank 11 GVRD communities in terms of the total volume of bulk dangerous goods being transported within each. The results are duplicated in Figure 2.19. Note that the TDG Study did not distinguish between the City and the District of North Vancouver.

FIGURE 2.19. TDG STUDY COMPARISON OF GVRD MUNICIPALITIES, 1986

MUNICIPALITY	TONNES (1986)
1. Burnaby	2,870,053
2. North Vancouver	2,297,202
3. Coquitlam	1,663,168
4. Port Moody	1,376,571
5. Surrey	951,000
6. New Westminster	824,630
7. Port Coquitlam	735,669
8. Vancouver	424,488
9. West Vancouver	152,741
10. Delta	145,084
11. Richmond	21,875

Source: Boydell, 1988.

As an additional point of reference, the City of Edmonton, Alberta, reports more than 8,000 fixed sites of concern, and greater than 200 truckloads and 100 rail tank cars passing through the city each day (MIACC, 1992).

We conclude from the available data that the overall risk from dangerous goods in North Vancouver is low, with the understanding that certain key locations are acknowledged as moderate risks. These locations, or "hot spots" within the community, are addressed below.

2.8.2 Hot Spots

In defining these hot spots, we looked for the close proximity of large volumes of high hazard commodities to sensitive populations or environmental habitat. Although accidents can occur virtually anywhere within the municipality, we intended to identify those locations that deserve special attention in terms of both prevention and response. The North Vancouver hot spots are, from east to west:

1. Lynn Creek Rail Yard. Rail operations bring more than 16,000 carloads a year of propane, chlorine, sulphur dioxide, and other dangerous commodities to this location, immediately adjacent to the Tilford Shopping Centre, the Cloverley School, a residential neighbourhood, and motorists on the Low Level Road/Cotton Drive. While accidents at rail yards tend to be less severe than on main lines, they can occur more frequently. An incident could require a precautionary evacuation of all persons within 1 km of the yard.

2. Rail Tunnel Beneath Esplanade. This 450-metre (1,500 ft) single-track rail tunnel under Esplanade means both pluses and minuses for the risk equation. The tunnel would likely shield pedestrians, office workers, and motorists from the immediate effects of an explosion or major fire involving hazardous material rail cars. The tunnel would, however, also severely hamper emergency response efforts. The only access to the tunnel is from either end or through one manhole. The tunnel lacks deluge sprinklers, standpipes, and emergency lighting. As other tunnel incidents have proven, effective response can be impossible, negating the positive effects of emergency preparedness. Responders facing a serious chemical fire within the tunnel could be forced to adopt a "let it burn" strategy, one that could mean the release of additional chemicals, severe damage to the tunnel, and evacuation of a wide area for days.

3. Upper Levels Highway. We currently lack conclusive data on the volume of chemicals transported by truck on this route, but the nature of the adjacent land uses and the presumed accident rate convinced us a chemical release in this area is likely and could be disastrous. Within 0.5 km of the Upper Levels Highway in the northern part of the City one finds the Court House, the Westview Shopping Centre, the North Vancouver High School, the Lonsdale School, the Carson Graham Secondary School, the Larson Road Elementary School, and the Hamilton Junior High School. In addition, the number of motorists present on this roadway at any time of the day suggests that a great number of persons could be exposed, and most have limited opportunities of escape.

Several other areas caught our attention and, although they perhaps cannot be classified as hot spots, deserve further consideration. These other locations include, from east to west:

- Rail lines from the C.N.'s Lynn Creek Yard to the B.C. Rail interchange, bringing bulk rail cars of high hazard chemicals within a hundred meters of the Low Level Road and Esplanade, exposing numerous offices, shops, and residences in the Queensbury and Lower Lonsdale neighbourhoods.

- Waterfront area, where dangerous goods are transported by truck to and from terminals and other marine facilities, such as Versatile Pacific Shipyards at 109 E. Esplanade and White Pass Transportation at the foot of St. Andrews Street.

- Marine shoreline, which could suffer significant economic impact and massive clean-up costs in the event of a major oil spill in Burrard Inlet.

- Lion's Gate Hospital, where a large number and variety of compressed gases, cleaning chemicals, and solvents are delivered regularly by truck.

- B.C. Rail / C.N. Rail interchange yard at the Mission Indian Reserve, where Mosquito Creek and six level road crossings may be found within 1 km.

2.8.3 Data Gaps

At this preliminary stage of research, many questions about dangerous goods risk in the City of North Vancouver remain unanswered. In this section, we identify gaps in on-hand data and attach a measure of importance to each. Figure 2.20 summarizes the current information needs related to the study in two categories: Data that are needed to perform even a rudimentary risk assessment, noted as "Required Data." Information that would contribute further to our understanding of risks from dangerous goods are listed in the right-hand column as "Additional Data."

Most of the data required to complete a risk assessment are accessible with moderate effort, with two exceptions. Information on both fixed facilities and road transport will require direct contact or observation through acceptable survey techniques. Data required for the rail and marine modes of transport may require manipulation of existent information by B.C. Rail, C.N. Rail, and the Vancouver Port Corporation.

Without detailed information on the types and quantities of dangerous goods in key facilities in the City of North Vancouver, a full risk assessment for this component cannot be undertaken. Several risk models are available to conduct such an assessment (refer to Appendix B) and, given the results of direct surveys, should provide interesting and valuable results. Data on fixed facilities would allow the community to focus prevention efforts on relatively high-risk operations, set priorities for emergency response, and allow the Fire Department to better ensure safety for firefighters and members of the public.

Further data on road transport volumes of dangerous goods are required to perform a risk assessment for the City. Specifically, the number of vehicles, types of goods, and routes taken must be collected either through roadside surveys or through direct contact with shippers, carriers, and receivers in the Lower Mainland. Current estimates are based on indirect inference from other surveys and ignores the use of local roadways. With this information, planners can ensure key carriers have emergency response plans, work with regular shippers to select low risk routes, and develop procedures for response to specific locations.

Missing from the marine information are data on the maximum volumes of certain commodities stored at the terminals and the means of storage and transfer. This information should be collected during a survey of marine terminal operators.

Suggestions for collecting missing data are offered in Section 5.0 of this report.

Consider putting recommended data in Appendix?

FIGURE 2.20. CITY OF NORTH VANCOUVER DATA GAPS

REQUIRED DATA	ADDITIONAL DATA
COMMUNITY SETTING	
1. Residential population density within 1 km of selected hazardous sites.	1. Transient population within 1 km of selected hazardous sites by time of day, day of week. 2. Property values for selected locations.
FIXED FACILITIES	
1. Premises with dangerous goods, identified by type, quantity of largest container, total quantity on site, and storage/process activity.	1. Number of dangerous goods vehicles serving waterfront facilities, including commodity types and container volumes. 2. Historical incidents for businesses similar to those present.
ROAD TRANSPORT	
1. Routes used for local distribution of fuels and chemicals. 2. Number of vehicles by product type, container volume, and route.	1. Origins and destinations of truck shipments using North Vancouver roadways. 2. Identity of carriers, shippers, and receivers of dangerous goods. 3. Historical incidents for road transport similar to that observed in community.

RAIL TRANSPORT	
1. Confirmation of assumed container volumes for bulk rail cars.	1. Number of less-than-carload shipments of dangerous commodities, by product type and container volume. 2. Details of operations at both Lynn Creek Yard and Terminal Yard, i.e., storage practices of rail cars and transloading to/from truck transport. 3. Roadbed and track condition and maintenance practices. 4. Historical incidents at yards and on main line.
MARINE TRANSPORT	
1. For terminals with dangerous goods: product type, quantity of largest on-shore containers, and methods for storage, handling, and transfer. 2. Capacity and normal volumes of dedicated chemical and fuel transport tankers and barges. 3. Capacity of common containers used for non-bulk shipments. 4. Number of port calls by marine vessels, by commodity type and volume.	1. Number of dangerous goods vehicle visits at terminal per year, identifying commodity types and container volumes. 2. Historical incidents for vessels similar to those calling at Vancouver.
PIPELINE TRANSPORT	
All essential information is available.	1. Historical incidents in Lower Mainland to identify possible scenarios.

EMERGENCY RESPONSE	
All essential information is available.	1. Fixed facilities with dangerous goods that also have emergency plans in place, employee awareness programs, response teams, and response equipment. 2. Extent of emergency preparedness among road carriers of dangerous goods, accounting for the range of carrier types.

SECTION 3.0

THE DISTRICT OF NORTH VANCOUVER

PHASE 2 - PRELIMINARY

RISK ASSESSMENT

SECTION 3.0

THE DISTRICT OF NORTH VANCOUVER
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THE DISTRICT OF NORTH VANCOUVER
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EXECUTIVE SUMMARY

(To be complete for Final Report)

SECTION 3.0 - THE DISTRICT OF NORTH VANCOUVER

3.1 COMMUNITY SETTING

The Corporation of the District of North Vancouver encompasses more than half of the populated region of the North Shore, from the community of Deep Cove in the east to the common border with the District of West Vancouver on the west (see Figure 3.1). The District of North Vancouver contains a number of unique community features that suggest the consequences of a major dangerous goods incident could be severe. There are several pockets of sensitive populations in high risk areas, as highlighted in Figure 3.1. Sensitive populations, from the aspect of dangerous goods safety, refer to:

- High concentrations of people in such facilities as theatres, shopping malls, and schools. An often overlooked population placed at particular risk from dangerous goods accidents include motorists on heavily travelled roadways.
- Members of the public that may have difficulty in evacuating an area quickly, such as residents of an institution, high-rise or residential area where there is restricted access.
- Persons who may sustain injury at low concentrations when exposed to a release of dangerous goods, such as children, the elderly, and some hospital residents.

Key among these sensitive population centres in the District of North Vancouver are the following:

1. Schools, such as the Norgate School, Maplewood Elementary School, and the Canadian International College
2. Residents in high-rise apartment buildings (greater than 10 stories), such as Woodcroft, the Plaza, and Lynn Moore
3. Community Care Facilities, such as Cedarview, North Shore Private Hospital, Lynn Manor
4. Shopping districts at West Lynn Mall, Pemberton Plaza, and Tilford Shopping Centre
5. High density worker populations at such facilities as Lion's Gate Hospital, Capilano College, Vancouver Shipyards, ICBC/Lonsdale Quay, and Phibbs Exchange
6. Motorists on Marine Drive, the Dollarton Highway, and the Upper Levels Highway

In addition to these population centres, the District of North Vancouver supports a number of environmental settings that are sensitive to hazardous materials. Sensitive environments, as past accidents have shown, primarily include bodies of water used as natural habitat or for potable water supply, such as lakes, rivers, creeks, and streams, as well as the shores of Burrard Inlet. The environments of priority concern are also shown on Figure 3.1.

Important environmental habitats in the District of North Vancouver that may experience adverse consequences from dangerous goods incidents include (North Van, 1992):

1. Capilano River
2. Lynn Creek
3. Seymour River
4. Marine shoreline along Burrard Inlet, especially the Maplewood Conservation Area and wetlands important for bird ~~migration~~ Habitat.

3.2 FIXED FACILITIES

The first attempt to catalogue dangerous goods in fixed facilities in the District of North Vancouver was undertaken by the Chemical Hazards Task Force in 1981. The results of this community effort led to the forerunner of today's emergency planning program. The Task Force no longer exists, however, and there have been no community risk assessments attempted within the last ten years.

The traditional approach to identifying facilities containing concentrations of dangerous goods relies on surveys and inspections. While the North Vancouver District Fire Department assists businesses in developing fire safety plans, there has been no comprehensive effort to date to survey and catalog all premises for the types and quantities of dangerous goods that may be present.

Direct contact with business owners is the only way to secure accurate data, and beyond the scope of this preliminary effort. For this interim phase, we adopted a secondary method. After consulting similar work elsewhere (ABAG, 1982; EPA, 1990; TNO, 1988), we developed a list of 98 key industry types considered most important to a dangerous goods risk assessment, organized by headings found in the local telephone directory and by 4-digit Standard Industrial Classification (SIC) code. Through this process, we identified the types of establishments known to handle hazardous substances.

To identify facilities of interest to the risk assessment, we used directories made available through the B.C. Telephone Company. Additional data were collected from the North Vancouver District Fire Department, the GVRD Air and Source Control Department, the B.C. Ministry of Environment, and Transport Canada. The North Vancouver District Business Licence Department was unable to provide a list of businesses by organization type via computer. Information on business type is collected on survey forms, but is not input into the current system. The District plans to install a new computer system in 1993 and will be able to provide this information in the future.

3.2.1 Fixed Facilities With Dangerous Goods

The results of this preliminary research are offered in map form on Figure 3.2 to illustrate the proximity of fixed facilities in relation to sensitive populations and environments.

Risk assessment models require information on 1) The types of chemicals present at a facility, and 2) The quantity of goods present at any given time. Some risk estimate methods also rely on information on the type of containers or processes where hazardous materials may be found. For several premises in North Vancouver District, the presence of dangerous goods is known, but not the quantity. The Fire Department regularly surveys the business community but not specifically for dangerous goods. Each property is surveyed at least once per year, more often for some occupancies.

The discrepancy between what we currently know and what remains unknown is illustrated in Figure 3.2. The black dots indicate premises for which we currently have sufficient information to perform a formal risk assessment; the red dots denote locations were dangerous goods are suspected, but where additional research is required.

The industry categories and premises of interest in North Vancouver District are listed in tabular form in Figure 3.3. Based on the limited information currently available, the top ten fixed facilities that present the greatest public risks from dangerous goods include the following:

1. Canadian Oxy Chemicals, 100 Amherst Avenue
2. Dow Chemical Canada, 1545 Bay Street
3. Drew Chemical, 78 Riverside Drive
4. Emchem Sales, 170 Harbour Avenue
5. Mohawk Oil Co., 170 Harbour Avenue
6. Sterling Pulp Chemicals, 100 Forester Street
7. Vancouver Wharves, 1995 West 1st Street

For some industries, chemical use may vary widely. Some of the higher risk facilities listed in Figure 3.2 provide information on dangerous goods to the local Fire Department and incorporate safety features into facility design. These premises may pose less risk than other facilities that are unknown to the Fire Department. We caution these assumptions are tentative, and must be verified through a community-wide survey and full risk assessment to be considered conclusive.

Figure 3.3 Fixed Facilities With Dangerous Goods In North Vancouver District

Air Conditioning Equipment - Servicing (7349)		Status*
Aers	1415 Hunter	S
Aircus	108-1861 Welch	S
Comstock Canada	1641 Welch	S
Domcom Services	1776 Deep Cove Rd	S
Duke & Bradshaw Mech.	1408 Crown	S
K-Sons Refrig. & Air Cond.	1970 Spicer	S
Seabreeze Refrig. & Air Cond.	3942 Frames Pl	S
Ammunition/Guns (5941)		
European Arms Distributor	275 Pemberton	S
Royal Canadian Cartridge & Mun.	1265 Coleman Close	S
The Dollarton Gun Trader	555 N Dollarton Way	S
Automobile Machine Shop Service (7539)		
Acklands Machine Shop	1088 Roosevelt Cres	S
White Glove Automotive	1141 W 15th	S
Automobile Parts & Supplies Whol & Mfrs (5013)		
Glasparts	1405 Pemberton	S
MPS Carcraft Supplies	2629 Walpole Cres	S
North Shore Parts & Indust. Sup.	1305 Welch	S
North Star Sales	1671 Haverhill Pl	S
Vancouver Parts Co. LTD	1380 Pemberton	S
Automobile Repairing & Service (7530)		
A J Transmission & Auto Repairs	1434 Crown	S
A-Plus Auto	1239 Welch	S
Aers Auto Electric & Refrigeration	1415 Hunter	S
Aers Radiators	1411 Hunter	S
Aggressive Auto Body	3034 Dollarton Hwy	S
Al Dyke Automotive	1525 Welch	S
All-Import Auto Service	1205 W 15th	S
Auto Haus	3941 Capilano	S
B & C Motors	1525 Welch	S
Barry's Automotive	235 Pemberton	S
Bodo Motors Automotive Services	1110 W 14th	S
Brake Check	1350 Marine	S
Canadian Tire Associate Store	1345 Marine	S
Capilano Volkswagon	1151 Marine	S
Car Craft John Hall's	1532 Bay	S
Coach Collision	1172 W 3rd	S
D & B Automotive	1485 Rupert	S
Deep Cove Garage	2102 Dollarton Hwy	S
Dominion Auto Repairs	1456 Dominion	S
E.M. & S. Preventative Maint.	710 E 9th	S
Grand Touring Car Repairs	1176 W 3rd	S
Harrison Performance Engineering	1481 Barrow	S
I B Auto Service	1189 W 16th	S
J D Auto Repairs	207-80 Orwell	S
Jeff's High Perform. Auto. Rep.	267 Pemberton	S
Jim Pattison Toyota	1765 Marine	S
Jubilee Plymouth Chrysler	1177 Marine	S
Levett Auto Metal	183 Pemberton	S
Luke's Automotive Specialties	1457 Charlotte	S
Master Tune-Up	1156 W 3rd	S
Mountview Jeep Eagle	1600 Marine	S
N & M Sports Car	1107 W 14th	S
Nor-Est Radiators	1175 W 14th	S
North Pro Auto Detailing & Repairs	1130 W 14th	S
North Shore Frame & Align. Centre	181 Pemberton	S
North Shore Off-Road Centre	1520 Richmond	S
North Shore Taxi Auto. Serv.	264 Pemberton	S
Performance Automotive Repairs	1418 Crown	S
Peter K Automotive	1124 W 15th	S
Precision Align. & Safety Serv.	1483 Barrow	S
Quick Lube	1481 Barrow	S
Salish Auto Haus	3941 Capilano Rd	S
Silk Cat Automotive Specialists	1053 Churchill Cres	S
Specialty Motor Cars (1970)	1235 Marine	S
Targa Performance	1397 Welch	S
Taylormotive Service	174 Pemberton	S
Turin Automotive	1405 Pemberton	S
Viking Automotive	115 Charles	S
Wagstaffe Automotive	118 Pemberton	S
White Glove Automotive	1141 W 15th	S
White's Specialty Truck & Auto.	1355 Crown	S
Automobile Restorations (7530)		
Autoclassic Restorations	1108 E 3rd	S
M & G Only Reconstruction Ltd	118 Pemberton	S
MT Autobody	104 Charles	S
Zoeller's Motor Vehicle Electrical	1335 Pemberton	S
Barbecue Equipment & Supplies (5984)		
Targa Performance	1397 Welch	S
Batteries Storage (3691)		
North Shore Battery Sales	95 Philip	S
P M Crane Rentals	207 Pemberton	S
Seaspan International	10 Pemberton	S
Biological Laboratories (8071)		
EVS Consultants	195 Pemberton	S
Pemberton Industries	207 Pemberton	S
Boat Builders (3732)		
ABD Aluminum Boats & Fab.	1667 Columbia	S
Adrenalin Marine	202-80 Orwell	S
Alvis Marine	104-80 Orwell	S
Exintari Yachts	5-90 Harbour	S
Hourston Glascraft	1365 Main	S
Seair Marine	1627 Columbia	S
Boat Repairing & Maintenance (3732)		
Blue Line Forklift & Marine Serv.	6-1331 McKeen	S
General Boatworks	1460 Columbia	S
Jack Murray Marine	1538 Columbia	S
Marisol Marine Centre	1637 Columbia	S
Pacific Finishing	1667 Columbia	S
Seycove Marine Services	2890 Panorama	S
Chemicals (2800) Study		
~~Albright & Wilson Americas~~	100 Forester	S
Canadianoxy Chemicals	100 Amherst	S
Dow Chemical Canada	1545 Bay	S
Drew Chemical	78 Riverside	S
Emchem Sales	170 Harbour	S
Smith Processing Labs	2104 Front	S
Universal Polymers	1123 W 14th	S
Dental Laboratories - To the Profession (8072)		
Quality Dental Laboratories	3036 Edgemont Blvd	S
Engineering Services (8711)		
Envirochem Services	145 Riverside Dr	S
Sanitherm Engineering	1365B Crown	S

C

*S = Suspected Dangerous Goods
C = Confirmed Type & Quantity of Dangerous Goods

Figure 3.3 Fixed Facilities With Dangerous Goods In North Vancouver District

		Status*
Fibre Glass Fabricators (3296)		
A B C Fibre Glass	1353 McKeen	S
Fraser Fibreglass	1681 Columbia	S
Levett Fibre Glass Fabricators	183 Pemberton	S
North West Fibre Mechanics	1196 W 21st	S
Puddlejumper Floats	1353 McKeen	S
Fumigating - Equipment & Supplies (5191)		
Dykhof Nurseries	460 Mountain Hwy	S
Maple Leaf Garden Centre	1343 Lynn Valley	S
Gas - Liquefied - Natural - Bottled & Bulk (5984)		
Bestway	1386 Main	S
Gas - Propane - Bottled & Bulk (5984)		
Superior Propane	260 Riverside	S
U-Haul Propane	1410 Main	S
Hospitals (8060)		
North Shore Private Hospital	1070 Lynn Vly	S
Industrial Equipment & Supplies (5084/5085)		
Ipax Industrial Supply	3017 Mountain Hwy	S
North Shore Parts & Indust. Sup.	1425 Main	S
Lubricating Oils & Greases (2992/5170)		
Mohawk Oil Co.	170 Harbour	S
Machine Shops (3500)		
All-Round Industries	251 Harbour	S
Altec Engineering	1447 Hunter	S
Citation Engineering	1406 Charlotte	S
Colonia Machine	1341 Welch	S
Elliott Steel	1514 Bay	S
Majer Manufacturing	328 Harbour	S
Mountain Mfg	1-90 Harbour	S
Nova Machine Works	1-119 Charles	S
Orion Engineering	1415 Dominion	S
Pacwest Mfg	1205 W 14th	S
Precision Valve & Crank	1404 Charlotte	S
Rotor Electric	1385 Main	S
Tooltec Engineering	231 Harbour	S
United Gear & Machine Works	168 Riverside	S
Westmark Engineering & Mach.	4050 St Marys	S
Manufacturing - Pharmacy (2834)		
Stanley Drug Products	1560 Columbia	S
Marine Cargo Handling (4491)		
Vancouver Wharves	1995 W 1st	C
Marine Repairs (3730)		
Alvis Marine	70 Orwell	S
Campbell Jack Marine	10 Orwell	S
Fisher Marine Exploration	10 Orwell	S
Rotor Electric	1385 Main	S
Medical & Hospital Equipment (5047)		
Sinclair Dental Co.	1601 Welch	S
Mufflers & Exhaust Systems Engines (7533)		
Al Dyke Automotive	1525 Welch	S
Speedy Muffler King	1910 Marine	S
Westlynn Service	1270 Lynn Vly	S
Paint Dealers - Retail (5231)		
Bricks N Blocks	1313 McKeen	S
Color Your World	2925 Lonsdale	S
Color Your World	1887 Marine	S
Gus' Hardware & Bldg Sup.	4260 Mt Seymour Pkwy	S
Hollyburn Lumber Company	3147 Woodbine	S
North Shore Paint & Tile Centre	1198 Marine Dr	S
United Landscape Supplies	125 Riverside	S
Woodstop Lumber	1335 Draycott Rd	S
Paint Mfrs (2851)		
International Paints	126 Harbour Ave	S
Pest Control - Exterminating & Fumigating (7342)		
North Shore Pest Control	261 Pemberton	S
Plastics - Fabricating, Finishing & Decorating (3080)		
Feature Plastics Industries	1433 Rupert	S
Plastics - Raw Materials - Powders, Liquids, Resins, Etc. (2820)		
Plama	5561 Nancy Green Wy	S
Plating (3471)		
Specialty Plating Co	1443 Dominion	S
Printers (2700)		
A J Print	1461 Marine	S
Acor Printing & Stationery	1395 Pemberton	S
Coast City Printers	431 Mountain Hwy	S
Concorde Copy Centres	1350 Pemberton	S
Heritage Press & Stationers	1077 Roosevelt Cres	S
Huber Printing	186 Pemberton	S
Imperial Printing	5-1501 Lynn Vly	S
Manhattan Graphics	1075B Marine	S
Polar Printing	431 Mountain Hwy	S
Printplus Press & Copy	1044 Marine	S
Quest Printing	231 Mountain Hwy	S
Zippy Print	1080B Marine	S
R.R. Switching & Terminal Services (4013)		
B.C. Rail	1321 W 1st	S
B.C. Rail	1490 McKeen	S
R.V. Park (7030)		
Capilano R.V. Park	295 Tomahawk	S
Refrigerating Equipment - Commercial (5078)		
Arcus	108-1861 Welch	S
Dudly Kill & Sons	1870 Spicer	S
Seabreeze Refrig. & Air Cond.	3942 Frames Pl	S
Research & Testing Services (8730)		
Cantech Inspections	1592 Bay	S
Coastech Research	80 Niobe	S
Sanitary Services (4950)		
Canadian Sani-Corp	1127 W 15th	S
North Shore Disposal Services	#110-80 Orwell	S
Schools - Technical & Trade (8249)		
Travel Training Centre	2-1583 Pemberton	S

*S = Suspected Dangerous Goods
C = Confirmed Type & Quantity of Dangerous Goods

Figure 3.3 Fixed Facilities With Dangerous Goods In North Vancouver District

Service Stations - Gasoline & Oil (5541)		Status*
Cap Tex Service Centre	1525 Welch	S
Capilano & Marine Esso Self Srv	2002 Marine	S
Capilano Service-Centre & Wash	1960 Marine	S
Central Motor Service	1012 Deep Cove Rd	S
Conway Pay Chevron	2698 Capilano Rd	S
Delbrook Esso	3707 Delbrook	S
Dollarton Service	489 N Dollarton Hwy	S
Esso Petroleum Canada	3017 Mountain Hwy	S
Fullerton Esso	1801 Capilano Rd	S
Highland Chevron Service	3150 Edgemont Blvd	S
Lynn Valley Chevron	2979 Mountain Hwy	S
Lynn Valley Esso Service	2747 Mountain Hwy	S
Main & Mountain Fuel Centre	185 Mountain Hwy	S
Main Street Town Pantry	1490 Main	S
Marine Drive Service	1396 Marine	S
Mountain Hwy & 27th Esso	2747 Mountain Hwy	S
North Van Esso	106 W Queens	S
Parkway Esso	2011 Dollarton Hwy	S
Parkway Service	2620 Mt Seymour Pkwy	S
Pemberton Auto Services	1110 W 15th	S
Pemberton Shell	1198 Marine	S
Riverside Service	2102 Dollarton Hwy	S
Riverside Shell Self Serve	194 Riverside	S
Shell Canada Products	1731 Capilano Rd	S
Super-Save Gas	1348 Marine	S
Uye's Service	1396 Marine	S
Village Esso	3089 Edgemont Blvd	S
West Lynn Service	1270 Lynn Vly	S
X-Cel Lube	1362 Marine	S
Ship Builders & Repairers (3731)		
Allied Shipbuilders	1870 Harbour Rd	S
McKenzie Barge & Marine Ways	3919 Dollarton Hwy	S
Pacific Western Shipbuilders Co	3829 Dollarton Hwy	S
Vancouver Shipyards Co	50 Pemberton	S
Skating/Curling Rinks (7990)		
Karen Magnussen Rec Centre	937 Lynn Vly	S
Swimming Pool Equipment & Supplies (5091)		
Anchor Marine Canvas	1181 W 16th	S
Blue Water Pools	1225 Welch	S
Crystalview Pool Services	104 Philip	S
Ideal Pool & Patio Supply	340 Lynn	S
Rocky's of B.C. Leisure	1372 Main	S
West Coast Pool Serv. & Sup.	1120 E 3rd	S
Taxi (4121)		
North Shore Taxi	250 Pemberton	S
Sunshine Cabs	260 Riverside	S
Testing Laboratories (8734)		
Biopacific Diagnostic	1430A Columbia	S
Coast Testing (Canada)	1474 Dominion	S
Warehousing & Storage (4220)		
Edgemont Moving & Storage	1588 Columbia	S
Northgate Warehousing & Dist.	1331 McKeen	S
Water Treatment Equipment Service & Supply ( )		
Alchem	2030 Marine	S
Weed Control Service (780)		
Beaver Tree Services	2290 Dollarton Hwy	S
Peregrine Landscaping	3559 Capilano Rd	S
Welding Equipment & Supplies (5084)		
Canadian Weldvent Systems	1189 Airlynn Pl	S
Thermadyne Welding Products	1165 Caledonia	S
Wholesale - Sporting & Recreation (5091)		
Polysol Pool Covers (1986)	104 Philip	S
Businesses of Unknown Industry Type		
ABC Packaging	130 Forester	S
Arrow Transportation Systems	320 Seymour Blvd	S
Astravan Distributors	159 Riverside Dr	S
Ballard Battery Systems	1164 W 15th	S
Bondar-Clegg & Company	130 Pemberton	S
Brad Bowes	810 Evelyn Dr	S
Caldwell Industries	384 Lynn	S
D & R Distributors	4671 Tourney Rd	S
International Chem. Expree (ICX)	320 Seymour Blvd	S
IPEC Consultants	2104 Front	S
J.C. Barr	1431 Crown	S
Mettalic Design Studio	644 Mountain Hwy	S
Rainbow Industrial Products	1427 Crown	S
Technital Distributors	#2-151 Riverside Dr	S
Wespro Industries	1458 Rupert	S
White & Peters	1344 Pemberton	S

*S = Suspected Dangerous Goods
C = Confirmed Type & Quantity of Dangerous Goods

Sources: North Vancouver District Fire Department, B.C. Tel Yellow Pages, Standard Industrial Classification (SIC) Codes, Transport Canada List of Facilities that Possibly Handle Dangerous Goods.

3.2.2 Fixed Facility Dangerous Goods Volumes

Although some quantities of dangerous goods are known for a handful of premises, data are insufficient at present to estimate the total quantity of such commodities in fixed facilities within the District of North Vancouver.

There are three large chemical manufacturers in the community, and several industry types within the community that could pose a significant threat to the public, such as warehouses, research laboratories containing radioactive substances, PCB storage locations, and propane distribution centres. The quantities of dangerous goods in fixed facilities will not be known until a survey can be conducted.

3.2.3 Fixed Facility Accident Rates

Accident rates for fixed facilities have been predicted for a number of industries, primarily those directly involved with hazardous activities, such as petroleum product refining and nuclear power generation. The Major Industry Accidents Council of Canada (MIACC) is currently compiling a risk assessment methodology that will apply universally-acceptable accident rates to a broad range of business operations. Until the methodology has been substantially completed, expected in the spring of 1993, accident rates for dangerous goods at fixed facilities in the community are unavailable.

3.3 ROAD TRANSPORT

Decades of research on hazardous material accidents have lead some experts to conclude that road transport presents the greatest risk of all transport modes (Rhoads, et al, 1986; Saccomanno, et al, 1987; TNO, 1988). Not only are vehicle accidents more numerous than rail, marine, or pipeline incidents, truck incidents are often more difficult in terms of emergency response.

Road transport characteristically offers many challenges to a risk assessment. Essential data on routes used, volumes shipped, and even the types of commodities on the roads are typically absent. Even if data could be collected for a given moment in time, changes in business opportunities and traffic patterns may mean significantly different risks over time.

3.3.1 Road Dangerous Goods Routes

The B.C. Transportation of Dangerous Goods Act authorizes municipalities to designate dangerous goods truck routes or to prohibit dangerous goods from some portion of the municipality. The District of North Vancouver has designated specific dangerous goods truck routes within the municipality.

For the District of North Vancouver, two types of roadway may be used to transport dangerous goods. Main dangerous goods routes include:

- Amherst Avenue
- Capilano Road / Nancy Green Way
- Deep Cove Road
- Dollarton Highway
- Lillooet Road
- Lynn Valley Road
- Upper Levels Highway

The alternate dangerous goods routes have been designated as:

- Marine Drive
- Mount Seymour Parkway
- Mountain Highway
- Queens Road / 29th Street
- William Avenue

Figure 3.4 provides an illustration of the major routes used to transport dangerous goods within the District. Local deliveries of gasoline, propane, and fuel oil in bulk amounts and chemicals in consumer quantities may occur on almost any commercial roadway. The use of these routes for through and local traffic in the District of North Vancouver should be confirmed through direct observation.

3.3.2 Road Dangerous Goods Volumes

There are currently no reliable data on the volume of dangerous goods transported by road within and through North Vancouver. To arrive at rough estimates of the volumes presented by such vehicles, two methods are applied below.

The first method uses available information on traffic counts to predict ball-park numbers of dangerous goods vehicles, a technique that has been used by the City of Portland, San Francisco Bay communities, and more recently, the Lower Mainland TDG Study, among others (Boydell, 1988; ICF Inc., 1985; Portland, 1982; TERA, 1984).

Research suggests that dangerous goods vehicles comprise a predictable percentage of truck traffic moving all goods. The Lower Mainland TDG Study suggested that five percent of all commercial trucks on the road at any given time are carrying dangerous goods, a somewhat conservative figure. Further, the TDG Study applied an average consignment load of five tonnes per vehicle, following a 1978 study completed for the Transport Canada Research and Development Centre, also considered to be conservative. Applying these assumptions, five percent of all trucks as dangerous goods vehicles and five tonnes per vehicle, to available traffic count information for the District roadways yields the results summarized in Figure 3.5.

Regulations

- 40 CFR Part 68 (Accidental Release Prevention and Risk Management Planning)
  - Regulations Regarding the List of Regulated Substances and Thresholds for Accidental Release Prevention (The List Rule)
  - Regulations Regarding the Risk Management Program (RMP Rule)
- SARA Title III - Emergency Planning and Community Right-to-Know Act Regulations
- The National Contingency Plan
- 40 CFR Chapter IV (Distribution of Off-Site Consequence Analysis Information)

(Note: To order a paper copy of any of the documents on these pages, contact the National Service Center for Environmental Publications (NSCEP) at 1-800-490-9198. The Adobe Acrobat Reader, a free software system, will be necessary to read documents in Portable Document Format (PDF). More information on PDF files can be found on the PDF information page.)

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40 CFR Chapter IV (Distribution of Off-Site Consequence Analysis Information) Final Rule: Public Distribution of Off-site Consequence Analysis (OCA) Information (Issued: August 4, 2000)

EPA and **DOJ** have finalized regulations governing public access to information concerning the potential off-site consequences of accidental releases from industrial facilities. The 1999 Chemical Safety Information, Site Security and Fuels Regulatory Relief Act required the government to assess both the chemical risk reduction benefits of allowing public access to OCA information and the increased risk of terrorist and other criminal activity from posting the information on the Internet. Based on these assessments, conducted by EPA and DOJ respectively, the final rule allows public access to the OCA portions of the RMPs in ways that minimize the likelihood of chemical accidents as well as the increased risk of terrorist and criminal activity associated with Internet posting.

- **Fact Sheet:** Chemical Safety Information, Site Security and Fuels Regulatory Relief Act: Public Distribution of Off-Site Consequence Analysis Information (April 2000). EPA has prepared a fact sheet (PDF)which summarizes the proposed rule.

40 CFR Part 68 (Accidental Release Prevention and Risk Management Planning)

The CFR is a codification of the rules published in the Federal Register by the Executive departments and agencies of the Federal Government.

- RMP and List Rules combined in the Code of Federal Regulations (CFR) (as of July 1, 2001).

Regulations Regarding the List of Regulated Substances and Thresholds for Accidental Release Prevention (The List Rule)

- List of Regulated Substances and Thresholds for Accidental Release Prevention; Requirements for Petitions under Section 112(r) of the Clean Air Act as Amended **(the List Rule)** (signed January 14, 1994, published January 31, 1994) (HTML)
- List of Regulated Substances and Thresholds for Accidental Release Prevention, Final Rule (signed August 19, 1997, published August 25, 1997)(HTML)
- List of Regulated Substances and Thresholds for Accidental Release Prevention; Amendments (signed December 18, 1997, published and effective January 6, 1998) (HTML)
- Title III Consolidated List of Lists (July 2001) (PDF)
- List of Regulated Substances and Thresholds for Accidental Release Prevention; Final Stay of Effectiveness. (signed May 24, 1996, published and effective June 20, 1996)(HTML)
- Amendments to the List of Regulated Substances and Thresholds for Accidental Release Prevention; Flammable Substances Used as Fuel or Held for Sale as Fuel at Retail Facilities (signed March 3, 2000, published March 13, 2000) (ASCII text)

Regulations Regarding the Risk Management Program (RMP Rule)

- Accidental Release Prevention Requirements: Risk Management Programs Under the Clean Air Act, Section 112(r)(7); List of Regulated Substances and Thresholds for Accidental Release Prevention **(the Risk Management Program or RMP Rule)** Final Rule (signed May 24, 1996, published and effective June 20, 1996)(PDF version)(424 KB) (ASCII text version)(470K)

Amendments to the Risk Management Program (RMP Rule)

- Accidental Release Prevention Requirements: Risk Management Programs Under Clean Air Act Section 112(r)(7); Amendments (Final rule signed December 29, 1998; Published January 6, 1999) (PDF) (124 KB)

  You can also download this rule from here in (PDF) and here in HTML.

SARA Title III - Emergency Planning and Community Right-to-Know Act Regulations

- EPCRA Regulations: 40 CFR Chapter I, Sub-chapter J includes all of EPCRA including trade secrecy provisions.
- Amendments to Hazardous Chemical Reporting Thresholds, Streamlining Requirements. 40 CFR Parts 355 and 370 (Signed May 21, 1998; Published June 8, 1998). (HTML)
- Amendments to the Emergency Planning and Community Right-to-Know Act (EPCRA) Sections 311 and 312

  The final rule raises the gasoline and diesel fuel thresholds that trigger Material Safety Data Sheet (MSDS) reporting and annual chemical inventory reporting under sections 311 and 312 of the Emergency Planning and Community Right-to-Know Act (EPCRA). This final rule promulgates new threshold levels of 75,000 gallons for gasoline and 100,000 gallons for diesel fuel, when stored entirely underground at retail gas stations that comply with requirements for underground storage tanks (USTs). These new thresholds are expected to relieve most retail gas stations from reporting gasoline and diesel fuel under these sections of EPCRA. However, gas stations should check with the appropriate state agency to see if they must report under any applicable state law. Retail gas stations meeting these criteria will not have to file gasoline and diesel fuel inventory reports for calendar year 1998 that are due March 1, 1999.

The National Contingency Plan

The National Contingency Plan (NCP) is the federal government's blueprint for responding to both oil spills and hazardous substance releases. The NCP is the result of our country's efforts to develop a national response capability and promote overall coordination among the many responders. Under the NCP, EPA is the lead federal response agency for spills/releases occurring in inland water zone, and the U.S. Coast Guard is the lead federal response agency for spills in the coastal zone and Great Lakes.

	EPA Home		OSWER Home		CEPPO Home	
	Search EPA		Search CEPPO	
	Calendar		Contact Us		What's New	

	Chemical Accident Prevention and RMP	
	Emergency Planning and Community Right-to-Know	
	Emergency Response || International Programs || Counter-Terrorism	
	Business and Industry || Concerned Citizens || Partnerships || State, Local, and Tribal	
	Databases and Software || Laws and Regulations || Publications	

Maintained by the Chemical Emergency Preparedness and Prevention Office (CEPPO), Office of Solid Waste and Emergency Response (OSWER), U.S. Environmental Protection Agency (EPA)

http://www.epa.gov/ceppo/lr-regs.htm

Last Updated: August 30, 2001

federal register

Wednesday
January 6, 1999

Part IV

Environmental Protection Agency

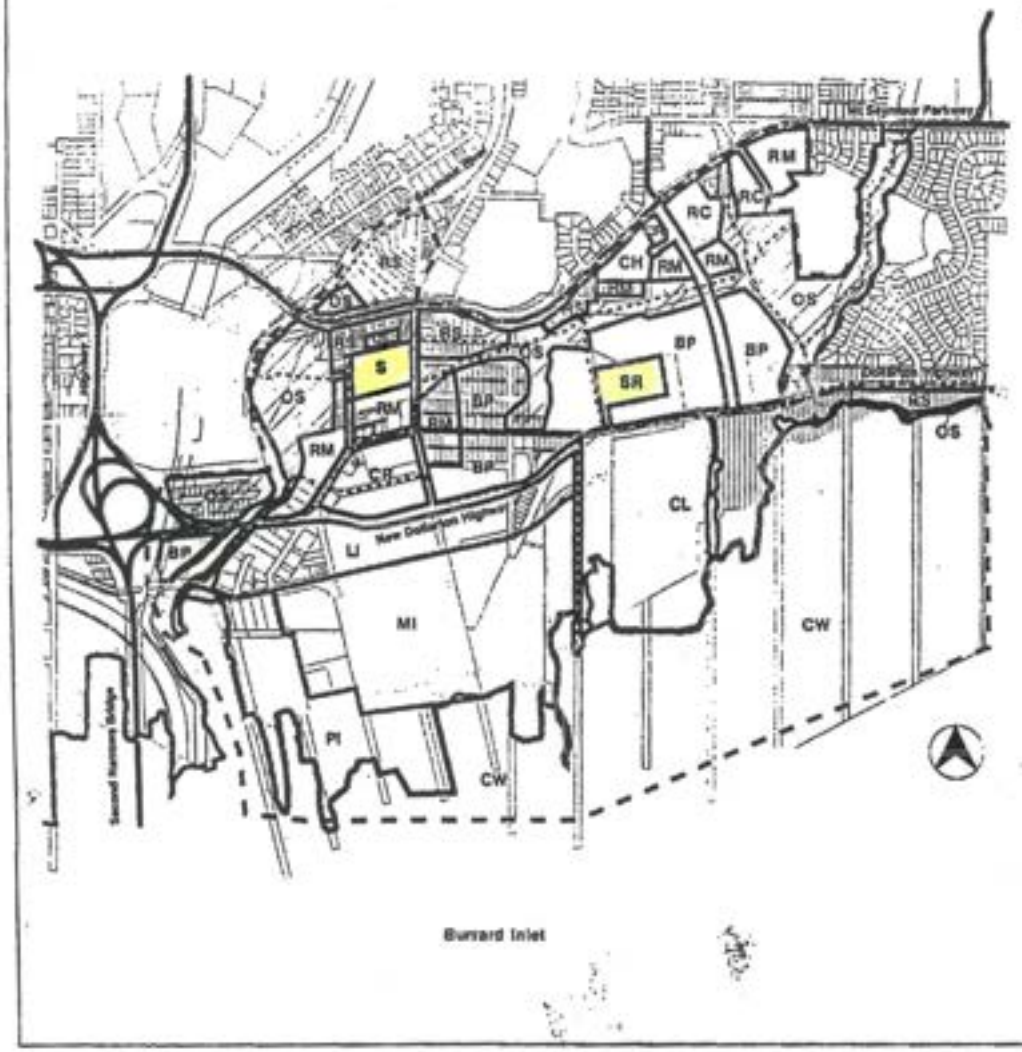
40 CFR Part 68
Accidental Release Prevention Requirements; Risk Management Programs Under Clean Air Act Section 112(r)(7), Amendments; Final Rule

North South

Sue 7171741

Maplewood Local Plan - Map

November 2000



LEGEND :

RESIDENTIAL
- RS Residential Low Density
- RM Residential Medium Density

COMMERCIAL
- C Commercial
- CR Commercial/Residential Mix

EMPLOYMENT
- BP Business Park
- LI Light Industrial
- MI Medium Industrial
- PI Port Industrial

OPEN SPACE & CONSERVATION
- OS Open Space
- CL Conservation-Land
- WC Conservation-Water

INSTITUTIONAL
- S School-Elementary
- SR School-Residential
- RC Recreational Centre
- YC Youth Centre
- CH Care Home

Trail ----------

Plan Boundary — — — — —

ISSUES

This brochure is to introduce you to the new draft local plan for Maplewood. The following illustrates the plans proposals:

Community Vision

- key vision for Maplewood is a complete, balanced and sustainable community where residents can live, shop and work.....with,
- a variety of housing for all ages and incomes
- new business parks with high visual standards and local jobs'
- more green space and a local trail system connecting the community.
- environmental protection for stream corridors
- a community so designed as to decrease reliance on the car
- accessible waterfronts

Environment & Conservation

- protect the Seymour River
- enhance and protect Maplewood, Blueridge and McCartney Creeks
- protect tree cover on the Windridge Escarpment
- support efforts to increase bird life in the Maplewood Conservation Area
- expand wildlife corridors

Parks, Open Space and Trails

- expand waterfront access opportunities
- a new park east of Blueridge Creek
- enhance Maplewood Children's Farm
- a new Maplewood community trail system

Residential

- more housing choices
- revitalise existing residential areas
- new development will provide benefits to community

Commercial

- a new attractive village centre
- make village centre pedestrian friendly
- more commercial employment opportunities
- high visual standards at prominent entranceway sites

Business Park

- encourage attractive, well-landscaped business parks
- the District's own business park will provide community open space
- encourage innovative live-work units

Industrial

- eventual removal of the chemical industry
- creation of attractive new light industrial areas south of new Dollarton Highway
- provide more public waterfront access in industrial areas
- clean up and improve existing light industrial areas

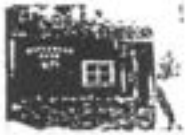
Transportation, Circulation and Utilities

- safe drop-off zone for school children on Riverside Drive
- extend Berkley Rd to join Dollarton Highway
- improve bus and bicycle facilities
- look at new seabus connection to Downtown

Community facilities and Services

- encourage new public art
- improve recreation facilities
- more seniors' space

Urban Design and Heritage



- create a Maplewood identity based on its history and environment
- preserve the community's heritage
- improve the appearance of Maplewood
- special controls for prominent entranceways community

Special Areas

- a new concept plan for Windridge Centre with more housing, retail and trails
- convert Front Street to a new retail street with apartments above shops
- an active, attractive and exciting new village centre with new shops and apartments
- better pedestrian facilities in Maplewood Village Centre

A new local plan for Maplewood has been drafted and is ready for your review at the following open houses. Please come, join your Maplewood neighbours and district staff, have a coffee, see the displays and provide us with your comments.

November 28, 2000
6-9 pm, Canadian International College
2420 Dollarton Highway

November 29, 2000
2-5 pm, Maplewood Pub
1970 Spicer Road

November 30, 2000
6-9pm, Canadian International College
2420 Dollarton Highway

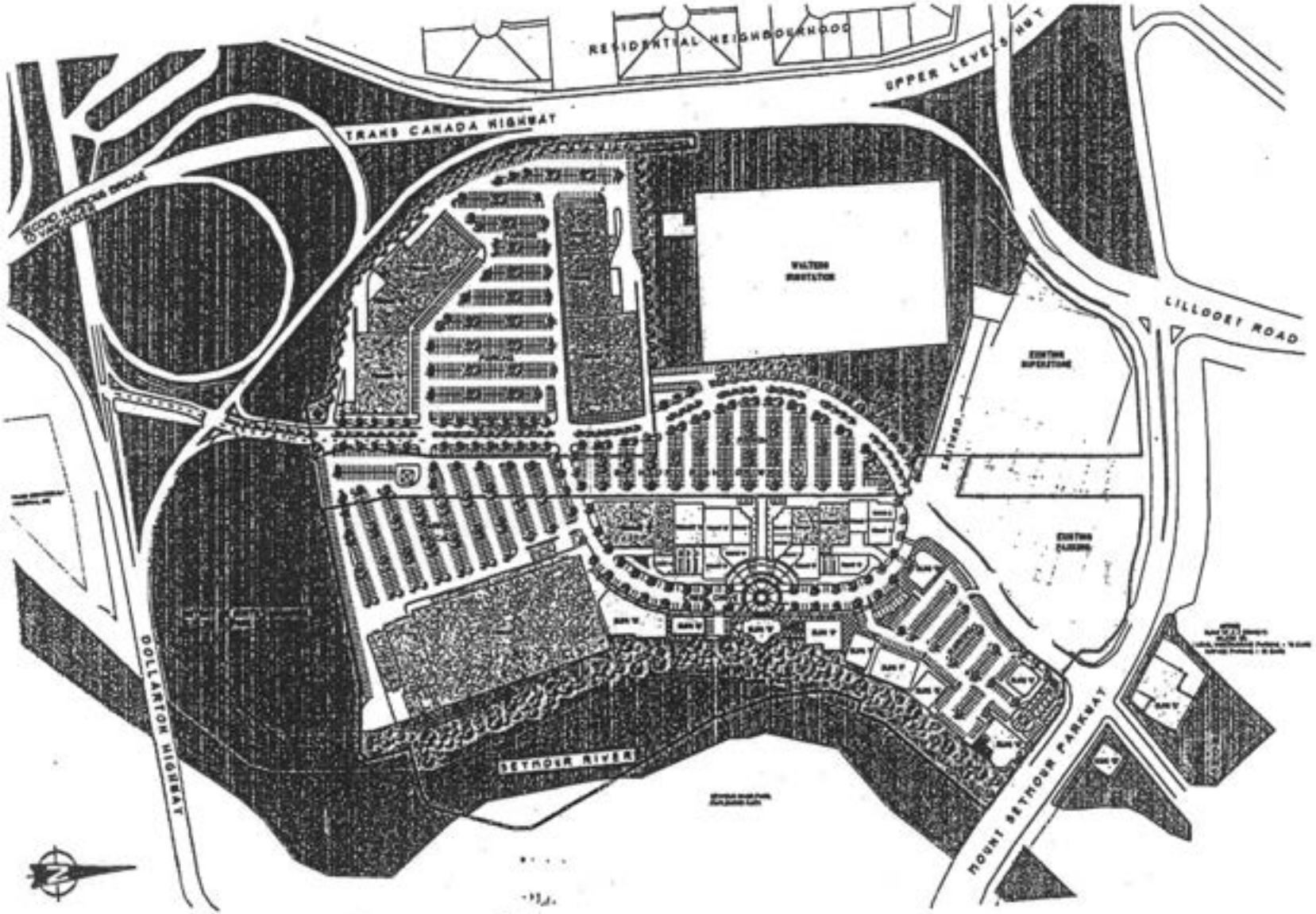
For more information, please call Jim Masterton Community Planning Department at 990-2330

DISTRICT of NORTH VANCOUVER

Maplewood Local Plan

This is how MAPLEWOOD WAS IN 1912..... how do you THINK IT'LL LOOK IN 2012?

ATTACHMENT A



PROJECT STATISTICS

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TENANT 'B'	=	[illegible] SQ.FT.
TENANT 'C'	=	[illegible] SQ.FT.
TENANT 'D'	=	[illegible] SQ.FT.
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TENANT 'F'	=	[illegible] SQ.FT.
TENANT 'G'	=	[illegible] SQ.FT.
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BUILDING 'C'	=	[illegible] SQ.FT.
BUILDING 'D'	=	[illegible] SQ.FT.
BUILDING 'E'	=	[illegible] SQ.FT.
BUILDING 'F'	=	[illegible] SQ.FT.
BUILDING 'G'	=	[illegible] SQ.FT.
BUILDING 'H'	=	[illegible] SQ.FT.
BUILDING 'I'	=	[illegible] SQ.FT.
BUILDING 'J'	=	[illegible] SQ.FT.
BUILDING 'K'	=	[illegible] SQ.FT.
BUILDING 'L'	=	[illegible] SQ.FT.
BUILDING 'M'	=	[illegible] SQ.FT.
TOTAL BLDG AREA:	=	[illegible] SQ.FT.

SITE PLAN

SCALE: 1" = [illegible]'-0"

SEYMOUR CREEK VILLAGE
NORTH VANCOUVER, BRITISH COLUMBIA

A JOINT VENTURE COMMERCIAL DEVELOPMENT
SQUAMISH NATION / PROGRESSIVE PROPERTIES LTD./ KINGSWOOD CAPITAL CORP.

urban design group
architects ltd.
[illegible] WEST HASTINGS
VANCOUVER, BC V6C 1E4
TELEPHONE [illegible]
FACSIMILE [illegible]

16/18

ATTACHMENT 3 to Schedule "A" of Bylaw 7234

SCHEDULE B DEVELOPMENT PERMIT AREAS

4.3 LOCAL PLAN GUIDELINES

4.3.4 Maplewood Local Planning Area- Windridge and Maplewood Centre Development Permit Guidelines (Detail Map).

4.3.4.1 Windridge Centre Guidelines

Design Objectives:
To create a consistent design theme and to ensure that all developments in Windridge are linked to the community trail system.

Specific Guidelines:
i) All new buildings to reflect a co-ordinated architectural theme to reflect the area's natural materials.
ii) All new developments to be extensively landscaped with visual linkages to landscaped public spaces.
iii) All new developments will make provision for linkages to the proposed community trail system.
iv) New buildings to be designed to be as energy-efficient as possible.

4.3.4.2 Maplewood Centre Guidelines

Design Objectives:
To create a high quality built environment that reflects the area's planned role as the major employment centre in Seymour; to respect nature and encourage sustainable buildings; to define the area's unique environment and history and reflect this in the new architecture.

Specific Guidelines:
I) The layout, design and scale of commercial and multi-family residential development should encourage a village-like character.
ii) Use of local building materials such as cedar shakes and siding and river rock and other design characteristics common to this area are to be encouraged.
iii) Widespread use of intensive colours on exterior surfaces is discouraged.
iv) New buildings to be designed to be as energy -- efficient as possible.
v) Buildings and public areas to be unified with a consistent landscape element ; the use of native vegetation should be encouraged.
vi) Signage to be integrated with design of building to enhance, not dominate, facades.
vii) Street furniture and lighting to be co-ordinated with overall landscaping and building concept.
viii) All electrical and telephone services to be placed underground where possible. All above- ground utility structures to be in unobtrusive locations and properly screened.
ix) Extensive paved areas should incorporate a variety of materials, patterns and textures
Benches and weather protection to be provided at bus stops.
x) Parking areas should be carefully designed as integral parts of development by incorporating significant landscaping and outdoor elements in a co-ordinated fashion. A reduction of the visual presence of the automobile in new developments is sought.

COUNCIL AGENDA/INFORMATION		
☐ In-Camera	Date: _____	Item # _____
☐ Regular	Date: _____	Item # _____
☐ Info Package	Date: _____	Item # _____
☐ Agenda Addendum	Date: _____	Item # _____

Dept. Manager	Director	Municipal Manager

The District of North Vancouver
REPORT TO COUNCIL

August 23, 2001
File: 5260-20/170
Tracking Number: RCA -

AUTHOR: Brian Edey, Transportation Planner, Engineering

SUBJECT: **Squamish IR #2 Seymour Creek Village Development - Transportation Status Report**

RECOMMENDATION: It is recommended that Council receive this report for information

REASON FOR REPORT: Council requested at the June 25, 2001 Regular Council meeting that staff prepare an updated traffic report in time for the Maplewood OCP public hearing, taking into consideration recent Federal, Provincial and GVRD data.

SUMMARY: The Squamish Nation recently presented a proposal for the construction of a retail complex "Seymour Creek Village Development" located on the Squamish Band I.R. #2 lands. The District received a proposed Site Plan outlining the proposed construction of 41 buildings with a combine total of 480,000 square foot of retail space.

District staff met with the Squamish Band and their representatives to review potential issues and concerns associated with this development. The Squamish Nation obtained the services of Ward Consulting Group to conduct a traffic impact study of the Development area. The transportation study is based on the 1982 "Seymour Connector Agreement" between the Government of Canada, Province of British Columbia and First Nations, which states that the Province must provide for all traffic generated by any future development on the site.

As the Seymour Creek Development falls within the jurisdiction of the Province, the traffic impacts are being reviewed by the Ministry of Transportation staff and will be included in their assessment of the redesign of the Second Narrows north bridgehead. The Ministry of Transportation (MoT) has expressed interest in re-developing their property that is adjacent to Highway 1 and Second Narrows Bridge ramps. Furthermore, BCTFA has indicated that any financial participation in the Dollarton Bridge project must be realized from the sale of property owned by MoT.

The Province has not provided any final detail on their assessment of the Seymour Creek Village Development or for their proposed re-design of the Second Narrows North Bridgehead. Once the land and transportation options have been refined, the information will

be forwarded to the District for review and comment.

BACKGROUND: On October 19, 2000 staff met with Squamish Nation representatives and their consultants team to outline Engineering and Planning concerns with the proposed Seymour Creek Village Development. The District comments were based on the site plan prepared by Urban Design Group Architects Ltd. (Attachment A) and presented to the District. Staff prepared context statements that outlined various concerns and comments which have been attached (Attachment B & C).

The proposal consisted of 480,000 square feet of retail space in approximately 41 buildings. Vehicle access is proposed to be from the existing traffic signal at Mount Seymour Parkway and Seymour Boulevard and a new access to Dollarton Highway / Main Street from the south of the site with a connection at the Highway One westbound on-ramp.

The Squamish Nation obtained the services of Ward Consulting Group to conduct a traffic impact study of the Development area. The starting point of the transportation study is based on the 1982 "Seymour Connector Agreement" between the Government of Canada, Province of British Columbia and First Nations, which was signed prior to the construction of the Mt. Seymour Parkway. This agreement states that the Province of British Columbia:

> *Shall, at its expense, improve the said (Seymour Connector) access as warranted from time to time by the volume of traffic generated by development on the Seymour Creek Indian Reserve No. 2 and provide suitable and adequate signalization at such time as the volumes of traffic warrants such signalization."*

The Ministry of Transportation (MoT) has expressed interest in re-developing their site located in the northeast corner of the Second Narrows "Iron Workers Memorial Bridge" bridgehead (former MoT North Vancouver District office site) and are currently conducting studies to determine the development viability of site and other transportation improvements.

As the Seymour Creek Village Development falls with in the jurisdiction of MoT the traffic impacts will be reviewed by the Ministry of Transportation (MoT) and be included in their assessment of the redesign of the Second Narrows north bridgehead. The District Transportation Planning Department has had only limited review of the Seymour Creek Village Development preliminary traffic report by Ward Consulting that was submitted to MoT.

MoT and BCTFA has had discussion with District and TransLink representatives over the last few months, where various options and alternatives were presented to address the transportation issues and development impacts in this area. MoT and BCTFA have requested that this information be held in confidence until they have completed their preliminary review of the different options. It is expected that this review and presentation of the preferred option will occur in October, 2001.

ANALYSIS: The Ward report outlined the potential vehicle volumes that would be generated by the Seymour Creek Village Development. The study outline several potential vehicle

access options to the surrounding streets and properties and the various traffic impacts that would result at these connections. Further study on the impact on the District road network is still needed.

If Seymour Blvd. is not extended south, then all additional site traffic will pass through the Mt. Seymour Parkway / Seymour Blvd. Intersection. However it is proposed, by the Developer, to extend Seymour Blvd. south to Main Street / Dollarton Highway to provide an alternative access route for traffic accessing the site. This would result in additional traffic signals being installed on the Dollarton Highway on-ramp to Highway One & Second Narrows and at Main Street & Dollarton Highway.

Timing/Approval Process Discussions are continuing with Ministry of Transportation (MoT), BCTFA concerning the and Squamish Nation development and revisions to the Second Narrows "Iron Workers Memorial Bridge" bridgehead. It is expected that additional details will be released by the Ministry later this Fall 2001.

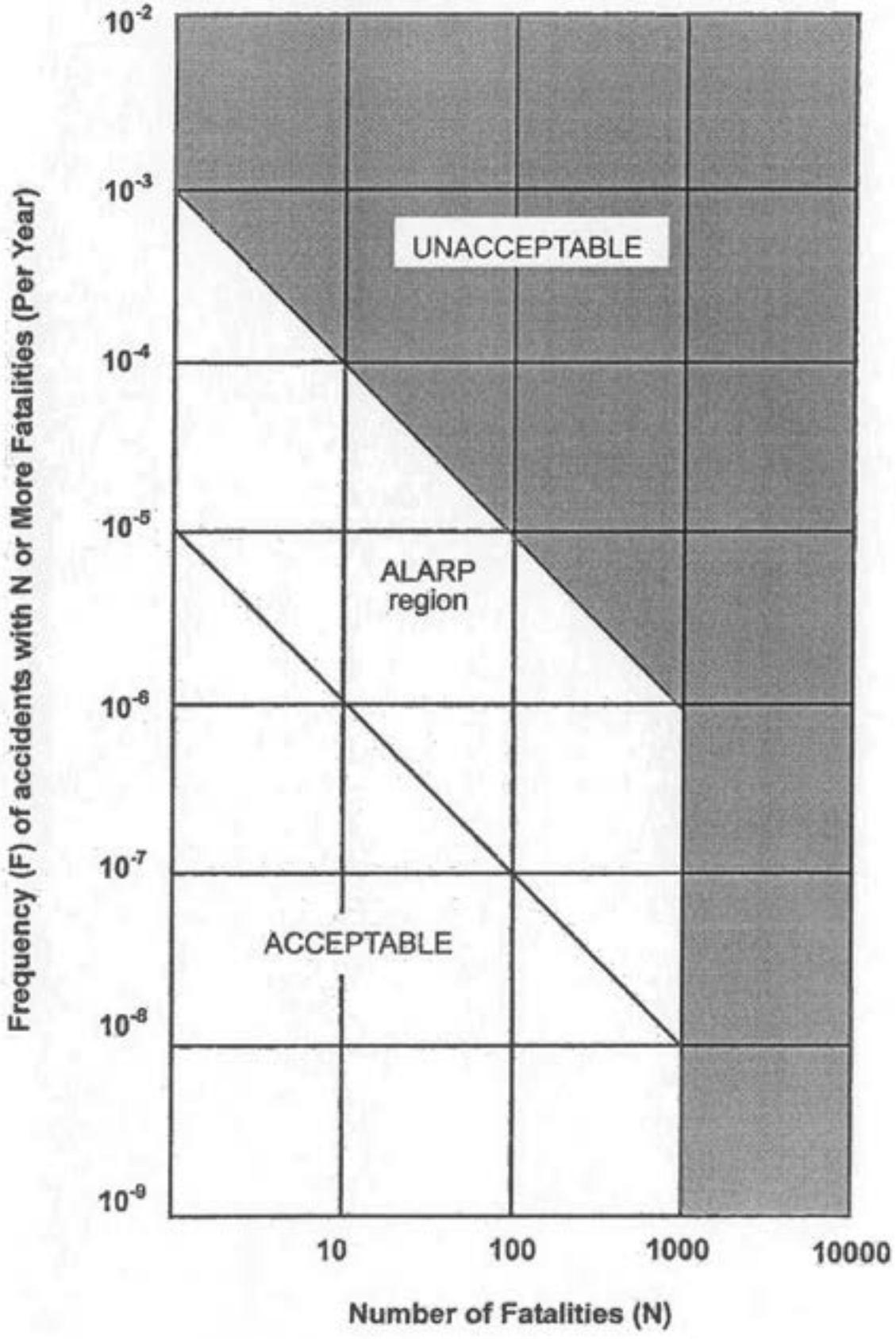
Brian Edey
Transportation Planner

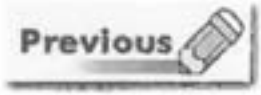
Attachments:
A. Site Plan of Seymour Creek Development
B. Transportation Dept – Context Statement
C. Planning Dept.- Seymour Creek Village review

REVIEWED WITH:	REVIEWED WITH:	REVIEWED WITH:	REVIEWED WITH:
❑ Eng. Trans/Public Works	❑ Clerk's Office	External Agencies:	Advisory Committees:
❑ Eng. Services	❑ Communications	❑ Library Board	❑ _____
❑ Eng. Parks	❑ Finance	❑ NS Health	❑ _____
❑ Eng. Utilities	❑ Fire Services	❑ RCMP	❑ _____
❑ Plg. Community Planning	❑ Human Resources	❑ Recreation Commission	
❑ Plg. Social Planning	❑ ITS	❑ Other: _____	
❑ Plg. Permits & Licenses			
❑ Plg. Land			
❑ Plg. Env. Protection			

Figure 3 Societal Risk Guidelines for Acceptable Risk Levels

[Text Version]

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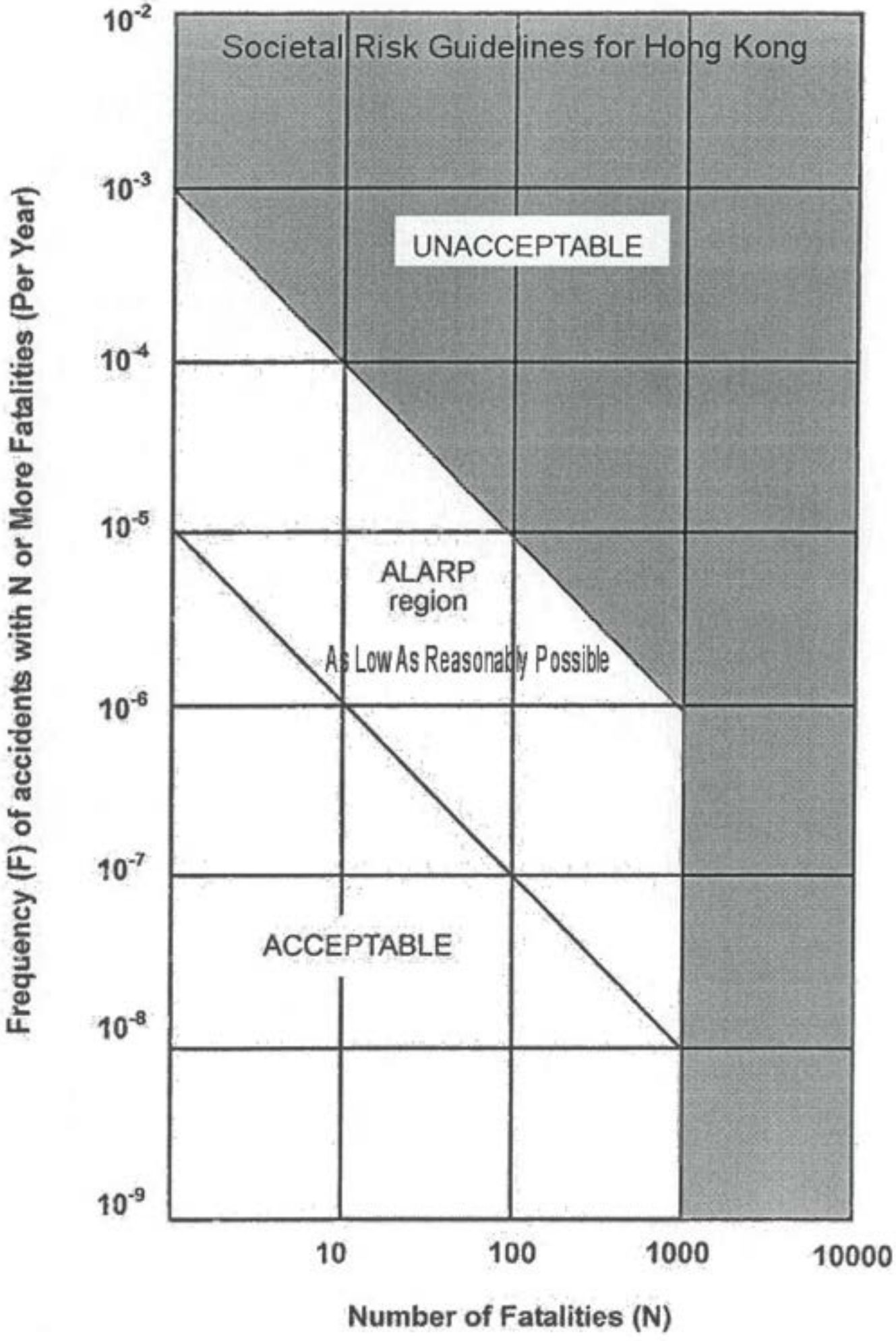
Societal Risk Guidelines for Hong Kong
UNACCEPTABLE
ALARP
region
As Low As Reasonably Possible
ACCEPTABLE
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
10^{-8}
10^{-9}
Frequency (F) of accidents with N or More Fatalities (Per Year)
10
100
1000
10000
Number of Fatalities (N)

Chapter 11 : Miscellaneous Planning Standards and Guidelines

1. Introduction

1.1 The purpose of this chapter is to provide planning standards and guidelines for those land uses or facilities which do not fall within the purview of other chapters. These facilities and land uses are not at present related to each other. However, some of them may be expanded or combined in future to form new chapters of their own. As such, this chapter may be expanded or curtailed to suit new requirements.

2. Underground Rock Cavern Development

2.1 Rock Cavern Development Opportunities

2.1.1 Underground rock cavern developments refer to developments inside large man-made underground spaces in rock. Hong Kong's geological conditions offer excellent opportunities for this type of development. The igneous rocks which underlie much of the metropolitan area and the New Territories are excellent excavation media below the weathered mantle and are ideal for forming man-made caverns. Caverns are designed on the principle of utilizing the strength of the rock mass to form the roof arch and sidewalls. Detailed guidance on site investigation, design and construction of caverns would be given in Geoguide 4 - Guide to Cavern Engineering.

2.1.2 Although most cavern developments incur higher capital costs than similar developments above-ground, the use of cavern space in highly developed and overcrowded areas of Hong Kong can be an economic proposition under certain circumstances. Examples of such cases are given in the detailed reports of the Study of the Potential Use of Underground Space (SPUN).

2.1.3 Underground cavern developments can also be an attractive alternative development form, in terms of potentially significant environmental benefits. These benefits include the potential to mitigate adverse environmental impacts associated with conventional surface developments of certain polluting uses and the provision of a very stable environment, which can achieve savings in running costs.

2.2 Possible Uses in Rock Caverns

2.2.1 Table 1 shows the possible uses of rock caverns suggested by the SPUN study consultants and recommended by the inter-departmental Working Group on Underground Rock Cavern Developments. The table is not exhaustive and should be used for general guidance only. Each application has to be considered on its own merits.

2.2.2 It must be recognised that changes in technology may help prevent or alleviate problems associated with the intended underground development. The suitability of each case should therefore be assessed on the basis of a pre-feasibility study and planning study described below.

[Simple Table Format]

Table 1 : Possible Uses for Rock Cavern Development

	Land Use	Possible[1]	Unsuitable [2]
1.	***Residential*** (Incl. residential institution)		*
2.	***Commercial***		
	Office	*	
	Retail	*	
	Entertainment	*	
	Hotel		*
	Ancillary Parking	*	
3.	***Commercial/Residential***		
	Commercial elements	*	
	Residential elements		*
4.	***Industrial***		
	Industry	*	
	Storage/Warehousing	*	
	Oil bulk storage	*	
	LPG bulk storage	*	
5.	***Education***		*
6.	***Vehicle Parking***	*	
7.	***Open Space***		*
8.	***Government/Institution/Community***		
	Abattoir	*	
	Civic centre/Community centre	*	
	Hospital/Polyclinic/Clinic		*
	Incinerator	*	
	Indoor games/Sports hall	*	
	Market (wholesale and retails)	*	
	Refuse transfer facilities	*	
	Sewage/Water treatment	*	
	Service reservoir	*	
	Transport connections & networks	*	
	Cemetery/Crematorium		*
	Columbarium/Mausoleum/Mortuary	*	
9.	***Utilities***		
	Power stations/Electricity sub-stations	*	

* SPUN's and Working Group's recommendations

1. Uses under this column are subject to pre-feasibility studies and planning studies to establish their suitability for development on a case by case basis.

2. Uses under this column are usually considered unsuitable for underground rock cavern development.

2.3 Planning Process for Rock Cavern Development

2.3.1 The planning process for handling rock cavern development is illustrated in the flow chart at Figure 1. It indicates the role of the Planning Department (Plan D), the Geotechnical Engineering Office (GEO) of the Civil Engineering Department (CED), the Lands Department (LD) and other relevant departments/agencies in the planning and development of underground rock caverns.

Site Identification

2.3.2 In the formulation of the sub-regional planning strategies and preparation of district town plans, PlanD shall refer the relevant public project proposals (particularly those already included in the Public Works Programme) to GEO for consideration. Relevant projects are those which, by their nature, are potentially suitable for rock cavern development as suggested in Table 1. GEO will then advise PlanD as to the opportunities for cavern development for these projects. Other sectoral planning studies may also identify potentially suitable cavern sites to meet their objectives or requirements. Site identification is through systematic geological mapping by the GEO or other study agents, who should work closely with the PlanD and the project departments to establish the potential for cavern development for the intended uses.

Pre-feasibility and Planning Studies

2.3.3 The purpose of conducting pre-feasibility and planning studies is to provide basic technical and planning information about the sites and an estimate of capital costs of development. The pre-feasibility studies will be carried out by the GEO and the planning studies co-ordinated by the Plan D. Such studies will safeguard against wastage of manpower and resources at the project planning stage.

2.3.4 Pre-feasibility studies are the initial appraisal of the geotechnical and engineering aspects of the cavern site for the proposed use. The study should produce preliminary design of cavern accommodation and an estimation of rock excavation and support costs.

2.3.5 The purpose of planning studies is to assess the viability and development parameters for the scheme which include :

a. *Use*
The study should provide justifications for the intended use. Any potential conflicts between the schemes and their immediate environment should be properly addressed in the planning study.

b. *Environment*
For projects which are likely to cause a significant impact on the environment (see para. 1.7, tables 1.1 & 1.2 of Chapter 9 for reference), the Environmental Protection Department should be consulted. The necessary procedures to be followed are discussed in Chapter 9 of the Hong Kong Planning Standards and Guidelines and summarized in a L&WB Technical Circular No. 9/88 "Environmental Review of Major Developments" for public works projects and in the Environmental Protection Department Advice Note no. 2/90 "Application of the Environmental Impact Assessment Process to Major Private Sector Projects" for private cavern development. The necessary preventive measures to mitigate the adverse environmental effects of the projects should be identified. In some cases quantitative environmental assessment may be required to determine the magnitude and severity of potential impacts, prior to any in-principle decision on the project.

c. *Safety*
The safety aspect of the cavern site should be adequately assessed in the initial planning stage. The study should take into account the overall size of a cavern which would have a direct effect on the ease of evacuation and on the safe use of the development.

d. *Traffic*
A traffic impact study should be conducted to address the effect of the intended development at both construction and operation stages. Interfaces and connections with the existing and planned roads, railway and other forms of transportation system should be examined.

e. *Financial*
For government projects, the user department, in consultation with relevant departments, will be required to submit a cost/benefit analysis of the scheme taking into consideration the additional costs, if any, of development underground and the potential financial and other benefits including the release of space above-ground for other uses. For private projects, a statement giving the development costs and appraisal on the financial viability will be required as part of the submission for planning approval.

Planning Procedure

2.3.6 Once the viability of a cavern development has been ascertained, site reservation can be made on the relevant Outline Development Plans/Layout Plans and Outline Zoning Plans in accordance with the normal planning procedures. Suitable zonings should be annotated on these plans to indicate the above-ground and underground development intentions as there may be different developments occupying the same site. At this stage, only the approximate boundaries of the underground rock cavern sites can be annotated.

Project Planning

2.3.7 Project planning for public sector works usually starts when the proposed development has been upgraded to Cat. B of the Public Works Programme. At this stage, detailed geotechnical investigation is required. For government projects, the user department or its works agent will proceed with detailed studies in accordance with the planning

requirements previously identified and the project requirements. Detailed guidance on investigation and design of cavern developments would be given in Geoguide 4 - Guide to Cavern Engineering and the Code of Practice on Fire Engineering for Caverns. Both documents are under preparation. Relevant issues to be considered include :

a. *Fire, Hazard and Public Safety Issues*
Fire/hazard prevention, means of escape and other public safety issues are of crucial importance to the design of cavern developments. The Director of Fire Services and the Principal Government Building Surveyor should be consulted on their requirements.

b. *Radon Emission and Gas Incidence*
It is standard practice in the design of all underground space to provide adequate ventilation in order to avoid the accumulation of gas. The Director of Environmental Protection, the Director of Fire Services, the Commissioner for Labour and the Director of Health should be consulted on their requirements.

c. *Blasting Noise, Vibration and Subsidence*
Some cavern schemes may require blasting in close proximity to building structures and transport lines. When such operations are likely to be involved, advice on the stability of adjoining structures and requirements for preventive measures where necessary should be sought from the Mines Divison of GEO and relevant authorities/ departments.

d. *Drainage, Servicing and Other Utility Provisions*
Consultation with the Director of Drainage Services, the Director of Water Supplies and other utility companies should be made on their requirements on the provision of utility facilities to the cavern development.

For private projects, a planning brief will be prepared by the Plan D to list the development parameters and the above technical requirements. The planning brief will be used as the basis for drawing up the lease conditions.

Land Disposal

2.3.8 The disposal of land for underground cavern development will follow current procedures either as a land allocation for public projects or a land sale/grant for private projects. Land sold/granted for private cavern projects would be counted towards the annual land sale quota.

2.3.9 Due to the complexity of space which cavern developments usually incur, there are practical difficulties in defining plot ratio and site coverage. The development content and relevant control on the cubic content of the development should ideally be specified in the form of a three dimensional development 'envelope' on the lease/engineering conditions. This 'envelope' should be developed in consultation with the GEO and should define an inner space within which cavern construction is permitted, and an outer surrounding space (for maintenance of cavern support) within which excavations or other works should not be permitted apart from access tunnels, drainage adits, and ventilation shafts. Relevant departments should be consulted on the maintenance requirements of the proposed development for incorporation in the engineering/lease conditions.

Project Implementation

2.3.10 All private cavern projects should follow the normal works approval procedures as surface developments. Relevant submissions and approvals are to be co-ordinated by the Building Authority in consultation with other departments. Caverns or any underground space adopted or constructed for occupation for any purpose, including associated access tunnels and access shafts, are considered to be buildings under Section 2(1) of the Buildings Ordinance. For public projects, the works agent would be required to comply with the Engineering Conditions for the land allocation.

2.3.11 To secure the operation and structural safety of the rock cavern development, a protection zone covering an area surrounding the development would be defined by the private developer or Government's works agent following detailed design and construction of the cavern. The GEO should be consulted on the proposed extent of the protection zone. The protection zone would be annotated on the ODP/LP and relevant departments, in particular GEO and BOO, should be consulted for any future development proposals traversing this zone.

3. Petrol Filling Stations (PFS)

3.1 Use

3.1.1 The principal function of PFS is to provide fuelling facilities as well as air and water for motor vehicles. In general and unless as otherwise specified, vehicular fuels may mean petrol, diesel, oil, and liquefied petroleum gas (LPG). Except as otherwise specified, PFS in this chapter generally refers to conventional petrol filling station, petrol cum

liquefied petroleum gas filling station and liquefied petroleum gas filling station.

3.1.2 In addition to fuelling facilities, servicing such as lubricating and cleansing may be undertaken in approved locations.

3.1.3 Some PFS also provide toilet facilities and retail sale compatible with and related to the operation of the station.

3.2 Location

3.2.1 Functionally, PFS should be located where they are readily accessible to vehicles to avoid motorists having to make unnecessary circuitous detours for the purpose of refuelling.

3.2.2 PFS fall into two loosely definable categories : those catering for the needs of through traffic and those serving on a local basis such as residential, commercial or industrial areas. For the former category, the fringe of built-up areas would be a suitable place where PFS are to be located to serve through traffic. Sites near the junctions of major roads also provide special accessibility and visibility. For the latter category, consideration should be given to reserve PFS sites at convenient locations not causing nuisance or unacceptable risk to adjacent users. They should be easily reached by vehicles without passing through local streets in high density commercial and/or residential areas.

3.3 Road Safety Considerations for Siting

3.3.1 Generally, PFS that are located on Expressways, Trunk Roads, Primary Distributor Roads or Rural Roads A should be at specially selected sites with well designed ingress and egress slip roads. On Expressways they should preferably form part of a service area, as indicated in Chapter 6, Volume 2, Transport Planning and Design Manual. On Trunk, Primary and Rural Roads A, the intervals should not be less than 5 km.

3.3.2 On single carriageway roads lower in the hierarchy, if stations are to be provided on either side of the road, they should not be located directly opposite each other, but should be staggered within visible distance of one another but not less than 100m apart, with the left hand station seen first. Where stations are located on the same side of the road, they should be spaced at least 300m apart unless they are contiguous with a common entrance and exit. On dual carriageway roads, stations may be sited opposite to one another.

3.3.3 On Expressways, PFS would be at least 2 km from any intersection. On Trunk Roads, Primary Distributor Roads and Rural Roads A, PFS should not be sited within 100m of any bends, vertical curve or road junction. In other words, a minimum sight distance of 100m should be provided on the approaches to PFS entrances and exits. For roads lower in the hierarchy, this distance should be 50m.

3.3.4 On the whole, PFS should be sited in such a way as to avoid unnecessary back tracking. The function of the road, the volume and speed of traffic on the particular stretch of road, visibility and other relevant factors should be taken into consideration in selecting PFS sites.

3.3.5 The Transport Department and the Hong Kong Police Force (Traffic Hqs) should be consulted on every case with regard to the traffic and road safety considerations as there may be circumstances which warrant a more flexible application of the above guidelines.

3.4 Layout of PFS

Site Dimensions

3.4.1 The site dimensions of new PFS are as follows :

[Simple Table Format]

Type of PFS	Minimum Size (m^2)	Minimum Frontage (m)	Minimum Depth* (m)	Minimum Width of Access Road (m)
(a) PFS without LPG facilities	375	25	15	6
(b) LPG filling station	375			
(c) PFS with LPG facilities	750#			

Note :

* Including footway.

\# Not necessarily required for an existing PFS which is retrofitted with LPG filling facilities.

3.4.2 Where container vehicle patronage is anticipated, the minimum frontage and depth of site are 40m and 15m respectively. There should be a minimum width of 3m for the footway and 8.5m for the access, with a barrier between the PFS and the carriageway. Where circumstance permits, the depth of the site should be greater than 15m taking into account the greater space required for manoeuvre of the container vehicles and greater width of footway separation.

Ingress and Egress

3.4.3 Whether in a built-up area or countryside, a PFS should be able to serve its customers clear of the highway and its ingress and egress should be designed to give good visibility.

3.4.4 In general, only one ingress and one egress are normally permitted and PFS shall be designed for one-way operation to avoid vehicles having to reverse and to discourage vehicles taking short-cuts by entering via the egress point and leaving via the ingress point.

3.4.5 However, where there are two or more road frontages and the PFS is sandwiched between two roads, an additional entrance or exit may be permitted if it would improve internal circulation and would neither disrupt traffic circulation on the roads fronting the site nor adversely affect evacuation of vehicles in emergency.

Filling Point

3.4.6 The filling points should be located to enhance internal circulation and avoid vehicle queue formation onto the adjacent roads. In addition, the station should be designed with the dispensers sited as near the exit as possible in order to ensure that vehicles will not stand on the carriageway while waiting to be refuelled.

Waiting Spaces

3.4.7 Adequate vehicle spaces should be provided within the station to avoid vehicles queuing along the public road. Within the site, one vehicle space should be provided adjacent to each metered filling point. Additionally, a minimum of four waiting spaces should be provided between the entrance and the filling points to hold vehicles awaiting refueling.

3.4.8 Where general lubrication and other servicing facilities are also available, four additional spaces should be provided for each service bay. Those spaces should not obstruct the refueling vehicles.

3.4.9 Consideration shall also be given to provide an additional space between each air-pumping point.

3.5 Environmental and Fire Safety Considerations

3.5.1 For PFS within built up areas, they should preferably be located in relatively open areas and not surrounded by developments. Where such requirement cannot be met, it is desirable that the surrounding buildings of the PFS are only low-rise.

3.5.2 The siting of PFS should take into account the potential noise impact on the adjacent sensitive receivers due to the operation of the PFS and vehicle movements in and out of the PFS, particularly during night hours. In this respect, the locations of the ingress/egress need to be carefully considered to avoid noise disturbances.

3.5.3 Where PFS are located near noise sensitive uses, all noise generating facilities of the PFS should be so arranged to minimise direct noise impact. Any noise impact should be mitigated with appropriate measures to satisfy the noise standards stipulated in Table 4.1 of Chapter 9 (Environment) of the HKPSG.

3.5.4 Restriction on operation hours of stations may also be required to minimize possible nuisance to noise sensitive uses. For definition of noise sensitive uses, Appendix 4.1 to Chapter 9 of the HKPSG should be referred to.

3.5.5 Adequate space should be made available within the PFS for tanks, vent pipes, tank filling points, tank vehicle off-loading stands, pumps and dispensers and buildings, to be placed to meet operational, safety and environmental considerations. The outlets of fuel tanks vent pipes should be suitably located to avoid nuisance to air sensitive uses.

3.5.6 Facilities for carwashing, petrol filling and maintenance activities should be covered as far as possible. All car servicing bays and lubrication bays should be covered. Such covering structure should not affect air circulation of the PFS.

3.5.7 Adequate petrol-intercepting facilities should be installed and maintained to intercept any waste water/grease/debris generated from the station prior to connection to any storm drain or sewer.

3.5.8 Drainage for covered area should be connected to foul sewer via petrol interceptor while that for open area should be connected to stormwater drain via petrol interceptor with stormwater bypass. Wastewater from other sources should be connected to foul sewer direct. Rainwater collected from roofs and canopies should be connected to stormwater drain direct. The surface drainage for covered area and open area should be separated by 150mm raised kerb or bump.

3.5.9 For small PFS with two to three islands for filling (or four to six dispensers) and isolated canopies occupying less than two-third of the total area, all surface drainage can be connected to the storm drains via a petrol interceptor.

3.5.10 If sewer connection is not available, appropriate wastewater treatment facility must be installed to receive effluents from the petrol-interceptor.

3.5.11 Chemical wastes produced should be handled properly. Under the Waste Disposal Ordinance (Cap. 354), the producer has to arrange for proper storage and disposal of the chemical wastes at licensed facilities and to engage a licensed collector to remove and transport the waste. Adequate vehicle access and headroom should be provided to allow clearance of chemical wastes from petrol interceptors. For those stations providing lubricating oil replacement services or other services generating chemical wastes, storage area should be provided for subsequent chemical waste collection and disposal. No drainage should be provided to the chemical waste storage area.

3.5.12 Fire hydrant should be provided within 100m from the PFS. Advices from FSD and WSD should be sought if the proposed PFS sites are located beyond 100m from existing fire hydrants.

3.5.13 The development of PFS without LPG filling facilities is governed under the Dangerous Goods Ordinance (Cap. 295) as well as other relevant ordinances. In granting a licence under Cap. 295, both the "off-site" and "on-site" risks of PFS have to be fully addressed. "Off-site" risk means the potential fire risk posed to life and neighbouring property in the event of a fire at the PFS whereas "on-site" risk refers to the potential fire risk associated with the operation, layout and facilities thereat.

3.5.14 Safety distances for all fuelling facilities in the station are in conformity with the requirements stipulated in the "Guidance for the Design, Construction, Modification and Maintenance of Petrol Filling Stations" published jointly by The Association for Petroleum and Explosives Administration and the Institute of Petroleum;

3.5.15 Other fire safety requirements may be imposed by relevant authorities to mitigate the "off-site" and "on-site" risks of PFS.

3.6 Visual Consideration

3.6.1 The design of PFS should not degrade the visual character and the quality of the locality.

3.6.2 Landscape treatment such as amenity stripes, boundary walls, buffer distance from adjacent developments, the design of the signposts, canopies, etc. can help to improve the appearance of PFS. Landscaping should be incorporated into the design of PFS as far as possible.

3.7 Special Requirements Relevant to LPG Filling Stations or PFS with LPG Filling Facilities

3.7.1 LPG filling station/facilities is classified as a notifiable gas installation under the Gas Safety Ordinance, Cap. 51, where a Quantitative Risk Assessment Report will be required to ascertain that the risk level posed by the station would be acceptable in accordance with the Government Risk Guidelines referred to in Chapter 11, Section 4.4. In general, they are subject to more stringent requirements than PFS without LPG filling facilities. While the suitability for incorporation of LPG filling facilities in PFS and the separation distances from land uses shall be subject to Quantitative Risk Assessment, as a general rule, the following separation distances should apply :

High-rise residential/educational/hospital : 55m

Commercial/recreational/industrial : 15m

Low density residential/incidental dwelling (sporadic dwellings dispersed over a large area) : 15m

3.7.2 According to the gas safety requirements, the vent pipes of pressure relief valves for underground LPG storage tanks of an LPG filling station shall not be obstructed by any obstacles. Moreover, the discharge outlets of the vent pipes shall be at least 4.5m from any openings of a building or any non-flameproof electrical equipment.

3.8 Special Requirements Relevant to PFS within Buildings

3.8.1 LPG filling station or LPG cum petrol filling station should be a free-standing development. It is not acceptable to put any part of the station within buildings from both gas safety and risk points of view.

3.8.2 For PFS without LPG filling facilities, the off-site risk mentioned in para. 3.5.13 for that particular station would initially determine its feasibility for incorporation within a building. Such off-site risk is considered unacceptable when population in the neighbourhood are exposed to danger of serious fire risks which cannot be mitigated by means of fire separation and/or dedicated fire protection system. As such, they should not be located in residential buildings, mixed commercial and residential buildings or basements of all types of buildings.

3.8.3 Siting of PFS without LPG filling facilities within buildings should be avoided as far as possible from environmental point of view. If they have to be located within buildings, they need to be located in areas of adequate air circulation to avoid accumulation of aerial emissions.

3.8.4 The ground floors of car park, industrial or commercial buildings may be used for PFS without LPG filling facilities provided that:-

a. The station is completely separated from other parts of the buildings by enclosures, both laterally and vertically, having a fire resistance period of four hours;

b. The site is open for ventilation at least on one of the longest sides or two adjoining sides;

c. Adequate ventilation, either natural or mechanical, is provided;

d. Adequate headroom should be provided for the safe operation of PFS;

e. The portion of the floor area immediately and vertically above the station in the building is to be used for occupancy with low fire/life risk acceptable to the Director of Fire Services e.g. car parking, mechanical plants;

f. For commercial buildings, the portion of the floor area of the three floors

immediately and vertically above the station should not be used for occupancy with high life risk or sleeping risk, such as child care centre, kindergarten, residential care home for the elderly, guest house and etc. In addition, any part of the buildings shall not be used for places of public entertainment and cinema according to the Building (Planning) Regulations. Other commercial uses may be permitted on the upper floors subject to acceptability of the off-site risk of the proposed station mentioned in para. 3.5.13 above;

g. Openings and windows, if any, on the three levels (floors) directly above the station should be bricked up. This however may be varied subject to a Quantitative Risk Assessment having regard to the design and occupancies of the building;

h. All other fire safety requirements imposed to mitigate the on-site risks are fully complied with; and

i. Any necessary planning approval has been granted by the Town Planning Board.

3.8.5 Some traffic guidelines should also be observed if the ground floors of carpark, industrial or commercial buildings are used for PFS :-

a. The ingress and egress should be separated from the vehicular entrance and exit of the buildings;

b. Adequate vehicle spaces should be provided within the station to avoid vehicles queuing along the public road; and

c. Adequate traffic signs and markings should be provided to guide users to/from the station.

3.9 The Question of Need

3.9.1 The need for PFS cannot be realistically quantified. Site reservation depends on the anticipated growth of the area and volume of traffic. In site reservation in new development areas, concerned departments would be consulted to ascertain the anticipated demand of such facility.

3.9.2 In assessing planning applications for PFS, all relevant factors including land use compatibility, traffic, environmental and fire safety would be taken into consideration and each case would be assessed on its individual merits. Should the application be considered acceptable, approval conditions may be imposed to ensure that the proposed facility could meet the various requirements. It must be emphasized that the absence of petrol of a particular brand does not constitute a need for additional PFS.

4. Potentially Hazardous Installations

4.1 Definition of Potentially Hazardous Installations

A Potentially Hazardous Installation (PHI) is an installation which stores hazardous materials in quantities equal to or greater than a specified threshold quantity, which varies with different substances. The threshold quantity generally follows the specification in the UK Notification of Installations Handling Hazardous Substances Regulations 1982. Some of the threshold quantities have been suitably amended in the light of local conditions. In addition, all explosives factories and Government explosives depots are classified as PHIs.

4.2 Threshold Quantities for Existing PHIs in Hong Kong

4.2.1 The threshold quantities for the more common types are as follows :-

[Table Summary]

Type	Quantity
Liquefied Petroleum Gas storage facilities (in oil terminals, bulk stores & substitute natural gas plant, etc.)	25 tonnes or more
Town gas installations	15 tonnes or more
Chlorine stores (mainly at water treatment works)	10 tonnes or more; or any storage in one tonne drums
Petrol or naphtha stores (mainly at oil depots)	10 000 tonnes or more
Liquid oxygen storage (mainly at industrial gas facilities)	500 tonnes or more
Explosive factories / Government explosives depots	any quantity

4.3 Risk Management

4.3.1 The Government's policy is to minimize the potential risks associated with a PHI to internationally acceptable levels by controlling the siting of PHIs and the land use in the vicinity, and by requiring the installation to be constructed and operated to specified standards. The Coordinating Committee on Land-use Planning and Control relating to Potentially Hazardous Installations (CCPHI) was established in December 1986 to coordinate Government actions in relation to PHIs in Hong Kong. Information on the list and location of PHIs, which is regularly updated by CCPHI, is contained in a separate pamphlet and will be made available upon request.

4.3.2 For every PHI, a Consultation Zone (CZ) should be delineated within which proposed development will be referred to CCPHI for consultation. The extent and size of the CZ is determined with regard to local variation in topography, the types of PHI and their storage capacities. For explosives factories and depots, in addition to the CZ, a Safety Zone (SZ) should be determined in accordance with the current British Table of Safety Distances (Explosives Acts 1875 and 1923).

4.3.3 Within the CZ of PHIs, planning restrictions may need to be imposed on future developments. Proposals for development that will result in an increase in the number of persons living or working in the CZ have to be submitted to CCPHI for consideration. Sizable developments are normally not approved.

4.3.4 Within the SZ for explosives depots, no inhabited buildings or congregation of people will be allowed. The size of the zone will depend upon the quantity of explosives stored.

4.3.5 Development proposals in the CZ will be assessed against the Government risk guidelines (section 4.4) to ensure that risks to the public are confined to within acceptable limits. Where the risk guidelines cannot be met, for existing PHIs, CCPHI will consider the necessary risk mitigation measures to bring the risk level down. Details of the risk guidelines, the undertaking of hazard assessments, planning studies and action plans are given in sections 4.4 and 4.5.

4.4 The Risk Guidelines

4.4.1 A set of Risk Guidelines (RG) has been adopted by CCPHI to assess the off-site risk levels of PHIs. These guidelines are expressed in terms of individual and societal risks.

4.4.2 Individual risk is the predicted increase in the chance of death per year to an individual who lives or works near to a PHI. As individual risk varies with location, it is often shown on a map of the area surrounding a PHI as contours of equal risk which decrease according to distance from the PHI (Figure 3). Furthermore, when utilizing risk contours, the estimated duration of exposure of a person to the PHI should also be taken into consideration to determine the individual risk for comparison with the RG. The CCPHI individual RG requires that the maximum level of off-site individual risk associated with PHIs should not exceed 1 in 100 000 per year i.e. 1×10^{-5}/year. To put this in perspective, the average annual risk of dying in a traffic accident is about 1 in 10 000.

4.4.3 Societal risk expresses the risks to the whole population living near a PHI. The societal RG is presented graphically in Figure 4. The acceptability of societal risk is judged against the frequency and number of deaths of potential incidents at the PHI. The societal RG is expressed in terms of lines plotting the frequency (F) of N or more deaths in the population from incidents at the PHI. Two FN risk lines are used in the societal RG to determine 'acceptable' or 'unacceptable' societal risks. In order to avoid major disasters resulting in more than 1000 deaths, there is a vertical cut-off line at the 1000 fatality level extending down to a frequency of 1 in a billion years. An intermediate region is also incorporated in the societal RG in which the acceptability of societal risk is borderline and should be reduced to a level which is "as low as reasonably practicable" (ALARP). It seeks to ensure that all practicable and cost-effective measures which can reduce risks will be considered.

4.5 The Undertaking of Hazard Assessments, Planning Studies and Action Plans for Existing and Proposed PHIs

Hazard Assessment (HA)

4.5.1 A HA is a technical study on the level of off-site individual and societal risks associated with a particular PHI. It is undertaken by suitably experienced specialists taking into account elements like the nature of the hazardous substances (such as their inflammability or toxicity) and the likely failure events (such as explosion and drifting of gas upon leakage). The HA will identify potential incidents at the PHI and calculate the frequency and consequences of each incident. The HA study will produce calculations of individual risk and societal risk for comparison against the RG. The HA will assess the risks posed by the PHI on the present and future population in its vicinity, and to determine what actions can be taken to reduce such risks.

4.5.2 For Government installations, the undertaking of HA will be steered by a Working Group to be chaired by the

commissioning department. For PHIs which are owned and operated by private companies, the HA will normally be undertaken by the private PHI operator in consultation with the Government (see Annex 1). The concerned department will assume a supervising role for the undertaking of HA.

Planning Study (PS)

4.5.3 A PS examines the present and future land use and development proposals in the neighbourhood of each PHI and advises on the necessary planning considerations and development control within the CZ of the PHI.

4.5.4 PS are to be undertaken by District Planning Offices (DPOs) concurrently with the HA. In the course of preparing the HA and PS, all present and future land uses and development options should be considered, and the relevant departments consulted. Recommendations should be made on how to ensure that the existing and future developments can be protected from being exposed to unacceptable risk caused by the respective PHI. These recommendations will be included in an Action Plan. EMSD and EPD should give technical advice in respect of the extent of hazard created by the PHI. DPOs should provide EMSD and EPD with detailed information on land use, buildings and population level within the CZ.

Action Plan (AP)

4.5.5 After the completion of the HA and the PS, an AP should be drawn up by the relevant DPO, setting out the actions required to bring the risk to a level which is as low as reasonably practicable. It sets out various measures, within the existing administrative and statutory framework, to implement the recommendations of the HA and PS. Possible actions may include, for example, reduced inventory level of hazardous substances at the PHI, physical and operational improvements to the installation, special planning and development control, and other immediate administrative and emergency measures.

4.5.6 DPOs should submit draft APs for the approval of CCPHI. DPOs should also incorporate relevant recommendations into the respective departmental plans and statutory outline zoning plans.

Role of Government Departments Dealing with PHIs

4.5.7 The current division of responsibilities among Government departments dealing with PHIs is given in Annex 1. The HA, PS and AP, when completed, will be submitted to CCPHI for consideration and endorsement.

4.6 Land Use Planning and Control in the Vicinity of Existing PHIs

4.6.1 The HA, PS and AP for a PHI will form the basis for land use planning and development control within the CZ. Depending on the findings and recommendations of the HA, the following are possible measures which may be taken to reduce risk or contain risk at its present level :-

a. statutory re-zoning to reduce development potential with regard to population in buildings or otherwise;

b. stopping public works and Housing Department projects for which there is no contractual commitment and which would increase population in buildings or otherwise;

c. for public works and Housing Department projects with contractual commitment which would increase population, modify as far as practicable to include preventive alterations or replanning of open space;

d. non-development clearance of squatters;

e. preventive alterations to existing public housing buildings, re-planning of estate open space, or construction of protective bunds;

f. advancing the date of redevelopment of a building in an old public housing estate;

g. relocation of hazardous release sources within the PHI site;

h. refusal of license or formal design approval for increased inventory at the PHI, or requirement for reduction in inventory at the PHI as a licensing condition or "improvement notice"; and

i. improvement to plants and buildings at the PHI site.

4.7 Processing Applications for New PHIs

4.7.1 The Government department which receives an application for establishing a PHI for Liquefied Petroleum Gas, Liquefied Natural Gas, Substitute Natural Gas or Town Gas should notify the Electrical and Mechanical Services

Department (EMSD) or the Environmental Protection Department (EPD) for all other non fuel gas PHIs. EMSD and EPD are responsible for advising the relevant licensing authorities on the off-site risks of PHIs.

4.7.2 The Planning Department should, in consultation with EMSD or EPD, conduct a site search to identify suitable sites for the proposed PHI. A HA and a PS should be undertaken when a site has been identified for the proposed PHI. The undertaking of HA and PS should follow the procedures as described in section 4.5 above.

4.7.3 The HA and PS should be submitted to CCPHI for endorsement. The proposer of the project will also have to go through all the usual planning application procedures.

4.7.4 The concerned District Council is normally consulted on any proposals to establish new PHIs in the district.

4.8 Interim Planning Guidelines for Dealing with Applications for Developments in the Vicinity of PHIs before Completion of Hazard Assessments and Planning Studies

4.8.1 It is assumed that, for interim planning purposes, existing PHIs will not be relocated before the completion of the HA and PS. The working principle is to try to reduce, wherever reasonably practicable, the number of people living, working and congregating (including transient population) in the CZ of a PHI. Any change which will result in an increase in the number of persons in the CZ should not be allowed, unless this results in any private party being deprived of development rights. Decisions affecting private rights will have to await the completion of the HA and PS.

4.8.2 The general guidelines for dealing with applications for development within the CZ are as follows :

a. no amendments of statutory or departmental town plans which allow an increase in planned population, whether in buildings or otherwise;

b. no lease modifications (including regrants) which allow increase in planned population, whether in buildings or otherwise;

c. no disposal or allocation of new sites for residential use or congregation, be they permanent or temporary developments and redevelopments;

d. decision on uncommitted public works and equivalent Housing Department projects which increase population in buildings or otherwise will have to await the completion of HA and PS; and

e. applications for development within the CZ that merit special consideration may be submitted to CCPHI for special approval.

4.9 Protection of Future PHI Sites

4.9.1 Site searches are conducted to identify possible future PHI sites. All these sites are in remote areas with sparse population. It is not the intention that the areas identified as having potential for PHIs should be precluded from development. Rather it is the intention that CCPHI should be able to monitor development pressures in areas which have the best attributes for future PHIs.

4.9.2 A "CCPHI Monitoring Zone" should be delineated for each potential PHI site. CCPHI should be consulted when non-PHI proposals arise within the zone which could prejudice the continued reservation of the site for PHI use.

5. Vehicle Repair Workshops

5.1 Use

5.1.1 Vehicle repair workshops (VRWs) provide an important service to the public. However, their operations often cause transport and environmental problems, particularly in residential areas and rural areas.

5.1.2 Existing VRWs are usually small establishments (less than 5 employees) occupying a net floor area between 50 to 100 sq.m. The common activities include mechanical work, welding, paint spraying and selling of tyres and automotive parts.

5.1.3 Due to site constraints, VRWs in the urban area usually repair private cars, taxis and light vans. Goods vehicles are normally repaired in the New Territories and container-vehicles near the container port areas.

5.2 Accommodation

5.2.1 VRWs should be located away from residential areas or sensitive receivers. Balancing between environmental objectives and business requirements, VRWs in the main urban area and new towns should be accommodated on the periphery of industrial areas, either in purpose-designed buildings or on the lower floors of industrial buildings. VRWs can combine with compatible uses, such as petrol-filling station, in suitable locations. Such buildings would need additional safety and fire prevention equipments. Advice from the Director of Fire Services should be sought at the

planning stage.

5.2.2 In the rural areas, low density VRW buildings compatible with the surrounding environment could be considered. VRWs may be planned on the periphery of new towns, or in urban transition areas on sites designated for rural workshop, taking land use, environmental, traffic and infrastructural criteria into consideration.

5.3 Locational Requirements

5.3.1 In planning for new VRWs, consideration should be given to the existing distribution of VRWs and additional demands arising from new developments.

5.3.2 VRWs generally prefer to be located in areas of reasonable proximity to their customers or to have a high degree of accessibility by road or public transport. Purpose-designed VRW buildings should be located on flat, easily formed and serviced land. However, they are usually constrained by the availability of suitable sites near population centres.

5.3.3 For buildings to be located in existing or proposed industrial areas, the exact location will need to be carefully assessed to avoid conflicts in land allocation for high-technology industries and industrial-office uses in such areas. Upgrading of suitable existing VRW sites in the rural areas should be encouraged, depending upon the meeting of land use, environmental, traffic and infrastructural criteria. Such sites should be, as far as possible, close to existing lorry parking and port back-up areas.

5.4 Planning Guidelines for VRWs

5.4.1 Building Characteristics

a. VRWs are workshop type activities which can operate on the lower floors of multi-storey industrial buildings. Suitable sites can be identified in the urban areas and new towns for the construction of special-purpose, multi-storey buildings to accommodate solely VRWs. The plot ratio guidelines given in Chapter 5 of the HKPSG should apply but an average plot ratio of 8 may be considered, taking local site conditions and other factors like viability into account.

b. In the rural areas, VRW sites can be generally larger as land rents are cheaper and some operations such as lorry or bus repairs require more space. Such operations are more akin to open storage-type operations and indeed may generate similar environmental problems. In such cases, it is recommended that the following development parameters be used :-

   i. low rise building of one to two storeys;

   ii. maximum plot ratio of 0.5;

   iii. provided with water supply and with proper sewage disposal system; and

   iv for open-air developments, adequate paving and drainage should be provided to minimise land contamination and drainage problems as well as suitable fencing to minimise visual impacts of unsightly development.

5.4.2 Minimum Site Size

a. A minimum floor plate of 729 sq.m. (27 m x 27 m) is required for high-rise purpose-designed buildings to achieve an efficiency ratio (net usable floor area/gross floor area) of 60 per cent, utilising a vehicle lift. For single-use multi-storey buildings for VRW accommodation, a minimum site area of 972 m^2 will be required. For buildings utilising ramps, a minimum floor plate of 1944 sq.m. (36 m x 54 m) is required to achieve a similar efficiency ratio. For low-rise lorry repair workshops, a minimum space of 1575 sq.m. per floor (35 m x 45 m) would be required with an efficiency ratio of 65%. On the basis of a plot ratio of 0.5 and a single-storey building, the minimum site area requirement is 3150 m^2.

b. The size of site should be determined according to local circumstances. Larger sites are preferred as they allow more flexibility in building design and achieve a better efficiency ratio.

5.4.3 Range of Unit Sizes

VRWs vary in sizes, ranging from small establishments (up to 100 sq.m.), medium establishments (100 to 200 sq.m.) to large establishments (over 200 sq.m.). Purpose-designed VRW buildings should provide the opportunities to

accommodate establishments of varying sizes.

5.4.4 Workspace Requirements

The term 'workspace' refers to an area large enough to accommodate a vehicle and the person working on it. In general, small VRWs have between 0.5 and 1 workspace per person. The larger firms have between 2 and 5 workspaces per person.

5.4.5 Internal Arrangements

It is preferable to locate the workshops for goods vehicles on the ground floor of a purpose-designed building (see Figure 4) to minimise the provision of heavy floor loadings and ramps for lorries which are expensive. Workshop for private cars, taxis and light vehicles would therefore be provided on the upper floors. A reception area doubling as a parking and holding area may be planned above the floor dedicated to goods vehicles. The holding area should be of appropriate size and designed in such a way as to avoid queuing of vehicles and tailing back onto public roads. The alternative design for goods vehicles suggested in Figure 5 would be appropriate for low-density workshop development in the rural areas.

5.4.6 Parking Requirements

In designing purpose-designed buildings or accommodating VRWs in industrial buildings, the general intention is to provide all the necessary facilities off-street, including parking requirements. A minimum of 2 parking spaces should be provided for each workshop unit or 0.75 parking space per workspace or 150 m^2 of GFA whichever is the higher. Parking may be provided on separate floors. Vehicle lifts may be provided as an alternative to ramping.

5.4.7 Other Facilities Required

In general, toilets should be shared and the building may make provision for a small canteen if appropriate. For multi-storey VRW buildings, a central management office and a general loading/unloading area would be required. Small VRWs would have to combine various functions within their usable areas. As a general guide, a two-person workshop would require an internal area of 10 x 9 sq.m., including storage and minor office space. For new VRWs premises, oil/petrol interceptors should be provided for dangerous goods such as engine oil, brake fluid, kerosene, paint and thinner. Dangerous goods stores should be planned at the periphery of the building facing the street for fire fighting purpose. Approval of Fire Services Department is necessary.

5.4.8 Environmental and General Design Consideration

The accommodation for VRWs should not result in adverse environmental impacts to surrounding developments and the general guidelines given in Chapter 9 of the HKPSG should be taken into consideration at the detailed design stage.

5.5 General Design Parameters for VRWs in Purpose-Designed Buildings or on the Lower Floors of Industrial Buildings

[Table Summary]

Parameter	Characteristics	Number	Assumptions
Workshop	Minimum size = 90 sq.m. (10x9 m). Each workshop to include a dangerous goods store to F.S.D's satisfaction and to include natural lighting and ventilation in accordance with the Factories and Industrial Undertakings Ordinance.	As desired.	Two working bays will be produced.
Access ramp	Gradient 1 in 5 for cars and 1 in 10 for goods vehicles. 3.5 m inner and 6.1 m outer radius for cars. 7.2 m inner and 13 m outer radius for lorries.	1	Designed on the basis of a minimum floor plate of 729 m^2.
Car lift	Minimum = 6.15 m x 3.2 m	Min. 1	-
Fire stairs	Minimum 5.25 m x 2.1 m	Min. 2	-
Floor to floor heights	5.2 m for cars 7.2 m for lorries.	-	-
Parking	Cars: 5.0 m x 2.4 m with minimum 2.4 m headroom. Goods vehicle : 11.0 m x 3.5 m with minimum 4.1 m headroom.	0.75 space per workspace, minimum 2 space per workshop	-
Street access	-	As few as possible	No reversing to or from street. Access point to avoid street corner: min. 15 m adopted.

6. Port Back-up and Open Storage Uses

6.1 Introduction

6.1.1 At present, sites reserved for open storage uses are zoned 'Open Storage' on Outline Zoning Plans (OZPs). Certain types of open storage and port back-up uses which are expected to generate significant impacts are put under Column 2 of the Notes pertaining to the 'Open Storage' zone. These uses require planning permission from the Town Planning Board. Open storage (not elsewhere specified), i.e. not specified in Column 2, is included under Column 1 and is always permitted. The 'Other Specified Uses' designation applies to sites specially reserved for port back-up uses, as in the case of 'Other Specified Uses (Container Back-up)' zoning.

6.1.2 The intention of the chapter is to provide guidance to district planners in zoning land for open storage uses and in determining which types of uses should be subject to more stringent control by putting them under Column 2 of the Notes of an OZP. The guidelines are also designed to inform the public of Government's land use policies with regard to these uses.

6.2 Definition of Port Back-up and Open Storage under the Guidelines

6.2.1 A broad distinction is proposed in these guidelines between open storage and port back-up uses, which are related to their different operational requirements and environmental, transportation and land use planning impacts. Within these two broad categories, specific forms of activities are defined.

6.2.2 *Open Storage*

a. 'Open storage' uses considered here relate to activities carried out on a site for which the greater part is uncovered (i.e. generally assumed to be more than 50%). Activities include storage, repair or breaking other than container-related uses. Storage activities ancillary to industrial, workshop, warehousing and other commercial activities on the same site are excluded from this definition. The definition however includes temporary structures such as those found on dumping and vehicle repair sites (for example galvanised sheeting used for carports), as

these do not radically differ from the appearance, nature or impact of operations carried out in open accommodation. The operational nature of a site, such as revealed in the description of an activity, can also be considered in determining whether its use comprises open storage.

b. Activities conforming to the above definition comprise those surveyed in the Study on Port Back-up Land and Open Storage Requirements, namely

- Storage of rattan and bamboo
- Storage of logs and timber
- Storage of ceramic/pottery products
- Storage of processed agricultural products
- Storage of scrap metal
- Storage of cans/tanks etc.
- Storage of paper and general rubbish
- Storage of cement/sand
- Storage of chemical products
- Storage of dangerous goods
- Storage of vehicles for stripping/breaking or repair
- Storage of new vehicles and vehicle parts for sale or disposal
- Vehicle depot

c. Given the wide range of operational activities and products covered by the above uses, grouping of these activities is useful for their general description reflecting distinct economic activities and the different impacts which such major types of activities generate on the environment. Four main groups comprise:

- Storage of construction materials and equipment
- Vehicle storage
- Storage of products
- Dumping and vehicle parts storage/repair activities

d. The above descriptions are considered to be an accurate definition of those activities which have spread throughout the Territory during the 1980's and which differ significantly from uses such as warehousing, workshops, and utility installations.

6.2.3 *Port Back-up*

a. Port back-up uses are those port-related activities which are situated off-port (i.e. beyond the perimeter of container terminals, river trade terminals and public and private cargo working areas). Such activities are essential to the operation of port activities but do not need to be located within the confines of the port.

b. The definition is based on both locational and operational characteristics. In general terms, on-port activities are those relating directly to quayside operations, such as container handling to/from ships, and activities requiring immediate access to the waterfront. Although by their nature, off-port activities do not require such close proximity to waterfront operations, some can still benefit from locations immediately adjacent or near to the port. For the purpose of these guidelines, the following activities are defined as port back-up uses:

- container lorry park (equivalent to container trailer/tractor park)

- empty container storage and repair

- container yard (for the storage and handling of loaded containers)

- container freight station

6.2.4 A precise description of each main category of open storage and port back-up use and the impacts these activities generate on the environment, transport and land use planning are provided in Annex 2.

6.3 Need for Greater Control

6.3.1 Over the last decade, land taken up for open storage and port back-up uses has doubled. Port back-up activities have recorded the highest rates of increase since 1983, expanding from under 30 sites covering 28 ha in 1983 to over 237 sites covering 196 ha in 1993.

6.3.2 The rapid rise of open storage and port back-up uses in many parts of Hong Kong's rural areas has occurred in a largely haphazard and uncontrolled manner. The driving force behind this proliferation of activities has been the increasing demand for cheap and relatively large sites, improved accessibility to the rural areas, and the economic benefits arising from converting agricultural land to storage uses which until 1990 when Interim Development Permission Areas were designated, was largely exempt from planning control.

6.3.3 The adverse forms of impacts, resulting from the growth in this type of storage activities, may be summarised as follows.

6.3.4 *Proliferation of Uses*

The scale of the sprawl of port back-up and open storage uses in the New Territories has resulted in a general degradation of the rural environment, changing the character of former agricultural areas such as Lau Fau Shan and Kam Tin to that of a poor quality, urban fringe type environment.

6.3.5 *Noncompatible Land Uses*

Many activities are located within areas not suitable for this type of use, being in close proximity to residential and Government, Institution and Community uses, or sensitive environmental areas such as Sites of Special Scientific Interest (SSSIs) where ecology systems may be disturbed, or areas of unspoilt countryside. Adverse environmental impacts on sensitive receivers such as noise from movements of heavy vehicles and container handling operations, air pollution from vehicular movements and visual intrusion are a result of such poor land use interface.

6.3.6 *Traffic Generation*

The dispersion of sites, particularly port back-up uses which are high traffic generators, has led to increase travel trips to the port, the border and between different container back-up sites. This has given rise to greater traffic congestion on the strategic road networks, (particularly along the Tolo Highway and Castle Peak Road), increased air pollution, traffic noise impact and travel costs, and reduction in operational efficiency, notably regarding access to the port. Sites in areas served by poor access roads, including rural tracks, have introduced inappropriate heavy vehicular traffic to the rural areas, leading to congestion on local roads, reducing environmental quality, and threatening road safety to village communities.

6.3.7 *Environmental Degradation*

In addition to traffic generation and sprawl of activities, many sites are currently degrading the environment through poor waste management practices, noise and air pollution from heavy vehicles, pollution of water courses and land contamination. Inadequate refuse collection methods and absence or poor maintenance of drains are current problems. The conversion of agricultural land to storage uses and the filling of fish ponds for such purposes also contribute to drainage problems. The obstruction of natural drainage systems has caused increasing flood risk.

6.3.8 *Operational Efficiency*

The ideal locations for many port back-up activities are near to the port, the border or close to strategic transport routes. However, the availability of cheap and relatively large sites from agricultural land has resulted in the dispersion of port back-up sites in the peripheral parts of the New Territories. Such dispersion is not conducive to effective operation of the industry.

6.4 Future Demand for Storage Use

6.4.1 Based on projections carried out in 1993, maximum demand for port back-up use could be in the order of 380 ha by 2001. Land for open storage is expected to generate demand of between 450 ha to 550 ha by 2001. By 2011, demand for port back-up and open storage land could register an estimated maximum increase of around 150% and 100% respectively representing a corresponding total land area of around 510 ha and 750 ha, compared with the levels in 1993. The above figures represent considerable land areas and since the estimated demand is so high, it is the planning intention that some existing sites which have less adverse environmental, traffic and drainage impacts can be retained at least in the short to medium term, until planned sites can be developed to accommodate the additional demand and relocate inappropriate existing uses.

6.4.2 The extent to which additional demand will manifest itself is nevertheless dependent on numerous factors, not least:

a. the growth in container throughput at Hong Kong's ports;

b. the degree to which the existing supply of land is retained for port back-up and open storage uses;

c. the degree to which activities are likely to locate in China; and

d. levels of efficiency in site utilisation.

6.4.3 The availability of new sites planned and the level of supporting infrastructure will also determine the rate and nature at which activities can be accommodated.

6.4.4 Both land demand and supply therefore need to be constantly updated in the light of the above considerations. Monitoring of economic and land use trends and changes should be undertaken to determine the extent of land provision required in the medium to long term. Such monitoring will also determine policies with respect to the enforcement of existing problem sites, and processing of planning applications.

6.4.5 The following guidelines are aimed at achieving a more effective distribution of port back-up and open storage sites, and improving the environmental, transport and land use planning for such activities.

6.5 Broad Area Policy Guidelines

6.5.1 Broad area policy guidelines are intended to provide a general planning framework at a spatial policy level. Broad areas are defined according to the existing distribution of port back-up and open storage sites and geographical characteristics such as land use patterns, road access and physical features.

6.5.2 The broad area policy guidelines define five different categories of areas, based on an evaluation of 25 broad areas where existing port back-up and open storage uses concentrate and new areas suitable for longer term accommodation. The guidelines should be applied flexibly in the course of district planning and/or assessment of planning application, with reference to the broad area recommendations contained in the "Study on Port Back-up Land and Open Storage Requirements" completed at the end of 1994.

6.5.3 *Type 1 Areas: Recommended for intensification*

These are areas which are generally suitable for continued use and further intensification in the short to medium term. Generally, conditions are such that little strategic road infrastructure improvements are needed although large scale intensification in some areas are subject to long term road construction. Individual sites may require mitigation measures to overcome such constraints as drainage and access.

6.5.4 *Types 2 Areas: Recommended for limited intensification*

These areas possess opportunities for limited intensification generally because of their strategic location, good infrastructure and conducive environment. Nevertheless, these areas may have other types of constraints, such as sensitive receivers (e.g. residential areas), which require intensification to be selective according to the types of uses and site locations.

6.5.5 *Type 3 Areas: Recommended for limited intensification with improvements*

These are areas which have more significant constraints in terms of land use compatibility, access and environmental quality and which require either greater investment in improvements/mitigation measures or a more limited allocation of sites.

6.5.6 *Type 4 Areas: Prevent proliferation of uses*

Further activities should be prevented from such areas which are considered to be incompatible to the environment.

6.5.7 *Type 5 Areas: Discontinue sites*

These areas are those where the long term aim should be to discontinue existing activities and improve the environmental quality of the area.

6.6 Broad Locational Principles

6.6.1 The following broad locational principles should be adopted for all open storage and port back-up uses.

6.6.2 *Encourage Concentration of Uses*

Wherever possible, uses should be concentrated in distinct areas and adjacent to existing sites, thus avoiding further proliferation of activities. Empty container storage and repair sites should not be allowed in areas of populated countryside. For open storage sites, concentration of activities at a local level is appropriate to activities such as dumping and construction materials/equipment storage which need to be distributed around various parts of the Territory to service different urban areas and construction sites. Concentration of activities would reduce the unsightly sprawl of

activities currently prevalent in many urban transition areas, reduce travel trips between sites, and allow economies of scale for Government to instigate infrastructural improvements and mitigative measures such as road upgrading and drainage improvements.

6.6.3 *Encourage Location to Strategic Areas*

Given Hong Kong's small land area, it is necessary to maximise land resources and operational efficiency. The planning of extensive new container port areas provide good opportunities for the concentration of port back-up activities here, and the development of new industrial areas also present longer term opportunities to provide appropriate solution spaces for open storage activities. Border areas well served by strategic infrastructure, may also be appropriate for port back-up activities given the increase in container movements to China and the presence of large port back-up sites already established here. Open storage uses should be concentrated at selected and clearly demarcated sites around major urban centres such as new towns, where activities are related to the needs of such urban areas, and on solution spaces near to industrial or port activities.

6.6.4 *Maximise Transport Efficiency*

New sites are best located near existing and new strategic road infrastructure, allowing traffic to be segregated from countryside areas and communities. However they should be subject to detailed traffic impact assessments on the overall capacity of the strategic road network as well as the local road system.

6.6.5 *Encourage Location in Environmentally Acceptable Areas*

The long term aim is to improve those rural areas currently blighted by port back-up and open storage uses by encouraging relocation to broad areas where activities would minimise environmental impacts. Reduction of sites in flood plain areas would also reduce potential flooding problems. The Territorial Development Strategy and Sub-regional Development Statements, which include strategic environmental planning policies for concentrating bad neighbour development away from sensitive receivers and environmental protection areas, should be adhered to and opportunities to locate activities in hitherto sparsely populated areas to the west of the Territory such as North East Lantau and Tuen Mun West should be maximised, subject to suitable access being provided.

6.7 General Locational Guidelines for Specific Uses

6.7.1 The following sub-paragraphs provide general guidelines for reserving sites in OZPs, Outline Development Plans, and Layout Plans or in considering planning applications from the private sector. They should be considered together with the detailed site planning standards and guidelines described in Section 6.8.

6.7.2 *Container Lorry Parks*

a. Sites should ideally be located in areas with good access to both the port and drivers' residences. In this regard, the port and industrial areas in Kwai Chung, including those off Container Terminals (CTs) 1 to 7 and the new CTs 8 and 9 facilities, offer appropriate locations in this respect although they are constrained by current shortages of land and competing pressures for other uses. Sites near the border with good access to strategic road networks are also recommended, provided the local roads can cope with its additional traffic and adequate public transport is provided for the workers.

b. New allocation of sites in OZPs should aim to develop large sites consistent with the policy of preventing proliferation of small sites. In areas where the identification of permanent sites is difficult, other temporary measures such as extension of short term tenancies and short term waivers and/or temporary use of reclamation sites should be supported wherever practicable.

c. The development of multi-storey container lorry parks should be encouraged in the urban areas, especially at Kwai Chung, where the demand for both on-port and off-port facilities is high. Such multi-storey parks may be combined with container freight station activities or other compatible uses to enhance viability.

6.7.3 *Container Storage and Repair*

The overriding need is for large sites to facilitate the use of machinery and on-site queuing areas for lorries, and allow maximum storage of containers during peak periods. Locations adjacent to the new container terminals are desirable for those activities storing containers for short periods of time. Those stored over longer periods (more than 3 days) can be located in other parts of the New Territories, preferably on sites near to the border and with easy access to the strategic road networks. Co-located with other container-related sites, including container lorry parks, is desirable to minimise traffic generation.

6.7.4 *Container Yards*

Sites should be located near waterfront areas or with good accessibility to points of distribution. Requirements include good security, 24-hour working conditions and good infrastructure and services, such as power supplies for

refrigerated containers. On-site queuing areas for vehicles are required during peak periods and interface with residential uses should be avoided where traffic volumes are high.

6.7.5 *Container Freight Stations (CFS)*

a. Priority should be given to sites near the port and within industrial zones of the main urban areas to facilitate access to main distribution points and markets and reduce travel trips. Industrial and godown uses are compatible to both the nature and impacts of these activities.

b. Although experiencing declining rates of demand at the port, CFS activities on or adjacent to the port remains a compatible use. CFS activities with longer dwell times can be accommodated in the New Territories, notably in areas of existing industrial, open storage or port back-up use.

6.7.6 *Storage of Construction Materials and Equipment*

a. Flexibility is required on the locational requirements to accommodate construction materials and equipment, which often require short term sites. For example, temporary sites can be located in newly reclaimed areas provided that they do not cause adverse impact to the environment. Consideration can be given to designate certain sites in the urban areas, such as the urban transition zone, for such uses on a permanent basis.

b. Interface with sensitive receivers should be avoided for the storage of cement and sand, and the visual impact should be minimised for equipment storage.

6.7.7 *Storage of Vehicles*

Large sites for new vehicle storage with less locational preference but good security are required. Sites may be required on a temporary basis given the seasonal nature of the industry. Multi-storey car parks may be considered as an alternative to open storage, as this provides good security. Variation in demand makes forward planning for this use difficult.

6.7.8 *Storage of Products*

Sites need not necessarily be located near to sources of distribution or markets, although logs and timber would best be situated near the production points such as saw-mills or near to where these are imported at port locations.

6.7.9 *Dumping and Vehicle Parts Storage/Repair Activities*

A concentration of activities is recommended in specially demarcated open storage sites outside urban areas. Dump sites could be adjacent to industrial, warehousing or other storage activities. Vehicle parts and storage uses could also be located near to container lorry parks in the New Territories.

6.8 Site Planning Standards and Guidelines

6.8.1 The followings are proposed to improve the environmental impacts of new sites, and existing sites where practicable. Such improvements can be achieved through the selection and/or approval of new sites, through application of regulatory measures, or voluntary actions by site operators.

6.8.2 *Land Use Interface*

a. Sites should not be located adjacent to sensitive receivers such as residential dwellings, hospitals, schools and other community facilities. Reference should be made to relevant sections of HKPSG Chapter 9, Environment. Sites within 100 metres of Country Parks and other sensitive environmental areas such as SSSIs should normally not be allowed unless it could be demonstrated that such uses would have insignificant impacts on the sensitive environmental areas. Compatible uses are industrial, godowns, port uses, other open storage and port back-up uses and public utility installations. Use of sites within major road corridors, where these do not adjoin sensitive receivers should be supported.

b. The use of buffering on both large and small sites should be encouraged. Buffer distances vary according to:

- the scale and nature of land use;
- the nature of its surroundings (e.g. topography, condition of surrounding roads, numbers and distribution of sensitive receivers, visual impact, etc);
- presence of man-made or natural screening features; and
- the urban or rural content of the surroundings.

c. Suitable buffer distances should therefore be determined on a site by site basis in accordance with the standards set out in Table 1.3 of HKPSG Chapter 9, Environment.

d. Sites which are screened from sensitive receivers by non-sensitive buildings, major transport alignments, natural vegetation and topography should be considered favourably.

6.8.3 *Visual Aspects*

a. Container stacking causes considerable visual intrusion in rural areas. Open storage, by nature of its uses, requires to accommodate products of varied size, shape and appearance. Activities which could theoretically be carried out on storage sites can result in visual and physical clutter. The provision of landscaping provides an opportunity to counter such effects.

b. Where proposed container storage and repair sites cause significant visual intrusion to surrounding or adjacent residential uses in the rural areas, stacking restrictions to a maximum of 3 units (equivalent to the height of a traditional village house) should be considered where practicable.

c. Landscaping is more effective for large sites which afford greater set backs from the road . Mounding with planting in the form of a continuous belt can effectively screen development and act as a noise buffer industrial or port (see Figure 6). Port back-up and open storage uses located in areas usually bring about less visual intrusion to the surrounding areas.

6.8.4 *Site Size and Intensity*

a. The approximate median values for each broad type of port back-up and open storage activity, as revealed by the survey in the Study on Port Back-up Land and Open Storage Requirements completed in 1994, should be used as a minimum site area for assessing whether applications for planning permission conform to current standards of provision.

[Table Summary]

Use	Minimum Site Requirement
Container storage and repair	5,100 m^2
Container yard	4,900 m^2
Container lorry park	3,000 m^2
Container freight station*	2,000 m^2
Open storage	1,000 m^2

* Sites in the New Territories should have a minimum area of 2,000 m^2. This requirement does not apply to facilities at the container port which are considerably larger.

b. However, the issue of site size for port back-up and open storage facilities is sensitive to a number of considerations not least:

- the availability and timing of land both at Territory-wide and local level;
- road and traffic conditions serving the site; and
- environmental and drainage constraints affecting the site.

c. Restricted availability of sites, particularly in the urban areas, and in the short to medium term when demand is estimated to outstrip land supply, may preclude the selection of sites over a certain size. Thus, smaller sites may need to be considered in the short to medium term. Moreover reductions in the area of designated sites

may result from environmental, drainage and transport constraints. In such instances, strict adherence to an optimum size would be too rigid an approach.

d. Moreover, the definition of a minimum and optimum size of site involves considerable uncertainties. It is difficult to justify in operational terms, given that increasing efficiency may not be correlated to increasing size of site. The ultimate efficiency will depend on the amount of goods/activities stored by a particular operation, which may operate more effectively on a small site than a large one. Similarly the area required for on-site parking is dependent on the numbers of trips and dwell t[illegible] generated by the activity, rather than size of site. It is recommended therefore that discretion should be used in both addressing planning application[illegible]nd designating sites in OZPs for use as open storage and port back-up pu[illegible]poses. This should be based on the individual merit of the site in question, its [illegible]lanning history (whether it is vacant or underused), its urban or rural context, the compatibility of its surroundings and, in the case of an application for planning permission, whether the applicant can demonstrate that no adverse impacts w[illegible]ld be generated.

e. For the p[illegible] of reserving sites for future use, emphasis should be placed on providing l[illegible]r sites areas to allow for a greater concentration of activities. These will also e[illegible]age greater investment on the site to improve services and efficiency [illegible]xample provision of utility infrastructure and increased mechani[illegible] and to ensure effective environmental protection measures are afforded.

f. As a gen[illegible]deline, the policy of locating port back-up use in large, integral areas su[illegible]ear to the container terminals, should prompt site reservations of over 1 h[illegible]re a major solution space is identified, based on strategic conside[illegible]eservation in excess of 10 ha should be allowed. The actual extent could ho[illegible]e determined by demand forecasts and land availability, as confirm[illegible]nitoring of demand and supply.

g. For multi-[illegible] buildings, it is recommended that the maximum Metroplan standard [illegible]own (at a plot ratio of 8) should be applied to a multi-storey containe[illegible]ark combined with other compatible uses.

h. For ope[illegible]e, sites of over 0.5 ha should be reserved where the objective is to create s[illegible]paces for new/reprovisioned growth. The actual size could also be linked t[illegible]unt of land to be discontinued in a particular broad area, due to enforce[illegible]t[illegible]ceedings or rezoning and would again be subject to land availability constrai[illegible]

i. Intensity [illegible]n each site varies according to location (i.e. on- or off-port), mechan[illegible] and types and length of products stored. As a general principle therefor[illegible]deline on intensity of use for off-port storage activities is not suitable and dis[illegible]hould be left to the operator in attaining the most effective site utilisati[illegible]ng transport and environmental conditions are satisfied. Stacking heights [illegible]ners are restricted to a maximum of seven units by operational constrai[illegible] may be restricted according to land use interface.

6.9 Transport

6.9.1 Container[illegible]s should be in areas with good access to the strategic road network. Sites should have a clearly defined e[illegible]point which complies with guidelines contained in the Transport Planning and Design Manual - Vol. 2, [illegible]. Additional points of access may be considered for large sites. Adequate parking and queuing areas s[illegible]vided within the curtilage of the site to avoid on-street parking and queuing. The arrangements fo[illegible]r queuing/parking areas should be to the satisfaction of Transport Department.

6.9.2 A traffic imp[illegible]ssment (TIA) should be conducted for each new site, having regard to the cumulative effects of other sites. The[illegible]ld include estimates of the amount, type and routing of traffic using the site, assessment of the extent of traffi[illegible]n nearby local and strategic road networks, and recommendations for solving any adverse impacts. The ad[illegible]e site access and off-street queuing/parking areas should also be demonstrated.

6.9.3 Adequate [illegible]hould be provided to allow sight lines to meet Transport Department's requirements.

6.10 Environme[illegible]anning Aspects

6.10.1 New sites [illegible]e subject to the appropriate level of the EIA process*:

a. For cont[illegible]torage and repair sites, container yards and container lorry parks, noise m[illegible] should be carried out to demonstrate that noise impacts on sensitive[illegible]ers are within recommended noise criteria contained in HKPSG Chapter [illegible]ronment;

b. Sites sh[illegible] properly paved to avoid potential land and water contamination from lea[illegible] oils, fuels and other discharges (relating mostly to container and vehicle [illegible]tivities, container lorry parks, dumping/breaking of motor vehicles and spil[illegible]tored materials). Dust emissions from vehicular traffic and contain[illegible]g on site and odour emissions should also be minimised;

c. Adequ[illegible]ge should be provided on site for disposal of storm water and discharg[illegible]uent. Domestic sewage must be discharged to the public sewerage if publi[illegible]e facilities are available. Sites located in flood risk zones should be subject [illegible]age impact study and necessary flood mitigation measures. The cumula[illegible]s on flood risk through conversion of agricultural land to storage uses is [illegible]concern and should be fully taken into account in assessing the feasibil[illegible]roposals;

d. Measur[illegible]te water quality impacts such as runoff containment through bunded[illegible]/fuel and chemical interception and sediment traps to intercept any leakag[illegible]age should be considered;

e. Adequa[illegible]on should be made for refuse collection and disposal on site. Moreov[illegible]s should meet fire safety standards;

f. Operati[illegible]estrictions could be considered where sites are assessed as causin[illegible]se or glare impacts, (mostly relating to container storage and yards).[illegible]e stipulated under the lease conditions which could also include monito[illegible]ments and measures embodied in a Code of Practice; and;

g. Refere[illegible] made to the Dangerous Goods Ordinance for guidelines on storag[illegible] and licencing procedures.

* The E[illegible]set out in PELB TC No. 2/92 "Environmental Impact Assessment of Major Development Projects" and E[illegible]. 2/92 "Environmental Impact Assessment Process to Major Private Sector Projects".

[illegible]vious Contents

THE CORPORATION OF THE DISTRICT OF NORTH VANCOUVER

AGENDA

WELCOME TO THE

PUBLIC HEARING

Council Chamber
Municipal Hall
355 West Queens Road, North Vancouver

Wednesday, September 5, 2001 7:00 p.m.

Council:
Mayor Don Bell

Councillor Ernie Crist
Councillor Heather Dunsford
Councillor Doug MacKay-Dunn
Councillor Bill Denault
Councillor Janice Harris
Councillor Lisa Muri

Bylaw 7234 "The District Official Community Plan, Amending Bylaw 52MAPLEWOOD LOCAL PLAN (to repeal the Maplewood Official Community Plan [Bylaw 5512] and add the Maplewood Local Plan to the District Official Community Plan [Bylaw 6300])

Purpose: To adopt the Maplewood Local Plan by adding it to the District Official Community Plan (Bylaw 6300)

a) Opening of Hearing by Mayor
b) Presentation by Planning Staff
c) Representations from the Public
d) Council Resolution
e) Close of Hearing by Mayor

****

2. Bylaw 7239 "The Seymour Official Community Plan Amending Bylaw 28" (to delete the lands contained within the boundaries of the Maplewood Local Plan [Bylaw 7234] from the Seymour Plan Map SC-12 and Development Permit Areas Map [DPA Map 1])

Purpose: To include lands in the Seymour area generally bounded by Mount Seymour Parkway, Lytton Street and Windsor Secondary School within the boundaries of the Maplewood Local Plan (Bylaw 7234)

a) Opening of Hearing by Mayor
b) Presentation by Planning Staff
c) Representations from the Public
d) Council Resolution
e) Close of Hearing by Mayor

****

Agenda Addendum Date: _____ Item # _____

_____

Director

_____

Dept.

Manager

_____

Municipal

Manager

The District of North Vancouver

REPORT TO COUNCIL

June 8,2001

File: 6520-20

Tracking Number: RCA -

AUTHOR: J.G.Masterton, Asst. Manager, Community Planning

SUBJECT: **Maplewood Local Plan**

RECOMMENDATION: That the attached bylaws 7234 and 7239 be given First Reading and referred to a Public Hearing on July 24, 2001.

REASON FOR REPORT: The Maplewood local plan has been prepared, in conjunction with Maplewood residents, as per Council's instruction in July, 2000. The plan is now presented in Bylaw form as an amendment to the District Official Community Plan.

SUMMARY: The new plan is a local plan and will become part of the District OCP. The current Maplewood OCP will be repealed. This is in line with other local plans in the past few years- Lynn Valley, Lower Capilano, Upper Capilano. The plan proposes a vision of Maplewood not unlike that espoused by the current Maplewood OCP adopted in 1983:

- conservation of major rivers and creeks
- preservation of the Windridge escarpment.
- provision of local jobs in business parks or in new light industrial areas
- some new parks
- a comprehensive community trail system
- some additional housing choices
- a revitalised community core
- protection of the Maplewood Conservation area for bird habitat

BACKGROUND: The original Maplewood OCP was adopted in 1983. Work started on the current plan as part of the Seymour planning process in 1997 when the various public input committees were set up. Council determined in July 2000, that there should be two plans in Seymour- the Maplewood local plan based primarily on current OCP boundaries, and the Seymour local plan, still under preparation.

EXISTING POLICY: Current District policy is to include local plans as part of the District OCP and repeal local OCP's.

ANALYSIS: The new plan is based greatly on the current Maplewood OCP and the following are highlights of the new plan:

- Preservation of McCartney, Blueridge and Maplewood Creeks
- Protection of the Seymour River
- Protection of the Maplewood Conservation area bird refuge
- Protection of the Windridge escarpment
- New waterfront viewpoints

- A community trail system
- A new community park in Windridge
- A revitalised community core
- New retail/apartments on Front Street
- More housing choice with new housing for families and seniors
- Provision of urban design guidelines for Windridge and Maplewood Centres
- Provision of a site for the BC Ambulance Service in Windridge
- Urban design guidelines for entranceway sites
- Several areas designated for business parks
- A focus on public art in Maplewood Centre and in business parks
- Replacement of chemical industry with lighter industry and specialised port-related uses.
- Berkley Road connecting Dollarton Highway with Mt Seymour Parkway

In early November, a plan summary was distributed to all residents and businesses in Maplewood and three open houses were held on November 28, 28 and 30, 2000. Feedback from the community in the shape of questionnaires was used to subsequently refine the plan.

Bylaw 7234 amends the District OCP by incorporating the Maplewood local plan into the District OCP.

Bylaw 7239 amends the Seymour Official Community Plan by deleting from the plan a small

Area (Seymour Estates apartment complex) and adding this area to Maplewood.

A Council Workshop (Public) was held on June 5, 2001 and the following issues were raised and debated with respect to the proposed local plan:

- Berkley Road connection to Dollarton Highway
- Possible Seabus connection to downtown Vancouver
- Protection of wetland and bird habitat within business parks
- Park Street pedestrian access
- Amount of rental housing in Maplewood
- Extent of additional housing in the plan
- Long term proposal to remove chemical industry
- Impact of Seymour Creek Reserve development
- Tourism potential of Maplewood Farm

- Cross-river pedestrian connections
- Slope stability of Windridge Escarpment
- Protection of creeks and rivers
- Ensuring Maplewood business benefits from new job creation

Concurrence: Reviewed by Advisory Planning Commission, Advisory Design Panel, Parks and Natural Environment Committee, Community Heritage Commission and Transportation Planning Advisory Committee. The North Vancouver School District, the North Vancouver Recreation Commission, and both the Tsleil Waututh and Squamish First Nations were all provided with copies of the plan. The City of North Vancouver was also sent a copy of the plan as per the Local Government Act and responded (Attachment 1) with concerns about the proposed connection of Mount Seymour Parkway and Keith Road in the longer term as that would increase traffic on Keith Road through the City of North Vancouver.

Financial Impacts: The financial impacts of this plan are numerous:

- land servicing costs for District property
- tax revenue from new development in new business areas
- revenue from sale of District lands (both residential land and land in business parks)
- infrastructure improvements in residential, commercial and industrial areas.
- costs of planning and engineering services
- potential property purchases
- subdivision and surveying costs for District land

Business Plan:

w **Social Policy Implications**: Provision of local jobs means a step towards a complete community as advocated in GVRD Liveable Region Strategic Plan.

w **Environmental Impact**: Local jobs also provide opportunity to reduce commuting across Burrard Inlet and so diminishing auto pollutant emissions.

w **Public Input**: Plan preparation in conjunction with Maplewood Community Association and local businesses. All Maplewood residents and businesses received a printed brochure (attached) providing a summary of plan and dates of open houses. Three open houses also held in November 2000. Communication was also established with large local businesses and agencies– Sterling Pulp Chemicals, Canadian International College, Global PacificTerminals, Allied Shipbuilders, Nexen Inc, Vancouver Port Authority, GVRD, The Wild Bird Trust and Environment Canada.

J.G. Masterton,

Asst Manager Community Planning

REVIEWED WITH:	REVIEWED WITH:	REVIEWED WITH:	REVIEWED WITH:
q Communications	q Finance	External Agencies:	Advisory Committees:
q Env. Protection	q Fire Services	q Recreation Commission	q _____
q Human Resources	q Clerk's Office	q Library Board	q _____
q Eng. Trans/Public Works	q Land	q Health Dept.	q _____
q Eng. Admin	q Building	q RCMP	
q Eng. Parks	q Community Planning	q Other: _____	
q Eng. Utilities			

FIGURE 3.5. METHOD 1 ESTIMATE OF DANGEROUS GOODS ROAD TRAFFIC, NORTH VANCOUVER DISTRICT

ROAD SEGMENT	ALL VEHICLES / YR	COMMERCIAL TRUCKS / YR (1)	DG VEHICLES / YR (2)	DG TONNES / YR(3)
1. Rte 1, on Mosquito Creek Bridge, east of Edgemont overpass	16,000,000	800,000	40,000	200,000
2. Rte 1, 0.8 km west of Mountain Hwy overpass	16,600,000	830,000	41,500	208,000
3. Dollarton Hwy, at Cutter Island Bridge	7,700,00	380,00	19,000	95,000
4. Rte 1, on Seconds Narrows Bridge	31,000,000	1,500,000	75,000	375,000

Source: B.C. Ministry of Transportation & Highways, 1992

Notes on Figure 3.5:

1 - Commercial truck traffic can vary considerably depending on such factors as local land use and available routes for delivery. The GVRD Urban Goods Movement suggests an average figure of 5 percent of all vehicles to represent commercial trucks.

2 - The Association of Bay Area Governments found in 1982 that between 1.2 and 5.1 percent of the trucks observed in a San Francisco survey were placarded for hazardous materials. A 1983 GVRD study found that dangerous goods comprise about 10 percent of all goods moving in the region. The U.S. Transportation Research Board estimates that between 5 and 15 percent of all trucks on the road at any given time are carrying dangerous goods. The 1987 TDG Study applied an average of 5 percent of all trucks to estimate the number of dangerous goods vehicles. In the absence of direct survey data, the 5 percent assumption has been applied in Figure 3.5.

3 - Dangerous goods may be carried in vehicles ranging in size from light to medium or heavy trucks, and in a variety of container volumes. A comprehensive study of Vancouver commerce completed for the Transport Canada Research and Development Centre in 1978 suggests that an average consignment load for all goods weighs about 5 tonnes. In the absence of direct survey results, we adopted a conservative figure of 5 tonnes per vehicle to represent the volume of all dangerous goods under this method.

Although this first method provides an estimate of truck traffic that is probably within an order of magnitude of actual traffic, the results are conservative and open to debate. A proper risk analysis of road traffic requires actual survey data.

The second method makes use of two available studies of dangerous goods vehicles for the Upper Levels Highway, Route 1. These studies provide some estimate of dangerous goods traffic volume, but also suggest the dominant types of commodities being transported. Unfortunately, this technique provides only a partial picture; not all actual shipments are included.

The first report was compiled by the Lower Mainland TDG Study in 1987 after contacting a limited number of transporters of truck-load (bulk) quantities of dangerous goods. These industry contacts supplied the origin and destination of a large number of shipments throughout the Lower Mainland, and confirmed routes used for deliveries. The only route through the District of North Vancouver reported in this survey was the Upper Levels Highway.

In the second study, the Squamish Fire Department shed additional light on the road transport of dangerous goods through North Vancouver when they surveyed bulk road transport of dangerous goods through Squamish in May of 1991. Traffic data were collected through direct contact with road carriers passing through Squamish. Although the exact origins of these shipments are unknown, it seems reasonable to assume that all truck traffic recorded by Squamish passed through North Vancouver on the Upper Levels Highway.

The results of both the TDG Study and the Squamish report are summarized in Figure 3.6.

The Squamish data suggests that about 4,200 truckloads of bulk dangerous goods pass through North Vancouver on the Upper Levels Highway annually, or about 15 trucks every working day of the year.

To confirm these figures, B.C. Ferries offered to monitor dangerous goods traffic at the brake check station on the Upper Levels Highway just south of Horseshoe Bay. For four days in December, from a Tuesday through a Friday, a total of 36 dangerous goods vehicles used the facility. Of these, 23 vehicles were bound for Squamish, 12 headed for the ferry terminal, and 1 travelled into the Horseshoe Bay community (B.C. Ferry Corporation, 1992). B.C. Ferry cautioned that traffic volumes can vary widely throughout the year; a more comprehensive survey is recommended.

A third assessment was conducted specifically for this Preliminary Risk Assessment using available traffic counts from B.C. Ferry Corporation at Horseshoe Bay. The B.C. Ferry Corporation randomly inspects commercial vehicles once they board ferry vessels to check compliance with regulations. We reviewed 1,082 inspection reports prepared between January and October, 1992, to assemble a list of commodities known to have left the Horseshoe Bay Terminal and therefore assumed to have travelled by road through North Vancouver. This study offers the first evidence of less-than-truckload (LTL) shipments through the community. Again, the Upper Levels Highway through North Vancouver is the assumed route for these vehicles.

FIGURE 3.6. METHOD 2 ESTIMATE OF DANGEROUS GOODS ON UPPER LEVELS HIGHWAY (Vehicles per Year)

RANK	PIN	COMMODITY	TDG STUDY 1987	SQUAMISH STUDY 1991
1	2015	Hydrogen Peroxide	60	1,229
2	1230	Methanol	-	828
3	1073	Liquid Oxygen	-	820
4	1202	Diesel Fuel	-	528
5	1075/ 1978	L.P.G. / Propane	-	258
6	1203	Gasoline	-	168
7	1824	Sodium Hydroxide	9	150
8	2186	Hydrogen Chloride	360	147
9	2428	Sodium Chlorate	-	108
		TOTAL	429	4,236

Sources: Adapted from TDG Study Road Working Group, 1987; Squamish Fire Department, 1991; Environment Canada, 1984.

"-" means no data reported

Figure 3.7 summarizes the top 15 commodities reported by number of vehicle inspections. Note that inspections were not possible for every commercial vehicle, and that some vehicles carried more than one commodity type.

FIGURE 3.7. TOP 15 COMMODITIES IN B.C. FERRY INSPECTIONS, Jan-Oct, 1992

RANK	PIN	COMMODITY	NUMBER OF VEHICLES
1	1072	Oxygen or Oxygen, Compressed	347
2	1001	Acetylene	154
3	1073	Oxygen, Liquid	112
4	1760	Corrosive Liquids, n.o.s.	103
5	1202	Fuel Oil	92
6	2974	Radioactive Materials, Special Form, n.o.s.	69
7	2794	Batteries, Wet, Filled with Acid	62
8	1263	Paint or Paint Related Material	47
9	1956	Compressed or Liquefied Gases, n.o.s.	39
10	1006	Argon, Compressed	32
11	1013	Carbon Dioxide	30
12	1824	Sodium Hydroxide, Solution	28
13	1066	Nitrogen	24
14	1075	Petroleum Gases or L.P.G.	21
15	1046	Helium, Compressed	20
		TOTAL	1,180

Source: B.C. Ferry Corporation, 1992.

The data shown in Figures 3.6 and 3.7 represent through shipments of dangerous goods, either to Squamish or to the ferry terminal at Horseshoe Bay. It is much more difficult to estimate local traffic, deliveries that originate or terminate in the District of North Vancouver.

Combining all available data from Squamish and the B.C. Ferry Corporation with the local distribution data suggests that North Vancouver roadways experience at least 6,000 dangerous goods shipments each year. This estimate is considered significantly low in that it omits ferry traffic that was not included in inspections, less-than-truckload shipments to Squamish, and local distribution of chemicals.

Figure 3.8 depicts available information on road transport in graphic form, acknowledging that such data are incomplete at present.

3.3.3 Road Accident Rates

Road accident rates represent the number of accidents on a given roadway divided by the number of vehicles that use that route. These rates are expressed in terms of the number of accidents per million vehicle-kilometres:

$$\text{Accident Rate} = \frac{\text{Number of Accidents}}{\text{Million Vehicle-Kms}}$$

Researchers recognize there are hundreds of factors that combine to determine the actual risk of dangerous goods transportation by road. Some of the factors related to the probability of a dangerous goods incident are listed below:

- Roadway types
- Number of lanes
- Number of intersections
- Roadway lighting
- Roadway visibility
- Road surface condition
- Traffic volume
- Traffic controls
- Terrain
- Vehicle speed
- Driver care
- Driver training
- Driver experience
- Vehicle condition
- Vehicle size
- Container type and size
- Time of day
- Time of year

One simplifying assumption is commonly applied to the method of estimating risks: Vehicles carrying dangerous goods are exposed to the same hazards as all other vehicles on the road. This assumption allows us to use available accident rates for all vehicles to represent accident probability involving dangerous goods vehicles.

Figure 3.9 presents common accident rates for a variety of road types found within Canada.

FIGURE 3.9. ACCIDENT RATES BY ROAD TYPE

ROADWAY TYPE	ACCIDENTS / MILLION VEHICLE-KM
Freeway / Expressway	0.8
Provincial Highways	1.2
Provincial Secondary Roads	1.5
Urban Arterials	3.5
Other Roadways	4.7

Source: LaMorte / Williams & Associates, 1987.

Applying these accident rates to North Vancouver District roadways yields:

- 0.8 accident per million vehicle kilometres for the Upper Levels Highway
- 1.5 accidents per million vehicle kilometres for the Dollarton Highway
- 3.5 accidents per million vehicle kilometres for urban arterial streets like Marine Drive, Lynn Valley Road, and Keith Road

Accident rates for principal roadways in North Vancouver are indicated in Figure 3.8, shown previously.

The North Vancouver RCMP and the District Engineering Department keep records on the number of vehicle accidents on municipal roadways. The ten intersections with the greatest number of accidents per year are listed in Figure 3.10.

FIGURE 3.10. INTERSECTIONS WITH HIGHEST NUMBER OF ACCIDENTS

RANK	INTERSECTION	1989	1990	1991
1	Capilano Road at Marine Drive	27	20	15
2	Marine Drive at Pemberton Avenue	15	15	15
3	Keith Road at Mountain Highway (west)	15	13	12
4	Lonsdale Avenue at 29th Street	-	11	9
5	Garden Avenue at Marine Drive	3	10	8
6	Main Street at Harbour Avenue	6	9	8
7	Keith Road at Mountain Highway (east)	5	9	7
8	Emerson Way at Mount Seymour Parkway	5	5	7
9	Delbrook Avenue at Queens Road	7	4	10
10	Lynn Valley Road at Mountain Highway	6	8	6

Source: North Vancouver District Engineering Department, 1992.

Note that these roadways also carry the highest traffic volumes in the District, and may not infer accident rates. It is also interesting to note that all ten intersections listed in Figure 3.10 may be found on designated dangerous goods truck routes.

What about ... Need a conclusion.

3.4 RAIL TRANSPORT

The rail transport of dangerous goods on the North Shore is currently conducted by two railway companies:

- British Columbia Rail (B.C. Rail)
- Canadian National Rail (C.N. Rail)

The provincial carrier, B.C. Rail, enters the study area from the north, while the C.N. line crosses the Second Narrows from Burnaby in the south. Both rail firms interchange cars at the Mission Indian Reserve in North Vancouver.

3.4.1 Rail Dangerous Goods Routes

The rail line transporting dangerous goods in North Vancouver District is shown in Figure 3.11, as described below.

The C.N. Rail mainline, comprising a portion of the Yale Subdivision, enters the North Shore as it crosses the rail bridge at the Second Narrows. The line passes under the TransCanada Highway, follows Railway Street to Lynn Creek, where it enters the City of North Vancouver. The main line then enters the C.N. Lynn Creek Yard, where rail cars may remain for varying periods of time between pick up and delivery. In general, dangerous commodities are not permitted to remain in yards for more than 48 hours.

A connecting line continues along the waterfront to meet the B.C. Rail interchange yard, then continues through the District of North Vancouver to the B.C. Rail Station and Terminal Yard, located at McKeen Avenue and Philip Avenue.

Along the combined 3.0 kms (1.9 mi) of mainline track within the District of North Vancouver, the rail line has 4 level crossings at the following roadway locations, listed from east to west:

1. Mountain Highway
2. Harbour Avenue
3. Pemberton Avenue
4. Philip Avenue

Amherst
Capilano (Van. Wharves)

3.4.2 Rail Dangerous Goods Volumes

The TDG Study in 1987 found that 24 commodities represented nearly 95 percent of the total dangerous goods moved by rail throughout the Lower Mainland. Ten of these products were transported through the District of North Vancouver in 1986, as summarized in Figure 3.12.

FIGURE 3.12. 1987 TDG STUDY RAIL NETWORK DATA (Car Movements per Year)

COMMODITY	Link 9: From South Rail Tunnel, Vancouver, to Lynn Creek Yard	Link 10: From Lynn Creek Yard to BC Rail Interchange
Sodium Hydroxide	5,075	472
Methanol	2,781	2,781
Ethylene Dichloride	1,958	-
Propane / L.P.G.	1,214	1,271
Chlorine	345	434
Sulphur Dioxide	42	35
Hydrogen Peroxide	28	32
Sulphuric Acid	28	-
Hydrochloric Acid	-	6
Sodium Chlorate	2	-
TOTAL	11,473	5,031

Source: Adapted from GVRD TDG Study, 1987

Sodium hydroxide and methanol shipments head the list in terms of the number of bulk rail cars travelling through the District of North Vancouver. More than 2,300 cars of extremely toxic gases, such as chlorine, ethylene dichloride, and sulphur dioxide were also transported within the community in 1986. The ten commodities researched by the TDG Study accounted for more than 16,000 car movements within District's limits in 1986, for an average of about 45 rail car movements per day.

3.4.3 Rail Accident Rates

A number of factors affect the probability of a rail accident, such as a rail crossing incident, collision or derailment. Such factors include (Sonntag, 1988):

- Auto Traffic at Crossings
- Condition of Rail Cars (rolling stock)
- Employee Supervision
- Employee Training
- Length of Train
- Pattern and Number of Rail Lines
- Rail Traffic
- Roadbed Condition
- Standard Operating Procedures
- Track Condition
- Train Speed

Rail firms record three types of accidents. First are the derailments, where wheels of a car leave the designated track. Often, derailments at low speeds leave the cars upright and cause no damage to the containers themselves. Derailments at faster speeds or where embankments are present may result in upset of the cars and a greater likelihood of container breach. Second are collisions, where one rail car or engine strikes another. These events can also cause container breach, especially when cars travel at greater speeds. The third accident type involves automobile vehicles where rail lines cross roadways. These crossing accidents can lead to derailment and breach of containers, again depending on the speeds involved.

Although trains and their cargoes are exposed to a number of hazards along any route, relatively few types of events have actually caused accidents in the past. Rail accidents throughout Canada have been steadily declining over the last ten years, due to improved track testing, maintenance programs, rolling stock, and better safety measures throughout the system (Transport Canada, 1990).

The most appropriate accident rate to apply to the B.C. Rail and C.N. Rail lines through North Vancouver District would be derived from the historical record for that line, tempered by recent improvements in the system. In the absence of such a figure, a rail accident rate used for the extensive Toronto rail study in 1987 was adopted for demonstration purposes. Throughout the Toronto region, which included many of the same rail conditions and operations found in North Vancouver, the accident rate was found to be 0.0196 accidents per million car-kilometres (Concord, 1987).

Conclusion ?

3.5 MARINE TRANSPORT

Marine shipments of dangerous goods in the vicinity of North Vancouver are governed in part by the Canadian Coast Guard and the Vancouver Port Corporation, a crown corporation operating under Transport Canada. In addition to waterway activity, the Vancouver Port Corporation also owns and controls a number of land parcels adjacent to Burrard Inlet, some of which are leased for industrial activity.

3.5.1 Marine Dangerous Goods Routes

The major components of the marine transport network for dangerous goods within the District of North Vancouver include a transit route in Burrard Inlet, and marine terminals where dangerous goods are known to be trans-shipped.

The majority of the marine traffic transiting Burrard Inlet consists of tug-barges and coastal tankers operating between Vancouver and other ports in B.C., Puget Sound, and Alaska (Sandwell, 1991).

Chemical tankers with total capacities varying from 7,500 to 40,000 DWT call at the Port 10 to 12 times per month. Petroleum tankers visit the Port of Vancouver once or twice a month. Refined product carriers range in capacity from 30,000 to 40,000 deadweight tonnes (DWT), and crude oil carriers range from 40,000 to 60,000 DWT. Liquefied petroleum gas cargo shipments in specialized foreign carriers no longer use the Port of Vancouver (Sandwell Swan Wooster, 1988).

Coastal vessels carry dedicated tanks, rail cars, and vehicle traffic along the coast of B.C. to Alaska and other U.S. ports. Railcar ferries operating out of the Port are designed to carry, on average, 25 standard railcars (Sandwell Swan Wooster, 1988).

Tugs and barges also operate along the coast. Barges carrying refined petroleum products range in size from 4,260 bbls. capacity and 100 feet in length to the largest U.S. barges of 116,000 bbls. capacity and 400 feet in length. Chemical barges range in size from about 1,800 DWT capacity and 200 feet length to about 5,000 DWT capacity and 270 foot length. Chemical barges carry caustic soda in hull tanks, sodium chlorate in hull and deck tanks, and chlorine in deck tanks (Sandwell Swan Wooster, 1988).

The Vancouver Port Corporation reports six principal marine terminals within the District of North Vancouver where dangerous goods are trans-shipped, as listed below and shown in Figure 3.13.

1. Albright & Wilson (now Sterling Pulp Chemicals)
2. B.C. Rail Terminal
3. Canadian Oxy Chemicals
4. Dow Chemical
5. Lynnterm (owned and operated by the Vancouver Port Corporation)
6. Vancouver Wharves

For Seaspan Terminals — NH_3, etc

3.5.2 Marine Dangerous Goods Volumes

The Port of Vancouver is Canada's largest deepsea port, and among the largest in North America in terms of foreign tonnage handled.

All marine traffic transiting Burrard Inlet and English Bay are required to report to the Vancouver Port Corporation detailed information on the types and quantities of dangerous goods destined for or received from a Port terminal, as well as information on the containment vessel, whether barge, tanker or container. Thus, the Port Corporation has an excellent record of the annual volumes of hazardous commodities within the harbour. Permit data do not record, however, goods that remain onboard during a port visit.

Figure 3.14 summarizes the volumes of bulk dangerous goods moving through the Port of Vancouver within the five years between 1985 and 1989.

FIGURE 3.14. BULK DANGEROUS GOODS MOVING THROUGH PORT OF VANCOUVER
(Tonnes per Year)

COMMODITY	1985	1986	1987	1988	1989
Crude Oil	195,921	439,922	646,051	1,024,692	804,817
Gasoline	1,353,084	1,424,247	1,466,294	1,207,048	1,062,910
Fuel Oil	1,723,634	1,642,659	2,041,998	1,910.633	1,862,819
Misc. Petroleum Products	311	32,295	1,012	589	491
Liquid Chemical Products	1,450,805	1,435,588	1,750,763	2,121,666	2,231,597
Oils, Fats, Waxes	225,934	171,680	266,975	151,165	63,764
Tallow	62,358	76,819	76,907	110,400	101,234
TOTAL	5,012,047	5,223,210	6,250,000	6,526,193	6,127,632

Sources: Sandwell, 1991; Port of Vancouver, 1991

Gasoline, diesel and fuel oils are carried in "product tankers" designed for the transport of refined petroleum products. Segregated ballast tanks (so no product is discharged with the ballast) are required for product tankers greater than 30,000 DWT. Inert gas systems (to prevent the buildup of explosive atmospheres in the tanker) are required for all product carriers.

With the crude oil carriers and product tankers, a number of specialty carriers move chemicals through the Port of Vancouver. According to the most recently available figures from the Vancouver Port Corporation, sodium hydroxide heads the list of top marine shipments of liquid chemicals through the Port by all vessel types. Figure 3.15 presents a summary of these shipments.

FIGURE 3.15. LIQUID CHEMICAL PRODUCTS THROUGH PORT OF VANCOUVER, 1991

COMMODITY	METRIC TONNES, 1991
Sodium Hydroxide (Caustic Soda)	1,008,000
Ethylene Dichloride	441,000
Methanol	399,000
Styrene Monomer	227,000
Sodium Chlorate Solution	188,000
Chlorine	49,000
TOTAL	2,312,000

Source: Vancouver Port Corporation, 1992

North Vancouver District's marine terminals handle a large variety and volume of hazardous commodities. A summary of the bulk dangerous goods passing through these terminals in 1991 is presented in Figure 3.16.

FIGURE 3.16. DANGEROUS GOODS THROUGHPUT AT NORTH VANCOUVER DISTRICT TERMINALS, 1991

TERMINAL	DANGEROUS GOODS	METRIC TONNES
Albright & Wilson	Sodium Chlorate Solution	6,000
	Sulphuric Acid	200
B.C. Rail	Caustic Soda	600
	Chlorine	1,000
	Hydrogen Peroxide	300
	Sodium Chlorate	100
	Sulphur	100
	Sulphur Dioxide	2,000
	Sulphuric Acid	1,000
Canadian Oxy	Acrylic Acid	1,500
	Caustic Soda	142,500
	Chlorine	37,100
	Ethylene Dichloride	2,000
	Hydrogen Peroxide	800
	Methyl Methacrylate	1,400
	Methyl Tertbutyl Ether	1,900
	Sodium Chlorate	14,800
	Sulphur Dioxide	800
	Sulphuric Acid	400
Dow Chemical	Caustic Soda	128,200
	Chlorine	800
	Ethylene Dichloride	58,300
	Sodium Chlorate	1,400
Lynnterm	Caustic Soda	57,000
	Ethylene Dichloride	123,000
	Methanol	17,000
	Mono Ethylene Glycol	3,900

	Styrene Monomer	7,600
Vancouver Wharves	Acetone	1,000
	Acrylonitrile	11,800
	Butanol	500
	Butyl Acrylate	2,200
	Dicyclopentadiene	2,200
	Dimethyl Formamide	1,000
	Epichlorohydrine	1,200
	Methanol	219,000
	Methyl Acrylate	700
	Methyl Methacrylate	600
	Styrene Monomer	10,500
	Toluene	5,200

Source: Vancouver Port Corporation, 1992

3.5.3 Marine Accident Rates

Sandwell recently conducted a study of tanker risks for the Vancouver Port Corporation and derived the accident rates shown in Figure 3.17.

FIGURE 3.17. TANKER ACCIDENT RATES (Accidents per 10,000 Port Calls)

Accident Type	Overall Tankers	Crude Tankers	Petroleum Tankers	Chemical Tankers	Coastal Tankers	Tanker Barges
Collisions	1.0	0.8	1.1	1.3	1.0	1.5
Groundings	4.0	3.4	4.0	4.8	3.8	1.0
Strikings	7.0	4.6	7.4	8.8	7.4	7.5
Fires/ Explosions	2.0	1.7	2.2	2.2	1.9	0.5
Structural Failures	0.5	0.6	0.5	0.5	0.4	1.5
TOTAL	14.5	11.0	15.1	17.5	14.4	12.0

Source: Adapted from Sandwell, 1991.

The probability of an accident involving a marine vessel in Burrard Inlet is greater than in English Bay or in the Strait of Georgia. During the 1987 Lower Mainland TDG Study, the Marine Subcommittee ranked the Burrard Inlet among the highest category of accident probability in the study area, considering such factors as (Sonntag, 1988):

- Tidal Patterns
- Congestion of Vessels
- Draft Restrictions
- Incidence of Fog
- Maneuverability
- Currents

Several persistent management problems in marine transportation have a strong influence on the likelihood of accidents. The States/British Columbia Oil Spill Task Force, after studying a number of pollution incidents concluded that significant shortfalls persisted in oil transportation management, including (States, 1990):

- Inadequate personnel training and qualifications
- Shortcomings in vessel design and integrity
- Insufficient traffic management
- Gaps in regulatory oversight
- Incomplete cost recovery opportunities

Although these conclusions were expressed with the oil transportation industry in mind, similar problems should be examined within the chemical shipping activity.

3.6 PIPELINE TRANSPORT

The transport of dangerous goods by pipeline is a frequently overlooked element of a community risk profile. Of several U.S. studies reviewed, few dealt with pipelines in any detail and many failed to acknowledge them at all.

We contacted the major natural gas distribution company operating on the North Shore, B.C. Gas, for information on the volumes and risks of this mode of transport. While they cooperated with our research, they cautioned that the movement of liquid or gaseous products through piping systems is so different from vehicle transport that comparisons are difficult.

3.6.1 Pipeline Routes

B.C. Gas carries natural gas to more than 40,000 customers on the North Shore through about 700 kms of distribution pipelines. Routes for the natural gas system are shown in Figure 3.18.

Natural gas is delivered to the North Shore by way of a new 24-inch trunk line across the Second Narrows Bridge. High pressure lines operating at 1,200 kPa (175 psi) transport the gas to a number of district regulator stations located throughout the North Shore, where pressure is reduced to about 400 kPa (60 psi).

Within the District of North Vancouver, B.C. Gas reports about 4.8 kms (3.0 mi) of high pressure pipeline. Five district regulator stations are maintained within or immediately adjacent to the District of North Vancouver at the following locations:

1. North end of Second Narrows Bridge, east side
2. North end of Second Narrows Bridge, west side
3. Keith Road and Salop Road (at border with North Vancouver City)
4. 15th Street at McGuire Avenue (at border with West Vancouver)
5. 29th Street at Jones Avenue (at border with North Vancouver City)

Smaller service pipes feed gas to above-ground meters outside buildings being served. In general, trunk and distribution lines follow the street systems throughout the urban and rural areas. Virtually all piping facilities are buried underground.

3.6.2 Pipeline Volumes

The B.C. Gas delivery system is designed to deliver a maximum of 126,00 cubic metres of gas per hour to the North Shore. Minimum load is typically 20 percent of this peak rate. Annual volumes depend on demand and fluctuate from year to year.

3.6.3 Pipeline Accident Rates

Accidents involving natural gas piping typically fall into three categories:

1. Third Party Damage. The rupture of an underground main or service piping generally correlates with excavation activity by a third party, that is, not employees of B.C. Gas. Although B.C. Gas has an active warning and prevention program to address excavation risks, about 100 such incidents occur each year throughout the Lower Mainland.

2. Underground Leakage. Leakage from underground pipe can occur where corrosion or mechanical joint problems exist. About 85 percent of such leaks are detected by sensitive equipment used by B.C. Gas to continually survey their distribution system. The remaining leaks are reported by the public or other agencies.

3. Impact Damage to Gas Meter. B.C. Gas protects above-ground meter sets that are vulnerable to vehicle traffic by installing large steel posts. Nevertheless, a small number of vehicle accidents lead to broken gas meters and leakage each year. Such events invariably require immediate evacuation of the building or area.

The effects of an earthquake in the Lower Mainland on the pipeline system are difficult to predict without more information. The new 24-inch trunk line carrying natural gas to the North Shore across the Second Narrows Bridge contains a pressure-sensitive valve that would automatically halt product flow if activated.

B.C. Gas reports no deaths, injuries, or fires related to gas distribution incidents since the North Shore first received natural gas in 1956. Building fires, gas leakage within a building, and malfunctioning appliances have been noted as related to customer-owned premises and equipment.

The Netherlands Organization for Applied Scientific Research has adopted a universal accident frequency for all pipelines of 0.00001 pool fires or gas cloud explosions per 100 m of pipeline length per year (TNO, 1988).

3.7 EMERGENCY PREPAREDNESS

Several risk models recognize the influence emergency preparedness can have on dangerous goods risk. Although a quick response does not affect accident probability, it has been known to reduce consequences in some instances. Through evacuation of those within zones of hazard, by containing spilled liquids, or by controlling the spread of fire, among other activities, emergency response crews have reduced the adverse effects of a large number of dangerous goods accidents.

In spite of the perceived benefits, accounting for emergency preparedness in a risk assessment remains a tenuous proposition. Several researchers have attempted to assign risk reduction factors given the presence of emergency plans, trained response crews, and appropriate equipment (Abkowitz, 1992; Alberta, 1986; LaMorte, 1987; TNO, 1988). A universally acceptable method, however, has yet to be proposed for direct use in risk calculations. In the absence of such a method, emergency preparedness can only be represented by qualitative descriptions.

3.7.1 Community Emergency Preparedness

The District of North Vancouver participates in the North Shore Emergency Program, sharing activities in accident prevention, preparedness, response and recovery with the City of North Vancouver and the District of West Vancouver.

The North Vancouver District Fire Department offers the community's primary response capability for all types of dangerous goods incident. Emergency procedures for the District call for Fire Department response to all incidents where fuels or chemicals may impact the general population, although fire officers may not take full control of the situation in all cases. The District response philosophy is to contain and control chemical hazards, not necessarily to repair ruptured or leaking containers. To accomplish their mission, the Fire Department has access to a full inventory of hazardous material response equipment.

District fire officers are provided dangerous goods response training through established educational programs. One Assistant Fire Chief has been assigned to provide dangerous goods training to all personnel. Others have participated in special training courses for waste handlers. Local industries, such as Canadian Oxy Chemicals and C.N. Rail also offer training opportunities and participate in emergency exercises.

During emergency conditions, the North Vancouver District Fire Department will consult a variety of experts, including the federal CANUTEC program, Environment Canada, C.N. Rail, Canadian Oxy, and Dow Chemical, depending on the nature of the incident. For road accidents, the Fire Department will identify the carrier and contact the shipper, where possible. Local weather and wind data sources include Environment Canada and the Harbour Air Control Tower. Evacuation areas are usually determined with the assistance of the Transport Canada CANUTEC Guide and through the use of on-site experts.

Community response to dangerous goods accidents may include the North Vancouver RCMP Detachment. Members of the North Vancouver RCMP have received awareness training through the TRANSCAER Program and with the assistance of C.N. Rail. Officers have a basic knowledge of hazards and response procedures, and have access to the Canadian Police Information System, which can list commodity names and safety measures by product identification number (PIN). RCMP response teams have airpacks in the vehicles, but generally stay well away from an incident site until the product has been identified. RCMP constables conduct evacuation procedures, where necessary, under the direction of the commanding fire officers. Evacuation zones are determined by the Fire Department in all cases. Coordinating officers attend monthly North Shore emergency planning meetings and participate in periodic exercises.

The North Vancouver District Engineering/Public Works Department responds to dangerous goods incidents when requested, but they lack a sophisticated response program. They have a limited amount of dyking materials, booms, and small sacks of absorbent for oil spills from motor vehicle accidents. They will spread sand or gravel and assist the Fire Department and the RCMP. Public Works personnel receive no specific training in dangerous goods handling or response.

3.7.2 Industry Emergency Preparedness

Although some fixed facilities within the District of North Vancouver are known to have prepared fire safety plans, it is difficult to estimate the number of premises that specifically address emergency response to dangerous goods incidents. Currently, response plans are in place for Canadian Oxy Chemicals, Dow Chemical, Sterling Pulp Chemicals, and several of the marine terminals located within the District. B.C. occupational health and safety regulations require employers to plan for worker protection from chemical releases, including warning systems and first aid. The extent of compliance among District business and industry suspected of holding and handling dangerous goods has not been examined.

Even where emergency plans have been prepared, however, the level of preparedness cannot be predicted. In a sample of 157 industry emergency response plans reviewed by the TDG Directorate of Transport Canada, 65 percent were found to be inadequate (Kittle, 1990).

Shippers and road transporters of certain high hazard dangerous goods are required by federal and provincial TDG regulations to prepare emergency response plans. Some of the more prominent carriers in the Lower Mainland, such as ICX and Trimac, are known to have plans, trained personnel, and response equipment. The extent of preparedness among other types of carriers, such as general freight haulers and couriers, is questionable. Although no statistics are available on emergency planning among all classes of road transporters, we suggest that emergency plans are the exception rather than the rule among road carriers.

Response to rail incidents within the boundaries of the District of North Vancouver would fall to B.C. Rail, with trained crews and heavy equipment at the Terminal Yard, and C.N. Rail. Both rail firm have developed emergency response plans and participate in planning exercises with the North Shore communities from time to time.

For marine accidents, the Vancouver Port Corporation (VPC) has an emergency plan with a scope from Pt. Atkins south to the U.S. border and all waters east, except the Fraser River. The plan covers all terminals and all types of incident. Although the VPC does not have a fire department (it contracts with local municipalities) it acts literally like a municipality, reviewing development plans and enforcing safety provisions. The VPC has its own police force of 40 personnel, with 9 boat crew and 3 boats. The Security force has prepared its own sub-plan.

Four VPC Harbour Masters have extensive training in dangerous goods, having completed emergency preparedness courses and Master mariner courses. VPC clean-up equipment is minimal, including absorbants, pads, small quantities of first response equipment and 1,000 ft of boom. The VPC relies on Burrard Clean to provide environmental protection following a spill. Focusing on oil spills, the stockpile of response equipment immediately available to the Port of Vancouver is presented in Figure 3.19.

To respond to natural gas pipeline incidents, B.C. Gas has prepared an emergency plan, communications procedures, trained crews, and specialized equipment. Distribution shut-off valves provided for emergency isolation in a serious event are inspected and maintained annually. Radio-equipped crews are available during workdays, and emergency crews are on stand-by around the clock. Emergency crews are given annual refresher training, covering such topics as analysis of leakage situation, live gas leakage repairs, and fire fighting techniques. B.C. Gas also provides training to local fire and police departments to assist in coordinating a response to a natural gas incident.

FIGURE 3.19. BOOMS AND SKIMMERS AVAILABLE TO THE PORT OF VANCOUVER

Burrard Clean		
Boom	1,920 m	0.8 m Versatech Zoom Boom
	1,829 m	0.5 m Inshore Boom
	610 m	0.6 m Harbour Boom
	304 m	0.6 m River Boom
Skimmers	1	12.8 m Bennett Mark 6D Skimmer
	1	15.2 m Marco Class VIIB Skimmer
	1	Oil Mop Mark 9DP
	2	Morris Industry MI-2 Skimmer
	2	Komara Mini Skimmers
	1	Scavenger Skimmer
Canadian Coast Guard		
Boom	1,000 m	0.9 m Bennett Boom
	1,220 m	0.6 m Inshore Boom
	308 m	0.5 m Versatech Boom
	305 m	0.4 River Boom
	500 m	0.8 m Vikoma SeaPack
Skimmers	1	Slicklicker
	2	Komara Mini Skimmers
	1	Morris Industry MI 30 Skimmer
	1	Semi-Portable Oil Mop
	1	Portable Oil Mop
	2	GT-185 Skimmers
Vancouver Port Corporation		
Boom	305 m	0.5 m Inshore Boom
Clean Sound		
Main Skimmers	3	JBF Skimmers

Source: Sandwell, 1991.

3.8 CONCLUSIONS

Because of the tentative and incomplete nature of the data presented above, few conclusions can be drawn with confidence. Yet, the purpose of this early assessment is, in part, to identify what we know and what further information is required. This section offers a limited view of the risks presented by dangerous goods to the community as a whole, identifies a few locations that deserve further attention, and lists the data required to complete a risk assessment for the District of North Vancouver.

3.8.1 Overall Level of Risk

Although no universally acceptable measure of community risk yet exists, the overall level of risk from dangerous goods in the District of North Vancouver can be placed in some perspective through the following observations.

- There are three primary chemical producers and two major marine terminals within the municipal boundaries, with about 240 other fixed facilities presumed to contain dangerous goods. This level of industrial activity suggests moderate community risks from hazardous materials.

- Road transport of bulk commodities is largely limited to through traffic using the Upper Levels Highway. Estimates predict at least 6,000 dangerous goods vehicles per year, or 20 trucks per day, and some methods suggest much more. Although data are lacking, a significant number of trucks may use urban arterials within the District, such as Marine Drive, Capilano Road, Lynn Valley Road, and Main Street, especially in the vicinity of the waterfront.

- A relatively large number of hazardous shipments travel by rail through the community, accounting for an average of about 45 cars per day. In some locations, yard and mainline operations bring bulk tank cars of such hazardous chemicals as chlorine, ethylene dichloride, and sulphur dioxide within on kilometre of commercial centres, workplaces, schools, and residences. Although rail incidents are rare, and the release of product from modern tank cars even more so, the proximity of these high volume hazardous materials to densely populated areas in North Vancouver indicate severe consequences should an accident occur.

- The total tonnage of fuels and liquid chemicals shipped past North Vancouver by marine traffic in English Bay far outweighs the combined dangerous goods by other modes. Marine accidents seldom occur and the prospect of community impact must be considered a very low probability.

One comparison of overall community risks in available literature comes from the 1988 TDG Study for the Lower Mainland. Based on limited research and incomplete data, the TDG Study attempted to compare and rank 11 GVRD communities in terms of the total volume of bulk dangerous goods being transported within each. The results are duplicated in Figure 3.20. Note that the TDG Study did not distinguish between the District and the City of North Vancouver.

FIGURE 3.20. TDG STUDY COMPARISON OF GVRD MUNICIPALITIES, 1986

MUNICIPALITY	TONNES (1986)
1. Burnaby	2,870,053
2. North Vancouver	2,297,202
3. Coquitlam	1,663,168
4. Port Moody	1,376,571
5. Surrey	951,000
6. New Westminster	824,630
7. Port Coquitlam	735,669
8. Vancouver	424,488
9. West Vancouver	152,741
10. Delta	145,084
11. Richmond	21,875

Source: Boydell, 1988.

As an additional point of reference, the City of Edmonton, Alberta, reports more than 8,000 fixed sites of concern, and greater than 200 truckloads and 100 rail tank cars passing through the city each day (MIACC, 1992).

We conclude from the available data that the overall risk from dangerous goods in the District of North Vancouver is highest among the three North Shore municipalities, but moderate in comparison with other North American cities. Certain key locations are acknowledged as high risk zones, worthy of a detailed risk assessment and careful attention to accident prevention and response. These locations, or "hot spots" within the community, are addressed below.

3.8.2 Hot Spots

In defining these hot spots, we looked for the close proximity of large volumes of high hazard commodities to sensitive populations or environmental habitat. Although accidents can occur virtually anywhere within the municipality, we intended to identify those locations that deserve special attention in terms of both prevention and response. The District of North Vancouver hot spots are, from east to west:

1. Maplewood Neighbourhood. Three large industrial facilities handle bulk quantities of high hazard chemicals in this portion of the community. Canadian Oxy Chemicals, Sterling Pulp Chemicals, and Drew Chemicals operate premises in close proximity to the Maplewood Elementary School, the 300 residential students at the Canadian International College, motorists on the Dollarton Highway, and the Maplewood Conservation Area. Some chemical manufacturing facilities rest on fill land, which is prone to liquefaction in an earthquake. In addition, significant volumes of dangerous goods are carried across the adjacent Second Narrows Bridge by road, rail and pipeline. Emergency preparedness for Maplewood residents is especially challenging because of a high turnover rate.

2. Lynnmour Neighbourhood. Residents, local workers, and motorists in the Lynnmour area south of Main Street are exposed to possible chemical release from several industrial operations, such as Dow Chemicals, the Mohawk Oil Company, and Lynnterm. Local truck deliveries of dangerous goods to businesses in the area may be higher than elsewhere in the District. Rail operations bring more than 6,000 carloads a year of propane, chlorine, sulphur dioxide, and other dangerous commodities into this neighbourhood. Like the Maplewood area, the adjacent Second Narrows Bridge introduces risk from a significant volume of dangerous goods carried by road, rail and pipeline.

3. Norgate Neighbourhood. Within one kilometre of such sensitive land uses as the Norgate School, the B.C. Rail and Royal Hudson passenger station, high-rise apartments, and MacKay Creek, a large number of dangerous goods may be found. Active industrial facilities on or near Welch Street mean a great variety of dangerous goods are present and delivered by truck, although they are likely found in less-than-bulk quantities. Vancouver Wharves activities include the transhipment of more than 200,000 tonnes of methanol annually, as well as significant quantities of extremely toxic acrylonitrile and styrene monomer. The B.C. Rail Terminal Yard at McKeen Avenue involves a large number of handling operations where dangerous goods are interchanged between rail cars and trucks. Both truck trailers and rail cars containing dangerous goods may be temporarily stored at the yard for varying periods.

4. Lower Capilano, Marine Drive at Capilano Road. We currently lack conclusive data on the volume of chemicals transported by truck through this neighbourhood, but the nature of the land uses and the presumed high accident rate convinced us a chemical release at this location could be likely and disastrous. Adjacent to this intersection one finds a number of commercial enterprises, such as the Pemberton Plaza, office towers, and close proximity to sensitive habitat in the Capilano River. More importantly, the number of motorists present at this location at any time of the day suggests that a great number of persons could be exposed, and most have limited opportunities of escape.

Several other areas caught our attention and, although they perhaps cannot be classified as hot spots, deserve further consideration. These other locations include, from east to west:

- Lilooet Road, where truck shipments are presumed to bring 1-tonne cylinders to the Seymour Dam, along the sensitive environment of Lynn Creek.
- Upper Levels Highway 1 where it passes the Keith Lynn School, the Orwell Street Elementary School, and Lynn Creek.
- Lynn Valley Road, where road transport of unknown quantities and types of dangerous goods are assumed to include gasoline, diesel fuel, and propane. These movements expose several schools, a senior citizen's home, the North Shore Private Hospital, the Karen Magnussen Arena, and the West Lynn Mall to risks from dangerous goods.
- Capilano Road, where truck shipments are presumed to bring 1-tonne cylinders through one of the highest accident intersections in the District, past several kilometres of residential housing, and in close proximity to the Capilano River.
- Marine shoreline, which could suffer significant economic impact and massive clean-up costs in the event of a major oil spill in Burrard Inlet.

3.8.3 Data Gaps

At this preliminary stage of research, many questions about dangerous goods risk in the District of North Vancouver remain unanswered. In this section, we identify gaps in on-hand data and attach a measure of importance to each. Figure 3.21 summarizes the current information needs related to the study in two categories: Data that are needed to perform even a rudimentary risk assessment, noted as "Required Data." Information that would contribute further to our understanding of risks from dangerous goods are listed in the right-hand column as "Additional Data."

Most of the data required to complete a risk assessment are accessible with moderate effort, with two exceptions. Information on both fixed facilities and road transport will require direct contact or observation through acceptable survey techniques. Data required for the rail and marine modes of transport may require manipulation of existent information by B.C. Rail, C.N. Rail, and the Vancouver Port Corporation, respectively.

Without detailed information on the types and quantities of dangerous goods in key facilities in the District of North Vancouver, a full risk assessment for this component cannot be undertaken. Several risk models are available to conduct such an assessment (refer to Appendix B) and, given the results of direct surveys, should provide interesting and valuable results. Data on fixed facilities would allow the community to focus prevention efforts on relatively high-risk operations, set priorities for emergency response, and allow the Fire Department to better ensure safety for firefighters and members of the public.

FIGURE 3.21. DISTRICT OF NORTH VANCOUVER DATA GAPS

REQUIRED DATA	ADDITIONAL DATA
COMMUNITY SETTING	
1. Residential population density within 1 km of selected hazardous sites.	1. Transient population within 1 km of selected hazardous sites by time of day, day of week. 2. Property values for selected locations.
FIXED FACILITIES	
1. Premises with dangerous goods, identified by type, quantity of largest container, total quantity on site, and storage/process activity.	1. Number of dangerous goods vehicles serving waterfront facilities, including commodity types and container volumes. 2. Historical incidents for businesses similar to those present.
ROAD TRANSPORT	
1. Routes used for local distribution of fuels and chemicals. 2. Number of vehicles by product type, container volume, and route.	1. Origins and destinations of truck shipments using North Vancouver roadways. 2. Identity of carriers, shippers, and receivers of dangerous goods. 3. Historical incidents for road transport similar to that observed in community.

RAIL TRANSPORT	
1. Confirmation of assumed container volumes for bulk rail cars.	1. Number of less-than-carload shipments of dangerous commodities, by product type and container volume. 2. Roadbed and track condition and maintenance practices. 3. Historical incidents for rail transport.
MARINE TRANSPORT	
1. For terminals with dangerous goods: product type, quantity of largest on-shore containers, and methods for storage, handling, and transfer. 2. Capacity and normal volumes of dedicated chemical and fuel transport tankers and barges. 3. Capacity of common containers used for non-bulk shipments. 4. Number of port calls by marine vessels, by commodity type and volume.	1. Number of dangerous goods vehicle visits at terminal per year, identifying commodity types and container volumes. 2. Historical incidents for vessels similar to those calling at Vancouver.
PIPELINE TRANSPORT	
All essential information is available.	1. Historical incidents in Lower Mainland to identify possible scenarios.

EMERGENCY RESPONSE	
All essential information is available.	1. Fixed facilities with dangerous goods that also have emergency plans in place, employee awareness programs, response teams, and response equipment. 2. Extent of emergency preparedness among road carriers of dangerous goods, accounting for the range of carrier types.

Further data on road transport volumes of dangerous goods are required to perform a risk assessment for the District. Specifically, the number of vehicles, types of goods, and routes taken must be collected either through roadside surveys or through direct contact with shippers, carriers, and receivers in the Lower Mainland. Current estimates are based on indirect inference from other surveys and ignores use of local roadways. With this information, planners can ensure key carriers have emergency response plans, work with regular shippers to select low risk routes, and develop procedures for response to specific locations.

Missing from the marine information are data on the maximum volumes of certain commodities stored at the terminals and the means of storage and transfer. This information should be collected during a survey of marine terminal operators.

Suggestions for collecting missing data are offered in Section 5.0 of this report.

SECTION 4.0

THE DISTRICT OF WEST VANCOUVER

PHASE 2 - PRELIMINARY RISK ASSESSMENT

SECTION 4.0

THE DISTRICT OF WEST VANCOUVER
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EXECUTIVE SUMMARY

(To be complete for Final Report)

SECTION 4.0 - THE DISTRICT OF WEST VANCOUVER

4.1 COMMUNITY SETTING

The Corporation of the District of West Vancouver encompasses the populated regions from the common border with the District of North Vancouver on the east to the community of Lion's Bay in the northwest (see Figure 4.1).

West Vancouver contains a number of unique community features that suggest the consequences of a major dangerous goods incident could be severe. There are several pockets of sensitive populations in high risk areas, as highlighted in Figure 4.1. Sensitive populations, from the aspect of dangerous goods safety, refer to:

- High concentrations of people in such facilities as theatres, shopping malls, and schools. An often overlooked population placed at particular risk from dangerous goods accidents include the motorists on heavily travelled roadways.
- Members of the public that may have difficulty in evacuating an area quickly, such as residents of an institution, high-rise or residential area where there is restricted access.
- Persons who may sustain injury at low concentrations when exposed to a release of dangerous goods, such as children, the elderly, and some hospital residents.

Key among these sensitive population centres in West Vancouver are the following:

1. Schools, such as the Irwin Park Elementary, the Hillside Middle School, Chartwell Elementary and Sentinel Secondary School.
2. Residents in high-rise apartment buildings (greater than 10 stories), such as Belleview Towers at 195 21st Street and Belleview Place (21 stories) at 2203 Belleview
3. Community Care Facilities, such as Beacon Hill Lodge at 525 Clyde Ave., Hollyburn House at 2095 Marine Drive, and Marineview Personal Care at 2246 Marine Drive.
4. Shopping Centres at Park Royal, and the commercial business districts on Marine Drive at Ambleside and Dundarave.
5. Motorists on Marine Drive, Taylor Way, and the TransCanada Highway.

In addition to these population centres, West Vancouver supports a number of environmental settings that are sensitive to hazardous materials. Sensitive environments, as historical accidents have shown, primarily include bodies of water used as natural habitat or for potable water supply, such as lakes, rivers, creeks, and streams, as well as the shores of Burrard Inlet. The environments of priority concern are also shown on Figure 4.1.

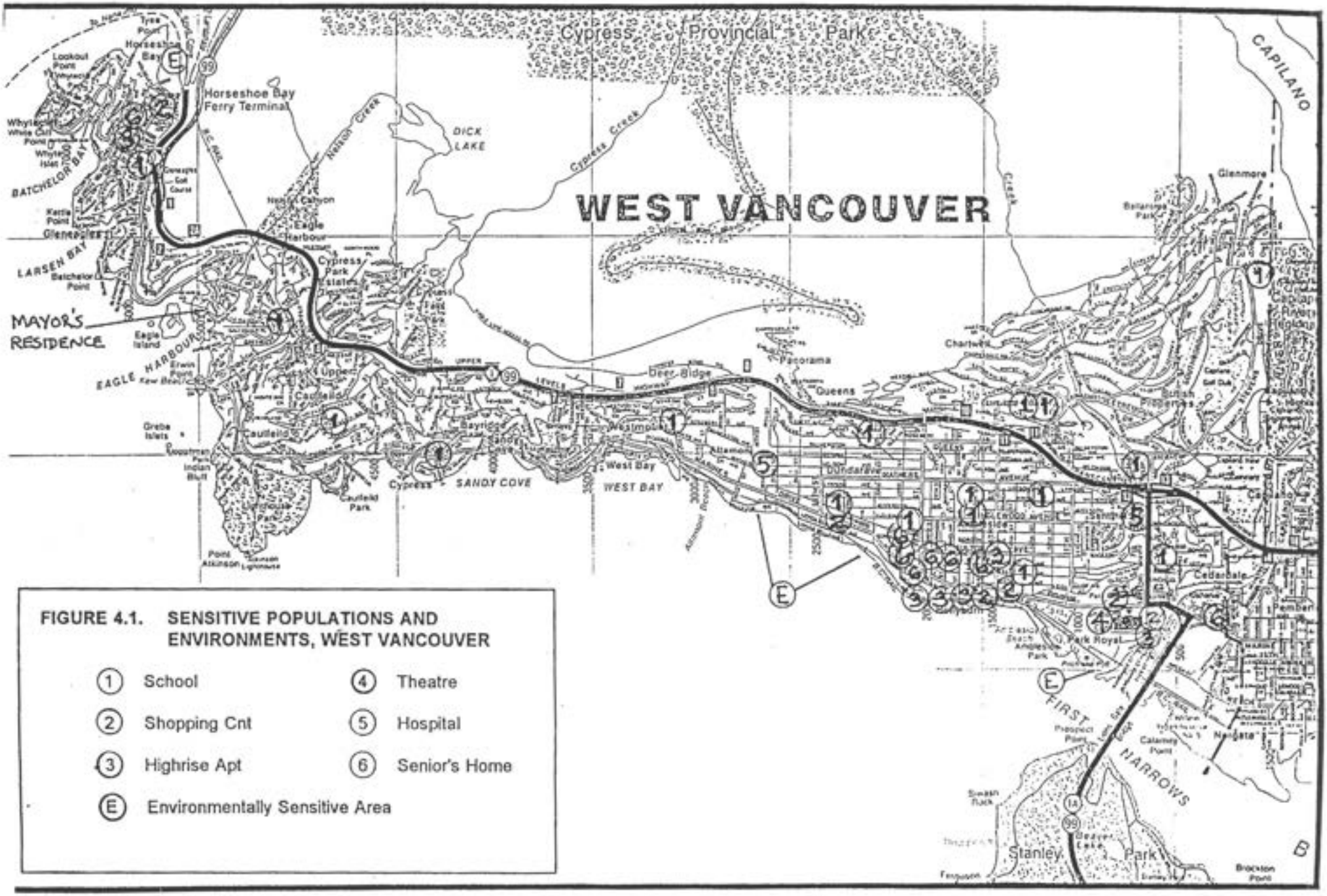


FIGURE 4.1. SENSITIVE POPULATIONS AND ENVIRONMENTS, WEST VANCOUVER

(1)	School	(4)	Theatre
(2)	Shopping Cnt	(5)	Hospital
(3)	Highrise Apt	(6)	Senior's Home
(E)	Environmentally Sensitive Area		

Important environmental habitats in West Vancouver that may experience adverse consequences from dangerous goods incidents include (West Van, 1988):

1. Capilano River
2. Nineteen other major watercourses within the community
3. Marine shoreline along Burrard Inlet and Horseshoe Bay

4.2 FIXED FACILITIES

The traditional approach to identifying facilities containing concentrations of dangerous goods relies on surveys and inspections. While the West Vancouver Fire Department assists businesses in developing fire safety plans, there has been no comprehensive effort to date to survey and catalog all premises for the types and quantities of dangerous goods that may be present.

Direct contact with business owners is the only way to secure accurate data, and beyond the scope of this preliminary effort. For this interim phase, we adopted a secondary method. After consulting similar work elsewhere (ABAG, 1982; EPA, 1990; TNO, 1988), we developed a list of 98 key industry types considered most important to a dangerous goods risk assessment, organized by headings found in the local telephone directory and by 4-digit Standard Industrial Classification (SIC) code. Through this process, we identified the types of establishments known to handle hazardous substances.

To identify facilities of interest to the risk assessment, we used directories made available through the Business Licence Department and the B.C. Telephone Company. Additional data were collected from the West Vancouver Fire Department, the GVRD Air and Source Control Department, the B.C. Ministry of Environment, and Transport Canada.

4.2.1 Fixed Facilities With Dangerous Goods

The results of this preliminary research are offered in map form on Figure 4.2 to illustrate the proximity of fixed facilities in relation to sensitive populations and environments.

Risk assessment models require information on 1) The types of chemicals present at a facility, and 2) The quantity of goods present at any given time. Some risk estimate methods also rely on information on the type of containers or processes where hazardous materials may be found. For several premises in West Vancouver, the presence of dangerous goods is known, but not the quantity.

The discrepancy between what we currently know and what remains unknown is illustrated in Figure 4.2. The black dots indicate premises for which we currently have sufficient information to perform a formal risk assessment; the red dots denote locations were dangerous goods are suspected, but where additional research is required.

The industry categories and premises of interest in West Vancouver are listed in tabular form in Figure 4.3.

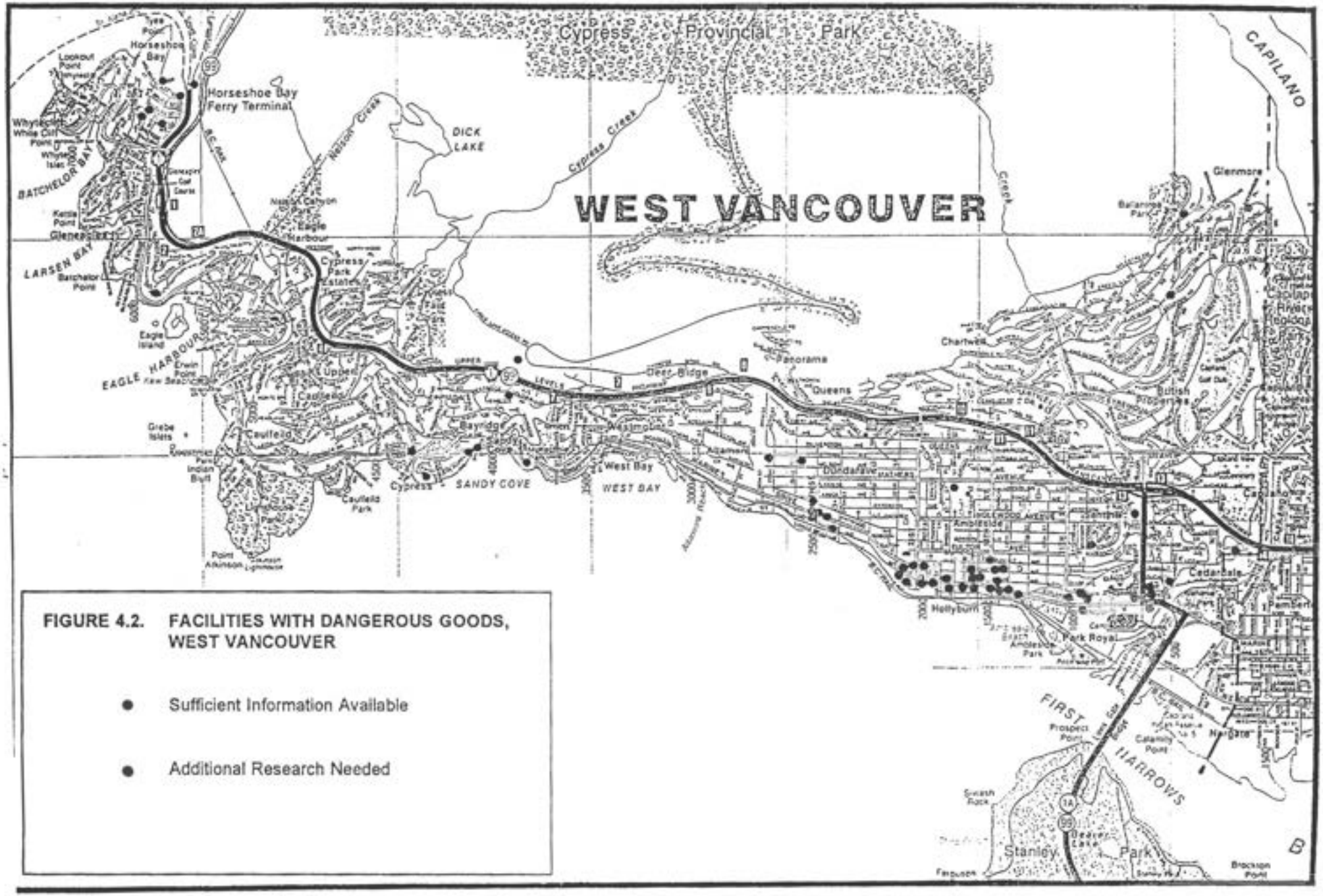


FIGURE 4.2. FACILITIES WITH DANGEROUS GOODS, WEST VANCOUVER

- Sufficient Information Available
- Additional Research Needed

Figure 4.3 Fixed Facilities With Dangerous Goods In West Vancouver

Automobile Parts & Supplies Whol & Mfrs (5013)		Status*
Elgar Agency	18-636 Clyde	S
Automobile Repairing & Service (7530)		
414349 B.C. Ltd	1525 Clyde	S
British Pacific Motors 1987	552-16th	S
Dave's Auto Body Shop	1431 Clyde	S
Dundarave Motors	2505 Marine	S
Minit-Tune Auto Centres	1525 Clyde	S
P V S Automotive	1439 Clyde	S
T L C Auto Detailing	1519 Clyde	S
Wetmore Motors	2203 Marine	S
Automobile Service Station (7530)		
343819 B.C.	675 Marine	S
Big Twin Enterprises	6390 Bay	S
Boat Builders (3732)		
Sceptre Yachts	2578 Nelson	S
Boat Repairing & Maintenance (3732)		
Boat Centre The Horseshoe Bay	6695 Nelson	S
Lightship Marine	5908 Marine	S
Race Rock Yacht Services	5908 Marine	S
William A. Lord	6705 Nelson	S
Chemicals (2800)		
Canadian Alchemists	104 Glenmore	S
Fortuna Chemicals & Plastics Inc	586 Craigmohr Dr	S
National Silicates	6-1742 Marine	S
Community Care Fac./Nursing Homes (8050)		
Beacon Hill Lodge	525 Clyde	C
Hollyburn House	2095 Marine	C
Laing Property Corp.	2095 Marine	C
Contractor - Refrigeration (7623)		
Toromont Industries	1095 Clivedon	S
Dental Laboratories - To the Profession (8072)		
Corona Dental Laboratory	35-659 Clyde	S
Dynamic Dental Ceramics	27-659 Clyde	S
Goldstar Dental Ceramics	27 659 Clyde	S
North Shore Dental Laboratory	975 Aubeneau Cres	S
Symmetric Dental Laboratory	200-1544 Marine	S
West Coast Dental Ceramics	1457 Marine	S
Disposal Service (4950)		
Tyee Disposal	6397 Argyle	S
Fumigating - Equipment & Supplies (5191)		
Maple Leaf Garden Centre	2558 Haywood	S
The Avant Gardener	1448 Marine	S
West Van Florist	1821 Marine	S
Gas - Liquefied - Natural - Bottled & Bulk (5984)		
CDS Research	100-565 17th	S
Hospitals (8060)		
Inglewood	725 Inglewood	S
West Vancouver Care Centre	1675 27th	S

*S = Suspected Dangerous Goods
C = Confirmed Type & Quantity of Dangerous Goods

Laboratories - Medical (8071)		Status*
Metropolitan Clinical Laboratories	2419 Bellevue	S
Metropolitan Clinical Laboratories	520 17th	S
Manufacturer - Canvas Products (2200)		
A-1 Canvas	5776 Marine	S
Marina (4493)		
Harbour Yacht Sales	5908 Marine	S
Sewell's Limited	6698 Wolseley	S
Thunderbird Marine Corp.	5776 Marine	S
Marine Repairs (3730)		
Vancouver Outboard Centre	5776 Marine	S
Marine Service Stations (5980)		
Sunset Marina	34 Sunset Beach	S
A.B.M. Industries	6695 Nelson	S
Northwest Propeller & Repair	34 Sunset Beach	S
Oriana Enterprises	5908 Marine	S
Multifamily Buildings (8800)		
(no name - multifamily)	2120 Argyle	C
Bayview	1550 Dutchess	C
Bellevue Place	2203 Bellevue	C
Norfolk	1819 Bellevue	C
Pacific Horizons	1427 Dutchess	C
Pacificana	1480 Esquimault	C
Seastrand	150 24th	C
Sparaway	235 Keith Rd	C
Sunset Mariner	1455 Dutchess	C
Tiffany Place	460 14th	C
Waterford House	1972 Bellevue	C
Municipal Works Yard ( )		
Municipal Works Yard	3755 Cypress Bowl Rd	C
Paint Dealers - Retail (5231)		
Howard's Paint & Wallpaper	1491 Marine	S
Simpson Home Hardware	1750 Marine	S
Paint Dealers - Whol (5198)		
General Paint	1029 S Park Royal	S
Pest Control - Exterminating & Fumigating (7342)		
A-1 Professional Pest Services	6-1742 Marine	S
Affordable Exterminators	4327 Erwin Dr	S
Gator Pest Control	922-3355	S
North & West Van Pest Control	640 St Andrews Rd	S
Printers (2700)		
Quill Printing	250-1425 Marine	S
Writings	873 Park Royal North	S
Refrigerating Equipment - Supplies & Parts - Whol & Mfrs (5078)		
Envirotech	3810 Marine	S
Research Laboratories (8733)		
Hatfield Consultants	1571 Bellevue	S
Environment Canada	4195 Marine	S
Environment Canada	4160 Marine	S
Dept. of Fisheries & Oceans	4160 Marine	S

Figure 4.3 Fixed Facilities With Dangerous Goods In West Vancouver

		Status*
Retail Trader - Garden Supplies (5261)		
Avant Gardener	1460 Marine	S
M.S.G. Enterprises	956 Park Royal	S
Retail Trader - Hardware (5251)		
Jim's West Van Hardware	2474 Marine	S
Tidley Lock & Key	1016 Park Royal	S
School (8211)		
West Van Secondary	1750 Mathers	C
Service Stations - Gasoline & Oil (5541)		
Ambleside Chevron	1613 Marine	S
Ambleside Esso	1890 Marine	S
Ambleside Self Serve	1490 Marine	S
Chevron Canada	1613 Marine	S
Chevron Park Royal	720 Park Royal North	S
Circle Service Management	1890 Marine	S
Cypress Park Mohawk	4370 Marine	S
Dundarave Motors	2505 Marine	S
Dunston Enterprises	1490 Marine	S
Herko Sales	1503 Marine	S
Horseshoe Bay Esso	6390 Bay	S
I & F Enterprises	1305 Marine	S
Marine & 15th Esso	1503 Marine	S
Mason's APM Services	3690 Westmount Rd	S
Petro Canada Products	675 Marine	S
Service Patrick R. & Fagerlund J.	4370 Marine	S
Surfside Service	2196 Marine	S
West Van Esso	1392 Marine	S
West Van Shell Service	1305 Marine	S
Westmount Chevron Service	2690 Westmount Rd	S
Yamashita Tsutomu	2505 Marine	S
Shipwright (3730)		
Thunderbird Shipwright	5776 Marine	S
Storage Yard (4225)		
Vancouver Wharves	Foot Capilano Rd	S
Towing & Tugboat Service (4492)		
Mercury Launch & Tug	6695 Nelson	S
Water Treatment Equipment Service & Supply ( )		
Clear N Fresh Water Systems	705-2025 Bellevue	S

*S = Suspected Dangerous Goods
C = Confirmed Type & Quantity of Dangerous Goods

Sources: West Vancouver Fire Department, West Vancouver Listing of Licensed Businesses, B.C. Tel Yellow Pages, Standard Industrial Classification (SIC) Codes.

Based on the limited information currently available, West Vancouver fixed facilities that present the greatest public risks from dangerous goods are assumed to include the following:

1. B.C. Ferry Terminal at Horseshoe Bay, where a large number of dangerous goods may be found in trucks over the course of a year.

2. Fisheries & Oceans Laboratories at 4160 Marine Drive contain a variety of compressed gases, solvents, cyanide products, acids, and radioactive materials in research quantities.

3. Auto service stations on Marine Drive.

For some industries, chemical uses may vary widely. Some of the higher risk facilities listed in Figure 4.2 provide information on dangerous goods to the local Fire Department and incorporate safety features into facility design. These premises may pose less risk than other facilities that are unknown to the Fire Department. We caution these assumptions are tentative, and must be verified through a community-wide survey and full risk assessment to be considered conclusive.

4.2.2 Fixed Facility Dangerous Goods Volumes

Although some quantities of dangerous goods are known for a handful of premises, data are insufficient at present to estimate the total quantity of such commodities in fixed facilities within West Vancouver.

Although there are no large chemical manufacturers in the community, as there are elsewhere on the North Shore, several industry types exist within the community that could pose a significant threat to the public, such as research laboratories containing radioactive substances, PCB storage locations, and propane distribution centres. The quantities of dangerous goods in fixed facilities will not be known until a survey can be conducted.

4.2.3 Fixed Facility Accident Rates

Accident rates for fixed facilities have been predicted for a number of industries, primarily those directly involved with hazardous activities, such as petroleum product refining and nuclear power generation. The Major Industry Accidents Council of Canada (MIACC) is currently compiling a risk assessment methodology that will apply universally-acceptable accident rates to a broad range of business operations. Until the methodology has been substantially completed, expected in the spring of 1993, accident rates for dangerous goods at fixed facilities in the community are unavàilable.

4.3 ROAD TRANSPORT

Decades of research on hazardous material accidents have lead some experts to conclude that road transport presents the greatest risk of all transport modes (Rhoads, et al, 1986; Saccomanno, et al, 1987; TNO, 1988). Not only are vehicle accidents more numerous than rail, marine, or pipeline incidents, truck incidents are often more difficult in terms of emergency response.

Road transport characteristically offers many challenges to a risk assessment. Essential data on routes used, volumes shipped, and even the types of commodities on the roads are typically absent. Even if data could be collected for a given moment in time, changes in business opportunities and traffic patterns may mean significantly different risks over time.

4.3.1 Road Dangerous Goods Routes

One element of risk from road transport in West Vancouver that can be estimated from existing data is the location of transport routes. Most communities experience two types of dangerous goods traffic: 1) Through traffic, where the origin and destination of the shipment are situated outside the community, and 2) Local distribution traffic, where goods originate at or are delivered to premises within the municipality.

For West Vancouver, roadways used to transport dangerous goods can be predicted from current knowledge. Certainly, the TransCanada Highway and Highway 99 are known to carry such shipments. Figure 4.4 provides an illustration of the major routes presumed to be used to transport dangerous goods within West Vancouver. Through traffic is assumed to use one of two routes:

THROUGH TRAFFIC
- TransCanada Hwy 1 / Hwy 99
- Marine Drive / Taylor Way / TransCanada Hwy 1 / Hwy 99

Although local deliveries of gasoline, propane, and fuel oil in bulk amounts and chemicals in consumer quantities may occur on almost any commercial roadway, two routes in West Vancouver are assumed to carry more dangerous goods vehicles than elsewhere in the community:

LOCAL TRAFFIC
- Marine Drive
- 15th Street

Routes for through and local traffic in West Vancouver should be confirmed through direct observation.

The B.C. Transportation of Dangerous Goods Act authorizes municipalities to designate dangerous goods truck routes or to prohibit dangerous goods from some portion of the municipality. To date, West Vancouver has not designated specific dangerous goods truck routes within the municipality. Some routes on the North Shore have restrictions on dangerous goods traffic, such as the First Narrows Bridge.

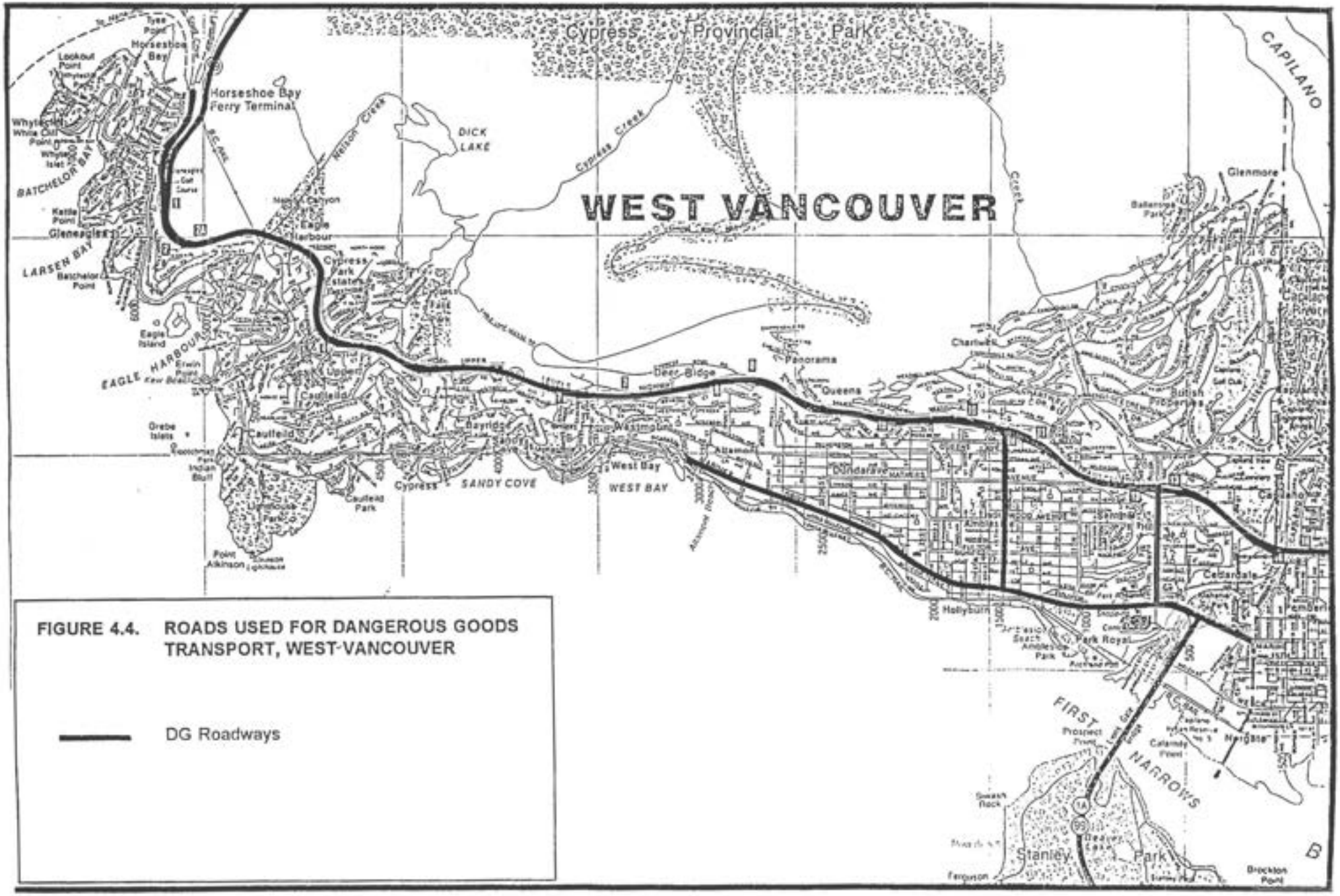


FIGURE 4.4. ROADS USED FOR DANGEROUS GOODS TRANSPORT, WEST VANCOUVER

DG Roadways

4.3.2 Road Dangerous Goods Volumes

There are currently no reliable data on the volume of dangerous goods transported by road within and through West Vancouver. To arrive at rough estimates of the volumes presented by such vehicles, two methods are applied below.

The first method uses available information on traffic counts to predict ball-park numbers of dangerous goods vehicles, a technique that has been used by the City of Portland, San Francisco Bay communities, and more recently, the Lower Mainland TDG Study, among others (Boydell, 1988; ICF Inc., 1985; Portland, 1982; TERA, 1984).

Research suggests that dangerous goods vehicles comprise a predictable percentage of truck traffic moving all goods. The Lower Mainland TDG Study suggested that five percent of all commercial trucks on the road at any given time are carrying dangerous goods, a somewhat conservative figure. Further, the TDG Study applied an average consignment load of five tonnes per vehicle, following a 1978 study completed for the Transport Canada Research and Development Centre, also considered to be conservative. Applying these assumptions, five percent of all trucks as dangerous goods vehicles and five tonnes per vehicle, to available traffic count information for West Vancouver roadways yields the results summarized in Figure 4.5.

Although this first method provides an estimate of truck traffic that is probably within an order of magnitude of actual traffic, the results are conservative and open to debate. A proper risk analysis of road traffic requires actual survey data.

The second method makes use of two available studies of dangerous goods vehicles for the TransCanada Highway, Route 1/99. These studies provide some estimate of dangerous goods traffic volume, but also suggest the dominant types of commodities being transported. Unfortunately, this technique provides only a partial picture; not all actual shipments are included.

The first report was compiled by the Lower Mainland TDG Study in 1987 after contacting a limited number of transporters of truck-load (bulk) quantities of dangerous goods. These industry contacts supplied the origin and destination of a large number of shipments throughout the Lower Mainland, and confirmed routes used for deliveries. The only route through West Vancouver reported in this survey was the TransCanada Highway.

In the second study, the Squamish Fire Department shed additional light on the road transport of dangerous goods through West Vancouver when they surveyed bulk road transport of dangerous goods through Squamish in May of 1991. Traffic data were collected through direct contact with road carriers passing through Squamish. Although the exact origins of these shipments are unknown, it seems reasonable to assume that all truck traffic recorded by Squamish passed through West Vancouver on the TransCanada Highway and Route 99.

The results of both the TDG Study and the Squamish report are summarized in Figure 4.6.

The Squamish data suggests that about 4,200 truckloads of bulk dangerous goods pass through West Vancouver on the TransCanada Highway annually, or about 15 trucks every working day of the year.

FIGURE 4.5. METHOD 1 ESTIMATE OF DANGEROUS GOODS ROAD TRAFFIC, WEST VANCOUVER

ROAD SEGMENT	ALL VEHICLES / YR	COMMERCIAL TRUCKS / YR (1)	DG VEHICLES / YR (2)	DG TONNES / YR(3)
1. Rte 99, 0.8 km north of Rte 1 at Horseshoe Bay	3,600,000	180,000	9,000	45,000
2. Rte 1/99 between Westmount and Caulfield interchanges near Cypress Creek	12,000,000	600,000	30,000	150,000
3. Rte 1/99, 0.2 km west of Taylor Way	15,000,000	750,000	37,500	187,500

Sources: B.C. Ministry of Transportation & Highways, 1992; West Vancouver Engineering Department, 1992.

Notes on Figure 4.5:

1 - Commercial truck traffic can vary considerably depending on such factors as local land use and available routes for delivery. The GVRD Urban Goods Movement suggests an average figure of 5 percent of all vehicles to represent commercial trucks.

2 - The Association of Bay Area Governments found in 1982 that between 1.2 and 5.1 percent of the trucks observed in a San Francisco survey were placarded for hazardous materials. A 1983 GVRD study found that dangerous goods comprise about 10 percent of all goods moving in the region. The U.S. Transportation Research Board estimates that between 5 and 15 percent of all trucks on the road at any given time are carrying dangerous goods. The 1987 TDG Study applied an average of 5 percent of all trucks to estimate the number of dangerous goods vehicles. In the absence of direct survey data, the 5 percent assumption has been applied in Figure 4.5.

3 - Dangerous goods may be carried in vehicles ranging in size from light to medium or heavy trucks, and in a variety of container volumes. A comprehensive study of Vancouver commerce completed for the Transport Canada Research and Development Centre in 1978 suggests that an average consignment load for all goods weighs about 5 tonnes. In the absence of direct survey results, we adopted a conservative figure of 5 tonnes per vehicle to represent the volume of all dangerous goods under this method.

FIGURE 4.6. METHOD 2 ESTIMATE OF DANGEROUS GOODS ON TRANSCANADA HIGHWAY (Vehicles per Year)

RANK	PIN	COMMODITY	TDG STUDY 1987	SQUAMISH STUDY 1991
1	2014	Hydrogen Peroxide	60	1,229
2	1230	Methanol	-	828
3	1073	Liquid Oxygen	-	820
4	1202	Diesel Fuel	-	528
5	1075/ 1978	L.P.G. / Propane	-	258
6	1203	Gasoline	-	168
7	1824	Sodium Hydroxide	9	150
8	2186	Hydrogen Chloride	380	147
9	2428	Sodium Chlorate	-	108
		TOTAL	449	4,236

Sources: Adapted from TDG Study Road Working Group, 1987; Squamish Fire Department, 1991; Environment Canada, 1984.

"-" means no data reported

To confirm these figures, B.C. Ferries offered to monitor dangerous goods traffic at the brake check station on the Upper Levels Highway just south of Horseshoe Bay. For four days in December, from a Tuesday through a Friday, a total of 36 dangerous goods vehicles used the facility. Of these, 23 vehicles were bound for Squamish, 12 headed for the ferry terminal, and 1 travelled into the Horseshoe Bay community (B.C. Ferry Corporation, 1992). B.C. Ferry cautioned that traffic volumes can vary widely throughout the year; a more comprehensive survey is recommended.

A third assessment was conducted specifically for this Preliminary Risk Assessment using available traffic counts from B.C. Ferry Corporation at Horseshoe Bay. The B.C. Ferry Corporation randomly inspects commercial vehicles once they board ferry vessels to check compliance with regulations. We reviewed 1,082 inspection reports prepared between January and October, 1992, to assemble a list of commodities known to have left the Horseshoe Bay Terminal and therefore assumed to have travelled by road through West Vancouver. This study offers the first evidence of less-than-truckload (LTL) shipments through the community. Again, the TransCanada Highway is the assumed route for these vehicles.

Figure 4.7 summarizes the top 15 commodities reported by number of vehicle inspections. Note that inspections were not possible for every commercial vehicle, and that some vehicles carried more than one commodity type.

FIGURE 4.7. TOP 15 COMMODITIES IN B.C. FERRY INSPECTIONS, Jan-Oct, 1992

RANK	PIN	COMMODITY	NUMBER OF VEHICLES
1	1072	Oxygen or Oxygen, Compressed	347
2	1001	Acetylene	154
3	1073	Oxygen, Liquid	112
4	1760	Corrosive Liquids, n.o.s.	103
5	1202	Fuel Oil	92
6	2974	Radioactive Materials, Special Form, n.o.s.	69
7	2794	Batteries, Wet, Filled with Acid	62
8	1263	Paint or Paint Related Material	47
9	1956	Compressed or Liquefied Gases, n.o.s.	39
10	1006	Argon, Compressed	32
11	1013	Carbon Dioxide	30
12	1824	Sodium Hydroxide, Solution	28
13	1066	Nitrogen	24
14	1075	Petroleum Gases or L.P.G.	21
15	1046	Helium, Compressed	20
		TOTAL	1,180

Source: B.C. Ferry Corporation, 1992.

The data shown in Figures 4.6 and 4.7 represent through shipments of dangerous goods, either to Squamish or to the ferry terminal at Horseshoe Bay. It is much more difficult to estimate local traffic, deliveries that originate or terminate in West Vancouver. The West Vancouver Fire Department estimate that local distribution of fuels alone amounted to more than 55 million litres in 1991. The 1991 totals for these principal fuels, including conversions from litres to the number of vehicles, are shown in Figure 4.8.

FIGURE 4.8. SUMMARY OF FUELS DISTRIBUTED LOCALLY IN WEST VANCOUVER, 1991

PIN	COMMODITY	LITRES	TONNES	VEHICLES
1203	Gasoline	53,000,000	42,200	950
1202	Diesel Fuel Oil	1,840,000	1,800	100
1978	Propane	560,000	325	40
	TOTAL	55,400,000	44,325	1,090

Sources: West Vancouver Fire Department, 1992; conversions from Environment Canada, 1984.

Combining all available data from Squamish and the B.C. Ferry Corporation with the local distribution data suggests that West Vancouver roadways experience at least 6,000 dangerous goods shipments each year. This estimate is considered significantly low in that it omits ferry traffic that was not included in inspections, less-than-truckload shipments to Squamish, and local distribution of chemicals other than fuels.

Figure 4.9 depicts available information on road transport in graphic form, acknowledging that such data are incomplete at present.

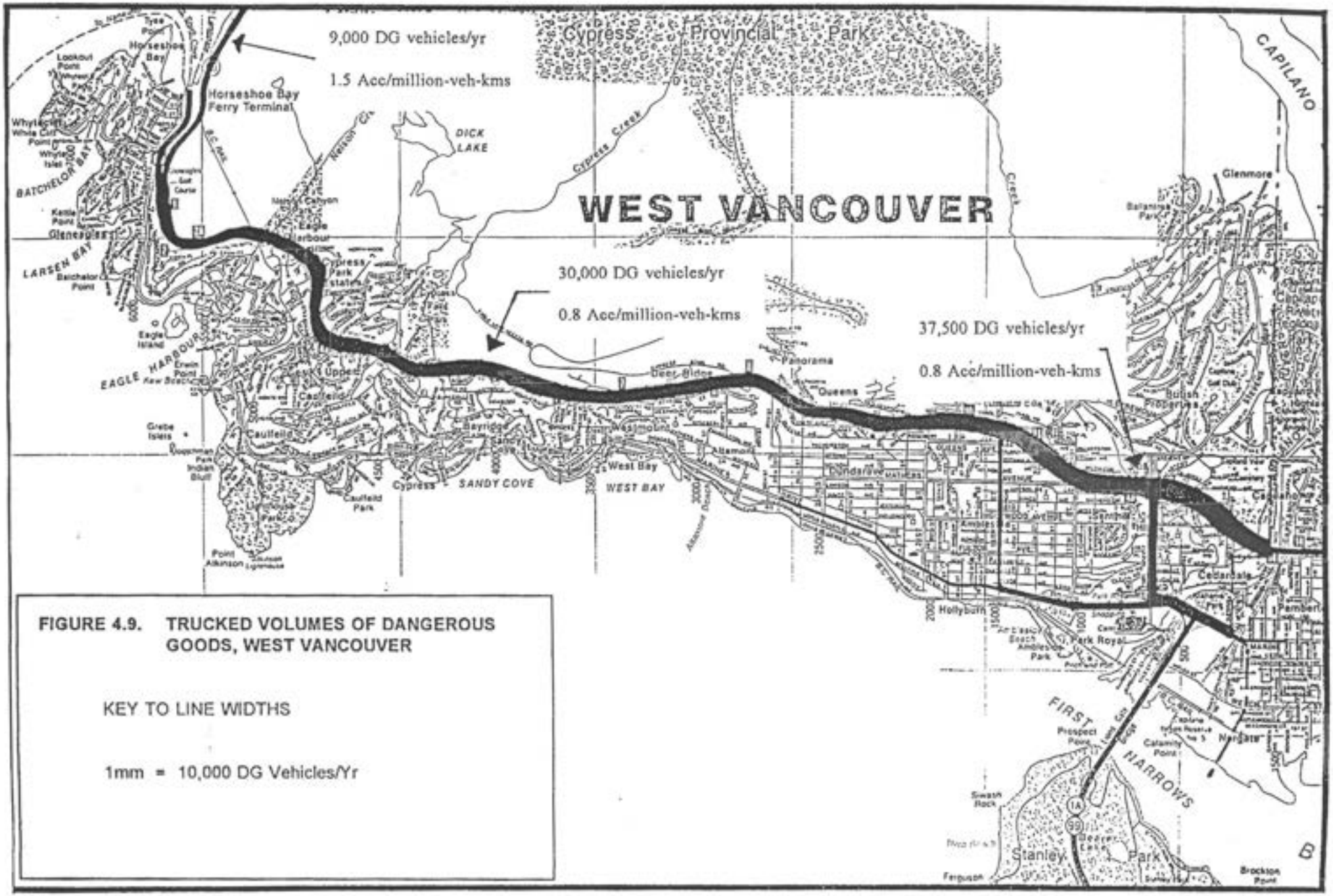
4.3.3 Road Accident Rates

Road accident rates represent the number of accidents on a given roadway divided by the number of vehicles that use that route. These rates are expressed in terms of the number of accidents per million vehicle-kilometres:

$$\text{Accident Rate} = \frac{\text{Number of Accidents}}{\text{Million Vehicle-Kms}}$$

Researchers recognize there are hundreds of factors that combine to determine the actual risk of dangerous goods transportation by road. Some of the factors related to the probability of a dangerous goods incident are listed below:

- Roadway types
- Number of lanes
- Number of intersections
- Roadway lighting
- Roadway visibility
- Road surface condition
- Traffic volume
- Traffic controls
- Terrain
- Vehicle speed
- Driver care
- Driver training
- Driver experience
- Vehicle condition
- Vehicle size
- Container type and size
- Time of day
- Time of year


9,000 DG vehicles/yr
1.5 Acc/million-veh-kms
30,000 DG vehicles/yr
0.8 Acc/million-veh-kms
37,500 DG vehicles/yr
0.8 Acc/million-veh-kms
WEST VANCOUVER
Cypress Provincial Park
CAPILANO
Horseshoe Bay
Horseshoe Bay Ferry Terminal
DICK LAKE
Cypress Creek
BATCHELOR BAY
LARSEN BAY
EAGLE HARBOUR
SANDY COVE
WEST BAY
Glenmore
Panorama
Queens
Caulfeild
Cypress
West Bay
Hollyburn
Park Royal
Cedardale
FIRST NARROWS
Stanley Park
Prospect Point
Siwash Rock
Brockton Point
FIGURE 4.9. TRUCKED VOLUMES OF DANGEROUS GOODS, WEST VANCOUVER
KEY TO LINE WIDTHS
1mm = 10,000 DG Vehicles/Yr

One simplifying assumption is commonly applied to the method of estimating risks: Vehicles carrying dangerous goods are exposed to the same hazards as all other vehicles on the road. This assumption allows us to use available accident rates for all vehicles to represent accident probability involving dangerous goods vehicles.

Figure 4.10 presents common accident rates for a variety of road types found within Canada.

FIGURE 4.10. ACCIDENT RATES BY ROAD TYPE

ROADWAY TYPE	ACCIDENTS / MILLION VEHICLE-KM
Freeway / Expressway	0.8
Provincial Highways	1.2
Provincial Secondary Roads	1.5
Urban Arterials	3.5
Other Roadways	4.7

Source: LaHorte / Williams & Associates, 1987.

Applying these accident rates to West Vancouver roadways yields:

- 0.8 accident per million vehicle kilometres for the TransCanada Highway
- 1.5 accidents per million vehicle kilometres for the Squamish Highway (likely a conservative number).
- 3.5 accidents per million vehicle kilometres for Marine Drive and Taylor Way

Accident rates for principal roadways in West Vancouver are indicated in Figure 4.9, shown previously.

4.4 RAIL TRANSPORT

The rail transport of dangerous goods on the North Shore is currently conducted by two railway companies:

- British Columbia Rail (B.C. Rail)
- Canadian National Rail (C.N. Rail)

The provincial carrier, B.C. Rail, enters the study area from the north, while the C.N. line crosses the Second Narrows from Burnaby in the south. Both rail firms interchange cars at the B.C. Rail yard in North Vancouver. Only B.C. Rail operates the single rail line that passes through West Vancouver.

4.4.1 Rail Dangerous Goods Routes

The rail line transporting dangerous goods in West Vancouver is shown in Figure 4.11, as described below.

B.C. Rail follows the coast of Howe Sound past Squamish and Lions Bay to enter the northwest corner of West Vancouver. The line essentially follows the shoreline from Horseshoe Bay through the West Vancouver neighbourhoods of Caulfield, West Bay, Dundarave, and Ambleside, to the waterfront and the end of the B.C. Rail main track at Pemberton Avenue in North Vancouver.

Just east of the First Narrows Bridge, near Vancouver Wharves, is the B.C. Rail Terminal Yard. Rail cars occasionally remain at this location for varying periods of time between pick up and delivery. In general, dangerous commodities are not permitted to remain in yards for more than 48 hours. A connecting line continues along the waterfront to meet the C.N. Rail interchange yard between Bewicke and Forbes at the Mission Indian Reserve.

Along the 14 kms of track between the First Narrows Bridge and the Rail Tunnel at Horseshoe Bay, the B.C. Rail line has 15 level crossings at the following roadway locations, listed from east to west:

1. 13th Street
2. 14th Street
3. 15th Street
4. 16th Street
5. 18th Street
6. 19th Street
7. 24th Street
8. 25th Street
9. 27th Street
10. 28th Street
11. Sharon Drive
12. Burkehill Road
13. McKenzie Drive
14. The Dale
15. Kew Road

4.4.2 Rail Dangerous Goods Volumes

The TDG Study in 1987 found that 24 commodities represented nearly 95 percent of the total dangerous goods moved by rail throughout the Lower Mainland. Eleven of these products are known to be transported through West Vancouver.

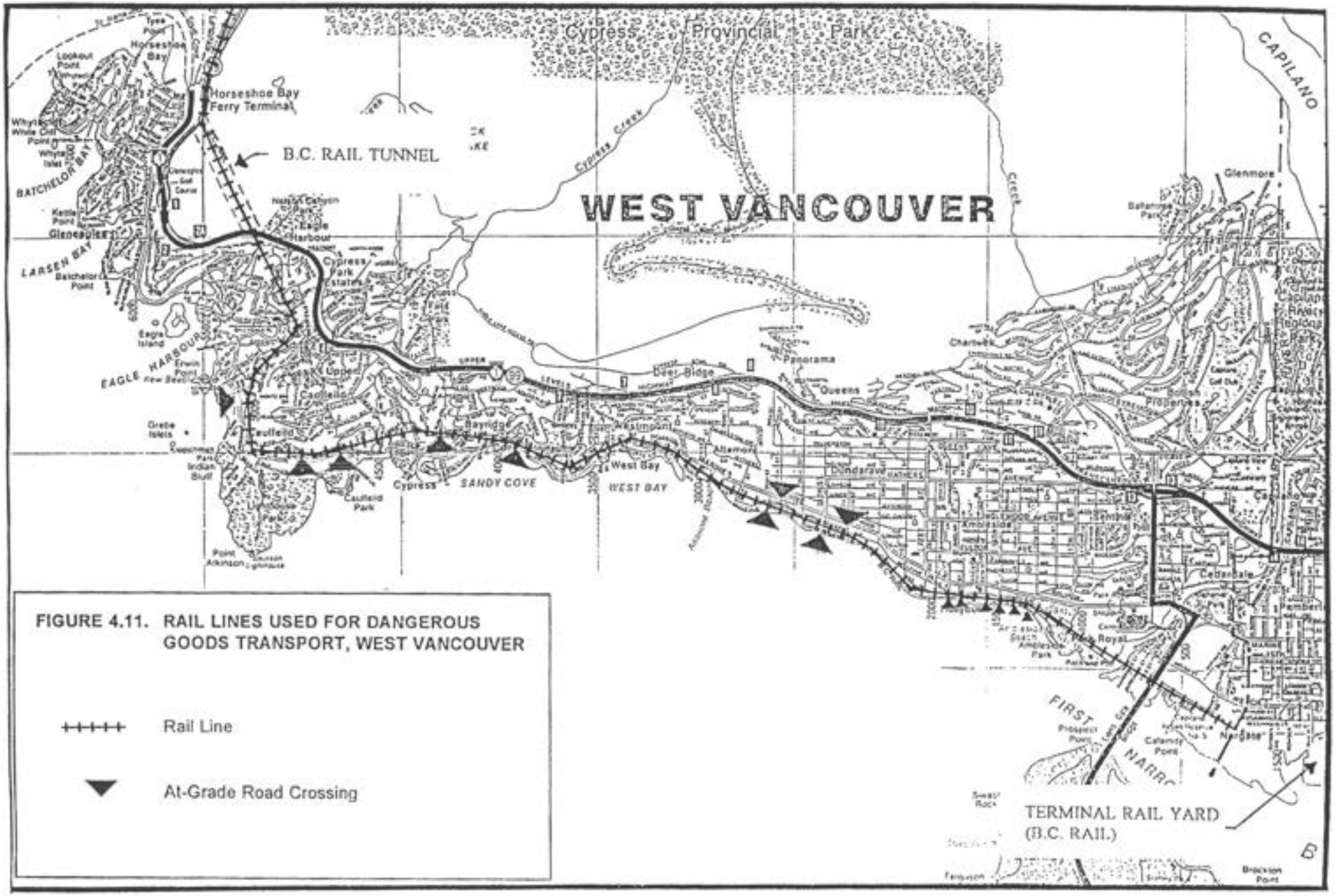


FIGURE 4.11. RAIL LINES USED FOR DANGEROUS GOODS TRANSPORT, WEST VANCOUVER

Rail Line

At-Grade Road Crossing

In May of 1991, the Squamish Fire Department researched the transport of dangerous goods by rail through Squamish, and presumably through West Vancouver. Traffic data were collected from B.C. Rail, who supplies regular reports on the volumes of dangerous goods transported through West Vancouver. The results of both the TDG Study and the Squamish report are summarized in Figure 4.12.

FIGURE 4.12. COMPARISON OF RAIL NETWORK DATA (Car Movements per Year)

COMMODITY	TDG STUDY 1987	SQUAMISH STUDY 1991
Propane / L.P.G.	1,196	2,466
Diesel Fuel Oil	-	1,869
Sodium Hydroxide	472	619
Methanol	-	* 507
Chlorine	286	344
Sulphur Dioxide	35	151
Sodium Chlorate	-	100
Hydrogen Peroxide	32	90
Sulphuric Acid	1	43
Sodium Hydrosulphide	-	34
Hydrochloric Acid	6	4
TOTAL	2,028	6,227

Source: Adapted from GVRD TDG Study, 1987; Squamish Fire Department, 1991; Conversions from Environment Canada, 1984.

* In 1992, the Squamish Fire Department advised that methanol shipments increased to this level from 0 at the time of their initial study in 1991.

Propane and LPG shipments head the list in terms of the number of bulk rail cars travelling through West Vancouver, averaging about 2,500 cars per year or about 7 cars per day. More than 500 cars of extremely toxic gases, such as chlorine and sulphur dioxide, were also carried through the community in 1991.

4.4.3 Rail Accident Rates

A number of factors affect the probability of a rail accident, such as a rail crossing incident, collision or derailment. Such factors include (Sonntag, 1988):

- Auto Traffic at Crossings
- Condition of Rail Cars (rolling stock)
- Employee Supervision
- Employee Training
- Length of Train
- Pattern and Number of Rail Lines
- Rail Traffic
- Roadbed Condition
- Standard Operating Procedures
- Track Condition
- Train Speed

Rail firms record three types of accidents. First are the derailments, where wheels of a car leave the designated track. Often, derailments at low speeds leave the cars upright and cause no damage to the containers themselves. Derailments at faster speeds or where embankments are present may result in upset of the cars and a greater likelihood of container breach. Second are collisions, where one rail car or engine strikes another. These events can also cause container breach, especially when cars travel at greater speeds. The third accident type involves automobile vehicles where rail lines cross roadways. These crossing accidents can lead to derailment and breach of containers, again depending on the speeds involved.

Although trains and their cargoes are exposed to a number of hazards along any route, relatively few types of events have actually caused accidents in the past. Rail accidents throughout Canada have been steadily declining over the last ten years, due to improved track testing, maintenance programs, rolling stock, and better safety measures throughout the system (Transport Canada, 1990).

The most appropriate accident rate to apply to the B.C. Rail line through West Vancouver would be derived from the historical record for that line, tempered by recent improvements in the system. In the absence of such a figure, a rail accident rate used for the extensive Toronto rail study in 1987 was adopted for demonstration purposes. Throughout the Toronto region, which included many of the same rail conditions and operations found in West Vancouver, the accident rate was found to be 0.0196 accidents per million car-kilometres (Concord, 1987).

4.5 MARINE TRANSPORT

Marine shipments of dangerous goods in the vicinity of West Vancouver are governed in part by the Canadian Coast Guard and the Vancouver Port Corporation, a crown corporation operating under Transport Canada. In addition to waterway activity, the Vancouver Port Corporation also owns and controls a number of land parcels adjacent to Burrard Inlet, some of which are leased for industrial activity.

4.5.1 Marine Dangerous Goods Routes

The major components of the marine transport network for dangerous goods within the vicinity of West Vancouver include a transit route beneath the First Narrows Bridge and through the northern half of English Bay. In addition, Horseshoe Bay in West Vancouver holds the Government dock and B.C. Ferry terminal, where dangerous goods are known to be trans-shipped.

The majority of the marine traffic transiting English Bay consists of tug-barges and coastal tankers operating between Vancouver and other ports in B.C., Puget Sound, and Alaska (Sandwell, 1991).

Chemical tankers with total capacities varying from 7,500 to 40,000 DWT call at the Port 10 to 12 times per month. Petroleum tankers visit the Port of Vancouver once or twice a month. Refined product carriers range in capacity from 30,000 to 40,000 deadweight tonnes (DWT), and crude oil carriers range from 40,000 to 60,000 DWT. Liquefied petroleum gas cargo shipments in specialized foreign carriers no longer use the Port of Vancouver (Sandwell Swan Wooster, 1988).

Coastal vessels carry dedicated tanks, rail cars, and vehicle traffic along the coast of B.C. to Alaska and other U.S. ports. Railcar ferries operating out of the Port are designed to carry, on average, 25 standard railcars (Sandwell Swan Wooster, 1988).

Tugs and barges also operate along the coast. Barges carrying refined petroleum products range in size from 4,260 bbls. capacity and 100 feet in length to the largest U.S. barges of 116,000 bbls. capacity and 400 feet in length. Chemical barges range in size from about 1,800 DWT capacity and 200 feet length to about 5,000 DWT capacity and 270 foot length. Chemical barges carry caustic soda in hull tanks, sodium chlorate in hull and deck tanks, and chlorine in deck tanks (Sandwell Swan Wooster, 1988).

B.C. Ferries provides regular vehicle and passenger service from the terminal at Horseshoe Bay. Trucks carrying certain dangerous goods in quantities designated under the IMDG Code are allowed on the ferries. Occasional shipments of explosives use the Government Wharf, also located at Horseshoe Bay.

The principal marine terminals in the vicinity of the District of West Vancouver, and the nearest neighbour terminals used to transport dangerous goods, are listed below and shown in Figure 4.13.

1. B.C. Ferry Corporation, Horseshoe Bay
2. Government Wharf, Horseshoe Bay
3. Vancouver Wharves, District of North Vancouver

In addition to these terminals, three anchorages are located just off the West Vancouver shore, designated as Anchorage 17, 18, and 19. These may be used by vessels carrying dangerous goods, but are usually only assigned to vessels if the 16 other anchorages in English Bay are occupied (VPC, 1992).

FIGURE 4.13. LOCATION OF MARINE ROUTES AND TERMINALS, WEST VANCOUVER

(18) ANCHORAGE (F) B.C. FERRY TERMINAL

(G) GOVT. DOCK (V) VANCOUVER WHARVES

MARINE ROUTE

4.5.2 Marine Dangerous Goods Volumes

The Port of Vancouver is Canada's largest deepsea port, and among the largest in North America in terms of foreign tonnage handled.

The largest marine freight terminal adjacent to West Vancouver is the Vancouver Wharves dock at the border with the District of North Vancouver. A summary of the bulk dangerous goods passing through this terminal in 1991 is presented in Figure 4.14.

All marine traffic transiting Burrard Inlet and English Bay are required to report to the Vancouver Port Corporation detailed information on the types and quantities of dangerous goods destined for or received from a Port terminal, as well as information on the containment vessel, whether barge, tanker or container. Thus, the Port Corporation has an excellent record of the annual volumes of hazardous commodities within the harbour. Permit data do not record, however, goods that remain onboard during a port visit.

Figure 4.15 summarizes the volumes of bulk dangerous goods moving through the Port of Vancouver within the five years between 1985 and 1989.

Gasoline, diesel and fuel oils are carried in "product tankers" designed for the transport of refined petroleum products. Segregated ballast tanks (so no product is discharged with the ballast) are required for product tankers greater than 30,000 DWT. Inert gas systems (to prevent the buildup of explosive atmospheres in the tanker) are required for all product carriers.

With the crude oil carriers and product tankers, a number of specialty carriers move chemicals through the Port of Vancouver. According to the most recently available figures from the Vancouver Port Corporation, sodium hydroxide heads the list of top marine shipments of liquid chemicals through the Port by all vessel types. Figure 4.16 presents a summary of these shipments.

The B.C. Ferry Corporation maintains a policy of transporting only those dangerous goods that are permitted through exemptions granted by the Canadian Coast Guard, and those which are carried by the Department of National Defence. In addition, one tank truck carrying propane is transported from Horseshoe Bay to Bowen island approximately every three weeks. Unreported quantities of dangerous goods are suspected of being transported on passenger ferries (Sandwell Swan Wooster, 1988).

Transport Canada inspectors, members of the West Vancouver Police, and other enforcers of dangerous goods regulations suspect that unauthorized truckloads of dangerous goods are being transported on passenger ferries from Horseshoe Bay. While such activity has not been confirmed to date, available B.C. Ferry data suggests that a number of carriers are at least attempting to board the ferries. Figure 4.17 presents the full list of vehicles that were refused access to passenger ferries at Horseshoe Bay from January to October, 1992.

FIGURE 4.14. DANGEROUS GOODS THROUGHPUT AT VANCOUVER WHARVES, 1991

TERMINAL	DANGEROUS GOODS	METRIC TONNES
Vancouver Wharves	Acetone	1,000
	Acrylonitrile	11,800
	Butanol	500
	Butyl Acrylate	2,200
	Dicyclopentadiene	2,200
	Dimethyl Formamide	1,000
	Epichlorohydrine	1,200
	Methanol	219,000
	Methyl Acrylate	700
	Methyl Methacrylate	600
	Styrene Monomer	10,500
	Toluene	5,200
	TOTAL	255,900

Source: Vancouver Port Corporation, 1992.

FIGURE 4.15. BULK DANGEROUS GOODS MOVING THROUGH PORT OF VANCOUVER
(Tonnes per Year)

COMMODITY	1985	1986	1987	1988	1989
Crude Oil	195,921	439,922	646,051	1,024,692	804,817
Gasoline	1,353,084	1,424,247	1,466,294	1,207,048	1,062,910
Fuel Oil	1,723,634	1,642,659	2,041,998	1,910.633	1,862,819
Misc. Petroleum Products	311	32,295	1,012	589	491
Liquid Chemical Products	1,450,805	1,435,588	1,750,763	2,121,666	2,231,597
Oils, Fats, Waxes	225,934	171,680	266,975	151,165	63,764
Tallow	62,358	76,819	76,907	110,400	101,234
TOTAL	5,012,047	5,223,210	6,250,000	6,526,193	6,127,632

Sources: Sandwell, 1991; Port of Vancouver, 1991

FIGURE 4.16. LIQUID CHEMICAL PRODUCTS THROUGH PORT OF VANCOUVER, 1991

COMMODITY	METRIC TONNES, 1991
Sodium Hydroxide (Caustic Soda)	1,008,000
Ethylene Dichloride	441,000
Methanol	399,000
Styrene Monomer	227,000
Sodium Chlorate Solution	188,000
Chlorine	49,000
TOTAL	2,312,000

Source: Vancouver Port Corporation, 1992

FIGURE 4.17. COMMERCIAL VEHICLES REFUSED BY B.C. FERRY CORP.
Jan to Oct, 1992

P.I.N.	PRODUCT NAME	TOTAL QTY.	CARRIER'S NAME
1001	Acetylene	2 cyl	Johnstone Boiler
1001 1072	Acetylene Oxygen	1 cyl 1 cyl	Air Products
1070 1073	Nitrous Oxide Liquid Oxygen	192 lbs 210 lbs	Peninsula Trans.
1072 1001 1006	Oxygen Acetylene Argon	10 cyl 10 cyl 1 cyl	#7631 MX
1993	Fabrigize	20 L	Bobcat
2031	Nitric Acid	100 lbs	Squamish Frt.
1866 2127 1896	Acetone Methylethylperoxide Resin Solution	na	B. Mathers
1202	Ridgecoat	6 drums	Island Farms
1978	Propane	2 500-lbs cyl	Tom Tooley Trucking
1073 2831 1263 1263 2794 1072	Liquid Oxygen Trichlorethane Paint Thinner Paint Thinner Batteries Oxygen	145 L 123 lbs 14 lbs 4-4 L cans 200 lbs 11 cyl	Squamish Frt.

P.I.N.	PRODUCT NAME	TOTAL QTY.	CARRIER'S NAME
1073 1072	Liquid Oxygen Oxygen (Comp.)	1 cyl 5 cyl	Comox Valley
1090	Acetone / Polyester Resin	5 gal each	#2523-VC
1978	Propane	80 lbs	#0789VY
9148	Sodium Phosphate Tribasic	20 kgs	Heidis Janitors
2428	Sodium Chlorate Solution	15,000 L	ICX
1230	Methylhydrate	36 - 1 L	Blue 1-ton 9916VN
1255	Shell Indusol Naptha	1025 L	Overland Freight
1263	Paint (Primer)	275 lbs	Seakand Marine Frt.
1268	Petroleum Distillates	625 lbs	Crestliner
1203	Gasoline (tidy tank)	na	The Tree People
1073	Liquid Oxygen and other goods	na	Comox Valley
1993	Flammable Liquid	205 L	Gibsons Bldg. Supp.
1760	Corrosive Liquids	na	Comox Valley
1005	Ammonia	na	Tofino Transp. Ltd.
1075	L.P.G.	20 lbs	B.C. Telephone Co.
1428	PCB Test Kit	1 kit	Comox Valley
1977	Nitrogen	5 cyl	Kannox
1049	Hydrogen	na	Western Research

na = data not available

4.5.3 Marine Accident Rates

During the 1987 Lower Mainland TDG Study, the Marine Subcommittee ranked the water area near the First Narrows Bridge among the highest category of accident probability in the study area, considering such factors as (Sonntag, 1988):

- Tidal Patterns
- Incidence of Fog
- Congestion of Vessels
- Maneuverability
- Draft Restrictions
- Currents

The States/British Columbia Oil Spill Task Force, after studying a number of pollution incidents concluded that several significant problems persisted in oil transportation management, including (States, 1990):

- Inadequate personnel training and qualifications
- Shortcomings in vessel design and integrity
- Insufficient traffic management
- Gaps in regulatory oversight
- Incomplete cost recovery opportunities

Although these results were expressed with the oil transportation industry in mind, similar problems can be expected within chemical shipping activities.

Sandwell recently conducted a study of tanker risks for the Vancouver Port Corporation and derived the accident rates shown in Figure 4.18.

FIGURE 4.18. TANKER ACCIDENT RATES (Accidents per 10,000 Port Calls)

Accident Type	Overall Tankers	Crude Tankers	Petroleum Tankers	Chemical Tankers	Coastal Tankers	Tanker Barges
Collisions	1.0	0.8	1.1	1.3	1.0	1.5
Groundings	4.0	3.4	4.0	4.8	3.8	1.0
Strikings	7.0	4.6	7.4	8.8	7.4	7.5
Fires/ Explosions	2.0	1.7	2.2	2.2	1.9	0.5
Structural Failures	0.5	0.6	0.5	0.5	0.4	1.5
TOTAL	14.5	11.0	15.1	17.5	14.4	12.0

Source: Adapted from Sandwell, 1991.

4.6 PIPELINE TRANSPORT

The transport of dangerous goods by pipeline is a frequently overlooked element of a community risk profile. Of several U.S. studies reviewed, few dealt with pipelines in any detail and many failed to acknowledge them at all.

We contacted the major natural gas distribution company operating on the North Shore, B.C. Gas, for information on the volumes and risks of this mode of transport. While they cooperated with our research, they cautioned that the movement of liquid or gaseous products through piping systems is so different from vehicle transport that comparisons are difficult.

4.6.1 Pipeline Routes

B.C. Gas carries natural gas to more than 40,000 customers on the North Shore through about 700 kms of distribution pipelines. Routes for the natural gas system are shown in Figure 4.19. Natural gas is delivered to the North Shore by way of a new 24-inch trunk line across the Second Narrows Bridge. High pressure lines operating at 1,200 kPa (175 psi) transport the gas to a number of district regulator stations located throughout the North Shore, where pressure is reduced to about 400 kPa (60 psi).

Within West Vancouver, B.C. Gas reports about 8.0 kms (5 mi) of high pressure pipeline. Four district regulator stations are maintained within West Vancouver at the following locations:

1. McGuire Avenue at Lawa Avenue
2. Marine Drive at the Capilano River
3. 11th Street at Mathers Avenue
4. 22nd Street at Mathers Avenue

Smaller service pipes feed gas to above-ground meters outside buildings being served. In general, trunk and distribution lines follow the street systems throughout the urban and rural areas. Virtually all piping facilities are buried underground.

4.6.2 Pipeline Volumes

The B.C. Gas delivery system is designed to deliver a maximum of 126,00 cubic metres of gas per hour to the North Shore. Minimum load is typically 20 percent of this peak rate. Annual volumes depend on demand and fluctuate from year to year.

4.6.3 Pipeline Accident Rates

Accidents involving natural gas piping typically fall into three categories:

1. Third Party Damage. The rupture of an underground main or service piping generally correlates with excavation activity by a third party, that is, not employees of B.C. Gas. Although B.C. Gas has an active warning and prevention program to address excavation risks, about 100 such incidents occur each year throughout the Lower Mainland.

2. Underground Leakage. Leakage from underground pipe can occur where corrosion or mechanical joint problems exist. About 85 percent of such leaks are detected by sensitive equipment used by B.C. Gas to continually survey their distribution system. The remaining leaks are reported by the public or other agencies.

3. Impact Damage to Gas Meter. B.C. Gas protects above-ground meter sets that are vulnerable to vehicle traffic by installing large steel posts. Nevertheless, a small number of vehicle accidents lead to broken gas meters and leakage each year. Such events invariably require immediate evacuation of the local building or area.

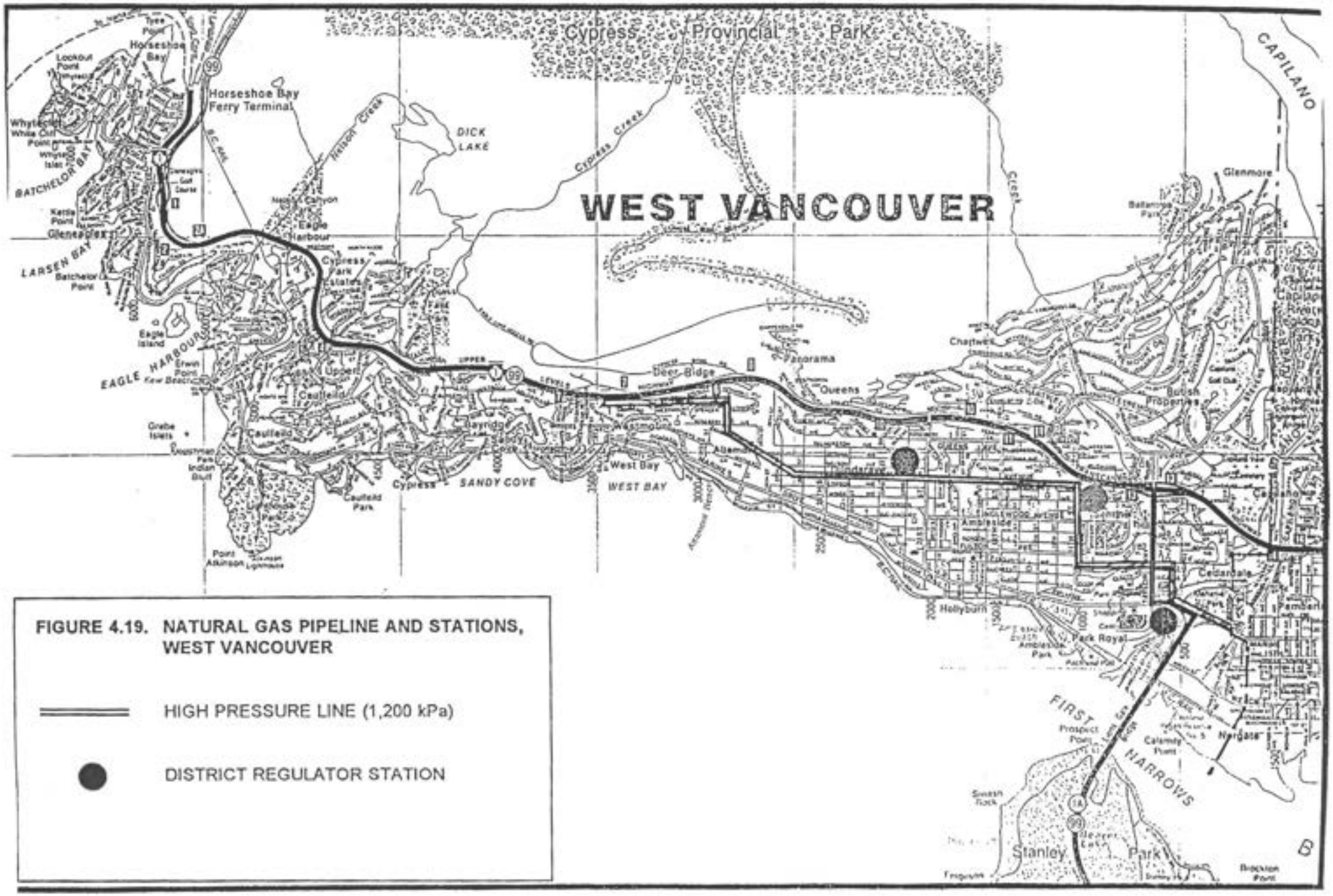


FIGURE 4.19. NATURAL GAS PIPELINE AND STATIONS, WEST VANCOUVER

HIGH PRESSURE LINE (1,200 kPa)

DISTRICT REGULATOR STATION

The effects of an earthquake in the Lower Mainland on the pipeline system are difficult to predict without more information. The new 24-inch trunk line carrying natural gas to the North Shore across the Second Narrows Bridge contains a pressure-sensitive valve that would automatically halt product flow if activated.

B.C. Gas reports no deaths, injuries, or fires related to gas distribution incidents since the North Shore first received natural gas in 1956. Building fires, gas leakage within a building, and malfunctioning appliances have been noted as related to customer-owned premises and equipment.

The Netherlands Organization for Applied Scientific Research has adopted a universal accident frequency for all pipelines of 0.00001 pool fires or gas cloud explosions per 100 m of pipeline length per year (TNO, 1988).

4.7 EMERGENCY PREPAREDNESS

Several risk models recognize the influence emergency preparedness can have on dangerous goods risk. Although a quick response does not affect accident probability, it has been known to reduce consequences in some instances. Through evacuation of those within zones of hazard, by containing spilled liquids, or by controlling the spread of fire, among other activities, emergency response crews have reduced the adverse effects of a large number of dangerous goods accidents.

In spite of the perceived benefits, accounting for emergency preparedness in a risk assessment remains a tenuous proposition. Several researchers have attempted to assign risk reduction factors given the presence of emergency plans, trained response crews, and appropriate equipment (Abkowitz, 1992; Alberta, 1986; LaMorte, 1987; TNO, 1988). A universally acceptable method, however, has yet to be proposed for direct use in risk calculations. In the absence of such a method, emergency preparedness can only be represented by qualitative descriptions.

4.7.1 Community Emergency Preparedness

The West Vancouver Fire Department offers the community's primary response capability for all types of dangerous goods incident. The Fire Department operates a Rescue Truck (Apparatus # 40), which responds to all hazardous material incidents. An inventory of the truck shows the hazardous material response equipment, listed in Figure 4.20.

The Fire Department receives calls from the B.C. Ferry terminal at Horseshoe Bay, and responds to road incidents on the Squamish Highway in unincorporated areas. West Vancouver does not currently have a mutual aid agreement with the Lion's Bay volunteer department.

Fire officers are provided dangerous goods response training through established educational programs offered by the Provincial Emergency Program, Emergency Preparedness Canada, and the Association of American Railroads in Colorado. The officers then train other Fire Department staff. Local industries, such as B.C. Rail, also offer training opportunities and emergency exercises.

During emergency conditions, the West Vancouver Fire Department will consult a variety of experts, including the federal CANUTEC program, B.C. Rail, and Canadian Oxy in North Vancouver, depending on the nature of the incident. For road accidents, the Fire Department will identify the carrier and contact the shipper, where possible. Local weather and wind data sources include Environment Canada and the GVRD.

Community response to dangerous goods accidents may include the West Vancouver Police Department. Police conduct evacuation procedures, where necessary, under the direction of the commanding fire officers. Evacuation zones are determined by the Fire Department in all cases. They are authorized to ticket offenders under the Provincial TDG Act.

Four West Vancouver Police officers have received Commercial Transport instruction through the B.C. Ministry of Transportation and Highways), which includes dangerous goods training. Other officers have a basic knowledge of hazards and response procedures. The Police response team has six sets of self contained breathing apparatus (SCBA), located at the Fire Hall. Senior coordinating officers attend monthly North Shore emergency planning meetings and participates in periodic exercises.

The West Vancouver Public Works Department responds to dangerous goods incidents when requested, but they lack a sophisticated response program. They have a limited amount of dyking materials, booms, and small sacks of absorbent for oil spills from motor vehicle accidents. They will spread sand or gravel and assist the Fire Department and the Police Department. They have pumped out creeks due to spills from oil tanks. Public Works personnel receive no specific training in dangerous goods handling or response.

4.7.2 Industry Emergency Preparedness

Although some fixed facilities within West Vancouver are known to have prepared fire safety plans, it is difficult to estimate the number of premises that specifically address emergency response to dangerous goods incidents. Currently, response plans are in place for Park Royal South, the Public Works Yards, and the school board building maintenance facilities. B.C. occupational health and safety regulations require employers to plan for worker protection from chemical releases, including warning systems and first aid. The extent of compliance among West Vancouver business and industry suspected of holding and handling dangerous goods has not been examined.

Even where emergency plans have been prepared, however, the level of preparedness cannot be predicted. In a sample of 157 industry emergency response plans reviewed by the TDG Directorate of Transport Canada, 65 percent were found to be inadequate (Kittle, 1990).

Shippers and road transporters of certain high hazard dangerous goods are required by federal and provincial TDG regulations to prepare emergency response plans. Some of the more prominent carriers in the Lower Mainland, such as ICX and Trimac, are known to have plans, trained personnel, and response equipment. The extent of preparedness among other types of carriers, such as general freight haulers and couriers, is questionable. Although no statistics are available on emergency planning among all classes of road transporters, we suggest that emergency plans are the exception rather than the rule among road carriers.

Response to rail incidents within the boundaries of West Vancouver would fall to B.C. Rail, which has trained crews and the appropriate heavy equipment at their Terminal Yard. B.C. Rail has developed an emergency response plan and participates in planning exercises with the North Shore communities from time to time.

For marine accidents, the Vancouver Port Corporation (VPC) has an emergency plan with a scope from Pt. Atkins south to the U.S. border and all waters east, except the Fraser River. The plan covers all terminals and all types of incident. Although the VPC does not have a fire department (it contracts with local municipalities), it acts literally like a municipality, reviewing development plans and enforcing safety provisions. The VPC has its own police force of 40 personnel, with 9 boat crew and 3 boats. The Security force has prepared its own sub-plan.

Four VPC Harbour Masters have extensive training in dangerous goods, having completed emergency preparedness courses and Master mariner courses. VPC clean-up equipment is minimal, including absorbants, pads, small quantities of first response equipment and 1,000 ft of boom. The VPC relies on Burrard Clean to provide environmental protection following a spill. Focusing on oil spills, the stockpile of response equipment immediately available to the Port of Vancouver is presented in Figure 2.18.

Product recovery activities for marine accidents are limited to spills of oil and other floating liquids. Most bulk chemicals would evaporate to the atmosphere or would mix or sink too rapidly to permit recovery. Focusing on oil spills, the stockpile of response equipment immediately available to the Port of Vancouver is presented in Figure 4.21.

To respond to natural gas pipeline incidents, B.C. Gas has prepared an emergency plan, communications procedures, trained crews, and specialized equipment. Distribution shut-off valves provided for emergency isolation in a serious event are inspected and maintained annually. Radio-equipped crews are available during workdays, and emergency crews are on stand-by around the clock. Emergency crews are given annual refresher training, covering such topics as analysis of leakage situation, live gas leakage repairs, and fire fighting techniques. B.C. Gas also provides training to local fire and police departments to assist in coordinating a response to a natural gas incident.

FIGURE 4.21. BOOMS AND SKIMMERS AVAILABLE TO THE PORT OF VANCOUVER

Burrard Clean		
Boom	1,920 m 1,829 m 610 m 304 m	0.8 m Versatech Zoom Boom 0.5 m Inshore Boom 0.6 m Harbour Boom 0.6 m River Boom
Skimmers	1 1 1 2 2 1	12.8 m Bennett Mark 6D Skimmer 15.2 m Marco Class VIIB Skimmer Oil Mop Mark 9DP Morris Industry MI-2 Skimmer Komara Mini Skimmers Scavenger Skimmer
Canadian Coast Guard		
Boom	1,000 m 1,220 m 308 m 305 m 500 m	0.9 m Bennett Boom 0.6 m Inshore Boom 0.5 m Versatech Boom 0.4 River Boom 0.8 m Vikoma SeaPack
Skimmers	1 2 1 1 1 2	Slicklicker Komara Mini Skimmers Morris Industry MI 30 Skimmer Semi-Portable Oil Mop Portable Oil Mop GT-185 Skimmers
Vancouver Port Corporation		
Boom	305 m	0.5 m Inshore Boom
Clean Sound		
Main Skimmers	3	JBF Skimmers

Source: Sandwell, 1991.

4.8 CONCLUSIONS

Because of the tentative and incomplete nature of the data presented above, few conclusions can be drawn with confidence. Yet, the purpose of this early assessment is, in part, to identify what we know and what further information is required. This section offers a limited view of the risks presented by dangerous goods to the community as a whole, identifies a few locations that deserve further attention, and lists the data required to complete a risk assessment for West Vancouver.

4.8.1 Overall Level of Risk

Although no universally acceptable measure of community risk yet exists, the overall level of risk from dangerous goods in West Vancouver can be placed in some perspective through the following observations.

- There are no primary chemical producers within the municipal boundaries, and the total number of about 100 fixed facilities presumed to contain dangerous goods is less than for other communities with a greater industrial base.

- Road transport of bulk commodities is largely limited to through traffic using the TransCanada Highway / Highway 99, estimated at about 6,000 vehicles per year, or 20 trucks per day. Although data are lacking, there are no indications that a significant number of trucks make use of urban arterials, such as Marine Drive. Road traffic has historically shown the highest accident rate among all transport modes.

- A relatively large number of hazardous shipments travel by rail through the community, annually bringing more than 6,000 rail cars of bulk dangerous goods within a hundred meters (in some locations) of schools, high-rise apartments, and commercial centres. Although rail incidents are rare, and the release of product from modern tank cars even more so, the proximity of these high volume hazardous materials to densely populated areas in West Vancouver indicate severe consequences should an accident occur.

- The total tonnage of fuels and liquid chemicals shipped past West Vancouver by marine traffic in English Bay far outweighs the combined dangerous goods by other modes. Marine accidents seldom occur and the prospect of community impact must be considered a very low probability.

One comparison of overall community risks in available literature comes from the 1988 TDG Study for the Lower Mainland. Based on limited research and incomplete data, the TDG Study attempted to compare and rank 11 GVRD communities in terms of the total volume of bulk dangerous goods being transported within each. The results are duplicated in Figure 4.22.

As an additional point of reference, the City of Edmonton, Alberta, reports more than 8,000 fixed sites of concern, and greater than 200 truckloads and 100 rail tank cars passing through the city each day (MIACC, 1992).

FIGURE 4.22. TDG STUDY COMPARISON OF GVRD MUNICIPALITIES, 1986

MUNICIPALITY	TONNES (1986)
1. Burnaby	2,870,053
2. North Vancouver	2,297,202
3. Coquitlam	1,663,168
4. Port Moody	1,376,571
5. Surrey	951,000
6. New Westminster	824,630
7. Port Coquitlam	735,669
8. Vancouver	424,488
9. West Vancouver	152,741
10. Delta	145,084
11. Richmond	21,875

Source: Boydell, 1988.

We conclude from the available data that the overall risk from dangerous goods in West Vancouver is low, with the proviso that certain key locations be acknowledged as moderate risks. These locations, or "hot spots" within the community are addressed below.

4.8.2 Hot Spots

In defining these hot spots, we looked for the close proximity of large volumes of high hazard commodities and sensitive populations or environmental habitat. Although accidents can occur virtually anywhere within the municipality, we intended to identify those locations that deserve special attention in terms of both prevention and response. The West Vancouver hot spots are, from east to west:

1. Taylor Way and Marine Drive. We currently lack conclusive data on the volume of chemicals transported by truck through this location, but the nature of the land uses and the presumed high accident rate convinced us a chemical release at this location could be likely and disastrous. Adjacent to this intersection one finds a number of commercial enterprises, office towers, close proximity to the Capilano River, and a movie theatre. More importantly, the number of motorists present at this location at any time of the day suggests that a great number of persons could be exposed, and most have limited opportunities of escape.

2. Ambleside. Rail operations bring more than 6,000 carloads a year of propane, chlorine, sulphur dioxide, and other dangerous commodities into this highly active and populated neighbourhood. Within a few hundred meters of the main line, one finds commercial shops, several high-rise apartments, a number of shoreline parks, an elementary school, and two senior citizen homes. While rail incidents are rare, the number of level road crossings in the Ambleside area suggests the likelihood of an accident is higher than elsewhere on the line.

3. Horseshoe Bay. The B.C. Ferry terminal in this community attracts a large number of commercial vehicles carrying dangerous goods in less-than-truckload quantities. Although bulk shipments of high hazard commodities use other means of marine transport, more than 1,000 dangerous goods vehicles per year are known to enter the terminal. As past incidents have tragically demonstrated, motorists in ferry line-ups can be readily exposed to commercial truck hazards. Still other dangerous goods trucks travel the local roads within the Horseshoe Bay community, carrying such products as gasoline and explosives. The restricted ability to evacuate this neighbourhood in the event of chemical release indicates a somewhat elevated level of risk.

Several other areas caught our attention and, although they perhaps cannot be classified as hot spots, deserve further consideration. These other locations include, from east to west:

- Vancouver Wharves operation at the border with the District of North Vancouver.
- Marine shoreline, in the event of a major oil spill.
- TransCanada Highway 1 where it passes the Westcot Elementary School and the Hillside Middle School.
- B.C. Rail main line where it passes near the Irwin Park Elementary School, the West Bay School, and the Caulfield Elementary School.
- B.C. Rail tunnel at Horseshoe Bay and sensitive environment at Nelson Creek, leading to Fisherman's Cove.
- Sea-to-Sky Highway leading to Lion's Bay and Squamish, and the unincorporated zone along the highway north of West Vancouver.

4.8.3 Data Gaps

At this preliminary stage of research, many questions about dangerous goods risk in West Vancouver remain unanswered. In this section, we identify gaps in on-hand data and attach a measure of importance to each. Figure 4.23 summarizes the current information needs related to the study in two categories: Data that are needed to perform even a rudimentary risk assessment, noted as "Required Data." Information that would contribute further to our understanding of risks from dangerous goods are listed in the right-hand column as "Additional Data."

FIGURE 4.23. WEST VANCOUVER DATA GAPS

REQUIRED DATA	ADDITIONAL DATA
COMMUNITY SETTING	
1. Residential population density within 1 km of selected hazardous sites.	1. Transient population within 1 km of selected hazardous sites by time of day, day of week. 2. Property values for selected locations.
FIXED FACILITIES	
1. Premises with dangerous goods, identified by type, quantity of largest container, total quantity on site, and storage/process activity.	1. Number of dangerous goods vehicles travelling through ferry terminal at Horseshoe Bay, including commodity types and container volumes. 2. Historical incidents for businesses similar to those present.
ROAD TRANSPORT	
1. Routes used for local distribution of fuels and chemicals. 2. Number of vehicles by product type, container volume, and route.	1. Origins and destinations of truck shipments using West Vancouver roadways. 2. Identity of carriers, shippers, and receivers of dangerous goods. 3. Historical incidents for road transport similar to that observed in community.

RAIL TRANSPORT	
1. Confirmation of assumed container volumes for bulk rail cars.	1. Number of less-than-carload shipments of dangerous commodities, by product type and container volume. 2. Details of operations at Terminal Yard, i.e., storage practices of rail cars and transloading to/from truck transport. 3. Roadbed and track condition and maintenance practices. 4. Historical incidents in Terminal Yard and main line.
MARINE TRANSPORT	
1. For terminals with dangerous goods: product type, quantity of largest on-shore containers, and methods for storage, handling, and transfer. 2. Capacity and normal volumes of dedicated chemical and fuel transport tankers and barges. 3. Capacity of common containers used for non-bulk shipments. 4. Number of port calls by marine vessels, by commodity type and volume. 5. Regular shipments of dangerous goods vehicles by ferry from Horseshoe Bay (e.g., propane to Bowen Island) by product type and container volume.	1. Number of dangerous goods vehicle visits at terminal per year, identifying commodity types and container volumes. 2. Historical incidents for vessels similar to those calling at Vancouver.
PIPELINE TRANSPORT	
All essential information is available.	1. Historical incidents in Lower Mainland to identify possible scenarios.

EMERGENCY RESPONSE	
All essential information is available.	1. Fixed facilities with dangerous goods that also have emergency plans in place, employee awareness programs, response teams, and response equipment. 2. Extent of emergency preparedness among road carriers of dangerous goods, accounting for the range of carrier types.

Most of the data required to complete a risk assessment are accessible with moderate effort, with two exceptions. Information on both fixed facilities and road transport will require direct contact or observation through an acceptable survey technique. Data required for the rail and marine modes of transport may require manipulation of existent information by B.C. Rail and the Vancouver Port Corporation, respectively.

Without detailed information on the types and quantities of dangerous goods in key facilities in West Vancouver, a risk assessment for this component cannot be undertaken. Several risk models are available to conduct such an assessment (refer to Appendix B) and, given the results of direct surveys, should provide interesting and valuable results. Data on fixed facilities would allow the community to focus prevention efforts on relatively high-risk operations, set priorities for emergency response, and allow the Fire Department to better ensure safety for firefighters and members of the public.

Further data on road transport volumes of dangerous goods are required to perform a risk assessment for West Vancouver. Specifically, the number of vehicles, types of goods, and routes taken must be collected either through roadside surveys or through direct contact with shippers, carriers, and receivers in the Lower Mainland. Current estimates are based on indirect inference from other surveys and ignores use of local roadways. With this information, planners can ensure key carriers have emergency response plans, work with regular shippers to select low risk routes, and develop procedures for response to specific locations.

Missing from the marine information are data on the maximum volumes of certain commodities stored at the terminals and the means of storage and transfer. This information should be collected during a survey of marine terminal operators.

Suggestions for collecting missing data are offered in Section 5.0 of this report.

SECTION 5.0

CONCLUSIONS & RECOMMENDATIONS

SECTION 5.0 - CONCLUSIONS & RECOMMENDATIONS

5.1 OVERALL RISKS FOR NORTH SHORE COMMUNITIES

From the information we have been able to gather so far, overall risks to North Shore communities from dangerous goods can be characterized as low to moderate. There are a number of locations where high volumes of very toxic and flammable materials are produced or transported in close proximity to dense populations, but the great majority of North Shore residents live and work outside these hazard zones.

Although there are several major chemical producers and transporters in the study area, primarily in the District of North Vancouver, the character of other fixed facilities appears average for a typical West Coast municipality. There are a large number of service stations, auto repair shops, machine shops, medical laboratories, and warehouses that collectively present significant hazards, but no more so than for other locations within the Greater Vancouver region.

Available information on highway transportation suggests that the Upper Levels Highway (TransCanada Hwy 1) carries a significant volume of hazardous materials. Although we can make a good guess at the types of products carried in the largest amounts, much remains unknown. We have little information on local deliveries of fuels and chemicals, and virtually no information on less-than-truckload shipments. The only point we can make with confidence is that much more dangerous goods traffic uses North Shore roadways than anyone has measured to date.

Our understanding of risk from rail, marine, and pipeline modes of transport is much greater than for fixed facilities and highway. Not only are the respective systems simpler to describe and understand, control of information usually rests with one or two organizations, such as C.N. Rail or B.C. Gas. Data on bulk movements of commodities are relatively easy to collect and display. From this preliminary assessment, we know that up to 11,000 rail tank cars are moved by train through the Lynn Creek Yard in North Vancouver City annually, and 6,000 cars make their way through densely populated centres in West Vancouver on the line to Squamish.

Marine transportation of hazardous goods far outweighs, in terms of tonnage, all other modal traffic combined. Bulk traffic by tankers and barges alone account for more than 6 million tonnes each year, and one-third of that are liquid chemical products, such as sodium hydroxide and ethylene dichloride. Although there has never been a major chemical release within the Port of Vancouver, there have been oil spills, ship collisions, groundings, and ship fires. The risk to the public from such events remains unclear at present.

The preliminary risk assessment identified ten hot spots on the North Shore, defined as locations where large volumes of high hazard commodities may be found in close proximity to sensitive populations or environmental habitat. The ten hot spots are shown in Figure 5.1 on the following page and summarized in the preceding sections for each municipality. Although these sites have been selected based on limited information, they are suggested to allow planners to focus prevention and emergency response efforts as early as possible.

Our confidence in outlining these community risks, however, is low because of the volume of absent data. Although information on rail, marine, and pipeline risks are presently available, substantial facts are lacking in two areas:

1. Fixed Facilities. Other than for the three large chemical producers and a handful of other premises, we have little information on the quantities of dangerous goods in North Shore businesses. This information is essential to a comprehensive understanding of risk.

2. Road Transport. Inference from related surveys suggests the amount of hazardous materials transported by truck in and through the North Shore may amount to 50,000 vehicles per year or more. Without an actual survey of existing traffic, however, conclusions on the level of risk presented by this transport mode are not possible.

Until such time as these data are collected and assessed, the overall level of community risk from hazardous materials will not be fully understood. Although there are a number of safety measures available for controlling dangerous goods risk, it would be difficult to justify any option, including the one of "no action," without further research in these areas.

5.2 NEED FOR FURTHER ACTION

While the overall risks of dangerous goods on the North Shore may seem low, when compared to such industrial centres as Houston, Texas, and Newark, New Jersey, there are still opportunities to reduce risk through prevention and response measures that are sensible, affordable, and worthy of effort.

The main purpose of a risk assessment is to identify sources and magnitudes of risk from dangerous goods, and uncover possible safety measures that may be addressed at the local level. A risk assessment is designed to offer two services. First, the process of collecting data and evaluating risk during the assessment often offers an understanding of the problem, the complex factors that influence accident probability and consequences, and the interactive systems that define the economic setting.

A risk assessment helps our overall awareness of risk, and allows members of the general public to better satisfy their "right-to-know." Although we can currently point to some areas of high concern, a comprehensive understanding of all aspects of community risk is lacking at present on the North Shore.

Second, a risk assessment offers a tool to aid decision-making. The number of risk control options available to municipalities is limited only by the imagination. Other North American communities have collectively implemented more than one hundred techniques to address dangerous goods risks, largely through trial and error.

Deciding which options to select, as well as where and when to implement, will be a difficult process. A risk assessment may provide the only tangible guidance in making these selections.

To evaluate the need for further action, it may be helpful to examine the lessons that others have learned from the community risk assessment process. Throughout the 1980's, a number of U.S. public organizations conducted community-wide risk assessments.

Figure 5.2 summarizes their findings and recommendations, as elaborated below:

Association of Bay Area Governments (BAY). San Francisco's risk assessment did not include probability or quantitative estimates of severity. Sensitive areas were identified based on population and environmental resources.

Indiana (IND). Indiana used a fairly simple risk assessment because of poor quality data available. They used road accident data to map areas of concern.

Massachusetts (MAS). Massachusetts limited its risk assessment to identifying geographic areas having high, moderate, and low hazards based on an inventory of dangerous goods.

Memphis (MEM). Memphis focused on a dangerous goods database and response efforts and did not perform a formal risk analysis.

New Orleans (NEW). New Orleans performed no formal risk assessment, preferring to rely on qualitative descriptions for decision-making.

Niagara (NIA). Niagara County conducted a detailed risk assessment using accident rates for road transport, accidents by season and month, population areas and environmentally sensitive areas.

Portland (POR). Portland conducted a 2-year hazard analysis for rail, road, marine, pipeline, and fixed facilities. A subsequent 2-year risk assessment was conducted for road transport only, resulting in a rudimentary and comparative risk assessment.

Puget Sound (PUG). Puget Sound did not perform a formal risk analysis.

It is imperative that we fill the gaps in our current knowledge, to ensure we proceed with safety programs with at least a rudimentary understanding of the types of commodities present, the volumes that may be released, and the locations of highest risk.

A full and detailed risk assessment for all community elements, however, is not warranted. As other communities in North America have pointed out, the benefits of a detailed risk assessment do not always justify the costs.

We recommend, therefore, that the North Shore communities proceed with a limited risk assessment, using one of the available risk screening models, such as the SERI program developed by MIACC (see Appendix B). The costs and information requirements of such an approach are considered minimal for the level of knowledge gained. If detailed analyses are later required, they would most likely be restricted to specific facilities, and can be funded on an as-needed basis.

5.3 ASSESSING RISKS

The risk assessment we have in mind would call for the following tasks:

Select Risk Assessment Model. Before further data are collected, the risk model should be selected and carefully reviewed. Most risk models rely on consistently applied standards for data collection. If the size of the largest container of dangerous goods is relevant to the calculation of risk, it should be collected for every facility. Risk results may vary considerably if data are "fudged" to fit the model.

FIGURE 5.2. SUMMARY OF RECOMMENDATIONS FROM U.S. RISK ASSESSMENTS

RECOMMENDATION	BAY	IND	MAS	MEM	NEW	NIA	POR	PUG
1. Adopt Specific HazMat Legislation	♦	♦	♦			♦	♦	
2. Adopt Storage Legislation			♦					
3. Adopt Zoning Restrictions	♦							
4. Certify Truck Drivers							♦	
5. Conduct Simulations				♦	♦			
6. Develop Cleanup Techniques						♦		
7. Develop DG Teams / HazMat Centre	♦	♦	♦			♦	♦	
8. Develop Response Strategies/Plan	♦	♦			♦		♦	♦
9. Ensure Fire Department Takes Lead			♦					
10. Establish Ongoing Planning Committee		♦		♦	♦	♦	♦	
11. Establish Time-of-Day Controls							♦	
12. Improve Coordination & Communication		♦				♦		♦
13. Improve Evacuation Procedures	♦						♦	
14. Improve Mutual Aid	♦	♦		♦				♦
15. Improve Reporting & Notification	♦		♦				♦	
16. Inform Public	♦					♦		
17. Inspect Trucks							♦	
18. Obtain Proper Response Equipment	♦	♦					♦	
19. Outline Responsibilities						♦		
20. Post Warning Signs	♦							
21. Select Truck Routes		♦					♦	
22. Set Fees for DG Permits	♦							
23. Train Responders at All Levels	♦	♦	♦	♦	♦	♦		♦

Source: U.S. DOT, 1987.

Manipulate Existing Data to Fit Model. Our Phase 2 research revealed ample data for a number of transport modes. Rail risks can be calculated, for example, with relatively little additional work on available data. The marine vessel database provided by the Port of Vancouver requires somewhat more effort, but nothing substantial. Additional work is also needed by B.C. Gas, particularly in confirming acceptable accident rates, but again the effort required can be measured in a matter of person-days.

Survey Fixed Facilities. To fill the unknowns in fixed facilities, we suggest a limited survey be conducted, using available questionnaire forms like those supplied with the SERI risk assessment model. The survey would be limited in terms of the types of businesses contacted. We identified about 600 North Shore businesses where dangerous goods are expected. A survey of these firms alone would add substantially to our understanding of the types and quantities of hazardous substances that may be found, and would help to assess current risks to members of the public.

Survey Road Traffic. Following techniques used in other North American communities over the past 12 years, we propose to conduct a limited survey of North Shore roadways. Two types of survey are possible, 1) Placard-counts, and 2) Direct contact with shippers, carriers, and receivers. We would explore both means to flesh out our knowledge of risks from road transport.

Run Model and Communicate Results. Once we have selected a suitable model and collected the essential data, we propose to run the risk assessment for a limited number of situations. Not all fixed facilities pose a risk high enough to a warrant detailed assessment. And yet, we would benefit greatly from a risk review for some industrial facilities. At this stage, significant time should also be devoted to communicating the results to all concerned parties.

With the steps outlined above, we propose to conduct a limited data collection and risk assessment, designed to fill the gaps in our current knowledge at the lowest possible cost.

5.4 RECOMMENDATIONS FOR PHASE 3

Phase 3 is intended as a preparation effort, allowing researchers to carefully plan the data collection needed to run the chosen risk assessment method. Before conducting the risk assessment, a great many details must be addressed, especially the need for consistent and complete data. It also provides an opportunity to focus on the essential data, and to design practical means for collecting them.

The third phase also provides an opportunity to establish the ongoing organizational support needed to ensure long term benefits from the risk assessment. This is the ideal time to involve those who will supply information and benefit from the results, to increase the efficiency of data collection by laying the groundwork for community-wide cooperation.

Phase 3 can be summarized in terms of seven tasks, as outlined below.

1. Prepare Study Plan. An initial plan for the conduct of Phase 3 will be developed, based on the results of Phase 2. Detailed tasks will be assigned to the study team, according to schedule.

2. Inaugurate Local Dangerous Goods Task Force. This is the time to assemble members of an ongoing Task Force (also called a Local Emergency Planning Committee in U.S. legislation). Members of the Task Force should be drawn from industries supplying risk data, municipal departments using risk information, provincial officials, and others deemed necessary to the program. The local Task Force will be expected to assume responsibility for implementing subsequent phases of this study, and will meet regularly during Phase 3 to establish their mandate, purposes, objectives, format, and funding mechanisms.

3. Identify All Possible Safety Measures. If a risk assessment is a decision-making tool, it makes sense to identify what options the decision-makers will face. In this task, we suggest that researchers identify all possible measures to control risks from dangerous goods, and offer examples of cost-efficient safety measures used by others. The data required to select, implement, and monitor each safety measure should be clearly identified.

4. Select Risk Assessment Methodology and Model. Several models are available for consideration. Based on the level of risks within the community, however, we suggest a relatively quick screening method would best suit the objectives at hand, such as that offered by MIACC. The appropriate model must be purchased and thoroughly reviewed in this task.

5. Identify Data Requirements for Risk Assessment. Based on the selected model, the research team must identify missing data that are essential for a complete assessment. At the same time, they must distil data requirements to those items that are easily accessible by data suppliers. This effort will likely require some assistance from local business and industry to design cost-effective survey techniques.

6. Identify Sources & Collection Methods. This is the design stage, where survey questions are developed and tested, sources are carefully examined to ensure compliance, and database programs are developed to handle the risk assessment. For each type of data to be collected, the research team should identify optional sources and collection methods. It would be helpful to consult with other municipalities on the design of successful surveys and questionnaires, and contact MIACC for data collection techniques.

7. Develop Detailed Plan for Next Phase. At the conclusion of Phase 3, the objectives for the following phase will be revised, and essential tasks will be detailed, with estimates of time and budget requirements.

These Phase 3 efforts would provide the following deliverables:

- Working Structure of Local Dangerous Goods Task Force
- List of All Possible Safety Measures, by Priority
- Risk Model Application Program
- Data Requirements for Full Risk Assessment
- Details on Data Collection Methods
- Work Plan for Phase 4

The total consultant effort of the Phase 3 effort will cost about $ 30,000, assuming voluntary participation by members of the local dangerous goods task force. In addition, the purchase of a risk assessment model, and hardware to house the program and database, may require in the range of $ 3,000 to $ 15,000, depending on the model selected.

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AND APPENDICES

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CP Coastal Marine

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APPENDIX B - RISK ASSESSMENT METHODS AND MODELS

Methodologies for assessing community risks from hazardous materials have been available for at least 13 years. Early models either relied heavily on gross generalizations or required main-frame computer time. Methods developed in the 1990's, however, offer a significant advantage that makes them universally accessible: They can be used with a personal computer.

To prepare for the North Shore risk assessment, we reviewed the field of risk assessment models that could be used by a municipality. Although significant effort and millions of dollars have been devoted to quantitative risk analyses for a variety of specific projects, ranging from the nuclear industry to rail re-routing, the type of method we were searching for had to be able to address the principal transport modes and fixed facilities.

Six options came to light that seemed representative of the risk models available. They range in terms of acceptability, complexity, and cost, as summarized below.

1. RISK ASSESSMENT FOR SMALL COMMUNITIES, Kansas State University - The Kansas State model was first introduced in 1979, and was employed by several U.S. communities with populations less than 50,000 during the 1980's. It was amended by the Association of Bay Area Governments (ABAG) for use in Union City in 1983, and subsequent procedures were finally published in 1986.

   - Designed as simple screening process to identify problem areas
   - Suggests business survey and road placard counts
   - Accounts for gross differences in chemical hazards
   - Plots 1-mile long, 1-mile wide transport segments
   - Acknowledges population density and special populations
   - Assigns a score to level of emergency preparedness

   ABAG improvements mean method can be applied to larger communities.
   - Calculates risk for different parts of community
   - Applies different accident rates for modes
   - Plots 1/2-mile wide sub-corridors

Cost of Model or Program:	Free
Cost of Ongoing Maintenance:	Low
Provides Desired Results:	Fair
Data Requirements:	Low
Complexity of Use:	Simple
Widespread Approval:	High

2. CAMEO / ALOHA / MARPLOT, EPA, NOAA - The U.S. Environmental Protection Agency and the National Oceanic and Atmospheric Association offer Computer Aided Management of Emergency Operations (CAMEO), which includes a gas dispersion model called Areal Locations of Hazardous Atmospheres (ALOHA), and a mapping subroutine called MARPLOT. Although CAMEO serves primarily as a response tool, recent advances have added an interesting risk assessment capability.

- Can be applied to both fixed facilities and transportation routes
- Requires chemical ID, maximum vessel quantity, concentration
- Calculates "worst case" as 1/10 IDLH lines on map, very conservative
- Permits scenario development by allowing user to vary:
    - Chemical identification
    - Weather stability class
    - Setting (urban or rural)
    - Wind speed and direction
    - Quantity released
    - Duration of release
    - Concentration level of concern (IDLH, 1/10 IDLH, other)
- Must rely on local population density database

Cost of Model or Program:	$ 400, plus $ 2,500 computer
Cost of Ongoing Maintenance:	Moderate
Provides Desired Results:	Good
Data Requirements:	Moderate
Complexity of Use:	Simple
Widespread Approval:	Moderate

3. IRAS, TNO / MIAAC - The Major Industrial Accidents Council of Canada (MIACC) has adapted a Dutch risk assessment model (developed by TNO) for use specifically by municipalities. The modified model has received tentative approval from both public safety agencies and private industry, has been applied in Edmonton, Alberta, and is currently being tested in Montreal, Quebec. A software application of the MIACC model, called the Industrial Risks Assessment System (IRAS or SERI in French) will be available by March, 1993.

- Addresses production, storage, and transportation
- Allows database management of dangerous goods inventories
- Requires organization information:
    - Substance ID
    - Substance category
    - Activities related to substance use
    - Substance quantity for each activity
    - Number and type of substance containers

- Addresses Emergency Measures
- Estimates zones of influence, injury and fatalities
- Uses grid system; no true GIS capability
- Can be linked to other open architecture systems, like SoftRisk
- Permits community-wide summary reports

Cost of Model or Program:	$ 1,000, plus $ 2,500 computer
Cost of Ongoing Maintenance:	Moderate
Provides Desired Results:	Good
Data Requirements:	Moderate
Complexity of Use:	Moderate
Widespread Approval:	Moderate

4. HAZTRANS, Abkowitz & Associates - A U.S. transportation safety consultant firm is currently marketing a hazardous materials risk model, targeted primarily at shippers. The model is capable of assessing options for route selection, including comparison of modes, throughout the U.S. The firm intends to extend their capability to Canada in 1993. The HAZTRANS model provides both qualitative (screening) and quantitative (comprehensive) risk assessment methods.

- Generates population exposures from transport segment
- Can identify high hazard fixed facilities and transport routes
- Chemical specific dispersion module available
- Requires industry and route information:
    - Chemical identification
    - Number and type of containers
    - Concentration
    - Daily traffic volumes
    - Release scenarios

- Assesses emergency response capability in cities and along routes
- Evacuation planning module available to determine feasible routes
- Compatible with Microsoft Windows

Cost of Model or Program:	Varies, plus $ 2,500 computer
Cost of Ongoing Maintenance:	Moderate
Provides Desired Results:	Good
Data Requirements:	Moderate
Complexity of Use:	Moderate
Widespread Approval:	Moderate

5. SAFETI III, HSE, Technica - Prepared for the United Kingdom's Health & Safety Executive by DNV Technica in 1991, this sophisticated model was developed to help decision-makers understand more fully the potential for disaster, and to gauge the effects of existing controls and safeguards. The model is national in scope and can be applied to a wide range of fixed facility and transportation concerns.

- Model attempted high level of precision and detail
- Road model accounts for different road types and motorist behaviour
- Includes interaction between passenger and dangerous goods trains
- Works from complete set of failure cases
- Consequences include motorists, passengers on train, as well as residents who live near source of risk
- Assumptions can be altered to test effectiveness of system changes
- Offers society risk estimate only, not individual risk
- Best for flammable vapours, limited use for toxic gases

Cost of Model or Program:	Model is free, but would require great deal of startup time, plus $ 2,500 computer
Cost of Ongoing Maintenance:	High
Provides Desired Results:	Good
Data Requirements:	High
Complexity of Use:	Complex
Widespread Approval:	Moderate

6. IRIMS, IIASA - The International Institute for Applied Systems Analysis (IIASA) developed this integrated system of databases, modelling and optimization techniques, coupled with a geographical information system (GIS) and computer graphics, for the European Communities' Joint Research Centre. IRIMS uses a risk and cost analysis model developed in collaboration with the Ludwig Boltsmann Institute, Vienna. Current test applications address continental routing options throughout Europe.

   - Integrates a number of related databases
   - Allows great deal of user interaction to test decision results
   - Presents risk results visually to enhance understanding
   - Places emphasis on the "man-machine interface"
   - Designed for a variety of decision-makers among public and private organizations.

Cost of Model or Program:	High, model must be adapted by IIASA
Cost of Ongoing Maintenance:	High
Provides Desired Results:	Excellent
Data Requirements:	High
Complexity of Use:	Complex
Widespread Approval:	High

APPENDIX C - HISTORICAL INCIDENTS

CANUTEC receives up to 20,000 calls per year, of which 500 are actual emergency situations (Kittle p10).

North Vancouver City
North Vancouver District
West Vancouver

COST SHARING AND CONSTRUCTION AGREEMENT

DOLLARTON HIGHWAY REALIGNMENT WORKS

THIS AGREEMENT date for reference the 25th day of July, 1995.

BETWEEN:

CANADIAN OCCIDENTAL PETROLEUM LTD. (Inc. No. A-0021567) with offices at 1500, 635 - 85th Avenue, S.W., Calgary, Alberta, T2P 3Z1

(herein called the "Company)

AND:

THE CORPORATION OF THE DISTRICT OF NORTH VANCOUVER, a municipal corporation under the *Municipal Act* having its municipal offices and postal address at 355 West Queens Road, North Vancouver, British Columbia, V7L 4K1

(herein called the "District")

W H E R E A S :

A. The District and the Company wish to construct a portion of the Dollarton Highway across lands owned by the Company to provide improved access to the surrounding lands.

B. The Company has applied to the District to rezone the Company Lands from I2-General Industrial to CD-Comprehensive Development light industrial, mixed use and commercial as shown in the Sketch Plan attached as Schedule "A";

C. The District and the Company wish to enter into this agreement to cooperate and share the costs of the construction of the realignment.

NOW THEREFORE THIS AGREEMENT WITNESSES that in consideration of the premises and the covenants and agreements herein contained, the parties hereto hereby covenant and agree as follows:

ARTICLE 1.00
INTERPRETATION

1.01 **DEFINITIONS.** In this Agreement:

(a) **"Agreement"** means this agreement and all Schedules attached hereto;

(b) **"Company's Clearing and Grubbing Payment"** has the meaning set out in Article 5.00.

(c) **"Company Lands"** means the lands described in Schedule "B";

(d) **"District Engineer"** means the municipal engineer of the District;

(e) **"Dollarton Realignment"** means the realignment of the Dollarton Highway and the improvement of neighbouring highways as generally shown and described in the Plan attached as Schedule "C";

(f) **"Dollarton Realignment Design"** has the meaning set out in Article 4.00.

(g) **"Dollarton Realignment Works"** means the installation and construction of all works and services, (whether performed by District staff or outside consultants and contractors) that, in the opinion of the District Engineer, are required for the Dollarton Realignment. For certainty, the Dollarton Realignment Works include, but are not limited to, highway works per se (such as road subgrade, pavement, curbs and sidewalks) and all associated works such as drainage and traffic control, underground utility connections to individual lots, ornamental street lighting, street name signs, bicycle lanes, landscaping (not including boulevards), and other works which, in the opinion of the District Engineer, are required.

(h) **"Letter of Credit"** means the letter of credit as described in Article 3.04.

(i) **"Rezoning Bylaw"** means the bylaw necessary to rezone the Company Lands in accordance with paragraph B of the preamble hereto.

(j) **"Target Substantial Completion Date"** means a target date of June 30, 1998 for substantial completion of the construction of the Dollarton Realignment Works. "Substantial completion" means the date when the construction of the works are complete except for deficiencies and toplift paving, and are being used or are available for their intended purposes.

ARTICLE 2.00
REZONING BYLAW AND DISTRICT AUTHORITY

2.01 **COUNCIL DISCRETION.** The District, by executing and delivering this Agreement to the Company, will not in any way restrict or abrogate, and will not be deemed to restrict or abrogate, the discretion of the District Council to deal with the Rezoning Bylaw or the District's other bylaws as it sees fit, in its absolute discretion, and in accordance with its lawful powers and duties under the *Municipal Act*.

2.02 **REZONING BYLAW.** The Company is entering into this Agreement on the basis that the Rezoning Bylaw will be adopted no later than June 30, 1997, and if, for any reason, the Rezoning Bylaw is not approved on or before that date, then, on written notice from the Company, this Agreement shall be terminated and at an end. For certainty, in such event neither the Company nor the District will have any further obligation to proceed with the Dollarton Realignment Works and the Company will have no obligation to pay the Letter of Credit. Also in such event the District will have no obligation to repay the monies paid to the District under Article 5.00, nor to do any additional work or remedial work to the Company Lands relating to any clearing and grubbing work that the District may have done prior to such termination of this Agreement.

2.03 **STATUTORY AUTHORITIES.** Nothing set out in this Agreement will be deemed to constitute a waiver of any lawful requirements of Statutory Authorities with which the Company would otherwise be obliged to comply, or will prejudice or effect the District's powers or duties in the exercise of its functions under any public or private statutes, bylaws, orders, or regulations, all of which the District may exercise or carry out as if the District had not executed or delivered this Agreement.

ARTICLE 3.00
DOLLARTON REALIGNMENT COSTS

3.01 **COMPANY'S SHARE OF THE DOLLARTON REALIGNMENT COSTS.** The Company's total contribution on account of the Dollarton Realignment Works will be:

(a) a payment of $3,000,000.00; plus

(b) the dedication of the portion or the Company Lands required for the Dollarton Realignment. The Company will transfer or dedicate such lands under separate agreement.

3.02 **DISTRICT CONTRIBUTION.** The District will pay all other costs of the Dollarton Realignment, in excess of the Company's contribution of $3,000,000.00 plus the land as described above.

3.03 **COMPANY TO RECEIVE REIMBURSEMENT.** The District will reimburse the Company for any costs the Company reasonably incurs, after the date of execution of this Agreement, on account of this Agreement, in excess of the $3,000,000.00 contribution, except for any costs caused or incurred due to the Company's negligent or wrongful act. Specifically, if the District fails to undertake the work package subcontracts in 1996 or 1997 as described below then the District shall reimburse the Company for all costs the Company incurs in accordance with the requirements of this Agreement, in excess of the $3,000,000.00 contribution, that are substantiated by cost records and invoices.

3.04 **LETTER OF CREDIT.** The Company will upon final adoption of the Rezoning Bylaw deliver to the District a clean and irrevocable letter of credit (the "Letter of Credit") in the amount of $3,000,000.00 minus any pre-payments (such as the Company's Clearing and Grubbing Payment as referred to in Article 5.01). The Letter of Credit will be payable on sight, to be drawn on a Canadian Schedule "A" Chartered Bank, have a term of least one year and otherwise be in form and on terms satisfactory to the District. The District will hold the Letter of Credit as security for the Company's obligations under this Agreement.

3.05 **NO WORK WITHOUT LETTER OF CREDIT.** Regardless of other provisions of this Agreement, except for the clearing and grubbing described in Article 5.00, neither the District nor the Company will proceed with the undertaking of any of the Dollarton Realignment Works prior to the District's receipt of the Letter of Credit. The District will proceed with the Dollarton Realignment Design in advance of the receipt of the Letter of Credit.

3.06 **DRAWS ON LETTER OF CREDIT AND REPLACEMENT.** The District will hold, and may draw upon, the Letter of Credit as follows:

(a) if at any time, and from time to time, the Company fails to pay an invoice as submitted by the District as provided by Article 6.02(c) then the District may, upon 3 working days written notice to the Company, draw upon the Letter of Credit in the amount owing as set out in the invoice unless the District receives payment for such invoice within the notice period;

(b) if the Letter of Credit will expire prior to the completion of the Dollarton Realignment Works the Company will deliver to the District, at least 30 days prior to its expiry, a replacement Letter of Credit, for a one year term, in the total amount of the Company's remaining unpaid contribution to the Dollarton Realignment Works on like terms. If the Company fails to do so the District may draw down from the Letter of Credit all the remaining balance and hold and draw upon the cash in lieu thereof.

ARTICLE 4.00
DESIGN

4.01 **DOLLARTON WORKS DESIGN.** The District will undertake, or cause to be undertaken, at its cost, all of the design work, the preparation of all specifications and construction drawings, the preparation of all tender and construction contract documents, all field surveys and layout, and all other engineering and related services included in or required for the Dollarton Realignment Works (collectively the "Dollarton Realignment Design").

4.02 **TIMELY DESIGN.** The District will perform the Dollarton Realignment Design in a timely way so as to permit and facilitate the construction of the Dollarton Realignment Works in accordance with Schedule D, and so that the Target Substantial Completion Date can be met.

4.03 **STANDARDS OF CONSTRUCTION.** The Dollarton Realignment Design will be to the standards which, in the discretion of the District Engineer, are required.

4.04 **CONSULTATION WITH THE COMPANY.** The District will, from time to time, prior to finalizing the Dollarton Realignment Design for the portion of the Dollarton Realignment Works that will be located on the Company Lands, and prior to finalizing the design of the two intersections on Amherst Avenue (Spicer Road/Amherst Avenue and Dollarton Highway/Amherst Avenue), consult with the Company, or the Company's consultants, regarding such design. The District will, considering overall costs including construction costs, and considering the interests of the public, make reasonable efforts to accommodate any of the

Company's suggestions or requests. The District will, in particular, consult with the Company regarding highway design details, including turning radius, in an effort to permit the Company's larger vehicles to be able to gain access to the Company Lands from the Dollarton Realignment. Nothing in this Agreement will be interpreted to mean that the District is required to agree to any design or construction provision that is contrary to established District policies, or good engineering practice. Without limiting the above, the District Engineer shall have complete authority and discretion, subject to applicable statutes and regulations, to determine the location of any vehicular access to the Dollarton Highway.

4.05 **LOCATION ON COMPANY LANDS.** The District will design the portion of the Dollarton Realignment Works that will be on the Company Lands substantially within the area indicated on the attached Schedule "C". The exact location of Dollarton Realignment Works on the Company Lands may vary, as required by the District Engineer.

ARTICLE 5.00
PRELIMINARY WORKS

5.01 **COMPANY'S CLEARING AND GRUBBING PAYMENT.** Immediately upon execution of this Agreement the Company will pay to the District a payment in the amount of 50% which the District Engineer determines will be the cost of clearing and grubbing of the portion of the Dollarton Realignment that will be on the Company Lands (the "Company's Clearing and Grubbing Payment") on account of the payment of the Dollarton Realignment Costs.

5.02 **CLEARING AND GRUBBING.** The District will upon execution of this Agreement and receipt of the Company's Clearing and Grubbing Payment proceed with the clearing and grubbing of the portion of the Dollarton Realignment that will be on the Company Lands. The District will undertake such clearing and grubbing either with its own forces or by contract with others.

ARTICLE 6.00
CONSTRUCTION

6.01 **COMPANY TO BE GENERAL CONTRACTOR.** Upon the final adoption of the Rezoning Bylaw by the District, the Company will, in accordance with the provisions of this Agreement, be the general contractor for the District and provide, or cause to be provided, the materials, equipment and services required for the construction of the Dollarton Realignment Works.

6.02 **COMPANY TO SUBCONTRACT WORK.** The Company will, in cooperation with the District, break the work into work packages made up of the work that can reasonably be completed in each of 1995, 1996 and 1997.

(a) The Company will, prior to commencing any work in any year, offer the entire work package for that year as a subcontract to the District. The Company recognizes that, before the District may enter into a subcontract for any year the District must have budget approval for anticipated costs, and accordingly the Company will give the District the reasonable opportunity to approve the District's budgets and accept the subcontract offer.

(b) The District agrees to perform the subcontract for the 1995 work package made up of work that the District can reasonably perform in 1995.

i) The District will commence such 1995 work immediately upon the adoption of the Rezoning Bylaw and the receipt of the Letter of Credit.

ii) The District shall undertake the Dollarton Realignment Construction using its own forces and/or, without any approval by the Company, by entering into contracts with contractors or others. The Company shall not be a party to such contracts.

(c) As the District undertakes any of the Dollarton Realignment Works, either by way of subcontract with the Company or otherwise, the District shall submit monthly invoices to the Company setting out the amounts the Company owes as its contribution on account of the Dollarton Realignment Works under this Agreement, in accordance with the percentage shares set out in Schedule D. The Company shall pay such invoice amounts within 30 days of receipt. The Company shall pay such invoices to the District or to a contractor or other party, as the District may direct.

(d) If in either 1996 or 1997 the District for any reason declines to accept the work package subcontract then:

i) the Company may, in accordance with the terms of this agreement, enter into contracts with others to perform that work package. If the District fails to accept the subcontract offer for the work package in any year, the Company shall not be required to incur

any costs other than those it would have incurred if the District had accepted such subcontract offer and the District specifically affirms the provisions of Article 3.03. If, in such event, the Company proceeds to enter into contracts with others to perform a work package then the Company shall submit invoices monthly for the District's share of the costs, as provided by Article 3.03, and the District shall pay such costs within 30 days of receipt; and

ii) the Company shall be afforded such additional time as is reasonably necessary to perform the work package in question and the Dollarton Realignment Works.

6.03 **DISTRICT APPROVAL.** All work, and all contracts and all costs of the Dollarton Realignment Works will be to the approval and satisfaction of the District. Without limiting the generality of the above:

(a) All work shall be performed strictly in accordance with the designs, specifications, drawings and instructions as provided by the District as part of the Dollarton Realignment Design, and in every respect to the satisfaction of the District Engineer;

(b) No portion of the Dollarton Realignment Works shall be covered or otherwise made inaccessible prior to the inspection and approval of the District.

(c) If in either 1996 or 1997 the District declines to accept the work package subcontract and the Company elects to engage others to perform that work package subcontract then:

i) The Company shall not retain any consultant or contractor, and shall not undertake any portion of the Dollarton Realignment Construction without the express written approval of the District Engineer, such approval not to be unreasonably withheld.

ii) The Company shall obtain the prior written approval of the District Engineer for all contracts with any consultant or contractor that will perform work related to the Dollarton Realignment Works or Construction.

iii) The Company shall not incur any cost without the prior written approval of the District Engineer, such approval not to be unreasonably withheld.

6.04 **COMPLY WITH SCHEDULE.** The Dollarton Realignment Works will be undertaken in accordance with Schedule D, or as otherwise directed in writing by the District.

6.05 **TARGET SUBSTANTIAL COMPLETION DATE.** The Company and the District shall cooperate so as to permit the completion of the Dollarton Realignment Construction by the Target Substantial Completion Date, subject to the provisions to extend the date as set out below.

(a) The Target Substantial Completion Date will be extended if the District or the Company suffers any delays in the Dollarton Realignment Design or Construction which are beyond the District's or the Company's reasonable control, including, without limitation, weather, labour strikes or labour disruption, or any other unforeseen circumstance.

(b) The parties acknowledge that the Target Substantial Completion Date is near the beginning of the 1997 construction season, and that the requirements of this Agreement will be met if, as of the Target Substantial Completion Date, the parties have proceeded diligently with Dollarton Realignment Construction has proceeded diligently and the plans and schedules for completion are such that the roadway portions of the Dollarton Realignment Works are to be substantially completed and available for use by the end of the 1997 construction season.

ARTICLE 7.00
LICENCE TO ENTER AND OCCUPY

7.01 **DISTRICT MAY ENTER.** The Company hereby grants to the District and its officers, employees, agents, consultants, contractors and licensees a license to enter on, occupy and use the Company Lands for all purposes as reasonably required for the District to carry out its obligations under this Agreement and generally as required for the design, inspection and construction of the portion of the Dollarton Realignment Works that will be located on the Company Lands.

ARTICLE 8.00
GENERAL PROVISIONS

8.01 **LATECOMER WAIVER.** The Company hereby waives, relinquishes and abandons any right which the Company now has or may at any time hereafter have for any contribution from the District or any other person on account of any costs incurred by the Company related to the Dollarton Realignment or to the Dollarton Realignment Works other than as expressly as set out in this Agreement. The Company agrees that none of the Dollarton Highway Realignment Works shall be construed to be "excess or extended services" as defined by Section 990 of the ***Municipal Act***. For certainty, and as further evidence that the Company gives the above waiver, the Company agrees with the District that, pursuant to s. 990(9) of the ***Municipal Act***, the term of any latecomer obligations shall be 1 day.

8.02 **SCHEDULES.** The following attached Schedules form a part of this Agreement:

(a) Schedule "A" - Sketch Plan of Zoning
(b) Schedule "B" - Lands
(c) Schedule "C" - Plan of Alignment
(d) Schedule "D" - Construction Segments

8.03 **NO PARTNERSHIP.** This Agreement is not intended to create a partnership, joint venture or agency between or among the Company and the District;

8.04 **NOTICES.** All notices, requests, demands and other communications hereunder shall be in writing and shall be deemed to have been duly given if delivered by hand or mailed postage prepaid addressed as follows:

(a) Company:

CANADIAN OCCIDENTAL PETROLEUM LTD.
1500, 635 - 8th Avenue S.W.
Calgary, Alberta
T2P 3Z1

Attention: Senior Vice-President
General Counsel & Secretary

FAX: (403) 263-8673

(b) District:

THE CORPORATION OF THE DISTRICT
OF NORTH VANCOUVER
District Municipal Hall
355 West Queens Road
North Vancouver, British Columbia
V7L 4K1

Attention: Clerk

FAX: (604) 984-9637.

8.05 **LEGAL FEES.** Except as expressly set out herein both the Company and the District will be responsible for any costs, fees and expenses including without limitation legal fees incurred by each of them in the negotiation and preparation of this Agreement.

8.06 **EXTENSIONS.** If any date set out or referred to in this Agreement on which any matter must be done occurs on a day on which the District office is not open to the public for business, then such date will be deemed to be extended to the next following day on which the District office is open to the public for business.

8.07 **TIME.** Time will be of the essence of this Agreement. If any party expressly or impliedly waives the requirement that time will be of the essence, that party may reinstate that requirement by delivering notice to the other party. If a time is specified in this Agreement for observing or performing any obligation, such time will be then local Vancouver, British Columbia time.

8.08 **CURRENCY.** Any reference to money in this Agreement is to lawful money of Canada.

8.09 **GOVERNING LAW.** This Agreement will be governed by and construed and enforced in accordance with the laws of the Province of British Columbia.

8.10 **REFERENCES.** If the singular, masculine, or neuter is used in this Agreement, the same will be deemed to include references to the plural, feminine, or body corporate according to the context in which it is used.

8.11 **CONSTRUCTION.** The division of this Agreement into articles, the insertion of headings, and the provision of a table of contents are for convenience of reference only and are not intended to govern, limit, or aid in the construction of any provision. In all cases, the language in this Agreement will be construed simply, according to its fair meaning, and not strictly for or against any party.

8.12 **NO LIMITATION.** The word "including" when following any general statement, term, or matter is not to be construed to limit such general statement, term, or matter to the specific items or matters set out immediately following such word or to similar items or matters whether or not non-limiting language such as "without limitation" or "but not limited to" or words of similar import is used with reference to, but rather such general statement, term, or matter is to be construed to refer to all other items or matters that could reasonably fall within the broadest possible scope of such general statement, term, or matter.

8.13 **PREAMBLE.** The preamble forms a part of this Agreement.

8.14 **VALIDITY OF PROVISIONS.** If any provision contained in this Agreement is for any reason held to be invalid, illegal or unenforceable in any respect such invalidity, illegality or enforceability will not effect any other provisions of this Agreement which will be construed as if such invalid, illegal or unenforceable provision had never been contained therein and such other provisions will be enforceable to the fullest extent permitted by law.

8.15 **WAIVER.** No consent or waiver, express or implied, by a party of any default by the other party in observing or performing its obligations under this Agreement will be deemed or construed to be a consent or waiver of any other default. Failure on the part of either party to complain of any act or failure to act by the other party or to declare the other party in default, irrespective of how long such failure continues, will not constitute a waiver by such party of its rights under this Agreement or at law or at equity.

8.16 **REMEDIES.** Each party to this Agreement, in addition to its rights under this Agreement or at law, will be entitled to all equitable remedies, including specific performance, injunction and/or declaratory relief, to enforce its rights under this Agreement.

8.17 **DISPUTES.** If a dispute occurs between the District and the Company with respect to any matter arising out of or relating to this Agreement then the following procedure shall apply:

(a) before a party may commence any proceeding, the dissatisfied party shall give the other party written notice of the dispute, with a full explanation of the complaining party's position;

(b) within seven (7) days of the receipt of the dispute notice, senior representatives of the parties who have not previously been directly involved in the dispute shall meet and review the matter in an attempt to reach agreements in good faith;

(c) if the dispute is not resolved within 7 days of the commencement of the settlement meetings, or if the other party fails or refuses to meet as provided by Article 8.17(b), then the complaining party may commence legal proceedings to resolve the dispute. If both parties agree then the dispute may be resolved by mediation and/or arbitration.

8.18 **APPROVALS, CONSENTS AND AGREEMENTS.** Except as otherwise expressly set out in this Agreement, where this Agreement provides for any approval, consent, or agreement with respect to any matter:

(a) it must be obtained prior to any action being taken thereon;

(b) it must be requested and responded to in writing; and

(c) if the party whose approval, consent, or agreement is requested withholds same, its response must set forth, in reasonable detail, its reasons for so withholding;

except that this provision will not restrict or abrogate, or be deemed to restrict or abrogate, the District in the lawful exercise of its powers or duties under the Act.

8.19 **FURTHER ASSURANCES.** Each of the parties from time to time will do all further acts and execute and deliver all further deeds and documents as the other party may reasonably require in order to fully perform and carry out the spirit and intent of this Agreement. Without limiting the foregoing, the Company shall, on the request of the District, execute and deliver or cause to be executed and delivered all such further agreements, instruments, easements, statutory rights-of-way and assurances as may be, in the opinion of the District, necessary to give full effect to the intent of this Agreement.

8.20 **ENURING EFFECT.** Except as otherwise herein expressly set out, the provisions of this Agreement will enure to the benefit of and be binding upon the successors and assigns of each of the parties.

IN WITNESS WHEREOF each of the parties has executed this Agreement by its duly authorized officers under seal as of the date and year first above written.

THE CORPORATE SEAL of **CANADIAN OCCIDENTAL PETROLEUM LTD.** was hereunto affixed in the presence of:

[redacted]

Authorized Signatory

[redacted]

Authorized Signatory

C/S

THE CORPORATE SEAL of **THE CORPORATION OF THE DISTRICT OF NORTH VANCOUVER** was hereunto affixed in the presence of:

[redacted]

Authorized Signatory

J. MURRAY DYKEMAN - Mayor

[redacted]

Authorized Signatory

AGNES HILSEN D/CLERK

C/S

1t 93/07/07 TITLE SEARCH PRINT - VANCOUVER Time: 13:58:56
equestor: (PF93500) DISTRICT OF NORTH VANCOUVER Page: 001
Title: G55859

SECTION 105
SECTION 172(3)

NCOUVER LAND TITLE OFFICE TITLE NO: G55859
FROM TITLE NO: 641076

PLICATION FOR REGISTRATION RECEIVED ON: 09 AUGUST, 1979
ENTERED: 13 AUGUST, 1979

GISTERED OWNER IN FEE SIMPLE:

CANADIAN OCCIDENTAL PETROLEUM LTD.
(REGISTRATION NO. 9720A)
100 AMHERST AVENUE
NORTH VANCOUVER, B.C.

SCRIPTION OF LAND:
IUNICIPALITY OF NORTH VANCOUVER

RCEL IDENTIFIER: 007-254-067
OT 1 OF LOT B DISTRICT LOT 611 PLAN 17800

AL NOTATIONS: NONE

RGES, LIENS AND INTERESTS:
TURE OF CHARGE
HARGE NUMBER DATE AND TIME OF APPLICATION

GHT OF WAY
82648M 24/01/1969 10:30
REGISTERED OWNER OF CHARGE:
BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
REMARKS: PART IN REFERENCE PLAN 9335
INTER ALIA

ATUTORY RESTRICTIVE COVENANT
56375 13/08/1979 13:30
REGISTERED OWNER OF CHARGE:
THE CORPORATION OF THE DISTRICT OF NORTH VANCOUVER

RTGAGE
76312 CANCELLED 29/07/1983 12:10
REGISTERED OWNER OF CHARGE:
THE ROYAL TRUST COMPANY
REMARKS: CERTIFIED TO BE A TRUE COPY
PURSUANT TO SEC. 198(4) L.T.A.
INTER ALIA
CANCELLED BY: GD17765 REGISTERED 06/02/1990 .

UTION - CHARGES MAY NOT APPEAR IN ORDER OF PRIORITY. SEE SECTION 27, L.T.A."

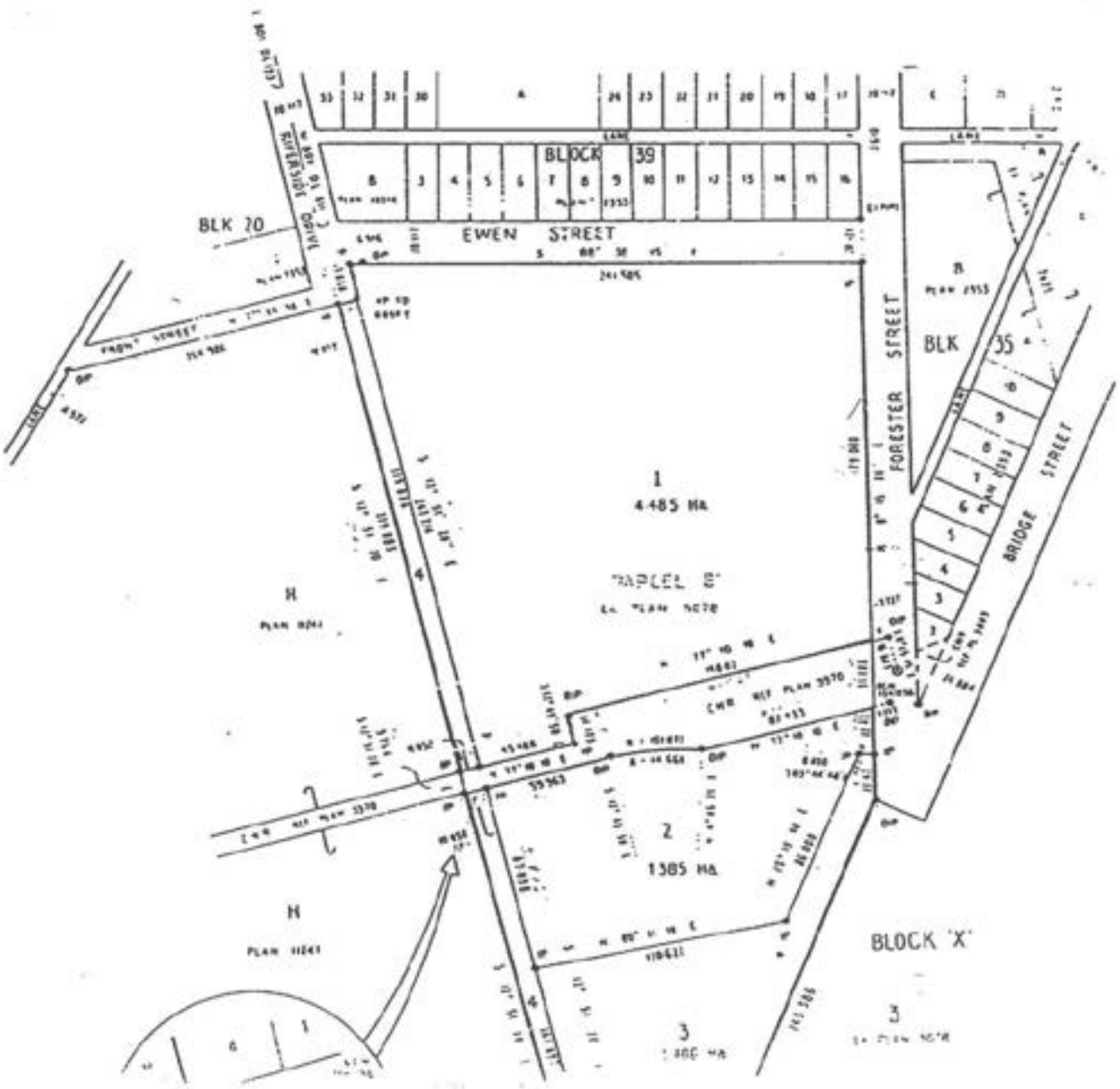
LI TE INDEFEASIBLE TITLE: NONE

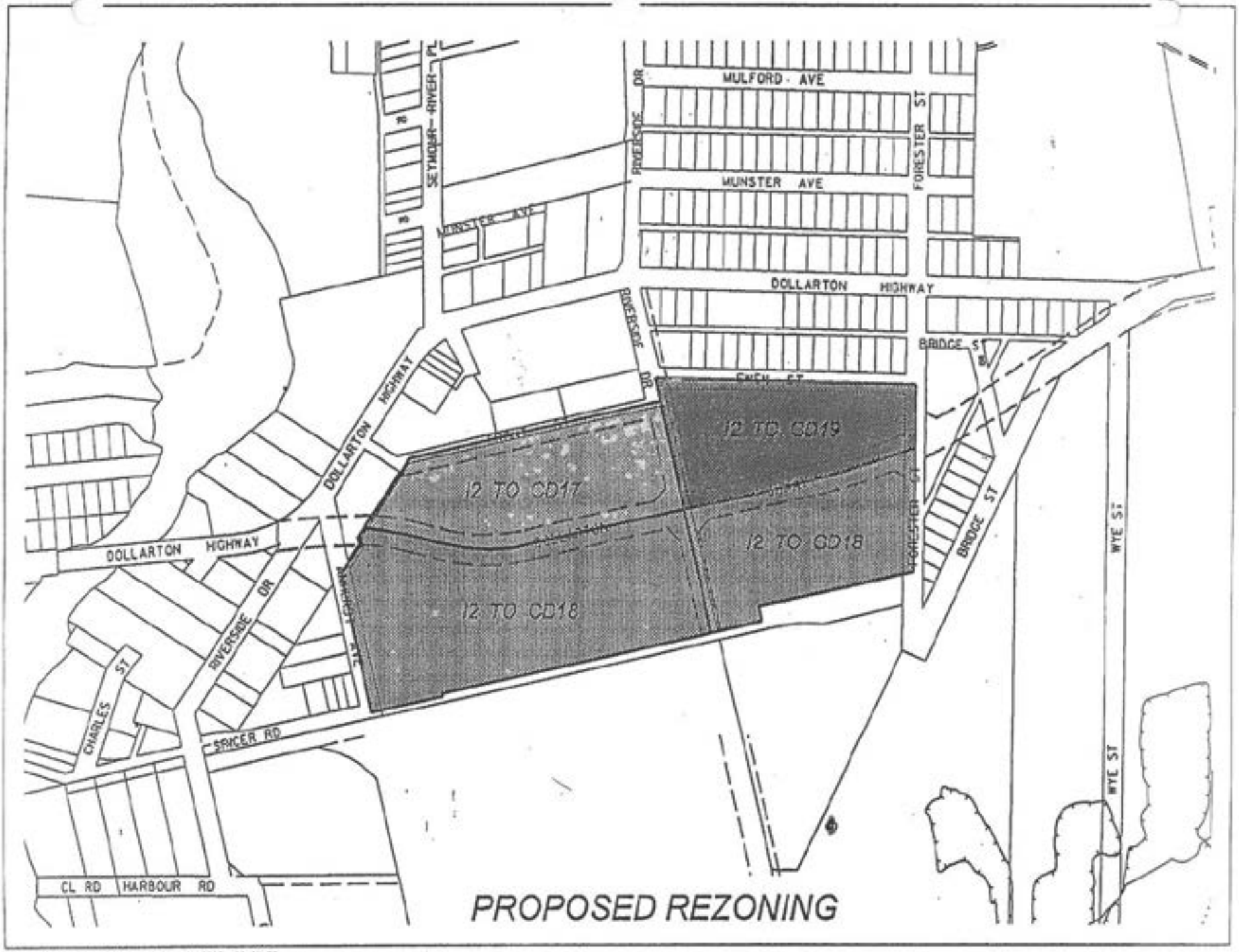
CONTINUES ON PAGE 002

SUBDIVISION PLAN OF PARCEL "B" (EXPLANATORY PLAN 5078) EXCEPT THAT PART INCLUDED IN REFERENCE PLAN 9970, DISTRICT LOT 611, GROUP ONE, NEW WESTMINSTER DISTRICT, PLAN 2353

SCALE 1 : 2000 (METRIC)

THIS PLAN LIES WITHIN THE GREATER VANCOUVER REGIONAL DISTRICT





PROPOSED REZONING

j:/users/shawn/da01lk03.ar May. 4, 1995 09:01:38

DL 612
DL 676
79
CD 19
CD17
CD 18
CD 18
LOCATION OF
PRIVATE OWNERS

RUSHMOOR BOROUGH COUNCIL

Version of 16th April 1998
P&T Committee meeting of 3rd February 1998
"Public Safety"
Farnborough Airfield
File ref: ppt9801

Public Safety Zones

DETR review

Contents:

1. Introduction
2. Background
3. Consultations by Rushmoor
4. Principal Issues
5. Risk Contour Analysis
6. Constrained cost benefit analysis
7. Shape and size of Risk Contours/PSZs
8. Proposed policy approach
9. Issues on which views are invited
10. Assessment
11. Proposals for development of the aerodrome and RLPR
12. Existing properties in the area
13. Response to detailed questions raised by the DETR
14. Other Issues
15. Legal/Financial Issues
16. Timetable
17. Financial Implications
18. Recommendation

Introduction

The purpose of this report is to consider a consultation published by the Department of the Environment, Transport and the Regions (DETR) relating to a review of airport public safety zones (PSZs). The consultation proposes that a PSZ should be established at Farnborough.

A copy of the consultation is available for inspection in the Members' Room. The document and the following background reports can also be inspected in Planning Policy and Transportation Services:

- DETR: Third party risk near airports and public safety zone policy: A report to the Department by consultants. October 1997

- National Air Traffic Services Ltd. R&D Report 9705: A crash location model for use in the vicinity of airports, 1997

The closing date for comments is 6 March 1998.

Background

The DETR's consultants note that risk is always present from naturally occurring hazards and from man's activities. There is no such thing as zero risk. On average, a man of 40 has a 1 in 600 chance of dying in the next year; at 60 this increases to 1 in 65. The average risk of death in a road accident is 6 in 100.000 per annum. Risk is a normal part of everyday life but not every risk is considered tolerable, particularly where the individual does not benefit from the risk.

PSZs are areas at the ends of runways at airports, within which development is restricted in order to minimise the number of people on the ground who are at risk in the event of an aircraft crash on take-off or landing. There are presently PSZs at twenty airports in Great Britain.

The existing system of PSZs was established in 1958 and has remained substantially unchanged. The previous Government announced the review in 1994. Consultants were commissioned to undertake technical work on whether it was possible to recommend a shape of PSZ, which related better to the statistical risk of accidents, and to advise on what development should be allowed or precluded in areas of greatest risk. They made recommendations to the DETR last year.

PSZs relate to safety on the ground. The Civil Aviation Authority imposes other requirements on maintaining obstacle free approach paths to aerodromes, through the system of licensing aerodromes.

Consultations by Rushmoor

The DETR has consulted the Local Government Association and Farnborough Business Aviation Limited which runs the existing Civil Enclave. Rushmoor has sent a copy of the consultation document to members of the Farnborough Aerodrome Consultation Panel encouraging them to respond direct to the DETR and offering to report any comments received by 20 January in this report. I will report any late comments at the meeting.

I have also sent a copy of the consultation to members of the Farnborough Aerodrome Inter Authority Liaison Group because any PSZ at Farnborough may extend into Hart and Surrey Heath. Farnborough College of Technology have been sent a copy since any PSZ is likely to include part of the College site.

Principal Issues

The DETR proposes to make no change to the broad PSZ policy that there

should be no significant increase in the number of people living, working or congregating in PSZs.

In examining PSZ policy issues the review also addresses many important issues affecting aviation risk which may have wider application. The review identifies a large number of issues inviting comments on seventeen separate proposals and raising thirteen questions on other detailed matters on which the Department's views are less firm at this stage.

Risk Contour Modelling

The DETR proposes to adopt a methodology developed by the consultants for assessing individual risk and modelling risk contours as a basis for PSZ policy. The model, developed for a sample of five airports, uses three elements to produce risk contours:

Movement data and crash records are used to calculate crash rates per movement for types of aircraft such as western airliners, executive jets and turbo props (Western airliners such as Boeings, McDonnell Douglas and Airbus have different crash rates to eastern jets such as Ilyushins and Tupolevs). When combined with data on movements by type for a given airport these provide an annual probability of a crash occurring.

The location of crash sites is modelled in relation to runways on the basis of global records of 354 accidents of aircraft over four tonnes; an older model is used for lighter aircraft.

The size of the area destroyed by a crash was calculated from historic data by aircraft type and it is assumed all people within such an area would be fatalities. When weighted for the mix of movements this provides an average crash area per airport.

When combined, these models enabled the consultants to model risk contours at the end of runways showing where individuals would be subject to risks of fatality of 1 in 10,000 and 1 in 100,000 per annum.

Constrained cost benefit analysis

The consultants developed a combination of cost benefit analysis and individual risk criteria termed 'constrained cost benefit analysis' (CCBA) as a method for setting limits on the degree of risk which is tolerable for people on the ground near airports. CCBA involves reducing risk to a tolerable level irrespective of costs and then further reducing it if the benefits of doing so exceed the costs.

CCBA requires an assessment of the level of risk which is tolerable by individuals not benefiting from the activity. A limit of 1 in 10,000 is proposed. It corresponds with the level used by the Health and Safety Executive in other industries and has been checked through a series of focus groups where people living near airports were asked their attitude to risks. A monetary figure also has to be set for the statistical value of a

human life. The figure applied is the one that the Department adopts for evaluation of road safety issues.

DETR proposes, in accordance with the consultants' recommendations derived from CCBA, that PSZs should correspond with areas subject to a risk greater than 1 in 100,000 per annum and that existing occupied development should be removed from areas subject to a risk greater than 1 in 10,000 per annum.

Shape and size of Risk Contours/PSZs

The shape of risk contours / PSZs resulting from the consultants' modelling are thin triangles tapering for a long distance from the runway end, whereas existing PSZs are shorter and funnel shaped growing wider with distance from the runway. The total area covered by PSZs remains substantially the same.

The consultants identified four options for setting PSZs. The DETR has chosen the simplest. It is based on standard triangles with fixed dimensions of 350 m wide and 3,500 m long for the busier airports, such as Heathrow, and two thirds of these values for less busy airports. These dimensions are calculated from 1994 movements and may change to reflect updating and allowances for future growth. The Department proposes to roll forward assumptions on aircraft movements every ten years.

Proposed policy approach

I in 10,000 risk contour

The DETR proposes to review the 1 in 10,000 per annum risk contour at airports at appropriate intervals and advise airport operators and local planning authorities as appropriate. Any existing housing and other development occupied by third parties for a high proportion of the day should be purchased by the aerodrome operator and removed. The paper notes that 1 in 10,000 contours are so close to airport runways that there is no development within them, apart from a very small number of properties at London Heathrow.

1 in 10,000 risk contour/PSZ

It is not necessary to remove existing development from outside of the I in 10,000 risk contour. However, it is proposed to restrict new or more intensive development. Within the I in 100,000 contour the DETR proposes not to approve:

- new housing and most types of new non residential development, including multi-storey car parks and transport terminals
- changes of use which would result in a higher density of human occupation (eg warehousing to industrial)

Non residential development with a low density of human occupation, such

as some warehousing, can be approved. It is not expected to be necessary to divert existing or proposed transport links.

A PSZ is specifically proposed for any new civil airport created at Farnborough'. It is the smallest of the twenty three airports mentioned; the others all have existing or proposed movement levels exceeding 50,000 per annum.

Issues on which views are invited

The Department seeks views on a number of more detailed matters which follow on from the consultants' work and upon which the Department's own views are less firm at this stage. The issues raised include:

- the most appropriate and practical approach to the question of extensions to existing housing and non-housing development
- the appropriateness and feasibility of different sized PSZs at an airport to reflect patterns of runway use
- whether there is a case for extending restrictions on sensitive new development such as schools, hospitals and sports stadia to certain defined areas outside the 1 in 100,000 contour
- whether PSZs should continue to start at, or close to, the end of the concrete
- whether playing fields, new or extended petrol stations and sites for storage of hazardous material are appropriate in PSZs
- the definition of warehousing and surface car parking as possible examples of low density development (no more than twenty people per acre of the ground footprint of the building and occupied for no more than eight hours, in relation to surface level car parking, are put forward for comment)
- whether notification of PSZs should be by large-scale maps or grid coordinates

Assessment

The projected national growth in aviation movements in the UK is likely to result in increased levels of risk to populations near airports. I believe that the consultation and the principal of a PSZ at Farnborough should be welcomed. It represents a clear acceptance by the Department that there is an element of risk to people on the ground and that it is the DETR's responsibility and it has to be managed.

The PSZ review breaks new ground by proposing a methodology for the establishment of aviation risk and tolerability levels to people on the ground. When third party risk has previously been debated, such as at the Manchester second runway planning inquiry, decision makers have had to consider alternative methodologies and assumptions proposed by participants and reach a view on what is an acceptable level of risk. The move towards an established methodology will assist any debate on safety issues at the Rushmoor Local Plan Inquiry.

The precise final size and shape of proposed PSZs is not yet clear. The DETR's consultants recommended dividing airports requiring restrictions into two classes, using triangles with fixed dimensions of 0.35 kilometres wide and 3.5 kilometres long for busier airports, such as Heathrow, and dimensions of two thirds of these values at less busy airports. These dimensions, based upon 1994 movement figures, may be updated and amended to reflect future potential traffic growth. The DETR's approach of fixing dimensions of PSZs based upon two classes may mean that Farnborough is likely to benefit from greater protection through a PSZ larger than it might statistically justify, because the number of proposed movements are considerably less than at other airports in the proposed two classes.

A PSZ at Farnborough will have implications for proposed land uses within the Aerodrome and on other property in the area. It is not possible to produce a definitive plan of the areas likely to be affected by any PSZ due to the uncertainty over the final dimensions and the point from which it is to be measured. A large scale plan and an overlay of a PSZ, to the current projected dimensions, will be available for inspection at the meeting.

A PSZ at the western end of the main runway will extend over the Basingstoke Canal and undeveloped MoD training land, extending into Hart towards Tweseldown racecourse. Any western PSZ is unlikely to have any significant implications due to the uninhabited nature of this area and the very strong constraints to development posed by its existing Site of Special Scientific Interest and Special Protection Area status.

At the eastern end of the main runway, any PSZ will affect areas of potential redevelopment on the Aerodrome and a narrow triangle of private properties which may extend across Farnborough as far east as the borough boundary. The implications at the eastern end of the runway can be subdivided into those affecting proposals for development of the Aerodrome, including those in the Rushmoor Local Plan Review (RLPR), and those affecting existing properties.

Proposals for development of the aerodrome and RLPR

No information is yet available on the area likely to be affected by a 1 in 10,000 risk at Farnborough within which there should be no development. It is assumed it will be entirely within the boundary of the operational Aerodrome. Between 40% and 80% of any proposed PSZ is likely to be on MoD land within the main 'factory' site; the exact proportion will depend upon its dimensions and the point from which it is measured. The main effects of any PSZ will be on use of employment land and the proposed internal road network.

Employment land

Policy FA3 of the deposited RLPR allocates land on the main 'factory' site for employment, a proportion of which must be for research and development uses (as amended by Pre-Inquiry Changes). Policy FA3. 1

states that:

> *'Planning permissions on land in the south east of the main factory site and part of the RAF Officers' mess, which are under the approach path to the main runway, will be given only when the proposals conform to any height and land use restrictions applied by the CAA....'*

This policy and accompanying text (para 11.115) was formulated when it was thought unlikely that the DETR would designate a PSZ at Famborough (as outlined in para 11.34 of the Plan). However, there would be a requirement to protect approach surfaces to the runway under separate Civil Aviation Authority (CAA) licensing provisions.

New employment development is now likely to be impracticable within the area affected by any PSZ. The development potential of this area may be restricted to reuse of existing buildings. These amount to between 7,000 and 18,000 sq m of floorspace with a past occupancy of up to about 200 employees. Reuse of buildings in this area may prejudice the Council's objectives of securing a comprehensive redevelopment. If there are any established rights it might be better if the part of the site affected was cleared. The master plan exercise for the Aerodrome (my report no. 9/98) proposes to make an allowance for the lost floorspace made elsewhere within the main 'factory' site.

Any PSZ is likely to include two grade two listed buildings within the Aerodrome; Gi (a former RAF HQ) and G29 (a former hangar). These are within the proposed employment area, their potential for a viable alternative use may be affected.

The DRA Assembly Hall, which has a capacity understood to be about 400, is likely to adjoin any PSZ. It may not be desirable for safety reasons to encourage its continued use.

Internal road network

Policy FA8 of the deposit Local Plan proposes a new district distributor road through the Aerodrome site from the Arrow Road / Elles Road junction to the vicinity of the Queens Hotel roundabout. This road will have to cross the PSZ. The DETR considers that individuals using transport routes across PSZs will only be in the area for a minute part of the day. As a result, the consultation says:

> *'it is not expected to be necessary to divert any proposed transport links, but the Department will consider the matter on its merits in each case.*

I believe that detailed consideration may need to be given to the precise route of any road. There may be advantages in not having road junctions in the PSZ, which might lead to individuals staying longer due to queueing.

Master plan

Members will recall that they considered a draft master plan for the Aerodrome in October (my report No. 74/97). Consideration of a final version was deferred to allow completion of a traffic impact study. The master plan has been amended to try and take account of the potential PSZ (see accompanying report No. 9/98).

Affect on local plan

I believe that, if the DETR does designate a PSZ at Farnborough, it would be appropriate to amend the Local Plan by deleting the policy and text and replacing it with a section for information which identifies the PSZ, the general policy approach and the area to which it applies. Such an amendment could be introduced as a formal proposed modification following the Local Plan Inquiry. I propose to make a submission to the inspector conducting the Inquiry on this basis.

Existing properties in the area

It is understood that no private properties will be in the 1 in 10,000 area requiring clearance. It is not possible to be precise on the properties which would be affected by a PSZ based upon a 1 in 100,000 risk area. It is likely to include the following existing uses:

- between about 80 and 250 residential properties including houses, flats and sheltered accommodation
- part of Farnborough College of Technology, including teaching and car parking areas
- a public house
- a car showroom with three pump petrol filling station
- a tyre and exhaust centre
- buildings in office use
- doctor's surgery and nursery school
- houses offering bed and breakfast and chiropody services

The area under the approach path to Farnborough is already substantially developed. Potential for infill development or more intensive redevelopment is also limited by Tree Preservation Orders and policy designations such as the Farnborough Park Low Density Housing Area. The Farnborough College of Technology site also appears to be developed to its maximum potential. The potential impact of any PSZ for development proposals, which may now be refused on safety grounds, appear to be fairly limited.

Response to detailed questions raised by the DETR

The DETR's consultants considered, on the basis of CCBA, that extensions of individual houses within PSZs could be approved. The DETR is not satisfied that it can be translated into clear cut guidance which local planning authorities can apply consistently, due to the cumulative effect of extensions and different considerations applying to whether proposals are

intended for the existing occupier. Therefore, it proposes to allow extensions where they would not increase the number of households living in a property and invites views on the most appropriate approach. I believe that controls on the number of households could be achieved through prohibiting 'granny annexes' and any extensions or changes of use which could result in more households in houses in multiple occupation, or self contained accommodation such as flats.

The proposed approach to non-residential development, of only allowing extensions where they would not increase the number of people working or congregating in an area, may prove difficult to administer, particularly where there are proposals to provide more space for an existing occupier. While it might be controlled through some form of standard planning obligation on maximum levels of occupancy to accompany the planning permission this would pose an administrative burden and prove very difficult to monitor and enforce.

At Farnborough, about 80% of movements are on the main runway. The majority of movements on the secondary runway are by helicopters which usually follow a different approach path. About 80% of movements on the main runway involve take offs and landings towards the south west. There may be a case for different size PSZs, to reflect the fact that the crash frequency rate for aircraft appears to be greater for landings than for take-offs.

The DETR recognises that some types of major accidents, such as those involving schools and hospitals, may have consequences beyond the immediate fatalities and casualties. They term these 'societal risks'. CCBA may not fully address the concerns in such cases, raising the question of whether further safety measures should be adopted even though they would not be directly cost-beneficial. The Department therefore welcomes views on not allowing new development of certain sensitive types within defined areas outside the 1 in 100,000 risk contour.

Farnborough College of Technology is an example of such a sensitive use which is likely to fall partly within and partly outside any defined PSZ. The College is already substantially developed with little room for further on-site expansion in the short or medium term until the relatively new buildings reach the end of their economic life. I believe that there may be a case for restrictions outside of a defined PSZ.

There may be a case for also specifying other sensitive uses such as creches, nurseries and places of public assembly. Such uses might be defined in terms of some or all of the Town and Country Planning (Use Classes) Order 1987 Class DI (Non-residential institutions) and / or Class D2 (Assembly and leisure).

Whether any PSZ should start at the end of the runway, or from the threshold (where aircraft aim to land), may be significant at Farnborough. At the eastern end of the main runway the threshold is presently located about 300 metres in towards the west. There is a possibility it may be displaced a

further 250 metres to meet CAA requirements to maintain an obstacle free approach surface. If a future operator wishes to maintain the existing take-off distance available, it may be necessary to extend the runway by up to about 150 metres at the eastern end. There may therefore be a difference of up to 700 metres between a PSZ measured from the end of the runway and one measured from a threshold. The area of any PSZ within the existing aerodrome boundary is likely to be nearly 80% with a further displaced threshold, falling to below 40% if the runway is extended. The number of private properties affected **will** be between about 80 and 250.

I understand that the dimensions of proposed PSZs have been determined using a crash consequence model which plots distance from the runway, rather than from any threshold. For crashes on take-off, the distance from the threshold is not relevant. I consider that the end of the runway may be a more appropriate start point. It would also represent a more precautionary approach since any PSZ will then extend further out.

The location of playing fields in PSZs is unlikely to be an issue in Farnborough. Whilst any open space is likely to have a low average occupational density, it might be appropriate to discourage equipped children's play spaces. The Council is not in a position to comment upon the degree of any additional risk posed by existing or proposed petrol filling stations or areas of storage of hazardous materials.

The DETR's proposed definition of low density development is no more than twenty people per acre of footprint of building. This equates to one employee per 202 sq m for a single storey building. Such a density is well below typical averages for warehousing of one employee per 44-60 sq m identified by recent national occupancy surveys. The definition would therefore appear to be an appropriate example of a low density. However, such an approach ignores the fact that some activities, such as storage of materials and cars take place outside and the degree of site coverage by buildings may vary. It may be more appropriate to express any definition in terms of persons per hectare rather than per footprint area. This would then address uses such as car storage etc.

I believe that notification of PSZs in map form would be more convenient to the Council, easier for the public to understand and involve the DETR in little additional expense.

Other Issues

The proposed PSZ takes no account of Airshow flying. The PSZ impinges on the South Gate area which is one of the main entrances and a marshalling area for the Airshow. There may be a need for the DETR to specifically address issues arising from the Airshow.

The method for assessing risk takes no account of local factors, such as ground levels, which may be of significance at Farnborough. I am concerned that these should be evaluated by the DETR in any decision.

I believe that it may be helpful to send the DETR a detailed pack of information on existing and proposed land uses within the likely area of any eastern PSZ at Farnborough, to inform their deliberations.

Legal/Financial Issues

I understand that it is normal practice to declare any PSZ on land charge searches on affected properties when it has been formally designated.

PSZ policy only applies to development needing planning permission; it does not affect property owners" Permitted Development' rights. There will be issues of interpretation in respect of its implementation which will need to be resolved, such as where property curtilages or buildings fall on the boundary and are partly inside and partly outside the zone.

PSZ policy is presently administered by the CAA which advises local planning authorities on behalf of the DETR. The CAA examines all planning applications in PSZs. Where planning permission for a development is refused, or conditions imposed, solely on the basis of a CAA recommendation, the CAA or local planning authority may have to acquire the site following a purchase notice. The local planning authority would then claim compensation from the CAA who would seek to recoup it from the airport operator. PSZs are designated through DETR circulars. Circular 2/92, 'Safeguarding Aerodromes, Technical Sites and Explosives Storage Areas' which provides the existing framework, will need to be amended in due course.

There is no general right of compensation to owners of property which is within a designated PSZ.

Timetable

The closing date for representations is 6 March 1998. I understand that the DETR hopes to reach decisions on some of the main issues by May, in time for a session on safety at the planning inquiry into the proposed fifth terminal at Heathrow. It would be helpful if the DETR reaches a decision regarding any proposed PSZ at Farnborough, and on the land use controls which would apply, in advance of our Local Plan Inquiry which is scheduled to begin in July.

Financial Implications

This report has no direct financial implications for the Council.

Recommendation

The proposal for a PSZ at Farnborough relates to any new civil airport created, it does not pre-judge the result of the local plan inquiry. I propose to send the DETR a copy of this report and of the plan displayed at the

meeting showing the possible extent of any proposed PSZ at Farnborough.

It is recommended that the Department of the Environment, Transport and the Regions be informed that Rushmoor Borough Council:

- welcomes the principle of a Public Safety Zone at Farnborough
- wishes to make the detailed comments on the Proposals and Questions set out in this report
- would welcome the opportunity to have further discussions with the Department of the Environment, Transport and the Regions and Civil Aviation Authority on the implications of any Public Safety Zone at Farnborough
- will expect the Department of the Environment, Transport and the Regions to provide evidence and appear at the forthcoming Rushmoor Local Plan Inquiry on the issues of Government policy for Farnborough and the application of Public Safety Zone policy to any new commercial airfield

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Created	9th February 1998
Valid	Indefinitely
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Chlorine leaks shut down water treatment plant

TAMPA — The Hillsborough River Water Treatment Plant typically pumps 80 million gallons of water a day, but two chlorine leaks shut the plant down for more than four hours Monday morning.

The first leak was reported at 9:30 a.m. The Rogers Park golf course was evacuated, because it was directly in the path of the chlorine gas cloud. Exposure to the chemical can be irritating, and in high doses, can be fatal.

Plant employees were almost allowed back in at 11:15 a.m., before a second line blew and sent a second cloud of chlorine into the air.

Everyone living within a one-mile radius of the plant got two phone calls from the city's reverse 911 system. The first call asked them to stay inside with their doors and windows locked. The second call, after the second leak, told them to leave.

Officials say the water supply was never tainted and residents won't have to make any further adjustments.

Nine people were taken to two hospitals after being exposed to the chlorine gas. One plant employee remains in serious condition.

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Analyzing the Daily Risks of Life

RICHARD WILSON
Harvard University
Cambridge, Massachusetts
1979

The world seems a very hazardous place. Every day the newspapers announce that some chemical has been found to be carcinogenic, or some catastrophic accident has occurred in some far-off place. This leads some of us to hanker after a simpler world where there are fewer risks to life. But does such a world really exist?

If we look back at the world of a century ago, we find that expectation of life was SO years; now it is 70 years. Therefore the sum of all the risks to which we are now exposed must be less than it was. We find that many of the large risks of the last century have been eliminated, leaving us conscious of a myriad of small risks, most of which have always existed.

The moment I climb out of bed I start taking risks. As I drowsily turn on the light I feel a slight tingle; my house is old with old wiring and there is a small risk of electrocution. Every year 500 people are electrocuted in the United States. I take a shower, and as I reach for the soap, I wonder about the many chemicals it contains. Are they all good for the skin, as the advertisements claim? My clothes have been cleaned with the best bleaching detergent. Most bleaching agents contain a chemical that fluoresces slightly in the sunlight to enhance the whiteness. Does this make bleaches carcinogenic?

I ponder this risk as I walk down to breakfast, taking care not to fall upon the stairs. Falls kill 16,000 people per year-mostly in domestic acci-dents. Shall I drink coffee or tea with my breakfast? Both contain caffeine, a well-known stimulant which may be carcinogenic. I have a sweet tooth; do I use sugar which makes me fat and gives me heart disease, or saccharin which we now know causes cancer? It is better to abstain.

After breakfast I make a sandwich for lunch. My son likes peanut butter. But improperly stored pea-nuts can develop a mold which produces a potent carcinogen-aflatoxin. In Africa and Southeast Asia, where aflatoxin appears more frequently, it has been blamed for numerous cases of liver cancer. In our (less natural) society storage facilities are better, so the risk is less-but it is not zero.

I prefer meat. But Americans, like other prosper-ous people, eat too much meat. It is not certain, but a meat-heavy diet probably contributes to cancer of the colon.

I live seven miles from work and can commute by car, by bicycle, or by bus. Which has the lowest risk? To travel by bicycle would keep my weight down, and bicycle riding does not cause pollution... but statistics show that it is more likely to involve me in an accident. And since a bicyclist is unprotected, fatal accidents are also frequent on a bicycle. A car would be safer, but a bus is safest. I am happy that I no longer have to choose between a horse and a canoe; both are more dangerous (per mile) than a bicycle.

As I approach Boston, I see the urban' haze caused by air pollution. There are toxic parts of air pollution which are not visible, as well. The risk to life caused by air pollution is high. Asthma victims have known this for a long time and fled the industrialized eastern United States for the purer air of the West. A press release from a government laboratory states that air pollution kills 20,000 people a year in the eastern United States. Air pollution, though still bad, has been reduced in most cities.

I remember the pea-soup London fogs of my youth caused by burning soft coal, where I could not see ahead ten feet; and the infamous week in Decem-ber of 1952 where 3,000 people died from air pollution in four days.

I go to a committee meeting in a small, unventi-lated room. Although I don't smoke tobacco, half of the committee does, and I am exposed to the poison which causes 40 per cent of all cancers and kills 15 per cent of all Americans. Even though I breathe less tobacco smoke than my smoking colleagues, I often get a headache. One of my friends, who is more allergic than I, wears goggles at work.

At mid-morning I take a drink of water. The water tastes of chlorine, showing that the city's sanitation engineers use chlorine to kill microbes in the water. By such methods the country has nearly wiped out cholera and typhus. But the chlorine reacts with organic matter in the water to produce many known carcinogens. One of them, chloroform, is produced in a concentration of 100 parts per billion; enough to present a health hazard.

discovered buried baghouse dust – the toxic debris collected by the air-emissions filters in metal foundries. According to Brian Allick, the recently retired manager of field services for the city's building inspectors, his department had the option of tearing the building down, but the city's lawyers advised against it; demolition of the structure could have left the city liable for the huge cost of cleaning up the site. (When Usaren went into receivership even the banks didn't want the building, because under Ontario law anyone who comes into possession of a polluted site can be held fully liable for clean-up costs, even if they didn't create the pollution.) Allick says that's why the receivers returned control of the property to Frank Levy in 1994.

After getting the building back, Levy was soon in trouble again. In February, 1995, the city charged him with a by-law infraction for allowing waste to accumulate at the site. He pleaded guilty, but was fined a mere $200.

Not long after, Levy entered into a written agreement on the use of the building with a company called Plastimet Inc. According to the agreement, which has been filed as evidence with Ontario's Environmental Appeal Board, Levy gave Plastimet the right to store and recycle plastics at the site in return for a minimum $2,400-per-month "licence fee," a set charge on every ton of material going into and out of the building, and $20,000 per year in "consulting fees." In return, Levy agreed to "faithfully serve and use his best efforts to promote the interests of Plastimet." The operator of Plastimet was a local businessman named Jack Lieberman.

Like Frank Levy, Jack Lieberman lives in Hamilton's posh Westdale neighbourhood. And like Frank Levy, he's had his run-ins with the authorities. Lieberman is part of what might be called Hamilton's "scrapocracy," the hierarchy of waste-disposal and environmental-service companies that has evolved in the Steel City. At the top of the junkyard pecking order are the diversified, high-tech operators. In the middle are the dealers who may actually recycle some of the stuff they pick up, but who also violate zoning laws, health, safety, and fire codes, and any other standard or regulation that constitutes an expense. At the bottom are the fly-by-nighters who collect disposal fees on trash, stockpile it in rented warehouses, and then walk away. Then there are those, like Jack Lieberman, who fit somewhere in the latter two categories.

In 1992, one of Lieberman's companies, CanAm Plastics Inc., shut down operations at a building and left it stuffed with 4,000 tonnes of plastic waste. Two years later, he was sentenced to six months in jail for defrauding the Ontario environment ministry and the Ontario Development Corporation. As the CBC's *fifth estate* revealed this past January, CanAm had applied, successfully, for a government grant to import recycling equipment, but in the application Lieberman had inflated the cost by hundreds of thousands of dollars. He served the minimum one-third of his jail time, and was released September 22, 1994.

In October, 1995, Lieberman moved Plastimet Inc. operations into the building he'd licensed from Levy on Wellington Street North, a location with not only a poor environmental track record but a history with the fire department as well. It had been the site of numerous arsons over the years, with the department having responded to no fewer than twenty-three calls there since 1985. Eventually, Plastimet too ran afoul of the fire department. In October, 1996, the company was cited for twenty fire-code violations at the site, including failure to have a required sprinkler system in place. Incredibly, it was given almost a full year – until September 15, 1997– to fix the problems.

Fire officials were scheduled to meet with Lieberman last July 11 to discuss his progress. By then, Plastimet had complied with the easiest requirements, but the million-dollar sprinkler system had not been installed, nor was there a fire-safety plan in place, and (most importantly) the requirement to reduce the amount of materials stored on site had not yet been met.

The meeting with fire officials, of course, never took place. Two days before it was to happen, the building went up in flames.

Hamilton Fire Department Pump Truck No. 1 arrived on the scene at 7:44 p.m. and, with it, Platoon Chief Jim Warden. As his truck pulled up, the veteran firefighter noted that flames engulfed the entire 80,000-square-foot property from end to end. The building's roof soon collapsed. Warden knew the strategy would have to be defensive.

Workers were evacuated from the ▸

neighbouring Ball Packaging building, and aerial water towers doused the building to keep it from catching fire too. The fire department called Hydro to shut off the power because overhead wires along Wellington Street were already burning, and officials radioed for trains to be stopped so that hoses could be laid over the tracks.

At 8:06 p.m., after Jack Lieberman advised the department that plastics and polyurethane foam were stored inside, Acting Deputy Chief James Cardwell ordered all firefighters to wear self-contained breathing apparatus (SCBA). He notified the ministry of the environment that a large amount of what was probably toxic smoke was going into the atmosphere, and he ordered the General Hospital and the Hamilton-Wentworth Detention Centre, both nearby, to shut down their air-handling systems. As thousands of litres of contaminated water runoff swept down the street and into sewers, calls were placed to Ontario's Spills Action Centre. "This is it. This is the big one," one caller noted.

Fire Chief Wes Shoemaker arrived at 8:25 p.m., and set up his command post in a parking lot north of the building. He began coordinating what would eventually be a team of 225 men fighting the blaze in rotating twelve-hour shifts. He took what firefighters call a "surround and drown" approach. He stationed pumper trucks and cranes around the building, and had eight unmanned master-stream hoses directed at the blaze. Roughly 45,000 litres of water per minute poured over the fire. Meanwhile, a roster of other agencies and private contractors were called in to help, including thirty-four industrial vacuum and tanker trucks that tackled the problem of the water runoff.

The chief, a veteran of the Edmonton fire department, had been on the job in Hamilton less than two weeks. He conferred with his senior staff who told him about the plastics on fire and the heavy contamination of the property. Nevertheless, Shoemaker decided not to declare the fire a "hazardous materials incident," which would have meant a precautionary evacuation, the outfitting of firefighters with extra protective equipment, and special decontamination procedures for them at the scene.

Within hours, some problems became apparent. For example, each firefighter was equipped with a thirty-minute – not one-hour – oxygen tank. Yet it could take fifteen minutes just to move into position and as long again to move back. So when the tank alarms sounded, firefighters fiddling about with new air tanks inevitably gulped unfiltered air in the very places where their exposure was the greatest.

Moreover, fire-safety officers later reported that some men worked in smoke without SCBA. Many, taking brief rests away from the fire, removed the cumbersome respiratory equipment. Many ate and drank from the canteen set up in the fire area. One report notes, "Pump 11 crew all had exposure to smoke conditions that were very heavy at times, also to the mist which burned eyes."

Parents made their children breathe through napkins as a sort of makeshift air filter. **Black circles quickly formed** over the mouth area

The fact is, though, that through much of the first night of the fire, no-one knew exactly *what* was spewing into the air. About forty minutes after the blaze got started, the fire department requested environment-ministry staff be sent over with specialized air monitoring equipment. When the ministry worker arrived, he took readings with a ninety-dollar handheld instrument whose measuring tubes were past their expiry date. The fire department desperately needed the ministry's Trace Atmospheric Gas Analyzer (TAGA) van, but the million-dollar vehicle was stationed in Toronto. (Before provincial budget cuts, Hamilton had had its own TAGA unit.)

Communications between agencies took on a Keystone Cops dimension. The Hamilton fire department called the ministry in Toronto for two hours, to no avail. The TAGA operator, it turned out, was on holiday and had taken his pager with him outside the province. Eventually the message got through, and TAGA staff went to the van to begin calibrating its complex equipment. But Hamilton fire-department officials were never informed. Frustrated, they called Acting Mayor Dave Wilson and local MPP Lillian Ross, who in turn contacted ministry staff in Toronto. Apparently whomever Wilson and Ross talked to didn't know what was going on, because the two politicians were informed that ministry staff in Hamilton were perfectly competent to handle matters, and the city could rent sophisticated monitoring equipment privately if it wanted.

By now it was the middle of the night and Lillian Ross was furious. She woke up the provincial Environment Minister, Norm Sterling, with a 3 a.m. phone call to get authorization for the dispatch of the TAGA van. Even then the van didn't get to the scene until almost 6 a.m. Thursday. The driver took a wrong turn on the outskirts of Hamilton and wound up in Dundas.

That morning, Thursday, July 10, residents in the vicinity of the fire awoke to find their cars coated in a gummy black substance.

By noon, the firefighters still hadn't reached the core of the blaze. Huge volumes of water – most of it, in fact – were simply bouncing off the building's collapsed roof, and so never reached the actual fire. Some firefighters stood for hours in lakes of water runoff which contained elevated levels of lead, chrome, zinc, and cadmium. The runoff was so acidic it etched the surface of the concrete, ate away at the bright orange stripes on their rubber boots, and when it flowed over their boot tops burned their skin. "The water picked up by our vacuum trucks was so contaminated it had to be disposed of as toxic waste," says Mitchell Gibbs, a manager at TEAM-1 Environmental Services, an emergency-response contractor whose crews were at the scene.

Wind shifts were a constant problem. When Platoon Chief Jim Warden returned for his second shift, at 4:30 p.m., Thursday, he found the department's command post so engulfed in smoke that he had to relocate it and all his support staff, including firefighters on break, police officers, and volunteers from the Salvation Army and the Red Cross.

Just how hazardous the situation was at this point is a matter of contention. By Thursday afternoon, officials on the scene

were getting back some airborne-contamination data from the TAGA van, which had spent much of the morning up on Hamilton Mountain calibrating its equipment, but the data weren't dire enough to trigger an evacuation. Bill Hunter, the region's director of environmental health, says most of the smoke to that point was going high into the sky, carrying contamination away, and the air inversions and wind shifts were so fitful as to pose no imminent danger.

Many people in the area, though, had a different sense of the situation. "The wind sometimes shifted by 180 degrees in minutes," says Mitchell Gibbs. "Chemical fallout rained down constantly on the area, killing shrubs and corroding trucks and mirrors, even pitting steel. Our men wore chemical suits and full respiratory protection. The strangest thing was for them to be standing beside people in ordinary street clothes. A cloud of fallout would descend, completely blocking from sight an unprotected person just feet away."

People were still out watching the fire, but some local residents were getting nervous. Ann Gallagher recalls looking out her window that afternoon and not seeing the end of her backyard for the smoke. "I went outside and asked a fire official why we weren't being evacuated," she says. " 'Don't worry,' the man told me. 'It's just a change in wind direction.' This from a man wearing a gas mask!"

Witnesses say Hamilton General Hospital was engulfed in grey or yellow smoke about seventy-five per cent of the time. The hospital was on standby for evacuation, with more than thirty ambulances and emergency vehicles lined up outside, but the city's Emergency Task Force, in conjunction with hospital administrators, decided that shutting off the building's ventilation system during wind shifts would suffice. A worker was stationed on top of the building to tell staff in the basement via two-way radio when to close the vents.

It was not a system that inspired confidence, nor was it particularly effective. The smell of smoke and burning plastic inevitably made its way inside. Indoor air tests found elevated levels of hydrogen chloride. Employees' eyes and throats burned and some were nauseated. Nurse Pat MacDonald, who worked two twelve-hour shifts during the fire, insists that patients, too, were exposed to the odours and gases. She still can't believe the hospital wasn't evacuated, when only thirty patients would have required complex interventions to be moved. The rest could have left by foot, wheelchair, or stretcher. "When we expressed concern about serious health risks, the hospital responded only to our superficial symptoms," says MacDonald. "Staff members were each issued a package of throat lozenges, a bottle of eye drops, and an incident report form. It was unbelievable."

Scott Rowand, president and CEO of the hospital, admits the symptoms his people felt were real enough, but maintains that the environment ministry assured the hospital that air quality was within acceptable limits. "There was more risk in moving patients than in keeping them here," he says.

Some firefighters stood for hours in runoff water that was **so acidic it ate away** at the bright orange stripes on their rubber boots

Likewise, back at the fire, nothing shook the "let's not panic" approach. A decontamination unit, essentially a portable wash and shower station for firefighters, sat at nearby Station 4, unused for the duration of the fire. Fire Chief Shoemaker apparently didn't think it necessary to call in the support of crews or equipment from surrounding cities or towns to help fight the fire, though they were available. Instead, his men continued working long shifts which increased their exposure. As the battle dragged on, firefighters were told they could take refuge in the cabs of their trucks, with or without masks on, leaving their hoses mounted on special stands, but the truck cabs offered no special air protection.

By the early morning hours of Friday, July 11, however, officials were starting to worry. Air quality was worsening – as water cools a plastics fire, the smoke and fallout increase. Shoemaker met with his senior officers, along with health and environment officials, and they decided to take more aggressive action. They sent in bulldozers to clear debris so that firefighters could get closer to the blaze. But there was still no evacuation order.

That morning, Jim Riosa, an area resident, awoke from his sleep to a shocking sight. "The neighbourhood looked like a scene from Sherlock Holmes's London," he remembers. "I went outside but couldn't see for more than a few feet. My eyes and throat burned. I called the police and asked whether it was safe to breathe this stuff. The cop answered, 'Let's just say that if I had a wife and child, I wouldn't let them stay in it.' That's when we decided to leave for our cottage."

It was on Friday that the city finally declared a state of emergency, and announced a "voluntary evacuation." People living in an eleven-block area around the fire were advised to leave. But since public-health officials still considered airborne chemical levels to be short of the danger threshold, no-one would be compelled to. And so it was up to ordinary citizens to decide for themselves. About 650 left; several did not, including an elderly woman who said her nose would tell her when it was time to go. "The attitude was basically: 'We'll evacuate you if you really want us to,' " says resident Ann Gallagher. "There was no sense of urgency at all."

The evacuation itself was a botch. When it was announced, the police officers who were supposed to direct people away from the area were still at their stations, awaiting delivery of air masks and chemical-proof goggles. So as people left their homes, they headed towards the one place where they thought they could get instructions: the fire scene.

Eventually, the masks, chemical cartridges, and goggles were rounded up, and the police hit the streets. Community centres took people in but most residents found accommodation with friends or relatives (which pointed up just how simple an earlier evacuation might have been). As in a time of plague, authorities affixed a sign to the door of each vacant house. Jim Riosa says: "It was very disturbing for residents on my street who were not told to evacuate to watch police in gas masks lead people away on nearby streets." People wondered, he says, does the danger really end at the stop sign? ▸

By Saturday morning, July 12, two and a half days after the fire had started, but barely more than twelve hours after the evacuation announcement, the fire was all but extinguished. By 1:30 a.m., Sunday, July 13, the fire department's thermal-imaging camera could detect no heat from the debris.

The environment ministry ordered the property owner, Levy, and Plastimet to clean up the mess, but the ministry eventually had to take control of the site. It hired a private contractor to deal with fire-related damage, and ordered a full environmental cleanup, which is ultimately to include removal of tonnes of metal-contaminated soil.

When residents returned to their homes, they were told not to worry. The region's Medical Officer of Health, Dr. Marilyn James, said it was safe to eat garden fruits and vegetables as long as they were washed first, though she did advise residents to wash their patio furniture with soap and water, and "put a little elbow grease into it." Those who lived in the evacuation zone were offered up to $250 compensation for their inconvenience.

Just over a week after the disaster, fire and health officials held a public meeting to deal with any outstanding concerns. They began by, in essence, congratulating themselves for a job well done fighting the fire and protecting the public. After all, there had been no fatalities, and residents were told their chemical exposure levels were acceptable.

But people were livid that the environment ministry hadn't issued more and sterner warnings. Local media had by then revealed that no-one had acted on earlier environment-ministry recommendations to clean up the property, and that Plastimet had been given a full year to comply with the fire code. The meeting erupted. A Greenpeace member pointed out that the fire had released more dioxin in three days than all of Canadian industry over a one-year period. "If this is what you guys consider a job well done," said Ann Gallagher, "I don't even want to be on this planet when you actually screw up!"

Over the next few weeks, the damning scientific numbers started to come out. Wastewater tests showed dioxin levels at 210 picograms per litre, whereas the provincial environment ministry's maximum allowable standard is 15 picograms. (And it's worth noting that Canada's standard is some 1,700 times *less* rigorous than that of the United States.) Some 60-million of the 100-million litres of water dumped on the fire wound up draining directly into Hamilton Harbour, less than 600 feet from the site. The level of zinc alone in the runoff, at 2,000 times that of normal surface water, was enough to kill fish in Lake Ontario.

Airborne toxin levels were even more distressing. Environment ministry tests done during the fire showed hydrogen chloride concentrations regularly hovering at 470 micrograms per cubic metre on residential streets. (The ministry's standard for acceptability is just 60 micrograms/m^3, and 20 micrograms/m^3 is typical on a smoggy Hamilton day.) The gas peaked at 780 micrograms/m^3 near the hospital and detention centre. Benzene reached levels of 250 parts per billion compared to the typical 2 parts.

A McMaster University chemist, Brian McCarry, did his own tests, and his air samples showed levels of another known carcinogen, PAH, at 800 micrograms/m^3 whereas 0.2 to 5 is the norm for Hamilton. Perhaps most frightening of all, the concentration of dioxin in the air, which normally runs between 0.02 and 0.04 picograms/m^3 in Hamilton, was as much as *10,000 times higher* near the fire.

That's what the firefighters breathed when their oxygen ran out, and what area residents who turned out for SmokeFest '97 took into their lungs.

As this information started to emerge, Hamilton health officials hastily revised their earlier advisory. Dr. James told people to peel their fruits and vegetables, and not to allow pets or children to play on lawns until tests showed dioxin levels had receded to normal background levels. They promised to follow up health concerns with a household questionnaire and a survey of hospital admissions. But even as people began reporting headaches, nausea, diarrhoea, and coughing spells after the fire, environmental health officer Bill Hunter dismissed many of the complaints as psychological reactions caused by stress and worry about the fire.

It wasn't long after the fire that more than one hundred firefighters – usually a hardy lot – began reporting illnesses and symptoms, everything from sore throats and ▸

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skin rashes, to infected eyes, swollen and burning feet, respiratory and gastrointestinal problems. Nine went on short-term disability leave, two contracted chronic chemical-induced asthma, and one, twenty-eight-year veteran George Cook, remains off duty. Cook had particularly bad luck at the fire. While delivering air masks to other firefighters, he hadn't been able to drive the pickup truck and wear his face mask at the same time, so he left off the mask. When he tripped on his way to the canteen area, he ingested a small amount of highly contaminated water. Medical tests show his lungs now work at only fifty-eight per cent of their capacity.

The deepest concern of both firefighters and area residents is for their long-term health. "Chemicals in the smoke have been associated with cancer of the liver, lungs, and brain," says Henry Watson, president of the Hamilton Professional Firefighters' Association. His members, he says, accept that their jobs involve risk, but believe their safety was needlessly compromised by senior fire officials who didn't order extra protective measures or call in reinforcements from other cities and towns. People who live in the area are still angry too, and include public-health officials on their list of the blameworthy. "They completely failed to protect the public by not demanding an early evacuation," says Charlotte Fournier. "They shouldn't keep their jobs."

Asked now about how decisions like the one not to evacuate were made, Chief Shoemaker refers constantly to the "decision-making team," which includes both his own senior staff, and officials from the public-health department, the environment ministry, and so on. As a newcomer to Hamilton, Shoemaker says, he had to rely on his deputy and assistant deputy to run the operational side of the response while he "mainly interacted with the other agencies in determining how we should respond to a rapidly changing situation."

Shoemaker says that, faced with a similar fire, he wouldn't do anything differently, at least tactically. "I guess we learned a few things, like not sending men up in baskets, or at least making sure you can provide them with continuous air supply." But he stands by the decision not to evacuate early. "Our response might have been different if this had been an overturned tanker trailer with dangerous chemicals inside," he says.

It's a position that reveals some disastrous shortcomings in Canada's industrial firefighting policies and standards. Fire codes are provincial but are unevenly enforced by municipalities. The codes don't specifically set out when an evacuation should be ordered, nor is there a hard-and-fast definition of a "hazardous materials incident." These things are entirely subjective. And so long as there are no tough, consistent standards, says Sean McManus, president of the Canadian Chapter of the International Association of Firefighters, "fire and health officials will continue to flip the coin on public safety."

Residents spent almost two full days **living in smoke and fallout** before an evacuation was announced – and then it was voluntary

Many in Hamilton insist officials there called it wrong. "No matter the eventual outcome, they played God with people's safety," says TEAM-1's Mitchell Gibbs. "It's commonly understood among emergency-response professionals that, in the face of unknown parameters with a chemical spill or fire, you over-protect. You assume the worst until empirical evidence allows you to downgrade the emergency." Indeed, the "Emergency Action Guide for Fires in Plastics Storage," compiled in 1981 by the Canadian Fire Service and the Society of the Plastics Industry in Canada, recommends firefighters use "special chemical suits if available" for the plastics involved in the Plastimet fire. And PVC is the *only* plastic for which the guide specifically recommends considering evacuation of the local area "until overhaul complete."

It's not as though precautionary evacuations are unheard-of. Everyone remembers the famous Mississauga train derailment of November, 1989. But even when a much smaller three-alarm blaze burned down a warehouse on Rogers Road in Toronto last October, the fire department evacuated the nearby houses because there could have been toxins in the smoke from burning roof tiles.

In Hamilton, many concerned area residents have joined a class-action lawsuit that seeks $200-million in damages from the city, the regional municipality, the provincial government, Plastimet, and Frank Levy. They're worried, in part, that they won't be able to prove in the future that an illness has a causal connection to the Plastimet fire. A hearing in August will determine whether the matter can go forward as a class-action suit.

Meanwhile, the provincial environment ministry has assessed clean-up costs at more than $1.8-million, and is trying to force Jack Lieberman and Frank Levy to pay up. Plastimet's insurance carrier has paid out $500,000, but both Frank Levy and Jack Lieberman are appealing the assessment, and argue that they're not responsible for the disaster. After all, though the building had been cited for fire-code violations, they still had two months before the deadline for compliance when the fire started. (Frank Levy has also tried to distance himself from his building's misfortune, saying he had "no ownership or other interest" in Plastimet. However the ministry of the environment does have the document that's gone to the Environment Appeal Board – the agreement between Levy and Plastimet on the use of the building which paid him licensing and consulting fees.)

No-one in Hamilton is resting easy. Last winter, the city seized control of another warehouse, the Equitrade Group facility on Gage Avenue, which was stuffed full of PVC plastic and other chemicals and had been found, five and a half months earlier, to be in violation of the fire codes. (It lacked, for instance, an appropriate sprinkler system.) When it seized the inventory, the fire department could not find another warehouse in Hamilton that was in compliance with fire and building codes where it could store the material. And people continue to worry about the long-term health effects of their exposure. Or, as one environmental chemist put it, at an Ontario Air and Waste Management Association meeting last fall, "It's true that nobody has died from the Plastimet fire… yet."

Figure 6.10

District of North Vancouver - Economic Development Strategy Study

DEVELOPMENT OPPORTUNITIES, CONSTRAINTS & IMPLICATIONS
MAPLEWOOD

LAND USE CHOICES	OPPORTUNITIES	CONSTRAINTS	ISSUES/IMPLICATIONS
Non-Waterfront: Proposed Maplewood Business Park			
Business Park	• Close proximity to Trans Canada Highway, as well as Dollarton Highway, Main Street and Mount Seymour Parkway. • There is demand for business park uses on the North Shore. • Maplewood Plaza provides existing commercial services for potential future employees. • A topographical escarpment separates potential business park uses from adjacent existing residences along Windridge Drive.	• Some private properties located within the site. • Site is currently treed. • Existing access to/from the Trans Canada Highway although available, is limited and will likely become more congested with the potential development of business park and other uses in the Maplewood area. • District of North Vancouver must confirm its commitments to move forward with servicing this site. These commitments will likely be contingent on the development of the adjacent CXY Chemical site.	• Any outstanding private properties within the site area need to be acquired. • Improvements to/from the Trans Canada Highway either via Riverside Drive to Mount Seymour Parkway or along Dollarton Hwy./Main Street will provide better access to potential • Timing of development of the adjacent CXY Chemical site will influence the timing of development of the proposed Maplewood Business Park site. • Should the development of the CXY Chemical site not proceed, the District will need to consider other strategies for the provision of services and road improvements for the proposed Maplewood Business Park site.
Non-Waterfront: VPC Vacant Lands (north of Dollarton Hwy.)			
Business Park, Light Industrial & Light Industrial/Office	• Site is located in close proximity to other future potential light industrial and business park land uses. • Site is located in proximity to Trans Canada Highway and has direct access onto Dollarton Highway.	• VPC Port 2010 Plan identifies this site as one which could potentially rezone to other land uses including residential use. • The existing Canadian International College occupies a significant central portion of the site.	• Although the market analysis suggests there will be demand for light industrial and business park uses on this site once the CXY Chemical and Maplewood Business Park sites have been developed (which could take over ten to fifteen years), there is immediate demand for residential uses (as suggested by a recent development proposal).
Residential	• VPC Port 2010 Plan identifies this site as one which could potentially rezone to other land uses including residential use. • Proximity to the waterfront could be seen as an amenity (especially if the Tolko Industries site redevelops with lighter industrial uses)	• The existing Canadian International College occupies a significant central portion of the site. • Proximity of the Sterling, Mohawk and CXY chemical plants could be seen as a negative component for potential new residential uses.	• There is immediate demand for residential uses on this site, however development of such uses would pre-empt any future preservation of vacant industrial lands for the 15 to 25 year horizon. • There would be little new employment (by home based businesses) or no new employment generated by residential uses.
Tolko Industries Site			
Heavy Industrial, Port/Marine Industrial & Transportation	• There is limited demand for these uses on this site. • Site has limited waterfront access. • Site will benefit from direct access to the proposed re-alignment of the Dollarton Highway.	• There will be pressure by other lighter industrial non-water dependent industries to develop on this site. • Waterfront does not have deep-sea terminal capabilities due to the mudflats. • Established Canada Wildlife Conservation Area to the east of the site will limit the spread of development to the east.	• Development and intensification of site with waterfront industrial uses will generate only a small number of new employees. • Development or uses on this site will for the eastern edge of the Maplewood industrial area, and should be designed to respect the adjacent Conservation Area.
Business Park, Light Industrial & Light Industrial/Office	• Site will benefit from direct access to the proposed re-alignment of the Dollarton Highway. • Waterfront location could be seen as an amenity for new development. • Opportunity exists for marine-related industries to develop in a larger business park setting, which may or may not make use of adjacent waterfront access or trickle down activity from adjacent waterfront port-related heavy industrial uses (including ship building and repair).	• Established Canada Wildlife Conservation Area to the east of the site will limit the spread of development to the east. • Marine-related industries may not have the ability to afford locations within a potential new light industrial park or business park. • Development of this site may be contingent on the timing of development of the CXY Chemical and proposed Maplewood Business Park sites. • Site contamination issues may need to be addressed before development of new land uses can occur.	• Development of light industrial, light industrial/office and business park uses would generate a significantly higher number of new employees than would intensification of the site with waterfront heavy industrial uses. • Development or uses on this site will for the eastern edge of the Maplewood industrial area, and should be designed to respect the adjacent Conservation Area. • Timing of development of this site will be influenced by the timing of development of the CXY Chemical and proposed Maplewood Business Park sites, especially with regard to road • If the site is found to be contaminated, site remediation may be necessary, which could affect the timing of any potential development.

Figure 6.10

District of North Vancouver - Economic Development Strategy Study

DEVELOPMENT OPPORTUNITIES, CONSTRAINTS & IMPLICATIONS
MAPLEWOOD

LAND USE CHOICES	OPPORTUNITIES	CONSTRAINTS	ISSUES/IMPLICATIONS
Waterfront & Port Related Heavy Industrial, Port/Marine Industrial & Transportation	• There is demand for the intensification of port oriented heavy industrial uses will occur over 5 to 10 year horizon. • Proposed "Dollarton Hwy. Re-Alignment" will provide more direct access to waterfront areas along Forester Ave. and Amherst Ave. • Most sites benefit from waterfront and rail access. • There is some demand for the Allied Shipyard site to continue serving the coastal shipping and maritime industry. • There are plans to develop the GVRD log storage site with a public works yard.	• Environmental conservation areas established by DFO, MoELP and VPC impact the ability of waterfront access for portions of some waterfront industrial sites. • Mudflats and shallow draft limit the capability of the waterfront to accommodate "deep sea terminal" uses. The VPC Port 2010 Plan does not identifies only the Canadian Occidental Petroleum (CXY) waterfront site for "deep sea terminal uses" • Groundside traffic accessing the waterfront areas must pass through the light industrial areas, and cross the CNR.	• Properties not owned or operated by VPC or port/terminal operators will be vulnerable to intensification by industries other than water-dependent heavy industries. • Consideration should be made to preserve opportunities for intensification of waterfront sites. • Consideration will need to be given to the mixing of waterfront industrial groundside traffic and traffic associated with light industrial areas and potential new business park areas.
Non-Waterfront: North of CNR/west of Amherst Ave. Light Industrial	• Development of owner occupied office space, in strata titled multi-tenant buildings. • Proximity to waterfront industrial activities allow trickle down industries to locate close to these activities. • There are some large properties, which offer redevelopment potential. • Maplewood Plaza and the Maplewood Pub provide some existing commercial services for employees.	• Too expensive to renovate or add on or strata title existing Light Industrial buildings. • New development must respect environmental setback requirements from Seymour River & conservation areas. • Most traffic is channeled onto Riverside Drive, then enters Dollarton Highway. Amherst Avenue provides only a limited alternative for access into the area. • Poor pedestrian facilities.	• Existing light industrial buildings will not likely intensify or redevelop until nearby vacant lands have been developed. • Road improvements will be necessary at the intersection of Riverside Drive and the proposed re-alignment of Dollarton Highway. A secondary access (such as Amherst Ave. should also be maintained). • Employees will likely continue to drive to and from work, as well as to commercial services, until better pedestrian facilities are constructed and more services are available within proximity. •
Non-Waterfront: CXY Chemical Site (north of CNR) Business Park, Light Industrial & Light Industrial/Office	• New development will provide a buffer and transition area between northern business park & residential uses and waterfront Heavy Industrial & Port/Marine Industrial development south of the CNR. • There is demand for business park uses on the North Shore. • Close proximity to Trans Canada Highway, as well as Dollarton Highway/Main Street and Mount Seymour Parkway. • The proposed re-alignment of Dollarton Highway will provide excellent road access to this site and define good development parcels. • CNR defines a boundary between existing waterfront heavy/port related industrial uses, and potential future light industrial and business park uses.	• Implications of proximity to the CXY Chemical plant and the associated impacts of a potential chlorine spill need to be determined. • Access on/off of Trans Canada Highway is not optimal and would likely require • Site is currently heavily treed.	• Special setbacks which recognize the hazard of a potential chemical or chlorine spill could limit the location and type of future new land uses and development for this site. • Removal of trees could result in environmental impacts as well as impacting the views of existing residents along Windridge Drive. • Completion of the proposed re-alignment of Dollarton Highway is essential to the development of this site proceeding. • Improvements to/from the Trans Canada Highway either via Riverside Drive to Mount Seymour Parkway or along Dollarton/Main Street will provide better access to potential development of this site. • Cooperation of property owners, developers and the District of North Vancouver will be essential to ensure services

CanOxy rezone returns

Martin Millerchip

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Fractious debate heats up council chamber of North Vancouver District

THE speeches were more organized if no less passionate, but nothing changed in a week.

North Vancouver District Council introduced Monday another bylaw to rezone a portion of the lands adjacent to a Maplewood chlorine plant owned by Canadian Occidental Petroleum Ltd. (CanOxy).

The vote saw the same 4-3 alignment of council that split last week over the proposal to abandon a previous attempt at the zoning and start again.

This will be the third time a bylaw has gone to public hearing over a proposal to realign the Dollarton Highway closer to CanOxy and develop an industrial business park alongside its length.

Councillors Ernie Crist, Pat Munroe and Lisa Muri continued to argue that public involvement in land-use planning for Seymour was being pre-empted by the CanOxy rezoning while Mayor Don Bell and councillors Trevor Carolan, Glenys Deering-Rob and Janice Harris supported the new bylaw for its refinement of previous public debate.

"The question we must answer tonight Mayor Bell is are we prepared to advance a bylaw that fine-tunes all the work that has gone into this proposed rezoning so far, or are we to surrender to a handful of zealots who advocate doing nothing for another 10 or 15 years," said Carolan.

Carolan argued that the economic redevelopment that would take place as a result of the rezoning had been tacitly accepted by the bulk of Seymour residents by their choice "to stay home in enormous numbers" during the last round of public hearings.

"This is not Gates Landing. It is not Cove and Mountain Forest. And because of this people have been willing to entrust this council with decision-making power on this issue.

"And that, Mayor Bell, is what is so embittering to the small, self-appointed elite in Seymour who seem to believe they've been conferred with a kind of divine right to speak as the only voice of the people of that large community.

"On behalf of the 25,000 or so people of my home area who have seen fit not to support several councillors and others here in opposition to this employment-generating rezoning proposal, I reject the schoolyard bullying tactics, name calling, vulgar theatrics and crocodile tears we've been obliged to endure from these self-righteous snobs," said Carolan in a prepared speech that he read standing up until he realized he was out of the TV camera's range by doing so.

Muri responded by listing and quoting from a number of adopted council policies that commit to various long-range planning strategies.

She pointed out that council had asked its Waterfront Task Force to prepare a draft plan of the district's entire waterfront with Maplewood included in the first of three stages.

She quoted from the district's Corporate Business Plan and the introduction to the Seymour Local Plan Review process which states that Maplewood is being merged with Deep Cove and East Seymour into one local plan. Muri noted that the Maplewood Community Association was one of seven community associations who asked for Seymour to be planned as one area to encourage greater public participation.

When Bell later said it was always in his mind that Maplewood would be held out of such a planning process, Muri responded, "I'm sorry Mayor Bell, I'm unable to read your mind."

Muri also noted Harris and Hudema, the district-paid consultant company, was in the middle of an economic development plan scheduled to be completed this summer.

"All of this gets chucked out the window because CXY (CanOxy) is getting impatient and nobody wants to sit back and look at the big picture," said Muri.

District planner Irwin Torry noted that a portion of the land slated for redevelopment (the northwest quadrant, closest to Maplewood's residential area) had been held out of this bylaw for further discussion.

Land uses for the areas closest to CanOxy have been reduced to 17 categories from 29, while land uses in the northeast quadrant have been reduced to 15 from 19.

Torry also noted that site coverage has been reduced to 80% with the intention of using much of the landscaped 20% alongside the Dollarton.

A 60-foot height limit will be allowed north of the highway.

There will be a public meeting to discuss the bylaw June 10 at North Vancouver District Hall. The public hearing will convene June 16.

In a related motion, council unanimously endorsed Crist's motion instructing staff to draft a bylaw that would outlaw the production and storage of chlorine on all properties throughout the district.

Such a bylaw, if passed, would not affect CanOxy unless its present plant was abandoned for a period of six months.

Chlorine gets another airing

Martin Millerchip APR 24/98

News Reporter
miller@unews.com

A public information meeting on land use issues surrounding a Seymour chlorine plant drew a smaller than expected crowd Wednesday.

North Vancouver District planning staff were primed and poised to lead as many as 10 focus groups in discussion of development plans proposed alongside a re-aligned Dollarton Highway.

But only four were needed to accommodate approximately 40 residents, leaving almost as many staff and politicians to circulate idly between the sea of empty chairs in the Maplewood community school gymnasium.

Coun. Lisa Muri called the turnout "a poor show" but said she wasn't especially surprised given that signs advertising the meeting were "unreadable, put up late, and not put up at all in the immediate community of

See Maplewood page **3**

NEWS graphic

PROPOSED land uses near the CanOxy chlorine plant are allowable risks. But how do you quantify them?

Maplewood residents push for redevelopment

From page **1**

Maplewood."

Nevertheless, discussion was intense as neighbors of Canadian Occidental Petroleum Ltd. (CanOxy) struggled to define what they would prefer to see if redevelopment of CanOxy land is approved.

The proposal to reroute the Dollarton Highway farther south onto land owned by CanOxy would allow development of 30 acres of presently bare land.

The district would also gain improved access to municipally-owned land east of Riverside Drive earmarked for a long-awaited business park.

Maplewood residents hope the plan will spark a revitalization of their dilapidated area.

John Walkley got a hugely appreciative chuckle when he projected a picture of Edgemont Village and pronounced, "We want our community to look just like that and we don't think that's all that much to ask."

He and Tom Young, chairman of the Maplewood Community Association, pressed for "non-toxic, non-polluting, odor-free" businesses for the new Dollarton Highway and the Maplewood Business Park.

Others agreed that this type of business should, ideally, be a high-employer generating substantial revenue and taxes.

Many speakers talked of "high tech" industry or "research and development" but acknowledged such a concept could easily be wishful thinking.

Robert Burns was applauded when he said, "No more recycling plants. We've got six. Diversify. Move them to Edgemont or Deep Cove."

The Maplewood residents made it clear that they want their area to become more of a people place by allowing residential housing to be built above small-scale retail shops servicing the new Dollarton businesses.

But their hopes of gaining a small local park from 5% of the adjacent development appeared dashed when district planning director Irwin Torry said the amenity allowances required under the Municipal Act would likely serve only to protect the creek bed area in the business park.

Wednesday's meeting was called on April 1 when council adjourned a two-night public hearing of the rezoning necessary for CanOxy's development proposal. The delay in the public hearing process came after some Seymour residents argued that the type of developments proposed alongside the re-aligned Dollarton had never been discussed because of prolonged focus on related safety issues.

Council decided that a break from the public hearing process would give staff and CanOxy an opportunity to determine whether amendments to the zoning proposals could accommodate some of the local Maplewood residents' wishes.

It was also hoped that the Seymour residents who had expressed dismay and anger that the rezoning process had been allowed to start at all would get involved.

Council heard several arguments that the CanOxy proposal should have been referred to the volunteer community groups discussing the update of the Seymour Official Community Plan.

The prospect of building closer to the chlorine-plant and the potential loss of life in the event of a catastrophe such as an earthquake forced an earlier version of the same development proposal off the rails.

However, proponents now say that a prolonged investigation of risk factors at the plant have made it safer and that the land uses proposed should be allowable.

Maplewood residents are more interested in getting their crime-infested location revitalized. The majority do not feel there is a risk in creating new businesses closer to CanOxy.

"I've had more chlorine fits in Ron Andrews pool than I ever did in Maplewood," said one to applause.

But Corrie Kost expressed disappointment at what was not discussed Wednesday.

"Four years of safety studies were forgotten or ignored. People have stuck their heads in the sand as if this plant didn't exist," Kost told the **News**.

Plans are also in the works to rebuild the two-lane Dollarton Bridge bottleneck into a four-lane affair in an attempt to reduce the rush-hour traffic jam out of Seymour every morning.

The new bridge will cost at least $6 million over and above the $3.75 million that the the district and CanOxy have each pledged to the re-routing of the Dollarton. Issues surrounding funding for the bridge, traffic and access will be discussed at another public meeting at district hall April 29 at 7 p.m.

[redacted]

Mr. Kost:

Andrea Finch of our office asked me to contact you regarding some questions you had raised. Just to make sure that we touch bases today, I thought I would e-mail you.

You asked a couple of questions:

1) can the District of North Vancouver seek compensation for loss of its property value due to land being close to the Can Ozy plant?
2) can they impose higher tax rates on hazardous industrial sites.

Question 1.

The only legal basis for claiming compensation for loss of property value would be suing Can Ozy in nuiscance. Nuiscance is a claim for damages because a person or company has unreasonably interfered with someone else's use and enjoyment of their land. Any claim would be by the owners and occupiers of the land affected by the chlorine plant.

What constitutes a nuiscance is determined by the courts and the courts will consider a number of factors. If the dimunition of land value is because of restrictions in zoning, I do not think there would be a successful claim against Canadian OCcidental. Similarly if the loss of land value is a result of the risk of chlorine leaks (not actual leaks), it would be very difficult to succeed in nuiscance. Courts will look at whether zoning allows CanOzy to operate and whether Canadian Occidental required changes in land use as a result of its operations or whether it has just restricted uses in the surrounding area. Based on what I know, I think a nuiscance action would be unlikely to succeed, but I am basing this on limited

information (Andrea's notes, your email's, my knowledge of the area).

Question 2

Municipalities do not have a power to set a special tax on hazardous industrial operations. They can set different tax rates for different classes of property, but there is a limited number of classifications. The District would need to increase the rate on all heavy industry land.

There also may be some restriction on the maximum rate that can be charged against heavy industry or the maximum ratio of the heavy industry "mil rate" to the residential rate. The rules for muncipal taxation are fairly arcane, and this is not my area of expertise. You are probably best off contacting people in the Ministry of Municipal Affairs to get more information. I would call the Municipal Financial Services Bransch at 250-387-4067.

I hope this information proves useful. Please call if you have any questions.

Chris Rolfe

CAN OXY (CXY) PUBLIC MEETING
Maplewood School, 420 Seymour River Place, North Vancouver
Wednesday April 22, 1998, 7:00 p.m.

AGENDA

1. INTRODUCTION - MAYOR BELL

2. MEETING ORGANIZATION - TERRY NEIMAN

3. PRESENTATIONS:
   a) PLANNING OVERVIEW - IRWIN TORRY
   b) CXY PROPOSAL - JANE FLEMING
   c) OPTIONS FOR NW QUADRANT- MAPLEWOOD COMMUNITY ASSN.

4. QUESTION AND ANSWER PERIOD

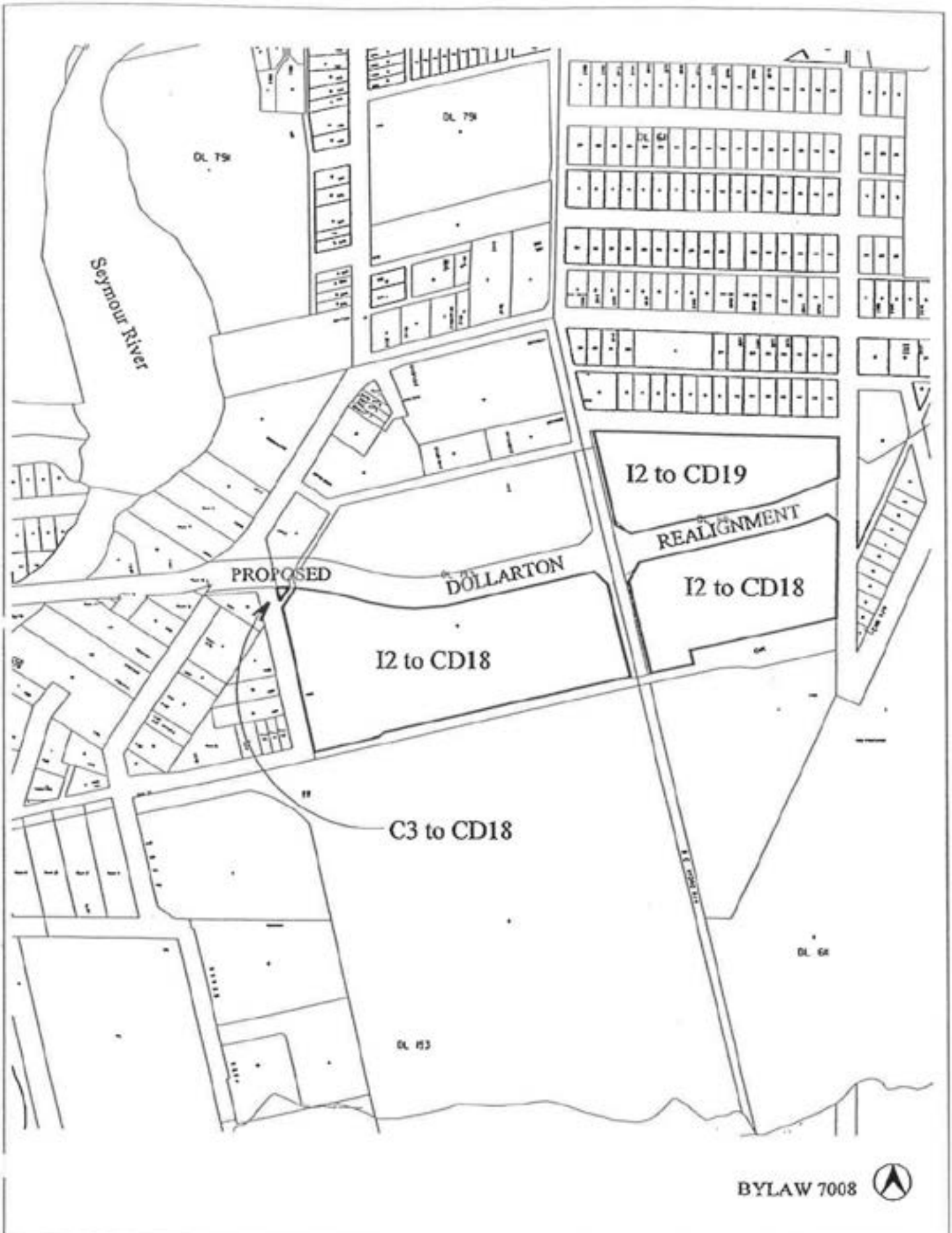
5. ORGANIZATION OF WORKSHOP - TERRY NEIMAN

6. SMALL GROUP DISCUSSIONS

7. REPORTING BACK BY DISCUSSION GROUPS

8. TABULATION OF FEEDBACK - TERRY NEIMAN

9. NEXT STEPS - MAYOR BELL


DL 751
DL 751
Seymour River
I2 to CD19
REALIGNMENT
PROPOSED
DOLLARTON
I2 to CD18
I2 to CD18
C3 to CD18
DL 6R
DL 153
BYLAW 7008

USES		EXISTING ZONING	PROPOSED ZONING		
		I2	CD18	CD19	RANKING
a)	Arena		✔		
b)	Animal shelter	✔			
c)	Auction room	✔	✔		
d)	Automotive bodyshops	✔			
e)	Automotive repair shops	✔	✔		
f)	Building supply establishment		✔		
g)	Business/office support services		✔	✔	
h)	Car wash		✔		
i)	Construction services	✔			
j)	Contractor services	✔	✔	✔	
k)	Custom manufacturing	✔	✔	✔	
l)	Delivery services	✔	✔	✔	
m)	Equipment rental establishments	✔	✔		
n)	Fitness centre		✔	✔	
o)	Garden centre		✔		
p)	Gas bar		✔		
q)	Gun shop	✔	✔		
r)	Health service purposes			✔	
s)	Heavy manufacturing	✔			
t)	Hobby beer and wine making establishments	✔	✔	✔	
u)	Household repair establishments		✔		
v)	Industrial product sales		✔	✔	
w)	Light manufacturing	✔	✔		
x)	Media-related establishments			✔	
y)	Mini-warehousing	✔	✔		
z)	Office purposes			✔	
aa)	Parking structure	✔	✔	✔	
bb)	Personal service shops			✔	

USES	EXISTING ZONING	PROPOSED ZONING		
	I2	CD18	CD19	RANKING
cc) Professional offices			✔	
dd) Research and development estab.	✔	✔	✔	
ee) Restaurant			✔	
ff) Retail food services		✔	✔	
gg) School, trade	✔	✔		
hh) Service station		✔		
ii) Specialized light industrial & tech. estab	✔	✔	✔	
jj) Transportation purposes	✔			
kk) Veterinary clinic	✔	✔		
ll) Veterinary hospital	✔	✔		
mm) Warehousing	✔	✔	✔	
nn) Wholesaling	✔	✔	✔	
oo) Works yard	✔			

COMPARISON OF DEVELOPMENT REGULATIONS

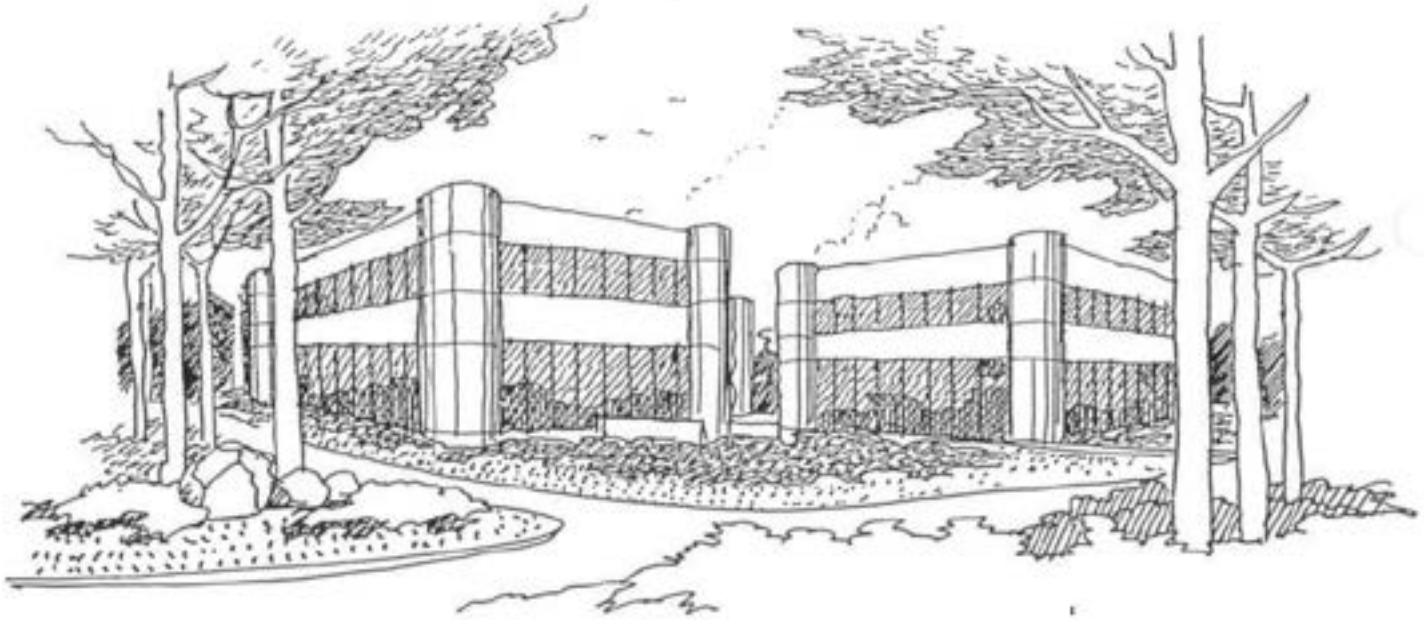
REGULATION	I2 ZONE	CD18 ZONE	CD19 ZONE
Setbacks Building	Not Specified	10m (33 ft.) from Doll. Hwy. 6m (20 ft.) from Riverside Dr. & Amherst Ave.	10m (33 ft.) from any street 5m (16.5 ft.) from interior rear or side lot line or any lane
Parking	Not Specified	6m (20 ft.) from Doll. Hwy. 3m (10 ft.) from Riverside Dr. & Amherst Ave.	6m (20 ft.) from any street 2m (16.5 ft.) from interior rear or side lot line or any lane
Accessory Floor Space	15% GFA	25% GLA	40% GLA
Building Area	Not Specified	Building Supply Establishment 5575m^2 (60,010 $ft.^2$)	Not Specified

COMPARISON OF DEVELOPMENT REGULATIONS

REGULATION	I2 ZONE	CD18 ZONE	CD19 ZONE
Building Height	12m (40 ft.)	12m (40 ft.)	18m (60 ft.)
Building Coverage	60%	60%	60%
Site Coverage	95%	90%	85%
FSR	Not Specified	1.5	2.0

1.1 Site Planning

Where a development "pod" contains more than one building, all buildings shall be designed using the same materials, massing, and design elements, and shall be consistent in their orientation. Buildings should be situated within a pod so as to minimize direct lines of site from one building into another, maximize use, and create opportunities within the pod for landscaping.



1.2 Service Areas

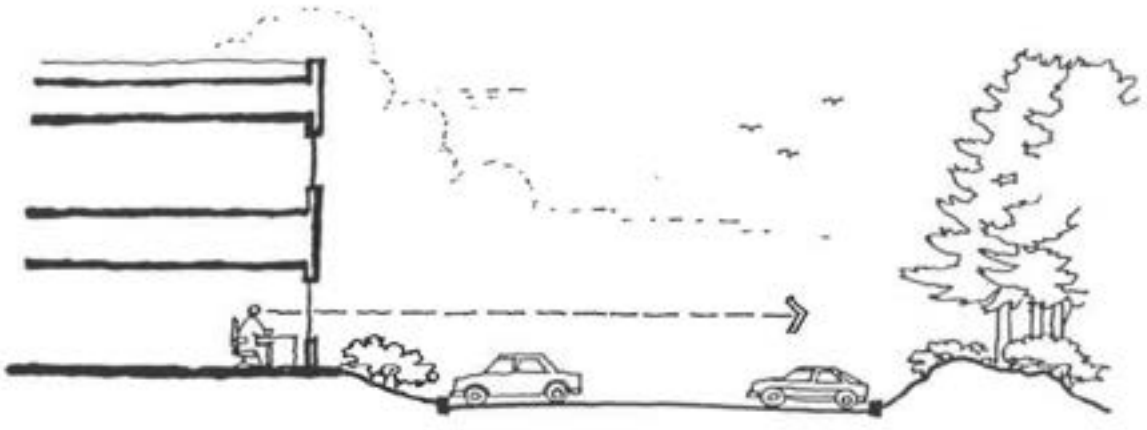
For development pods with more than one building, buildings shall cluster around service courts and use common areas for loading, truck maneuvering, and garbage/recycling so as to minimize the area required for these functions. Service courts should generally be to the interior of a pod and not directly visible from main driveways. Exterior storage of equipment and materials is not permitted. Vehicles used by tenants may be stored outside in service court areas, which may be fenced for security reasons. All garbage and recycling functions shall be completely screened from view.

1.3 Visibility

Buildings and/or groups of buildings should be sited to have a prime orientation toward the access driveway, and be clearly visible from the main road. Access driveways should have a vista of the building or buildings in their landscape setting as each pod is approached.

1.4 Views

Buildings should take advantage of the natural setting in providing views outward from within working areas. Grading and landscaping should be used to avoid a direct eye-level view of parked cars from ground floor work areas. Natural grades of the site should be used to advantage to create open views.



1.5 Entries

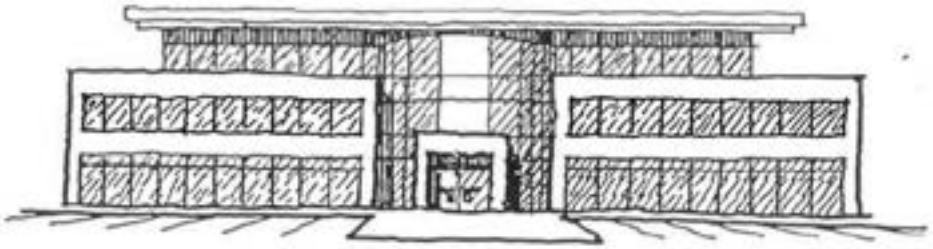
Main entries should be readily identifiable and have clear access. Architectural devices such as a change in massing, fenestration, canopies, or curtainwall glazing should be used to accent the entry. Building identification (name, number) shall be readily visible. Handicapped and visitor parking is to be located close to building entries.

1.6 Multi-tenant Buildings

Multi-tenant buildings with direct exterior access to individual tenants should incorporate repetitive design elements to identify the multi-tenant nature of the building and the tenant entries. Multi-tenant identification shall be confined to a number/name at the doorway plus a multi-tenant directory located so as to be clearly visible when the building is approached from the main driveway.

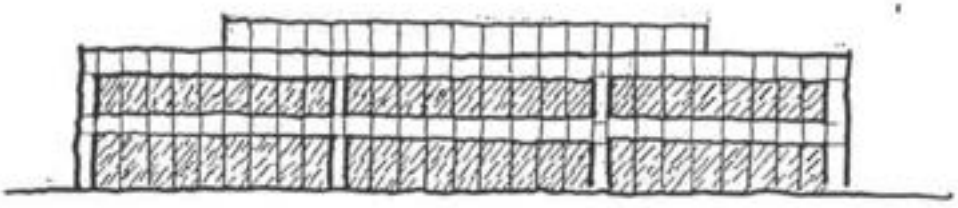
1.7 Higher Buildings

Buildings over two storeys in height shall incorporate steps or setbacks to reduce their apparent mass and impact.



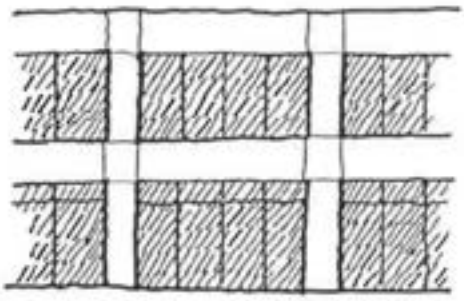
1.8 Roofscapes

Roof lines will generally accentuate horizontal lines. Peaks, gables, arches, or mansard roofs are not recommended. Rooftop mechanical equipment shall be screened using cladding materials consistent with the rest of the building.



1.9 Materials

Generally, materials used should have a large plain surface, and not be made up of small individual elements. Examples of materials consistent with this approach would be glass, prefabricated metal panels, fiberglass panels, and sand finished stucco. Not recommended would be materials consisting of small individual elements such as wood siding, brick, block, or slat or corrugated type metal siding. Individual structural elements such as columns, beams, suspension cables and rods, and structural connectors, and architectural elements such as canopies and railings can be accentuated to contribute to the "high-tech" design character.



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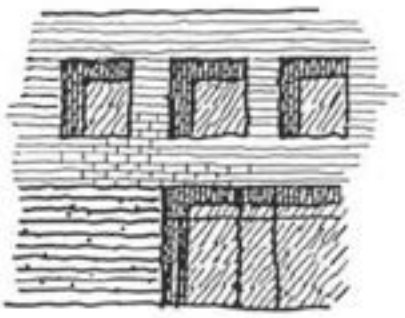

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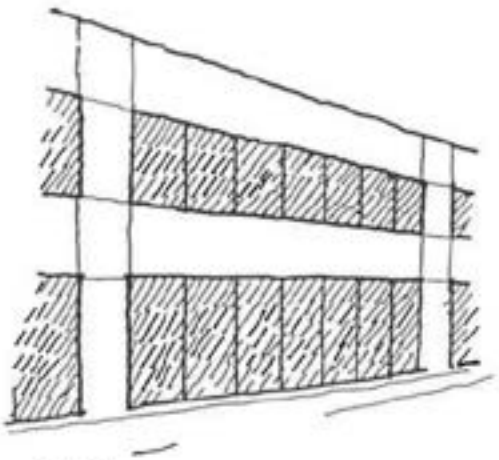
1.10 Windows

Generally, windows should be grouped into strips or curtainwall configurations as opposed to individual punched windows.



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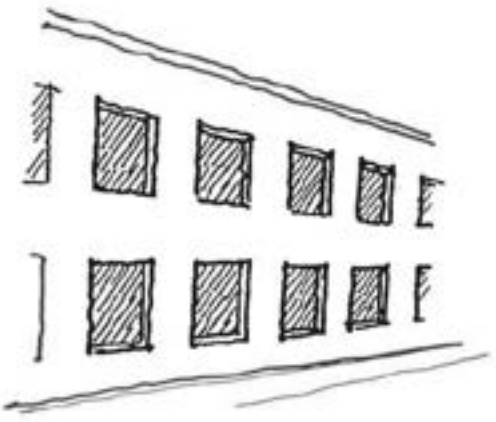

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1.11 Facade Treatment

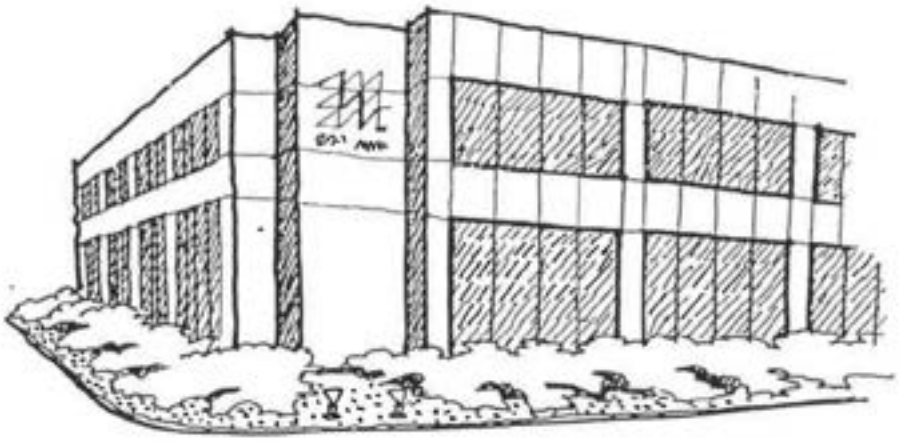
The architectural treatment of elevations and the use of materials should generally be consistent and complementary on all facades.

1.12 Building Lighting

Exterior lighting of the building should be used to emphasize main entrances and other architectural features. Light from the interior of the building can also be utilized to emphasize atriums, lobbies, or equipment or processes which may be of architectural interest. Care should be taken that building lighting does not cause glare or shine directly into adjacent buildings.

1.13 Signage

Freestanding signs at each pod shall give directions to individual buildings and/or tenants. All directory signs and traffic control shall be designed strictly to a park standard. No pylon signs shall be permitted. Signage on building facades shall be restricted to one corporate logo and/or name per building, of a maximum size of 10 sq. metres. No signage is to project above or beyond building edges. No flashing or projecting signs will be permitted. On multi-tenant buildings with individual tenant entries, individual tenants may have a name and/or number of maximum 1 sq. metre over their individual entry, and all tenant signs shall be of the same type.



Roadways

All roads are to be curved and designed to best suit the site grades from a visually aesthetic as well as safety standpoint. Roads that are straight lines with exaggerated axis are not encouraged.

All public roads are to have a public sidewalk on one side, the side being the one adjacent to the park zone. The entry roads are to have a grassed boulevard. The public sidewalk should take on a curvilinear route oriented to the natural forested buffer as opposed to the roadside. All public walkways are to be disabled accessible with no slopes over 6% and no cross slopes greater than 2%.

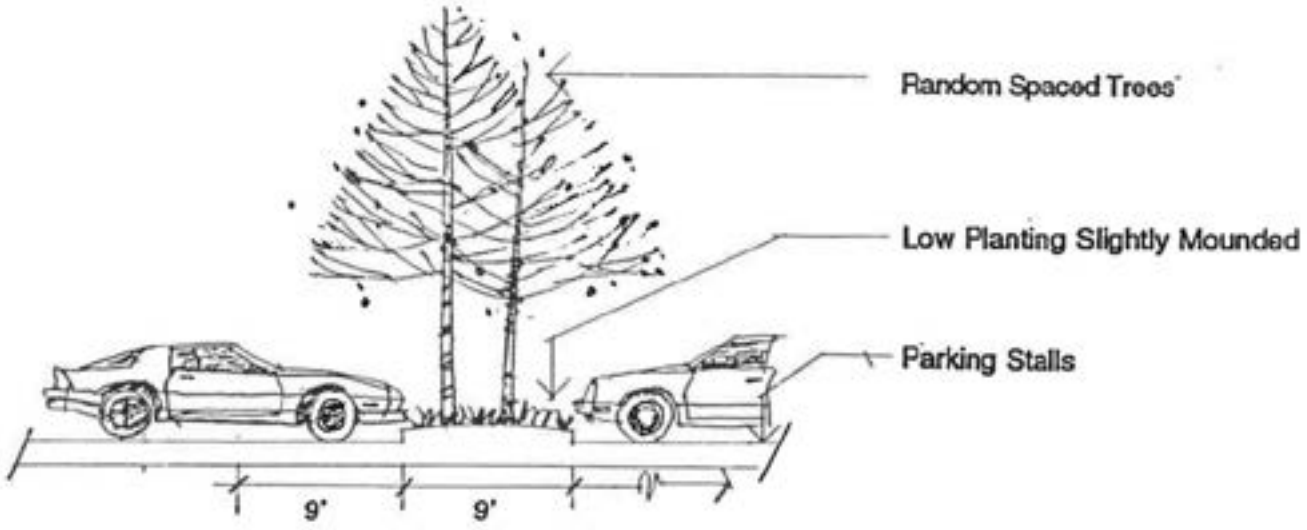
All plant material used for median and or boulevard planting is to be large scale native or non-ornamental deciduous trees. The trees should be planted in random naturalistic groupings and not single rows of uniform spacing. The planting under the trees should be grass or low ground cover.

Private roads should have a sidewalk (min. 4ft.) on one side of the road, which provides direct accessibility to all buildings.

Parking Areas

Parking is to be set into parkland and landscape and to be visually insignificant. Larger parking areas should be broken down into smaller zones by landscape buffers. These buffers should be a minimum of 9' wide and should be slightly bermed to decrease the visual impact of the parking areas.

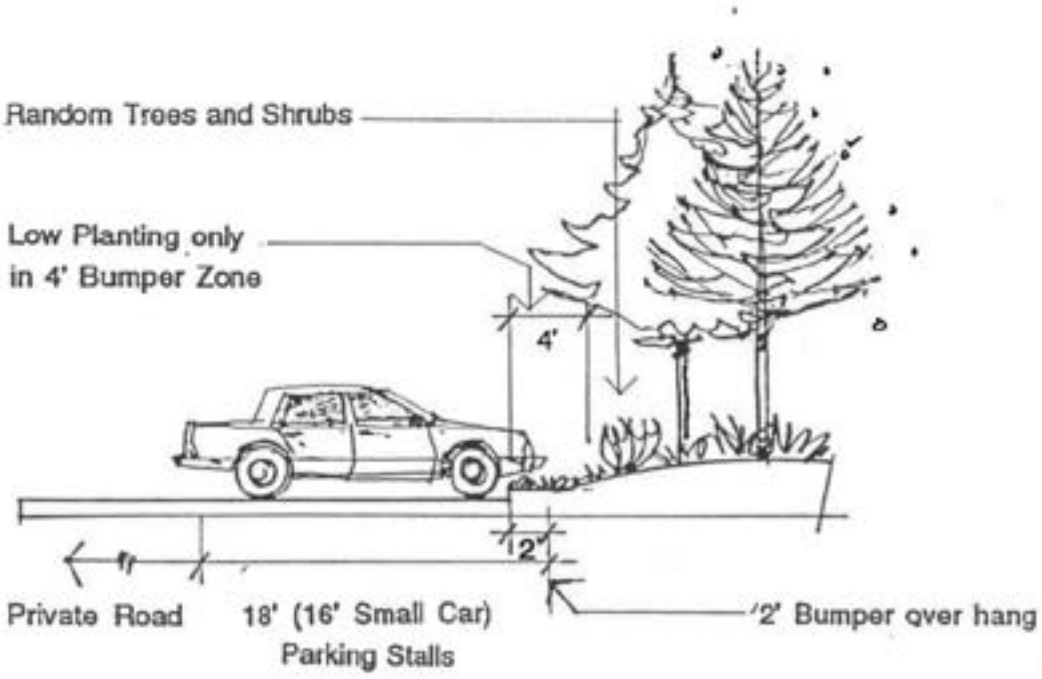
In parking areas no more than 20 continuous parking stalls should be provided without a planted landscape island. Groups of trees, coniferous and deciduous, should be planted in these islands and not single trees. Grasses and ground covers should be planted in the parking areas. Shrub bed areas are not encouraged and should only be used for special accent features.



PARKING ISLANDS

The planted parking islands are to be a minimum of one car stall width (9 feet). Parking areas should follow alongside the private roads and take on a slightly curvilinear layout.

Parking zones should have a 2 foot landscaped bumper zone where no sidewalk is present. Where a sidewalk is required, a 2 foot paved surface can provide a bumper zone with a 4 foot sidewalk beyond.



PARKING ZONE - LANDSCAPE BUFFER ZONE

Suggested Plant List

Species marked with an asterisk (*) are not suitable for roadway or parking area landscaping.

Trees

Western Red Cedar
Douglas Fir
Western Hemlock
Sitka Spruce
White Birch
Red Alder
Poplar
*Big Leaf Maple
*Pacific Dogwood
*Pacific Willow
*Willow
*European Mt. Ash

Shrubs

Salmonberry
Red-osier Dogwood
Salal
Red Huckleberry
*Red berry elder
Wild Rose
Siverweed
*Thimbleberry
*Cascara
*Black twinberry
Spiraea
Indian Plum

Ground Cover, Grasses and Flowers

Kinnikinnick
*Fireweed
*Purple loosestrife
Wild Ginger
Twinflower
*Sweetpea
Peppergrass
Red clover
White clover
*Chocolate Lily
*False lily-of-the-Valley
*Yarrow
*Floxglove

"**automotive repair shop**" means land, buildings and structures used for the mechanical repair and servicing of vehicles, motorcycles and recreation vehicles or craft and may include the accessory sale, installation or servicing of related parts and accessories. This use class includes: tire shops; automotive glass shops; muffler shops; transmission shops; automotive upholstery shops; lubricating shops and similar uses. This use class does not include automotive body shops;

"**building supply establishment**" means land, buildings and structures used for the sale, either at retail or wholesale, of a variety of tools, paints, hardware, plumbing and electrical items, building products and gardening equipment and materials but does not include the sale of automobile parts and accessories, manufacturing or servicing of goods. This use class is differentiated from a retail purpose by the exterior storage of wood, metal, concrete and gardening supplies or products;

"**business/office support services**" means land and buildings used to provide support services to businesses which are characterized by one or more of the following features: the use of mechanical equipment for printing, duplicating or photographic processing; the provision of office custodial, maintenance or security services; the sale, rental or servicing of office equipment furniture; the provision of clerical, secretarial employment or telephone answering services which may include training. Typical uses would include: printing and photographic processing establishments; janitorial and security firms; office equipment sales, servicing and repair establishments; and, clerical services;

"**contractor services**" means land, buildings and structures used for the offices of building contractors providing services such as painting, plumbing, heating, electrical, gas fitting, roofing, tiling or similar services and may include the fabrication or assembly of building components such as doors, windows, kitchen and bathroom fixtures and fireplaces or similar products and the sale of such products, either at retail or wholesale. This use class may also include floor area used for showroom/display purposes and all goods and materials associated with this use class shall be kept within an enclosed building. This use class does not include construction services or the manufacturing or sale of household items such as furniture, carpets and appliances;

"**custom manufacturing establishments**" means land and buildings used for the small scale on-site production of specialized goods by five or fewer production employees. Typical uses would include but not necessarily be limited to the manufacture of jewellery, toys, musical instruments and computers; the production of pottery; and, sculpture/art studios;

"**delivery services**" means land, buildings and structures for businesses providing for the delivery of people, goods and services where fleet vehicles used for such delivery are not available for sale, rent or lease. This use class includes: taxi services; messenger and courier services; and, mobile catering services, including the production of catered foods. This use class does not include transportation purposes;

"**equipment rental establishments**" means land and buildings used for the rental of tools, appliances, recreation equipment, office equipment, light construction equipment, or similar items but does not include the rental of motor vehicles, motorized boats or industrial equipment or vehicles;

"**fitness centre**" means land, buildings and structures for active physical recreation on a commercial basis, generally in a gymnasium type setting where patrons are participants and which may include the accessory sale of associated equipment and clothing. Typical uses would include: racquet clubs; weight training gyms; climbing gyms; aerobic or similar studios; and, batting cages. This use class does not include: dance studios intended to teach various types of dance; municipal recreation facilities such as rinks or courts; bowling alleys; and, dance halls;

"**garden centre**" means the use of land and buildings for the cultivation, propagation, display and retail sale of plants as well as associated landscaping and gardening supplies and is distinguished from a nursery;

"**household repair services**" means land and buildings used for the provision of repair services for goods, equipment and appliances normally found within the home. This use class includes radio, television and appliance repair shops, furniture refinishing and upholstery shops. This use class does not include the retail sale or wholesale of goods or products except for the accessory sale of parts and accessories;

"**industrial product sales establishments**" means land and buildings used for the wholesale, rent or lease of products generally intended for industrial or commercial users such as industrial machinery and equipment, trade tools and supplies, machinery parts, restaurant equipment, office furniture and store fixtures, but does not include heavy industrial vehicles such as trucks, cranes, and construction equipment;

"**light manufacturing**" means land and buildings used for: the assembly, fabrication or processing of semi-finished or finished products from previously manufactured components; and, the servicing, testing and repairing of goods and equipment entirely within an enclosed building from which there may be no external nuisances or impacts. Typical uses would include the manufacture of glass, plastics, textiles, small machinery, upholstered products, electrical/electronics, woodwork/millwork, precision instruments, paper products, auto parts and accessories, furniture and pharmaceutical products;

"**media-related establishments**" means land, buildings and structures used for music, film and video production studios, advertising establishments, printing and publishing establishments and radio and television stations;

"**personal service shop**" means land, buildings and structures used for the provision of services related to the care and appearance of the body or the cleaning and repair of personal effects. This use class includes: dry cleaning depots and laundromats; tanning salons; hairdressing salons; barber shops; tailors and dressmakers; and shoe repair shops. This use class does not include household repair establishments or health service purposes;

"**research and development establishments**" means land and buildings used for analytical, scientific and technical research, development and testing purposes which may involve the small scale manufacturing or assembly of prototypes and the sale of technical data, but does not include medical, dental or other health science-related laboratories that directly service the public;

"**restaurant, major**" means land and buildings used for the provision of prepared food and beverages for on-site public consumption with a seating capacity of more than 10 persons. Typical uses may include: cafes; theatre restaurants; cocktail lounges; and, banquet rooms. This use class does not include neighbourhood public houses or drive-in restaurants;

"**retail food services**" means land, buildings and structures used for the provision of prepared foods and beverages for either on or off-site consumption with a seating capacity of not more than 10 persons. Typical uses would include: delicatessens; cafes; refreshment stands; sandwich bars; and take-out food services. This use class does not include: restaurants; neighbourhood public houses; drive-in restaurants; cocktail lounges or retail food stores;

"**warehousing**" means the storage of goods or products for distribution but does not include wholesaling;

"**wholesaling**" means the use of land and buildings for the wholesaling of merchandise in bulk to retailers, other businesses, institutions or government agencies for their own use or for resale and where any floor area in storage space exceeds any floor area used for showroom or display purposes;

Regulating Air Toxics in Rhode Island: Policy vs. Technical Decisions*

Julie A. Roqué**

Introduction

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Until recently, the U.S. Environmental Protection Agency (EPA) delegated the responsibility for managing air toxics to the states. The R.I. Clean Air Act provides that state's Department of Environmental Management (DEM) with the authority to promulgate air quality standards and to implement pollution prevention or control programs.

In 1984, DEM proposed the development of an Air Toxics Regulation to control certain industrial emissions. An advisory committee met monthly with officials to review the regulation as it was being written. Notwithstanding the committee's approval, when it went to public hearing in May 1987, the regulation generated over two years of controversy.

This paper will examine the regulation and the processes by which it was derived and resulting controversy was resolved. Ultimately, it will try to show that, had certain questions been initially identified as ones of "policy" rather than "science", much time and effort might have been saved.

The Regulation

Its provisions generally

The Air Toxics Regulation defines Acceptable Ambient Levels (AALs), chemical-specific standards that are used to calculate allowable rates of emissions from major air pollution sources. The AALs are health-based standards in that they are intended to limit ambient concentrations of toxics to levels DEM has deemed "safe"; that is, levels at which exposures to individuals are believed to be below thresholds for noncarcinogenic, adverse health effects, or to result only in "acceptable" additional cancer risks.

Carcinogens

For carcinogens, the regulation has two sets of standards: (1) AALs governing substances posing an additional risk of one in a million for an individual developing a particular type of cancer over a lifetime of exposure (hereinafter 10-6 risks), and (2) "AALs with LAER" governing risks of one in one hundred thousand (hereinafter 10-5 risks). A permit may be issued for a source if its emissions are not expected to increase ground level concentrations by more than contemplated by the AAL standards. If the concentrations pose higher risks, DEM can require installation of controls to achieve the "Lowest Achievable Emission Rate" (LAER).

LAER is defined as the most stringent emission limitation imposed by any other state or is considered technologically achievable by a particular industrial category of sources. Permits then may be issued if emissions from sources that have installed LAER meet the 10-5 AALs.

Regulating Air Toxics in Rhode Island: Policy vs. Technical Decisions*

Julie A. Roqué**

Introduction

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opposition, despite having had a technical representative on the advisory committee. It also lodged an unsuccessful attempt to block the regulation, charging that the AALs were "arbitrary and capricious."5

After the regulation was promulgated in 1988, the Chamber threatened further legal action. It argued that the methods were overly risk averse, claimed that alternative assumptions in the risk assessments would provide less stringent standards and urged that the AALs should be relaxed.6

For example, they criticized the use of a linearized multistage model to extrapolate from high to low doses.7 They also objected to basing risk estimates only on the most sensitive species and the most pronounced effect reported; converting animal exposures to human doses using factors based on surface area; and using lower 95% confidence limits on doses to calculate the AALs.

Resolution

At the directive of the governor, DEM officials, beginning in 1988, met with Chamber representatives to review the methods by which the AALs were derived. The Chamber finally dropped its threat of legal action in July 1989 after a rigorous, two day meeting attended by it and representatives of statewide health and environmental organizations. The purpose of the meeting was to review the technical details of the AAL calculations and allow a toxicologist hired by the Chamber to question DEM about their methods.

The toxicologist presented only general arguments against the methods used to derive the AALs: why it may not be appropriate to use animal data for calculating human risks; why people may not be as sensitive as the most sensitive animal species; that the linearized multistage model and the 95% LCL can overestimate risks by orders of magnitude; and that, for some compounds, there is evidence to believe that body weight is a more appropriate measure of interspecies variability. Later, the toxicologist questioned how default values for animal and human body weights and other variables were obtained. However, the toxicologist agreed that there are no conclusive answers to such questions.

Ultimately, a number of "points of agreement" were reached concerning the process by which future regulations would be developed. These included that DEM would: provide more complete documentation; consider outside peer review of future AALs; consider forming a science panel to advise regulators; and incorporate new scientific information into the derivations of the AALs as the agency finds it appropriate.

However, as mentioned earlier, DEM had made a series of policy decisions prior to the development of the AALs. Those did not appear to cause significant controversy, although they were perhaps even more influential than issues in dispute. They had been designated as policy choices from the beginning and appeared to leave little room for purely technical criticism. Disputes on scientific issues did not end up being resolved on technical grounds. Had more critical choices been earlier recognized as turning on policy, much debate might have been avoided.

Sensitivity Analyses of Decision Rules

Undertaking a task such as deriving AALs requires choosing among competing decision rules. Some of the rules used by DEM are are set forth below in Table 1 -- along with plausible alternatives.

To focus debate on key issues, it is useful to attempt to determine which decision rules play the largest role in the final regulatory determinations. To do this, rules can first be put into two categories: those for which the variations in final risk estimates depend upon particular sets of data and those for which variations are directly proportional to constant ratios.

Basic policy foundations

It was decided initially that toxic emissions in Rhode Island warranted regulatory action; that DEM would weigh administrative feasibility by regulating 40 substances (not all carcinogens) from only the highest priority users; that the AALs would be health-based; and that DEM would maximize consistency between the AALs and other state and federal standards.

The last was accomplished by using EPA Guidelines2 that recommend criteria for the selection and interpretation of animal data, a standardized scaling factor based on a surface area basis for conversions of doses across species, and the use of the linearized multistage model for high-to-low dose extrapolation. Many of these propositions are policy based in that they may overlook certain scientific knowledge available for some toxins, in order to simplify the decision process and strike a balance between accuracy and consistency in and between risk assessments. Moreover, they clearly suggest overstating risks and erring on the side of protecting the public health.

Also, under the regulation, risks at or below the 10-6 level are considered de minimis and are not regulated. Those between 10-6 and 10-5 are reduced if feasible according to the LAER approach. Sources that poses more than that level of risk may be required to change their processes or shut down. These choices are clearly ones of policy.

Technical foundations

When AALs for carcinogens were first proposed, it appeared that there were sufficient data available to develop them for 28 compounds. The data for 3 chemicals, however, were later found inadequate for assessment, and another, formaldehyde, posed special problems because of existing high background concentrations.

Fourteen of the remaining twenty-four compounds had been previously evaluated by the Carcinogenic Assessment Group (CAG) at EPA, and their unit risk estimates3 were used to calculate AALs by assuming a linear dose-response relation. Also, DEM used assessments for perchloroethylene and trichloroethylene generated by the Northeast States for Coordinated Air Use Management (NESCAUM), a coalition of regulators from the New England states plus New York and New Jersey.

Figure 1 shows the steps in calculating AALs for the remaining eight compounds. These methods are in accordance with the EPA Guidelines4 and had been used by CAG and NESCAUM for the sixteen substances mentioned above.

Although the Guidelines prescribe methods for dealing with the major sources of variations in cancer risk assessments, data are scarce and often are reported in very different forms. Thus, other assumptions had to be incorporated into calculations of the AALs. Informal precedents set by EPA in the development of unit risks or standards for other compounds were relied upon whenever possible. These involved issues such as the minimum number of dose groups in animal bioassays and the use of the 95% lower confidence limit (95% LCL) on the dose corresponding to the levels of risk at which the standards were to be set.

Figure 1
Derivations of the AALs... [Omitted]

Opposition

At the public hearing in 1987, the Rhode Island Chamber of Commerce Federation voiced strong

The data-specific decision rules are: the choice of effect; calculation of AALs based on a single effect; averaging animal doses over their lifetimes; the choice of the dose-response relation; the goodness-of-fit criterion; and the use of the lower confidence limit on dose. The variation in risk estimates attributed to these rules cannot be evaluated without case-by-case calculations and therefore multiple extrapolations were performed for every data set (or combinations of data sets) for each toxic.

The second type of decision rules are: the choice of the interspecies conversion factor; default values for consumption rates, body weights and lifespans in animals; and default values for inhalation rates and body weights in humans. These terms may enter the risk calculations at more than one point, but they are constant and simple proportions can be formulated.

Table 1... [Omitted]

Decision rules that introduce the greatest variation into the AALs can be identified by sensitivity analyses. Such analyses indicate how the AALs would have varied had different decision rules been employed and are easily undertaken -- many could be performed on the back of an envelope. Sensitivity analyses for the rules in Table 1 are summarized in Table 2.

Table 2... [Omitted]

Each range represents the ratios of ambient concentrations that would have been calculated by varying assumptions for each decision rule, to the AALs that were adopted in the Air Toxics Regulation. A factor change of 0.5, for example, indicates that an AAL that would have been calculated using an alternative decision rule would have been 0.5 x the current value, or twice as stringent. Conversely, a factor change of 2 means the AAL would be twice as high, or half as stringent.

Individually, most decisions are trivial in comparison to the choice of the dose-response relation. Multiplying the extremes of these ranges could provide a "super worst case" measure of the degree by which risk estimates might be over- or understated.8 Even combined, all of the other decisions do not outweigh the influence of the dose-response model.

The risk tolerance of decision rules

Figure 2, below, sorts decision rules into four categories: risk averse, risk prone, best guess, and "???." Those in the risk averse box are likely to have provided AALs that are more stringent than necessary to achieve the desired risk levels; ones in the risk prone box led to less stringent AALs; and "best guess" decisions are those that are unlikely to over- or understate the "true" risk.

The dose-response relation is placed in a fourth box because there is no evidence supporting the choice of one dose-response model over another for any substance evaluated. Further, the sensitivity calculations indicate that the linearized multistage model may have overestimated the AALs for some compounds, but underestimated them for others. Lacking better chemical-specific information, dose-response decisions cannot categorized as risk averse, risk prone, or best guess.

Figure 2
Risk Aversity of Risk Assessment Assumptions... [Omitted]

Some risk adverse rules were stated explicitly when the Air Toxics Regulation was written, e.g., that humans are at least as sensitive as the most sensitive animal species (choice of effect) that the 95% LCL would be used. (The 95% LCL may be considered risk averse 'on the average.' Although it is not risk

averse for a single potency assessment, as a lower bound, it is likely to overstate estimates for groups of potencies on the whole.) These could have somewhat significant impacts on the AALs.

However, other rules, whenever adopted, had little influence. Pooling effects; different animal consumption rates, weights or lifespans; human weights; and dropping the goodness-of-fit criterion would have changed the final standards by factors of two or less. And in many cases, these changes would have been lost when the AALs were rounded off to single digits.

The factor changes for high-to-low dose extrapolation demonstrated that the linearized multistage relation is not usually the most risk averse model and, in fact, is risk prone for certain sets of data. Further, the use of other dose-response relations could have decreased some of the AALs (making them more stringent) by factors greater than those by which other AALs would have increased. The sensitivity analyses did not consider the special susceptibility of children to certain toxics which, if taken into account, might indicate that several of these rules are even less risk averse or more risk prone.9

Risk Debates

Policy and uncertainty

The choice of different dose-response relations can provide widely varying risk estimates and may change regulatory decisions. In many instances, however, available scientific information is so limited that one cannot approximate the uncertainty associated with an estimate, or even predict whether certain models will over- or understate risks; this was especially true for the air toxics evaluated by DEM.

As noted above, altering most of the other decision rules would not alter the regulatory decisions. Yet, risk controversies often involve lengthy debates about the assumptions that are the most accurate even for those rules.

Some questions could, in theory, be "answered" with sufficient scientific information. The choice of dose-response models is one of those. Table 3 lists other issues facing DEM in regulating carcinogens under the Air Toxics program.

Table 3... [Omitted]

Each rule or set of rules is categorized grossly as "policy" or "uncertainty" as indicators of the sources of variation in risk estimates. Rules categorized as "uncertainty" would be redefined or avoided altogether if we had "perfect" information. Thus, rules with sources of variation designated as "uncertainty" are designed to deal with gaps in scientific knowledge. Of course, in the absense of "perfect" scientific information, the treatment of uncertainty is itself a policy decision -- one closely tied to choosing an appropriate level of risk aversion.

"Perfect" scientific information would enable regulators to resolve some controversies, but policy decisions still would remain. In fact, some would become more difficult once we could predict reliably who might be most affected by risk sources. E.g, should the "average" or the most sensitive individual be protected, or how should individual risks be weighed against benefits to society as a whole?

Academic vs. policy science

The distinctions between basic or "academic" science and applied or "policy" science may also exacerbate the tendency to dwell on technical issues. The differences between the two have been explored by authors

who agree that both have valid, if different, goals.10

The primary goal of academic science is knowledge; this includes developing, usually relatively free of urgent need, further understanding of natural and biological processes that, at least in the near term, may or may not prove socially useful. The goals of policy-driven science are usually to solve pressing problems. Rather than not act at all in the face of potential for large adverse consequences, agencies often use data that would be insufficient by the standards of academic science.

How risk measures are defined also may differ between these two types of science. In academic science, measures often are used to best describe a set of observations; i.e., to be internally valid. Policy research, on the other hand, demands that knowledge be generalized to very different situations than those in which the data may have been collected.

The objectives of risk assessments can determine how scientific information is interpreted and used.11 Also, in the face of limited resources, regulators often rely on very questionable assumptions to shift the burden of proof onto risk generators. Whether one agrees or not, their choice to do so is clearly not a technical issue.

Conclusion

Rather than argue over explicit policy choices, critics dive into endless technical debates about what are the most "scientifically correct" methods to assess risks. As one author points out: "... in our profoundly numerical contemporary culture, numbers are symbols of precision, accuracy, and objectivity."12 Even when the variation in risk estimates is characterized, numbers suggest higher levels of accuracy than they really represent.

Regulators are particularly vulnerable to technical attacks because, e.g. allowable rates of discharges are usually set with precision. Yet, investments in new controls are, for the most part, all or nothing, and industries that are just over allowable limits can be required to install pollution controls that may be very expensive for the level of reduction achieved.13

Thus, industry may have an incentive to delay. One way to accomplish delay is to argue over endless details.14 Also, technical arguments are often encouraged and sometimes even required by regulatory and legal institutions for political reasons. The manipulation of technical information to such ends has been explored by others. One concludes that "Having the balance of scientific evidence on one's side provides strong support and legitimacy for a position."15 Another observes that "By invoking the authoritative canons of scientific reasoning and method, public authorities and others who have a stake in technical issues seek to demonstrate the rationality of their position and thereby gain political support and acceptance."16 The result is that quantitative analyses may be granted undeserved prominence in public policy debates, and basic factors driving controversies may be blurred or buried by technical arguments.

Risk management controversies should not be contests over who can produce the most "experts" with the strongest credentials -- ones where non-technical interests are often excluded. Regulators can accomplish that end and limit pointless debate by 1) characterizing the variation in risk estimates; 2) providing full presentations of risk calculations, methods and assumptions; and 3) stating policy choices upon which risk assessments are based. Technical criticism appears to dissipate quickly when policy decisions about even legitimate scientific questions are made explicit. The object should not be to eliminate controversy but to force everyone to grapple with tough policy choices that may be concealed in a mass of often irrelevant technical details.

* This paper is based upon some of Dr. Roqué's graduate research. During 1986-87, she was responsible for developing the standards for carcinogens discussed here. She would like to thank Barbara Morin of the Rhode Island DEM and Professors Harold Ward, Kim Boekelheide, Nelson Fausto, Robert Kates, and Alan Morrison, her graduate advisors at Brown.

** Dr. Roqué received a B.S. and M.S. in chemistry from the University of California, San Diego, and Brown University, respectively. She also received her Ph.D. from Brown -- in an independently designed interdisciplinary program entitled "Environmental Risk Policy."

1 Kean, Dealing With Toxic Air Pollutants: New Initiatives, Issues in Science and Technology 19-27 (Summer 1986).

2 U.S. Environmental Protection Agency, Guidelines for Carcinogenic Risk Assessment, 51 Fed. Reg. 33,992-34,003 (1986).

3 Unit risks are the risks associated with inhaling air contaminated with 1 mg/m3 of a pollutant over a lifetime.

4 Supra, note 2.

5 Rhode Island Chamber of Commerce Federation, Petition to R.I. Superior Court for Temporary Restraining Order Against the R.I. Department of Environmental Management, Division of Air and Hazardous Materials, Regulation 22, Air Toxics (Mar. 1988) (copy of petition available from the Rhode Island Department of Environmental Management, Legal Services, 83 Park Street, Providence, RI 02903).

6 For similar views see, e.g., Nichols & Zeckhauser, The Perils of Prudence: How Conservative Risk Assessments Distort Regulation, 10 Regulation 13-24 (Nov./Dec. 1986); Paustenbach, Health Risk Assessments: Opportunities and Pitfalls, 14 COLUMBIA J. ENVT'L L. 379-410 (1989); Anderson, Scientific Developments in Risk Assessment: Legal Implications, 14 COLUM. J. ENVTL. L. 411-25 (1989).

7 This point is well documented for a number of animal carcinogens where the use of different dose-response relations can alter unit risk values by orders of magnitude. See, for example: Schneiderman, Regulation of Carcinogens in an Imprecise World, 363 ANNALS OF THE N.Y. ACADEMY OF SCIENCES 217-32 (1981); Van Ryzin, Quantitative Risk Assessment, 22 J. OCCUPATIONAL MED. 321-26 (1980); Crump, Methods for Carcino genic Risk Assessment, ch. 7 in PRINCIPLES OF HEALTH RISK ASSESSMENT 279-319 (1985); Brown, Learning About Toxicity in Humans from Studies on Animals, 13 CHEMTECH 350-58 (1983) and ENVIRON, Elements of Toxicology and Chemical Risk Assessment 40 (1986).

8 Multiplying these factors assumes the "correct" values are the extremes for each. Clearly, the likelihood of such a case is small, if not negligible, and this simplification provides an overestimate. See Finkel, Is Risk Assessment Really Too Conservative?: Revising the Revisionists, 14 COLUM. J. ENVTL. L. 447 (1989).

9 See D. KANE, ENVIRONMENTAL HAZARDS TO YOUNG CHILDREN (1985).

10 See, for example Ravetz, Usable Knowledge, Usable Ignorance: Incomplete Science with Policy Implications, ch. 15 in SUSTAINABLE DEVELOPMENT OF THE BIOSPHERE 415-32 (WILLIAM C. CLARK & R.E. MUNN ed. 1986); and Ravetz, Uncertainty, Ignorance and Policy, ch. 7 in SCIENCE FOR PUBLIC POLICY 77-93 (HARVEY BROOKS & CHESTER L. COOPER ed. 1987).

11 Russell & Gruber, Risk Assessment in Environmental Policy-Making, 236 SCIENCE 286-290 (1987).

12 D. STONE, POLICY PARADOX AND POLITICAL REASON 136 (1988).

13 As a matter of regulatory discretion, however, companies are usually allowed considerable leeway.

14 Moreover, in the case of proposed new facilities, people who oppose them may also have an incentive to delay.

15 Rushefsky, The Misuse of Science in Governmental Decisionmaking, 9 SCIENCE, TECHNOLOGY & HUMAN VALUES 54 (1984).

16 Ronald Brickman, as quoted in Rushefsky, The Misuse of Science in Governmental Decisionmaking, 9 SCIENCE, TECHNOLOGY & HUMAN VALUES 54 (1984).

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Risk Articles Index

Quest Consultants Inc.

Quantitative Risk Analysis

Wahsatch Gas Gathering Pipeline System

John B. Cornwell and William E. Martinsen

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Norman, Oklahoma

Quest Consultants Inc. was retained by Union Pacific Resources Company (UPRC) to conduct a quantitative risk analysis of a natural gas gathering system located in southwestern Wyoming. The objective of the analysis was to determine the risk the pipeline and associated wells pose to the public population along the pipeline route. This required the completion of four major tasks.

Task 1
Determine potential pipeline and wellhead accidents that could create life-threatening hazards to persons located near the pipeline or well sites.

Task 2
Derive the frequency of occurrence (probability) of each accident identified in the first task.

Task 3
Determine the consequences of each accident identified in the first task.

Task 4
Combine the consequences and the probability of occurrence of each accident to arrive at a measure of public risk created by the pipeline and well network.

The natural gas being produced and transported through the network varies in composition from one section of pipeline to another, according to the gas produced from each well. However, all pipeline sections transport natural gas containing some hydrogen sulfide. The pipeline creates no hazards for persons near the pipeline or well sites as long as the sour natural gas is contained within the pipeline.

Accidental releases of sour natural gas from the well/pipeline network could create potentially life-threatening hazards to persons near the location of the release. Due to the presence of hydrogen sulfide in the natural gas, the vapor cloud created by a release of gas to the atmosphere would be toxic as well as flammable. Persons inhaling air containing toxic hydrogen sulfide vapor could be fatally injured if the combination of hydrogen sulfide concentration and time of exposure exceeds the lethality threshold. If the cloud is ignited, persons in or very near the flammable vapor cloud could be fatally injured by the heat energy released by the fire.

The frequency of occurrence of each potential pipeline accident identified in Task 1 was estimated from historical pipeline failure rate data gathered by the U.S. Department of Transportation. Event trees were

then used to estimate the percentage of releases of various sizes that would create a toxic or fire hazard. For example, it was estimated that 50 percent of moderate-sized releases of sour natural gas from the pipeline do not ignite but do create a toxic cloud; 10 percent ignite immediately upon release and create a torch fire; and 40 percent ignite after some delay, thus creating a toxic cloud followed by a torch fire.

The frequency of sour gas well blowouts was derived from sour gas well historical data. The largest documented data base covers wells in the Province of Alberta, Canada. According to the data, an uncontrolled sour gas well blowout would occur with a frequency of 3.55E-06 blowouts per well per year. This failure rate is for wells equipped with subsurface safety valves (SSSV's). All the wells in the Wahsatch network will be equipped with SSSV's.

Computerized consequence models were used to calculate the extent of potentially lethal hazard zones for toxic vapor clouds and/or gas fires created by each potential accident identified in Task 1. Calculations were repeated for numerous combinations of wind speed and atmospheric stability conditions in order to account for the effects of local weather data.

When making these calculations, it was assumed that large releases of gas (ruptures and punctures) from underground pipelines were capable of blowing away the soil overburden because of the pipeline's high operating pressure. As a result, the released gas enters the atmosphere with high velocity, resulting in rapid mixing with air near the point of release. For corrosion holes, it was assumed that the gas being released from an underground pipeline was incapable of blowing away the soil overburden. As a result, the released gas enters the atmosphere with little momentum after passing through the soil above the pipeline.

The number of persons expected to receive fatal injuries due to exposure to each of the toxic or fire hazard zones was determined as a function of wind direction. The risk was then calculated by summing the potential exposures to each of the hazards for all accidents identified in Task 1, and modifying the exposures to each potential hazard zone by its probability of occurrence. For example, the probability of a specific flash fire is the product of the following probabilities.

- Probability of the accident that releases sour natural gas.
- Probability that the release creates a flammable vapor cloud under a unique combination of wind speed, wind direction, and atmospheric stability conditions.
- Probability that the flammable vapor cloud is not ignited immediately but is ignited after some delay.

The number of persons potentially exposed to a specific hazard zone is a function of the population density and distribution near the accident location. The population density varies along each pipeline section, and many of the sections do not have any permanent dwellings or population close enough to the pipeline to be affected by a pipeline release. In addition, some of the physical aspects of the pipeline (e.g., pipe diameter and operating pressure) and the composition of the gas in the pipeline also vary with location. Therefore, the pipeline/well network was divided into twelve pipeline sections and six well sites on the basis of pipeline diameter, operating pressure, and local population density. A drawing of the proposed pipeline/well system is presented in Figure 1. Calculations of expected failure rates and exposures were performed for each of the twelve pipeline sections and six well locations.

For each pipeline section or well site, one particular accident will create the largest potentially lethal hazard zone for that section. As an example, along Section L9 (the portion of the pipeline crossing Interstate 80), this accident is a full rupture of the pipeline without ignition of the flammable cloud, thus resulting in a possible toxic exposure downwind of the release. Under worst case atmospheric conditions, the toxic

hazard zone extends 2,600 feet from the point of release. Under the worst case conditions, it takes about 11 minutes for the cloud to reach its maximum extent. The hazard "footprint" associated with this event is illustrated in two ways in Figure 2. One method presents the footprint as a "hazard corridor" that extends 2,600 feet on both sides of the pipeline for the entire length of Section L9. This presentation is misleading since everyone within this corridor cannot be simultaneously exposed to potentially lethal hazards from any single accident. A more realistic illustration of the maximum potential hazard zone along Section L9 of the pipeline is illustrated by the shaded area in Figure 2. This shaded area illustrates the hazard footprint that would be expected IF a full rupture of the pipeline were to occur, **AND** the wind is blowing perpendicular to the pipeline at a low speed, **AND** "worst case" atmospheric conditions exist, **AND** the vapor cloud does not ignite. The probability of the simultaneous occurrence of these conditions is about 1.87E-07 occurrences/pipeline mile-year, or approximately once in 5,330,000 years.

Figure 3 presents the results of the risk analysis of the four pipeline sections and two wells located near the southwestern city limits of Evanston. This is the only portion of the pipeline/well network that has a resident population within 2,000 feet of the pipeline. The hazard corridor for this portion of the pipeline/well network is represented by the dashed line, marked "hazard corridor," on Figure 3. The results of the risk analysis are presented in Figure 3 as individual risk contours. Each contour illustrates the annual risk the pipeline/well network poses to persons near the pipeline or wells as a function of their distance from the pipeline and wells. As can be seen in Figure 3, the highest risk along this section of the pipeline network is to persons located immediately above the pipeline. The maximum risk posed by this portion of pipeline is about 5.0E-6 chances of fatality per year. This is for an individual located directly above the pipeline 24 hours per day for 365 days. In other words, an individual in this area of the pipeline network would have one chance in 200,000 of being fatally injured by some release from the pipeline for an entire year, if this individual remained directly above the pipeline for an entire year. An individual in this same area, but located 50 meters from the pipeline, would have about one chance in one million of being fatally injured by a release from the pipeline, if the individual were present at that location for the entire year.

The risk posed to the population within the appropriate "hazard corridor" for the pipeline/well network can also be presented in the form of *f/N* curves. This type of risk presentation, often called societal risk, is a plot of the frequency, *f*, at which *N* or more persons are expected to be fatally injured. Figure 4 is the *f/N* curve for the pipeline/well network. The *f/N* curve for UPRC's Wahsatch Gas Gathering System (twelve pipeline sections and six wells) shows the frequency of accidents that would affect one or more persons, on average, is less than 6.0E-07 chances/year, or one chance in 1.7 million.

Figure 5 plots the *f/N* curve for the pipeline/well network against the Off-Site Risk Guidelines proposed by the County of Santa Barbara (California) System Safety and Reliability Committee. As shown in Figure 5, the societal risk posed by the Wahsatch Gathering System is well within the *De Minimis* (acceptable) region.

Historical data on fatal accidents involving natural gas gathering and transmission pipelines have been compiled by the Department of Transportation (DOT). During the 14.5 years for which summary data are available, the maximum number of fatalities due to any single accident was six, and only two accidents caused six fatalities. For the pipeline/well network involved in this study, the maximum expected number of fatalities for any single accident is five on average. Figure 6 compares the *f/N* curve for all the pipeline sections to the *f/N* curve derived from the DOT historical data. (In order to make this comparison, the accident frequencies are presented as accidents per mile of pipeline per year.) As shown in Figure 6, the predicted *f/N* curve for the Wahsatch pipeline network is less than the *f/N* curve derived from the DOT's historical data. This is primarily due to the sparse population along the pipeline route.

To put this type of evaluation into perspective, it is instructive to look at the types of risks people are

ordinarily exposed to during day-to-day life. Table 1 lists the risks a citizen of the Evanston area might be exposed to each and every day. As can be seen in the table, there are voluntary activities (driving a car) and involuntary activities (being hit by lightning) that involve risks higher than those due to the Wahsatch pipeline/well network.

A second pipeline/well network was evaluated in this work. The second network is identical to that presented in Figure 1, with the addition of two wells (Champlin 375 C and Kindler-Reese), 15,400 feet of 6-inch pipeline, and 500 feet of 3-inch pipeline (Sections L10, L11, and L12). This pipeline/well network is presented in Figure 7. The two additional wells and associated pipeline are located in remote areas, with no permanent residents or business within the 2,000 foot hazard corridor; thus, they do not contribute to the societal risk (as presented on the *f/N* curve) of the pipeline/well network.

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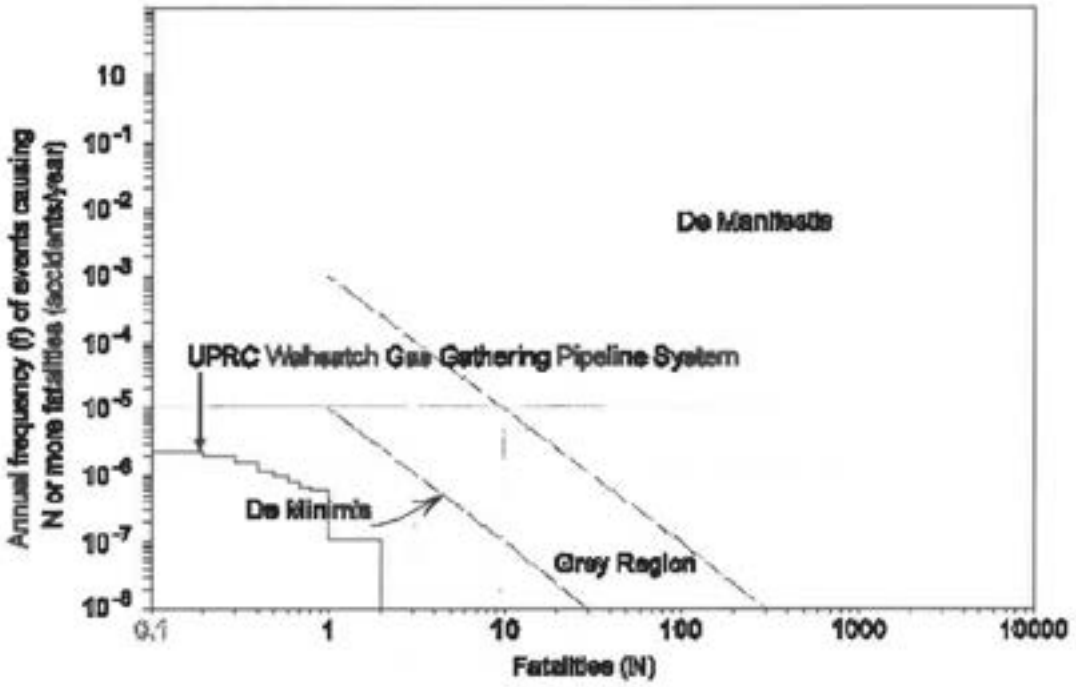
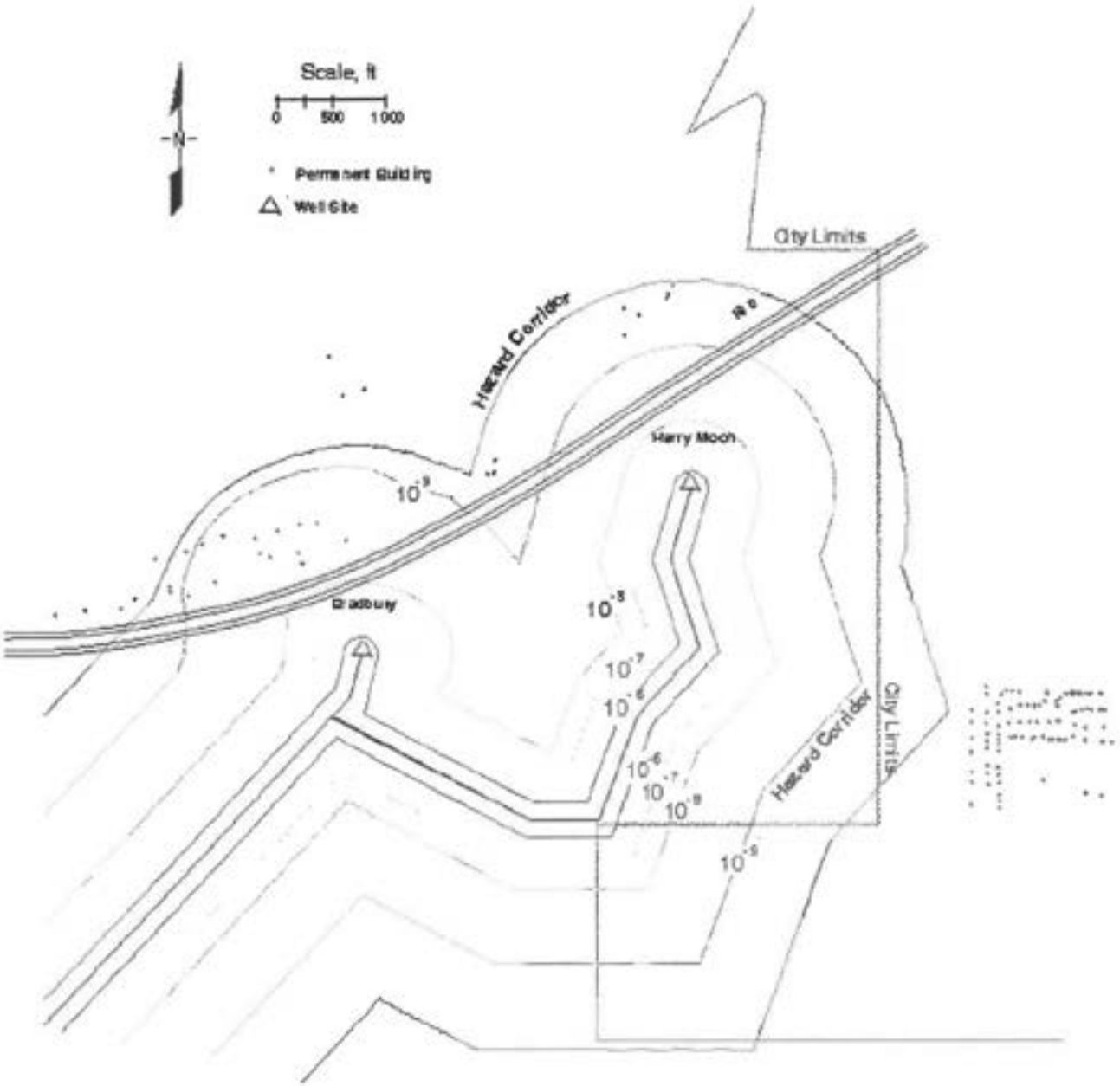
Table 1
Individual Risk of Early Fatality by Various Causes

Hazard	Approximate Individual Risk of Early Fatality	
	Probability/Year	One Chance in
Heart disease	3.12×10^{-3}	320
Cancer	1.96×10^{-3}	510
All accidents	3.90×10^{-4}	2,560
Motor vehicles	1.98×10^{-4}	5,030
Homicides	8.66×10^{-5}	11,500
Drowning	2.09×10^{-5}	47,600
Fires, burns	1.93×10^{-5}	51,800
Release of gas from Wahsatch pipeline/well network (maximum risk level – on pipeline center or wellhead)	5.20×10^{-6}	192,300
Civil aviation	5.19×10^{-6}	192,600
Water transport	3.90×10^{-6}	256,000
Railroads	2.56×10^{-6}	389,000
Lightning	4.06×10^{-7}	2,464,000
Bites and stings	2.79×10^{-7}	3,570,000
Release of gas from Wahsatch pipeline/well network (risk level - 100 meters either side of pipeline or wellhead)	2.00×10^{-7}	5,000,000
Release of gas from Wahsatch pipeline/well network (risk level - 300 meters either side of pipeline or wellhead)	2.50×10^{-9}	400,000,000

Comparison of the f/N Curve for UPRC's Wahsatch Gas Gathering Pipeline System and the Proposed Off-Site Risk Guidelines for the County of Santa Barbara




Scale, ft
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Permanent Building
Well Site
City Limits
Hazard Corridor
Harry Moon
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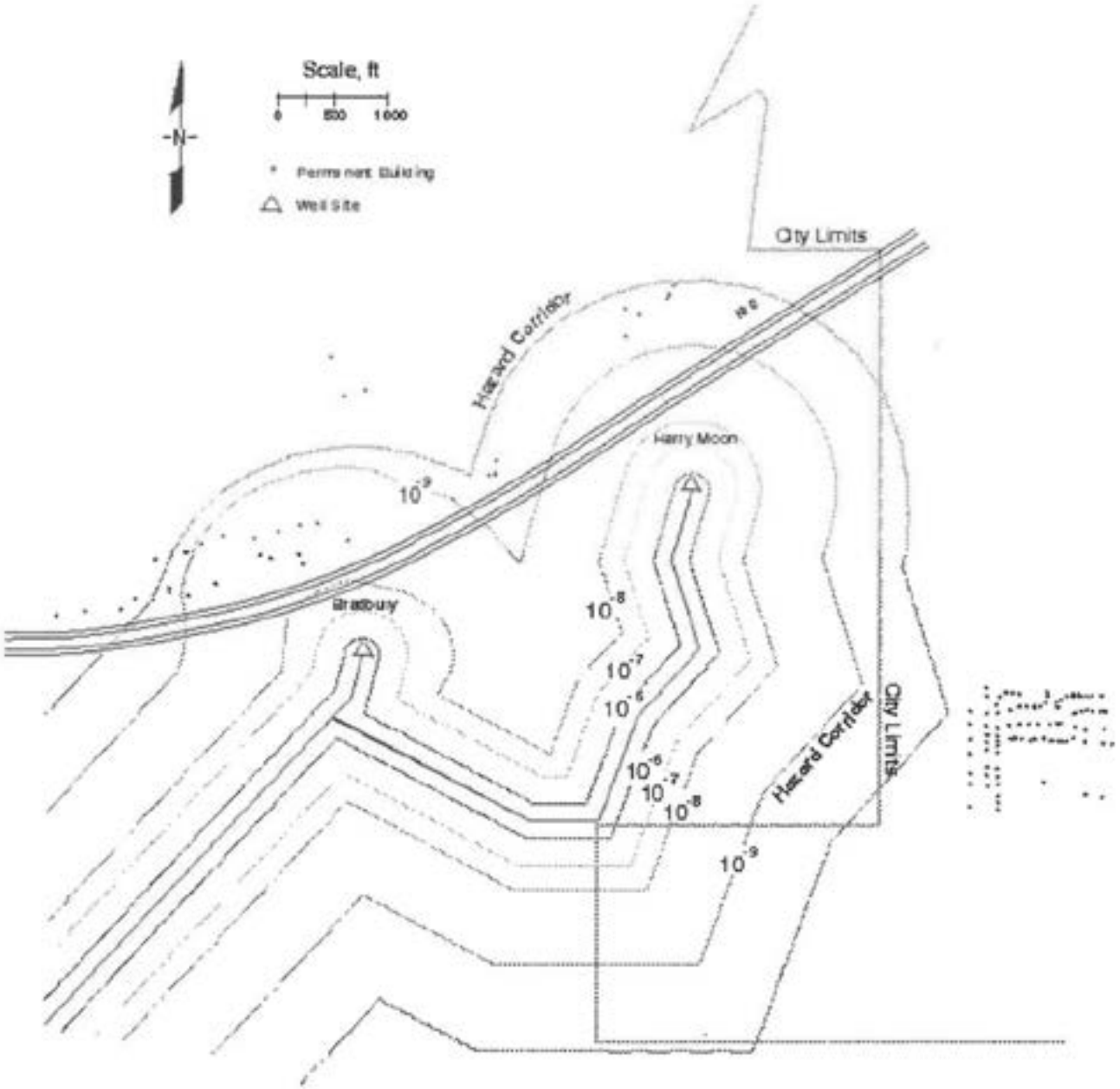
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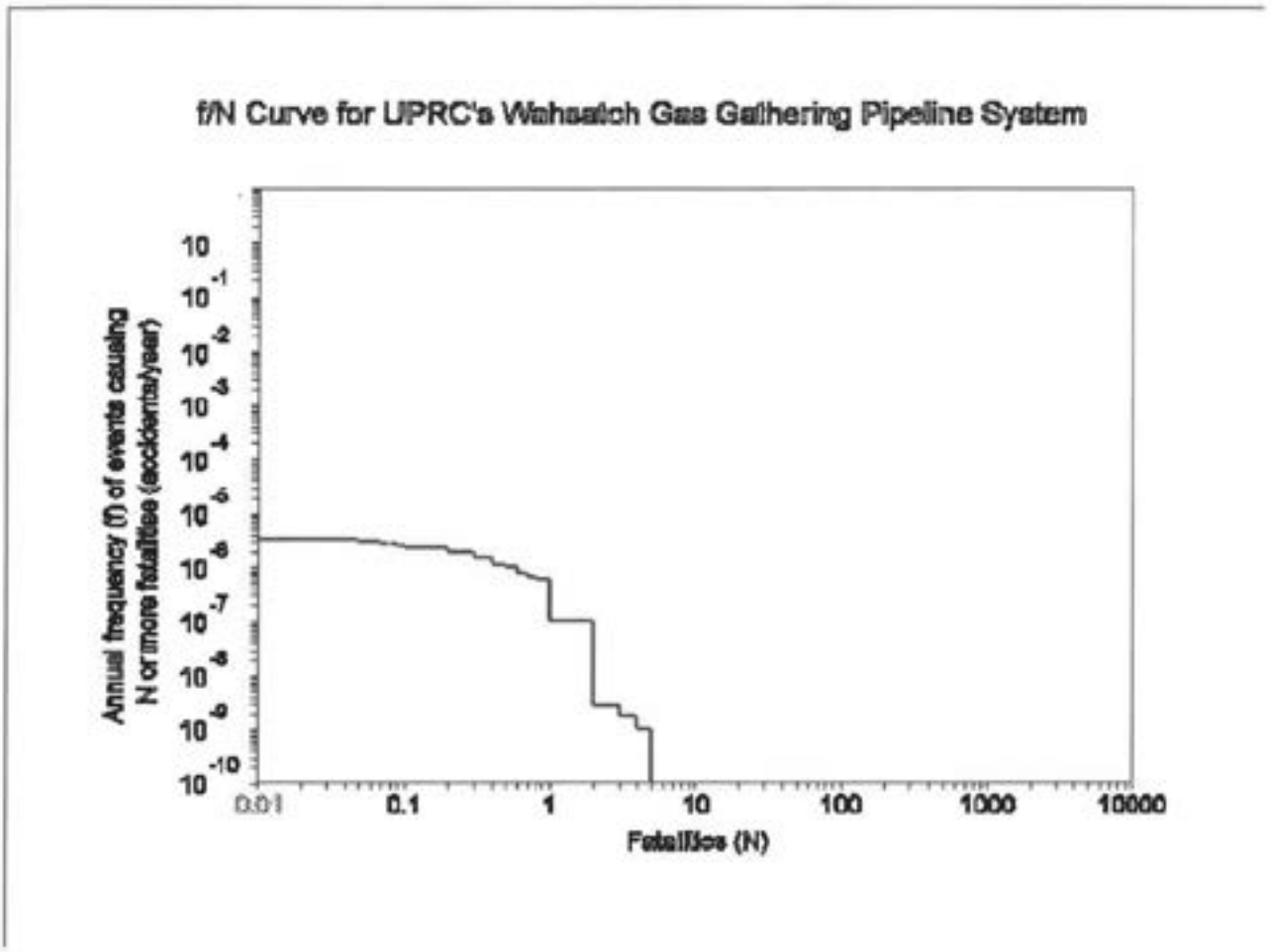
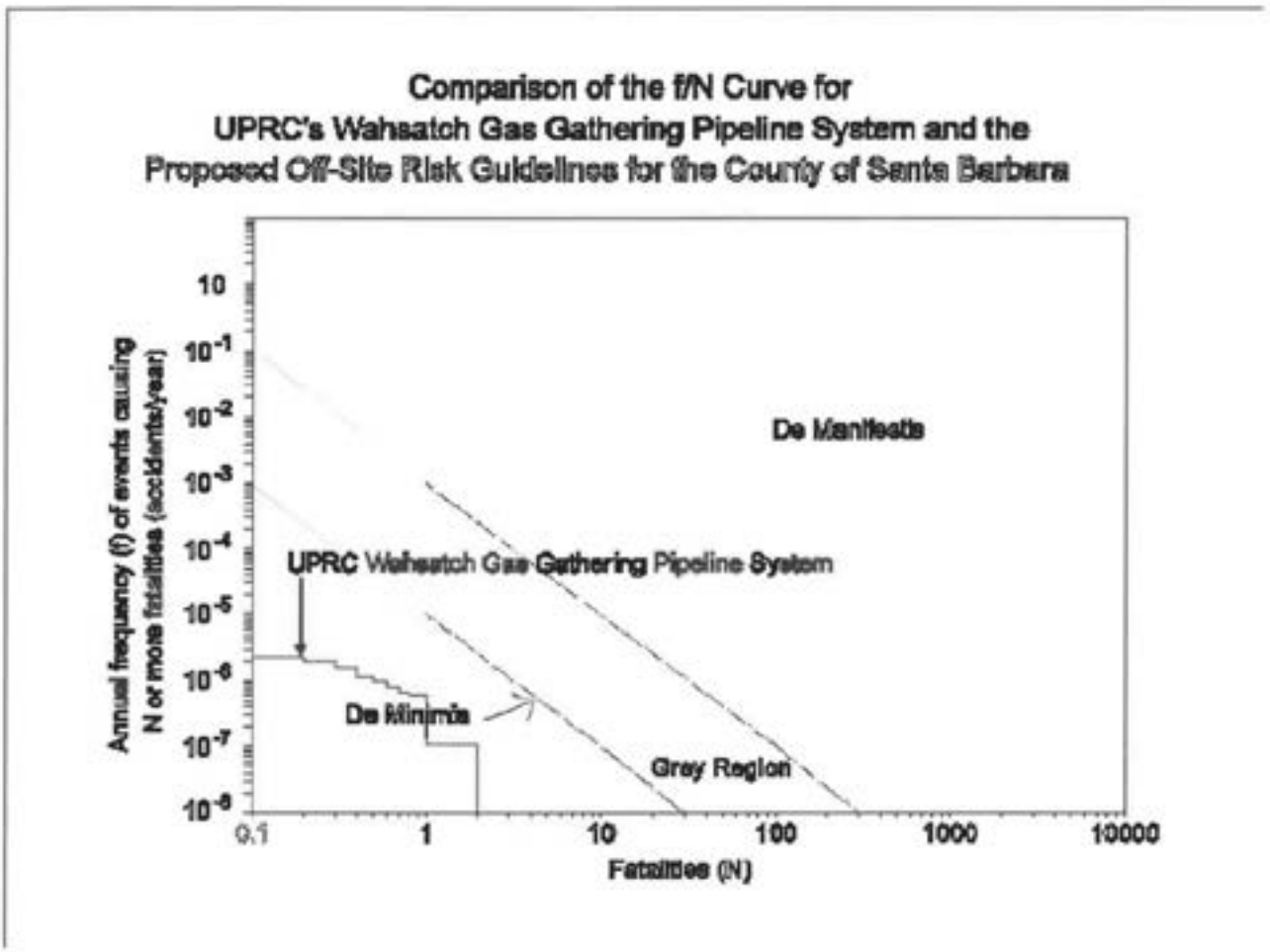
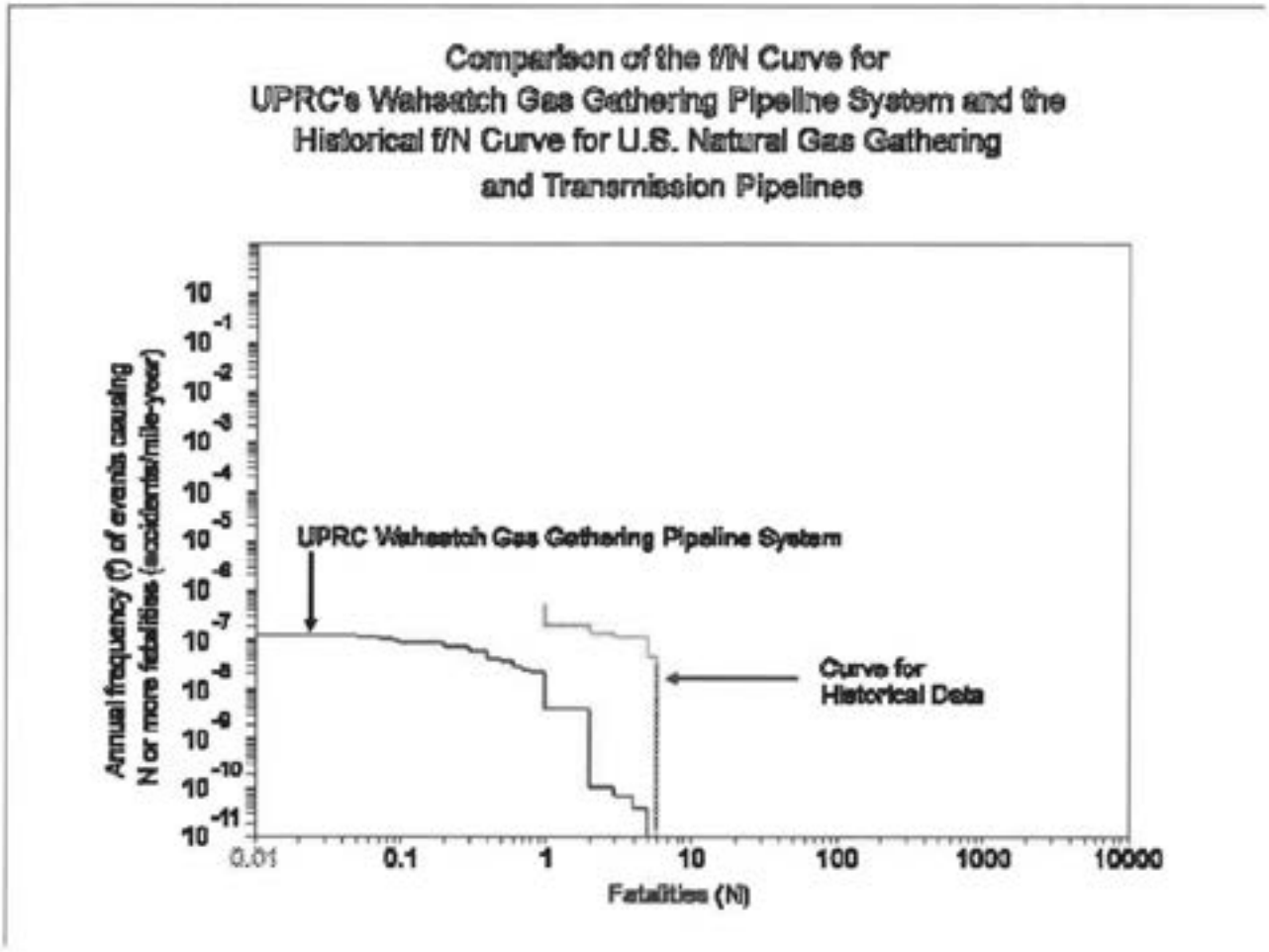
City Limits


f/N Curve for UPRC's Wahsatch Gas Gathering Pipeline System
Annual frequency (f) of events causing N or more fatalities (accidents/year)
10
10 -1
10 -2
10 -3
10 -4
10 -5
10 -6
10 -7
10 -8
10 -9
10 -10
0.01
0.1
1
10
100
1000
10000
Fatalities (N)


Comparison of the f/N Curve for
UPRC's Wahsatch Gas Gathering Pipeline System and the
Proposed Off-Site Risk Guidelines for the County of Santa Barbara
Annual frequency (f) of events causing
N or more fatalities (accidents/year)
10
10-1
10-2
10-3
10-4
10-5
10-6
10-7
10-8
De Manifestis
UPRC Wahsatch Gas Gathering Pipeline System
De Minimis
Grey Region
0.1
1
10
100
1000
10000
Fatalities (N)


Comparison of the f/N Curve for
UPRC's Wahsatch Gas Gathering Pipeline System and the
Historical f/N Curve for U.S. Natural Gas Gathering
and Transmission Pipelines
Annual frequency (f) of events causing
N or more fatalities (accidents/mile-year)
10
10 -1
10 -2
10 -3
10 -4
10 -5
10 -6
10 -7
10 -8
10 -9
10 -10
10 -11
UPRC Wahsatch Gas Gathering Pipeline System
Curve for
Historical Data
0.01
0.1
1
10
100
1000
10000
Fatalities (N)

1

Acceptable Risk: A Conceptual Proposal*

Baruch Fischhoff**

Introduction: The Search for Acceptability

Perhaps the most widely sought quantity in the management of hazardous technologies is the acceptable level of risk.1 Technologies whose risks fall below that level could go about their business, without worrying further about the risks that they impose on others. Riskier technologies would face closure if they could not be brought into compliance. For designers and operators, having a well-defined acceptable level of risk would provide a clear target for managing their technology. For regulators, identifying an acceptable level of risk would mean resolving value issues at the time that standards are set, allowing an agency's technical staff to monitor compliance mechanically, without having to make case-specific political and ethical decisions. For the public, a clearly enunciated acceptable level of risk would provide a concise focus for evaluating how well its welfare is being protected -- saving it from having to understand the details of the technical processes creating those risks.

A recent example is the attempt by the Environmental Protection Agency (EPA)2 to cope with a case involving vinyl chloride.3 EPA interpreted that case to require it, first, to assess the health risks for emissions of a particular pollutant and, second, to determine an acceptable risk for a source category emitting that pollutant.4 An earlier example is the Nuclear Regulatory Commission's5 attempt to set the overall level of safety expected for nuclear power plants.6 Both are still in process, and it is premature to judge their outcomes.

Yet, an ominous sign may be found in an EPA study done to prepare for dealing with the vinyl chloride case. It "surveyed a range of health risks that our society faces" and reviewed acceptable-risk standards of government and independent institutions.7 This led EPA to find that "No fixed level of risk could be identified as accept-able in all cases and under all regulatory programs...," and that:8

...the acceptability of risk is a relative concept and involves consideration of different factors. Considerations in these judgments may include: The certainty and severity of the risk; the reversibility of the health effect; the knowledge or familiarity of the risk; whether the risk is voluntarily accepted or involuntarily imposed; whether individuals are compensated for their exposure to the risk; the advantages of the activity; and the risks and advantages for any alternatives.

To regulate a technology in a logically defensible way, one must consider all its consequences, i.e., both risks and benefits. To regulate in an ethically defensible way, one must consider its impact on individuals, as well as on society as a whole.

An analytical procedure is advanced here to meet these constraints in determining the acceptability of technologies, one that is consistent with court decisions and compatible with general public values. The next section formulates this concept more precisely. It is followed by a discussion of how it could be implemented procedurally and describes modest compromises to the absolute principle to make it practicable. Embedded in an acceptable political process, the suggested procedure would offer some chance of making the regulation of hazardous technologies more predictable and satisfying. Along these lines, the final part of the paper speculates on how this procedure would affect the fate of particular technologies.

In an essay such as this, it is impossible to work out all the details; the proposal should be judged by whether the concept makes sense and whether its implementation seems workable. It should be appraised in

absolute terms: How well could it ever work? What degree of closure would it provide? It should also be considered relatively (recognizing the opportunities competing approaches have had to be proven or discredited): How does it compare to what we have?

This proposal tries to implement the non-utilitarian principle that a technology must provide acceptable consequences for everyone affected by it. Pursuing it as far as possible should produce a better regulatory process than current approaches -- ones focused on other ethical principles (or no explicit principles at all).

If the proposal is attractive, then one might undertake the chore of working out its details. That would involve some daunting challenges, e.g., estimating the scientific uncertainty regarding the magnitude of a technology's risks and eliciting citizens' willingness to trade off diverse costs and benefits.

It will be argued here that such obstacles are a sign of strength rather than weakness. They are inherent in analytically defining acceptable risk and revealed most clearly by an approach that attempts to address them head on. Short cuts can have both direct costs (e.g., antagonizing those whose issues are ignored) and opportunity costs (e.g., keeping scientists from working on neglected issues).

A final proviso is that the proposal would provide an incomplete path to regulatory reform even if all its methodological problems were solved. An analytical principle for evaluating the acceptability of technologies may become a point of departure for struggles, possibly involving suits, lobbying, hearings, demonstrations and negotiations. An analytical approach to acceptability can only hope to forestall some conflicts, by identifying politically unacceptable solutions, and focus others, by concentrating attention on critical unresolved issues. However attractive its logic, an analytical approach will aggravate controversy if offered as a substitute for an acceptable political process. People quite legitimately care as much about how decisions are made as what decisions are made.9

A Proposal for Acceptability: Balancing Risks and Benefits

As EPA has noted, the acceptability of a risk depends on many factors. In their everyday lives, people do not accept or reject risks in isolation. Rather, they make choices among courses of actions, whose consequences may include risks. If people accept a course of action, like deciding to drive somewhere, despite knowing about risks, then those risks might be termed acceptable in the context of the other consequences of that action. They need not be acceptable in any absolute sense. Those same individuals might choose a riskier course of action (e.g., deciding to pass a slow car), if it brought a compensating benefit. Or, they might choose a less risky course of action (e.g., postponing a trip home until well after the bars close), if that could be done at reasonable cost. A level of risk that is acceptable for one activity might seem horrendously high or wonderfully low in other contexts. In ordinary discourse, it is so easy to lose the essential context of decisions that the term "acceptable level of risk" might best be avoided.10

In this light, a technology should be acceptable to an individual if it creates an acceptable balance of personal risks and benefits. If a technology is acceptable for each member of society, then it should be satisfactory to society as a whole. One might call the risks of that technology societally acceptable (considering its benefits), just as one might call its benefits societally acceptable (considering its risks). A focus on action may produce the best language, that of a societally acceptable technology. This is the definition being advocated here: A technology has a societally acceptable level of risk if its benefits outweigh its risks for every member of society.11

The ethical core of this proposal may be seen most sharply by contrasting it with the utilitarianism of approaches that look at the total benefits accruing to a society from a technology, when judging the acceptability of its risks. A rough method for doing so is to perform a cost-benefit analysis, summarizing

economic measures of a technology's total benefits and total costs (including the risks that it imposes). A central ethical assumption of many such analyses is that one should look at the overall balance of consequences for society, while ignoring the balance actually experienced by individuals. Under this assumption, one would not care if a technology made society as a whole better off, at the price of making some of its members miserable. Nor would one care if a few people received very large net benefits, while many others had small net losses; or, if many people had small net benefits, while imposing large net losses on a few (e.g., those living near a landfill that accepts hazardous wastes from a large area).12

The rationale for this indifference to the fate of individuals is often some variant on the potential Pareto improvement principle. It holds that an action is acceptable if its excess of benefits over risks is sufficiently great that those who "win" from the action could compensate losers. However, they need not do so. The losers in these transactions may not know, much less be persuaded by, the efficiency arguments supporting this principle. Nor may they see themselves as winners often enough, in the set of decisions resolved by these procedures, to overlook the apparent injustices of a particular decision. Rather than trusting to any long run, they may want to be compensated in every transaction. It would take only a mildly cynical view of how society distributes its wealth to justify a fear of routinely getting the short end of the stick.13

Concern for the fate of individuals is embodied in regulations, like those reviewed by EPA, that specify acceptable levels of individual risk. For example, the maximum risk to someone living 70 years at a plant boundary might be set at one chance in a million of dying from a particular kind of emission. These regulations do not, however, invoke the benefits to these individuals as a concern in setting risk levels. Conceivably, some notion of benefit may underlie the standards. However, as long as they are not mentioned specifically, one cannot evaluate the appropriateness of the tradeoffs created by these standards. Indeed, the standards seem to deny the existence of tradeoffs. They do not distinguish, for example, between the situation of a middle-aged worker at the plant, who voluntarily lives near the gate to use cheap housing and avoid a nerve-racking commute, and that of a child whose parents could not afford to move when the plant set up shop next door.

No reasonable individual would want his or her personal life to be governed by a rigid acceptable level of risk. Nor should a reasonable society want a single level of risk to govern all technologies, regardless of their other features, including the benefits that they bring. Furthermore, reasonable individuals should not want government to take such inflexible actions on their behalf. It is not logically defensible to set a single level of acceptable risk for all technologies, unless a principled decision has been made to ignore all other factors. Had EPA's survey found that agencies make the same demands of diverse technologies, it would have provided a serious indictment of our regulatory processes.

Thus, again, the present proposal is that a technology is acceptable if it creates acceptable risk-benefit tradeoffs for every member of society. This criterion is advanced as a general political-ethical principle of the sort that would be endorsed by most citizens as a fundamental regulatory philosophy. It allows risks to be balanced by benefits, but protects individuals in cases where the greatest good for the greatest number might come at their expense.

If this proposal appears ethically sound, then the critical question becomes whether it can be implemented. Doing so would require: a fuller definition of "acceptable tradeoffs," a credible means for measuring those tradeoffs and an orderly procedure for applying them to evaluating individual technologies. Subsequent sections discuss these topics in turn, suggesting a work plan for developing practical standards from this conceptual proposal. A final section considers how implementing that plan would affect various stakeholders: industries, regulatory agencies, members of the public, and public interest organizations. It concludes that putting the fate of individual citizens at the center of the regulatory process may actually make life easier for many technologies.

As mentioned, in a democratic society, analysis cannot replace process, only inform it. However, a sound analysis can create a disputable presumption regarding what the outcome of that process should be. A technology that failed this test would bear an extra burden, either to create better tradeoffs for the individuals it affects or to demonstrate why it deserves special dispensation. Citizens opposed to a technology that had passed this test would bear an extra burden of proof to argue why it should pass more rigorous standards. People opposed to an analytical result will, naturally, criticize its technical details. However, that should be much less frustrating than trying to get the details right for an analysis that itself made no sense.

The goal of this proposal is not to enshrine and defend a single absolutist principle. Rather, it attempts to create a workable compromise. It qualifies and elaborates the core concept in ways that preserve and refine its basic thrust, in the hopes that it will resolve many issues (to the point where they do not seem worthy of debate) and focus debate on the others. It aims at fewer, but better conflicts.

Defining Acceptable Technologies

Conceptually, the most straightforward approach to determining the acceptability of a particular technology is simply asking all relevant citizens whether they are satisfied with how it affects them personally. The present section analyzes the reasons why such direct assessment is not viable. It argues, in effect, that, although the present proposal is for the people, it cannot be by the people -- at least not in this fully democratic sense. This discussion leads to a refined statement of the acceptable technology principle.14

Sampling Limitations

Vast numbers of people are exposed to at least some risk from many technologies. Indeed, where atmospheric distribution of toxins is possible, every person on the planet may be exposed. Given the intensive interviewing needed to elicit informed judgments regarding risk-benefit tradeoffs,15 it is impossible to ask everyone about everything. Thus, the most that can be elicited is general guidance regarding the kinds of tradeoffs most people would accept -- were they asked in a way that allowed them to understand the risks, the benefits and their own attitudes toward the tradeoffs.

Such direct evidence of concern is also the least that can be obtained if public welfare is to be at the center of regulatory processes. For example, one cannot rely on risk professionals' speculations regarding "what the public wants." The limits to expert opinions can be seen in disagreements among them about that.16 Professionals contact the public so irregularly, and their life experiences are so different, that they cannot claim accurate knowledge. Also, there is too much opportunity to report "what I think I would want were I in the public's place" or even "what I would like the public to want." Analogous criticisms limit the value of other potential stand-ins for genuine citizens (e.g., public interest advocates, elected representatives, pundits), although citizens might wish to consider such opinions when deciding which tradeoffs are right for them.

Thus, acceptable tradeoffs must be ones that citizens endorse in principle. They cannot want to be asked to evaluate their fate at the hands of every single technology, much less every change in its operating procedures. Being forced to have an opinion on every problem would mean being denied the opportunity to have articulated opinions on any problem.17

Although one might, in principle, ask every citizen about those general standards, a properly chosen sample should provide estimates of any desired precision. Moreover, the queried sample deserves the chance to develop thoughtful positions on these fateful issues and will need more opportunities for reflection than is

possible with conventional survey research.18 Thus, sample size might be sacrificed for measurement accuracy, securing fewer people, but ones who really have a basis for their opinion -- not unlike the situation with common law juries.

Complexity

The impossibility of asking everyone about everything reflects not just the number of potential decisions but also their complexity. For example, the money saved by not reducing a risk typically goes directly to the risk's producer. Nonetheless, other individuals, including those exposed to the risk, may receive indirect benefits as those cost savings pass through the economy. When federal government facilities operate at riskier levels, then taxes might be lower for all citizens, including those who bear the additional risks. Similarly, allowing a privately owned plant to operate more riskily might encourage it to remain in a community, leave it with more capital for local investment and encourage more generous wages. The ripple effects of such actions might benefit risk-bearers who are neither employees nor stock owners. Conversely, technologies should also be held accountable for indirect costs created by their risks. Some may be hard to measure or of uncertain relevance;19 e.g., the anxiety caused by concern over a landfill can have real health effects, even if rooted in misunderstandings.20

Identifying all of these consequences, much less quantifying them, is not work for the timid. A "classic" example of these difficulties might be found in the controversy over the direct and indirect risks of energy systems, prompted by Inhaber's analysis.21 Individuals might at best hope to understand the full set of personal effects for a handful of risky technologies for which they had a particular interest. As a result, it is a proper regulatory function to analyze the risks and benefits that a technology creates for individual citizens, then subject those summary measures of acceptability to the general standards produced by representative groups of ordinary citizens.22

Strategic Responses

Were they asked to judge the tradeoffs associated with a specific technology, properly informed individuals would realize that its fate hinged on their consent. If they sought to get the best possible deal for themselves, then they should exploit this position and demand more benefits than they would ordinarily view as constituting adequate compensation. Indeed, there would be no constraints on their demands beyond a technology's ability to pay. Some people might like the idea of stripping industries of all but the minimum profits needed to be viable. Yet, doing so would involve a greater shift of political power than is likely within any current regulatory system.23 The present proposal has the more modest goal of giving legal standing to the welfare of all citizens, including those whose lack of political standing might otherwise allow the imposition of unacceptable tradeoffs.

In this approach, people are not represented directly, but through their values, namely, the values that they would express in a situation where they could neither exploit some artificial veto power nor be exploited by coercive social arrangements. Such a standard would imply some surrender of absolute sovereignty on both sides were it implemented rigidly. A theory for justifying that restraint on individual choice is that an orderly society needs the limited right to impose risks in return for due compensation, just as it needs the limited right to secure property for the public good (e.g., road building). With declarations of eminent domain, the property is a physical object and the compensation is determined primarily by market value. Here, the "property" is the degree of personal safety that is lost through exposure to a technology. Proper compensation is the level of benefit that people would ordinarily consider to offset risks like those of the technology -- absent any advantages or disadvantages in bargaining position.

Individual Differences

If asked, different people might accept very different tradeoffs. Some may dislike risks to health and safety so much that they demand enormous compensation in return for any exposure. They do this in their own lives, and they expect the same treatment for risks from technological sources. Other people may be so indifferent to such risks that they require relatively little compensation. In their own lives, they do little to reduce risks, even ones whose benefits are minimal. Technological risks bother them equally little.24 It would be hard for a single regulatory policy (or a single configuration of a regulated technology) to satisfy individuals at both extremes. Risk-avoiding individuals would be aghast at the uncompensated riskiness of a technology that satisfied their risk-indifferent counterparts. The latter might be bemused at the resources "wasted" in needless risk reduction. They might be angry if they believed that some of those resources might otherwise come their way.

Thus, a third "compromise" of the ideal of using each affected citizen's values for each situation is needed: Rather than having to satisfy every possible set of values, a technology should be required to produce acceptable sets of consequences for individuals having "reasonable" values. This criterion is analogous to the reasonable person standard, a routine feature of legal proceedings. It is meant to exclude those who fall well outside the normal range. On the one hand, a technology would not have to satisfy individuals who would do almost anything to avoid the sort of risks that it creates. On the other hand, a technology would get no credit for satisfying individuals who care little about self protection or actually enjoy risk exposure.25

Like the other principles advanced in this proposal, if this one is accepted, then work could begin on its implementation (discussed in greater, but still partial detail, in the following section). One possible operational definition of "unreasonable risk avoidance" is willingly taking actions that create risks greater than the ones that they are meant to avoid (e.g., risking malnutrition in order to avoid foodstuffs with minimal pesticide residues). One possible operational definition of unreasonable risk acceptance is routinely passing up low- (or no-) cost opportunities to reduce risks. A fuller implementation might also explore creating a distribution of individuals in terms of their degrees of risk-aversiveness, then truncate symmetrically at some extreme fractiles. Again, the focus in this essay is on developing a proposal worthy of such detail. The act of defining "reasonable values" means imposing a general societal standard on the individual desires that societally regulated technologies must meet. Some individuals will be told, in effect, that they are not entitled to as much compensation for risk as they usually demand, while others will be getting more than they would ordinarily expect. It is an empirical question whether the same citizens will prove to have unreasonable values in case after case -- or whether different people will prove most averse to different risks.26

Legitimacy of Evaluative Criteria

In its Survey of Risks, EPA listed several conditioning factors that might affect judgments of acceptability. Some of these seem to have been drawn from psychologists' "psychometric" studies of risk, initiated by Fischhoff, Slovic, Lichtenstein, Read and Combs.27 These studies have found that laypeople want higher levels of safety from technologies whose risks have certain qualitative properties, such as being unfamiliar, evoking a feeling of dread and being perceived as poorly understood by science. For example, a technology whose risks were imposed involuntarily would have to provide greater benefits than a technology with the same amount of risk, but whose adoption was voluntary.28 Because technologies vary on these factors, people would not find any single risk level acceptable for all technologies.29

Whether such double standards ought to be imposed on technologies, just because the public wants them, is a matter of regulatory philosophy. For example, one might want greater benefits from technologies that evoke a feeling of dread, in order to compensate its citizens for the attendant loss in quality of life.

However, one might also believe that a technology is not responsible for how people feel about it, even when those feelings are based on accurate risk perceptions. One might want greater benefits from technologies whose risks are poorly understood by science in order to encourage better research or to create a reserve for unpleasant surprises. However, one might also want to be neutral toward uncertainty, in order to avoid discouraging new technologies.

The organic or enabling legislation of an agency may, however, have no place for some of these considerations. That is, if left to their own devices, citizens might base their acceptability judgments on factors that have no legal relevance. As a result, citizens asked to evaluate tradeoffs would have to be focused on factors they are allowed to consider by an agency empowered to determine which attributes of risk and benefit are legitimate bases for public policy. Beyond that, it would be required to let representative citizens determine what weight, if any, should be given to each.30

Summary

The acceptability of a technology should depend on the acceptability of its consequences for individual citizens. However, for both practical and philosophical reasons, that determination cannot be left to those citizens. There are too many issues, of too great complexity, for citizens to be able to identify their own best interests regarding every technology that poses some risk to them. Even if individuals knew their own minds, society does not have the resources to solicit opinions from everyone in every case. Moreover, individuals would have every incentive to demand exaggerated compensation, exploiting the need to secure their personal acceptance of a technology. Indeed, the best informed individuals might also be the most unreasonable. Even individuals who do not respond strategically may have unreasonable demands for protection or unreasonable willingness to accept risks. Finally, judgments that are not out of the ordinary may still reflect concerns that are not appropriate bases for regulatory policy.

These considerations lead to this principle:

A technology is acceptable if it creates an acceptable set of consequences for every member of society. Compliance should be determined by applying a general evaluative standard to the best available estimates of the technology's consequences. That standard should express the values of individuals with reasonable attitudes towards risk, constrained to focus on legally relevant consequences, and allowed to develop well-articulated positions.

The next section elaborates on procedures that could be used for implementation. They require basic research to determine general rules of acceptability (with input from representative citizens and within constraints set by regulations), followed by applied research to apply them to specific circumstances. Such an objective determination of subjective values is needed to protect individuals from being exploited by society and society from being coerced by individuals.

Determining Acceptable Tradeoffs

Implementing a regulatory principle has two steps: developing explicit general rules, thereby defining acceptable performance; and applying those rules to specific technologies, thereby determining their fate. All political-ethical-value questions should be resolved in the first step, so that the second involves only technical application of rules. The first requires political judgment to determine what kinds of tradeoffs are acceptable; the second requires scientific judgment to estimate the risks and benefits of particular technologies with enough precision to determine whether it meets the standard. The first step calls primarily for input from the social sciences, for measuring citizens' general attitudes toward risk-benefit tradeoffs.31 The second calls for inputs from various sciences, for measuring specific risks and benefits.32

As with any practical procedures in a complex world, these will require compromises to be implemented. The problems associated with risk and benefit assessment are well known and debated.33 They will not be repeated here, except to note that they often produce estimates of a variety of consequences (both good and bad), ranging over many orders of magnitude (from the best to the worst), and are often surrounded by considerable uncertainty (regarding both which measures and which models to use). The general rules must apply to tradeoffs among those kinds of outputs.

What follows is a conceptual analysis of how the development of such standards could be organized. It proposes a procedure with three stages: screening, balancing, and adjusting. The screening stage establishes whether, for regulatory purposes, an individual is considered to be exposed to risk from a technology (and would require some compensating benefit). The balancing stage identifies acceptable tradeoffs for exposed individuals. The adjusting stage incorporates additional factors needed to ensure a credible regulatory process, beyond what can be captured in summaries of risks and benefits.

A Measurement Philosophy

Two basic ways to get at people's values are observing their behavior (revealed preferences) and asking them (expressed preferences). As discussed below, the first method is limited unless one can identify the perceptions and constraints that underlie an action. In many cases, it will be extremely difficult to identify any action that clearly reflects many critical tradeoffs.34

As for the second, in principle, one can ask about anything. In practice, though, the fact that we have questions need not mean that our informants have answers. It is difficult to formulate precise value questions, much less render them comprehensible and help people work through the implications of their own preferences.35 Although the present proposal does no more than require directly facing questions implicit in many risk decisions, these questions often make us uneasy. Thus, it seems unrealistic to rely on standard survey methodology, with its dispassionate interviewers presenting questions in a manner designed to avoid any possible influence (or reactivity). Adopting that stance with respondents who lack articulated views means capturing fragmentary opinions and presenting them as deeply held true values. A more appropriate strategy is to work with respondents, helping them to understand issues and develop stable positions. It means striving to balance biases, rather than trying to avoid them altogether. Although unconventional in survey research, such a philosophy underlies decision analysis.36 Its procedures were created for situations with complex consequences and stakes sufficiently high to motivate individual involvement. Surveys are sometimes depicted as mock elections (opinion polls). The procedure required here might better be seen as creating mock commissions or juries, with a random sample of citizens impaneled to work things through on behalf of their peers.

Interviews would, logically, include an element of revealed preferences, and would call upon people to reflect on their own prior behavior and the reasons motivating it. Regarding risks that had apparently been ignored, they could be, e.g., asked: Did they not care? Did they have accurate perceptions? Would they make the same decision again? Did they even think about their actions?

Although daunting, such elicitation need not be perfect. Applying the acceptable-technology principle will lead to the same regulatory decision for all tradeoffs within some range. If an elicitation procedure shows that people's tradeoffs lie within that range, then that is all that would be needed. The measurement techniques best suited to this task seem to be those of decision analysis.37

Screening

Clearly, people do not pay attention to all risks in their lives, especially smaller ones. This has prompted many proposals for inferring a de minimis level of risk.38 According to these proposals, risks below some level can be ignored when technologies are regulated.

Unfortunately, such proposals fail to ask (or at least determine) whether people really do not care about risks they seemingly ignore. Do people even know they exist? If so, do they really know how great they are? How much thought have they given to the issues? If particular risks seem unacceptable, do people have any avenue, or energy, for expressing concerns? If they accept a technology, is it because the risks are negligible, or because there are compensating benefits? How accurately do they perceive any benefits? Without answers to these questions, no clear conclusions can be drawn from observed behavior.

Once the potential of revealed preference analyses has been exhausted, expressed preferences would be explored. The critical question for standard setting is: What risks are people willing to ignore, so that no compensating benefit is required, if they are exposed to risks at that level? This judgment should not consider the transaction costs of either evaluating risks or collecting compensation. The agency implementing the general standard would handle both. It would commission (or review) the risk analyses. It would exact and allocate any needed compensation, beyond what would occur naturally.39

A successful screening procedure could dramatically reduce the number of individuals whose welfare needs to be considered. Such success might seem improbable in light of the observation that citizens often seem very agitated by risks that many experts view as very small. That suggests that no risk is so small that no compensation is required. The problem with this inference is its simplistic interpretation of citizens' behavior. They may not accept the experts' claims. Or, they may object to the people and the political process managing the risk. That is, they may feel that they are losing rights and respect, but be constrained to talk about risks. Experts may prefer to call the public stupid rather than to admit that they have treated it high handedly.

Balancing

Whenever a technology poses non-negligible risks to an individual, it would then have to pass a risk-benefit test, showing that its consequences are acceptable, as judged by the general standard set for reasonable individuals. These standards can be developed with the same kinds of procedures as are available for screening decisions:

* a. observing the preferences that may have been revealed in past decisions,

* b. asking people in the abstract what tradeoffs they deem acceptable,

* c. asking people to evaluate hypothetical situations that embed abstract tradeoffs in concrete examples, and

* d. asking people to review their own previous decisions, clarifying the tradeoffs that those choices were meant to embody.

Such research would need to provide not only its best estimate of these value judgments, but also an assessment of its own definitiveness, suitable for sensitivity analyses.

In reviewing past decisions, as in procedures a and d above, the greatest credence would be given to cases fulfilling the conditions of informed consent; that is, where the decision-making process was well-informed, thoughtful, and uncoerced. Where people were uninformed or misinformed (regarding risks or benefits),

analysts must reconstruct the decisions that people thought they were making. Where people were unable to make thoughtful choices, analysts must divine which choices would have emerged under more favorable circumstances. Barriers to thoughtfulness include being rushed and simply not knowing how to organize one's work. Although time pressure can complicate decision making, poor choices are often made with all the time in the world.40

Actions, to be analyzed at all for evidence of people's values, need to represent decisions, i.e., they need to reflect choices among alternative courses of action. In the language of risk analysis, they need to be voluntary. Deriving standards from involuntary decisions means interpreting as acceptable whatever tradeoffs people have been forced to accept. It means enshrining the injustices of the past in prescriptions for the future.

Adjusting

No set of general rules will apply equally well in all circumstances. To preserve the public credibility and political viability of an approach, an agency must be able to adjust its determinations in situations having crucial features that are not represented in its general rules. On the other hand, if its work is not to become a patchwork of special pleading, then it must attempt to codify those exceptions in advance. Three examples follow, concerning the sort of systematic exceptions that might be applied to the acceptable-technology principle:

* People want not only to receive attractive deals, but also to feel that they have been treated fairly. Even if a technology provides them with an acceptable risk-benefit tradeoff, people may be dissatisfied, for example, if they feel that the technology's sponsors could have paid them more without impairing the technology's economic viability. They may be dissatisfied if a technology was located in their community simply because it cost less to provide them with an acceptable tradeoff than it would have cost to satisfy residents of a wealthier community (who are accustomed to receiving more compensation for any given level of risk). They may be dissatisfied if they believe that others got a better deal than they did.41 These are predictable, familiar human emotions. Whether they have standing requires a regulatory determination. If they do, then the decisions emerging from the screening and balancing stages might have to be adjusted. For example, an agency might impose a "poverty premium," demanding higher compensation for risks in poorer communities. If not, then the agency should be explicit about the irrelevance of these issues.42

* Citizens might be dissatisfied if the search for additional safety stopped once a technology had been deemed acceptable -- just as its owners' might be dissatisfied if they were still required to incorporate every new safety device. A compromise adjustment might be to require additional safety measures that passed an explicit cost-effectiveness criterion (e.g., reduced radiation exposure for less than $1,000 per person-rem43). Such a rule might reassure the public that there are incentives for developing safety measures (insofar as the inventor of an efficient risk-reduction method could expect to have it mandated), without imposing an unreasonable burden on industry.

* The acceptable-technology principle is exclusively egoistic. In it, individuals judge the acceptability of a technology solely by the risks and benefits that they personally receive from it. However, people also make sacrifices for the sake of others. For example, the neighbors of a landfill might tolerate somewhat higher risk levels if the alternative was shipping the waste to a developing country, or if they felt that this was their part in a social process that ensured an orderly distribution of risk burdens across the country. Assuming that some underlying order can be discerned, altruistic adjustments might also be incorporated in the standard.44

Finally, of course, after screening and balancing, adjustment would require legal or administrative

mechanisms to integrate determinations from this procedure with others that might be legally required.

Summary

The core of any safety determination is a value judgment defining the "acceptability" of risk. In the approach proposed here, that judgment is expressed in terms of a performance standard, specifying risk-benefit tradeoffs that a technology must produce, rather than a technical standard, specifying design and operation details. This requires that performance be evaluated by individual citizens. Once operational, it would involve a set of general rules for: screening cases, to eliminate those where a technology poses a negligible risk; balancing risks and benefits in the remaining cases, thereby characterizing acceptable tradeoffs; and adjusting the balance statement to accommodate additional factors.

Deriving such rules will require detailed analysis, using some combination of the procedures outlined here. Some of these methods rely on what people say about their values, whereas others rely on what people actually do when their values are at stake. None are perfect. All provide some complementary insights, assuming that their strengths and weaknesses are understood. The more satisfactory their implementation, the fewer issues will have to be addressed on an ad hoc basis when the standard is applied. As mentioned, the product of applying this procedure would be the point of departure for political processes, wherein the affected parties struggle over the acceptance of its recommendations. That is the fate of any regulatory decision. The hope with this proposal is that the ensuing struggles will be fewer and better focused, by virtue of embodying a principle that places individual citizens' welfare at its core, provides industry with a predictable standard and sensible incentives, and anticipates the major exceptions.

Applying the Standard

Compared to existing approaches, a new approach has the advantage of being unsullied by failures and compromises. Yet, it has the disadvantage of having all the hard work of implementation in front of it. Whether further elaboration is warranted depends on its promise. As an aid to appraising its promise, this section considers potential challenges to its practicality and political acceptability.

Practicality

Perhaps the most obvious practical problem with this approach is the apparent need to calculate risks and benefits separately for every individual exposed to non-negligible risks (and to establish the negligibility of the risks to everyone else). Where there are many such individuals, this could require horrendous computation. Making it manageable will require a structural analysis of how risks and benefits are distributed. For example, the estimation process might begin with the individuals bearing the greatest risk (to see if their benefits are commensurate)45 or with the individuals receiving the least benefit (to see if their risks are non-commensurate). One then might look for individuals experiencing intermediate levels of risk who receive unusually low benefits, before considering individuals (or classes of individuals) whose situations bear detailed analysis.

A common situation will be individuals who receive little risk and little benefit from a technology. Very small risks may come from very unlikely worst-case scenarios or from pollutants distributed widely at very low concentrations. Very small benefits may come from diffuse contributions to the overall economy. For example, a factory may ever-so-slightly reduce taxes or the threat of unemployment for individuals living on the other side of town or state. Thus, the acceptability of the technology for the vast majority of people will involve roughly the same risk and benefit estimates. In some cases, applying the general rule will yield so clear-cut a result that no refinements are needed. It may be that the small benefit far outweighs the minimal risk, even for the most averse (but still reasonable) individuals in that class. Or, the technology may be so

far out of line that a redesign or compensation plan is needed before proceeding with the analysis.

All regulatory approaches must contend with uncertainties left by even the best risk and benefit assessment methods. To be treated systematically, uncertainties must be summarized quantitatively.46 One can then determine whether a technology is in compliance, to any desired degree of confidence (e.g., can one be 95% certain that the benefits outweigh the risks?). A technology's impacts may be poorly understood in an absolute sense, but still be well enough known to allow a regulatory judgment. The level of confidence demanded would be part of the general standard.

Uncertainties are often particularly large where risks and benefits are particularly small.47 Fortunately for the sake of the analysis, people may demand less precision here than with more consequential technologies. The screening procedure will show some risks to be negligible, whereas others can be justified by any arguable benefits. If so, a rough calculation of risk and benefit might be enough to demonstrate acceptability with adequate confidence. Further work might reveal other shortcuts that are scientifically and ethically acceptable. For example, people might accept replacing person-by-person assessments with class-by-class assessments, especially if the science was better at the aggregate level. Rather than estimating the impacts for each individual residing ten to fifty miles from a factory, one might estimate the total risks and benefits accruing to these individuals, under the assumption that they bear roughly equal shares of each.

Political Acceptability

Ideally, a regulatory proposal would be evaluated solely in terms of the general ethical principles that it embodies, its compliance with legal constraints, and its practicality -- and not in terms of the specific decisions that it will produce.48 To that end, the formulation of this proposal has been motivated by the desire to address the principled objections that can be raised against utilitarian philosophies (which ignore distributional effects) and risk-only philosophies (which ignore all other effects). It was hoped that this appeal would foster the patience needed to work out its technical details.

Realistically, though, people will judge the procedure by how its application will affect them personally. One possible defense against such strategic behavior is to argue that regulatory processes are so complex that it is hard to predict their outcomes. As a result, honesty is the best policy when designing general procedures. If the principles underlying a proposal are sound, then one should trust it to allow the merits of one's position to emerge in specific applications. The following paragraphs discuss what each of three groups of stakeholders might find if it tried to project how this approach would affect its vested interests.

For regulators, a working version of this proposal would make regulatory operations more efficient, by reducing them to the routine application of an accepted rule, and less controversial, by concentrating political-ethical questions in the role-development process. Even failures might be relatively productive, if the logical coherence of the approach made it relatively easy to diagnose their sources. That might make it easier for an agency to press legislators for a clearer mandate. On the other hand, any change in procedure brings disruption, surprises, and the need for a transition period.

For industry (or government, when it sponsors technologies), any predictable, efficient process should reduce costs due to regulatory delays and unpleasant surprises. Having to provide an acceptable balance of consequences for all affected individuals is a rigorous standard. However, it is also one that provides considerable design freedom in achieving compliance (whether by increasing benefits or by decreasing risks). The focus on individuals also offers a potential solution to the recurrent problem of what to do when large numbers of people receive small exposures, without resorting to de minimis arguments like "they shouldn't mind a little risk" and without having to choose among the competing models for estimating low-exposure risks. People may agree to let a vague chance of a very small risk be balanced by a vague

chance of a very small benefit -- if the choice is made within a generally credible procedure.

For citizens, the approach officially places the welfare of individuals at the center of regulatory policy. It offers an explicit set of procedures, open to review at both the standard-setting and standard-application stages. It does, however, undermine the legitimacy of risk-only standards which have sometimes been favored by public interest advocates. Whether those advocates would oppose this proposal should depend on whether they have promoted rigid risk standards primarily as a strategic position, designed to manipulate regulatory processes that are seen to underweight risks to the public. Recognizing both the risks and the benefits of technologies, as proposed here, seems like a reasonable compromise.

Conclusion

Orderly regulation requires well-specified, logically defensible procedures. Without them, regulation is chaotic, unpredictable and frustrating, with little promise of providing either the sort of protection the public desires or the sort of stable environment that industry needs. Within these goals, an approach has been developed that makes the welfare of individual citizens the primary concern of regulatory processes, while still providing industry with a clear, flexible, and sensible set of requirements. A plan is sketched for putting this conceptual proposal into practice. Details are necessarily sketchy and merit elaboration only if the proposal seems practical enough and political enough to offer the possibility of a more orderly and coherent treatment of acceptability -- a task that so far has defied our best efforts, especially efforts attempting to specify a fixed level of "acceptable risk."

Notes

* Support for this research was provided under National Science Foundation Grant SES-8715564. It is gratefully acknowledged, as are the helpful comments of Cindy Atman, Adrian Cohen, Robyn Dawes, Hadi Dowlatabadi, Thomas Field, Gregory Fischer, Lita Furby, Neil King, Eric Males, Jon Merz, Granger Morgan, Tom Smuts, Ola Svenson, and Earle Young, Jr., as well as those of several anonymous reviewers. The views expressed are those of the author.

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1 Howard I. Adler & Alvin M. Weinberg, An Approach to Setting Radiation Standards, 34 Health Phys. 719 (1978); James O. Corbett, Risk Assessment Criteria for Radioactive Waste Disposal, 8 Risk Anal. 575 (1988); Health & Safety Executive, The Tolerability of Risks from Nuclear Power Stations, (London 1987); William R. Lowrance, Of Acceptable Risk (1976); Paul Milvy, A General Guideline for Management of Risk from Carcinogens, 6 Risk Anal. 67 (1986); Chauncey Starr, Risk Criteria for Nuclear Power Plants: A Pragmatic Proposal, 1 Risk Anal. 113 (1981); and Chauncey Starr, Risk Management Assessment and Acceptability, 5 Risk Anal. 97 (1985).

2 Environmental Protection Agency, National Emission Standards for Hazardous Air Pollutants..., 53 Fed. Reg. 28,495 (1988).

3 Natural Resources Defense Council, Inc. v. U.S. Environmental Protection Agency, 824 F.2d 1146 (D.C. Cir. 1977).

4 55 Fed. Reg., at 28512-513.

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6 See, e.g., Vickie M. Bier, The U.S. Nuclear Regulatory Commission's Safety Goal Policy: A Critical Review, 8 Risk Anal. 563 (1988); Baruch Fischhoff, Acceptable Risk: The Case of Nuclear Power, 2 J. Pol'y Anal. & Mgmt. 559 (1983); J. Michael Griesmeyer & David Okrent, Risk Management and Decision Rules for Light Water Reactors, 1 Risk Anal. 121 (1981); Kenneth A. Solomon et al., An Evaluation of Alternative Safety Criteria for Nuclear Power Plants, 5 Risk Anal. 209 (1985).

7 Survey of Risks (Dkt. No. OAQPS 79-3. Part I, Dkt. item X-B-1).

8 53 Fed. Reg., at 28,513.

9 See, e.g., Daniel J. Fiorino, Regulatory Negotiation as a Policy Process, 48 Pub. Adm. Rev. 764 (1988); Daniel J. Fiorino, Citizen Participation and Environmental Risk, 15 Sci. Tech. & Human Values 226 (1990); Sheldon Krimsky & Alonzo Plough, Environmental Hazards: Communicating Risks as a Social Process (1988); Controversy: Politics of Technical Decisions (Dorothy Nelkin ed. 1978); Harry J. Otway & Detlof von Winterfeldt, Beyond Acceptable Risk: On the Social Acceptability of Technologies, 14 Pol'y Sci. 247 (1982); Lillie C. Trimble, What Do Citizens Want in the Siting of Waste Management Facilities? 8 Risk Anal. 375 (1988); and Elaine Vaughn, Individual and Cultural Differences in Adaptation to Environmental Risks, 48 Am. Psych. 673 (1993).

10 The (UK) Health & Safety Executive, supra note 1, uses the term "tolerable" to describe risks that are accepted for the time being, until a more attractive tradeoff can be found. See also, Baruch Fischhoff et al., Acceptable Risk (1981).

11 There is no reason why these "benefits" should be restricted to economic consequences or even noneconomic ones for which putative economic equivalents exist. People could in principle, be compensated by peace of mind, feelings of satisfaction, or reduction of other risks. See, e.g., Baruch Fischhoff & Louis A. Cox., Jr., Conceptual Framework for Benefit Assessment in Benefits Assessment: The State of the Art (Judith D. Bentkover, Vincent T. Covello & Jeryl Mumpower eds. 1985); Baruch Fischhoff & Lita Furby, Measuring Values: A Conceptual Framework for Interpreting Transactions, 1 J. Risk & Uncert. 147 (1988).

12 The controversial nature of such aggregate analyses may be seen in the conflict between Executive Order 12,291, see, e.g., Fischhoff & Cox, supra note 11 and the Court's opinion in the vinyl chloride case, supra note 3. The former requires cost-benefit analyses, examining the overall impact of significant federal regulatory actions, ignoring which individuals get the costs and which get the benefits. The latter prohibits EPA from considering the cost or feasibility of compliance in setting the acceptable level of risk, thereby ignoring the benefits that less costly operation might bring to society as a whole.

See also Michael S. Baram, Cost-Benefit Analysis: An Inadequate Basis for Health, Safety, and Environmental Regulatory Decision Making, 8 Ecol. L.Q. 473 (1980); John T. Campen, Benefit, Cost & Beyond (1986); David W. Pearce, Cost Benefit Analysis (1983); Elizabeth Stokey & Richard Zeckhauser, A Primer for Policy Analysis (1978).

13 See, e.g., Robert Bullard, Dumping in Dixie: Race, Class, and Environmental Quality (1990) and Commission for Racial Justice, Toxic Wastes and Race in the United States (1987).

14 Whether (and how) public opinion needs to be consulted regarding the adoption of a specific standards is, of course, also a matter of administrative procedure and law. For example, the Court's opinion of the

Vinyl Chloride case appears to call for the adoption of a standard that the general public would endorse, were it possible to solicit its collective opinion in a way that ensured full understanding of the standards and their implications. EPA's request for comments on its proposed approaches repeatedly mentions concern for the public's desires. Many regulatory procedures call for public hearings, followed by orderly written responses to questions raised in them. The present proposal is intended to comply with these constraints, and perhaps give them structure. Detailed analyses of particular settings must await a future opportunity.

15 See, e.g., Baruch Fischhoff, Value Elicitation: Is There Anything in There? 46 Am. Psych. 835 (1991) and Ralph L. Keeney & Howard Raiffa, Decisions with Multiple Objectives (1976).

16 See, e.g., National Research Council, Risk Perception and Communication (1989); Paul Slovic, Perception of Risk, 236 Science 280 (1987); Vaughn, supra note 9; and Abraham H. Wandersman & William K. Hallman, Are People Acting Rationally? 48 Am. Psych. 681 (1993).

17 See, e.g., Jacques Ellul, Propaganda (1969).

18 See, e.g., Fischhoff, supra note 15.

19 An issue currently in litigation is whether technologies can be held liable for the existence value of natural resources, that is, the value that people assign to the very existence of, say, the Grand Canyon in a relatively pristine state. If the courts decided that existence value had legal standing, then the threat that a technology posed to the environment could become a risk requiring compensation. Measuring these threats and the values attributed to them would be a significant methodological challenge.

20 See Andrew Baum & India Fleming, Implications of Psychological Research on Stress and Technological Accidents, 48 Am. Psych. 665 (1993).

21 See Herbert Inhaber, Risk with Energy from Conventional and Non-Conventional Sources, 203 Science 718 (1979); see also John H. Herbert, C. Swanson & P. Reddy, A Risky Business, 21(6) Environment 28 (1979).

22 Those general standards might specify, e.g., that a technology should be responsible only for the concern that its risks would generate if they were properly understood.

23 Adopting such a confiscatory policy would also raise the difficult question of how to divide the spoils among those citizens who have preferred strategic responses.

24 See e.g., Risk Taking (J. Frank Yates ed. 1992).

25 Such individuals derive unusual benefit from the risk, meaning that their preferred risk-benefit tradeoffs may not be all that different from those of nonrisk seekers.

26 Note that individuals who are extremely averse to risks need not be extremely sensitive to them (a protected class in some regulations). One could respond more acutely to a given exposure to a toxin, yet still not want particularly large compensation particular probability of such a response.

27 See supra note 7; compare Baruch Fischhoff et al., How Safe Is Safe Enough? A Psychometric Study of Attitudes towards Technological Risks and Benefits, 8 Pol'y Sciences 127 (1978)

28 The idea of looking for a double standard was proposed by Chauncey Starr in Social Benefit versus

Technological Risk, 165 Science 1232 (1969). A list of features that might prompt double standards was compiled by Lowrance, supra note 1.

Further studies in this "tradition" are summarized in Robin Gregory & Robert Mendelsohn, Perceived Risk, Dread and Benefits, 13 Risk Anal. 259 (1993); Slovic, supra note 16; and Paul Slovic, Baruch Fischhoff & Sarah Lichtenstein, Behavioral Decision Theory Perspectives on Risk and Safety, 56 Acta Psych. 183 (1984).

29 See, e.g., Baruch Fischhoff, Stephen Watson & Chris Hope, Defining Risk, 17 Pol'y Sciences 123 (1984).

30 Where citizens felt strongly about factors that they could not consider, then the agency might maintain two sets of books, one for legitimate factors and one for all factors. Over time, changes in the regulatory climate might allow the omitted factors to be included, much as environmental effects are gradually being incorporated in national accounts. See, e.g., Environmental Accounting for Sustainable Development (Y. J. Ahmad, S. El Serafy & E. Lutz eds. 1989); Ecological Economics: The Science and Management of Sustainabilty (Robert Constanza ed. 1991); and Robert Solow, An Almost Practical Step Toward Sustainability (1992).

31 The humanities might also pay a critical role in formulating possible tradeoff rules, as inputs to the citizens entrusted with expressing public values (through the best-available social-science procedure).

32 See, e.g., Baruch Fischhoff, Setting Standards: A Systematic Approach to Managing Public Health and Safety Risks, 30 Mgmt. Sci. 823 (1984).

33 See, e.g., Bentkover et al., supra note 11; Silvio O. Funtowicz & Jeremy R. Ravetz, Uncertainty and Quality in Science for Policy (1990); M. Granger Morgan & Max Henrion, Uncertainty: A Guide to Dealing with Uncertainty in Quantitative Risk and Policy Analysis (1990).

A recent interchange can be found in the Center for Risk Analysis discussion of the Office of Management and Budget's critique of risk assessment procedures in the federal government; see Office of Management and Budget, Current Regulatory Issues in Risk Assessment and Risk Management (1990) and Center for Risk Analysis, OMB vs. the Agencies: the Future of Cancer Risk Assessment (1991).

34 See, e.g., Fischhoff & Cox, supra note 11; Fischhoff et al., supra note 27; and Paul Slovic & Baruch Fischhoff, Targeting Risks: Comments on Wilde's "Theory of Risk Homeostasis," 2 Risk Anal. 231 (1983).

35 See, e.g., Fischhoff, supra note 15; Fischhoff & Furby, supra note 11; The Origin of Values (Michael Hechter, Richard E. Mischod, & Lynn Nadel eds. 1993); Robert C. Mitchell & Richard T. Carson, Using Surveys to Value Public Goods: The Contingent Valuation Method (1989).

36 See, e.g., Ronald Howard, On Fates Comparable to Death, 30 Mgmt. Sci. 407 (1984); Howard Raiffa, Decision Analysis (1968); Stephen Watson & Denis Buede, Decision Synthesis (1987); and Detlof von Winterfeldt & Ward Edwards, Decision Analysis and Behavioral Research (1986).

An example of the sort of progress that might be made through a focused effort to develop measurement techniques of the sort that can be found in recent studies of attitudes toward fairness. See, e.g., C. Harvey, Decision Analysis Models for Social Attitudes toward Equity, 21 Mgmt. Sci. 1199 (1985); Daniel Kahneman, Jack Knetsch & Richard Thaler, Fairness as a Constraint on Profit-Seeking: Entitlements in the Market, 76 Am. Econ. Rev. 728 (1986); L. Robin Keller & Rakesh K. Sarin, Equity in Social Risk: Some

Empirical Observations, 8 Risk Anal. 135 (1988); Barbara Mellers, Fair Allocations of Salaries and Taxes, 12 J. Exp. Psych.: Human Percept. & Perf. 80 (1986).

37 See supra Howard; Watson & Buede and von Winterfeldt & Edwards.

38 See, e.g., Cyril L. Comar, Risk: A Pragmatic de minimis Approach, 203 Science 319 (1979); Joseph Fiskel, Toward a de minimus Policy in Risk Regulation, 5 Risk Anal. 257 (1985); Health & Safety Executive, supra note 1; Milvy, supra note 1; Jeryl Mumpower, An Analysis of the de minimis Strategy for Risk Management, 6 Risk Anal. 437 (1986); Gerald J. S. Wilde, A Theory of Risk Homeostasis, 2 Risk Anal. 209 (1982).

39 That is, where a technology does not inherently provide enough benefits to compensate a group of citizens, it could make direct transfers to them. Because the acceptability of a technology depends on its net benefits (after transaction costs), those who manage it would be motivated to find the most efficient allocation scheme, for which the agency would be a likely vehicle.

40 See J. Frank Yates, Judgment and Decision Making (1989) and Yates, supra note 24.

41 See, e.g., Lita Furby, Psychology and Justice in Justice in Views from the Social Sciences 153 (Ronald L. Cohen ed. 1986); Kahneman, supra note 26 and Krimsky & Plough, supra note 9. See also recent studies mentioned supra in note 36.

42 E.g., it could say "In setting standards for specific technologies, the agency cannot address issues of economic equality nor can it consider people's jealousy or upset regarding their neighbors' fate -- as long as they have been treated in accordance with our general principles. If those feelings and inequities have any standing, they would have to be addressed within the context of other federal policies, such as income tax rates."

43 Supra note 5.

44 This is one possible way to represent concern for future generations. The obvious alternative would be calculating the consequences for future individuals. As one got very distant in time, both costs and benefits would often (but not always) become vanishingly small, so that the computational load need not be overwhelming.

45 This would be in keeping with EPA's practice of calculating risks to the maximally exposed individual.

46 See, e.g., Funtowicz & Ravetz and Morgan & Henrion, supra note 33.

47 Consider, e.g., the controversies over threshold effects or indirect economic impacts.

48 See, e.g., John Rawls, A Theory of Justice (1971).

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Risk Articles Index

Defining Worst Case Releases for the EPA's Risk Management Program

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Abstract

The United States Environmental Protection Agency (USEPA) has proposed regulations that outline risk management program guidelines. The intent of these guidelines is to reduce the number and magnitude of accidents involving hazardous materials. The proposed regulations will require all facilities that process or store flammable or toxic materials in quantities greater than specified thresholds to register with the EPA, perform hazard assessments, and submit publicly available risk management plans (RMPs) to federal, state, and local authorities.

The offsite consequence analysis portion of the hazard assessment has been criticized for its definition of worst case releases. The current proposal by the USEPA (supplemental rule, March 1995) defines the worst case release as a release that fully depletes any hazardous material inventory in ten minutes. This approach oversimplifies the complex process involved in an actual release, and has the potential to severely underestimate or overestimate the extent of a specific hazard. This paper examines the issue of defining release rates, and illustrates how this definition can affect the outcome of the consequence analysis. The need for more sophisticated methods is demonstrated by calculating hazard zones for several ammonia storage system release scenarios. Results of this analysis show that the ten-minute spill duration may be appropriate for some cases, but is clearly inappropriate for others.

Introduction

The Environmental Protection Agency's (EPA) Risk Management Program is scheduled to go into effect in the spring of 1996. Facilities that are covered by the rule, based on the *List of Regulated Substances and Thresholds for Accidental Release Prevention*, will have three years to comply with the new regulations. Each facility will be required to develop a risk management program, which must include a hazard assessment. The hazard assessment includes documenting the facility's accident history for the past five years, and performing an offsite consequence analysis. The hazard assessment will be documented in a Risk Management Plan (RMP). The RMP document will be submitted to local, state, and federal authorities, and will be made available to the public. This will allow local emergency planning committees (LEPCs) or state emergency response commissions (SERCs) to interface with the facility in a more consistent and open manner.

When performing the offsite consequence analysis, each facility will be required to examine all onsite materials that are present in quantities exceeding specified thresholds. Within the RMP, "worst case" and "more likely" accident scenarios will be reported for toxic, flammable, and explosive substances. All worst case scenarios will involve a release of the maximum quantity of material stored, during "worst case" weather conditions. Gas releases are defined such that the maximum quantity of stored material would be released in ten minutes. Liquid releases are defined in terms of a pool that would form in ten minutes, and the pool evaporation rate is used as the vapor release rate. This approach is similar to what is presented in the EPA's 1987 publication, *Technical Guidance for Hazard Analysis*.

The EPA release and dispersion methodology presented in this paper follows the guidelines given in *Technical Guidance*. Although it provides a simple way to analyze a release at most facilities, this approach neglects many important properties of actual releases. As examples, this paper presents release and dispersion analyses for three sizes of anhydrous ammonia storage tanks. Release rates and downwind dispersion distances are determined using EPA methodology, and using more complex models. The results are compared to show the need for more sophisticated methods, and the importance of correctly defining a release scenario when examining a "worst case" release.

Release Rate Issues

The EPA initially defined the worst case release to be an instantaneous failure of the containment vessel. After receiving criticism concerning the definition of worst case, the EPA now proposes that a worst case scenario release the entire inventory of hazardous material in ten minutes. For vapor releases, the only factor involved in determining a release rate is the mass of material stored. Releases of materials stored as liquids above their normal boiling points (liquefied gases) are treated as gases upon release. For most liquids, including refrigerated materials, the release rate is simply the volatilization (or evaporation) rate from the liquid pool. This is determined by the liquid pool or diked area, and a material's molecular weight, vapor pressure, and storage temperature. The examples and analyses presented here consider only a liquefied gas (ammonia), which the EPA methodology treats as a gas upon release.

In many consequence analysis studies, a credible worst case scenario is usually modeled as a full rupture of the vessel's largest piping connection. This simulates a broken pipe or a hole in the containment vessel itself. The fluid release rate is determined by the storage pressure and temperature, the hole size, and the physical and thermodynamic properties of the fluid. The EPA method ignores these variables by defining the release duration to be ten minutes and the release quantity to be the quantity stored, resulting in a constant release rate that depends only on the mass of material stored. For a release occurring through a hole in the storage vessel or through a broken pipe with no assumed length (i.e., friction and pressure drop are ignored), the storage conditions define the factors needed to calculate a more realistic release rate.

For a liquid stored above its normal boiling point (superheated liquid), a portion of the liquid will "flash" to vapor as the released fluid comes to equilibrium at atmospheric pressure. Rapid expansion of the vapor will break the remaining portion of the liquid stream into fine droplets. Larger drops may fall to the ground, but many remain suspended in the atmosphere as an aerosol. Aerosol droplets travel downwind with the vapor and eventually evaporate. The EPA method assumes that a superheated liquid changes entirely to vapor upon release, thus ignoring the properties of an aerosol cloud and the possibility of liquid falling on the ground. Although this assumption might produce the worst case scenario for some releases, it may represent a situation that is not physically possible.

Example Cases

Three sizes of ammonia storage tanks were chosen to demonstrate the process of calculating release rates. Although the three tanks have different capacities, they all use the same size outlet piping. The ammonia is stored as liquefied gas (pressurized liquid at ambient temperature.) Upon release, all the ammonia either flashes or becomes entrained in the vapor to form an aerosol cloud. Additional data for all three cases is presented in Table 1. In all three cases, the quantity of ammonia stored is well above the 10,000 lb threshold given by the EPA. These cases represent realistic storage sizes and conditions for ammonia storage at many facilities.

Comparison of Release Rates

In accordance with the EPA method, release rates were computed by dividing the total amount of material stored by ten minutes (600 seconds). These values are presented graphically in Figure 1. Using a more complex model, which will be designated as the "pipe break" model, release rates were determined by using the thermodynamic and physical properties of ammonia, storage pressure and temperature, and the release hole area. The release rates computed by this method are also shown in Figure 1. From inspection of Figure 1, it is clearly seen that the pipe break method uses the release hole size when computing the release rate, and vessel inventory only affects release duration. Since the maximum connection size for all three cases is three inches, the release rate from all three pipe break cases is 93 kg/s (205 lb/s). Release rates for the three EPA cases focus on the quantity of material stored instead of the size of the release hole. This means that larger quantities of material will always produce larger hazards. Although possible, this is not necessarily a credible assumption.

Dispersion Models Used

Both the EPA and pipe break cases were modeled using a point-source Gaussian model and a momentum jet model, Ooms. Formulations for the point-source Gaussian were taken directly from the *Technical Guidance for Hazards Analysis*, which also presents look-up tables for flowrate versus concentration endpoint based on the Gaussian model. When the desired concentration endpoint and release rate fall within the bounds of these tables, they may be used. Release rates for several of the scenarios presented here are greater than 10,000 pounds per minute, which exceeds the limit of the tables. Consequently, the equations given for the point-source Gaussian model were used to solve all the example scenarios for distances to concentrations at the release height. Variables include release rate, wind speed, gas concentration, and the horizontal and vertical dispersion parameters. The dispersion parameters are functions of downwind distance that vary with atmospheric stability class and terrain (rural or urban). When stability class, wind speed, concentration endpoint, and release rate are known, the equations are solved iteratively for downwind distance.

Although simple, the point-source Gaussian model has many drawbacks. The model is insensitive to release duration, release velocity and orientation, material phase, thermodynamics, and release area, as well as other variables. This insensitivity severely limits the model's use in any general application to varied release scenarios. The Gaussian model is also very sensitive to low wind speeds and stable atmospheric combinations, such as the conditions specified by the EPA for worst case analysis. Worst case weather conditions are defined by a wind speed of 1.5 m/s (3.4 mi/hr) and an atmospheric stability of F (very stable). This model is well suited to look-up tables and provides a simple dispersion modeling scheme, but its results must be used with caution. In *Technical Guidance*, it is claimed that calculations resulting in distances below 0.1 mile and above ten miles are "not valid" for the model.

Ooms is a publicly available momentum jet dispersion model which was incorporated into the DEGADIS model, and is available from the EPA. The model used for this analysis has been modified to include aerosol thermodynamics and to enable jet releases at orientations other than vertical. Releases were set up with the rates and durations given in Figure 1. A surface roughness of 0.04 meters was used; this corresponds to long grass or crops and represents rural conditions. All cases were modeled as horizontal releases at grade from a three-inch diameter hole.

Comparison of Modeling Results

Dispersion results for the three example cases using the Ooms and Gaussian models are presented in Table 2. These results represent the worst case accidents using the EPA's definition of "worst case" weather conditions. Both models were run using rural terrain conditions. Example calculations were performed to

ERPG-2 and ERPG-3 levels. A comparison of distances to the ERPG-2 level is shown graphically in Figure 2. The ERPG endpoints have been defined by the American Industrial Hygiene Association (AIHA) as exposure levels that represent the threshold of serious or adverse health effects (ERPG-2) or potentially life-threatening effects (ERPG-3) for exposures up to 60 minutes. The EPA has suggested that one of these levels may be adopted as the toxic endpoint for use within the risk management program.

Calculations for "average" weather conditions, as defined in *Technical Guidance*, were also performed; these results appear in Table 3. These cases represent a more common wind speed of 5.32 m/s (11.9 mi/hr) and a "neutral" atmospheric stability of D. Both models were run using rural terrain conditions.

Results in Tables 2 and 3, and Figure 2, illustrate how changes in the release rate affect dispersion calculations. Release rates determined by the pipe break model are based on the mechanics of fluid flow; therefore, they reflect the true release rates of liquefied ammonia from a three-inch hole. The EPA method will produce the true release rate only in specific situations. Case 2 was specifically designed to show how the EPA methodology can predict a reasonable release rate for a unique accident scenario; the tank size, hole size, storage temperature and pressure, and liquid level were chosen so that the true release rate would match a ten-minute release for the same mass of ammonia. Downwind dispersion results for Case 1 show how stretching the release rate over ten minutes for a smaller tank can produce an underprediction of the hazard zone, compared with a more realistic release rate. Allowing the release to take ten minutes artificially lowers the release rate for this example. Case 3 demonstrates an overprediction of the hazard when the stored material is artificially released at an impossibly high release rate. The simple variance of tank size (doubling and halving the size used in Case 2) causes the EPA methodology to produce misleading answers. Forcing a ten-minute release creates an accident scenario that is not based on a credible event. This often results in misrepresentation of "worst case" accidents and produces results that vary significantly from those obtained using a more rigorous method. If an EPA-only methodology is used (ten-minute spill; Gaussian model), the variance in hazard distance predictions for the example cases becomes very large.

The ten-minute release combined with look-up tables provides a method that gives results with very little investment of time or effort, and occasionally these results may be acceptable. However, for many cases, reasonable answers will not be attained.

As seen in Tables 2 and 3, the Gaussian model consistently overpredicts the Ooms model for superheated releases of ammonia. The results in Table 2 emphasize the Gaussian model's sensitivity to low wind speed and stable atmospheric conditions. When comparing the Gaussian results in Tables 2 and 3, this weakness is further exaggerated; the low wind and stable atmospheric condition distances are approximately one hundred times higher than those computed using a moderate wind speed and neutral atmospheric conditions. Results from the Ooms model show a threefold increase when comparing the low wind/stable conditions with moderate/neutralconditions. Gaussian distances, although longer, are within the same range as the Ooms distances for moderate/neutral conditions.

Under moderate/neutral conditions (Table 3), the Gaussian results seem reasonable. When examining the results for low wind/stable conditions (Table 2), the Gaussian results are clearly not reasonable. If the EPA publishes look-up tables similar to those in *Technical Guidance*, many of the EPA/Gaussian combinations seen in Table 2 would produce an answer of "greater than ten miles." This type of result is clearly inappropriate for RMP presentation, and will require more sophisticated methods to accurately model the release and dispersion.

Choosing a Dispersion Model

Before calculating hazard distances, all input variables for a dispersion model must be correctly defined. Once a credible release scenario is properly defined, a suitable model will produce reasonable results. To obtain consistent results, the user should carefully match the specific type of release (liquid spill, momentum jet, etc.) with a model designed for such a release.

Many public domain models are available for release rate calculation and dispersion analysis. Consulting firms who have proprietary models (such as the modified Ooms model used for this paper) may be retained to perform a hazard analysis. Whether a publicly available or proprietary model is chosen, care must be taken to ensure that the model is appropriate for the release scenario. For example, the EPA's worst case weather conditions can cause problems with many models; thus, it is a primary concern when selecting a model.

Conclusions

The risk management program proposed by the EPA will prove to be a challenge to any facility required to comply. The consequence analysis portion of the RMP document will be one of the most closely examined sections. The EPA has proposed a methodology that defines "worst case" scenarios with a ten-minute release duration for the entire inventory of material. They have also suggested that look-up tables for determining downwind distances to specific hazard levels will be published. These tables will most likely be based on a Gaussian model, and will present downwind distances to various endpoints as a function of release rate. The EPA method may produce results that are acceptable for select cases, but most often it will over or underpredict the hazard.

One of the primary factors that influences the results from a dispersion model is the release rate. Use of the EPA's simple ten-minute release duration will misrepresent many worst case accidents. The scenario taken as a credible worst case does not necessarily empty the entire inventory of material in ten minutes. Using the ten-minute release can create situations where the risks posed by a facility on the public may not be correctly portrayed within the RMP. If variation from the EPA methodology is allowed, many methods and models are available that can better represent actual releases.

Choosing a model for any type of hazard calculation is not a simple decision. A full understanding of all the factors involved in a release is required. Hazard distances generated by models and presented in the RMP must accurately demonstrate the potential impact of a hazardous material release. Otherwise, regulating agencies and the public will develop a flawed perception about the risks that a facility poses. The proper representation and modeling of worst case releases will put the apparent risk of a facility in proper perspective and allow the RMP to be an effective and trusted document.

References

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Contract 68-02-435.

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Community Planning and Building, Land and Bylaw Services Division Telephone 604 987 7131 Fax 984 8664

May 7, 1998
File: 3060-20/8.93

Corrie Kost
Federation of North Vancouver Community Assocs.
[redacted]

Dear Mr. Kost:

Re: Proposed Can Oxy Rezoning - Report of Facilitator of Public Workshop Held April 22, 1998

Please find enclosed a report from Neiman and Associates regarding the special public workshop held on April 22 at Maplewood School. Copies have been sent to Council and Community Associations in Seymour and to FONVCA.

Yours truly,

[redacted]

James G. Masterton
Registered Planner
Assistant Manager of Planning

JGM/lk
Attach.

Document No: 121926

Report on the Public Meeting and Workshop on Land Use and Design Issues Relating to CXY Proposal

Maplewood School, 22 April 1998

Prepared by:

NEIMAN & ASSOCIATES

1234 W. 41ST AVENUE
VANCOUVER, BC V6M 1X3

30 April 1998

1. The Purpose of the Meeting

The Municipal Council of the District of North Vancouver is considering a rezoning application by Canadian Occidental Petroleum Ltd. ("CXY") for property adjacent to the Dollarton Highway in the Maplewood area of North Vancouver. The proposed zoning for the property included over forty uses (see Agenda Package in Appendix A). After a public hearing process, Council elected to hold a workshop to give residents of the area an opportunity to voice their desires, needs and preferences regarding uses and design guidelines for the property.

The purpose of the workshop was to identify which of those uses were favored by the residents, which they felt should be prohibited and -- given those preferences -- what the design guidelines should be. Residents were also to be asked to suggest other possible uses not listed in CXY's zoning proposal. This information would then go to Council to be considered when ruling on CXY's application.

Please note that the workshop was not designed to be a statistically accurate sampling of the opinions of all residents of the District. It was intended to be an accurate reflection of the opinions of a self-selected group of residents, primarily from Maplewood -- which is adjacent to the site and, and East Seymour -- which is a few miles east of the properties listed in the rezoning application.

2. The Process

During the week of 6 April the Community Planning Department engaged Neiman & Associates ("the Consultant") to provide a neutral and unbiased moderator to facilitate the public meeting process and synthesize the public's input, providing a report of the results of the workshop to Council. The proposed workshop format included introductory remarks by Mayor Bell, followed by brief presentations from the Community Planning Department, CXY and the Maplewood Community Association. The workshop would then break up into concurrent focus group sessions led by District staff. The workshop would conclude with reports given by residents from each of the focus groups. As there was no way to predict the turnout, preparations were made to accommodate up to one hundred residents.

The Planning Department assembled a team of ten staff to act as focus group facilitators at the workshop. On the afternoon of 20 April, the Consultant met with the staff facilitators to provide guidelines for their participation. Guidelines included the following:

- The role of the facilitator is to assure open discussion and full participation of residents.

- The facilitator offers no opinions, suggested uses or design guidelines, interpretation of information presented or evaluation of input from residents.

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Guidelines (cont.):

- The facilitator is to seek clarification from residents regarding the interests behind the positions they take. For example, if a resident is against having a parking structure in the area, it could be because they do not like the look of parking structures, or because they don't like the associated traffic, or because they feel that parking structures invite crime, etc. The facilitator's role is to encourage residents to share their interests and to generate a list of interests to help Council understand what the residents want.
- The facilitator is to oversee the group's election of group reporter.
- The facilitator is to acknowledge and record any concerns residents have about the rezoning application process and the workshop process, while keeping their group focused on the task of providing Council with input on public opinion.
- If time permits, the facilitator is to ask residents to rank their most and least favorite uses.

On the evening of 20 April, Council elected to hold a question and answer period before the focus sessions of the workshop. The Consultant met briefly with Council to discuss the agenda and timetable for incorporating this into the workshop.

Based on the final agenda and timetable, the Consultant provided the volunteers with a facilitator guide and a template for the reports of group discussions (see Appendix A).

3. The Meeting

The meeting took place the Maplewood School, 420 Seymour River Place, North Vancouver, on Wednesday, 22 April 1998. The meeting was scheduled to begin at 7:00 p.m. It began at 7:20 p.m., with remarks by Mayor Bell. An agenda package was distributed to all attendees at the door (see Appendix A). Approximately eighty people were present at the beginning of the workshop, including about fifty residents.

The Planning Department presentation began at 7:25 p.m. and lasted approximately ten minutes. They also provided an information display on one side of the meeting room.

The CXY presentation began at 7:35 p.m. and lasted approximately ten minutes. At the meeting, CXY announced it had amended its list of proposed uses, eliminating about one quarter of the original list.

The Maplewood Community Association presentation began at 7:45 p.m. and lasted approximately fifteen minutes.

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The question and answer session was limited to 45 minutes. Each speaker was given up to two minutes to ask their question (see Appendix B for a list of topics). Answers were limited to five minutes each. Follow-up questions were allowed within the five minute allotment for answers. It began at 8:00 p.m., and ended at 8:45 p.m.

The small group discussions began after a short break, at 8:50 p.m.. There were between forty and forty-five residents participating. Four groups were organized, with one or two facilitators each. The discussion portion lasted until 10:15 p.m.. It was followed by reports from each group, beginning at 10:20 p.m., and concluding remarks by Mayor Bell. The meeting ended at 11:00 p.m..

4. Results

The complete list of uses and proposed design guidelines for each group is attached in Appendix B. These lists come directly from the flip charts generated by each group. While there were differences between focus groups, there were common themes. The following are highlights.

The primary interests expressed by the majority of residents were the following:

- maintaining the quiet and privacy of residential areas;
- minimal levels of traffic;
- creation of jobs that benefit local residents, and
- reflects the desired aesthetics of Maplewood through the establishment of upscale and professional service establishments, high-tech businesses and clean, green surroundings.

Several residents noted that they agreed strongly with CXY's deletion of certain uses, and that other uses might be possible as long as they met the above interests. **Most groups felt that there was no need to rank the acceptable uses, as long as the above interests were met.**

The preferred uses included the following:

- High-tech and Research & Development,
- Personal services and professional offices that do not attract heavy commuting by single-occupancy vehicles or by industrial vehicles, such as trucks,
- "Higher-value" and "upscale" restaurants that would cater to the kinds of people who work in the above businesses and are open at convenient times for the residents,

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Preferred uses (cont.)

- Media and film industry related businesses,
- A combination of retail, manufacturing and warehouse businesses,
- Buffer, "green" space and nature areas to balance the buildings.

Suggestions and additional uses included, mixed residential/industrial/commercial, a branch campus of BCIT, a business park (with an emphasis on the *park*), banking (one group listed a bank machine site as it's #1 use).

Unacceptable uses focused on businesses working against the interests expressed above, including:

- large structures like warehouses, big box supermarkets and shopping centres and parking structures that block views and attract traffic,
- strip mall, service station, fast food, delivery and drive-through type businesses that attract people or generate noise,
- environmentally unfriendly businesses like recycling plants, automotive repair, equipment rental.

Groups were divided on storage facilities, noting that some might be desirable if they support the kinds of businesses that are wanted.

There was less time given to discussion of design guidelines. Brief discussion centered on issues of preserving the look of Maplewood, maintaining the privacy of residents (e.g., no buildings or parking structures more than three stories tall), maintaining the trees for aesthetic reasons and/or environmental reasons, and a balance of pedestrian friendly businesses and high-tech business.

5. Observations and Comments

The purpose of the workshop was to give as many as 100 residents a chance to voice their opinions on the use of the land in question. There were some assumptions behind the questions asked of the public. Among them was that safety and other risk management issues were not on the agenda, but that other issues -- such as population impact -- could be considered. Therefore, the question of the evening was:

> *Given that there are over forty acceptable uses for the land in the zoning restriction, and that Council was going ahead with considering the zoning application, which of those uses do the residents prefer or object to?*

The feedback from attendees largely reflected that residents were satisfied with the question, and that they had a fair opportunity to be heard.

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There were also some complaints. There were complaints from a few people that the question and answer period was not long enough. The reasons they gave the Consultant reflect unresolved issues that were beyond the scope of the workshop (e.g., the validity of the environmental studies). Their concerns could be better addressed at a meeting dedicated to those issues. Feedback from other attendees reflected that the questions and answers did not help contribute to answering the question of the evening, and only served to lengthen the proceedings.

Some residents expressed concern that the fourth quadrant of the land in question should have been considered as part of the discussion at the meeting. Their concern was that zoning restrictions approved for CD 18 and CD 19 would then be automatically applied to this other quadrant. Their interest is in allowing mixed commercial and residential uses in this area, thus creating a "village centre." This was recorded in the focus group notes and is mentioned here for emphasis.

There was considerable feedback from residents and facilitators that the room was too noisy. Future workshops of this nature would work better if groups had separate rooms.

There was also feedback from a couple of residents that they felt that their facilitator(s) influenced the agenda to have some of their own preferred uses and design guidelines considered. The Consultant was made aware this during the workshop and made a brief intervention with each group to address the concern.

The residents showed a high level of commitment to the meeting and expressed satisfaction over being allowed to have a flexible process to discuss their interests. Overall, the group facilitators did an outstanding job of working within their guidelines and facilitating a flexible process under physically demanding conditions. The result was a collaborative, respectful exchange of information that followed the format, agenda and timeline provided by Council.

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Appendix A

- **Facilitators' guidelines and worksheet**
- **Agenda package**

Facilitator Guide for CXY Rezoning meeting

1) Introductions and selection of group reporters (approx 10 minutes)

2) Brainstorm Uses (approx 20 minutes)
beginning with list of uses, record additional uses. DO NOT judge or evaluate the items on this list.

3) Explore Interests (approx. 35 minutes)
discuss which uses are generally favored by this group. Facilitate a discussion of what needs and/or interests are addressed by the uses described. Generate a list of interests on the flip chart as you do this.

4) Organize Results (approx. 15 minutes)
rank the uses and interests according to the following formula:

strongly in favor	+3
in favor	+1
neutral	0
against	- 1
strongly against	-3

tally the votes and record the results. Voting can be done either by a show of hands, or by having people write their rankings on their individual worksheets (note: a closed ballot takes a long time).

5) Summarize Information (approx. 5 minutes)
have the group reporter take the group's finished worksheet and give them an opportunity to ask questions or clarify comments. NOTE: during the "Report Back" portion of the meeting, the facilitator will ask each group how well their reporter has reflected their group's comments.

Report of Group Discussion

Our top acceptable uses were:	Our unacceptable uses were:
1	1
2	2
3	3
4	4
5	5

Additional uses suggested:

1
2
3
4
5

We believe these choices reflect the following interests of the community:

1
2
3
4
5

We note the following key elements should be considered in developing design guidelines:

1
2
3
4
5

We note the following areas of disagreement within our group:

1
2

CAN OXY (CXY) PUBLIC MEETING
Maplewood School, 420 Seymour River Place, North Vancouver
Wednesday April 22, 1998, 7:00 p.m.

AGENDA

1. INTRODUCTION - MAYOR BELL

2. MEETING ORGANIZATION - TERRY NEIMAN

3. PRESENTATIONS:
   a) PLANNING OVERVIEW - IRWIN TORRY
   b) CXY PROPOSAL - JANE FLEMING
   c) OPTIONS FOR NW QUADRANT- MAPLEWOOD COMMUNITY ASSN.

4. QUESTION AND ANSWER PERIOD

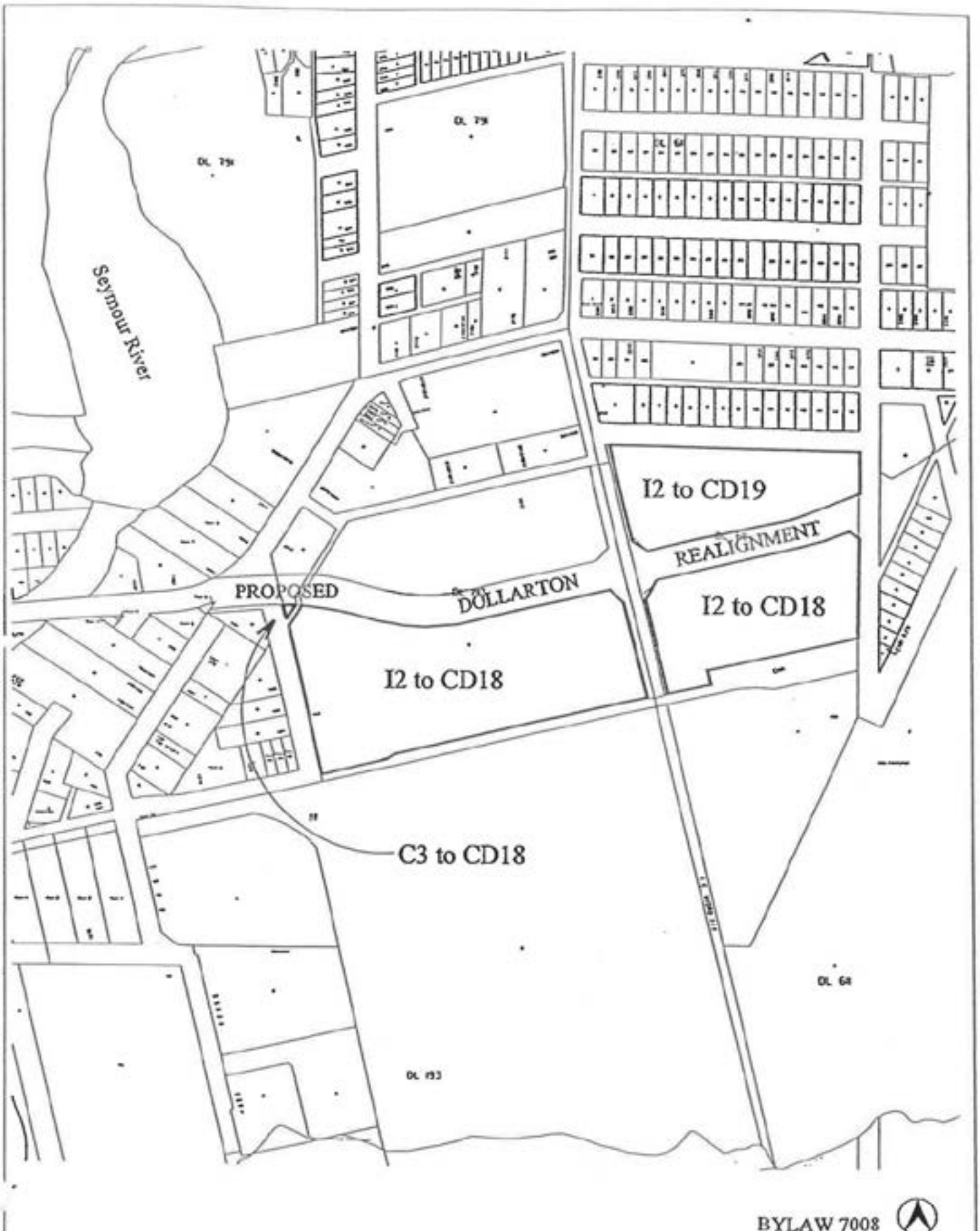
5. ORGANIZATION OF WORKSHOP - TERRY NEIMAN

6. SMALL GROUP DISCUSSIONS

7. REPORTING BACK BY DISCUSSION GROUPS

8. TABULATION OF FEEDBACK - TERRY NEIMAN

9. NEXT STEPS - MAYOR BELL


DL 751
DL 751
Seymour River
I2 to CD19
REALIGNMENT
PROPOSED
DOLLARTON
I2 to CD18
I2 to CD18
C3 to CD18
DL 64
DL 193
BYLAW 7008

USES	EXISTING ZONING	PROPOSED ZONING		
	I2	CD18	CD19	RANKING
a) Arena		✔		
b) Animal shelter	✔			
c) Auction room	✔	✔		
d) Automotive bodyshops	✔			
e) Automotive repair shops	✔	✔		
f) Building supply establishment		✔		
g) Business/office support services		✔	✔	
h) Car wash		✔		
i) Construction services	✔			
j) Contractor services	✔	✔	✔	
k) Custom manufacturing	✔	✔	✔	
l) Delivery services	✔	✔	✔	
m) Equipment rental establishments	✔	✔		
n) Fitness centre		✔	✔	
o) Garden centre		✔		
p) Gas bar		✔		
q) Gun shop	✔	✔		
r) Health service purposes			✔	
s) Heavy manufacturing	✔			
t) Hobby beer and wine making establishments	✔	✔	✔	
u) Household repair establishments		✔		
v) Industrial product sales		✔	✔	
w) Light manufacturing	✔	✔		
x) Media-related establishments			✔	
y) Mini-warehousing	✔	✔		
z) Office purposes			✔	
aa) Parking structure	✔	✔	✔	
bb) Personal service shops			✔	

USES	EXISTING ZONING	PROPOSED ZONING		
	I2	CD18	CD19	RANKING
cc) Professional offices			✔	
dd) Research and development estab.	✔	✔	✔	
ee) Restaurant			✔	
ff) Retail food services		✔	✔	
gg) School, trade	✔	✔		
hh) Service station		✔		
ii) Specialized light industrial & tech. estab	✔	✔	✔	
jj) Transportation purposes	✔			
kk) Veterinary clinic	✔	✔		
ll) Veterinary hospital	✔	✔		
mm) Warehousing	✔	✔	✔	
nn) Wholesaling	✔	✔	✔	
oo) Works yard	✔			

COMPARISON OF DEVELOPMENT REGULATIONS

REGULATION	I2 ZONE	CD18 ZONE	CD19 ZONE
Setbacks Building	Not Specified	10m (33 ft.) from Doll. Hwy. 6m (20 ft.) from Riverside Dr. & Amherst Ave.	10m (33 ft.) from any street 5m (16.5 ft.) from interior rear or side lot line or any lane
Parking	Not Specified	6m (20 ft.) from Doll. Hwy. 3m (10 ft.) from Riverside Dr. & Amherst Ave.	6m (20 ft.) from any street 2m (16.5 ft.) from interior rear or side lot line or any lane
Accessory Floor Space	15% GFA	25% GLA	40% GLA
Building Area	Not Specified	Building Supply Establishment 5575m^2 (60,010 $ft.^2$)	Not Specified

COMPARISON OF DEVELOPMENT REGULATIONS

REGULATION	I2 ZONE	CD18 ZONE	CD19 ZONE
Building Height	**12m (40 ft.)**	**12m (40 ft.)**	**18m (60 ft.)**
Building Coverage	**60%**	**60%**	**60%**
Site Coverage	**95%**	**90%**	**85%**
FSR	**Not Specified**	**1.5**	**2.0**

1.1 Site Planning

Where a development "pod" contains more than one building, all buildings shall be designed using the same materials, massing, and design elements, and shall be consistent in their orientation. Buildings should be situated within a pod so as to minimize direct lines of site from one building into another, maximize use, and create opportunities within the pod for landscaping.

1.2 Service Areas

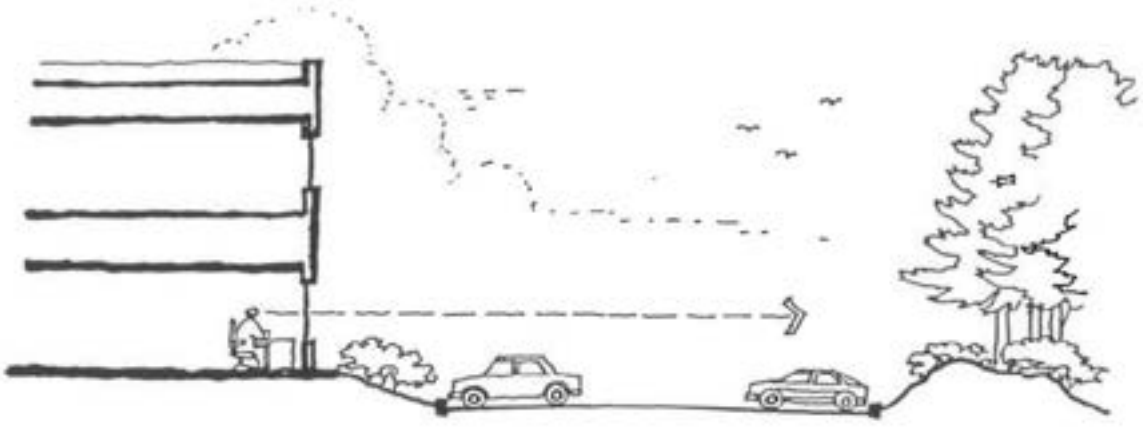
For development pods with more than one building, buildings shall cluster around service courts and use common areas for loading, truck maneuvering, and garbage/recycling so as to minimize the area required for these functions. Service courts should generally be to the interior of a pod and not directly visible from main driveways. Exterior storage of equipment and materials is not permitted. Vehicles used by tenants may be stored outside in service court areas, which may be fenced for security reasons. All garbage and recycling functions shall be completely screened from view.

1.3 Visibility

Buildings and/or groups of buildings should be sited to have a prime orientation toward the access driveway, and be clearly visible from the main road. Access driveways should have a vista of the building or buildings in their landscape setting as each pod is approached.

1.4 Views

Buildings should take advantage of the natural setting in providing views outward from within working areas. Grading and landscaping should be used to avoid a direct eye-level view of parked cars from ground floor work areas. Natural grades of the site should be used to advantage to create open views.

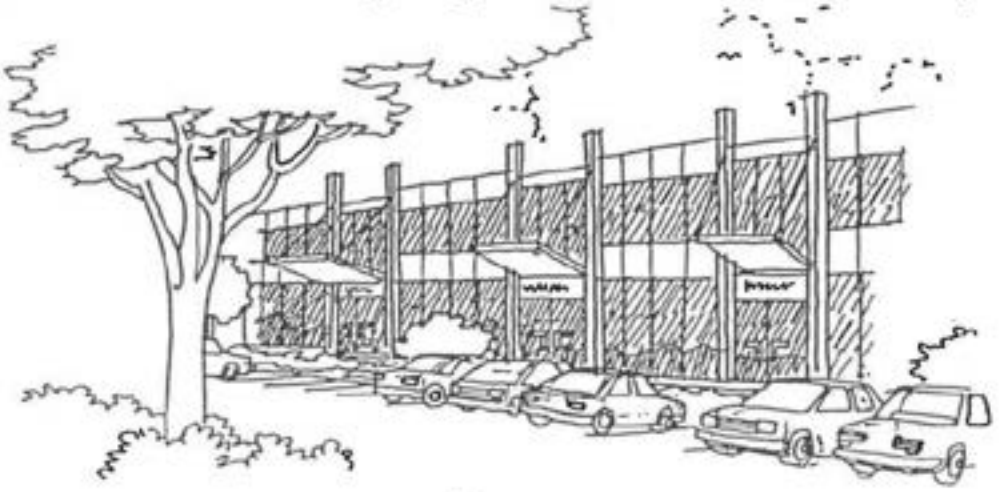


1.5 Entries

Main entries should be readily identifiable and have clear access. Architectural devices such as a change in massing, fenestration, canopies, or curtainwall glazing should be used to accent the entry. Building identification (name, number) shall be readily visible. Handicapped and visitor parking is to be located close to building entries.

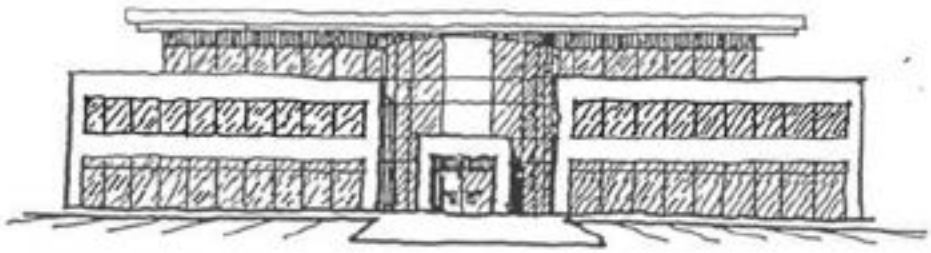
1.6 Multi-tenant Buildings

Multi-tenant buildings with direct exterior access to individual tenants should incorporate repetitive design elements to identify the multi-tenant nature of the building and the tenant entries. Multi-tenant identification shall be confined to a number/name at the doorway plus a multi-tenant directory located so as to be clearly visible when the building is approached from the main driveway.



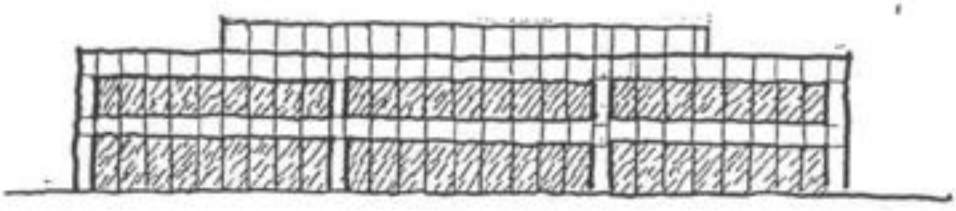
1.7 Higher Buildings

Buildings over two storeys in height shall incorporate steps or setbacks to reduce their apparent mass and impact.



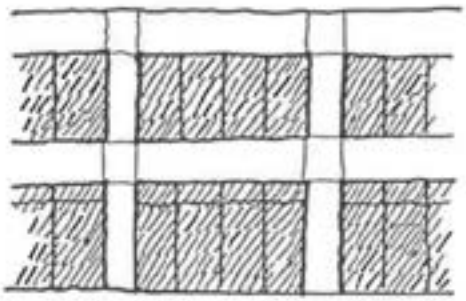
1.8 Roofscapes

Roof lines will generally accentuate horizontal lines. Peaks, gables, arches, or mansard roofs are not recommended. Rooftop mechanical equipment shall be screened using cladding materials consistent with the rest of the building.



1.9 Materials

Generally, materials used should have a large plain surface, and not be made up of small individual elements. Examples of materials consistent with this approach would be glass, prefabricated metal panels, fiberglass panels, and sand finished stucco. Not recommended would be materials consisting of small individual elements such as wood siding, brick, block, or slat or corrugated type metal siding. Individual structural elements such as columns, beams, suspension cables and rods, and structural connectors, and architectural elements such as canopies and railings can be accentuated to contribute to the "high-tech" design character.



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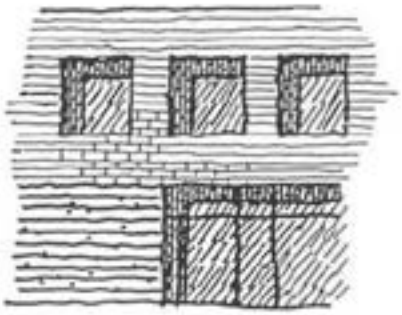

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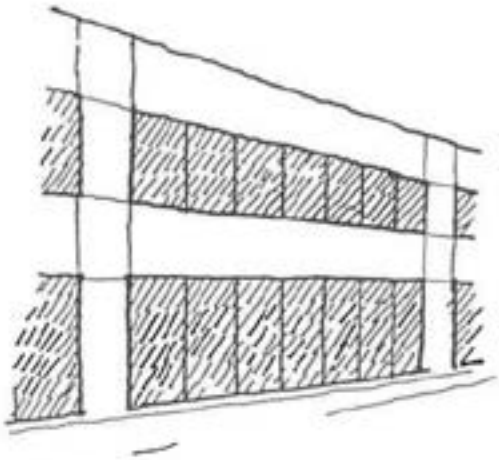
1.10 Windows

Generally, windows should be grouped into strips or curtainwall configurations as opposed to individual punched windows.



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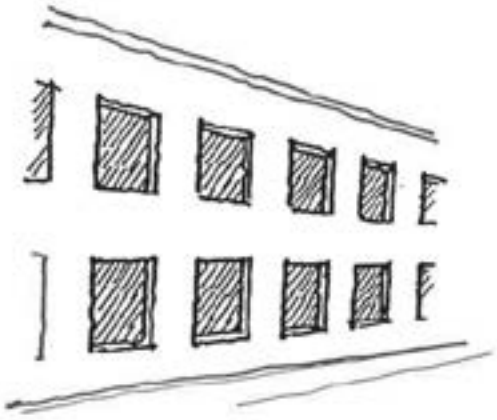

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1.11 Facade Treatment

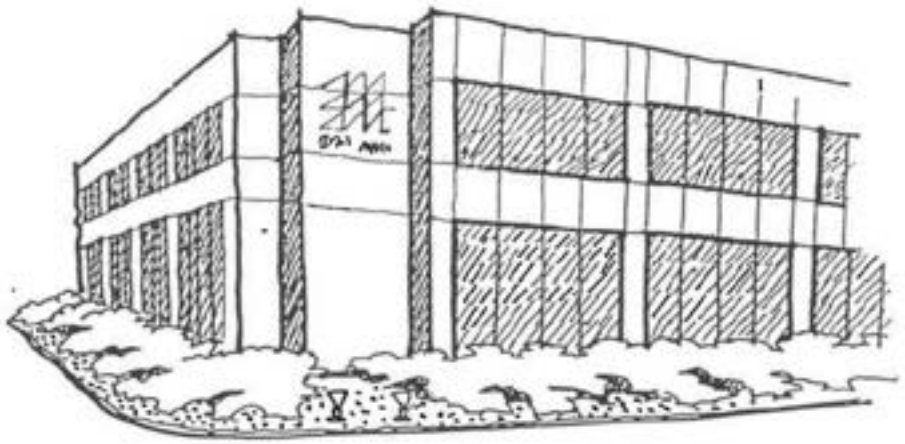
The architectural treatment of elevations and the use of materials should generally be consistent and complementary on all facades.

1.12 Building Lighting

Exterior lighting of the building should be used to emphasize main entrances and other architectural features. Light from the interior of the building can also be utilized to emphasize atriums, lobbies, or equipment or processes which may be of architectural interest. Care should be taken that building lighting does not cause glare or shine directly into adjacent buildings.

1.13 Signage

Freestanding signs at each pod shall give directions to individual buildings and/or tenants. All directory signs and traffic control shall be designed strictly to a park standard. No pylon signs shall be permitted. Signage on building facades shall be restricted to one corporate logo and/or name per building, of a maximum size of 10 sq. metres. No signage is to project above or beyond building edges. No flashing or projecting signs will be permitted. On multi-tenant buildings with individual tenant entries, individual tenants may have a name and/or number of maximum 1 sq. metre over their individual entry, and all tenant signs shall be of the same type.



Roadways

All roads are to be curved and designed to best suit the site grades from a visually aesthetic as well as safety standpoint. Roads that are straight lines with exaggerated axis are not encouraged.

All public roads are to have a public sidewalk on one side, the side being the one adjacent to the park zone. The entry roads are to have a grassed boulevard. The public sidewalk should take on a curvilinear route oriented to the natural forested buffer as opposed to the roadside. All public walkways are to be disabled accessible with no slopes over 6% and no cross slopes greater than 2%.

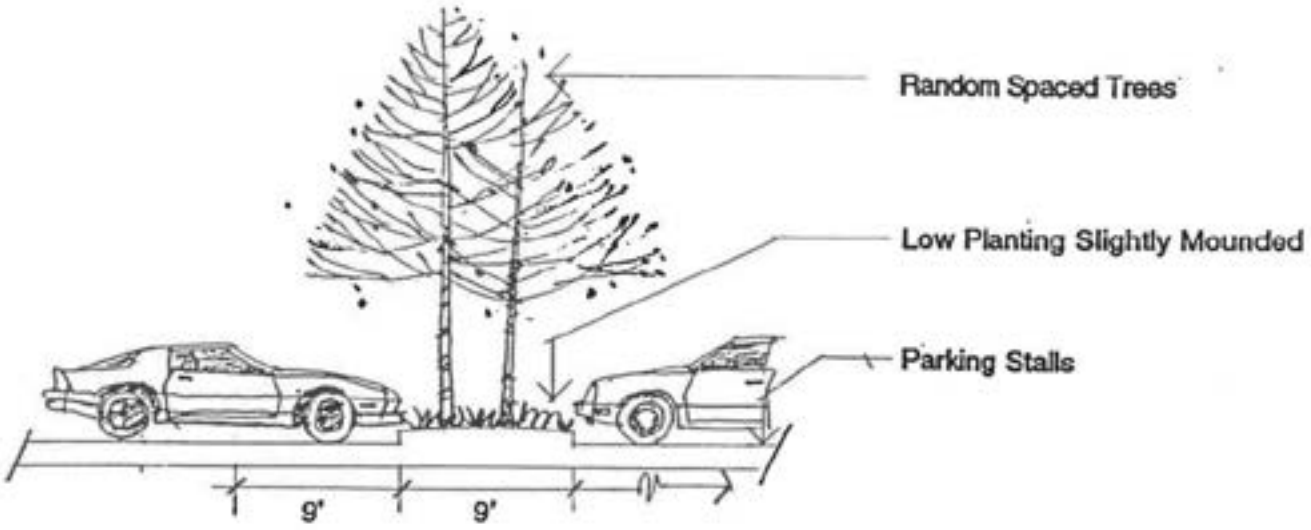
All plant material used for median and or boulevard planting is to be large scale native or non-ornamental deciduous trees. The trees should be planted in random naturalistic groupings and not single rows of uniform spacing. The planting under the trees should be grass or low ground cover.

Private roads should have a sidewalk (min. 4ft.) on one side of the road, which provides direct accessibility to all buildings.

Parking Areas

Parking is to be set into parkland and landscape and to be visually insignificant. Larger parking areas should be broken down into smaller zones by landscape buffers. These buffers should be a minimum of 9' wide and should be slightly bermed to decrease the visual impact of the parking areas.

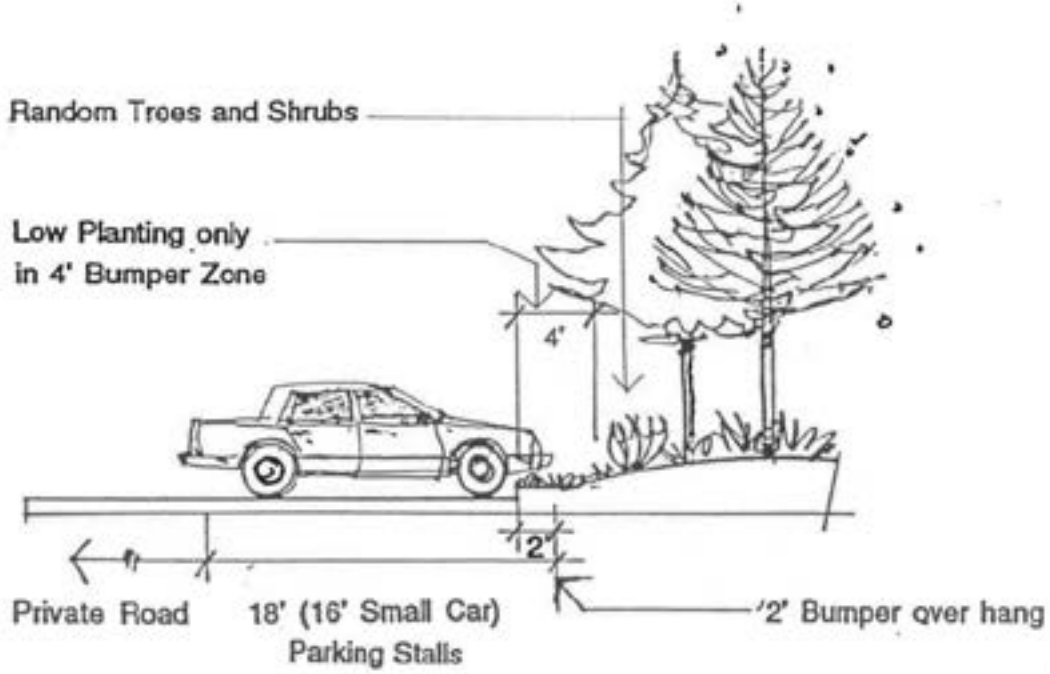
In parking areas no more than 20 continuous parking stalls should be provided without a planted landscape island. Groups of trees, coniferous and deciduous, should be planted in these islands and not single trees. Grasses and ground covers should be planted in the parking areas. Shrub bed areas are not encouraged and should only be used for special accent features.



PARKING ISLANDS

The planted parking islands are to be a minimum of one car stall width (9 feet). Parking areas should follow alongside the private roads and take on a slightly curvilinear layout.

Parking zones should have a 2 foot landscaped bumper zone where no sidewalk is present. Where a sidewalk is required, a 2 foot paved surface can provide a bumper zone with a 4 foot sidewalk beyond.



PARKING ZONE - LANDSCAPE BUFFER ZONE

Suggested Plant List

Species marked with an asterisk (*) are not suitable for roadway or parking area landscaping.

Trees

Western Red Cedar
Douglas Fir
Western Hemlock
Sitka Spruce
White Birch
Red Alder
Poplar
*Big Leaf Maple
*Pacific Dogwood
*Pacific Willow
*Willow
*European Mt. Ash

Shrubs

Salmonberry
Red-osier Dogwood
Salal
Red Huckleberry
*Red berry elder
Wild Rose
Siverweed
*Thimbleberry
*Cascara
*Black twinberry
Spiraea
Indian Plum

Ground Cover, Grasses and Flowers

Kinnikinnick
*Fireweed
*Purple loosestrife
Wild Ginger
Twinflower
*Sweetpea
Peppergrass
Red clover
White clover
*Chocolate Lily
*False lily-of-the-Valley
*Yarrow
*Floxglove

"**household repair services**" means land and buildings used for the provision of repair services for goods, equipment and appliances normally found within the home. This use class includes radio, television and appliance repair shops, furniture refinishing and upholstery shops. This use class does not include the retail sale or wholesale of goods or products except for the accessory sale of parts and accessories;

"**industrial product sales establishments**" means land and buildings used for the wholesale, rent or lease of products generally intended for industrial or commercial users such as industrial machinery and equipment, trade tools and supplies, machinery parts, restaurant equipment, office furniture and store fixtures, but does not include heavy industrial vehicles such as trucks, cranes, and construction equipment;

"**light manufacturing**" means land and buildings used for: the assembly, fabrication or processing of semi-finished or finished products from previously manufactured components; and, the servicing, testing and repairing of goods and equipment entirely within an enclosed building from which there may be no external nuisances or impacts. Typical uses would include the manufacture of glass, plastics, textiles, small machinery, upholstered products, electrical/electronics, woodwork/millwork, precision instruments, paper products, auto parts and accessories, furniture and pharmaceutical products;

"**media-related establishments**" means land, buildings and structures used for music, film and video production studios, advertising establishments, printing and publishing establishments and radio and television stations;

"**personal service shop**" means land, buildings and structures used for the provision of services related to the care and appearance of the body or the cleaning and repair of personal effects. This use class includes: dry cleaning depots and laundromats; tanning salons; hairdressing salons; barber shops; tailors and dressmakers; and shoe repair shops. This use class does not include household repair establishments or health service purposes;

"**research and development establishments**" means land and buildings used for analytical, scientific and technical research, development and testing purposes which may involve the small scale manufacturing or assembly of prototypes and the sale of technical data, but does not include medical, dental or other health science-related laboratories that directly service the public;

"**restaurant, major**" means land and buildings used for the provision of prepared food and beverages for on-site public consumption with a seating capacity of more than 10 persons. Typical uses may include: cafes; theatre restaurants; cocktail lounges; and, banquet rooms. This use class does not include neighbourhood public houses or drive-in restaurants;

"**retail food services**" means land, buildings and structures used for the provision of prepared foods and beverages for either on or off-site consumption with a seating capacity of not more than 10 persons. Typical uses would include: delicatessens; cafes; refreshment stands; sandwich bars; and take-out food services. This use class does not include: restaurants; neighbourhood public houses; drive-in restaurants; cocktail lounges or retail food stores;

"**warehousing**" means the storage of goods or products for distribution but does not include wholesaling;

"**wholesaling**" means the use of land and buildings for the wholesaling of merchandise in bulk to retailers, other businesses, institutions or government agencies for their own use or for resale and where any floor area in storage space exceeds any floor area used for showroom or display purposes;

"**automotive repair shop**" means land, buildings and structures used for the mechanical repair and servicing of vehicles, motorcycles and recreation vehicles or craft and may include the accessory sale, installation or servicing of related parts and accessories. This use class includes: tire shops; automotive glass shops; muffler shops; transmission shops; automotive upholstery shops; lubricating shops and similar uses. This use class does not include automotive body shops;

"**building supply establishment**" means land, buildings and structures used for the sale, either at retail or wholesale, of a variety of tools, paints, hardware, plumbing and electrical items, building products and gardening equipment and materials but does not include the sale of automobile parts and accessories, manufacturing or servicing of goods. This use class is differentiated from a retail purpose by the exterior storage of wood, metal, concrete and gardening supplies or products;

"**business/office support services**" means land and buildings used to provide support services to businesses which are characterized by one or more of the following features: the use of mechanical equipment for printing, duplicating or photographic processing; the provision of office custodial, maintenance or security services; the sale, rental or servicing of office equipment furniture; the provision of clerical, secretarial employment or telephone answering services which may include training. Typical uses would include: printing and photographic processing establishments; janitorial and security firms; office equipment sales, servicing and repair establishments; and, clerical services;

"**contractor services**" means land, buildings and structures used for the offices of building contractors providing services such as painting, plumbing, heating, electrical, gas fitting, roofing, tiling or similar services and may include the fabrication or assembly of building components such as doors, windows, kitchen and bathroom fixtures and fireplaces or similar products and the sale of such products, either at retail or wholesale. This use class may also include floor area used for showroom/display purposes and all goods and materials associated with this use class shall be kept within an enclosed building. This use class does not include construction services or the manufacturing or sale of household items such as furniture, carpets and appliances;

"**custom manufacturing establishments**" means land and buildings used for the small scale on-site production of specialized goods by five or fewer production employees. Typical uses would include but not necessarily be limited to the manufacture of jewellery, toys, musical instruments and computers; the production of pottery; and, sculpture/art studios;

"**delivery services**" means land, buildings and structures for businesses providing for the delivery of people, goods and services where fleet vehicles used for such delivery are not available for sale, rent or lease. This use class includes: taxi services; messenger and courier services; and, mobile catering services, including the production of catered foods. This use class does not include transportation purposes;

"**equipment rental establishments**" means land and buildings used for the rental of tools, appliances, recreation equipment, office equipment, light construction equipment, or similar items but does not include the rental of motor vehicles, motorized boats or industrial equipment or vehicles;

"**fitness centre**" means land, buildings and structures for active physical recreation on a commercial basis, generally in a gymnasium type setting where patrons are participants and which may include the accessory sale of associated equipment and clothing. Typical uses would include: racquet clubs; weight training gyms; climbing gyms; aerobic or similar studios; and, batting cages. This use class does not include: dance studios intended to teach various types of dance; municipal recreation facilities such as rinks or courts; bowling alleys; and, dance halls;

"**garden centre**" means the use of land and buildings for the cultivation, propagation, display and retail sale of plants as well as associated landscaping and gardening supplies and is distinguished from a nursery;

Appendix B

- **Groups' notes**
- **Topics of questions from question and answer session**

Phil Chapman's Notes
No Signage for this meeting in Maplewood!

(Unacceptable uses for CD18)
- Automotive Repair Shop
- any business that conflicts with other businesses.
- any warehouse type industry that does not take full advantage of the assets of this unique area.
- Auction rooms bring a lot of people - not so many jobs. Also, arenas,
- service station - no - causes more traffic
- no wholesale - big box retail
- warehouse - little employment

Acceptable Uses for CD18
- office - high density employment, because good jobs can bring less traffic (not heavy) (less commuting -= less trucks)
- research & development business
- any business that increases tax base , is non-toxic, non-polluting, and has little incoming traffic (clients, customers)
- higher value employment restaurants
- office if meets MIACC guidelines
- the "buffer" between the heavy industry and the community should be considered the vacant industrial land (waste dump) south of CD18
- park/green space between residential and NE, NE corner
- split in group for need for 2 separate zones (CD19 VSCD18)
- clarify health services - lab OK., and OK in NW quadrant

CD19
- Industrial product sales catering to local business
- higher value employment restaurants (no fast food/no drive thru's)
- "wholesaling" means more definition. We want no more high volume trucks.

Design Guidelines

- no strip malls
- OCP guidelines are OK except for window & footprint size is too large
- support pod development - with loading bays in backs
- shared access
- discreet signage
- underground parking
- permeable grounds for water exchange
- green space - park atmosphere
- wildlife corridors
- economic viability of building design
- guidelines for design should be aesthetically pleasing to community and where possible, adjust guidelines for compatibility with our uses.

OPTIONS FOR HEIGHT

- There was a variety of opion about height, with some wanting:

-- 2 stories with no underground

-- 3 stories with sloped roof w/underground parking. Need better public transportation. Need to consider lack of permeable ground space with large above ground parking lots or- 4 stories with underground parking.

-- poll agreed that 6 storeys was too tall

- take advantage of the quality of life/image of the district when selling development. NW quadrant
- OK for village subject to MIACC guidelines, transport/subject to resolution of problems.
- CANOXY's benefits of these improvements - they fund all improvements, infrastructure

Tamsin and Des' Team's Notes **Summary**

Tamsin - Summary Sheet 1

What we <u>most don't</u> want

1. Noise
   - 24 hour exterior/noisy operations
   - delivery services
   - Delivery / trucking
     create noise) Both unwanted
     create traffic)

Express view of some - CXY would not be there.

Summary Sheet 2

What We Most <u>Want</u>

1. Knowledge
   High Tech
   Clean, quiet, jobs that pay well.

Our ideal but we recognize that it probably won't happen.
(Area of debate)

Note: Group agrees with CXY's proposal to take out these uses (as discussed by Jane).

Summary Sheet 3 (cont'd)

JOBS
   Good jobs i.e. $
   Jobs for Youth
   Jobs with a future

Concept not shared by all - not 1 issue for each group member

---

For (6/10) group members another #1 issue was to include the NW corner and create a "complete community"

Business **<u>PARK</u>** -emphasis on the park

- Aesthetics are critical

- Character of Maplewood
  - Trees
  - Buildings

Tamsin/Des

April 22nd Noise - 1

Uses We Don't Want:

- 24 hour operation = Noise
- no drive-through restaurants
- business that does attract the highest volume at peak hours - **does not over-burden existing traffic system (more so)**
- wholesale/warehousing (reason - not many jobs and not well paid)
- delivery services
- but storage may have merit

Additional Positive Uses

What we want

- Storage should be an accessory use

Fears/Concerns

- Green Belt exists - we don't want an asphalt jungle
- Natural barrier exists
- Trees along south edge - buffer - provide visual screen

Desires (Each group member's desire):

- Mini Edgemont in "NW"
- pleasing to the eye, get a break from area to area
- no more noise than we have now (x 10 - in full support)
    - no Industrial noise
- happy with CXY's progress in last 3 weeks
- Low noise, low buildings (under 3 storeys), keeping trees, upgrading area. (buildings Industrial or residential)
- reduce traffic flow in residential areas (traffic from Seymour).
- temper discussion with realism.
- Noise, traffic, building size - protect the feel of Maplewood - privacy views, residential character
- ideal jobs for the information age
- entry apprenticeship jobs for youth
- As many jobs as possible -- to reduce traffic
- 90% R&D
- 10% complementary/Retail support
- This is the vision but it may not be attainable so R& D complementary use like Engineers &. Architects
- High Tech
  clean
  quiet
  pays well and may cut down on commuting, e.g. Ballard Power

Robert and Lisa's Notes

REPORTER'S SUMMARY

Acceptable Uses

1. Hi-Tech - Marine Biotech
2. Businesses for employees locally oriented
3. Professional offices (Dentists/Drs./Lawyers)
4. Retail mini warehouse manufacturing business
5. Media related in CD18 CD19

Unacceptable Uses
1. Recycling plants
2. Automotive body repair
3. Big box supermarket
4. No shopping centre
5. No strip mall
6. No fast food

Additional Uses - 5% public use CXY
1. Theatre - Play Community
2. Mix of residential\ commercial users in the C? NW quadrant.
3. Business for residents
   - coffee shop
   - banks
   - restaurants
   - fitness
4. CPC - Community Police
5. Retail -- storefront

Yes, there should be some relocations expanded
- Recycling - don't want but no concensus - think some relocations to oher communities a good idea.
- CPC Office - (Walking the Beat)

Some Different Issues:
- Elimination of heavy industry
- out of area chlorine producing

DESIGN

- Visual Statement "This is a Village" entry sign
- HOV Lanes
  - through the Site on Dollarton (re-alignment)
  - Meridian down centre of road

USES IN C? ZONE (NW QUADRANT)
Majority
- Minimum residential retail - storefront

1 no because 1 safety concern with having residential use

- Wendy's - no fast food
- Banking
- High end restaurant
  Theatre
    Community
    Movie
    Commercial
- Entertainment
    Adult only
- Small cabaret
- Fitness
- Businesses for locals
- Small pub
- Small retail

Residential Safety Guidelines

DESIGN
- 2 to 3 levels of residence
- 1 level business (like Edgemont or early bird site at Main/Mountain
- Concern for Residential
  Must be really sheltered - people may become upset with business operation sights & sounds.
- One linear strip - visual appeal
- people friendly, courtyard, benches

USES IN CD18 AND CD19 ZONES

- Hi-Tech III
    Software program
    Bio-tech
    Info-tech
    Marine bio-tech
- No Mega Movie Theatre
- No Restaurants (Earl's Like)
- No Automotive Body Shop
- No Construction Services
- No Custom Manufacturing
- No Mini Warehousing single employee
- Less service where people coming and going - want more internal job oriented.
- This could be INC?

DESIGN ISSUES
- Pedestrian friendly,
- If uses left too broad, won't get hi-tech
- Want Green pristine investment, want restrictive area
  like community oriented businesses
  20,000 sq. ft. , density is 1 - 4 storey height - Discovery Park
- 3-1/2 to 5 persons P/1000 sq. ft.
- 43.5 x 3.5 x 95 sq. ft. = 150 persons per acre
- too many people per acre

* more research
⊗ Too broad

USES IN CD18 & CD19

- No Shopping Centre
- No Strip Malls
- Some warehouses and Office/Retail combination
- Engineering
- Light manufacturing
- Ballard Plant
- No Animal shelter
- No Automotive body shops
- Certifying/Testing Agencies for products, e.g. CSA encourage

DESIGN ISSUES

- Procedural issues around zoning bylaw: - expansion possibilities
- Need Flexible zoning - can limit number of people employed so that the office in front and warehouse in back can happen
- non-toxic
- odour free
- non-polluting
- quiet
-

USES IN CD18 & CD19

- retail food -small Safeway
- coffee shops - delis
- convenience stores
- Sandwich bars
- restaurant fully serviced sites
- community theatre interests- cc? - 4 theatres, no more
- running track - outdoor, view corridor
- warehousing - small scale with some retail concern if by warehousing it becomes a "tent zone" - small, retail
- night time oriented businesses needed as well
- Restaurants - p/p sq. ft., ps ack, adults, families

DESIGN

- try and reduce traffic
- safety issues cost / tax / income
- increase employment in the area skill appropriate jobs
- viability
- view corridor
- running track
- walks / connection minimal warehousing uses encourage higher employment generators

CXY REZONING MEETING
FACILITATOR'S REPORT (Mark Bostwick)

riority Concerns:

1. To improve Maplewood Village first, creating a mixed use zone in CD 17.

2. To protect safety of residents and employees in the area, and generally discourage uses that draw in large numbers of non-residents/non-employees.

Acceptable Uses (with comments)

1. Bank Machine
   - none currently
   - would reduce necessity to drive

2. Personal services
   - would be convenient for residents and workers
   - might provide some local employment
   - would reduce necessity to drive by locals

3. Professional offices
   - provide jobs
   - clean
   - convenient for locals
   - could be architecturally attractive

4. R & D
   - good paying jobs
   - clean
   - bring in municipal tax revenue

5. Media related
   - compatible with North Shore industry
   - bring in municipal tax revenue
   - compatible with Cap College programs
   - would provide training for locals
   - (negative): might bring in people, especially students.

Comments: Group preferred not to rank these uses, except for generally strong support for a bank machine. Feeling that test will be in the overall (all four parcels) vision, not the individual permitted uses. Group did not make a distinction between sites 18 and 19.

2. Unacceptable uses (and comments)

1. Support for the exclusions introduced by CanOxy.

2. Some support (not a complete consensus) for discouraging uses that attract people would might be endangered. Some argued that the area already has many visitors, i.e. the pub and that the safety issue has been overstated.

3. Equipment rental
   associated with heavy traffic
   brings in people
   yards are environmentally unfriendly and ugly

3. Parking structure
   dubious about need

4. Warehousing
   takes up too much land
   not particularly complementary to other uses
   (pos): some felt it might be "complementary" if used to store products of other activities on site.

5. Large restaurant
   would bring in outside customers
   (pos) better quality food
   (pos) reduce necessity of driving to eat
   (pos) serves employees
   (pos) provide local employment

6. Delivery services
   too much traffic

Comments: Group again preferred not to rank, since overall vision should come first.
Residents suggested that they did not understand how much tax revenue and other value would be brought in by each specific use, nor which would provide the most jobs. This made it hard to say yes or no to some uses.

3. Design issues

The group did not have a chance for a full discussion of these issues. Among the topics briefly discussed were:

Like:

Grass
Sophisticated landscaping (both hard and soft)
berms
trees
porous parking
inclusion of park/trails/wildlife corridors

security and safety considerations

Mixed views:

Glass (did not like mirror walls, but perhaps some glass is okay)

Negative:

stucco

4 General Comments

1. Productivity reduced by the noise, crowding, etc of the space. Should have made better preparation for buzz groups so that participants could converse without interference.

2. Consultant disrupted and deflected discussion by impromptu interventions.

3. Area requiring further discussion: clarify the interests of those who do not want a lot of visitors into the area. Was some disagreement whether safety was a relevant factor.

4. Area requiring further discussion: several participants were not convinced that areas 18 and 19 should be re-zoned separate from area 17. This led to a reluctance to make strong recommendations regarding what should be permitted in areas 18 and 19. Nor is it clear how those who live outside the area feel about the idea of mixed use in area 17.

5. Area requiring further discussion: group did not have much chance to discuss how CanOxy might contribute to improvement of the neighbourhood beyond its funding for the road re-alignment.

Questions Raised During the Question and Answer Period:

- Taxes: who is going to pay?
- Do the design guidelines apply to CXY Development (aesthetics important)
- What is the dollar figure in tax reduction?
- What is the suitability of residential rezoning?
- The displays (at the side of the meeting hall) do not match the handout
- Why hasn't Council come to conclusion on safety guidelines?
- Are there toxic metals buried on the site?
- What about the digging area -- is there asbestos sludge?
- When is the job going to start?
- What does "office support services" mean?
- What is permitted in terms of office use?
- What about lighting?

COUNCIL AGENDA/INFORMATION

☐ In-Camera	Date:	Item #
☐ Regular	Date:	Item #
☐ Info Package	Date:	Item #
☑ Agenda Addendum	Date: April 27/98	Item # AOB

Dept. Manager	Director	Municipal Manager

The Corporation of the District of North Vancouver

REPORT TO COUNCIL

Circulated at the request of: Councillor ERNIE CRIST COPY

April 24, 1998
File: 3060-20-8.93

AUTHOR: Councillor Ernie Crist

SUBJECT: Rezoning of Property being used for the Production of Chlorine

---

RECOMMENDATION:

THAT

1) in light of misleading staff information to Council, Councillor Crist's recently submitted motion concerning the rezoning of property being used for the production of chlorine, be reconsidered; and

2) staff be instructed to prepare a Bylaw affecting the rezoning of all properties in the District of North Vancouver currently being used for the production of chlorine, from a waterfront industrial zone (I1) and general industrial zone (I2) to a new comprehensive development zone allowing light industrial, commercial, tourist and port related industries and businesses that are environmentally safe and clean.

REASON FOR REPORT:

During a recent Council debate regarding the above issue (transcript attached), members of Council received misleading information from one staff member. This may well have been the reason why Councillor Crist's motion did not carry.

The presence of chlorine production facilities in our increasingly dense residential environment constitutes a fundamental contradiction. In the pursuit of its long term economic goals of promoting the location of labour intensive, clean and environmentally friendly industries and businesses, the use of land for ongoing large scale production of chlorine in the District, is contrary to the District's interests and impacts in a negative fashion, the realization of optimum land use in the Maplewood area. It acts as a barrier in attracting the kind of industries best suited for the District's environment.

While the production of hazardous chemicals in the District is, at present, legally non-conforming, the use of land on which such production facilities are located is not.

Councillor Crist specifically addressed the rezoning of lands used for the production of chlorine as opposed to the production of hazardous chemicals, per se, which is already prohibited but legally non-conforming. These two issues, though connected, are in fact, two different aspects of the same question.

During a recent Council debate in connection with a motion submitted by Councillor Crist attempting to deal with the aspect of actual land use, Council received incomplete and in fact, misleading information. Also, in a recent issue of the Vancouver Sun (copy attached), a staff member continued to misrepresent the land use aspect of this issue, adding to considerable confusion in the eyes of the public.

With the rezoning of land in the District of North Vancouver, currently used to allow the production of chlorine, District Council would be clearly articulating the District's long term vision and intentions concerning the future use of such lands. The opportunity to address this issue is further enhanced by the need to expend a significant sum of money for the creation of a business park and industries next to chlorine producing facilities that are more compatible with the production of chlorine (i.e., heavy industry, non-labour intensive, etc...), than they are in fulfilling the long term objectives and needs of the District.

Waterfront properties is in high demand by companies throughout the world. It is crucial that we not sacrifice our long term vision, for a short term perceived gain.

EC/nfv

Encl.

Submitted by:

Councillor Ernie Crist

.....

DHB Mr. Masterton, I would like to ask some questions then I would like to go to Councillor Deering-Robb. For clarification, first of all, presently, chlorine production is not allowed within the zoning that is on the property is it not? Is it a non-conforming use now?

JM Yes your Worship.

The CanOxy site is zoned heavy industrial I1 and I2 and in both of these zones, the manufacturer of hazardous substances specifically chlorine is prohibited so that the plant would be non-conforming. Part of the plant is, of course, in Port Corporation land so it tends to be outside our zoning regulations but for the most part any of the plant which is above the Port Corporation land is non-conforming.

Also your Worship, under the District OCP, the manufacturer of hazardous substances is also specifically discouraged under the OCP.

DHB In fact, it is my recollection when we did the servicing agreement with the Squamish Band for IR2 -- which is the area at the north end of the Second Narrows Bridge. In fact, one of the concerns we had was the potential within that area for the location of hazardous chemicals and as I recall, Council, our agreement as to our ability to service, to provide water and sewer which was part of the agreement to get the Seymour Bridge that connects the Mount Seymour Parkway -- and it now has resulted in the Real Canadian Superstore being located there -- in fact indicate that we will not service, for example, that land -- any chemical plant or hazardous chemical plant. So my understanding was, that in fact, that it is non-conforming now, and if that plant for example were to suffer major destruction for some reason, fire or something ....

Is it 75% under the Bylaw?

JM That's right your Worship

DHB ... that it could not be rebuilt. The other aspect with respect to clarification, Councillor Muri. Under non-conforming, the grandfathering does not apply to

the owner of the property. It applies to the **use**, I believe. So for example, if you had a gas station in an area and you rezone the area, if it was an ESSO station, CHEVRON could take over and continue the same use. It is not to the particular owner but for the **use** of the property.

JM It applies to the site your Worship.

DHB It applies to the site and not the owner. It is the **use**. It is not grandfathered. If it is non-conforming use, it is the **use** that can carry on. So CanOxy, to be specific here, has a non-conforming use now, could sell it to ABC Chlorine Company and they could carry on. And ABC could sell it to XYZ .... and they could carry on theoretically.

LM So we could continually make chlorine forever?

DHB Once the **use** becomes non-conforming. It is my understanding again Mr. Masterton, if someone goes in and creates a use contrary to a planned zoning that is in place, then that it is legally non-conforming. It is legally not allowed and the municipality can have that removed. But if there had been a **use** and it is has not been restricted, and if Bylaws are introduced which restrict that **use** and the Bylaws have changed to restrict that **use** or to prohibit that **use** and it becomes non-conforming and that **use** can carry on until the owners of the property can be given time to determine not to.

JM Essentially, that is correct, your Worship. It is a grandfathering really. The only limitation is you can increase the level of non-conformity so CanOxy really can expand the plant for manufacturing chlorine. They can stay there and manufacture as long as he so wish.

LM And they could sell it to somebody who can also manufacture chlorine.

JM Yes.

DHB No change of the zoning will affect that and we could change the zoning to parkland and it is still non-conforming use. It is non-conforming now.

JM It is already non-conforming now, your Worship. The zoning change would not make any difference at all.

LM Sorry Mayor Bell.

DHB I was trying to make some clarification of points.

My concern, Council, I will support the idea and could not remember -- that is the reason I asked the question because my understanding was is that it is non-conforming now.

To try and change the nature of non-conforming, in other words, it is currently heavy industrial, and to change it so that it is light industrial, for example, to change the degree of non-conformity -- it's non-conforming -- because it is hazardous so it isn't as though it is a little bit impregnated, it is. The light is on. It is not a shade of it. But I think changing it now ... trying to go in and change ... now that we have a message that it is non-conforming, they can't expand, that to try and determine now that the zone as to this motion that it be light industrial, commercial, tourist and port related industries and businesses ... before we get the report from our waterfront industrial task force who, in fact, is looking at that piece of land along the waterfront and other pieces of waterfront land within the District that is currently zoned industrial and to make recommendations to this Council, in its future to predetermine, for example, that it should be tourist in that area, I think is premature.

I think that tourism is something we need to promote in the addition of some tourism properties, but I would not suggest at this point, us going down to the Vancouver Wharves or Lynnterm and try to change the tourist area at this point. Unless we get some indications from the experts that in fact Port land, industrial Port land that is located in the waterfront in Vancouver is not attractive for that purpose because of either cross or accessibility of the harbour or other things. I think we would be defeating the purpose of having that particular group just looking specifically at this land. Mr. Masterton?

JM With respect to your comments regarding the Waterfront Task Force, your Worship, that is correct.

One of the concerns expressed by the Task Force and you may recall the "fill" recommendation. Once you allow the light industrial uses in heavy industrial zone, the values go up. Which makes it very difficult for existing heavy industrial uses to continue. To change the equation that by allowing the uses as suggested in this motion, may well be that a lot heavy industrial uses are moved up.

The Watefront Task Force, will actually be commenting on this with a report back to Council probably by the summer.

DHB And the ship building industry that is down there is considered heavy industrial. Is it not?

JM Yes.

DHB I think we need to have..... I appreciate the spirit and I ... certainly if you ask me, "Can we relocate another chlorine plant down there? No."

If it was not there and they wanted to come in and wanted to rezone an area and move into it. Then I would say, "No."

But I think to decide and say we're going to change it into something else. Some other non-conforming use, and there is a non-conforming use that is there right now is pre-empting the report. The Task Force has been asked to look specifically at these waterfront lands, industrial lands.

That is my comment. I have Councillor Deering-Robb, or have I checked you off? Councillor Deering-Robb?

.....

EC First of all, I would like to disagree with the Mayor's interpretation and the staff's interpretation. The point is that the recommendation are as follows:

Maybe it would help if people read it carefully. "....THAT staff be instructed to prepare a bylaw effecting the rezoning of all properties in the District of North Vancouver currently being used for the production of chlorine from a Waterfront Industrial Zone (I1) and General Industrial Zone (I2) to a new Comprehensive Development Zone allowing light industrial, commercial, tourist and port related industries and businesses that are environmentally safe and clean." That is the gist of the motion.

Now what does that mean? What it means is that, this course of action is far more restrictive than anything we have in place now. That is the gist. Far more restrictive.

If something happens to OXY, if the plant is destroyed, if production has to stop for one reason or another, if expansion is necessary -- vertically or horizontally for that matter -- then they are no longer in a legally non-conforming situation .... or in a legally conforming situation, I should say. What is more important is that with this motion, you are sending a clear message to everyone, including to OXY, the community and the whole world. That this plant will not be allowed to expand -- the production will not be allowed to expand -- in fact, we are indicating our desire to see them leave. Because they act as a barrier in putting these lands to the best or highest use. That is the message. All these was avoided in this debate, particularly by the Mayor.

So I suggest to you, Council, that you read the motion carefully and incidentally, Mr. Masterton was ... , may not have been aware that this was drawn up with the assistance of his boss. Thank you.

DHB Councillor Crist, in response to your question, I did address specifically that point because in your report, it appears that perhaps you are not aware that in fact they are already in a non-conforming status because the wording of your memo says that, "such a rezoning would permit the existing industry to continue, meaning CanOxy, but it would put them into a legally non-conforming status. They are already there.

EC No they are not, Mr. Mayor. What they are, is the production is. The land we are talking about ... land use here. It seems that you are incapable of discerning the difference. We are talking about two things. Land use and industrial use. Production of chlorine is one thing, the land use is something totally different. I am talking about the land use here.

DHB Just to finish this debate. I am not suggesting that having industrial is not appropriate. That is why I asked the question about zoning for ship yards. I think the kind of zoning we have down there ... Allied shipyards .... isn't appropriate use.

EC That is labour intensive, Mr. Mayor. We are talking about labour intensive industries and shipyards are clean industries, believe it or not, labour intensive.

DHB Not always, are shipyards clean industries, but they may be. But we have a problem. I am looking at the site at Cates landing in which we determined that as a result of the shipbuilding that was going on there that there is

contamination on the water from the grinding of the iron filings of the ships from the cleaning.

What I am saying is that we do have a task force. In response to Councillor Muri, I appreciate your comments about reports and waiting for reports. We specifically asked the task force to look at these lands. These are the lands below the railroad tracks.

COUNCIL AGENDA/INFORMATION

☐ In-Camera	Date:	Item #
☑ Regular	Date: Apr 6 '98	Item # 12
☐ Info Package	Date:	Item #
☐ Agenda Addendum	Date:	Item #

Dept. Manager	Director	Municipal Manager

The Corporation of the District of North Vancouver

REPORT TO COUNCIL

March 18, 1998
File: 3060-20/8.93

COUNCIL AGENDA
Date: April 14/98
Item: # 3.

AUTHOR: Councillor Ernie Crist

SUBJECT: **Rezoning of Property Being Used for the Production of Chlorine**

RECOMMENDATION:

THAT staff be instructed to prepare a bylaw effecting the rezoning of all properties in the District of North Vancouver currently being used for the production of chlorine from a Waterfront Industrial Zone (I1) and General Industrial Zone (I2) to a new Comprehensive Development Zone allowing light industrial, commercial, tourist and port related industries and businesses that are environmentally safe and clean.

REASON FOR REPORT:

The presence of chlorine production facilities in our increasingly dense residential environment constitutes a fundamental contradiction. In the pursuit of its long term economic goals of promoting the location of labour intensive, clean and environmentally friendly industries and businesses, the ongoing large scale production of chlorine is contrary to the interests of the District and negatively impacts the realization of optimum land use in the Maplewood area.

Since the current Maplewood and Seymour plans are being reviewed, we have an opportunity to make some fundamental changes to the District's goals and objectives.

Such a rezoning would permit the existing industries to continue but it would put them into a legally non-conforming status. By proceeding with such a rezoning the District of North Vancouver would be clearly articulating its long term vision and intentions.

~~211~~
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The opportunity to address this issue is further enhanced by the need to expend significant sums of money for the creation of a business park and industries next to chlorine producing facilities that are more compatible with the production of chlorine (i.e. heavy industry, non-labour intensive, etc.) than they are in fulfilling the long term objectives and needs of the District.

Waterfront property is in high demand by companies throughout the world. It is crucial that we not sacrifice our long term vision for a short term perceived gain.

Submitted by:

Councillor Ernie Crist

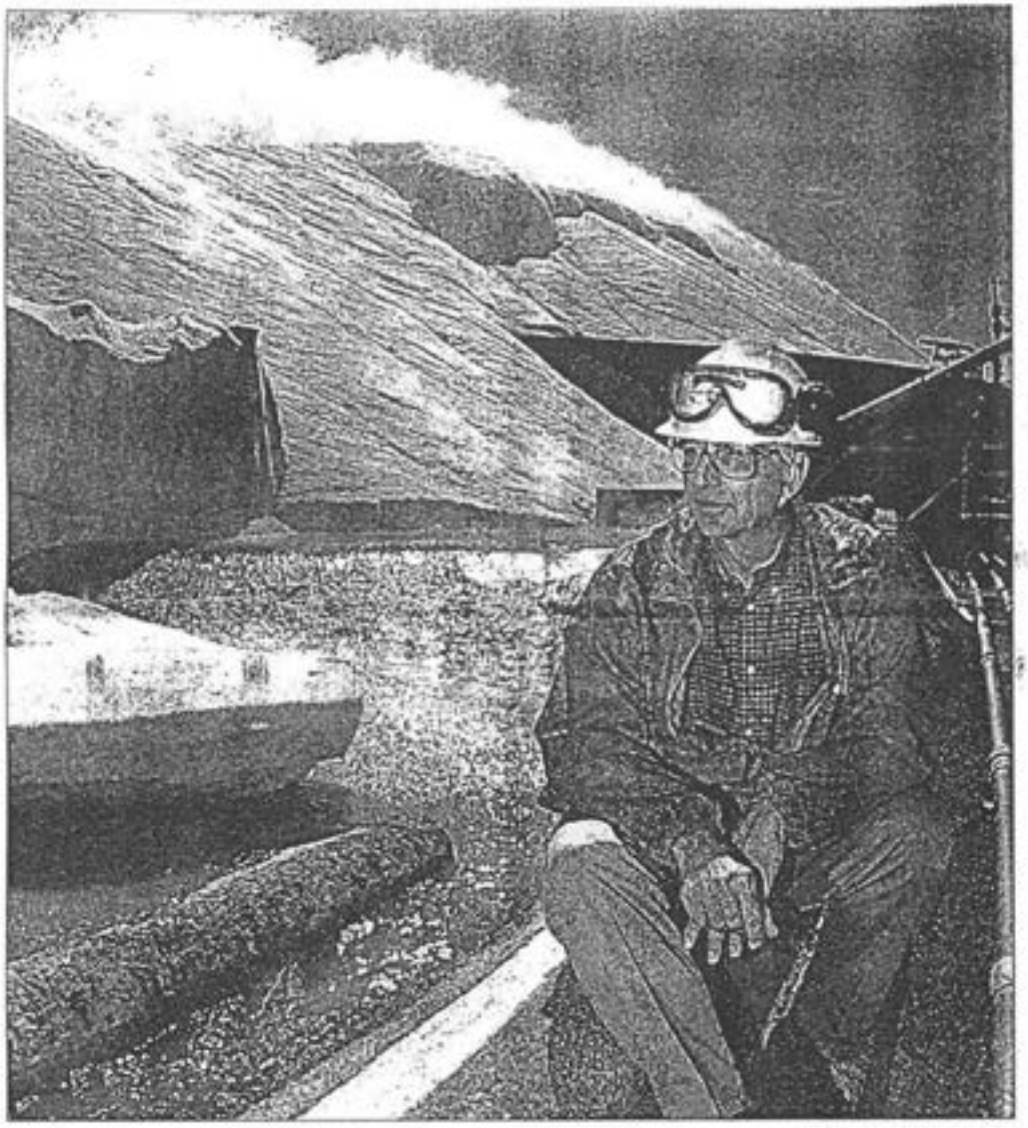
EC/lj/jd

xc: J.I. Torry, Acting Director-Community Planning

216
16

Vancouver Sun
Thursday, April 23, 1998

It needs a little salt....



IAN SMITH/Vancouver Sun

MOUNTAIN OF SALT: Plant manager John Billham views pile of Mexican salt that will be used in the production of chlorine gas at the CXY Chemicals facility in North Vancouver.

North Van chlorine gas plant 'very profitable,' manager says

About five railway tank cars of the toxic gas are produced every day.

GLENN BOHN
VANCOUVER SUN

A perfectly natural and usually innocuous substance, sea salt, is the raw material for the deadly chlorine gas CXY Chemicals produces at its North Vancouver plant.

The company imports white hills of sodium chloride from Mexico to make about five railway tank cars of the toxic gas each day.

Plant manager John Billham says most of that output travels thousands of kilometres by rail to chemical plants in Texas and Gulf Coast states — not primarily to B.C. pulp mills. That's because pollution laws have weaned the pulp industry away from paper bleaching processes that generate dioxins and other chlorine-based contaminants.

Billham concedes there's no longer a good technical reason for a chlorine production plant, which consumes as much electrical power as every home and business in North Vancouver, in a Lower Mainland suburb.

But when asked how long the hazardous chemical plant will stay where it is — near the Maplewood neighborhood and the northeast end of the Second Narrows Bridge — the answer becomes more complex.

"It's a business decision," Billham said in a recent interview before a plant tour. "The plant is making about $80 million a year in sales. It's a very profitable business, so there isn't any business logic, at this point, to take this plant out.

"At some point, my expectation is that the company will say this is no longer a viable place to make chlorine.

"At what point will that be? If you want my best guess, it's five to 15 years. The business scene will change to the point where we can't compete."

Exactly how long B.C.'s only chlorine production plant should stay put has been one of the issues raised by councillors and other residents at public hearings into a proposed rezoning sought by the

SEE PLANT, B8

PLANT from B1

Chemical company seeks rezoning approval

chemical company. The company wants the district's approval to allow a mix of retail businesses, warehouses and light industries on land between the plant and the Maplewood residential neighborhood.

That rezoning was the subject of a public meeting Wednesday and another is scheduled for April 30. A public hearing on the issue resumes May 21.

The fate of the proposed development remains before council, but district officials have already told council the 41-year old CXY Chemicals plant has the legal right to remain open. That's despite an old district zoning bylaw that prohibits the production of hazardous products such as chlorine and explosives.

Council got that advice after Councillor Ernie Crist made an unsuccessful bid earlier this month to rezone all existing production facilities to "light industrial, commercial, tourist and port-related industries, and businesses that are environmentally safe and clean."

He suggested such a zoning would put the existing plant in a "legally non-conforming status."

But Jim Masterton, the district's assistant planner, said the CXY Chemicals plant is already non-conforming, because a previous council passed a zoning bylaw that prohibits the manufacturing of hazardous substances at that site. The official community plan for the Maplewood area also discourages those kinds of hazardous businesses.

The company could sell its chlorine plant to another company and production could continue in the same plant, but Mayor Don Bell said the plant cannot be expanded or rebuilt.

COPY

The Corporation of the District of North Vancouver

May 04, 1998
File: 3060-20-8.93

TO: Gord Howie, Municipal Manager

FROM: Councillor Ernie Crist

SUBJECT: April 14, 1998 Motion: Rezoning of Property being used for the Production of Chlorine File No. 3060-20-8.93

At the regular Council meeting of Monday, April 14th and in connection with my motion regarding rezoning of property being used for the production of chlorine, I reiterated the points made in my motion that:

> "Although the production of hazardous chemicals, including chlorine, in the District of North Vancouver was legally non-conforming, the purpose for **THIS** motion was to make the lands currently used for the production of chlorine legally non-conforming as well." This was to be accomplished through a re-zoning of all lands currently used for such production (i.e., chlorine).

In the ensuing debate, interrupted by Mayor Don Bell, Mr. Masterton was asked the following:

> "For clarification, first of all, presently, chlorine production is not allowed within the zoning within the property, Is it not? Is it a non-conforming use now?"

Mr. Masterton's answer was:

> "The CanOxy site is zone Heavy Industrial I1 and I2 and in both of these zones, the manufacture of hazardous substances specifically chlorine is prohibited so that the plant would be non-conforming."

This was clearly misleading! Mr. Masterton was clearly referring to the production of hazardous chemicals (i.e., chlorine) and in fact avoided the issue raised by Councillor Crist that the motion before Council was dealing with **land use**.

Subsequently, in his rebuttal, Councillor Crist stated:

> "First of all, I would like to disagree with the Mayor's interpretation and the staff's interpretation" The point is that the recommendation are as follows: "That staff (i.e., Masterton) be instructed to prepare a bylaw affecting the rezoning of all

properties in the District of North Vancouver currently being used for the production of chlorine from Waterfront Industrial Zone (I1) and General Industrial Zone (I2), to a new Comprehensive Development Zone allowing Light Industrial, Commercial, Tourist and Port related industries and businesses that are environmentally safe and clean." "That is the gist of the motion."

Following this statement, the Mayor once again, interjecting and insisting that my motion was redundant, since the production of chlorine was already legally non-conforming, stated that:

"It appears that perhaps you are not aware, that in fact, they are already in a non-conforming status because the wording of your memo says that, "Such a rezoning would permit the existing industry to continue, meaning CanOxy, but would put them in a legally non-conforming status."

To which Councillor Crist replied:

"No they are not, Mr. Mayor. The production **is**. We are talking about two things: Land use and Industrial use. Production of chlorine is one thing, land use is something totally different. I am talking about the **land use** here."

This debate was quoted in the *Vancouver Sun* on Thursday, April 23rd and was written by Glenn Bohn. In that story, the *Sun* reporter stated the following:

"Council got that advice after Councillor Ernie Crist made an unsuccessful bid earlier this month to rezone all existing production facilities to "light industrial, commercial, tourist and port-related industries, and businesses that are environmentally safe and clean."

"He suggested such a zoning would put the existing plant in a "legally non-conforming status."

"But Jim Masterton, the District's Assistant Planner, said the CXY Chemical plant is already non-conforming, because a previous Council passed a Zoning Bylaw that prohibits the manufacturing of hazardous substances at that site. The Official Community Plan for the Maplewood area also discourages those kinds of hazardous businesses."

"The company could sell its chlorine plant to another company and production could continue in the same plant, but Mayor Don Bell said that the plant cannot be expanded or rebuilt."

At issue here is that the information supplied by Mr. Masterton was misleading and, in fact, erroneous. The motion made by Councillor Crist dealt specifically with **land use** and not with production, per se.

This statement made by the Assistant Planner caused confusion among the public as well as Council. It may well have been the reason why Council voted against the motion made by Councillor Crist.
In response to being challenged on this issue, dated April 24, 1998, Mr. Masterton provided the following explanation to Council:

> "In the *Vancouver Sun*, on April 23rd, there was an article by Glenn Bohn entitled, "*North Vancouver Chlorine Gas Plant 'Very Profitable,' Manager Says.*" (attached)
>
> "In it, the reporter discusses the issue of non-conformity as they affect the CXY plant. This memo is to advise Council that, at no time did the reporter interview me separately, in the preparation of the article which seems to have been derived from the debate in Council on April 14th on Councillor Crist's motion.

Mr. Masterton is clearly avoiding the issue. The issue is not whether he was interviewed in person or whether the reporter quoted Mr. Masterton from the debate in Council.

The issue is, and this is something Mr. Masterton seems to avoid, whether Mr. Masterton was quoted correctly. And the answer to that is, "Yes, Mr. Masterton was quoted correctly." That is to say, he provided Council with that misleading information in public and in turn was quoted correctly in the *Vancouver Sun*.

I strongly suggest that Mr. Masterton set the record straight. His memo of April the 24th clearly does not do that. The situation is made worse in light of the statement made by Mr. Masterton to Councillor Crist, following this debate on Council, in which Mr. Masterton clearly showed his biases by stating:

> "I do not want to jeopardise the existence of heavy industry in the Maplewood area which would undoubtedly occur if Canadian Oxy were to leave."

I suggest that it is not up to Mr. Masterton to make such a political statement. Mr. Masterton's job is to provide accurate and professional information to Council at all times. If he wishes to make political decisions, he ought to run for political office. I request that Mr. Masterton be advised by the Manager of his duties and his professional obligations and that this letter be put in his file as a record of his performance.

This issue is of extreme importance to the residents of the District. It cannot be dealt with lightly, neither will I tolerate to be lied to in public by staff. I like to have a reply in writing with copies to: Mayor and Council, Glenn Bohn, Reporter --*Vancouver Sun*, all Community Associations.

EC/nfv
Encl.

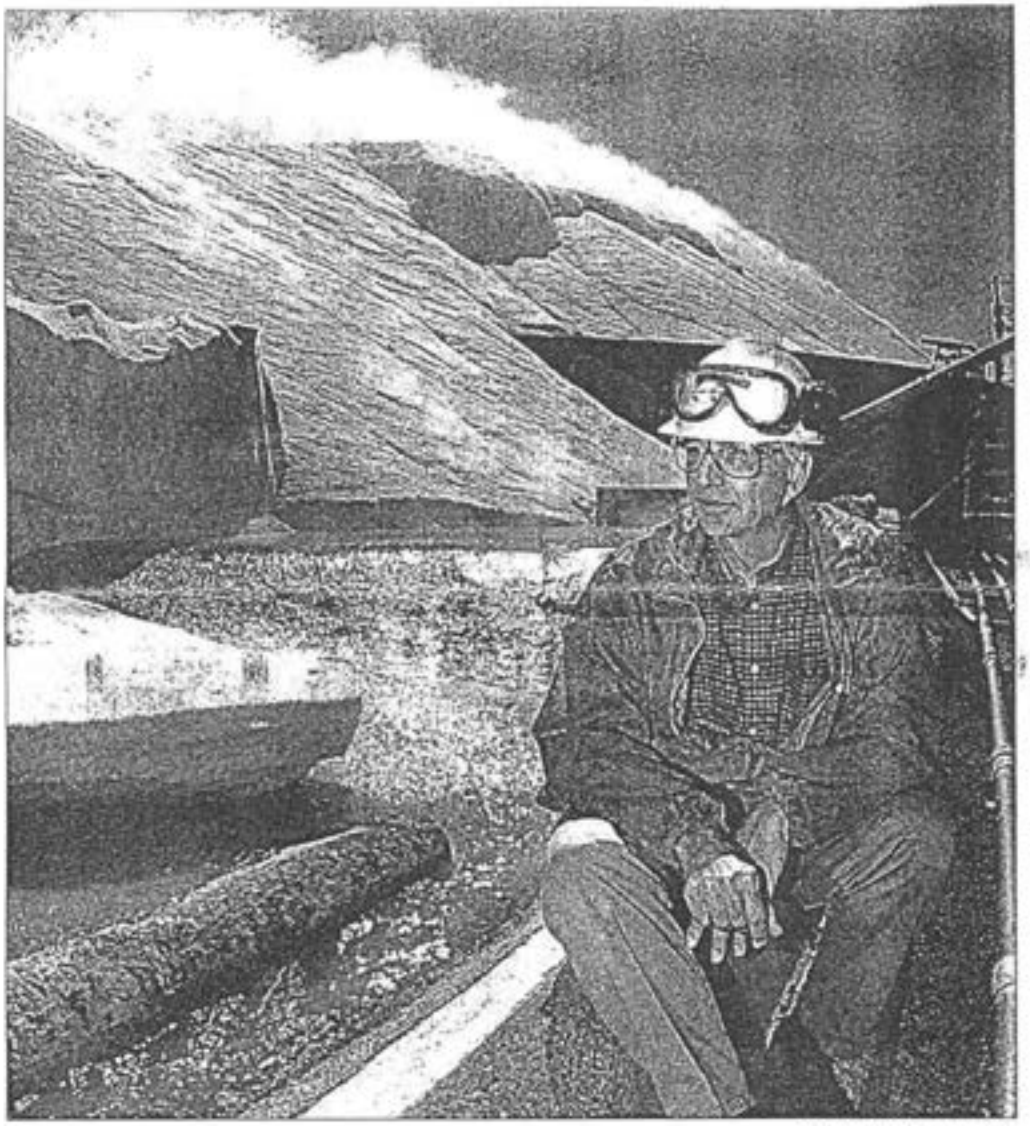
Dictated by:

Councillor Ernie Crist

xc: Mayor and Council
J. Irwin Torry, Acting Dir. -- Community Plng., Bldg., Land & Bylaw Services
Glenn Bohn, Reporter --*Vancouver Sun*
All Community Associations

Vancouver Sun
Thursday, April 23, 1998

It needs a little salt....



IAN SMITH/Vancouver Sun

MOUNTAIN OF SALT: Plant manager John Billham views pile of Mexican salt that will be used in the production of chlorine gas at the CXY Chemicals facility in North Vancouver.

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VANCOUVER SUN

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Exactly how long B.C.'s only chlorine production plant should stay put has been one of the issues raised by councillors and other residents at public hearings into a proposed rezoning sought by the

SEE PLANT, B5

PLANT from B1

Chemical company seeks rezoning approval

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The fate of the proposed development remains before council, but district officials have already told council the 41-year old CXY Chemicals plant has the legal right to remain open. That's despite an old district zoning bylaw that prohibits the production of hazardous products such as chlorine and explosives.

Council got that advice after Councillor Ernie Crist made an unsuccessful bid earlier this month to rezone all existing production facilities to "light industrial, commercial, tourist and port-related industries, and businesses that are environmentally safe and clean."

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The Corporation of
The District of North Vancouver
355 West Queens Road
North Vancouver
British Columbia
V7N 2K6

Fire Services Administration Offices
1110 Lynn Valley Road
North Vancouver, B.C.
V7J 1Z9

Director of Fire Services, Richard A. Grant
Telephone 604 980 7575 Fax 988 5249

April 27, 1998
File 1470/01/--

Mr. C. Kosts
[redacted]

Dear Mr. Kosts:

Attached is a copy of a memo from Chief Brian Stegavig which deals with Bylaw 5344 and CXY Chemicals.

I trust the information contained in this memo will answer the questions you raised in your letter to Mayor and Council, but if you do require further clarification, please do not hestiate to contact me.

Yours sincerely,

THE CORPORATION OF THE
DISTRICT OF NORTH VANCOUVER

[redacted]
R. A. Grant
Director of Fire Services

cbc/enc.

xc: Mayor and Council

April 23/98

To: Terry Neiman
Facilitator

From: Corrie Kost
[redacted]

Re: March 22/98 Public Meeting at Maplewood School
Bylaw 7008 Land Uses

Dear Terry Neiman,

Just a few points to follow-up on this meeting.

- I found the public Q/A period at beginning of meeting inadequate to allow enough members present (including myself) to participate.
- Since all groups dealt with the same topics there was little opportunity for in-depth exchange of information on special concerns (eg. risk assessment, transportation figures that would be generated by specific land uses, tax benefits for the different land uses, number of employees generated by specific land uses....to name a few.)
- I felt that, despite my enthusiasm and in-depth knowledge of certain issues, there was little opportunity to communicate this. When I tried, I was accused (by a councillor who was present in our group!) of dominating the discussion, even though my remarks spanned only about 1 minute!
- The active participation of members of council (as was the case at our group) should not have taken place. It is the role of the facilitator (we had two, since we were a combined group) to ensure this and that all who wish to make their opinions known can freely do so.
- **The salient point, accepted by many members of the group, put forward by a participant who manages a number of high-tech industrial parks in the Lower Mainland, that one should restrict the number of land uses to just a few, was never put forward in the final wrap-up presentation.**

In summary, I found the results less than satisfactory. Too mushy, with not enough hard information or facts presented. I came away feeling that it was basically a "wish-list" not based on the reality that there is a hazardous chlorine plant close by, nor based on a business plan which ensured an adequate return on a $10million investment by the District tax-payers. I expected more from this meeting.

Yours truly,

[redacted]
Corrie Kost

cc: Dennis Back
District Clerk

BOX

Maplewood issues missed

Dear Editor:

There are two over-riding issues regarding Canadian Occidental's rezoning application for the land surrounding their Maplewood chlorine plant.

The **North Shore News** missed them both (Timothy Renshaw's April 5 column).

For one thing Oxy's rezoning application takes place in the midst of a review of the Seymour Community Plan.

What is the use spending hundreds of thousands of dollars of taxpayers' money asking the public for input when the review process is being hijacked before it is completed? Does this not make a mockery of the public participation process we are constantly crowing about? Or is Canadian Oxy immune from these policies?

And to call the people in Seymour "nimbyites" for objecting to this conspiracy is not only unfair, it is an insult.

The second point is the contention that the Canadian Oxy proposal to surround itself with a heavy industries and a warehouse buffer zone is too good to pass up. Thank you for the advice.

It is nothing of the sort of course, no more than snake oil is good for cancer. On the contrary, such a development will do nothing for the municipality and even less for the people in Maplewood.

CanOxy's proposal may make sense for Oxy but it is not what the district needs. Warehouses and heavy industries will not bring more jobs, neither will they improve the area. Whatever problems exist today will get worse.

Such industries are neither labor nor tax intensive. Neither are they conducive to our North Shore environment. In any case, let the people themselves decide what is good for them. Remember public participation?

Ernie Crist, Councillor
District of North Vancouver

north shore news
MAIL BOX APR 14/98

Maplewood hearing distorted

Dear Editor:

Mr. Renshaw's (April 5) column, "Get Maplewood area in gear" does a great disservice to the democratic decision-making process and distorts the results of the recent public hearing on the re-zoning of lands owned by Canadian Occidental Petroleum.

The article states that the "forces of no growth-anywhere-anyhow are strong and getting stronger" on the issues of business development in Maplewood.

As anyone who attended the two nights of hearings should know, critics of the rezoning proposal did not question the desirability of economic development via a business park for Maplewood.

There is strong support among district residents for business parks, particularly the types which will encourage stable jobs such as research institutions and light manufacturing.

I think district residents, and Seymour residents in particular, want sustainable employment in the area so that local people can find good jobs with a future.

At the public hearing it was clear that there is common agreement that we want to encourage clean, non-polluting industries that expand the tax base.

Unfortunately, no such vision emerged from district hall or CanOxy. Instead, the list of permitted uses included in the rezoning bylaw emphasizes retail and the type of businesses that attract huge amounts of traffic, small buildings, and lots of asphalt and concrete.

The area has the potential to attract businesses that will make a long-term commitment to this most depressed zone, but it takes time to work out a vision of how a community should develop.

Consider for a moment that in addition to CanOxy's 30 acres, there's the Tolko lands, the Port of Vancouver land and the District's own Maplewood lands - it's not a "one gear" step.

Those who spoke against the re-zoning of CXY lands and the expenditure of $10 million of district funds to realign the Dollarton highway and build a new two-lane bridge across the Seymour River, did so because the public has only been informed of one aspect of the issue.

Two public meetings were held in 1997 to discuss the assessment of the risks posed by the production of chlorine.

There was no information given or discussion of the complex financing and land use decisions.

If citizens are expected to finance millions in tax dollars for economic development, shouldn't they be informed about financial, transportation, social, environmental and other impacts of such a development proposal? Not according to district hall and Canadian Occidental.

Were district residents expected to read detailed documents to learn about their $3.75 million share of the Dollarton re-alignment? Expected to figure out the various options for financing the new $6 million dollar bridge?

How about the financial, social and ethical implications of expropriating residents who live along Dollarton at the foot of the district's own Maplewood development area?

Mr. Renshaw calls this way of proceeding without information meetings, getting into "gear."

He presumably means third gear because an important one was omitted deliberately.

Second gear is the necessary one of informing the public about the details of a highly controversial project.

Even Mayor (Don) Bell admitted as much in council during the public hearing.

Mr. Renshaw's article not only distorted the purposes for which many people spoke at the public hearing, it also missed the positive results of the public hearing.

Council has now agreed to initiate a public information process which will include some kind of open forum on the re-zoning issue and an open council meeting on the financial implications of the project.

I think an important principle has been recognized by council.

Don't try to ram a multi-million dollar re-zoning project through when millions of dollars of the public's money are at stake.

Citizens who have an interest in how their tax dollars are spent have every right to question the process and make positive suggestions for improvements.

One can understand Canadian Occidental's rush to rezone and the desire of the people of Maplewood to see the main highway removed from their community.

However, all of North Vancouver has a vital stake in the success of this project because of its potential impact not only on the people living in Maplewood but everyone from youth looking for future jobs to every tax-paying householder.

Allan Orr
North Vancouver

APR 12/98

District *of* North Vancouver

dialogue

www.dnv.org

Council Meeting Agenda

April 14 - 7:00 p.m.

1. Tax Stabilization Account
2. Size of Accessory Buildings in Single Family Residential Zones
3. Rezoning of Property Being Used for the Production of Chlorine
4. Development Variance Permit - 4088 Highland Place
5. Park Reservation Bylaw - 4100 Block Virginia Crescent
6. Rezoning Bylaw - Memorial Gardens - 1505 Lillooet Road
7. 552 Crestwood Avenue - Slope Stabilization

Development Permits as follows:

8. 2102 Dollarton Highway
9. 1270 Lynn Valley Road
10. 3015 Woodbine Drive
11. 4710 Capilano Road
12. Lot B - West 14th Street, Creekside Business Park
13. Tree Cutting on District Properties
14. Procedures for Rezoning Applications - Public Information Meetings/Signage
15. Council Committee Appointments
16. Parkgate Construction - Expenditure of Funds

For more information on the agenda call 990-2211 or refer to District InfoWeb.

CXY Rezoning discussion continues

Council adjourned the Public Hearing on this rezoning to allow further public discussion on related issues.

Two meetings are being scheduled: one to focus on land use and design on the site and another to focus on funding of the proposed Dollarton Realignment and Seymour River bridge.

Further details on these upcoming meetings will be included in next Sunday's Dialogue.

Public meetings on CXY/Dollarton Proposals

1

Land Use and Design Issues
April 22 - 7 p.m.
Maplewood School
420 Seymour River Place

2

Funding of Dollarton Realignment and Bridge
April 29 - 7 p.m.
Council Chambers

Watch this space for further information

working together for a better community

Meeting to discuss chlorine firm's plans

Canadian Occidental Petroleum wants to sell vacant land for other uses.

A chlorine company's controversial plans for a light industrial and commercial development is the subject of a public meeting April 22 at Maplewood elementary school.

Last week, after two evenings of public hearings, North Vancouver district council voted 6-1 to adjourn the hearings until May 21 so district staff could organize at least one public meeting before another hearing. The Canadian Occidental Petroleum proposal was first unveiled in 1991.

The development proposal — which council hasn't yet approved — would allow the company to sell vacant land for uses that range from high-tech industries to gun shops and car washes.

The April 22 "workshop" — to begin at 7 p.m. — won't be as formal as the quasi-judicial public hearings required during the passing of the project's development bylaw, a district official says.

"It's not like a grandstanding situation where you make speeches," assistant planner Jim Masterton said in an interview this week. "It's sitting around a table with fellow residents, working through a facilitator, to express opinions and directions of the issues."

north sho
VIEWP

CanOxy options

THE Maplewood debate deserves to be held over. As reported in the April 3 News, the issue of rezoning property in the south Seymour area of North Vancouver District has galvanized the community. And for good reason.

A two-night public hearing was adjourned April 1 after district council determined that too many questions remained unanswered.

There is little debate that something needs to be done with the 30-acre buffer zone to the north of Canadian Occidental Petroleum's CXY chlorine plant. The property is but one piece of a site jigsaw puzzle that has the potential to house a dynamic residential/business/commercial core — a core that is currently missing in the district.

But the nature of that core and the future complexion of the Maplewood area's waterfront need further clarification.

Rezoning the CanOxy property is not a new idea. The district and the chemical company have been at it since 1992. It has passed through numerous reviews and environmental assessments. But the public, as illustrated by last week's hearing, has still not had its say nor been fully convinced that the route proposed is the route that will be best for the municipality.

A series of public meetings on the issue has therefore been set, after which the hearing itself will be reconvened on May 21. There will be no excuse at that time for all residents concerned not to be fully informed on all the issues surrounding the Maplewood development opportunity. And no excuse to delay a decision on it further.

Fax to Andrea Finch

[redacted]

The proposed use & plans for the "buffer zone" lands.

April 18 /1998

To: Andrie Finch

From: Corrie Kost

[redacted]

Re: Environmental concerns of a Chlorine Plant.

Further to our telephone conversion, I have attached the current land uses **(I2)** and the proposed land uses **(CD18 & CD19)** for the buffer zones. Of particular concern was the retail food services and restaurant uses of these lands. You will recall that one of my original questions was whether a Municipality government has the right to impose an "environmental hazard tax", i.e impose special tax rates on land that are used in a manner that impose risks and other restrictions on publically owned adjacent properties. If you require additional information please let me know. I will unfortunately be away from April 24 to May 14. The public hearing on this issue resumes May 21.

Yours truly,

[redacted]

Corrie Kost

ps: The above replaces previous fax which had property incorrectly designated as I1

CanOxy Zoning Comparison - Current & Proposed

	Current I2	Proposed CD18	Proposed CD19
animal shelter	x		
arena		x	
auction room	x	x	
auto body shop	x		
auto repair	x	x	
building supply establishment		x	
business/office support service		x	x
car wash		x	
contractor services	x	x	x
custom manufacturing	x	x	x
delivery services	x	x	x
equipment rental establishment	x	x	
fitness centre		x	x
garden centre		x	
gas bar		x	
gun shop	x	x	
health services purpose			x
heavy manufacturing	x		
hobby beer & wine making	x	x	x
household repair services		x	

	Current I2	Proposed CD18	Proposed CD19
ind. product sales establishment		x	x
light manufacturing	x	x	
media related establishments			x
mini-warehousing	x	x	
office purposes			x
parking structure	x	x	x
personal services shops			x
professional offices			x
research & development est.	x	x	x
restaurant			x
retail food services		x	x
school, trade	x	x	
service station		x	
specialized light ind & technology	x	x	x
transportation purposes	x		
veterinary clinic	x	x	
veterinary hospitals	x	x	
warehousing	x	x	x
wholesaling	x	x	x
works yard	x		

P01
PHONE NO. : 604 929 2090
FROM : SADLER & CO

CanOxy Zoning Comparison - Current & Proposed

	Current I2	Proposed CD18	Proposed CD19
animal shelter	x		
arena		x	
auction room	x	x	
auto body shop	x		
auto repair	x	x	
building supply establishment		x	
business/office support service		x	x
car wash		x	
contractor services	x	x	x
custom manufacturing	x	x	x
delivery services	x	x	x
equipment rental establishment	x	x	
fitness centre		x	x
garden centre		x	
gas bar		x	
gun shop	x	x	
health services purpose			x
heavy manufacturing	x		
hobby beer & wine making	x	x	x
household repair services		x	

	Current I2	Proposed CD18	Proposed CD19
ind. product sales establishment		x	x
light manufacturing	x	x	
media related establishments			x
mini-warehousing	x	x	
office purposes			x
parking structure	x	x	x
personal services shops			x
professional offices			x
research & development est.	x	x	x
restaurant			x
retail food services		x	x
school, trade	x	x	
service station		x	
specialized light ind & technology	x	x	x
transportation purposes	x		
veterinary clinic	x	x	
veterinary hospitals	x	x	
warehousing	x	x	x
wholesaling	x	x	x
works yard	x		

ATTACHMENT 6

P02
PHONE NO. : 604 929 2090
FROM : SADLER & CO

CanOxy Zoning Principal Uses Comparison

Current Uses Removed if Rezoned:

animal shelter

auto body shop

heavy manufacturing

transportation purposes

works yard

Proposed Additional Uses under CD18 & CD19:

arena

building supply establishment

business/office support service

car wash

fitness centre

garden centre

gas bar

health services purpose

household repair service

industrial product sales est.

media related establishments

office purposes

personal services shops

professional offices

restaurant

retail food services

service station

ATTACHMENT 7

P83
PHONE NO. : 604 929 2698
FROM : SADLER & CO

CanOxy Re-zoning Size Regulation Comparison

	Current I2	Proposed CD18	Proposed CD19
Height	40 feet	40 feet	60 feet
Building Coverage	60%	60%	60%
Site Coverage	95%	90%	85%
F.S.R.	?	1.5	2.0

Current I2 zoning limits the retail sale of goods to an accessory use except in the case of:

a) auction room b) contractor services c) gun shop d) hobby beer & wine-making

ATTACHMENT 8

April 18/98

To: Mayor and Members of Council
District of North Vancouver

From: Corrie Kost
2851 Colwood Dr. V7R 2R3

Re: **Bylaw 5344 and Public Hearing on Bylaw 7008**

Your Worship and Members of Council,

Further to the public input process on Bylaw 7008 and my concerns on the risk aspects of the lands in question being rezoned, I have attached extracts of District Bylaw 5344 (FIRE BYLAW) . I wish to draw Council's attention to section 20A (a) parts ii and iii. The questions I would like to see addressed are:

1) Do any of the parts of this bylaw apply to Canoxy?

2) Does Canoxy "...exceed in total volume the amount normally handled by the user of the dangerous goods in a 48-hour period..." and if so, was a permit issued by the Fire Chief to authorize it being exceeded? To clarify, say that 100 tons/day is shipped, are they storing more than the allowed 200 tons?

Yours truly,
C. J. Kost
Corrie Kost

cc: Dennis Back
Clerk, District of North Vancouver

CONSOLIDATION OF BYLAW 5344 AS AT JUNE 25, 1990
UP TO AND INCLUDING BYLAW 6257

THE CORPORATION OF THE DISTRICT OF NORTH VANCOUVER

BYLAW 5344

A bylaw made pursuant to sections 699 and 700 of the Municipal Act

The Council for The Corporation of the District of North Vancouver enacts the following:

Title

1. This Bylaw may be cited as the "FIRE BYLAW".

Definitions

2. In this bylaw

Approval means acceptance as satisfactory to the Fire Chief;

Dangerous Goods for the purpose of this bylaw has the meaning set out in the 'Transport of Dangerous Goods Act', S.B.C. 1985, Chapter 17;
(5471 5795)

Regulation of Dangerous Goods

20A. The following regulations apply to dangerous goods:

(a) Storage

(i) except for a propane refuelling station, liquified petroleum gas (propane), compressed natural gas and liquified natural gas, shall not be stored in any Zone, as defined in the District of North Vancouver Zoning Bylaw, 1965 as amended, in any quantity greater than the maximum provided for as follows: (6027)

Zone	Maximum Quantity
(a) RS1, RS2, RS3, RS4, RS5 RG1, RG2, RG3, RG4, RG5	(1,000 U.S. gallon water capacity) (3,785 litre)
(b) RH1, RH2, RH3 C1, C2, C3, C4, C5 I3, I4 PRO, PA	(3,000 U.S. gallon water capacity) (11,355 litre)
(c) I1, I2	(12,000 U.S. gallon water capacity) (45,400 litre)

(ii) except for chlorine usage by the Greater Vancouver Water District for water and waste purification, **not more than an aggregate capacity of 300 lbs. (136 kg) of chlorine may be located on any site;**
(5795)

(iii)dangerous goods stored on the user's property in transit containers may not exceed in total volume the amount normally handled by the user of the dangerous goods in a 48-hour period, or in any greater amounts or for longer time periods unless authorized by permit from the Fire Chief.

(b) Manufacturing

The manufacture of dangerous goods is regulated in the District of North Vancouver Zoning Bylaw, 1965, as amended;

CONSOLIDATION OF BYLAW 5344 AS AT JUNE 25, 1990
UP TO AND INCLUDING BYLAW 6257

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(b) Manufacturing

The manufacture of dangerous goods is regulated in the District of North Vancouver Zoning Bylaw, 1965, as amended;

— local community is most impacted by design
— what business park do you need/want — high tech is the industry
— body type/count in RISK assessment

PROPOSED FORMAT :
PUBLIC FORUM: CXY REZONING
APRIL 22,1998 - 7 p.m. to 10 p.m. Maplewood School, Seymour River Place

---

PROGRAM

6:30 P.M. Sign in

7:00 p.m. Welcome -
Mayor Bell - Outline pupose of meeting and introduce facilitator

Presentations -
Review land uses, design guidelines for CanOxy site
Irwin Torry, Manager Community Planning

7:15 p.m. Group discussion - key questions

1. Land use:
   a) What land uses allowed under the proposed zoning are acceptable to the community?
   b) Are there any that are not?
   c) Are there any additional land uses not addressed in the proposal that could be considered?

2. Design guidelines:
   a) What key elements should be considered in developing design guidelines for this area -- setbacks, height, material (finishings), landscaping , signage.
3. Are there other issues relating to the CanOxy rezoning application?
4. Consensus:
   a) What are the areas of agreement relating to the above questions.
   b) What are the areas of disagreement relating to the above questions

9:00 p.m. Report Back from each discussion group
- facilitated general discussion

9:45 p.m. Next Steps - Mayor Bell

GROUPS:
Estimated attendance is 100. Therefore we are organizing for discussion groups of 10, each facilitated by a trained staff member or community volunteer. A member of the group will be asked to record. Facilitators will meet at 5 p.m. for an overview of the meeting format and role of facilitator.

COUNCIL PARTICIPATION
Council members may join a discussion group, or depending on the number of groups circulate between two groups to listen to discussion and answer questions.

STAFF RESOURCES
District Staff will be available to answer specific question from any group.

SIGN IN AND ASSIGNMENT
To ensure that each group has a mix of people and to encourage interaction, nametags will be provided with a preassigned group number (1 - 10).

- Need shot fact sheets.
- report back not by a staff member. (give a bad impression otherwise)
- record of results. - need more empirical data at end.

- use of lands needs detailing

PROPOSAL -- FOR DISCUSSION PURPOSES
PUBLIC INVOLVEMENT PROCESS
CXY REZONING /DOLLARTON HIGHWAY REALIGNMENT --
APRIL,1998

Purpose:
To provide opportunity for further discussion of proposals for the CXY site and Dollarton road/bridge improvements, prior to continuing the public hearing on the CXY rezoning.

Level of Public Involvement:
Consultation with residents to:

- review land uses and discuss design guidelines for the CanOxy site
- update information on the Dollarton realignment and bridge improvement proposals and funding options
- provide an opportunity to identify and address public concerns with the proposals.

Who needs to be involved:
1. Local Community Association representatives
2. Local businesses and institutions, and their work force
3. Adjacent residents
4. Seymour area residents
5. District residents

NB: Due to the recent Public Hearings (advertising, signage, notifications, media coverage) , the awareness level in the community is high. Attendance at the Public Hearings also reflect the level of interest in the community relating to this issue. Therefore, the following process builds on the existing awareness and interest.

Activities	Timing
1. Pre-meeting Publicity	
1.1 **Meeting** with key stakeholder groups	April 16
1.2 **Letter** - notification of the meeting. Distributed to households, businesses and institutions in the area.	April 11
1.3 **Advertisement** - an invitation to meetings and how to get more information. NSNews	April 12/19
1.4 **Signs** in the vicinity of the site advising of the meeting	April 17
2. Public Meeting on Land Use- April 22	
2.1. Displays - information on: land-use options; OCP policies; design guidelines; CXY operations; risk comparisons.	April 22 7:00 to 10 p.m.
2.2 Presentation - an overview of the land use alternatives, etc. A facilitator will coordinate (chair?) the meeting.	Maplewood School, Seymour River Place
2.3 Group Discussion (see attached outline) with flip charts to note key points of discussions	
2.4 Question/comment forms for additional written input	

3. Public Meeting on Dollarton realignment/ bridge **3.1. Displays** - information on: land-use options; OCP policies; design guidelines; CXY operations; risk comparisons. **3.2 Presentation** - an overview of the proposals, progress to date, funding options **3.3 Question and Answer -** public comment period followed by Council comments and questions **3.4 Question/comment forms** for additional written input	April 29 7:00 to 9 p.m. District Hall
Public Hearing continuation	May ?. District Hall

Good growth wanted

Dear Editor:

No Growth Gang — who me?

As the last speaker on the first night of public hearing meetings for the proposed CXY business park, I was a bit perturbed when it came to sign up on a speaker's list.

You see, it only allows for speakers "FOR" or "AGAINST" — whereas I felt my comments were "almost for and not quite against."

As I listened to the 27 other speakers that night, I had a different picture than Mr. Timothy Renshaw (April 5 column) of the public opinion of the business park.

On the Yes side I heard the sentiment, "build a business park, take the traffic out of Maplewood, build economic development base for the district" and on the No side — the same: "build a business park, take the traffic out of Maplewood, build economic development base for the District."

On both sides of the speaker's list, thoughtful ideas about how to best achieve this. No signs of a No Growth Gang lynching anywhere. Maybe it was different on the second night of the hearing?

Speaking for my own point of view: I very much support the development of a solid viable tax base for the district, new employment opportunities, an improved transportation link for Seymour and traffic peace for Maplewood.

I don't happen to believe that business uses such as gun shops, pawn shops, building supply centres, exercise studios are the way to do that — a 'mish mash' was my rating.

Furthermore, Mr. Renshaw is correct that the risk assessment studies are complete and the findings judged acceptable by the professionals; and it is widely acknowledged that CXY is a good corporate citizen with a well-run operation which contributes much needed taxes to our economy.

However, the professionals also advise careful community consideration of the land-use adjacent to the plant so that appropriate risk exposures are developed.

Translation: don't put a lot of people next to a chlorine plant.

Again, this requires thoughtful evaluation of each of the business uses in the park.

Lastly, the construction of the Dollarton re-alignment and bridge will require $10 million of our district taxpayers' money. This significant investment deserves the taxpayer's involvement before — not after the fact. Especially when some of the funding options on the table include large townhouse developments east of Seymour, raids on the Heritage fund and new taxes.

So Mr. Renshaw, I think you misconstrued — Asking for "Good Growth" is not the same as shouting "No Growth," which the public hearing transcripts will show was the flavor of the night.

Angela Trudeau
angela@techtrain.bc.ca

Big boxes get yet another no

Dear Editor:

The Coalition for a Healthy Community (CHC) has just learned that Home Depot was refused permission to locate a store at a shopping centre in Victoria, B.C.

The decision even included the word "irrevocable." CHC would therefore like to correct its statement that the North Shore community could be the 64th to "Say NO to big boxes."

We will be the 65th!

Peter Miller
CHC vice-president
West Vancouver

The table below lays out the kind of information about the business uses which I feel would be necessary to evaluate the impact of each in terms of transportation load, risk and economic value to the District.

Re: the meeting content rather than structure: To my minbd, the key purpose of this meeting is public information. Therefore, I would hope that detailed factual presentations would be a major part of the night. Discussion and exchange of ideas should come after that, even if this involves a second night. I say this because one of the significant problems with this project and public opinon of it, is that it s a very complex issue with many inter-related facts. Most people, including myself have pieces of the whole picture, rather than all of it. At the public hearing we got to hear what people's opinions were. Before those opinions can develop/change or approach community consensus, people will need more information.

Also, I hope that the meeting format will provide for the development of more than one 'model' of the business park. I don't believe complete community consensus will emerge from this, although I hope I am wrong. I think that we are heading toward a point where we have two or three very different models of business park and area development and I think it will come down to Council having to select one. The meeting will go much smoother if the format allows for this to happen.

The information I would like to see presented would include:

1. **Presentation by CXY**

- Essentially, this meeting, or a part of it, would/should have been held by CXY. I would like to see a presentation by them be an early part of the meeting, offering the public information about what they are proposing.

2. **Presentation by Planning**

- history of project

CD Zones

- explanation of the development process using CD zones - what happens all the way to completed construction and what public input occurs and when, what is changeable and what is fixed at each stage.

Economic Impact

- DCC's expected
- tax revenue expected - perhaps with an explanation of the economic benefits
- employment creation of different classifications of business

Business park design discussion

- explanation of building design options and standards as compared to other areas or examples of parks
- explanation of green space/unbuilt space portion of lots - fulfillment of expectations for paths, trails and other public areas as expressed by Maplewood comunity association.

Angela Trudeau
Telephone: (604) 929-4367 Fax: (604) 929-7441
e-mail angela@techtrain.bc.ca

- other than road construction and bridge construction - what other District expenditures and budget costs will be required - ie. road upgrading, sidewalks, planning department staff time, infrastructure costs (water,sewer)

Telecommunications

- The District has an agreement with BCTel - does this park receive the advanced telecommunications linkage as well, and is the routing being placed for cabling at the same time?

3. Presentation by Ross Petersen

History of QRA and other risk assessment

explanation of risk assessment and what the results mean. Perhaps some clarification of what risk figures mean compared with other events in people's lives.

discussion of what the public is supposed to do with this information. Also, what is MIACC, how is it applied, and other standrads which are available. What examples or community experiences can he draw on for 'guidance'

emergency planning measure in place and contemplated for this area. Considerations in business park design and business uses.

4. Discussion

Bylaw 7008 - Business Impact Analysis

business use	typical square footage	parking spaces	number of employees	number of customer visits per week	estimated annual municipal tax revenue

Angela Trudeau
Telephone: (604) 929-4367 Fax: (604) 929-7441
e-mail angela@techtrain.bc.ca

Bylaw 7008 - Business Impact Analysis

business use	typical square footage	parking spaces	number of employees	number of customer visits per week	estimated annual municipal tax revenue

Angela Trudeau
Telephone: (604) 929-4367 Fax: (604) 929-7441
e-mail angela@techtrain.bc.ca

COUNCIL AGENDA/INFORMATION		
☐ In-Camera	Date: _____	Item # _____
☐ Regular	Date: _____	Item # _____
☐ Info Package	Date: _____	Item # _____
☐ Agenda Addendum	Date: _____	Item # _____

Dept. Manager	Director	Municipal Manager

The Corporation of the District of North Vancouver

REPORT TO COUNCIL

April 11, 1997
File: 3060-20

AUTHOR: Councillor Ernie Crist

SUBJECT: **Maplewood Area - Dollarton Highway Realignment**

RECOMMENDATION:

THAT

1. staff be requested to provide an update report on the CanOxy/Dollarton Highway Realignment issues in the Maplewood area; and

2. the report contain all relevant background material including the chemical hazard aspects of CanOxy and its implications for the location of a business park and residential development in the Maplewood area, plus the legal aspects pertaining to the agreement with CanOxy in regards to the Dollarton area, as well as projected costs and monies spent so far.

REASON FOR REPORT:

The future of the Maplewood area may be impacted as a result of recent developments such as the CanOxy Dollarton realignment, and the United Properties Housing proposal, plus its impact on traffic and transportation for Seymour, etc. In addition, it is timely to inform the public about past studies in connection with the hazardous chemical industry in that area and to provide all the necessary background material and information for both the public and council's benefit.

Submitted by:

Councillor Ernie Crist

EC/dlh/mlm

xc: Mayor & Council
R.E. Plunkett, Director of Planning & Development Services
R.J. West-Sells, Director of Parks & Engineering Services

COUNCIL AGENDA/INFORMATION		
☐ In-Camera	Date: _____	Item # _____
☐ Regular	Date: _____	Item # _____
☐ Info Package	Date: _____	Item # _____
☐ Agenda Addendum	Date: _____	Item # _____

Dept. Manager	Director	Municipal Manager

The Corporation of the District of North Vancouver

REPORT TO COUNCIL

September 23, 1997
File: 3060-00

AUTHOR: Doug Allan, Senior Development Planner

SUBJECT: PROPOSED MULTI-FAMILY DEVELOPMENT PROJECT-DOLLARTON HIGHWAY

RECOMMENDATION

It is recommended that Council provide direction to staff to either: a) process a rezoning and development permit application for a multi-family residential project at 1984, 1988 and 2012 Dollarton Highway; or, b) defer consideration until the Seymour OCP is sufficiently advanced to provide the necessary land use policy direction.

REASON FOR REPORT

Given that the Seymour OCP review process is scheduled to commence this fall, staff request direction from Council in regard to a proposed development application.

SUMMARY

Staff have received a preliminary multi-family residential development proposal for property located at 1984, 1988 and 2012 Dollarton Highway, adjacent to the Seymour River. This project is consistent with the Maplewood OCP. However, given that the Seymour OCP review (including the Maplewood Area) will commence this fall, staff seek direction from Council as to whether to process the application or defer consideration until such time as the OCP review is advanced to the point where any land use policy changes affecting the subject property are known.

BACKGROUND

The rezoning process for the subject properties began in April 1993 but was deferred until the CanOxy Quantitative Risk Assessment (QRA) report was completed in 1994.

The 1997 updated QRA report shifted the risk hazard contours such that residential development on the subject properties could be considered and as a result, the owners are

now anxious to proceed with the project. However, staff advised that due to the impending Seymour OCP review, Council will have to provide direction on whether to proceed with the application or defer it. Consequently, the owners submitted a preliminary proposal for Council's consideration.

EXISTING POLICY

1. Maplewood OCP: The OCP designates the subject properties as "Residential RM" which includes multi-family housing at densities generally ranging between 12 and 18 units per acre (30-45 units/ha) as shown on Attachment A. Applicable objectives and land use policies include the protection and revitalization of existing residential areas, increasing housing options and provision of waterfront access.

   The lands are also designated as development permit areas for protection of the natural environment, protection of development from hazardous conditions and regulation of the form and character of development.

2. Zoning: The subject properties are zoned Single-Family Residential 6000 Zone (RS4) as shown on the accompanying zoning map (Attachment B).

ANALYSIS

1. The Proposal: The proposal involves the rezoning of three single-family residential properties located at 1984, 1988 and 2012 Dollarton Highway, east of the Seymour River bridge crossing, from RS4 to RM3 and the issuance of a development permit.

   The project consists of a total of 36 strata residential units in two four storey buildings with an interconnecting lounge and lobby area. The units are comprised of 28 two bedroom and den units and 8 three bedroom units approximately 1400 sq.ft. in size. The buildings are designed to step back from the Seymour River and the fourth level is located partially within the roof structure. All residential parking is provided underground and accessed from an internal drive aisle. The buildings are set back 15m (50 ft.) from the top of the existing bank and a 3.7m (12ft.) public walkway is provided within this setback area. A site plan, building elevations and cross-section are appended as Attachment C.

2. Site and Surrounding Area: The treed site is currently occupied by three single-family houses. Surrounding land uses consist of: to the west, two developed single-family (RS4) lots and to the north, a multi-family residential project (RM3). South of Dollarton Highway there are a variety of developed light industrial I3 lots, a former service station site (C3), a mixed commercial/residential complex and single storey commercial uses (C2). An area plan is included as Attachment D.

3. 1997 Updated Risk Assessment - Bovar Concord:

Under the original QRA, the subject properties were situated between the 10^{-4} and 10^{-5} risk contours which, utilizing the MIACC land use guidelines, would prohibit residential uses.

However, under the updated QRA, the risk contours were revised such that the subject lots are now situated between the 10^{-5} and 10^{-6} contours which would permit low density residential according to the MIACC guidelines. Copies of the updated risk contours and MIACC guidelines are included as Attachments E and F.

Options:

Council has two options when considering this preliminary project:

1. Direct staff to process a rezoning and development permit application; or,

2. Advise the owners that the application is premature in light of the impending review of the Seymour OCP.

Doug Allan
Registered Planner
Senior Development Planner

DA/lk
Attachments:
A - Maplewood OCP Map
B - Zoning Map
C - Project Plans
D - Area Plan
E - Updated Risk Contours
F - MIACC Guidelines

REVIEWED WITH:	REVIEWED WITH:	REVIEWED WITH:	REVIEWED WITH:
❑ Communications	❑ Finance	External Agencies:	Advisory Committees:
❑ Env. Protection	❑ Fire Services	❑ Recreation Commission	❑ _____
❑ Human Resources	❑ Legislative Services	❑ Library Board	❑ _____
❑ Eng. Public Works	❑ Land	❑ Health Dept.	❑ _____
❑ Eng. Admin.	❑ Permits & Licenses	❑ RCMP	
❑ Eng. Parks	❑ Planning	❑ Other: _____	
	❑ Social Planning		

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Environmental Groups Call For Phase-Out Of Industrial Chlorine Use Nationwide

- *To*: dioxin-l@essential.org
- *Subject*: Environmental Groups Call For Phase-Out Of Industrial Chlorine Use Nationwide
- *From*: slester@essential.org
- *Date*: Tue, 23 Apr 1996 09:51:01 -0400 (EDT)

Press Release -- For Immediate Release
April 22, Earth Day

CONTACTS
* Dr. Richard Clapp, Epidemiologist, Boston University, 617-638-4731
* Fred Millar, Nuclear Waste Citizens Coalition, 202-547-5796
* Charlie Cray, Greenpeace's Toxics Campaigner, 312-563-6060
* Peter Montague Ph.D., Environmental Research Foundation, 410-263-1584
* Tony Tweedale, Montana CHEER, 406-542-1709
* Hope Sieck, Montana CHEER, 406-542-1919
* Anne Hedges, Montana Environmental Information Center, 406-443-2520
* Darrell Geist, Cold Mountain, Cold Rivers 406-728-0867

Environmental Groups Call For Phase-Out Of Industrial Chlorine Use Nationwide

MISSOULA (MT) An assembly of local, state and national groups today honored Earth Day by calling for a phase-out of industrial chlorine use nationwide. The groups request follows in the wake of one of the nation's worst chlorine accidents.

In the early morning hours of April 11th, a Montana Rail Link train derailed 1 mile west of Alberton, Montana. Five tanker cars filled with industrial chemicals derailed -- including four filled with chlorine. One of the tankers ruptured and reportedly released more than 60 tons of chlorine, sending a toxic plume of chlorine gas across the Clark Fork River, in the path of motorists on Interstate 90 and over surrounding residences.

Approximately 1,000 people were forced to flee their homes. The chlorine plume killed one person and hospitalized 352 people. An 8 to 12 square mile zone in the vicinity of the spill was evacuated.

The chlorine was produced at Georgia Pacific West in Bellingham, Washington and was intended for bleaching pulp and paper at two Georgia Pacific pulp mills in Crossett, Arkansas and Port Hudson, Louisiana.

"This accident and others that have occurred recently worldwide, add increased urgency to the need to a global phase-out of industrial chlorine use," said Charlie Cray, Greenpeace's Toxics Campaigner. "Substitutes currently exist for all major industrial uses of chlorine, including pulp and paper, PVC plastics and solvents."

"We all face a constant danger from the transporting, handling, use and by-products of chlorine -- it is an unnecessary and unacceptable risk," said Darrell Geist of Cold Mountain, Cold Rivers. "We need to go back to what Rachel Carson alerted us to in her book "Silent Spring" -- that there are certain chemicals that are so inherently dangerous that we should not

allow them into our communities."

The community has the right to decide if the use of chlorine and its transport through communities is an acceptable risk we are willing to take. Fred Millar, a consumer advocate with Nuclear Waste Citizens Coalition, and Friends of the Earth's Toxics Campaigner for 15 years, in Washington DC, stated, "People are being kept drastically in the dark about the risk and dangers of the potential for on-going chlorine spills by the very industries that make it, ship it and use it."

The chlorine plume interacted with another spilled chemical (potassium cresylate) to form organic chlorine compounds, including chlorophenols. When released into the environment, chlorine can interact with other compounds and form highly toxic and persistent organochlorine compounds.

"Persistent organochlorine compounds represent a very real and ongoing threat to the health of people and wildlife," according to Dr. Richard Clapp, a professor of epidemiology at Boston University, and advisor to the EPA. "Organochlorines have a whole range of effects, including thyroid and immune disregulation, cancers, endocrine disruption, and are potent reproductive and developmental toxins. Because most persist in the environment and accumulate in fatty tissue, people are exposed to organochlorines, largely via air emissions, deposition and uptake through the food chain."

The spilled chlorine is less than what one local pulp and paper mill brings into the Missoula Valley every week -- almost 100 tons, or more than one rail tanker.

"According to Stone Container's 1994 toxic release forms, 17,300 pounds of chlorine were discharged into the air and over 4,800 tons of chlorine were used to bleach pulp at its Missoula mill," said Hope Sieck of the Montana Coalition for Health, Environmental and Economic Rights. "A chlorine-free mill will significantly benefit worker health, the environment, human health, and the company through reduced regulation, remediation, liabilities and chemical purchasing."

The groups called for an immediate phase-out of industrial chlorine use in the following sectors for which substitutes have been proven effective and affordable: pulp and paper bleaching, refrigerants, most solvents, dry cleaning, PVC/PVDC plastics and pesticides, which account for 75 percent of all chlorine used in Canada and the U.S.

"Phasing out chlorine as an industrial feed stock -- as suggested by the International Joint Commission (on the Great Lakes) -- would solve a large proportion of the world's chemical contamination problems at one fell swoop," said Peter Montague, Ph.D. of the Environmental Research Foundation.

"There's a growing consensus among scientists, policy makers and pollution experts that regulation of certain chemicals in the last decade has failed," said Anne Hedges of the Montana Environmental Information Center. "From PVC plastic to chlorine bleach to solvents, refrigerants and pesticides, chlorine represents one of the biggest hazards in our lives, and should be phased-out once and for all."

The groups calling for a phase-out of industrial chlorine use nationwide are the Montana Environmental Information Center, Montana CHEER, Montana Student Environmental Action Coalition, Montana Ecosystems Defense Council, Montana Chemical Injury Information Network, Montana Public Interest Research Group, Montanans Against Toxic Burning, Native Forest Network, Missoula Valley Improvement Association, Jeannette Rankin Peace Resource Center, Wounded Earth Environmental Project, Friends of the Bitterroot, Friends of the Wild Swan, Voices Of The Environment, Greenpeace International, VOTE Action Committee, The Ecology Center, the Environmental

Research Foundation, Citizens Clearinghouse for Hazardous Wastes and Cold Mountain, Cold Rivers.

-30-

Cold Mountain, Cold Rivers Inc.
Box 7941 Missoula, Montana 59807
Phone & Fax 406-728-0867
cmcr@ism.net

- Prev by Date: **Re: chlorine dioxide**
- Next by Date: **Chlorine dioxide is good for...?**
- Prev by thread: **Dioxin and Diabetes**
- Next by thread: **Chlorine dioxide is good for...?**
- Index(es):
  - **Date**
  - **Thread**

City Council

1998 Council Members List

WARD	NAME AND ADDRESS	BUSINESS AND ADDRESS	TERM
1ST	BOB RYAN 2723 Cedarwood Ave Bellingham, WA 98225 671-1776	Ryan Enterprises 3212 Northwest Ave - Suite C #208 Bellingham, WA 98225 671-0779; 671-0260 (Fax)	1/96 - 12/99
2ND	GENE KNUTSON 1722 Akron Court Bellingham, WA 98226 734-4686	Bellingham Cold Storage 2825 Roeder Avenue PO Box 895 Bellingham, WA 98227-0895 733-1640; 671-1259 (Fax)	1/98 - 12/01
3RD	ARNE HANNA 1158 Grant Street Bellingham, WA 98225 733-7262	Hanna-Hurlbut Auto Sales and Budget Rent-A-Car 1405 Dupont Street Bellingham, WA 98225 671-3800; 671-0299 (Fax)	1/96 - 12/99
4TH	Leslie Richardson 2812 Niagara Bellingham, WA 98226 733-7673	Lynden Travel Agency 523 Front Street Lynden, WA 98264	1/98 - 12/01
5TH	PAT ROWE 407 S. State Bellingham, WA 98225 676-9984		1/96 - 12/99

6TH	Barbara Ryan 621 Canyon View Drive Bellingham, WA 98225 671-8376	Waycross Investment Mgmt. Co. 1326 Commercial Street Bellingham, WA 98225 671-0148; 671-8936 (Fax)	1/98 - 12/01
AT LARGE	LOUISE BJORNSON 2829 Birchwood Bellingham, WA 98225 733-7756		1/98 - 12/99

COUNCIL PRESIDENT: BOB RYAN
COUNCIL PRESIDENT PRO TEMPORE: LOUISE BJORNSON
MAYOR PRO TEMPORE: ARNE HANNA

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RECORD OF PROCEEDING OF CITY COUNCIL
CITY OF BELLINGHAM, WASHINGTON

February 08,1993	Book:	Page:

REGULAR MEETING

MONDAY 07:00 PM

COUNCIL CHAMBERS
CITY HALL

Called To Order The meeting was called to order by Council President, Mark Asmundson. Patricia Decker, Director, of Planning and Community Development, led in a salute to the flag.

Roll Call
Present:

First Ward Councilmember Don Gischer, Second Ward Councilmember Foster Rose, Third Ward Councilmember Arne Hanna, Fourth Ward Councilmember Mark Asmundson, Fifth Ward Councilmember Joy Keenan, Sixth Ward Councilmember Tip Johnson, Councilmember At Large Louise Bjornson

Excused:

ANNOUNCEMENT(S)

City Hall will be closed Monday, February 15 for Presidents' Day; City Council will meet Tuesday, February 16.
Packet deadline for February 22: Wednesday, February 17; 3:00 PM

APPROVAL OF MINUTES

MINUTES of 1/25/93 BJORNSON MOVED, GISCHER SECONDED, the approval of the subject minutes. MOTION CARRIED.

MINUTES of 2/01/93 BJORNSON MOVED, GISCHER SECONDED, the approval of the subject minutes. MOTION CARRIED.

15 - MINUTE PUBLIC COMMENT PERIOD

1. Jeff Pierce, 1101 Harris, essentially, spoke to the great earthquake vulnerability in the area, while expressing concerns over the potential leakage of the gas pipeline into the sewer system and wells testing procedures. He provided reference materials for the record on what natural

gas does when it comes into contact with chlorine gas. Of particular concern, these facilities were adjoined right next to one another.

2. Jo Taber, read a prepared statement into the record, expressing concern for the Georgia-Pacific Plant, specifically chlorine stored in the downtown facility, and the explosion that occurred last week in terms of the potential hazard to the community. Of particular concern, there was a lack of information available to the public when that incident occurred. After calling a variety of local emergency and disaster response people, her understanding was that the City has been "incredibly lucky" in the past. Moreover, if there is a disaster of any magnitude, the City is not prepared to handle it; and, ultimately, there would be fatalities that could cost as much as $2,000,000/lawsuit. She felt the whole issue is something that Council needs to address.

3. Reg Williams, 2636 Franklin, basically, expressed his fond hopes that some day the City would have a Convention Center, which would be "very good business." He felt the Convention Center would do a great deal in making the Arts Center successful. He was very concerned over the use of Convention Center funds for other purposes.

4. Linda Ruff, addressed a "cheaper" alternative to the Arts Center proposal. In short, she asked that the City consider constructing a wooden shelter adjacent to the bus station for approximately 150 vendors like Pioneer Market for a classification of art in downtown Bellingham. She felt it was a waste of money to spend much more than $100,000.

5. Dorothy Dale, basically, supported the comments made by Joe Taber attesting to the lack of satisfactory information as the available to the public during the latest incident at Georgia-Pacific. In essence, she hoped there would be more effort city-wide on needed safety procedures.

6. Christina Cline, 2913 Broad Street, initially, asked for a show of hands from people present who were interested in the issue of safety in Bellingham. She asked if the matter could be placed on the agenda as a special issue. In response, Mayor Douglas expressed his willingness to meet with any group that wishes to discuss both that incident and safety procedures in place. Chair Asmundson agreed that was the place to start, as did Councilmember Johnson. However, if that does not prove satisfactory, Councilmember Johnson explained the process for placing the matter on the Public Safety Committee to ensure Council's review of these concerns.

7. Mitch Freedman, emphasized that the issue is not the lack of information but rather that the chlorine plant has no business being downtown. No emergency procedure would come close to assuring safety and the profile on this issue needs to be raised. Chair Asmundson responded.

PRESENTATION(S)

AB10578 1. SITE FOR NORTHWEST CENTER FOR ART: STAFF RECOMMENDATION TO PURCHASE THE NORTHERN BUILDING

Upon introductory comment, Patricia Decker, Director of Planning and Community Development, was called upon for the staff presentation. To begin with, she distributed packets of information to members of the audience

(refer to Attachment 1). To summarize, Ms. Decker then walked through the presentation, elaborating on the steps leading to the staff recommendation for acquisition of the Northern Building, former Levin's Warehouse (Exh A); the specific features of that site; and finally, the estimate of value and the negotiated price (Exh B).

In the second place, Steve Price, Manager, Community Development, walked through the specific components and a Pro Forma Work Sheet (Exh C) and Pro Forma Assumptions (Exh C-1). Moreover, they discussed the comparison between the Northern Building site and the site of the Maritime Heritage Center behind the Whatcom Museum (Exh E) and expenditures to date (Exh D). In closing, they reviewed the overall project schedule and staff recommendation (Exhibit F) for Art Center design and construction time line.

Of specific interest, the Northern Building, of historical significance, located at 1125 to 1131 Railroad Boulevard, was built in 1913 for use by the Washington Grocery Company. The 4-story building contains approximately 44,000 square feet of usable space and is in good structural condition, providing for ease of renovation. Its significant size allows for additional City goals in terms of downtown housing. In 1928, the Northern Grocery Company began operating from the building. In recent years the structure was owned and used by the Levin's Furniture Company. Most recently, the structure was purchased by Jim Talbot for development as office space and ground floor retail. Moreover, he has performed the demolition and essentially removed all the outdated materials.

On the whole, the building has great community visibility and is located on a major arterial with excellent transportation access, close to the transit facility and immediately adjacent to a major trail system on Railroad. Staff believes the purchase price of $712,500 negotiated with the owner represents a fair and reasonable offer compared to an MAI appraisal of $698,000, approximately 2% lower than the negotiated price. There has been an engineering study already performed on the structural integrity of the building, which adds to the value to the appraisal beyond the negotiated price. The terms call for cash on the closing date of March 15, 1993. In addition to the building, a 30-car parking lot has been included in the acquisition across the alley on Chestnut.

In developing their factual analysis, staff maintains that the Northern Building site would provide the City with a number of advantages, particularly, for an Art Center compared to the Maritime Heritage site, as follows:

1. The proposed project would allow for the renovation and use of a currently vacant and historic building, which is a policy direction in the Comprehensive Plan and an objective of the visions for Bellingham process.

2. The renovation of this building would further the implementation of the City's Downtown Development Strategy.

3. The renovation could serve as incentive and encouragement to other redevelopment plans in the area and follows along a tradition in downtown for

Council Member Hall reported that he attended several meetings and mentioned that the Parking Commission will be coming forward with new ideas in the near future, as well as the Parks Advisory Board and the issue of skateboards. He also mentioned a memo from the Mayor to the Finance Director regarding a four percent increase in a CPI figure from last year.

Don Keenan, Deputy Mayor, stated that the Seattle metropolitan area, as compared to the United States as a whole, has a substantially higher cost of living than other areas of the country.

Council Member Hall commented on the criminal justice subject and stated that he heard a news commentary on KGMI Radio that relayed information of certain counties back east charging criminals a set price per day by garnishing their wages.

Council Member Hanna stated his support of this concept.

Some discussion was held concerning the recent Bellingham Herald editorial that suggested that City Council should consider bi-weekly meetings. President Rowe reported that the Mayor is looking into this subject and will report back to Council on this possibility.

Council Member Ayers commented that the press is absent and could have reported on issues here tonight, noted that it is not the meetings that are the problem and that he does not support bi-weekly meetings. He further noted that the County Council has communication breakdowns caused by meeting bi-weekly. Ayers feels that increasing the legislative staff to assist Council Members in obtaining information would make a significant difference.

Council also discussed the possibility of limiting public meetings to 30-minutes. President Rowe mentioned that he is opposed to imposing a 3 minute time limit on speakers.

Council Member Knutson stated his support of a 3-5 minute limit when a large number of people (20-30) appear to speak on a subject.

Some discussion followed on the subject of sign-up sheets; Ayers supports; Bjornson opposes.

President Rowe stated that most people who appear at a Council meeting do so maybe one time in their entire life. He acknowledges the need to limit speakers to 5-minutes at large public hearings. However, he is opposed to stringent guidelines that may result in a citizen having a negative experience before Council.

ADJOURNMENT

There being no further business, the meeting adjourned at 9:40 PM.

Pat Rowe, Council President

ATTEST:

Finance Secretary

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Environmental Health Center

Environment Writer

Chlorine (Cl2) Chemical Backgrounder

Description:

Chlorine is a greenish-yellow gas with a pungent, irritating odor. It is used to bleach fabrics, to purify water, to bleach woodpulp and paper, to disinfect, to clean dairy equipment, to control biofouling in cooling systems, to shrink-proof wool, and to detin and dezinc iron. It is used for sterilization for root canals, tooth extractions, irrigations, or wounds.

It is also used in the manufacturing of pesticides, antifreeze, refrigerants, antiknock compounds, plastics, and resins.

It is used in the manufacturing of synthetic rubber and plastics, chlorinated hydrocarbons, polyvinyl chloride, ethylene dichloride hypochlorous acid, chlorobenzene, chlorinated lime, carbon tetrachloride, ethylene and propylene oxides, glycols, trichloroethylene, perchloroethylene, chloroform, vinylidene chloride, polychloroproprene, hydrogen chloride, metal chlorides, chloracetic acid, chloral, synthetic glycerine, methyl chlorides, chlorinated benzenes, tetraethyl lead, fluorine compounds, titanium tetrachloride, monochloroacetic acid, phosgene, chloroisocyanuric acid, phosphorus chloride dichlorobutene, and chlorinate paraffins.

Chemical properties:

Chlorine is corrosive to some forms of plastics, rubber, and coatings. It is soluble in chlorides, alkali, and alcohols. It combines readily with all elements except the rare gases, excluding xenon, and nitrogen. It reacts explosively or forms explosive compounds with many common substances such as acetylene, ether, turpentine, ammonia, fuel gas, hydrogen, and finely divided metals. It is a noncombustible gas, and a strong oxidizer.

Chlorine is heavier than air, and less water-soluble than ammonia. Water dissolves about twice its volume of chlorine gas, forming a mixture of hydrochloric and hypochlorous acids.

Synonyms for chlorine are chlorine gas, chlorine water, molecular chlorine, javelle water, and NaOCl.

Health effects:

Chlorine exposure occurs through inhalation, or skin or eye contact. Exposure can cause burning of eyes, nose, and mouth; lacrimation and rhinorrhea; coughing, sneezing, choking, and substernal pain; nausea and vomiting; headaches and dizziness; syncope; fatal pulmonary edema; pneumonia; conjunctivitis; keratitis; pharyngitis; burning chest pain; dyspnea; hemoptysis; hypoxemia; dermatitis; and skin blisters.

When inhaled in high concentrations, chlorine causes emphysema and damage to the pulmonary blood vessels. Chronic exposure can cause corrosion of the teeth. Cardiac arrest may occur secondary to hypoxia.

Inhalation of small amounts of chlorine causes few or no symptoms. In larger amounts, it is a powerful irritant to the mucous membranes of the eyes, nose, and throat.

Exposures of 1-3 ppm can cause mild mucous membrane irritation; 5-15 ppm, moderate irritation of upper respiratory tract; 30 ppm, immediate chest pain, vomiting, dyspnea, and cough; 40-60 ppm, toxic pneumonitis and pulmonary edema; 430 ppm, lethal over 30 minutes; and 1,000 ppm, death within a few minutes. Death is possible from asphyxia, shock, reflex spasm in

the larynx, or massive pulmonary edema.

Populations at special risk from chlorine exposure are individuals with pulmonary disease, breathing problems, bronchitis, or chronic lung conditions.

Economics:

The production volume of chlorine in 1995 was 25.09 billion pounds, which ranked tenth in the production volumes of the country's top 50 chemicals. Production volume in 1994 was 24.37 billion pounds, which ranked ninth that year.

U.S. manufacturers of chlorine are Amax Inc., Rowley, UT; Dow Chemical USA, Pittsburg, CA, and Plaquemine, LA; Akzo America, Inc., Le Moyne, AL; Bayer USA Inc., Baytown, TX; E.I. DuPont de Nemours & Co., Inc., Niagara Falls, NJ; Formosa Plastics Corp. USA, Baton Rouge, LA; Fort Howard Corp., Green Bay, WI, and Muskogee, OK; General Electric Co., Burkville, AL, and Mount Vernon, IN; Georgia Gulf Corp., Plaquemine, LA; Georgia-Pacific Corp., Bellingham, WA, and Brunswick, GA; B.F. Goodrich Co., Calvert City, KY; Hanlin Group, Inc., Acme, NC, Ashtabula, OH, Brunswick, GA, Moundsville, WV, Orrington, ME, and Syracuse, N.Y.;

La Roche Holdings, Inc., Gramery, LA; Niachlor, Inc., Niagara Falls, NY; Occidental Petroleum Corp., Covent, LA, Corpus Christi, TX, Deer Park, TX, Delaware City, DE, La Porte, TX, Mobile, AL, Muscle Shoals, AL, Niagara Falls, NY, Tacoma, WA, and Taft, LA; Olin Corp., Augusta, GA, Charleston, TN, McIntosh, AL, and Niagara Falls, NY; Oregon Metallurgial Corp., Albany, OR; Pennwalt Corp., Portland, OR, and Tacoma, WA; Pioneer Chlor Alkali Co., Henderson, NV, and St. Gabriel, LA; PPG Industries, Inc., Lake Charles, LA, and Natrium, WV; RMI Co., Ashtabula, OH; Titanium Metals Corp. of America, Henderson, NV; Trans Resources Inc., Vicksburg, MS; Vulcan Materials Co., Geismar, LA, Port Edwards, WI, and Wichita, KS; and Weyerhaeuser Co., Longview, WA.

Regulation:

The Occupational Safety and Health Administration (OSHA) has set a permissible exposure limit, time-weighted average, for chlorine of .5ppm (1.5 mg/m3); short-term exposure limit is 1 ppm (3 mg/m3).

Chlorine is regulated under the Clean Water Act; Emergency Planning and Community Right-to-Know Act; Clean Air Act; Comprehensive Environmental Response, Compensation, and Liability Act; and Federal Insecticide, Fungicide, and Rodenticide Act.

Under the Emergency Planning and Community Right-to-Know Act, releases of more than one pound of chlorine into the air, water, and land must be reported annually and entered into the Toxic Release Inventory (TRI). In 1994, 60,432,224 pounds of chlorine were released by 1,449 facilities. Of those releases, 60,357,013 pounds were released into the air, water, and land; those releases ranked 11th of the TRI's top 50 chemicals with the largest air, water, and land releases.

Releases of chlorine in 1994 represented a 20.6 percent decrease in releases from 1993's total of 76,154,785. That decrease was the third highest of the TRI's 343 chemicals and 22 chemical categories. Releases in 1994 also represented a decrease from 1992 (87,411,253 pounds), and 1988/baseline (141,426,877 pounds).

In 1994, 1,276,642 pounds of chlorine releases were fugitive or nonpoint air emissions; 58,502,168 pounds were stack or point air emissions; 516,005 pounds were surface water discharges; 74,311 pounds were released by underground injection; and 63,098 pounds were released to land.

In 1994, 2,833,114 pounds of chlorine were transferred to recycling; 4,310 pounds were transferred to energy recovery; 345,447 pounds were transferred to treatment; 883,757 pounds were transferred to publicly owned treatment works; 15,133 pounds were transferred to disposal; and 5,005 pounds were transferred off-site.

According to EPA waste management information, in 1994, 85,515,731 pounds of chlorine were recycled on-site; 2,832,062 pounds were recycled off-site; 1,303,170 pounds were used for energy recovery on-site; 4,809 pounds were used for energy recovery off-site; 216,618,766 pounds were treated on-site; 1,165,675 pounds were treated off-site; and 60,418,267 pounds were released or disposed of.

In 1994, the 10 states in which the largest amounts of chlorine were released were Utah (50,456,113 pounds); Illinois (3,660,302 pounds); Louisiana (1,365,169 pounds); New York (1,283,219 pounds); Arizona (1,081,489 pounds); Texas (959,472 pounds); Minnesota (691,525 pounds); North Carolina (555,676 pounds); Washington (415,575 pounds); and Alabama (394,409 pounds).

In 1994, the 10 facilities which released to largest amounts of chlorine were Magnesium Corp., Rowley, UT (50,150,000 pounds); Cabot Corp., Tuscola, IL (3,525,584 pounds); Photocircuits Corp., Glen Cove, N.Y. (1,173,764 pounds); Arkansas Steel Assoc., Newport, AR (973,659 pounds); Dow Chemical Co., Freeport, TX (335,002 pounds); Western Zirconium, Ogden, UT (300,250 pounds); Martin Mills, Inc., Saint Martin, LA (292,000 pounds); Advance Circuits, Inc., Roseville, MN (283,600 pounds); Kaiser Aluminum, Spokane, WA (218,800 pounds); and Advance Circuits, Inc., Minnetonka, MN (216,755 pounds).

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Environmental Health Center
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National Safety Council

July 1, 1997 | Disclaimer/Policy

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VIEWP

Chlorine stink

The folks who run our neighborhood friendly chlorine plant are responsible people.

Canadian Occidental Petroleum Ltd. has, in the past 10 years, demonstrated a willingness to environmentally clean up its site, involve the public in community safety issues and offered this newspaper plant access that was not always so easily obtained.

But the company operates an older plant by industry standards and production volume is fixed by new safety measures. Not surprisingly, it would like to take advantage of the value in its land, especially if that land can be zoned to a more lucrative commercial designation.

A financial deal was struck with North Vancouver District to realign Dollarton Highway to the benefit of both parties' land assembly plans.

We won't debate whether this might appear to prejudge the outcome of any rezoning application.

We won't debate whether, after two years of safety studies, the public is being told up front that the same amount of chlorine is still on site — it's just in rail cars, not storage tanks.

We won't debate why land uses forbidden under a previous zoning application "until such time as the plant is permanently closed" are now allowable because the plant is safer.

We won't debate council's choice to press ahead with major rezoning in Seymour at the very time that the area's Official Community Plan is being created.

But you should.

Tuesday, March 31, 7 p.m. at District Hall.

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Last updated: 24 March 1998 at 11:00 p.m. CST.

Junk Science: An Epidemic that Hurts Us All

an interview with Steven J. Milloy

Public health expert Steven J. Milloy is executive director of The Advancement of Sound Science Coalition (TASSC) and publisher of the Junk Science Home Page (http://www.junkscience.com). He is the author of several books and reports, including *Choices in Risk Assessment: The Role of Science Policy in the Environmental Risk Management Process*, a widely acclaimed publication that resulted from his work for the U.S. Department of Energy examining the relative roles of science and policy in regulatory risk assessment.

Mr. Milloy frequently discusses junk science on radio and television; has testified on risk assessment and Superfund several times before the U.S. Congress; and has testified and lectured on risk assessment before such diverse groups as the U.S. Department of Energy, the U.S. Environmental Protection Agency, the National Institute of Medicine, the American Bar Association, and the Manhattan Institute.

Mr. Milloy holds a B.A. in Natural Sciences from The Johns Hopkins University, a Master of Health Sciences in Biostatistics from The Johns Hopkins University School of Public Health, a Juris Doctorate from the University of Baltimore, and a Master of Laws from the Georgetown University Law Center.

Cohen: *What is junk science?*

Milloy: To paraphrase what Supreme Court Justice Potter Stewart said about obscenity in *Jacobellis v. State of Ohio* in 1964, "I can't define junk science, but I know it when I see it." Junk science is usually what we read about in newspapers or hear about in the news. Junk science is scientific information, data, or analyses that is blatantly over- or incorrectly interpreted to further some agenda.

It is important to realize that most science is not junk science. But what junk science lacks in quantity, it makes up for in impact on our daily lives.

Cohen: *Who are the chief practitioners of junk science?*

Milloy: "Junk science" is used by lawsuit-happy trial lawyers to fuel specious personal injury lawsuits; by the "food police" and environmental Chicken Littles to advance extreme social and political agendas; by power-drunk government bureaucrats to increase regulatory authority; by cut-throat corporations to undercut their competitors or sell bogus products; and by unethical-to-dishonest scientists in the quest for fame and fortune.

Cohen: *Why should people be concerned about junk science?*

Milloy: Junk science hurts all of us. For example, junk science has deprived all of us of our right to make health care choices. In 1997, the most-effective over-the-counter laxative ingredient (i.e., phenolpthalein) was taken off the market because of an unfounded fear of cancer risk. And morbidly obese individuals were denied the use of the most effective diet drugs based on

sketchy data.

Junk science also steals public health resources. Just last year, EPA promulgated new air quality standards that are the most expensive environmental regulation in history. Those standards are based on junk science. American businesses and consumers will be paying more than $100 billion a year to implement these standards, and many other public needs will have to go unfilled.

During congressional hearings into the proposed air quality standards, Dr. Christopher Grande, an emergency room physician and executive director of the International Trauma Anesthesia and Critical Care Society, testified that the proposed standards represented "the latest raid on our scarce public health resources."

Cohen: *What is the m.o. of the junk scientist?*

Milloy: Here are some tips for spotting junk science. First, watch out for the "one-study wonders." "Study shows laxatives cause cancer." "Selenium prevents cancer new study says." Can these headlines be right? Not likely. No one study proves anything. Science is not a quick-and-dirty one-study endeavor. Scientific knowledge is gained slowly and incrementally over time.

Also be wary of "science by press conference." Science occurs in laboratories, not in press conferences or newsrooms. Simply put, headlines ain't science. Dan Rather, Peter Jennings, and Tom Brokaw read scripts off teleprompters; they aren't Nobel laureates. The *Washington Post* and *New York Times* are newspapers, not peer-reviewed science journals. *60 Minutes* is television entertainment, not a science-on-video series.

Look for claims of "causation." Junk scientists love to say that one thing "causes" another. But causation is usually more complex than a junk scientists would have you believe.

Body counts are another red flag.. Smoking kills 400,000 people every year. Obesity kills 300,000. Air pollution kills 60,000. "Body counts" and other population risk numbers scream out "I AM JUNK SCIENCE!"

Finally, watch out for mathematical models. Many junk scientists try to use computer-based mathematical modeling to predict how systems will react under various conditions. Depending on the complexity of the system, modeling may work to some degree. The problem, however, is that some modelers think they can model anything, regardless of its complexity.

The best ongoing example of modeling gone awry is global climate change. Things like global climate, ecosystems, and higher-order living organisms (like humans) are probably too complex to be represented by mathematical equations.

Cohen: *How pervasive is junk science? Is it on the increase?*

Milloy: Junk science is everywhere. Its "success" has caused an epidemic of bad science. From courtrooms, to advocacy groups like the Center for Science in the Public Interest and the extreme environmental groups, to regulatory agencies, to the White House, to formerly respected groups like the American Lung Association, American Heart Association, and American Cancer Society, junk science has become a way of life.

Cohen: *During the recent debate over the new air quality standards, EPA Administrator Carol Browner was often accused of pushing junk science. In your view, was this allegation justified?*

Milloy: Carol Browner pushed through the most expensive environmental regulation ever adopted in the U.S., and it was based on the weakest, most exaggerated "science" I can think of. Calling it "junk science" is almost too kind. EPA was so vulnerable on the science on this rule--and knew it--that it refused to release for independent review the data underlying the studies that were used to support the new standards. Unfortunately, Congress was too scared of EPA to make a big deal about it.

Cohen: *In addition to the new air quality standards and global climate change, could you cite a couple of other examples of junk science?*

Milloy: The recent hysteria about "environmental estrogens"--so-called manmade chemicals in the environment that allegedly disrupt hormonal systems, causing everything from infertility to cancer to attention deficit disorder--is a travesty. In 1996, a study by Tulane University scientists claimed that combinations of pesticides were very potent environmental estrogens. Congress then passed a law mandating that EPA test for these chemicals. One year later, the Tulane study was retracted by its authors because the results could not be duplicated in any other lab in the world. Study gone; law stayed.

A case of junk science to watch carefully is the ongoing controversy over the diet drug combination fen-phen. The drugs were forced off the market by the FDA based on very preliminary and not strikingly scientific information that users were developing valvular heart disease. New data have since emerged casting doubt on the link between the drugs and heart disease. In the

meantime, personal injury lawyers have filed numerous class action lawsuits.

Cohen: *It appears that junk science has found a comfortable home in the federal regulatory structure. What is its role in the courtroom?*

Milloy: Junk science is the bread-and-butter of personal injury lawyers. In the silicone breast implant litigation, the lawyers stand to earn a good chunk of a tentative $4 billion settlement. The fen-phen litigation is potentially even greater, as millions more people have used fen-phen than have had silicone breast implants.

Cohen: *How does The Advancement of Sound Science Coalition fit into the battle against junk science?*

TASSC's sole purpose is to combat junk science and promote the use of sound science in public policy. Its membership includes scientists, academicians, former public officials, and representatives from business and industry . . . as well as everyday Americans who are concerned about the growing influence of junk science.

TASSC sponsors the Junk Science Home Page (http://www.junkscience.com), which helps inform public officials, the media, and the general public about the consequences of inappropriate science. TASSC also recently sponsored a Global Warming Sweepstakes, in which people who submitted their views on the climate change treaty to President Clinton were entered into a random drawing for $1,000.00. Through these activities, and by publishing reports and commentaries, TASSC is actively and aggressively challenging junk science and its pushers.

For more information about The Advancement of Sound Science Coalition, write to 1155 Connecticut Avenue NW #300, Washington, DC 20036; phone 202/467-8586; fax 202/467-0748. Mr. Milloy can also be reached by email at milloy@cais.com.

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- Important Notice -

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The Air & Waste Management Association's (A&WMA) online publications provide information on environmental science, research, and policy issues. They are the Association's primary method of fulfilling its stated purpose: to enhance environmental knowledge by providing quality information on which to base environmental decisions.

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The Air & Waste Management Association maintains editorial and executive offices at:
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Return to A&WMA Homepage

CHLORINE

Other names

Liquefied Chlorine

Molecular formula

CL_2

Physical properties

Relative Vapour Density (air = 1) (20°C):	2.50
Vapour Pressure (20°C):	666 kPa
Specific Gravity (liquid) (-35°C):	1.56
% Volatile by Volume:	100
Flammability Limits (%):	N App
Solubility in Water (20°C):	0.7%
Boiling Point:	–34.0°C

Chlorine is greenish yellow gas/amber liquid with pungent and irritating odour.

The product is very slightly soluble in water and is soluble (decomposes) in alkalis.

Chlorine reacts explosively or forms explosive compounds with many common chemicals, especially acetylene, turpentine, alcohols, anhydrous ammonia, fuel gas, hydrocarbons, oil, hydrogen, and finely divided metals. It becomes corrosive if mixed with water and reacts with iron if heated above 100°C.

End uses

Most of the chlorine produced in Australia is used in the manufacture of other chemical products.

ICI Australia produces approximately 100,000 tonnes of chlorine per annum with the single biggest use (almost half) being the manufacture of vinyl at its petrochemical complex at Botany, New South Wales. Other chemical products produced using chlorine as a feedstock include hydrochloric acid (for steel pickling and food processing), sodium hypochlorite, for use as a bleach for domestic cleaning purposes, in swimming pools as a sanitiser and in the manufacture of Cereclor (Trade Mark) (made by adding chlorine to paraffin oil or melted paraffin wax). Cereclor is an additive for lubricants, plasticisers in plastics and rubbers and as a flame retardant in paints.

Other major uses for chlorine in industry include:

- **Purification of water**
  The chlorination of potable water to kill harmful micro-organisms is extensively used, both in Australia and overseas, as an effective measure to protect public health.
- **Disinfection of sewage effluent**
  Chlorine is used to destroy or control harmful bacteria.
- **Treatment of industrial cooling waters**
  Chlorine prevents the formation of bacterial slimes on heat exchange surfaces and on filters.

- **Bleach for paper manufacture**

  Chlorine is used in the pulp and paper industry to prevent discoloration during storage or exposure to sunlight. It also maintains the structure and strength of paper and improves its capacity to absorb water. Chlorine is used in conjunction with other chemicals to produce high quality pulp necessary for the manufacture of printing and photocopy papers.

Depending on the volume consumed by the customer, chlorine is supplied in 70kg, 900kg or 12 tonne containers.

Production process

Chlorine was discovered by the German chemist Scheele in 1774 and identified as an element by the English scientist Davy in 1810.

Older production processes involved oxidation of hydrogen chloride, usually with air. An example is the Deacon Process:

$$4HCl + O_2 = H_2O + 2Cl_2$$

Hydrogen chloride + air = water + chlorine

In this process, copper chloride was used as a catalyst, to assist the reaction.

Modern methods of manufacture use electrolysis, the process of converting ions into elements by means of an electric current. The process can still be called an oxidation, since the negative charge on the chlorine ion is removed by causing it to come into contact with the anode of the cell.

The process of electrolysis requires:

- Electrodes: anode and cathode
- Solution (or molten salt): electrolyte
- Electric current: direct current

The electrodes and electrolyte are called a cell.

In the electrolysis of salt (passing an electric current through a saturated solution of salt (brine)) chlorine, caustic soda and hydrogen are produced in the fixed chemical ratio of 1/1.13/0.028. This is called an Electrochemical Unit (ECU).

These products can be produced by a variety of different manufacturing technologies although all accomplish the same overall chemical reaction, which basically splits sodium chloride (salt) into its component parts of sodium hydroxide and chlorine.

At ICI Australia, two technologies are being utilised:

- At Botany, New South Wales and Yarraville, Victoria, the mercury cell process is used and, in this instance, saturated brine travels down a steel trough approximately 15 metres long and one metre wide between a flowing film of mercury (the cathode) and platinised titanium plates (the anodes). Direct current is applied between the anode and cathode. Chlorine liberated at the anodes collects above the brine and is led off as a hot, wet and corrosive gas.

  Sodium ions are discharged at the surface of the flowing mercury cathode, forming an amalgam of low concentration with the mercury, which flows out of the cell without reacting with the water or chlorine.

  The mercury cell thus has two products:

  (a) Hot, wet chlorine; and

  (b) Sodium amalgam.

- The soda cell or decomposer, is a cylindrical steel trough filled with graphite balls or graphite electrodes. The sodium amalgam is passed, along with pure water, into the decomposer, where it reacts to produce sodium hydroxide as a controlled 50% aqueous solution and hydrogen gas, liberating

free mercury which is recycled back to the electrolytic cell. The graphite provides a surface that facilitates this reaction.

The two parts are often referred to as the brine cell, and the soda cell.

The reactions in the mercury cell are:

Brine Cell:

$2Cl^- =$ $Cl_2 + e$

$Na + e =$ Na

$Na + Hg =$ Na/Hg
(Sodium amalgam)

Soda Cell:

$2\ Na/Hg + 2\ H_2O =$ $2NaOH + H_2 + 2\ Hg$
(Caustic Soda) + (Hydrogen) + (Mercury)

Chlorine from the cells is then cooled, dried, (using concentrated sulphuric acid) compressed and sent either as cell gas to other chemical manufacturing operations on the site (e.g. in the manufacture of vinyl) or to chlorine liquefication for compression into cyclinders for sale to a large number of industrial end markets.

The Yarwun, Queensland plant utilises membrane cell technology.

This operates with perfluorinated ion exchange membranes and allows the operation of electrolytic cells which produce high strength caustic at a low operating voltage.

In the membrane cell, charge transport occurs by the selective movement of sodium ions across the membrane from anolyte to catholyte. There is no bulk flow of liquid across the membrane.

Because the membrane is impermeable to chloride or hydroxyl ions, the anolyte does not become basic (alkalinity promotes oxygen evolution and anode coating loss) and the caustic product remains uncontaminated by chloride ions.

The anolyte chamber is made of titanium and the catholyte chamber is made of nickel. These metals are used since they resist the effect of the chemicals produced and do not contaminate the product.

The normal working life of the anode and cathode coatings varies from three to six years.

Energy consumption

From Faraday's law, electrolysis is defined as the decomposition of an inorganic compound by passing an electric current through it.

To determine the unit of electric charge (coulomb) the charge on one mole of electrons, the following calculation is used.

1 mole of electrons = 6.0220×10^{23} electrons

Charge on 1 electrons= 1.6022×10^{-19} coulombs

1 Faraday= $6.0220 \times 10^{23} \times 1.6022 \times 10^{-19}$

= 96485 coulomb

For every tonne of chlorine generated, 755.98 KAhr of electricity is required. To determine the DC (Direct current) energy usage at 100 per cent efficiency, the formula is:

$$P = 7.5598 \times 10^6 \quad \frac{V}{n_i n_c}$$

Where n_i is the current efficiency in the manufacture of chlorine.

n_c is the conversion efficiency from alternating to direct current.

The most efficient decomposition voltages for sodium chloride across each mercury cell are in the range of 3.1–3.7 volts.

At the Yarwun plant the voltage across each membrane cell is in the range of 3.2–3.7 volts.

Electricity is the single biggest input cost in the manufacture of chlorine. Consequently there is a major effort to ensure that the manufacturing process is operating efficiently.

With chlorine production via the mercury cell process, electrical power consumption is kept to a minimum by:

- Ensuring the brine is as pure as possible. Impurities increase the amount of hydrogen formed which reduces current efficiency.
- Ensuring the brine flow is correct. Too high a brine rate decreases the cell temperature (range 70–80°C Celsius) and hence the electrical conductivity of the brine. Alternatively, too low a brine rate leads to excessive temperatures thus causing very high cell voltages. The most efficient voltage across each cell is in the range of 3.1–3.7 volts.
- Ensuring that the anodes are correctly adjusted. If the anodes are set too high, the cell voltages will be higher than necessary, wasting power. If the anodes are set too low, the sodium and chlorine tend to recombine, thereby wasting the electric power needed to separate them. The coating on the titanium anodes gradually wears away which increases the voltage and the level of hydrogen. These are replaced at predetermined levels for recoating.
- Ensuring that all electrical contacts are clean and tight to avoid an increase in the electrical resistance and a power wastage through heat.

Electrical power consumption in the membrane cell process is minimised by:

- Ensuring the brine is very pure. This means less than 50 parts per billion (ppb) levels of hardness (Ca Mg) as they block the passage of Na through the membranes. Other trace elements can also cause a similar affect.
- Ensuring that the brine and catholoyte flows leaving the cell are kept hot (87°C).
- Ensuring that the electrical contacts are clean and tight.

Waste management during manufacture

The Management of waste occurs at different stages during the production process.

The first occurs with the purification of salt supplied to the factory.

These impurities include calcium, magnesium, sulphate and trace metals. The amounts vary from shipment to shipment and can cause production inefficiencies. For example, the presence of magnesium will cause a high level of hydrogen, whereas calcium can cause deposits of calcium sulphate and thickened mercury.

These impurities are removed by adding calcium chloride, sodium carbonate and sodium hydroxide to the brine. A flocculating agent (eg Alfloc) is also added to assist in the formation of a good, rapid settling floc. The sludge containing these impurities is then removed.

Mercury is an essential part of the mercury cell process and stringent steps are taken to control and minimise the mercury usage during chlorine manufacture.

Different techniques are used to recover the traces of mercury from the three products chlorine, caustic soda and hydrogen.

Mercury entering or leaving the cell is washed with filtered water to remove any impurities that may be present. This water is then passed through a special mercury trap where the mercury is recovered.

Following their manufacture, the chlorine and hydrogen gas is cooled to form a condensate. Any mercury vapour contained in these gases is then drained from the condensate receiver and returned to the cells. The chlorine condensate is returned to the brine circuit. The hydrogen condensate is then used as a supply feed for caustic soda production which occurs in a separate cell (the denuder). This is filled with graphite balls. The water which has been used to wash the mercury is itself passed through this denuder together with the sodium amalgam where pure mercury is collected and once again passed to the cells.

Quality control during manufacture

An integral part of the overall production process is the emphasis placed on quality control testing. A wide range of tests are conducted on the raw material (salt), the intermediate solution (brine) and the products (chlorine, sodium hydroxide, sodium hypochlorite and hydrochloric acid) of the chlor-alkali process. These tests are carried out by "in-line" instruments, plant operators and the laboratory. Analytical techniques employed include:

- Titrations (eg alkalinity of caustic soda)
- Atomic absorption spectrophotometry (eg calcium and magnesium in brine)
- UV-Visible spectroscopy (eg sulphate in brine and iron in caustic soda)
- Ion selective electrodes (eg chloride in water and products)
- Gravimetric analysis (eg moisture content of chlorine is monitored using a gravimetric technique involving absorption of moisture on magnesium perchlorate). The presence of nitrogen trichloride is determined by converting to ammonia, and measurement by UV-Visible spectroscopy via the Nessler method.
- Gas chromatograph (measuring hydrogen and oxygen levels in chlorine).

Personnel

There are a range of careers associated with the production of chlorine. These include:

Production

- Chemical plant operators

Production Support

- Engineering:

  chemical, mechanical, electrical, civil

- Laboratory:

  laboratory technicians, chemists

- Administration:

  general management, quality management, accounting, purchasing, human resource management, safety officer, occupational health nurse, typing and secretarial, computing, training

- Maintenance:

  mechanical trades, instrument/electrical technicians

- Transport/stores:

  drivers, storemen

- Sales/Marketing

  sales representatives

Some of these jobs may be provided by "contract labour", consultants etc depending upon the complexity, duration and extent of the work to be performed.

Handling

Storage and transport

Chlorine is classified as a 2.3 (POISONOUS GAS) and 5.1 (OXIDIZING AGENT) Dangerous Substance for the purpose of transport. Refer to relevant regulations for storage and transport requirements.

This material is a Scheduled Poison (S7) and must be stored, maintained and used in accordance with the relevant regulations.

The product is a corrosive, compressed gas. Consequently, avoid thermal and physical shock. Chlorine must be stored away from sources of heat and away from combustible materials, oxidising agents and foodstuffs. Cylinders are to be stored securely in upright position and should be checked regularly for leaks.

Spills

In the event of a spill, clear area of all unprotected personnel and evacuate personnel from downwind areas. Increase ventilation. Wear full protective equipment to prevent skin and eye contamination and inhalation of vapours. Stop leak if possible by closing valves. (Leaks can be detected by using dilute ammonia solution).

Gas

For a small gas leak, increase ventilation and allow gas to vent in safe area. Otherwise use fire hoses equipped with fog nozzles to disperse gas downwind. DO NOT spray water directly on the leak or chlorine container. Alert emergency services.

Liquid

Large volumes of gas will evaporate from liquid spill. Contain using sand and earth–prevent runoff into drains and waterways. For small liquid spillages, allow vaporisation and treat as above. Larger spills should be contained with soil or sand and, if safe to do so, cover with a large plastic sheet.

The Australian Code for the Transport of Dangerous Goods by Road and Rail has identified chlorine as a pollutant to the environment. In the event of a spillage notify the local environmental protection authority or emergency services.

Disposal

Refer to State Land Waste Management Authority or supplier.

Fire/explosion hazard

Chlorine is non flammable but will support combustion. Fires may be started upon contact with organic substances. The escape of gas will hinder control of fire. Cylinders and drums may vent or rupture under fire conditions, consequently, keep containers cool with water spray. On burning, chlorine will emit noxious fumes. Fire fighters must wear self-contained breathing apparatus.

Safety data

Health effects

Short term exposure to chlorine by all routes is considered to be toxic. Note that the effects from exposure may be delayed. Inhalation can be fatal.

Skin

Chlorine liquid is corrosive to the skin and can cause skin burns and 'frost-bite' effects. Contact with skin can cause severe irritation, particularly if the skin is moist.

Eyes

A severe eye irritant. Eye irritation may occur at 3–5 parts per million (ppm). Contamination of eyes can result in permanent injury.

Inhalation

Chlorine odour can be smelt at levels as low as 0.5–2 ppm. The vapour is severely irritating to mucous membranes and respiratory tract. Above 30 ppm intense coughing, choking and chest pain will occur immediately; vomiting may also occur. Delayed effects can include bronchitis and pulmonary oedema.

Ingestion

Not a likely route of exposure due to gaseous state at room temperature. Ingestion of liquid will cause severe gastrointestinal burns.

Chronic exposure can result in dental erosion and reduced respiratory capacity.

First aid

Skin

Immediately wash contaminated skin with plenty of water. Remove contaminated clothing and wash before re-use. If swelling, redness, blistering or irritation occurs, seek medical advice.

Eyes

Immediately irrigate with copious quantities of water for at least 15 minutes. Eyelids to be held open. Remove clothing if contaminated.

Inhalation

Remove victim from exposure—avoid becoming a casualty. Remove contaminated clothing and loosen remaining clothing. Allow patient to assume most comfortable position and keep warm. Keep at rest until fully recovered. If breathing laboured and patient cyanotic (blue), ensure airways are clear and have a qualified person give oxygen through a face mask. If breathing has stopped apply artificial respiration at once. In event of cardiac arrest, apply external cardiac massage. Seek immediate medical advice.

Ingestion

Immediately rinse mouth with water. Give water to drink. DO NOT induce vomiting. If vomiting occurs give further water to achieve effective dilution. Seek immediate medical assistance.

Poison Information Centres in each state capital city can provide additional assistance for scheduled poisons.

Attachments

Chlorine production process

Mercury cell and membrane cell diagrams

ICI Australia
October 1992

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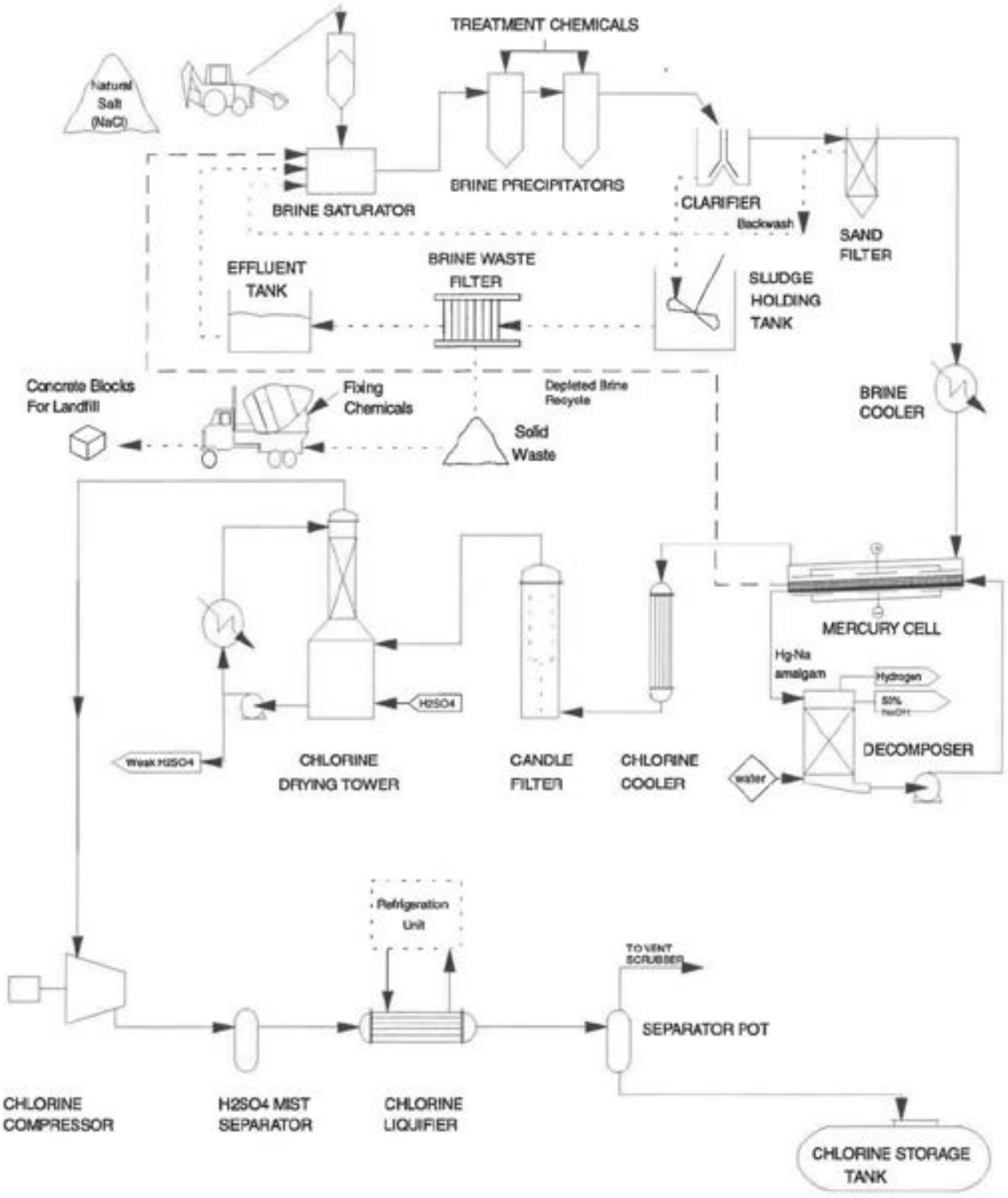
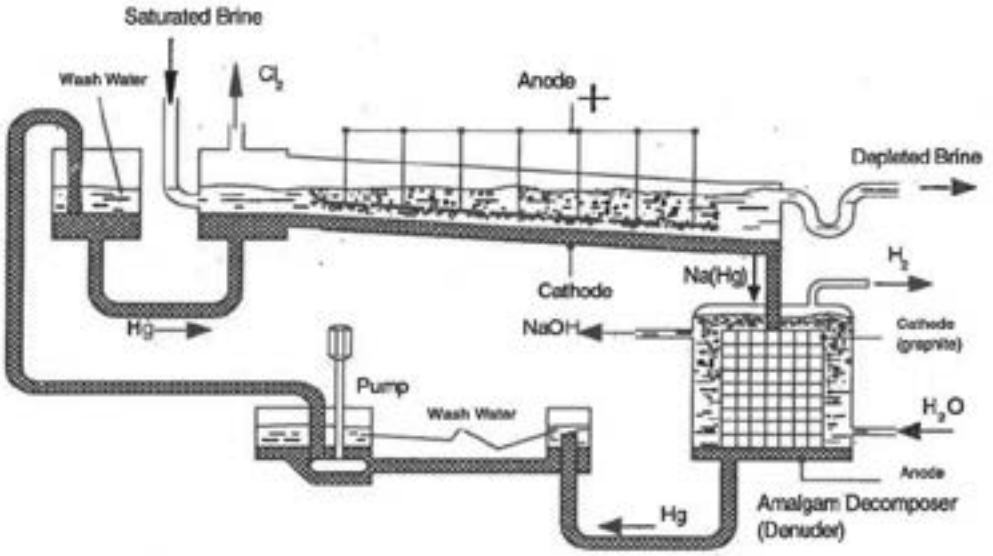
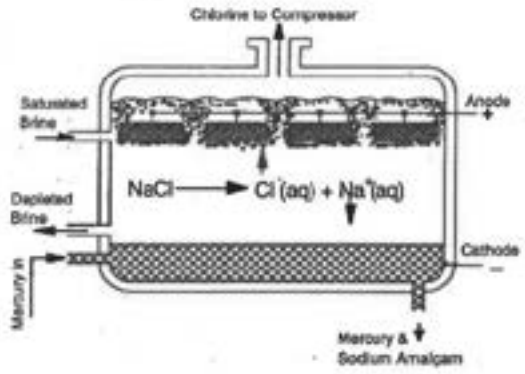
CHLORINE PRODUCTION: PROCESS FLOW DIAGRAM



Chlorine Production: Process Flow Diagram





Anodic half-reaction

$2Cl^-(aq) \Rightarrow Cl_2(g) + 2e^-$

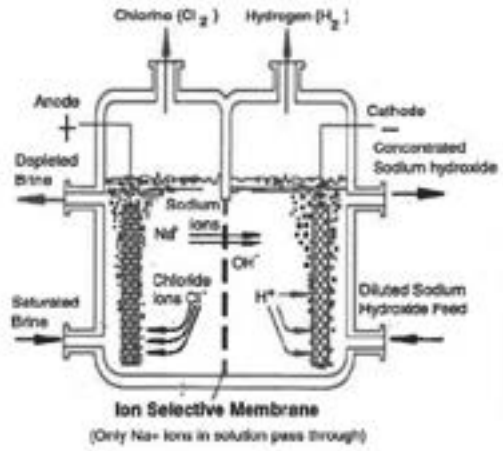
Cathodic half-reaction

$Na^+(aq) + Hg + 2e^- \Rightarrow 2Na(Hg)$

Overall reaction

$2NaCl(aq) + Hg \Rightarrow Cl_2(g) + 2Na(Hg)$

Mercury Cell



Anodic half-reaction

$2NaCl \Rightarrow Cl(g) + 2Na^+ + 2e^-$

Cathodic half-reaction

$2H_2O + 2Na^+ + 2e \Rightarrow H(g) + 2NaOH$

Overall reaction

$2H_2O + 2NaCl \Rightarrow Cl(g) + H_2(g) + 2NaOH$

Membrane Cell

OPPT Chemical Fact Sheet EPA 749-F-94-010

CHEMICALS IN THE ENVIRONMENT: CHLORINE (CAS NO. 7782-50-5)

prepared by
OFFICE OF POLLUTION PREVENTION AND TOXICS
U.S. ENVIRONMENTAL PROTECTION AGENCY
August 1994

Chemicals can be released to the environment as a result of their manufacture, processing, and use. EPA has developed information summaries on selected chemicals to describe how you might be exposed to these chemicals, how exposure to them might affect you and the environment, what happens to them in the environment, who regulates them, and whom to contact for additional information. EPA is committed to reducing environmental releases of chemicals through source reduction and other practices that reduce creation of pollutants.

WHAT IS CHLORINE, HOW IS IT USED, AND HOW MIGHT I BE EXPOSED?

Chlorine is a highly reactive gas. It is a naturally occurring element. Chlorine is produced in very large amounts (23 billion pounds in 1992) by eighteen companies in the United States. US demand for chlorine is expected to increase slightly over the next several years and then decline. The expected decline in US demand is due to environmental concerns for chlorinated organic chemicals. The largest users of chlorine are companies that make ethylene dichloride and other chlorinated solvents, polyvinyl chloride (PVC) resins, chlorofluorocarbons, and propylene oxide. Paper companies use chlorine to bleach paper. Water and wastewater treatment plants use chlorine to reduce water levels of microorganisms that can spread disease to humans.

Exposure to chlorine can occur in the workplace or in the environment following releases to air, water, or land. People who use laundry bleach and swimming pool chemicals containing chlorine products are usually not exposed to chlorine itself. Chlorine is generally found only in industrial settings. Chlorine enters the body breathed in with contaminated air or when consumed with contaminated food or water. It does not remain in the body due to its reactivity.

WHAT HAPPENS TO CHLORINE IN THE ENVIRONMENT?

Chlorine dissolves when mixed with water. It can also escape from water and enter air under certain conditions. Most direct releases of chlorine to the environment are to air and to surface water. Once in air or in water, chlorine reacts with other chemicals. It combines with inorganic material in water to form chloride salts. It combines with organic material in water to form chlorinated organic chemicals. Because of its reactivity chlorine is not likely to move through the ground and enter groundwater. Plants and animals are not likely to store chlorine.

HOW DOES CHLORINE AFFECT HUMAN HEALTH AND THE ENVIRONMENT?

Effects of chlorine on human health and the environment depend on how much chlorine is present and the length and frequency of exposure. Effects also depend on the health of a person or condition of the environment when exposure occurs.

Breathing small amounts of chlorine for short periods of time adversely affects the human respiratory system. Effects range from coughing and chest pain to water retention in the lungs. Chlorine

irritates the skin, the eyes, and the respiratory system. These effects are not likely to occur at levels of chlorine that are normally found in the environment.

Human health effects associated with breathing or otherwise consuming small amounts of chlorine over long periods of time are not known. They are currently under investigation. Some studies show that workers develop adverse effects from repeat inhalation exposure to chlorine, but others do not. Laboratory studies show that repeat exposure to chlorine in air can adversely affect the immune system, the blood, the heart, and the respiratory system of animals.

Chlorine causes environmental harm at low levels. Chlorine is especially harmful to organisms living in water and in soil.

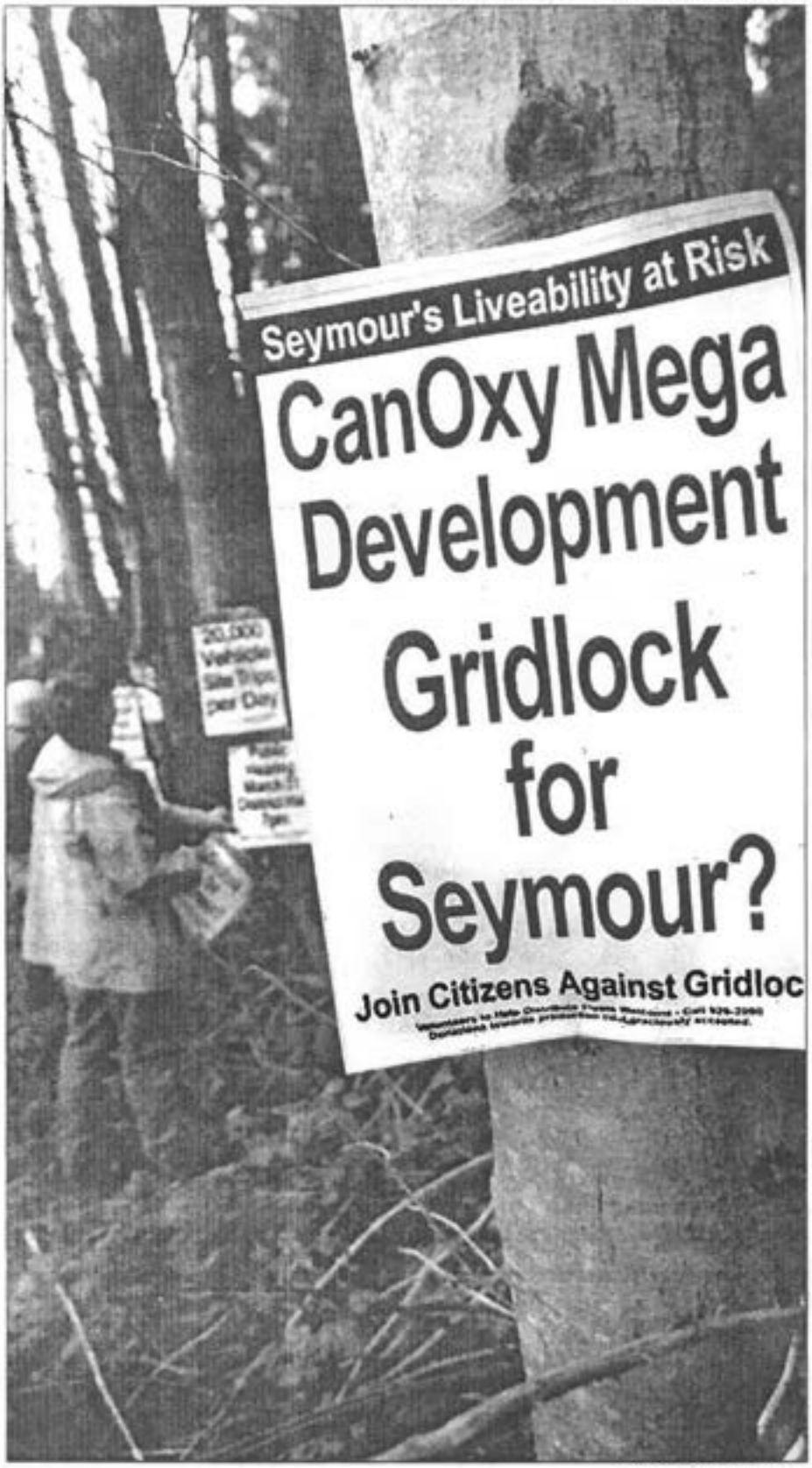
WHAT EPA PROGRAM OFFICES REGULATE CHLORINE, AND UNDER WHAT LAWS IS IT REGULATED?

EPA OFFICE	LAW	PHONE NUMBER
Pollution Prevention & Toxics	Toxic Substances Control Act	(202) 554-1404
	Emergency Planning and Community Right-to-Know Act (EPCRA) Regulations (Sec. 313)	(800) 535-0202
	Toxics Release Inventory data	(202) 260-1531
Air	Clean Air Act	(919) 541-0888
Solid Waste & Emergency Response	Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)/ Resource Conservation and Recovery Act / EPCRA (Sec. 304/311/312)	(800) 535-0202
Water	Clean Water Act	(202) 260-7588

A technical support document can be requested from the TSCA Assistance Information Service, (202) 554-1404.

WHAT OTHER FEDERAL AGENCIES OR GROUPS CAN I CONTACT FOR INFORMATION ON CHLORINE?

AGENCY/GROUP	PHONE NUMBER
Agency for Toxic Substances and Disease Registry	(404) 639-6000
American Conference of Governmental Industrial Hygienists	(513) 742-2020
Consumer Product Safety Commission	(301) 504-0994
Food and Drug Administration	(301) 443-3170
National Institute for Environmental Health Sciences (EnviroHealth Clearinghouse)	(800) 643-4794
National Institute for Occupational Safety and Health (NIOSH)	(800) 356-4674
Occupational Safety and Health Administration (Check your local phone book under U.S. Department of Labor)	



NEWS photo Mike Wakefield

CanOxy confrontation

SOME Seymour residents are concerned that proposed rezoning of CanOxy lands along a realigned Dollarton Highway will add retail use and increased traffic to an area already facing daily backups from the Second Narrows interchange. The public hearing goes Tuesday, 7 p.m. at N.V. District Hall.

APR 1/98

mailbox

Public left in dark about chlorine plant

Open letter to North Vancouver District Mayor Don Bell

Re: CXY public hearing March 31.

The general public knows virtually nothing about this rezoning application.

They have been kept completely in the dark.

There have been no public meetings to explain what is proposed.

All meetings held have addressed only the safety concerns at the chlorine plant and not what uses would be made on the rezoned land.

The fact that Your Worship permitted this to proceed to a public hearing on March 31 without first holding a public information meeting is unconscionable.

Buildings 69 feet high could line the Dollarton. Vehicle trips up to 20,000 per day in and off the 30-acre site will have a catastrophic impact on the Dollarton area transportation network, yet no detailed traffic analysis was provided.

Taxpayers will contribute $10 million in infrastructure with no promise that our livability won't be degraded.

Despite this, no public information meeting has been held.

I believe Mayor Bell, you have made a mockery of the process and have performed a grave injustice to your community.

The public must not be railroaded into compliance.

David Sadler
North Vancouver

Get Maplewood area upgrade in gear

THE No Growth Gang has ridden into the Maplewood neighborhood with guns blazing.

Timothy Renshaw

ripping yarns

At stake is perhaps North Vancouver District's last chance to develop a significant business residential core that will generate some much needed tax revenue and employment opportunities for the municipality — tax revenue that is not entirely drawn from the pockets of the municipality's residential property owners; concentrated employment opportunities that do not reside elsewhere in the district.

But the forces of no-growth-anywhere-anyhow in the district are strong and getting stronger — even though unpleasant economic realities are fast sneaking up on district taxpayers.

The freezing of residential development in the Cove and Mountain forest area has, for example, removed a large chunk of potential residential tax money from future district budgets.

Green consciousness is admirable, but the fact is that North Vancouver District spends more than it reaps in tax revenue.

Thus the debate over pillaging the district's land bank and Heritage Fund to bolster capital and operating budgets as presented in an earlier column.

But with the Maplewood area we are not talking about any green oasis.

It is an industrial-residential area in need of overhaul.

It represents multifold opportunity for the district and its residents.

Where to start?

How about with jobs? We can't do with too many of those, but the district currently has a shortage.

If you remove the industrial core of North Vancouver City, North Vancouver remains predominantly a bedroom community. Primarily residential with few areas that can support concentrated commercial/light industrial job development.

Maplewood is one of those areas.

Rezoning the 30-acre piece of property that currently serves as a buffer zone between Canadian Occidental Petroleum Ltd.'s (CanOxy's) CXY chemical plant and existing area business and residential is the first step in realizing a huge economic development opportunity for North Vancouver District.

If you combine the 30 acres of CanOxy property with the three adjacent Maplewood-area sites that could be developed over the next 10 to 15 years — 40 acres owned by the Vancouver Port Corp. north of the Dollarton Highway anchored by the Crab Shack; an adjacent 25-acre site owned by the district and the 20-acre Tolko Sawmill site to the east of the CXY plant — you come up with 115 acres of developable property that could eventually generate an estimated 6,500 jobs and countless new business opportunities in North Vancouver District.

That is a significant number by any measure.

In addition to the jobs would be the commercial and other taxes generated by such homegrown initiative.

The district currently has one of the most lopsided residential-to-commercial/industrial business tax ratios in the province. Residential taxpayers currently contribute about 74% of the municipality's tax total.

Which means that residential property taxes currently keep the district afloat.

CanOxy's CXY plant, an $80 million per year business, pays the district approximately $1.3 million each year in taxes — one of the biggest industrial taxpayers in the municipality.

But apart from the chemical plant there is precious little else on the district's industrial tax rolls.

The plant has been in operation since October 1957; it remains a viable business, earning annual profits in the $25 million range.

It is not going any where folks.

If the current rezoning from heavy industrial to light industrial/commercial is not approved, the chemical plant will carry on turning out chlorine for the vinyl industry and caustic soda for the pulp industry.

Its 30-acre buffer zone could be used for some other heavy industrial operation: anyone for a Maplewood concrete plant?

Little wonder that North Vancouver District initiated the push to rezone the land six years ago.

CanOxy, which owns about half of the 55-acre property its CXY plant sits on, would benefit from enhanced land value if the buffer zone were to be rezoned.

But the district's payoff would likewise be substantial.

The No Growth Gang has raised legitimate concerns about such issues as increased traffic and the development of any kind close to a chlorine plant and the dangers posed by it.

But deaths attributed to chlorine plant gas leaks since the plant began operation back in 1957 thus far total zero.

The spectre of a major chlorine leak resulting from an earthquake is serious but that occurrence would be serious regardless of whether the Maplewood industrial area is developed or not.

The Maplewood development issue has ground through various studies, risk assessments and reviews since 1992. It is long past time to move forward.

There will be complications from the area's re-development. There will be increased traffic, more activity, safety concerns.

But there will also be a made-in-North Vancouver District bonanza of jobs and tax revenue that will pay off for the municipality and its residents for years to come.

It will spell tax relief and local business vitality like no other opportunity the district has in its arsenal of expansion and growth.

You can save the district's green heritage, but unless you develop its commercial and business opportunities the cost to maintain the area's lifestyle will fast become too much for current taxpayers to bear.

Even the No Growth Gang has to see that reality.

Chlorine plant land sparks fiery debate

Rezoning would allow retail and commercial

Stories by Frank Luba
Lower Mainland Reporter

North Vancouver is divided over the future of land surrounding a potentially deadly chlorine plant on its waterfront.

Two days of heated public hearings on the rezoning of land around the CXY Chemicals plant last week were adjourned to May 21 to allow for more public input.

"The sparks were flying," said Coun. Ernie Crist of the district of North Vancouver.

The hearing was the result of the district proposing to create comprehensive development zones around the Dollarton Highway area near the Second Narrows Bridge. The zones would allow a wide range of uses including commercial and retail.

Part of the rezoning would include re-aligning Dollarton through CXY property to improve the notoriously narrow road while diverting traffic from Maplewood, the adjacent residential neighborhood.

CXY, which is owned by Canadian Occidental Petroleum Ltd., would profit by selling its property for development. The district also would be ahead by developing its land holdings as part of the Maplewood Business Park, as well as gaining increased tax revenue.

While plans for the area around CXY remain unresolved, the Maplewood neighborhood flounders.

Tom Young, president of the Maplewood Community Association, said he's seen the area turn into a "dump" because the future is unclear.

But another faction is opposed to any development around a facility where there could be a catastrophe such as the release of choking, blinding chlorine.

Crist says the district isn't going to get the kind of labor-intensive, clean industry it wants in Maplewood.

"The industries we want are not going to move next door to a chlorine plant," said Crist. "It's like putting an oil refinery in Lake Louise."

Crist would prefer to see the zoning amended to attract clean, green industries.

"We can't get rid of (CXY)," said Crist. "What we can do is send a message to CXY and the community that this production facility is no longer welcome. Times have changed.

"The land should be put to the best, highest use."

The Maplewood residents want to have input on their future.

"This is our community and we'd like to have a say in what happens," said Young.

"In general we support (rezoning) but we have conditions."

Among those conditions are a reduction in site coverage, a minimum of five per cent of the land for public use, and covenants against uses such as supermarkets, drive-through or fast-food restaurants, big box retail, car lots, pawnshops, flea markets or salvage yards.

The association also wants a mixed commercial-residential component on the northwest corner of the property.

Staff graphic by Ed Agavin

'The industries we want are not going to move next door to a chlorine plant. It's like putting an oil refinery in Lake Louise'
— Coun. Ernie Crist

Worst-case scenario a major disaster

One day, the threat of a chlorine spill hanging over Vancouver will vanish.

CXY Chemicals plant manager John Billham says the facility will continue to operate as long as it is economically viable but his best guess is it will continue to run for another five to 15 years.

"Any chemical plant has a finite life," said Billham.

Because of changes that include reducing the amount of chlorine stored on the site, the dangers have been reduced.

The worst-case scenario at the plant is the rupture of the 300-tonne storage tank in a severe earthquake or other such disaster.

The frequency of that risk is estimated to be about one occurrence in 16,000 years.

But the results would be deadly.

"There would be serious impact potentially 14 kilometres or 10 miles in any downwind direction," said Billham.

"You'd choke primarily," said the 38-year veteran of chemical plants who prefers to work with chlorine because the smell of even small amounts is very noticeable.

"A lot of chemicals don't give you that early warning," said Billham.

The chemical, which is used in water purification, pulp and paper and plastic production, also has a blinding effect.

CanOxy debate held over

Shirtsleeve sessions set for public

Martin Millerchip APR 3/98

News Reporter
miller@nsnews.com

A six-year process to determine the future density of bare land presently buffering a Seymour chlorine plant will get still more public debate.

North Vancouver District Council adjourned a two-night public hearing Wednesday of Canadian Occidental Petroleum Ltd.'s (CanOxy) application to redevelop part of its industrial land.

Council directed staff to hold a series of public meetings on issues relating to the proposed rezoning bylaw and will reconvene the public hearing on May 21.

Coun. Lisa Muri told the **News** on Thursday that if any major zoning amendments come out of the process, the present bylaw will have to be abandoned and a new public hearing process started.

If that scenario is correct, it would be the third attempt at upzoning portions of land CanOxy owns between the Dollarton Highway and its waterfront plant at 100 Amherst Ave.

Muri said she is pleased that there will "finally" be an attempt to bring everyone to the table to discuss points of conflict outside of the zoning process.

"I'm dismayed this didn't happen before. So far, we have just pitted community associations against each other and subverted the Official Community Plan. It's been a disaster."

Coun. Ernie Crist voted against the adjournment, but only because he wanted to defeat the present application outright.

"This whole thing was neither community nor council driven," said Crist.

"I'm not blaming CanOxy, but there's been a leadership vacuum and the whole Seymour planning process has been stopped to accommodate them."

More than 50 speakers signed up to speak Tuesday night from a huge crowd that overflowed North Vancouver District's council chamber into a second meeting room.

At 10:45 p.m., when Mayor Don Bell called a halt to the proceedings, only 24 speakers had been heard, evenly split for and against the proposal.

The hearing continued Wednesday night with another four-hour meeting.

Those in favor of the upzoning said it would revitalize the Maplewood neighborhood and re-align the Dollarton Highway with CanOxy footing some of the bill.

Opponents argued that the land-use decision was premature and undermined the community process begun last year on a major update of the Seymour Official Community Plan.

See Site page **3**

NEWS photo Paul McGrath

PROPOSED redevelopment of industrial land surrounding Canadian Occidental's Maplewood chlorine plant drew a huge crowd to North Vancouver District Hall Tuesday. The hearing was adjourned Wednesday for more public input.

Site density debate deferred

From page 1

Despite the length of some of the presentations, the hearing was unusually quiet as the packed gallery concentrated on the interwoven issues of planning process, density, land use, safety and cost.

CanOxy first applied to rezone in 1993.

In 1995, details of a cost-sharing agreement between the district and CanOxy were made public in which each side had pledged $3.75 million towards the costs of the infrastructure involved in the potential development, including realigning the Dollarton Highway. (That figure did not include rebuilding the Dollarton Bridge to two lanes in each direction at a projected cost of $6 million.)

The safety issue of increased density adjacent to a chlorine plant saw council members adjourn a June 1996 public hearing to better educate themselves and the public about risk assessment.

Council appointed its own consultant to review CanOxy's risk assessment study and over a year was spent re-evaluating the site's risk management.

The elimination of a bunged chlorine storage tank, the reduction of on-site chlorine storage to one 300-tonne tank and other safety measures led to an adjustment of the risk contours drawn around the site and the potential higher public use.

Nevertheless, some members of the public were surprised when a new rezoning application came forward earlier this month that created development zones allowing uses previously forbidden "until such time as the plant is permanently closed."

CanOxy withdrew one development area from the current rezoning application in response to requests from Maplewood residents to add a residential component to the plans.

But plans for the so-called CD19 zone include restaurants, offices, fitness centres, restaurants and retail food services.

CanOxy spokesman Jane Fleming said the company had no specific plans for the look of the developments that would take place on its land, a process she said would take five to seven years to build out, but guaranteed there would be no Big Box retail outlets on the site.

Fleming told the **News** on Thursday the six-year process has been costly for the company "not only in dollars but in terms of human resources."

Of the new delay and the planned public meetings she said, "We want to work with the community and listen to their concerns and see if we can work out something."

NEWS graphics

A rerouted highway and four development zones are proposed by CanOxy.

Issue elicits pros and cons

On the need to move the traffic on the Dollarton Highway out of Maplewood:

"The risk of a child getting killed on the Dollarton Highway is much higher than anyone getting killed by chlorine." — *John Walkley*

"Council's job is to make sure that the risks of a chlorine exposure in the Maplewood community is zero." — *Lee Muirhead*

On the public involvement in the safety review.

"...we are entering the court of public opinion only at the end of the process, virtually eliminating the opportunity to have all public concerns addressed by the risk assessment process and running the risk of creating unnecessary suspicion on behalf of the public who have not had an opportunity to be a part of the overall process." — *Ron Peterson, co-ordinator North & West Vancouver Emergency Program*

On public involvement in the planning process.

"If we say that we are committed to community consultation and participation in the decisions which shape our municipality, then we can't pick and choose which issues we will involve the community in. We have to take the time to make that happen consistently. Otherwise there will be no public faith in process." — *Angela Trudeau, co-chairman, Blueridge Community Association*

On the possibility of using the Heritage Fund to pay for a new Dollarton bridge.

"Heritage means for our children, it is not meant to be overdraft protection for our chequing account." — *Angela Trudeau*

BRITISH COLUMBIA

NEWS RELEASE

For Immediate Release
VI016 - 97/98
March 3, 1998

Ministry of Environment, Lands and Parks

PORT ALICE COMPANY CHARGED FOR CHLORINE RELEASE

NANAIMO - The Ministry of Environment, Lands and Parks announced today charges have been laid against Western Pulp Limited Partnership for a chlorine release at the company's Port Alice pulp mill.

Charges were laid on February 27, 1998 following an investigation by the Conservation Officer Service into a chlorine release during the unloading of a rail car. The discharge occurred as a result of a torn chemical transfer line.

The company was charged with two counts under the Waste Management Act for discharging effluent and air contaminants into the environment. The first court appearance is scheduled for April 7, 1998 in Port Hardy provincial court.

Potential fines for offences under the Waste Management Act can range up to a maximum of $1 million.

- 30 -

Contact: Charmane Edwards, (250) 751-3252
Communications
Vancouver Island

Diane Tetarenko, (250) 751-3165
Conservation Officer, IIU

Nanaimo

Apr-04-98 06:45P Councillor Lisa Muri 604 929 2635 P.02

Dollarton Highway Re-alignment Cost Sharing Project

No.	Segment	Section	Total	Cost Sharing by CanOxy	CanOxy Share	CDNV Share
1	Dollarton	West Of Riverside North	1,786,000	50.00%	893,000	893,000
2	Dollarton	East of Riverside North	1,014,000	50.00%	507,000	507,000
3	Dollarton	East of Forester	1,230,000	0.00%	0	1,230,000
4	Spicer		295,000	0.00%	0	295,000
5	Amherst		310,000	50.00%	155,000	155,000
6	Front		234,000	100.00%	234,000	0
7	Riverside	North Of Front	303,000	0.00%	0	303,000
8	Riverside	North to Front	293,000	100.00%	293,000	0
9	Riverside	South	633,000	100.00%	633,000	0
10	Forester	North to Ewen	227,000	50.00%	113,500	113,500
11	Forester	South	183,000	50.00%	91,500	91,500
12	Forester	Drainage South	160,000	50.00%	80,000	80,000
13	Forester	Access Road	82,000	0.00%	0	82,000
		Construction Cost	**6,750,000**		**3,000,000**	**3,750,000**
14	Land Contribution by CanOxy		750,000	100.00%	750,000	0
		Project Cost	**7,500,000**		**3,750,000**	**3,750,000**

Schedule D

C2. What are the public safety/risk implications of an increase in the volume of liquid chlorine stored on the CXY property at some point in the future?

Again, an agreement limits the fixed storage volume. If the volume stored in one tank were to increase, the potential consequences and therefore the risk contours might extend further from the plant. If the volume increase was brought about by having more tanks in service, but there was no increase in any one tank's volume, then the frequency of a release could increase but the consequences would not increase. This could also shift the risk contours further from the site.

April 1/98

To: Mayor and Members of Council
District of North Vancouver

From: Corrie Kost, 2851 Colwood Dr. V7R 2R3

Re: **Bylaw 7008 - Rezoning Bylaw 1089**

Your Worship and Members of Council,

This is a follow-up to my presentation at the Public Hearing of March 31/98.

It has been brought to my attention that the number of employees at CXY was incorrectly stated in my presentation. **I therefore wish to correct that error.**

What I quoted was from page 10 of the Document One of the Summer/97 CAP report which refers to the number of employees at the Sterling Pulp Chemical Plant. The correct figures for CXY are on page 9 and are as follows.

"CXY's North Vancouver site employs 173 people with 30% of those living on the North Shore. The company's site payroll and benefits equal $10million per year, and it pays $1.3 million in annual municipal taxes."

My apologies to all those at CXY.

Yours truly,

C. J. Kost

Corrie Kost

cc: Dennis Back
Clerk

..\district\canoxy\le010498.sam

District of North Vancouver

dialogue

www.dnv.org

Council Meeting Agenda

March 23 - 7:00 p.m.

Delegations

1. Mr. Jim Cuthbert, Seycove Community Programs Society and Parkgate Operating Model Subcommittee regarding Parkgate Community Centre Operating Model
2. Ms Angela Trudeau regarding Environmental Sustainability Measures
3. Ms Sabra Woodworth regarding Kilmer Road Subdivision

Council Matters

4. Proposed Residential Development - Kilmer Road
5. Bylaw 7011 Text amendment - casino gaming/video lottery terminal games
6. Business License - Mousehole Bed & Breakfast
7. Business License - Summit View Bed and Breakfast
8. Council Remuneration and Expenses incurred during 1997
9. Guidelines of Communication and Election Procedure for the North Shore Representative to the Greater Vancouver Regional Transit Authority (GVTA)
10. 1998 Annual Budget Approval Bylaw
11. 1998-2002 Capital Expenditure Program Bylaw
12. 1998 Heritage (Tax Sale Lands Reserve Fund) Appropriation Bylaw #1

For more information on the agenda call 990-2211 or refer to District InfoWeb.

Watch Council Meetings on Rogers Cable 4 -- 10 a.m. Saturdays.

Court of Revision

Frontage-Tax Assessment Roll

NOTICE IS HEREBY GIVEN that the Court of Revision to deal with the Frontage-Tax Assessment Roll will sit on Tuesday, April 7, 1998, at 5:00 p.m. in the Council Chamber of the Municipal Hall, 355 West Queens Road, North Vancouver, B.C.

Dennis W. Back
Municipal Clerk

DATED at North Vancouver, B.C.
this 22nd day of March, 1998.

Community Corner

Roche Point Community Association welcomes Superintendent Jamie Graham of the R.C.M.P. at their next meeting on Wednesday, March 25, at Seycove Secondary School, Room 220. Superintendent Graham will be discussing Community Policing and crime prevention in the community.

The boundaries of Roche Point Community Association are Mount Seymour Parkway on the North, Dollarton Waterfront on the South, Fairway Drive on the East, and Apex Avenue on the West. New Members are welcome!

For more information, contact Chris Kwan at 929-3660.

East Seymour Community Association welcomes guest speaker John Lewis, of the Board of Education Facilities Review Committee, to discuss Meeting Area Needs for High School, on Tuesday, March 31, 7:30 p.m. at Dorothy Lynas School. Come and voice your concerns, find out what the Ministry of Education figures are, and help strategize.

For more information contact Deanne Mandell at 929-4993.

Public Hearing - CXY Chemicals Ltd.

BYLAW 7008 - "Rezoning Bylaw 1089"

Public Hearings are scheduled to provide an opportunity for Council to hear from those who believe their interest in property may be affected by changes to this Bylaw, as outlined to the right:

This Public Hearing is held under the provisions of the *Municipal Act*. All persons who believe their interest in property may be affected by the proposal will be afforded an opportunity to be heard in person and/or by written submission. Written submissions will be accepted up to the conclusion of the Public Hearing on Tuesday, March 31, 1998.

Copies of the Bylaw, resolutions, supporting staff reports and any relevant background material are available for review from March 18th through March 31st, 1998 in the District of North Vancouver's Clerk's Office or Planning Department at the Municipal Hall. The Municipal Hall is located at 355 West Queens Road and is open Monday through Friday, except Statutory Holidays between the hours of 8:30 a.m. and 4:30 p.m.

Dennis W. Back, Municipal Clerk,
March 20, 1998

Applicant

CXY Chemicals Ltd. (Canadian Occidental Petroleum Ltd.)

Subject Land

Portion of Lot 5, Block H, D.L. 193 and 611, Plan 12801, VPC V-1381(4) Parcel "A" Land 330,284 sq.ft., Parcel "B" Water 217,766 sq.ft. and V-1381(3) Water 21,399 sq. ft. (PID:007-253-265); Lot 1 of Lot B, D.L. 611, Plan 17800 (PID:007-254-067); and Portion of Lot A, Block B, D.L. 193, Plan 1367 (PID: 014-536-415). Those properties generally bounded by Amherst Avenue on the west, the CNR rail line to the south, the realigned Dollarton Highway and Ewen Street to the north and, Forester Street to the east as illustrated on the map below.

Proposed Amendments

To amend the Zoning Bylaw to create two new Comprehensive Development Zones, 18 (CD18) and 19 (CD19) and to rezone the subject lands from General Industrial (I2) and General Commercial Zone 3 (C3) to those new zones.

Purpose

The purpose of the rezoning is to establish specific land use and development regulations for the subject properties to enable the Company to develop its lands in a manner consistent with the current Maplewood Official Community Plan.

Tuesday
March 31, 1998
7:00 p.m.
Council Chamber
355 W. Queens Rd.
North Vancouver

Youth Achievement Awards Programs

The District of North Vancouver is calling for nominations for the Youth Achievements Awards, which recognize district youth in two categories:

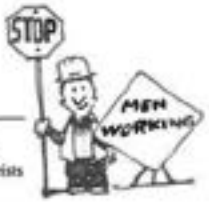
Certificate of Achievement - recognizes youth who have demonstrated outstanding achievement in some particular endeavor, including those who exhibit exceptional progress and commitment to personal improvement.
Certificate of Community Service - Recognizes youth who have made significant contributions to the community on a voluntary basis while working with a volunteer organization. Contributions made while working with neighbourhood groups, school groups and other non-profit organizations would be considered.

An awards ceremony will be held at District Hall during Youth Week - May 3 - 9, 1998.

Pick up nomination forms in the Community Planning Department, at Municipal Hall, 355 West Queens Rd. (Monday - Friday 8:30 a.m. - 4:30 p.m.).

For more information call Teri Derbaix at 990-2454.

Waterworks Project - Montroyal Boulevard



During the period from March 23 to June 30, The District will be undertaking a waterworks project on Montroyal Boulevard from Capilano Road to Delbrook Avenue. Motorists are advised to expect delays and to plan alternate routes.

working together for a better community

COUNCIL AGENDA/INFORMATION

☐ In-Camera	Date:	Item #
☒ Regular	Date: March 16/98	Item # 1
☐ Info Package	Date:	Item #
☐ Agenda Addendum	Date:	Item #

Dept. Manager | Director | Municipal Manager

The Corporation of the District of North Vancouver

REPORT TO COUNCIL

ORIGINAL

File No. 3060-20/8.93

PLANNING

March 6, 1998
File: 3060-20/8.93

AUTHOR: J. Irwin Torry, A/Director of Community Planning and Building, Land and Bylaw Services

SUBJECT: **A: REZONING APPLICATION FOR CANADIAN OCCIDENTAL PETROLEUM LTD.; B: NEW DOLLARTON BRIDGE; C: PROPOSED MULTI-FAMILY DEVELOPMENT PROJECT ON DOLLARTON HIGHWAY; AND, D: MAPLEWOOD BUSINESS PARK**

RECOMMENDATIONS:

It is recommended that Council:

1. **Abandon Bylaw 6762 which was considered at a public hearing held on June 11, 1996;**

2. **Introduce Bylaw 7008 creating Comprehensive Development Zones 18 and 19 and rezoning lands owned by Canadian Occidental Petroleum Ltd. and Imperial Oil Co. Ltd. from C3 and I2 to CD18 and CD19;**

3. **Refer Bylaw 7008 to a Public Hearing on March 31, 1998;**

4. **Amend the existing cost sharing agreement for the construction of a realigned Dollarton Highway (July 1995) to provide:**

   a) **for a phased construction of this roadway and divert $1,700,000 of DNV funding from existing cost sharing arrangement towards a new Dollarton Bridge estimated to cost $6,000,000;**

5. **Provide direction to staff on other sources of funding to be used to accelerate construction of a new Dollarton Bridge ($4,300,000 required);**

6. Provide direction to staff to either:

a) process a rezoning and development permit application for a multi-family residential project at 1984, 1988 and 2012 Dollarton Highway; or

b) defer consideration until the Seymour Local Plan is sufficiently advanced to provide the necessary land use policy direction; and

7. Authorize staff to proceed with replotting schemes which would relocate up to fifteen existing properties (11 single family and 4 industrial) along Dollarton Highway to more suitable locations within Maplewood.

REASON FOR REPORT:

To report back to Council on the issues surrounding the proposed Canadian Occidental Petroleum Ltd. rezoning application, the Dollarton Highway realignment, the new Dollarton Bridge, the proposed multi-family development project on Dollarton Highway and Maplewood Business Park.

BACKGROUND:

On June 11, 1996 Council adjourned the public hearing on Canadian Occidental Petroleum Ltd.'s (COPL) rezoning application and requested staff to obtain an independent review of the Bovar-Concord Environmental Quantitative Risk Assessment Study. In addition to obtaining an independent review of this Risk Assessment Study, Council instructed staff and COPL to hold a public information meeting with surrounding residents, businesses and community groups to better explain the risks associated with the production of chlorine, the long term health risks of exposure to low levels of chlorine, levels of chlorine production, methods and volume of on-site storage (i.e., 300 tonne tank and/or rail cars), risk management concepts, risks associated with the transport of chlorine and rail cars and evacuation plans in the event of an emergency.

On July 26, 1996 Council approved the appointment of Arthur D. Little Inc. to complete the independent review of the QRA study prepared by Bovar Concord and undertake an assessment of the 1978 Beak report.

On October 21, 1996 Arthur D. Little submitted the assessment of the 1978 Beak report (Exhibit 1).

From November 1996 until April 1997 Bovar Concord and Arthur D. Little exchanged additional material and information as requested by Arthur D. Little.

In May, 1997 Canadian Occidental Petroleum Ltd. and Bovar Concord decided to update the August 1994 QRA study to reflect all the improvements that had occurred at the plant up to

December 31, 1996. This report entitled "CXY Chemicals North Vancouver Plant Assessment of Chlorine Safety Risk to the Public 1997 Update Report is included as Exhibit 2.

On July 11, 1997 Arthur D. Little submitted their independent review of the CXY Chemicals Assessment of Chlorine Safety Risk to the Public, 1997 Update Report (Exhibit 3).

On August 12, 1997 Arthur D. Little presented the findings from their independent review to District Council.

Pursuant to the direction provided by Council at the adjourned public hearing, District staff and COPL representatives held an open house, together with a question and answer period on September 23, 1997. The meeting focused on the Risk Assessment report, the independent review, improvements to plant operations, safety concerns, shipment of chlorine in rail cards, emergency response issues, the Dollarton Highway realignment and land use alternatives for COPL lands. A complete copy of the questions and answers from this meeting is included as Exhibit 4.

As some detailed information was not available in response to specific questions a further meeting was held on October 30, 1997. A summary of the specific questions and answers is included as Exhibit 5.

EXISTING POLICY:

Under the Maplewood OCP the Canadian Occidental Petroleum lands are designated as "Commercial", "Light Industrial" and "Mixed Use". The proposed multi-family development project on Dollarton Highway is designated as "Residential RM" which includes multi-family housing at densities generally ranging between 12 to 18 units per acre. The Maplewood Business Park is designated as a "Mixed Use" area allowing for a range of industrial, office and support services.

ANALYSIS:

A. Canadian Occidental Petroleum Limited - Rezoning Application

1. Updated Report Concerning Assessment of Chlorine Safety Risks to the Public: 1997

In 1994 COPL undertook a Quantitative Risk Assessment (QRA) as part of its long term risk management programme to assess public safety risks associated with the operation of its plant and to assist in land use planning in the vicinity of the facility.

The 1997 updated report was prepared in response to issues raised by the District's consultant conducting the independent peer review and the fact that

on site fixed tank storage had been reduced from three tanks storing 1500 tonnes to one 300 tonne tank and the discontinuance of use of fixed tank shipments of chlorine by barge.

The process of estimating the risks of a facility, judging its safety and development of risk control measures comprises the risk management process.

Many different hazardous events can potentially occur in a chemical manufacturing facility. The QRA process begins with an examination of the plant's history, its components, operations and an inventory of hazardous substances that are used, transported and manufactured. The next step in the risk assessment process is to answer the question what can go wrong? When a list of potential negative events is completed, the questions are asked, how often are these events expected to occur? And what are the consequences?

To determine the total facility risk, possible hazardous events are identified, grouped into categories and their associated risks added together. For each category, the worst case event in that category is selected to represent all events identified in that category. This process ensures that total facility risk is overestimated for purposes of incorporating additional safety measures.

When total facility risk is estimated, comparison is made to risk acceptability criteria such as those developed by the Major Industrial Accidents Council of Canada (MIACC) referred to in Exhibit 6. These criteria are based on the understanding that an individual risk or annual probability of fatality of 1 in a million (10^{-6}) is commonly considered acceptable and equates to unrestricted land use, including high-density residential development. Commercial development, offices and low-density residential development are acceptable in the 10 to 1 in a million or 10^{-5} to 10^{-6} individual risk zone. Manufacturing, warehouses, and open spaces such as parks are acceptable in the 100 to 10 in a million zone, or 10^{-4} to 10^{-5} individual risk zone.

The results from the 1997 updated report indicate that on average a chlorine release from the 300 tonne storage tank, in a non-earthquake situation, could occur with a frequency of 10^{-5} per year or 1 chance in 100,000 years. An earthquake related chlorine release from the 300 tonne storage tank could occur with a frequency of 5×10^{-5} per year, or 5 chances in 100,000 years.

The worst case events for the COPL plant were identified as a rupture of the 300 tonne storage tank during a severe earthquake. The total frequency of such events is estimated to be in the order of one occurrence in 16,000 years.

Conclusions from the 1997 updated report indicate that the proposed land uses contemplated in the comprehensive development zones are consistent with the Major Industrial Accidents Council of Canada (MIACC) guidelines.

In Canada, MIACC developed the risk acceptability criteria presented in Exhibit 6. These criteria are specified in terms of permitted land uses for specified levels of individual risk. These criteria have been used in conjunction with the risk hazard contours generated from the 1997 updated report to define the permitted land uses within each zone.

2. Independent Peer Review Conducted by Arthur D. Little Incorporated

The independent review undertaken by Arthur D. Little Incorporated covered:

- the identification of hazards - what can go wrong?
- the frequency analysis - how likely is it to happen?
- the consequence analysis - what happens if the undesired event occurs?
- the overall estimation of risks - which combines all of the previous items together to develop an estimate of the risk to the affected community.

The independent review concluded that "there are a number of facts which have been either over or under estimated for individual events; however, the overall results are judged to be reasonable representations of the public risk levels associated with current chlorine plant conditions and operations'.

While not the focus of the current planning and land use decision, the consultant believed it was "important to note that the area to the west of CXY Chemicals plant is at a higher risk level than might be desired. This in not at all surprising given the proximity of the western plant boundary to the storage tanks and rail car loading stations. This is an existing land use which has experienced a significant reduction in risk as a result of the recent changes in plant operations and the plant improvements. It will be important to maintain good communications with the operations to the west of the plant for the purpose of emergency response and proper action in the event of a release".

3. Amended Comprehensive Development Zones

Given the safety improvements, reduced levels of on-site fixed tank storage and the discontinuance of fixed tank shipment of chlorine by barge, the individual risk contours around the COPL chemical plant changed from the 1994 risk contours. Using these revised risk contours (illustrated in Exhibit 7) in conjunction with the MIACC risk acceptability criteria resulted in several use changes to the three comprehensive development zones.

In addition to use changes, the conditions pertaining to chlorine storage and shipping procedures have been eliminated from the zoning bylaw but maintained within the implementation agreement.

The implementation agreement will still require COPL to:

- give an annual statutory declaration stating that the fixed tank chlorine storage at the plant will not exceed 300 tonnes as originally agreed to; and
- give the District or an independent expert, right of access to inspect the plant to ensure that the specified conditions on storage and shipping are being met;

As a result of the changes in uses within the three zones staff recommend that the original Bylaw 6762 (Exhibit 8) considered at the June 11, 1996 public hearing be abandoned and the new zoning Bylaw 7008 (Exhibit 9) be introduced and referred to a public hearing on March 31, 1998.

It should be noted that following a meeting with the Maplewood Community Association on February 26, 1998 the zoning for the proposed commercial area north of the realigned Dollarton Highway and west of an extension of Riverside Drive has been deleted from Bylaw 7008. The Maplewood Community Association requested more time to assess the relationship of proposed commercial uses with existing businesses and uses located north of Front Street.

The Maplewood Community Association was also desirous of encouraging housing above proposed commercial uses. As this type of development was not contemplated in the Maplewood Official Community Plan the municipal solicitor advises that Council would have to approve an amendment to the existing policy document prior to introducing residential uses.

4. Amendments to the Existing Cost Sharing Agreement between COPL and District of North Vancouver

COPL and the District of North Vancouver entered into a cost sharing agreement regarding the construction of a realigned Dollarton Highway and other road improvements resulting from this proposed development. The existing agreement contemplates both COPL and the District providing $3,750,000 to complete all related works within two years of adoption of the zoning bylaws.

Since development of this property will be phased over several years it is suggested that the construction of a realigned Dollarton Highway and other road improvements also be phased.

A phased construction programme would require COPL to contribute $1,353,000, plus $750,000 in land, and the District to fund $1,978,000 worth of improvements (refer to Exhibit 10).

This would allow the District to divert approximately $1,700,00 from the existing cost sharing agreement to the construction of a new Dollarton bridge which has been identified by the community as a much needed improvement to the transportation system.

5. Implementation Agreement

In order for the rezoning, phased construction of a realigned Dollarton Highway and development of COPL property to proceed, COPL will execute restrictive covenants and covenants under Section 219 of the Land Title Act. These covenants will be registered against title to COPL's development lands and remaining plant lands and are designed to enforce the limits on land use and the chlorine storage/shipping conditions at the plant, as identified in the 1997 updated risk assessment report. The overall implementation process for these agreements is set out in an umbrella "Implementation Agreement" which will only be signed should the rezoning bylaws proceed to adoption. Specifics on the implementation agreement and the series of required covenants are outlined in Exhibit 11.

B. New Dollarton Bridge

The original cost sharing agreement between COPL and the District of North Vancouver contemplated the construction of a four lane realigned Dollarton Highway within two years of the zoning bylaw being adopted. This could have resulted in two west bound lanes converging into one lane at the existing bridge, not to mention the traffic from the existing Dollarton roadway.

To address this bottleneck situation the amended Development Cost Charge Bylaw includes a new Dollarton Bridge at a cost of $6,000,000. Waiting for the necessary funding from development projects (i.e., COPL industrial and Maplewood Business Park) would exacerbate an already congested traffic situation. Consequently staff recommend a phased construction programme for a realigned Dollarton Highway (assuming Council proceeds with the COPL rezoning application) and construction of a new Dollarton bridge at the beginning of the development programme in Maplewood as opposed to the end of process.

1. Alternate funding packages available for the new Dollarton bridge include:

   a) reallocation of existing funds in conjunction with a loan from the Heritage Fund;

i) reallocation of existing funds;

- diversion of $1,700,000 in DNV funds from the existing cost sharing arrangement with COPL; and
- $2,600,000 from previously approved land development projects (Mystery Crescent and Roche Point); plus

ii) a loan of $1,700,000 from the Heritage Fund to the Development Cost Charge Bylaw (estimated DCC revenue for Dollarton Bridge is $2,619,240); or

b) reallocation of existing funds in conjunction with potential revenue from existing, yet unsold, land development projects;

i) reallocation of existing funds;

- diversion of $1,700,000 in DNV funds from the existing cost sharing arrangement with COPL; and
- $2,600,000 from previously approved land development projects (Mystery Crescent and Roche Point); plus

ii) a loan of $1,700,000 from either:

- the anticipated revenue of $3,080,000 from the sale of 14 lots on Kilmer Avenue; or
- the anticipated revenue of $6,160,000 from the sale of 22 lots on Anne Macdonald Way to the Development Cost Charge Bylaw (estimated DCC revenue for Dollarton Bridge is $2,619,240); or

c) forwarding the $6,000,000 project to the electorate as a referendum item in 1999.

2. Impact of Using Different Funding Sources for new Dollarton Bridge:

a) **Existing cost sharing funds $1,700,000**. These funds will need to be replaced at some future date in order to complete the road.

b) **Previously approved land development funds $2,600,000**. This is the source of funding to undertake any future land developments. If used for the bridge it will need to be replaced if the District wishes to develop land. These funds have been provided by the Heritage Fund on the basis that they will be repaid from land sale proceeds.

c) **Loans from the Heritage Fund for DCC Share**. A loan would not be able to pay interest to the Heritage Fund as payment of interest on

internal loans is not permitted by the Municipal Act. This loss of interest would exist until such time the DCC's for the bridge are collected and repaid to the Heritage Fund. Also, this loan would tie up a significant portion of the Heritage Fund capital. This reduced income to the Fund means that there will be reduced money available to pay for capital additions in the order of $100,000 per year.

d) **Borrow through referendum process**. Unless a special referendum is held before November 1999, the bridge project could not start until the year 2000. The estimated DCC proceeds at $2.6 million would be used to reduce the repayment costs of the debt.

C. Proposed Multi-Family Development Project at 1984, 1988 and 2012 Dollarton Highway

On October 14, 1997 Council deferred consideration of this proposed rezoning application "pending a report from staff on how this development proposal may be impacted by the Seymour River bridgehead, Dollarton Highway realignment, business park proposal and Can Oxy concerns".

The proposed multi-family rezoning application will not be impacted by the proposed Dollarton bridge or the Dollarton Highway realignment (illustrated on Exhibit 12).

Using the risk contours from the updated 1997 Bovar Environmental report, in conjunction with MIACC risk acceptability criteria, low density residential development would be an acceptable land use.

Staff now require direction from Council on whether to process the rezoning and development permit application for a multi-family residential project at 1984, 1988 and 2012 Dollarton Highway or defer consideration until the Seymour Local Plan is sufficiently advanced to provide the necessary land use policy direction.

D. Maplewood Business Park

During the public information meetings held in September and October, 1997 a few residents living along Dollarton Highway expressed concern that the proposed business park would force them out of the community. In response to these concerns staff advised the residents that there is potential to exchange their lots for more suitable lots on the periphery of the business park via a replot. Staff now recommend that we proceed with discussions with the residents. The process of discussion would include the most appropriate area for a residential replot, timing issues and costs.

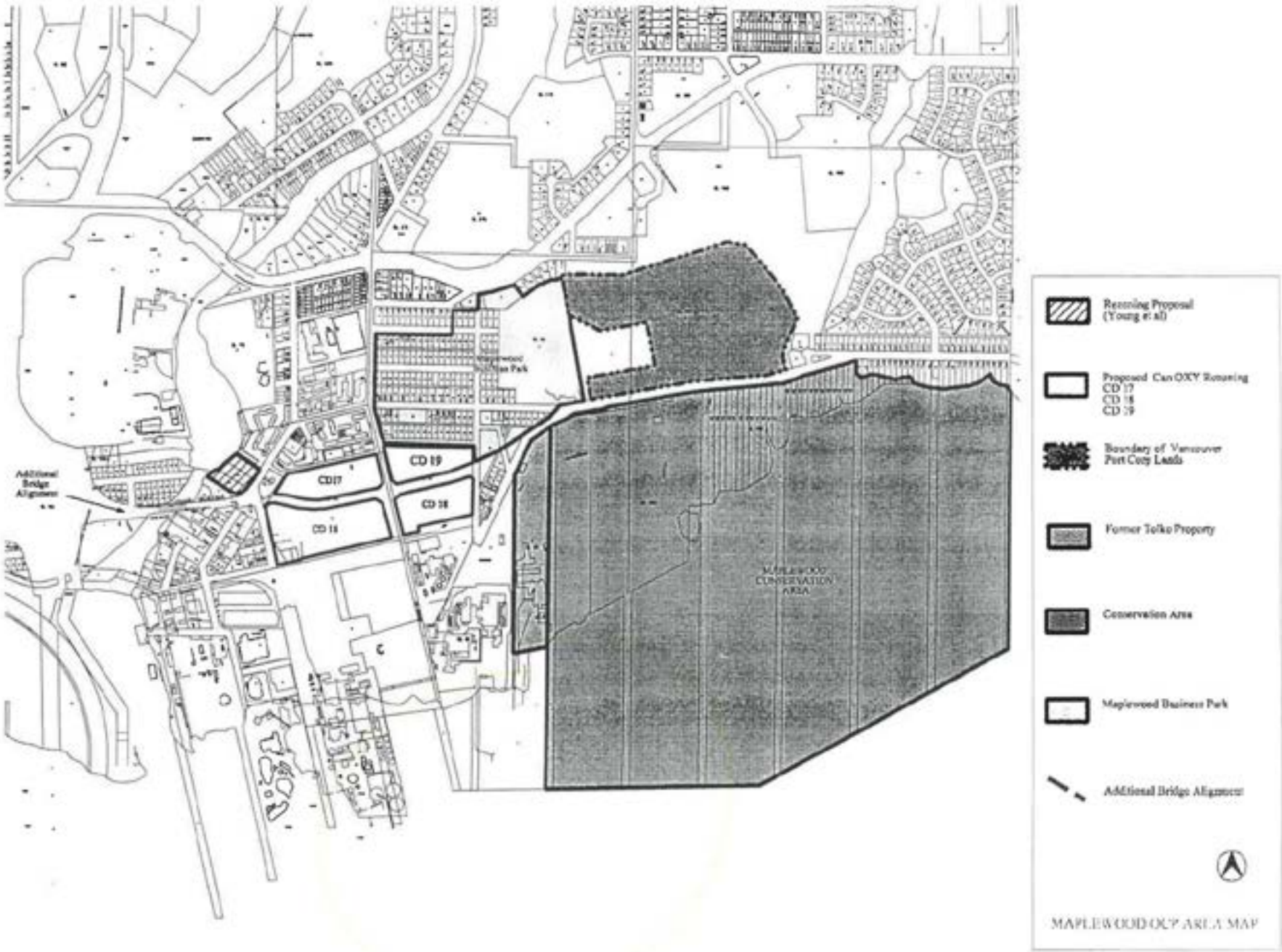
Funding for the legal survey for the Maplewood replot is available in the existing Maplewood land development account. Further funding requirements for potential property relocation or purchase would be determined during the course of discussions with the Dollarton property owners.

While the replotting process is being completed, staff will have an opportunity to review with Council such strategic issues as sale of land versus leases, District sponsored development or sale of raw land via proposal call for specific uses (ie., film industry) and a review of the concept plan and specific zoning regulations.

J. Irwin Torry
A/Director of Community Planning and Building, Land and Bylaw Services Division

JIT/lk/dw
Attach.

REVIEWED WITH:	REVIEWED WITH:	REVIEWED WITH:	REVIEWED WITH:
☐ Communications	☐ Finance	External Agencies:	Advisory Committees:
☐ Env. Protection	☐ Fire Services	☐ Recreation Commission	☐ _____
☐ Human Resources	☐ Legislative Services	☐ Library Board	☐ _____
☐ Eng. Public Works	☐ Land	☐ Health Dept.	☐ _____
☐ Eng. Admin.	☐ Permits & Licenses	☐ RCMP	
☐ Eng. Parks	☐ Planning	☐ Other: _____	
	☐ Social Planning		



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Exhibits

1. Arthur D. Little Inc.'s assessment of the 1978 Beak report.

2. Bovar Environmental's 1997 Update Report on CXY Chemicals North Vancouver Plant Assessment of Chlorine Safety Risk to the Public.

3. Arthur D. Little Inc.'s independent review of the CXY Chemicals North Vancouver Plant Assessment of Chlorine Safety Risk to the Public 1997 Update Report.

4. Questions and Answers from September 23, 1997 public information meeting.

5. Summary of Questions and Answers from October 30, 1997 meeting.

6. Major Industrial Accidents Council of Canada (MIACC) Risk Acceptability Criteria.

7. Individual Risk Distribution around COPL Chemical Plant - 1997 Operations and Allowable Land Use According to MIACC Risk Acceptability Criteria.

8. Original Zoning Bylaw 6762.

9. Zoning Bylaw 7008.

10. Phased Construction of Dollarton Highway Realignment and Funding Options for a New Dollarton Bridge.

11. Summary of Required Agreements and Covenants.

12. Relationship Between Proposed Multi-Family Rezoning Application and Proposed Dollarton Bridge and Dollarton Highway Realignment.

Exhibit 1

Arthur D. Little Inc.'s assessment of the 1978 Beak report

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Arthur D Little

Arthur D. Little of Canada Limited
67 Yonge Street, Suite 400
Toronto, Ontario
M5E 1J8 Canada

Telephone (1) 416.361.1051
Fax (1) 416.361.1155

October 21, 1996

J. Irwin Torry
Manager of Planning
The Corporation of The District of North Vancouver
355 West Queens Road
North Vancouver
British Columbia
V7N 2K6

Re: ADL Reference No. 30728

Dear Mr. Torry:

Arthur D. Little of Canada Limited is pleased to submit this summary of our independent review of *Chemical Hazard Evaluation of the Maplewood Chemical Industry*, prepared by Beak Consultants, and submitted in June 1978. The District of North Vancouver requested this independent review to determine the overall usefulness and appropriateness of the 1978 report to present day decision-making needs.

This review was based on the report presented as well as several telephone conversations with Canadian Oxy personnel. We had initially planned to also conduct one or more telephone interviews with the Council or staff to better understand the purpose and proposed use of the report so that we would have a context in which to judge its relevance. However, based on our discussions with Canadian Oxy personnel, we no longer felt this was necessary.

The table below summarizes many of the factors that we evaluated during our telephone interviews and review. The effects and significance of the various factors were determined by reviewing the report and appendices in detail using our knowledge of current practices both in the chemical industry and in risk analysis methodology and assumptions, coupled with the results of our discussions with plant staff.

The material in this letter reflects Arthur D. Little's best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this letter, or any reliance on or decisions to be made based on it, are the responsibility of such third party. Arthur D. Little accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on the information contained in this letter.

J. Irwin Torry
Manager of Planning
The Corporation of The District of North Vancouver

Table 1: Relevancy of the 1978 Report

General Factors Influencing Relevance	1978 Study	Present Situation
scope of study	focus was on selected operations and chemicals, primarily chlorine and related products	materials other than toxics (e.g., propane) are also receiving attention
	risk of concern was acute risk to public; no discussion of environmental risks	environmental risks are of much greater concern, and could also be covered in a broad overview report such as this
	focus varied between Maplewood for fixed sites, general Vancouver area for transportation, and entire route for risks per shipment	report such as this would be expected to focus on a better defined area
surroundings/ external factors	1978 populations	encroaching residential and commercial populations
	considered local meteorology and terrain	still relevant
	some seismic analysis; general equipment response/failure predicted	more equipment-specific reviews and analyses conducted in interim
transportation	55-ton cars for chlorine	90-ton cars; rail car fleet has improved; release probabilities vary significantly for different types of rail cars (i.e., pressure versus non-pressure cars)
	used average accident rates for mid 1970's; data given on a per-shipment basis	major improvements to infrastructure have yielded significant reductions in rail accident rates since 1978; truck accident rates have not changed very much; marine rates are very location-specific, but the Port of Vancouver has undertaken a number of studies and initiatives to reduce risk so improvements would be expected; data is now generally expressed on a per-mile basis
	mid 1970's hazardous material shipment levels	significant increases in number of shipments at the site (about twice as many rail cars per year) and in Vancouver area in general; increased usage of intermodal containers (ISO-tainers)

J. Irwin Torry
Manager of Planning
The Corporation of The District of North Vancouver

General Factors Influencing Relevance	1978 Study	Present Situation
operations	report did not take specifics of site and process into account, but rather relied on average industry experience; operation probably was fairly typical at this time	have improved procedures, quality programs and practices; less instrumentation and controls than might be found in a newer facility
	on-site inventory of up to 1780 tons of chlorine	total inventory limited to 550 tons of chlorine since 1995
	Chlorine Institute best practices	Responsible Care provides additional guidance
equipment age/ condition	20-year old operation	40-year old operation with few changes to physical plant, but well maintained and good attention to safety
	three 150-ton chlorine tanks; two 666-ton chlorine tanks	three 150-ton tanks removed; 318-ton chlorine tank added at some point in the past
		have added non-destructive testing of lines; do internal vessel inspections every 3 years instead of 5; more detection and automatic isolation; enhancements in earthquake resistance of equipment; adding motor-operated valve to rail car side of loading hose
		propane tanks moved further from chlorine operations
emergency response	concerned about both direct and secondary impacts	still relevant
	provided safety manuals and emergency response plans	out-of-date as there are more coordinated programs and site and local organizations have changed
	lack of coordinated response cited	much stronger and better coordinated emergency response programs/teams and better equipment available both locally and in the region
	concern over communication capabilities	much better and more reliable communication systems in place in the plants, the community, and the region
	most likely scenarios analyzed; maximum of 1000 pounds released	general practice is to evaluate a worst-credible release in addition to more likely (smaller) releases

J. Irwin Torry
Manager of Planning
The Corporation of The District of North Vancouver

General Factors Influencing Relevance	1978 Study	Present Situation
methodology	list of scenarios of concern	most are still relevant to some extent
	lists of incidents in industry and transportation	past events are generally still relevant, although many administrative controls and design improvements have been developed to limit the chance of them occurring again; more recent events could be added to lists
	used industry averages to give frequency ranges and release quantities	estimates are now out-of-date; industry-wide data is no more meaningful today than it was then as it does not indicate whether or not a given facility is better or worse than average and does not account for site-specific differences in activity levels, inventory, isolation capabilities, etc.; enough time has passed to know if some of the predicted frequencies were realistic; typical practice is to calculate flow rates based on the actual equipment and operating conditions
	coarse risk calculations	appropriate that they be coarse, but hard to accurately calculate estimates of individual risk when only considering the most likely events; low frequency/high consequence events must generally be considered
	simplified algorithms for consequence modeling predictions	significant improvements in consequence models
	concentrations of concern specified	minor, mostly insignificant changes

The 1978 report was intended to raise community awareness and help educate the interested reader. This need still remains, but today is more typically focused on the specific equipment, operations, and management systems of the industrial operations in a community than on the basic hazards of various chemicals. Without this degree of specificity, it is difficult to motivate improvements.

The 1978 report gave ideas on what it meant to classify Maplewood as an "active" chemical area and suggested that this characteristic must be factored into planning activities. However, it did not provide enough information on which to base such

activities, other than to support the general need for strong emergency response planning and capabilities.

The basic recommendations of the 1978 report still make sense, and are typical of good management practices in the chemical industry today. However, we believe that the 1978 report has served its purpose, and that its continued use today would be inappropriate, except for some of the basic information on the chemicals and processes. Should you wish to update the report, there are numerous examples of community-wide reporting activities designed to address OSHA and EPA requirements that would help to structure your efforts. These reports are generally prepared by the operations of interest and then consolidated, rather than being prepared "externally" as the 1978 report was.

Please let me know if I can clarify any of these points or if you have additional questions.

Sincerely,

[redacted]

Lisa M. Bendixen
Principal, Safety and Risk

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Exhibit 2

Bovar Environmental's 1997 Update Report on CXY Chemicals North Vancouver Plant Assessment of Chlorine Safety Risk to the Public

Document No: 113804

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CXY CHEMICALS
NORTH VANCOUVER PLANT
ASSESSMENT OF CHLORINE SAFETY RISK TO THE PUBLIC

1997 UPDATE REPORT

for
CXY CHEMICALS
100 Amherst Avenue
North Vancouver, B. C.
V6H 1S4

by
BOVAR Environmental
Risk Assessment Group
Calgary/Toronto

July 4, 1997

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EXECUTIVE SUMMARY

Background

For the past 20 years, the District of North Vancouver has planned the Maplewood area as an "employment centre," building on a long history of industrial development and waterfront activity in the region. With community input over the years, policies were established and an Official Community Plan was adopted as a by-law. The Plan designated large parcels of developed and vacant land, both public and private, for light industrial, commercial and residential use. It also proposed relocating the Dollarton Highway south of its present location.

The proposed Dollarton Highway realignment is located on land owned by Canadian Occidental Petroleum Limited (CanadianOxy), but is beyond the boundaries of a plant operated by CXY Chemicals, an industrial chemicals joint venture in which CanadianOxy has a majority interest. As part of the Dollarton Highway relocation, rezoning of the CanadianOxy lands north of the Canadian National Railway (CNR) right-of-way is required. These lands are not used for plant operations, and rezoning will ensure that any development which does occur will conform to the Official Community Plan. Other development proposals are under consideration in the vicinity. These include rezoning of the Port lands for residential purposes and further development of District-owned lands for a business park. The realignment of the Dollarton Highway is key to these developments, both to improve traffic circulation and to provide increased visibility of the employment area.

The general area of CXY Chemicals plant in North Vancouver is shown in Figure 1 on page 2, and the proposed development area is displayed in Figure 2 on page 3.

The CXY Chemicals plant in North Vancouver produces mainly chlorine, as well as caustic soda and muriatic acid and ships these products by rail and barge to customers in British Columbia, other provinces in Canada, the United States and offshore to other countries. These products have many uses in a variety of industries, including water purification, pulp and paper manufacturing and plastic production. The plant is 30% smaller in capacity than the industry average and has a compact design with short pipe runs.

Purpose and Objectives

This report provides an assessment of chlorine safety risk to the public in the context of proposed land uses in the vicinity of the plant. Information in this report is based on Quantitative Risk Assessment (QRA) methodology. Using guidelines established by the Major Industrial Accidents Council of Canada (MIACC), the QRA process evaluates if the risk to the public is acceptable. Recommendations for managing risk can then be made. In addition, part of the QRA process is to inform the public of results of the QRA and ensure their participation in risk management decisions, such as land use planning.

FIGURE 1 GENERAL AREA OF CXY CHEMICALS NORTH VANCOUVER PLANT

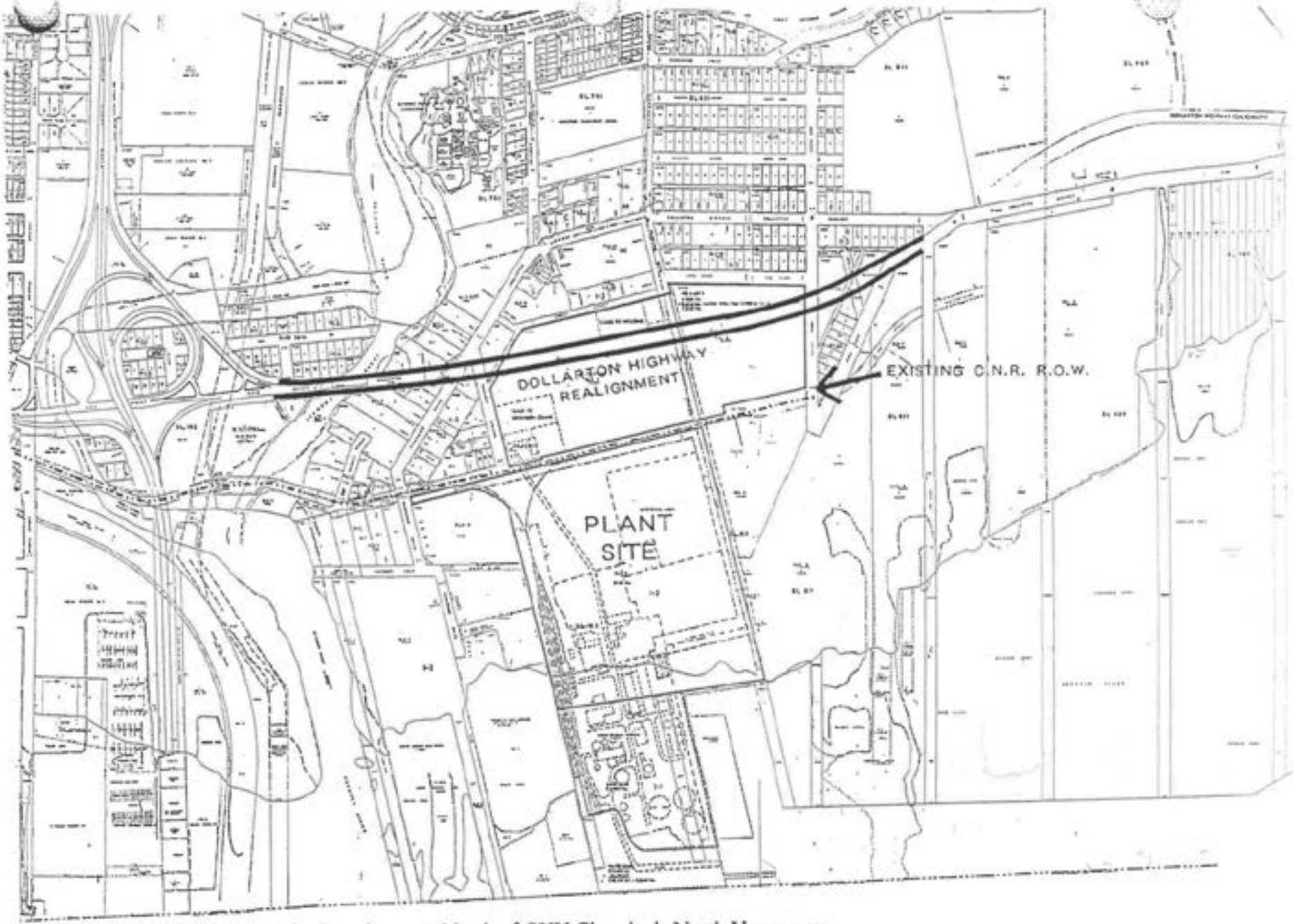

Figure 2 Area Proposed for Development North of CXY Chemicals North Vancouver.

This report builds on work previously undertaken. In 1994, as part of its commitment to the Responsible Care® Codes of Practice, CXY Chemicals retained BOVAR Environmental to conduct a QRA to assess public safety risks associated with the plant's operations. To assist with the land use planning process in the neighbourhood, the 1994 report also addressed off-site risks of potential chlorine releases by comparing estimated risks to guidelines established by MIACC. Those guidelines are described in Figure 3 on page 5.

Two operational scenarios were examined in the 1994 study: the first one was 1994 operations as they existed, and the second one was an alternative operations scenario with significantly reduced chlorine inventory. The 1994 alternative operations scenario is very similar to current 1997 operational settings at the plant as a number of process improvements and significant upgrades to plant safety have been undertaken. The three main changes implemented as a result of the 1994 QRA report were:

- reducing plant inventory of liquefied chlorine gas to one 300 tonne storage tank from three tanks storing a total of 1500 tonnes;
- moving a propane storage tank to a more remote location on the site; and
- discontinuing the use of a barge with three, 300 tonne fixed tanks for shipping chlorine.

The alternative operations scenario in the 1994 QRA report examined the reduced-inventory situation. The report concluded that under this scenario, then-existing and proposed land uses were generally consistent with MIACC criteria. MIACC guidelines are a common tool for land use planning.

In June 1996, a public hearing was held to consider the rezoning of the CanadianOxy lands and the related Dollarton Highway realignment. During the hearing, the public raised questions about the plant and the safety of its operations. In response to these concerns, the Council of North Vancouver requested an independent peer review of the 1994 report and retained A. D. Little to carry it out.

The following report was prepared both in response to questions raised by the District's consultant and as an update to the 1994 QRA. This report reflects the most up-to-date conditions at the plant as well as the most current data and methodology used for the risk analysis.

Risk Assessment Process

The process of estimating the risks of a facility, judging its safety and development of risk control measures, if required, comprises the risk management process. The steps in the risk management process are described in Appendix C and shown in Figure C-1.

Many different hazardous events can potentially occur in a chemical manufacturing facility. The QRA process begins with an examination of the plant's history, its components, operations and an inventory of hazardous substances that are used, transported and manufactured. An

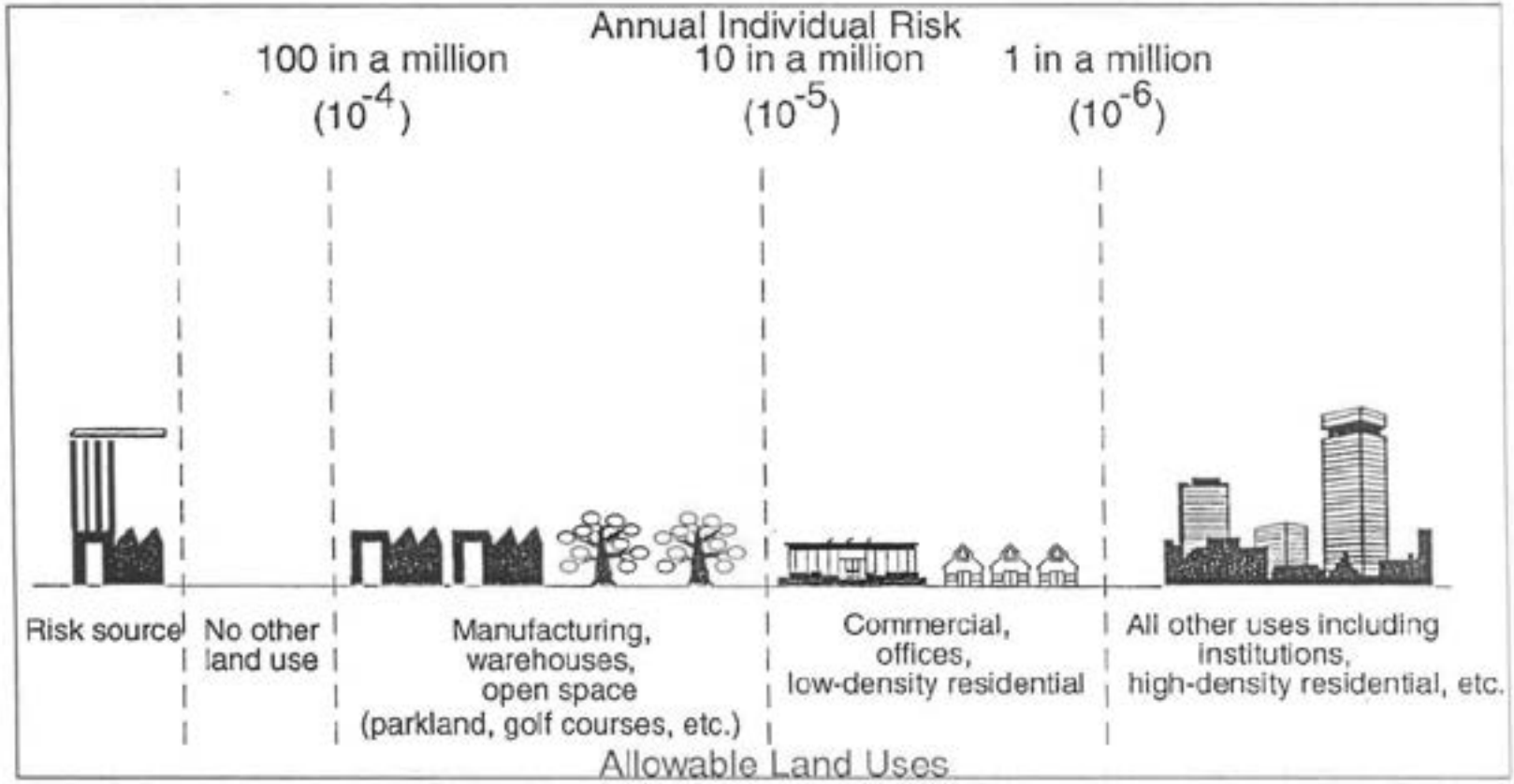

Figure 3 Risk Acceptability Criteria
Major Industrial Accident Council of Canada (MIACC)

examination of the population, land use and climate of the surrounding area that might be affected by hazardous events in the facility is also undertaken.

The next step in the risk assessment process is to answer the question *what can go wrong*? When a list of potential negative events is completed, the questions are asked, *how often are these events expected to occur?* and *what are the consequences*?

To determine the total facility risk, possible hazardous events are identified, grouped into categories and their associated risks are added together. For each category, the worst case event in that category is selected to represent all events identified in that category. This process ensures that total facility risk is overestimated for purposes of incorporating additional safety measures.

Modelling the physics and consequences of a chlorine gas release is a complex procedure. BOVAR Environmental has developed its own models that calculate dispersion of chlorine after a release. For this QRA, BOVAR have used their models to combine frequency and consequence information to assess the facility risk.

When total facility risk is estimated, comparison is made to risk acceptability guidelines such as those by MIACC (Figure 3, page 5). These guidelines are based on the understanding that an individual risk or annual probability of fatality of 1 in a million (10^{-6}) is commonly considered acceptable and equates to unrestricted land use, including high-density residential development. Commercial development, offices and low-density residential development are acceptable in the 10 to 1 in a million or 10^{-5} to 10^{-6} individual risk zone. Manufacturing, warehouses, and open spaces such as parks are acceptable in the 100 to 10 in a million zone, or 10^{-4} to 10^{-5} individual risk zone.

Along with inventory reductions, CXY Chemicals has implemented several significant changes to the plant's operations since 1994. BOVAR took these changes into account to provide an up-to-date picture of off-site risk related to chlorine safety in 1997. To prepare the 1997 update report, BOVAR made two additional site visits in 1997, conducted interviews with plant personnel and reviewed updated information on plant operations and storage conditions. CXY Chemicals collected data on inventory, pressure and temperature in the 300 tonne storage tank in 1997. BOVAR also had discussions with A. D. Little, the peer reviewer retained by the District of North Vancouver to ensure that both consultants were using the same updated information on plant conditions and on the risk assessment methodology used in the 1997 report.

Results

On average, a chlorine release from the storage tank in a non-earthquake situation could occur with a frequency of 10^{-5} per year or 1 chance in 100,000 years (Table B-1, Appendix B). An earthquake-related chlorine release from the storage tank could occur with a frequency of 5×10^{-5} per year, or 5 chances in 100,000 years (Table B-2, Appendix B). Potential releases and their expected frequencies from sources other than the storage tank are described in Table B-3 (Appendix B). Consequences of these events in terms of distances from the plant to 1%

probability of fatality in the direction of the wind are shown in Figure B-1 , Hazard Zone Lengths Following Each Release Event (Appendix B).

The worst case events for the CXY plant were identified as the rupture of the 300 tonne storage tank during a severe earthquake or from other causes, resulting in chlorine releases from the storage tank. The total frequency of all such events is estimated to be very low, in the order of one occurrence in 16,000 years. This low frequency incorporates several factors, including the tank fill level frequency (see Table B-1, Appendix B) and the earthquake frequency (see Table B-5, Appendix B). As a result, the risk to the public is considered to be low. The magnitude of an earthquake such as that used in the QRA would cause widespread damage and historically has never been experienced in Vancouver. In arriving at these results, it was assumed that individuals were not evacuated or sheltered in buildings, but were fully exposed to the chlorine cloud. These assumptions result in overestimation of consequences.

Individual risk contours in the vicinity of the plant are superimposed on an aerial photograph and shown in Figure 4 on page 8. These contours indicate that the buffer zone is limited to plant boundaries in the northerly direction.

Conclusions

The 1997 update to the 1994 Quantitative Risk Assessment indicates that proposed land uses north of the CXY Chemicals' plant in North Vancouver are consistent with MIACC guidelines (Figure 3 on page 5). Manufacturing and open space development would be acceptable in the north outside plant boundaries. Commercial and low-density residential development could proceed beyond the rail line north of the plant. Unrestricted land use would be acceptable beyond approximately 600 metres to 700 metres north of the rail line.

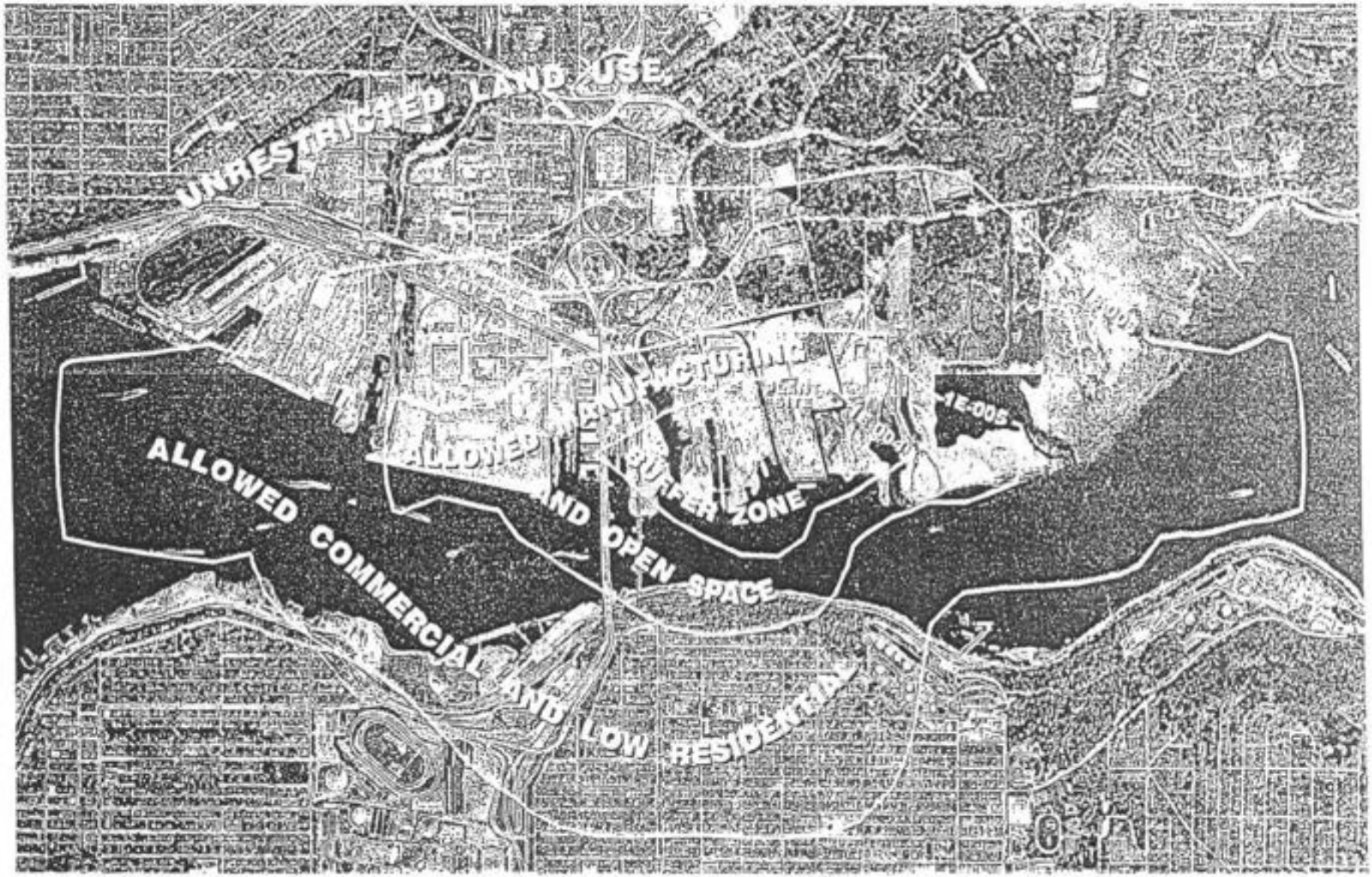

Figure 4 **Individual Risk Distribution Around Plant – 1997 Operations and Allowable Land Use According to MIACC* Guidelines**

*MIACC - Major Industrial Accidents Council of Canada

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1. INTRODUCTION

Background

For the past 20 years, the District of North Vancouver has planned the Maplewood area as an "employment centre," building on a long history of industrial development and waterfront activity in the region. With community input over the years, policies were established and an Official Community Plan was adopted as a by-law. The Plan designated large parcels of developed and vacant land, both public and private, for light industrial, commercial and residential use. It also proposed the relocation of the Dollarton Highway south of its present location.

The proposed Dollarton Highway realignment is located on land owned by Canadian Occidental Petroleum Limited (CanadianOxy), but is beyond the boundaries of the plant that is operated by their wholly owned subsidiary, CXY Chemicals. As part of the Dollarton Highway relocation, rezoning of the CanadianOxy lands north of the Canadian National Railway (CNR) right-of-way is required. These lands are not used as part of the plant operations, and the rezoning will ensure that any development which does occur will conform to the Official Community Plan. Other development proposals are under consideration in the vicinity. These include the rezoning of the Port lands for residential purposes and further development of District-owned lands for a business park. Realignment of the Dollarton Highway is key to these developments, both to improve traffic circulation and to provide increased visibility of the employment area.

The general area of CXY Chemicals plant in North Vancouver is shown in Figure 1 on page 5, and the proposed development area is displayed in Figure 2 on page 6.

Risk Assessment and Management Process

The CXY Chemicals plant manufactures and stores chlorine. Events can occur at the plant that may pose a risk to public safety. For example, the accidental release of large quantities of chlorine, a toxic gas, can pose a significant hazard to the public.

This report provides an assessment of chlorine safety risk to the public in the context of existing and proposed land uses in the vicinity of the plant. The results of this study will be provided to the District of North Vancouver for use in land use planning in the vicinity of the plant. Information in this report is based on Quantitative Risk Assessment (QRA) methodology which is described in greater detail in the Risk Assessment section of this report and in Appendix C which outlines the risk management process. The QRA process estimates risks by first identifying *what* can occur in terms of worst case as well as more realistic events, and then estimates how *frequently* they can occur and what their *consequences* could be. Using guidelines established by the Major Industrial Accidents Council of Canada (MIACC), the QRA process evaluates if the risk to the public is acceptable. Recommendations for managing risk can then be made. In addition, part of the QRA process is to inform the public of the results of the QRA and ensure their participation in risk management decisions, such as land use planning.

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to assess pu blic safety risk of the plant's operations to determine what, if any, improve en ts could be made; and

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Section Guid e

ort has five sectio ns. Following this introduction, Section 2 provides a brief description CXY Chem ical s plant in North Vancouver, with particular emphasis on existing ns and safet y measures. Section 3 provides a brief description of the risk assessment Section 4 c ontains an overview of the risk assessment methods that were used. The of the assess ment of chlorine safety risks to the public are described in Section 5. s ions are pres en ted in the last section, Section 6.. In the Appendices, Appendix A contains tion on the CXY Chemicals plant, Appendix B contains tables and figures used in the lyses and Ap pe nd ix C contains a description of the risk management process.

1. INTRODUCTION

Background

For the past 20 years, the District of North Vancouver has planned the Maplewood area as an "employment centre," building on a long history of industrial development and waterfront activity in the region. With community input over the years, policies were established and an Official Community Plan was adopted as a by-law. The Plan designated large parcels of developed and vacant land, both public and private, for light industrial, commercial and residential use. It also proposed the relocation of the Dollarton Highway south of its present location.

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This report builds on previous work. CXY Chemicals, as part of its commitment to the North Vancouver community and to the Responsible Care® Codes of Practice, retained BOVAR Environmental in 1994 to conduct the QRA of its operations. The report had two purposes:

- to assess public safety risk of the plant's operations to determine what, if any, improvements could be made; and

- to clarify whether proposed land uses in the vicinity of the plant were appropriate.

Two operational scenarios were examined in the 1994 study: the first one was 1994 operations as they existed; the second one was an alternative operations scenario with significantly reduced chlorine inventory. The 1994 alternative operations scenario is very similar to current 1997 operational settings at the plant, although in addition to the reduction in fixed tank storage (see below), a number of process improvements and significant upgrades to plant safety have also been undertaken since 1994. Some of these were not incorporated in the 1994 alternative operations scenario. The three main changes implemented as a result of the 1994 QRA were:

- reducing the plant inventory of liquefied chlorine gas to one 300 tonne storage tank from three tanks storing a total of 1500 tonnes;

- moving a propane storage tank to a more remote location on the site; and

- discontinuing the use of a barge with three, 300 tonne fixed tanks for shipping chlorine.

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The following report was prepared both in response to questions raised by the District's consultant and as an update to the 1994 QRA. This report reflects the most up-to-date conditions at the plant and the most current data and methodology in the analysis.

Report Section Guide

This report has five sections. Following this introduction, Section 2 provides a brief description of the CXY Chemicals plant in North Vancouver, with particular emphasis on existing operations and safety measures. Section 3 provides a brief description of the risk assessment process. Section 4 contains an overview of the risk assessment methods that were used. The results of the assessment of chlorine safety risks to the public are described in Section 5. Conclusions are presented in the last section, Section 6.. In the Appendices, Appendix A contains information on the CXY Chemicals plant, Appendix B contains tables and figures used in the risk analyses and Appendix C contains a description of the risk management process.

2. THE CXY CHEMICALS PLANT IN NORTH VANCOUVER

Plant Description

The CXY Chemicals plant in North Vancouver produces chlorine, caustic soda (sodium hydroxide), and muriatic (hydrochloric) acid using a "Chlor-Alkali Process." The basic materials used in the process include salt (sodium chloride), water and electrical energy. Electrical energy is applied to the salt and water mixture (brine), to produce chlorine, hydrogen and sodium hydroxide.

The plant's products have many uses in a variety of industries, including water purification, pulp and paper manufacturing and plastics manufacture. The CXY Chemicals plant is 30% smaller in capacity than industry average and has a compact design with short pipe runs.

Products leave the plant by rail and barge to be shipped to customers in British Columbia, other parts of Canada, the United States and offshore to other countries.

A diagram of the plant's layout is included in Figure A-1, Appendix A.

Manufacturing, Storage and Shipping

Chlorine gas from electrolytic cells is cooled, compressed and transferred in liquefied form to a 300 tonne storage tank where it is held at about -13°C. It is transferred from the storage tank to insulated railway cars for shipping. Railcars are also loaded onto a marine barge for shipping from the CXY Chemicals plant.

Plant Safety Upgrades

CXY Chemicals is committed to ensuring its environmental systems and equipment are kept in excellent working order. Risks and performance are continually monitored, and safety audits are conducted regularly.

The plant is well maintained and has modern chlorine safety systems and standards. CXY Chemicals has a Preventative Maintenance system and Operator and Loader training programs and procedures. A site Emergency Plan involves all local authorities and assigned site staff. A fully trained Chlorine Emergency Response team, which is recognized throughout North America for its expertise, is at the plant site and on call 24 hours a day.

The plant monitors real-time ambient air quality and wind direction and can quickly determine the source of a leak if one were to occur. The plant has improved its safety performance relative to reducing chlorine leaks. As indicated in Table A-1, Appendix A, there have been only a few minor releases of chlorine to the air since 1994.

Since 1995, CXY Chemicals has made significant investments in reducing chlorine inventory and upgrading the plant. The following actions are some of the specific safety upgrades that have been implemented since 1994 to ensure maintenance of the highest standards of safety.

- Reducing fixed tank storage from three tanks, totaling 1500 tonnes to one 300 tonne tank

- Discontinuing the use of a barge with three, 300 tonne tanks for marine shipping of chlorine.

- Adding a second railway tank car loading station in 1997, enabling maintenance without shutting down the loading operation. This new station features the latest design. It automatically shuts off the flow of chlorine if a hose breaks. Valves that connect the two hoses to the tank car automatically close if a leak occurs in the loading line, or if the rail car is moved from its preset loading position.

- Replacing all main chlorine lines from liquefiers to the pump tank were replaced in 1996. The amount of piping was reduced and all remaining pipes were fully painted before insulating. All welds were 100% radiographed. All pipes were inspected and pressure tested before installation and after field welds. To completely clean the inside of all pipes, they were sandblasted.

- Moving the propane storage tank outside the plant to the far northern edge of the parking lot where it is well protected against collision.

- Installing two new air compressors of the latest design in 1996 The new compressors ensure air supply to plant pneumatic instrumentation during normal, abnormal and shutdown conditions.

- Improving collision protection from vehicular traffic for the natural gas line outside the boiler house was also completed.

In 1996, CXY Chemicals spent approximately 40% of its capital reducing chlorine inventory at the plant and plans to invest 20% of its annual capital over the next two years on maintaining and improving environmental equipment.

3. THE RISK ASSESSMENT AND MANAGEMENT PROCESS

We live in a world of risk. No matter how careful we are, there is a chance a person may be hurt even in the safest of activities. However, an activity is considered safe if the risks are acceptable. In Canada, the Major Industrial Accidents Council of Canada (MIACC) has established guidelines for acceptable risk for different types of development. While these guidelines are not laws, they are generally used in Canada as the standard for evaluating the acceptability of various risks from industrial and commercial activities.

The following pages contain a brief description of risk terminology and an overview of how the QRA process was applied at the CXY Chemicals plant. Appendix C also contains a description and flow chart of the risk management process.

Important Definitions and Methodology

Risk of a hazardous event is defined as the chance of that event occurring and the harm that could result from it. To estimate the level of risk, the following equation is commonly applied:

Hazardous Event Risk = Event Frequency x Event Consequence.

Many different hazardous events can potentially occur in a chemical facility. Each possible hazardous event contributes its share to total facility risk, which is calculated by adding risks of possible events that could occur in the facility. To simplify the QRA process, events with similar consequences are considered in groups, such as "large releases" or "small releases." To determine the total facility risk, possible hazardous events are identified, grouped into categories, and their associated risks are added together. For each category, the worst case event is selected to represent all the events in that category, a process that ensures the risk is always overestimated.

Public risk can be thought of from an individual and societal perspective.

Individual risk of fatality is the chance (in any year) that a person living near a hazardous facility might die because of potential accidents at that facility. Since the severity of impact of accidents usually decreases with distance from the facility, the individual risk (of fatality) will decrease with distance. The variation of individual risk around a facility is usually presented on a map in terms of constant risk lines or contours. Depending on the nature of the accident, other factors such as wind direction, topography and climatic conditions affect the risk zones and hence the risk contours. Similar risk contours can be drawn for risk of injury.

Societal risk is the total expected number of fatalities in a year because of a hazardous facility and is estimated from all possible events. Societal risk can also be thought of as the number of people exposed to given levels of individual risk (i.e., the number of people within individual risk contours), which can be visualized more easily when risk contours are presented on maps showing land use. The risk acceptability guidelines proposed by MIACC are based on this interpretation of societal risk.

Risk management includes all of the actions performed to reduce the frequency of hazardous events and their consequences to prevent or reduce the possibility of loss of life, illness or injury, or damage to property or the environment.

Risk assessment begins with a system description or examination of the facility consisting of its components, operations, and an inventory of hazardous substances that are used, transported and manufactured. During this phase, information on the population, land use and climate of the surrounding area that might be affected by hazardous events in the facility is also collected.

The next step in the risk assessment process is to answer the question, *What can go wrong*? In a quantitative risk assessment, two other questions are also asked: *How often is the event expected to occur*? and *What are the consequences*? Historical data and other methods, including computer modelling of the behaviour of hazardous substances, are used to answer these questions. The findings for all three of these questions are combined to estimate the risk and to evaluate its acceptability. This process is used extensively throughout the world.

The next step in the risk management process is risk control. If the risk assessment shows that the risk is acceptable, then changes to the facility are not required. However, to proactively manage risks, programs such as regular safety audits are conducted on an on-going basis. These programs are also reviewed periodically, as risks may change over time at a hazardous facility. If the risk is unacceptable, there are several courses of action:

1. To improve safety at a facility, operators may make technical changes, such as modifying design or reducing inventories.

2. Operators may also make management changes to inspections, maintenance, training and work practices. Emergency response plans and exercises are generally addressed by both the facility operators and municipal fire departments.

3. The third type of risk control measure, restricting land use surrounding the facility, is handled by municipal planning departments.

As shown in Figure C-1, Appendix C, an essential component of the risk management process is stakeholder participation, which includes keeping the public informed, helping them understand how the facility's risks are defined, measured and managed and ensuring public participation in risk control decisions such as land use.

The QRA Process at the CXY Chemicals Plant

BOVAR followed the general steps outlined above to conduct the 1994 QRA and 1997 update report. To prepare the 1997 report, BOVAR made two additional site visits in 1997, conducted interviews with plant personnel and reviewed updated information on plant operations and storage conditions. CXY Chemicals collected data on inventory, pressure and temperature in the 300 tonne chlorine storage tank for the 1997 assessment. BOVAR also had discussions with A. D. Little who reviewed the 1994 study to ensure that both consultants were using the same updated information on plant conditions and the risk assessment methodology used in this report.

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Worst case and other more realistic potential hazardous events at the plant were identified. Tables B1 to B3, Appendix B, present the release events including the analyses while Table B-4 outlines assumptions made. The frequencies and consequences of release events were estimated using historical data, fault trees and event trees[1], and BOVAR's proprietary models for modelling chlorine releases and quantifying risk, taking into account local weather patterns. BOVAR's computer models are consistent with the recommendations of the Centre for Chemical Process Safety and the Chlorine Institute.

Methods

Time and space-dependent concentration profiles for each release were determined using BOVAR's model based on the SLAB model developed by Lawrence Livermore Laboratories (Ermak, 1990) and adapted by BOVAR for risk analysis applications. This model takes into account the heavy gas behaviour of chlorine clouds released from pressure-liquefied storage, the thermodynamics of evaporating droplets within the cloud and the effect of atmospheric humidity on the thermodynamics of the gas cloud. The model does not take into account significant terrain features other than surface roughness. (There are no practical models available that correctly model terrain effects on heavy gas clouds.)

Hazard Identification and Frequency Analysis

The hazardous events of interest to the present study are significant chlorine releases into the atmosphere. The major hazard of concern is toxicity of a chlorine cloud with potential to reach areas outside the CXY Chemicals plant boundaries.

Several approaches were adopted in this study to estimate frequency of hazardous events. The first approach involved using existing industry data on historical accidents for chlorine releases.

The second approach involved Fault Tree Analysis which is a common approach when events of interest have a very low probability of occurrence, i.e. they have occurred only very infrequently or not at all in the past. External Event Analysis was also conducted where several events were considered in the frequency analysis. Earthquakes were found to be the most significant external events that could result in rapid release of all or most of the contents of the 300 tonne storage tank.

Meteorology

The dispersion models require data on frequency of occurrence of wind conditions (speed and direction) and turbulence. Greater Vancouver Regional District (GVRD) data were selected as representative of weather frequencies in the plant area. Four weather conditions, (C stability, 2 metres per second [m/s]) (D Stability, 2 m/s), (E stability, 1 m/s), and (F Stability, 1.5 m/s) were selected to represent all weather conditions.

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[1] Fault trees are logic diagrams that show how a system can fail.
Event trees are graphical logic models that identify and quantify possible outcomes of a hazardous event.

Individual Consequences of Selected Release Scenarios

Individual consequences of chlorine releases were estimated in terms of downwind probability of fatality for chlorine release scenarios, four weather conditions and in dispersion over sea or land. Rates of release from pressurized containment for the different scenarios were estimated taking into account thermodynamics of flash evaporation. Assumed blowdown of pipelines and vessels allowed for effects of reduced temperatures and pressures on release rates.

Further details on rates of release, dispersion and risk calculations are provided in Tables B-1 through B-3 in Appendix B. Table B-1 details storage tank releases not related to an earthquake, Table B-2 outlines earthquake-related releases and Table B-3 displays release scenarios from sources other than the storage tank. Assumptions regarding frequency and size of release events are outlined in Table B-4, Appendix B.

Distribution of Individual Risk around the Plant and Comparison with Risk Acceptability Guidelines

Individual risk in the vicinity of the CXY Chemicals plant is calculated by adding individual risks caused by each release event, taking into account wind direction and weather frequencies. The potential risks expressed as annualized probability of fatality are then compared to guidelines provided by MIACC to aid in the development of land use decisions.

4. RESULTS

On average, a chlorine release from the storage tank in a non-earthquake situation could occur with a frequency of 10^{-5} per year or 1 chance in 100,000 years (Table B-1, Appendix B). An earthquake-related chlorine release from the storage tank could occur with a frequency of 5×10^{-5} per year, or 5 chances in 100,000 years (Table B-2, Appendix B). Potential releases and their expected frequencies from sources other than the storage tank are described in Table B-3 (Appendix B). Consequences of these events in terms of distances from the plant to 1% probability of fatality in the direction of the wind are shown in Figure B-1 , Hazard Zone Lengths Following Each Release Event (Appendix B).

The worst case events for the CXY plant were identified as the rupture of the 300 tonne storage tank during a severe earthquake or from other causes, resulting in chlorine releases from the storage tank. The total frequency of all such events is estimated to be very low, in the order of one occurrence in 16,000 years. This low frequency incorporates several factors, including the tank fill level frequency (see Table B-1, Appendix B) and the earthquake frequency (see Table B-5, Appendix B). As a result, the risk to the public is considered to be low. The magnitude of an earthquake such as that used in the QRA would cause widespread damage and historically has never been experienced in Vancouver. In arriving at these results, it was assumed that individuals were not evacuated or sheltered in buildings, but were fully exposed to the chlorine cloud. These assumptions result in overestimation of consequences.

Individual risk contours in the vicinity of the plant are superimposed on an aerial photograph and shown in Figure 4 on page 8. These contours indicate that the buffer zone is limited to plant boundaries in the northerly direction.

5. CONCLUSION

CXY Chemicals has implemented significant safety improvements at the facility since the 1994 study, and these enhancements have significantly reduced the risk to public safety from the operating conditions in 1994. This was achieved by reducing the storage of liquefied chlorine gas to one 300 tonne storage tank from three tanks storing 1500 tonnes, moving a propane storage tank to a more remote location, discontinuing the use of a barge with three, 300 tonne fixed tanks, and several other safety improvements.

Contours of individual risk around the CXY Chemicals plant as derived in this QRA, using updated 1997 information, indicate the risk to public safety in the vicinity of the CXY plant is well within MIACC's guidelines for the proposed land use. The buffer zone is limited to plant boundaries to the north. To the north of plant boundaries, manufacturing and open space development are acceptable under MIACC's Risk Acceptability Criteria. Using the same criteria, commercial and low-density residential and industrial development could proceed beyond the rail line north of the plant, and unrestricted land use is an acceptable option beyond approximately 600 metres to 700 metres north of the rail line. Wind speed, direction and weather patterns were taken into account in these calculations.

It must be emphasized that the QRA process generally uses methods and assumptions that would lead to an overestimation of risk. For example, it assumes that everyone remains outdoors during each hazardous event, whereas being indoors would provide some degree of protection against chlorine gas. Therefore, risk at any location would be generally smaller than shown in Figure 4 on page 8.

APPENDIX A
CXY Chemicals North Vancouver Plant Information

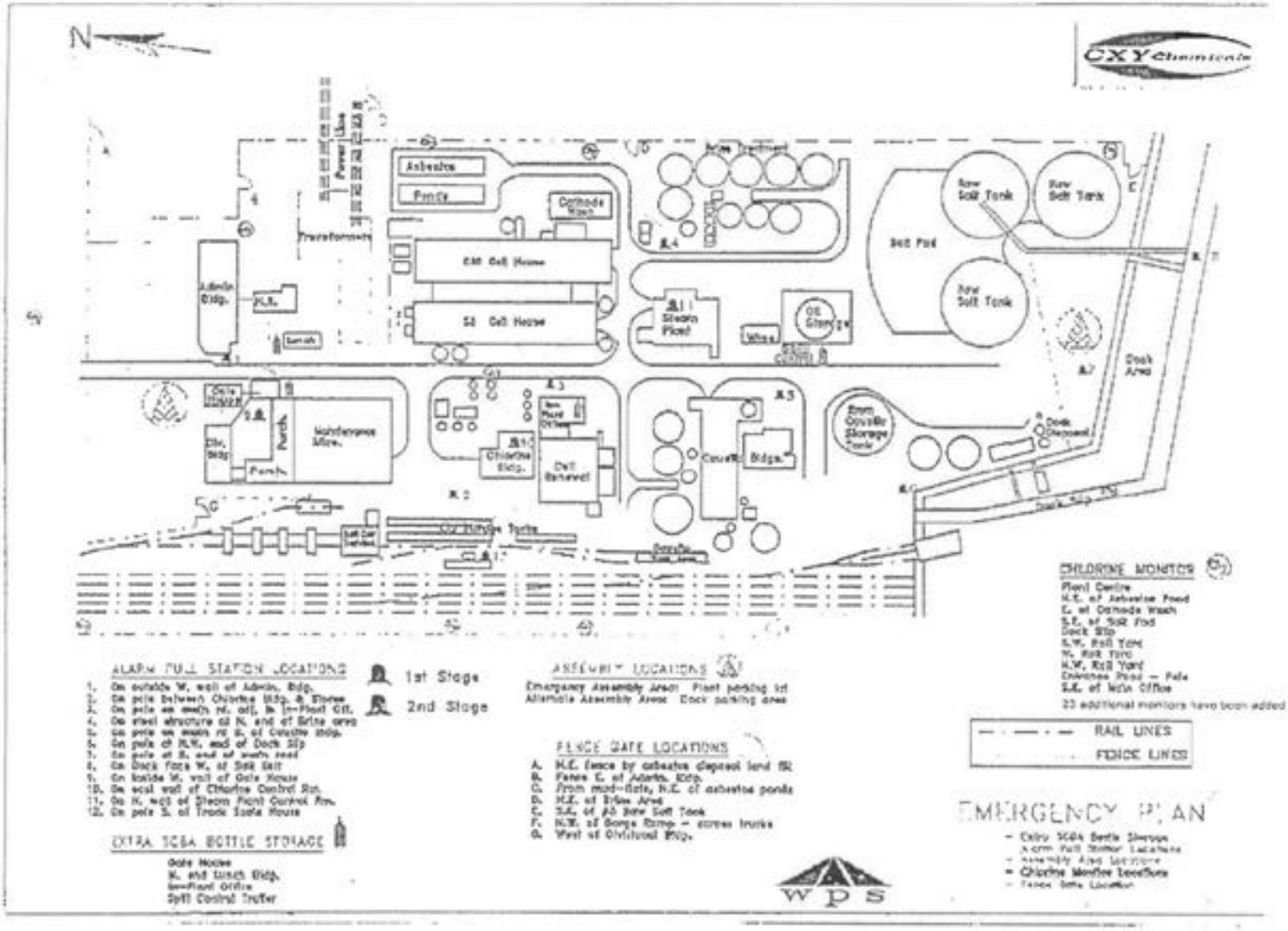


Figure A-1 CXY Chemicals North Vancouver Plant Layout

Table A-1 North Vancouver Plant Incident Record - Chlorine to Air (1994 - 1997).

Year	Remarks	Quantity kg	Cause
1994			
February	Emergency Vent System Surge	<5	EQ
June	Failed Gasket	15	EQ
July	Dockline	<5	EQ
November	Rupture Disk Loading	<5	EQ
November	Area	<5	EQ
December	Cell House Back Pressure Passing Valve Reboiler Failure	180	EQ
1995	No Incidents		
1996			
May	EVS Surge	<5	HE
October	Power Failure	<5	EQ
1997			
YTD- June	No Incidents		

EQ - Equipment Failure
HE - Human Error

APPENDIX B
Risk Analysis Information

Table B-1 Storage Tank Release Scenarios (non-earthquake).

Hazardous Event	Mass Released (tonnes)	Release Rate (kg/s) (assumed) (2)	Storage Pressure (psig) (3)	Storage Temp. (°C) (4)	Flash Fraction (%)	Mist Fraction (%)	Initial Boil-off (%) (1)	Total That Goes Into the Cloud During the Release (%)	Fraction of Time in this Condition (3)	Rupture Frequency (#/year)	Frequency of Event (#/year)
Storage Tank Capacity Release [1a]	289	700	65-80 (no air)	20	18	82		100	0.001	10^{-5}	10^{-8}
Large release [1b]	225	700	60-80 (air-padded)	-13	7	5	38	50	0.01	10^{-5}	10^{-7}
Medium release [1c]	200	700	50-75 (air-padded)	-13	7	5	38	50	0.05	10^{-5}	$5x10^{-7}$
Medium release [1d]	180	700	50-75 (air-padded)	-13	7	5	38	50	0.18	10^{-5}	$1.8x10^{-6}$
Medium release [1e]	150	700	50-75 (air-padded)	-13	7	5	38	50	0.32	10^{-5}	$3.2x10^{-6}$
Small release [1f]	100	700	50-65 (air-padded)	-13	7	5	38	50	0.30	10^{-5}	$3x10^{-6}$
Small release [1g]	50	700	50-65 (air-padded)	-13	7	5	38	50	0.12	10^{-5}	$1.2x10^{-6}$
Small release (6-day shutdown) [1h]	50	700	65-80 (no air)	20	18	82		100	0.02	10^{-5}	$2x10^{-7}$
							Total		1.001		10^{-5}

(1) storage tank spill containment dike is assumed to be ineffective for these scenarios

(2) approximately 0.30 m diameter hole

(3) based on plant operational data for March 1997; this follows the 1997 operational plan

(4) based on plant measurements in May 1997 except for [1a] and [1h]; assumed value for these latter two; the temperature of -13°C is expected to be generally representative of conditions throughout the year

Table B-2 Storage Tank Release Scenarios (earthquake).

Hazardous Event	Mass Released (tonnes)	Release Rate (kg/s) (assumed) (2)	Storage Pressure (psig) (3)	Storage Temp. (°C) (4)	Flash Fraction (%)	Mist Fraction (%)	Initial Boil-off (%) (1)	Total That Goes Into the Cloud During the Release (%)	Fraction of Time in this Condition (3)	Earthquake Frequency that would Rupture the Tank (#/year) (5)	Frequency of Event (#/year)
Storage Tank Capacity Release [1a/e]	289	700	65-80 (no air)	20	18	82		100	0.001	2.20×10^{-4}	2.20×10^{-7}
Large release [1b/e]	225	700	60-80 (air-padded)	-13	7	5	13	25	0.01	1.33×10^{-4}	1.33×10^{-6}
Medium release [1c/e]	200	700	50-75 (air-padded)	-13	7	5	13	25	0.05	1.11×10^{-4}	5.56×10^{-6}
Medium release [1d/e]	180	700	50-75 (air-padded)	-13	7	5	13	25	0.18	8.33×10^{-5}	1.50×10^{-5}
Medium release [1e/e]	150	700	50-75 (air-padded)	-13	7	5	13	25	0.32	5.88×10^{-5}	1.88×10^{-5}
Small release [1f/e]	100	700	50-65 (air-padded)	-13	7	5	13	25	0.30	2.70×10^{-5}	8.10×10^{-6}
Small release [1g/e]	50	700	50-65 (air-padded)	-13	7	5	13	25	0.12	1.25×10^{-5}	1.50×10^{-6}
Small release (6-day shutdown) [1h/e]	50	700	65-80 (no air)	20	18	82		100	0.02	1.25×10^{-5}	2.50×10^{-7}
							Total		1.001		5.08×10^{-5}

(1) storage tank spill containment dike is expected to be effective at these earthquake levels (based on Hooley and Schubak, 1997; see Appendix A1)

(2) approximately 0.30 m diameter hole

(3) based on plant operational data for March 1997; this follows the 1997 operational plan

(4) based on plant measurements in May 1997 except for [1a] and [1h]; assumed value for these latter two; the temperature of -13°C is expected to be generally representative of conditions throughout the year

(5) based on earthquake analysis, for given tank inventory levels, from Hooley and Shubak, 1994 (see Table B-5)

Table B-3 Release Scenarios (Other than from the Storage Tank).

Hazardous Event	Mass Released (tonnes unless otherwise noted)	Release Rate (kg/s)	Hole Dia. (m)	Storage Temperature (°C)	Flash Fraction (%)	Assumed Mist Fraction (%)	Assumed Initial Boil-off (%) (1)	Total % in cloud	Frequency of Event (#/year)
PSV large release[2a)]	13.5	15	0.1	-	100			100	10^{-4}
PSV small release[2b]	1.4	0.34	0.1	-	100			100	$9.4x10^{-2}$
Pump tank large release - simultaneous both tanks [3a]									1.1×10^{-4}
on-line tank	4.3	60	0.075	-20	5	15	40	60	
off-line tank	4.3	60	0.075	-3	10	50	40	100	
Pipe break large release [4a]	1	25	0.075	-18	5	20	40	65	$3x10^{-3}$
					100			100	
Pipe break small release [4b]	0.1	0.2	0.075	-	87	13		100	$2.8x10^{-2}$
Rail-car large release [5a]	82	55	0.075	10	13	87		100	1.25×10^{-6}
Scrubber release [6a]	1.35	4.5	0.1	-	100			100	$2x10^{-2}$
Scrubber release [6b]	5 kg	1	0.1	-	100			100	1
Hose (1" dia) break [7a]	11 kg	5	0.025	-13	7	30	63	100	$5x10^{-2}$
Hose break and protection system failure [8a]	4.5	5	0.025	-13	7	30	63	100	$5x10^{-4}$

Table B-4 Notes for Frequency and Release Size Estimates.

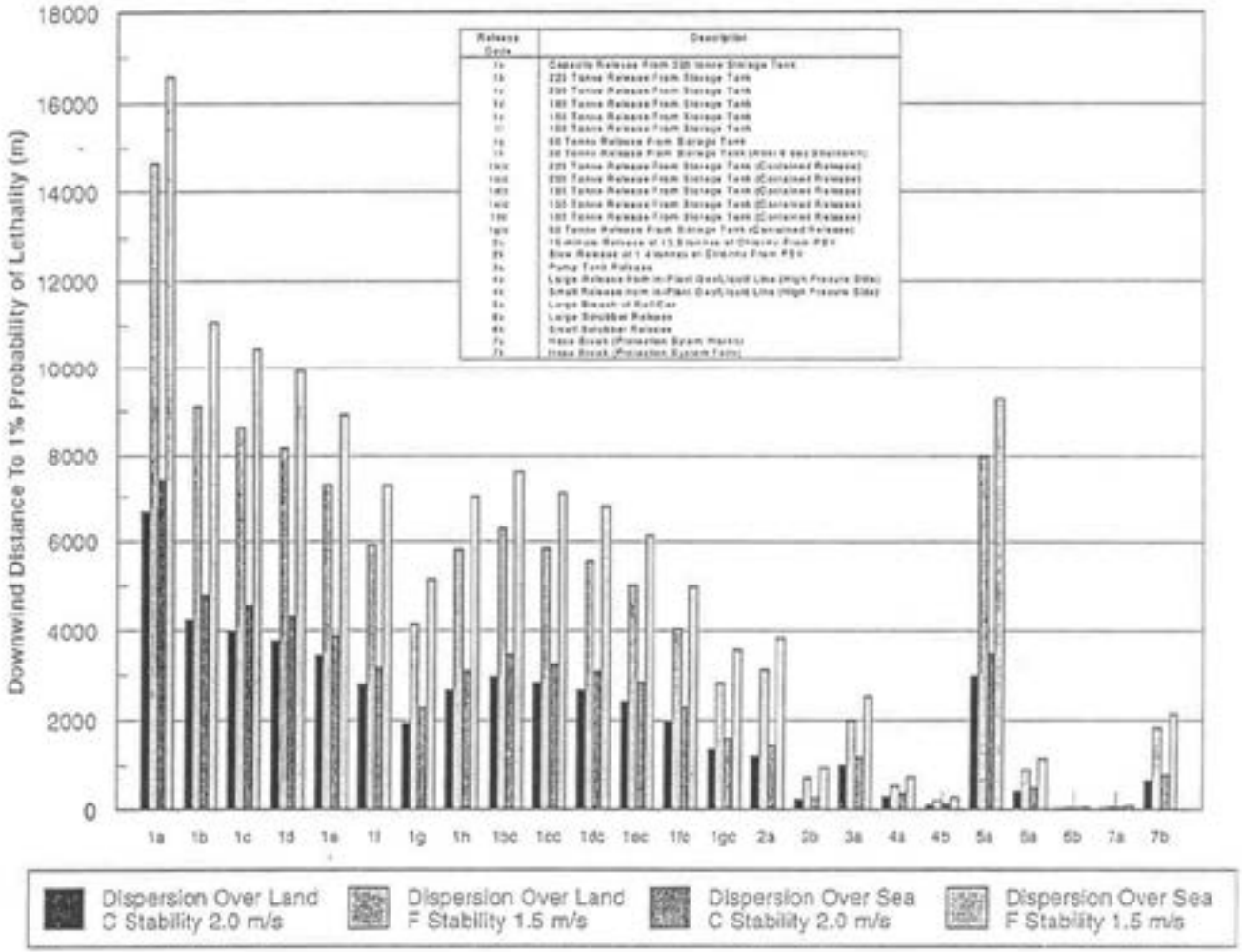
Storage tank rupture, spill containment ineffective	release as a result of a hole developing on the side of the tank, for example as a result of corrosion, with the liquid chlorine jetting out beyond the spill containment dike; frequency estimate based on historical pressure vessel failure data (Bush, 1988); release size based on inventory
Storage tank rupture, spill containment effective	release as result of a hole developing at the bottom of the tank, for example as a result of an earthquake; the spill containment is expected to be effective under such severe earthquake conditions (Hooley and Schubak, 1997); frequency estimate based on Hooley and Schubak, 1994; release size based on inventory
PSV large release[2a)]	frequency estimate based on plant-specific event tree for 15 minute sustained release, with control system failure as initiating event (from 1994 study)
PSV small release[2b]	frequency and release size based on historical industry-wide data (plant experience indicates no such release; see Appendix A3 for a list of plant experience)
Pump tank large release - simultaneous both tanks [3a]	frequency based on earthquake analysis for the strenghtened support structure (from Hooley and Shubak, 1994); release size based on inventory
Pipe large release [4a]	frequency based on historical industry-wide data for releases larger than 1 tonne, adjusted by a factor of 10 to recognize new piping and plant NDT practice; release size based on estimated inventory released over 40 seconds (see below for piping lengths)
Pipe small release [4b]	frequency based on historical industry-wide data, adjusted by a factor of 10 to recognize new piping and plant NDT practice; release size based on average of historical industry-wide data for releases smaller than 1 tonne; assumed release time of 500 s to isolate section (plant experience indicates no such release; plant piping length is approximately 245 m gas and 110 m liquid lines; the piping lengths at this plant have been minimized as a result of the recentpipe replacement program)
Rail-car large release [5a]	frequency estimate based on major Toronto area rail yard frequencies (1987 study for Transport Canada), adjusted for traffic and other conditions at the CXY yard; release size based on inventory
Scrubber release [6a]	assumed 5 minute sustained release; the frequency estimate is conservatively based on: one assumed failure over plant lifetime (plant experience indicates no such release), and the improved redundancies in plant protection systems against scrubber failure
Scrubber release [6b]	estimated historical plant experience is approximately once per year of a reportable "puff" release; "reportable" includes any incident with a detectable odour, or a perimeter alarm going off; typically these releases are much less than 5 kg
Hose break [7a]	historical generic data, adjusted for plant-specific usage hours, and also by a factor of 10 based on historical plant experience and hose inspection and replacement program practiced at the plant; assumed 2 second blow-down time for all liquid between valves
Hose break and protection system failure [8a]	combination of [7a] with an assumed protection system failure of 1%, resulting in a 15 minute sustained release until operator intervention

Table B-5 Estimation of Earthquake Frequencies for Storage Tank Release Events.

Cl2 Weight (tonnes)	Cl2 Weight (1000 lb)	Gross Weight (Tank plus Cl_2) (1000 lb)	Return Period (years) (from Hooley and Schubak, 1994)	Return Period (years) (interpolated from Hooley and Schubak, 1994)	Earthquake Frequency (#/year)	Fraction of Time Tank Contents at this Condition (From Plant Data March 1997)	Event Frequency (#/year)	
350	771	941	3000		3.33E-04	0	0.00E+00	
289	637	807	4500		2.22E-04	0.001	2.22E-07	note 1
225	496	666	7500		1.33E-04	0.01	1.33E-06	
200	441	611		9000	1.11E-04	0.05	5.56E-06	
180	396	566		12000	8.33E-05	0.18	1.50E-05	
150	330	500		17000	5.88E-05	0.32	1.88E-05	
140	308	478	20000		5.00E-05			
100	220	390		37000	2.70E-05	0.30	8.11E-06	
50	110	280	80000		1.25E-05	0.14	1.75E-06	

tank weight = 170000 lb
note 1: fraction of time based on assumed error condition - conservative estimate

Figure B.1 Hazard Zone Lengths Following Each Release Event (Distances Based on Maximum Downwind Extent of Individual Consequences Defined by 1% Probability of Lethality) (1997 Operations: 1 - 300 tonne tank; no chlorine tank barge) (All Scenarios, No Evacuation)



APPENDIX C
Risk Management Process

e *Risk Management Process*

e process of estimating the risks of a facility, judging its safety, and development of risk ntrol measures if required, comprises the risk management process. Before risk can be naged, it must be understood. The steps in the risk management process are shown in flow rt form in Figure C-1.

tem description consists of understanding the components of the facility and how it operates, ablishing an inventory of hazardous substances used, transported, and manufactured, and ng familiar with the surrounding area that might be affected by hazardous events in the ility, in terms of population, land-use, and climate, etc. Examples of hazardous facilities are mical plants, refineries, and transportation corridors where dangerous goods are transported, h as rail corridors, pipelines or waterways.

k analysis helps to understand the risk of a hazardous facility and the reductions in risk ievable given certain risk control measures.

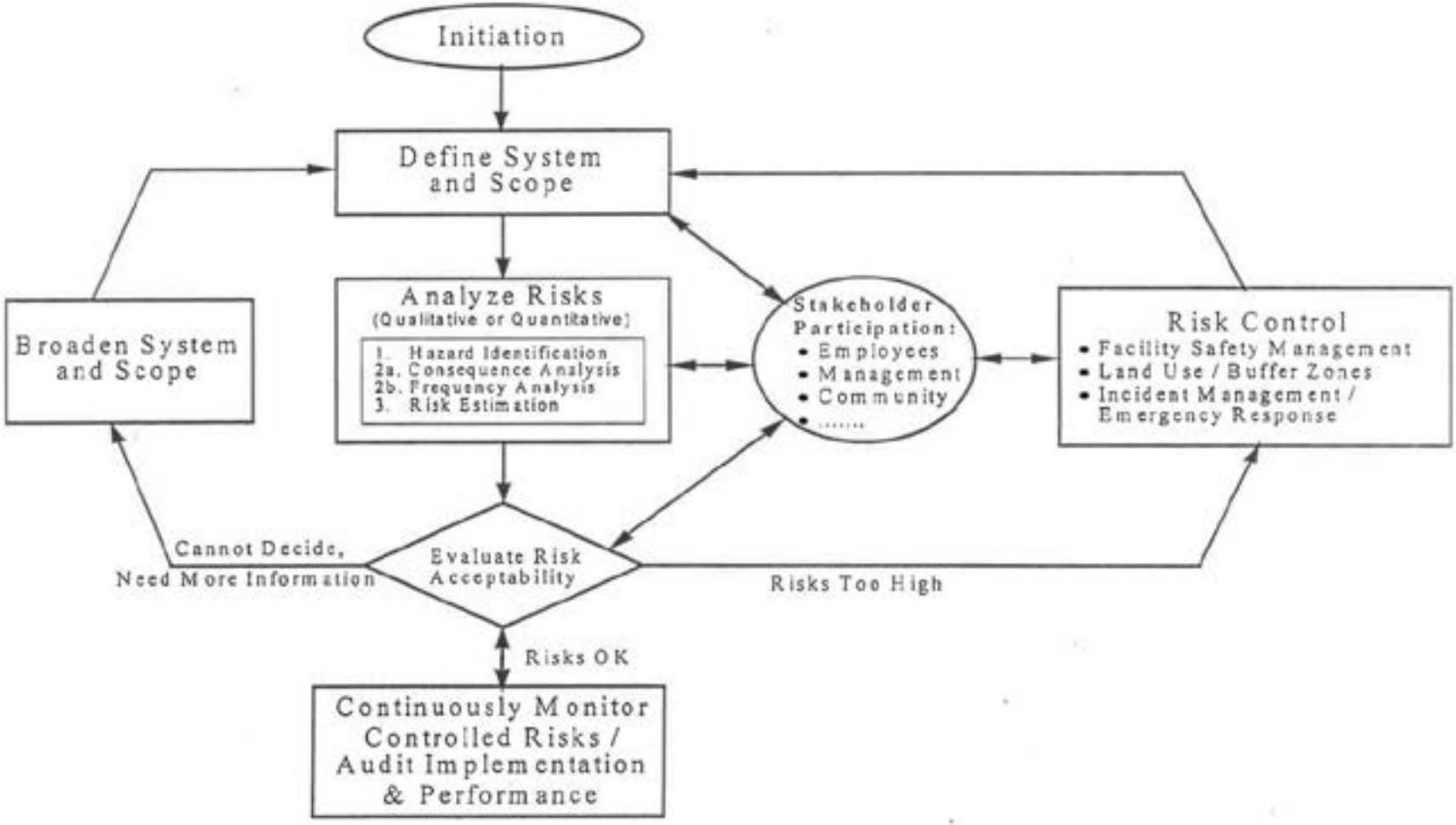
zard identification answers the question: *What can go wrong?* Potentially hazardous events identified and defined in this step. For example, the realization that one can get hit by a car ile crossing a street, and that one could die or become injured as a result of this accident, stitutes the hazard identification step.

quency analysis and consequence analysis answer the following questions for the identified nts: *How often is the event expected to occur?* and, if it occurs, *What are the consequences of event? Frequency analysis* makes use of *historical accident data* in similar facilities. For y rare events, fault and event trees are also used. *Consequence analysis* consists of modelling behaviour of releases of hazardous substances, and their impact on critical receptors making of *dose/response (vulnerability) data* and models. *Risk estimation* is the process by which frequencies and consequences of events are combined to quantify risk.

results of risk analysis are used extensively in risk management decisions throughout the ld.

uncertainties in estimating the chance of rare events, and in projecting the effects on human ulations, are considerable. However, high uncertainty does not mean high risk. Estimation ncertainties in risk estimates is currently an area of active research.

Figure C-1 The General Risk Management Framework



Risk evaluation answers the questions: *Is the risk judged to be acceptable?*, and, *Do we need to do anything about it?* Whether we judge a risk to be small or large, acceptable or unacceptable depends on many factors. *Voluntary risks* are those we assume due to some perceived benefit, e.g., smoking, sky-diving. *Involuntary risks* are imposed on people by decisions made by others or by natural occurrence, e.g., second-hand smoke, violent storms. A hazardous facility is often seen as posing an involuntary risk on someone living nearby (especially if the facility is built after the person starts living there) but it might be seen as a voluntary risk if someone chooses to live near an existing facility provided that the person is aware of the risks before moving there. The MIACC risk acceptability criteria are designed for cases of involuntary risk resulting from hazardous facilities. They are intended to be used as public safety guidelines.

The combined process of *risk analysis* and *risk evaluation* is usually called *risk assessment*.

If the risks are judged to be acceptable, then further risk control measures, or system changes will not be required. However, it is then essential to develop programs to *monitor* the situation at a hazardous facility so as to proactively manage the risks of the operation, which may change over time. *Safety audits* are among the tools used for this purpose.

If it is judged that further safety improvements are required, risk control options introducing system modifications need to be examined.

Risk control answers the question: *What can be done to reduce the risks?* Risk can be reduced by decreasing the chance and/or consequences of hazardous events. Risk control measures can be broadly classified into

- safety management of the hazardous facility; this includes technological measures, such as design changes, inventory reduction, etc., and management measures, such as inspection, maintenance, training and work practices,
- incident management, such as emergency response, emergency response plans and exercises, and
- land-use restrictions.

The "facility safety management" type of risk control measures can generally only be taken by the operators of a hazardous facility. Incident management issues are generally addressed jointly by municipal fire departments and the operators of the facility. The third type of risk control measures is addressed by municipal planning departments.

Risk control measures will have certain costs associated with them. By estimating the risk reduction possible for each option, it is possible to assess the costs and benefits for each option, and informed decisions on which option should be selected can be made on this basis.

Risk management is the process by which the risks associated with hazardous activities are estimated, evaluated, and reduced, if required, using risk control measures. Communication of

APPENDIX C
Risk Management Process

The Risk Management Process

The process of estimating the risks of a facility, judging its safety, and development of risk control measures if required, comprises the risk management process. Before risk can be managed, it must be understood. The steps in the risk management process are shown in flow chart form in Figure C-1.

System description consists of understanding the components of the facility and how it operates, establishing an inventory of hazardous substances used, transported, and manufactured, and being familiar with the surrounding area that might be affected by hazardous events in the facility, in terms of population, land-use, and climate, etc. Examples of hazardous facilities are chemical plants, refineries, and transportation corridors where dangerous goods are transported, such as rail corridors, pipelines or waterways.

Risk analysis helps to understand the risk of a hazardous facility and the reductions in risk achievable given certain risk control measures.

Hazard identification answers the question: *What can go wrong?* Potentially hazardous events are identified and defined in this step. For example, the realization that one can get hit by a car while crossing a street, and that one could die or become injured as a result of this accident, constitutes the hazard identification step.

Frequency analysis and consequence analysis answer the following questions for the identified events: *How often is the event expected to occur?* and, if it occurs, *What are the consequences of the event? Frequency analysis* makes use of *historical accident data* in similar facilities. For very rare events, fault and event trees are also used. *Consequence analysis* consists of modelling the behaviour of releases of hazardous substances, and their impact on critical receptors making use of *dose/response (vulnerability) data* and models. *Risk estimation* is the process by which the frequencies and consequences of events are combined to quantify risk.

The results of risk analysis are used extensively in risk management decisions throughout the world.

The uncertainties in estimating the chance of rare events, and in projecting the effects on human populations, are considerable. However, high uncertainty does not mean high risk. Estimation of uncertainties in risk estimates is currently an area of active research.

the risks to the public exposed to these risks, and participation of the affected public in understanding the risks, the acceptability of these risks and the risk control measures that would be implemented, are essential components of the risk management process.

Common Risks

In evaluating levels of individual risk, and putting the risk acceptability criteria into perspective, it is useful to keep in mind the risk levels encountered in other activities. Some common risks are presented in Table C-1 for this purpose.

Table C-1 Common Risks in Canada (a)

Cause	Individual Risk (b)
Motor Vehicle Accident	170
Falls	73
Poisoning (c)	27
Dwelling Fires	20
Excessive Cold	5
Cataclysmic Storm	0.5
Earth Movements	0.2
Lightning	0.12

(a) Data presented are Canada-wide and were derived from information in "Causes of Death" Statistics Canada Publication #84-203 (1985).

(b) These are average individual risk values, based on a population of ~25,000,000. Data are rounded.

(c) Poisoning includes accidental poisoning due to poisonous and other substances, surgical complications and misadventures to patients.

The data in this table indicate that some of the risks which we are familiar with range from 170 chances in a million (1.7×10^{-4}) per year (chance of death due to a motor vehicle accident) to 0.12 chances in a million (1.2×10^{-7}) per year (lightning). While not directly comparable, these values are presented to put into perspective the risk acceptability guidelines presented in Figure C-1, where it is indicated that, above 100 chances in a million (10^{-4}) no land use other than the risk source would be allowed, and no restrictions to land use would apply below an individual risk level of 1 in a million (10^{-6}) per year. It should be noted that the risks shown in Table C-1 are different in character from the risks due to a hazardous facility. For example, dying in a motor vehicle accident is usually considered to be a voluntary risk, i.e., one chooses to get into the vehicle. Dying as a result of lightning may or may not be considered voluntary since one can try to avoid being in places susceptible to a lightning strike (such as being in the middle of a field during an electrical storm with a metal rod in one's hand). The distinguishing feature of these risks from risks due to a hazardous facility is that these are not considered "dread" hazards. Dread hazards usually have the following characteristics: potential for multiple fatalities, man-made, and generally of an involuntary nature. Therefore, the numbers given in the table should not be used to justify a hazardous facility but rather only to put the risk numbers in perspective.

Accuracy of the Quantitative Risk Analysis Process

The level of detail in Quantitative Risk Analysis (QRA), and hence the accuracy of the estimated risk, can vary significantly depending on the scope selected at the beginning of the assessment. The 1994 study scope provided for the following:

- familiarization with plant systems and operation based on review of plant drawings, findings of existing studies and a site visit and interviews with personnel;
- identification of the more significant events that could lead to releases with potential public consequences, based on the review and plant visit using knowledge-based HAZOP (HAZard and Operability study technique;
- estimation of the frequencies of these hypothetical events based on a combination of historical accident data and top level fault trees where historical data were not sufficient;
- estimation of hazard zones and potential consequences for the release events using state-of-the-art dispersion and vulnerability models, taking into account the commonly encountered weather conditions at the plant site;
- estimation and presentation of risk in quantitative terms by combining the frequency and consequence information; and
- evaluation of this risk by comparing it to commonly used acceptability criteria.

The 1997 Update Report built on the information and findings from the 1994 study. To prepare the 1997 update report, BOVAR made two additional site visits in 1997, conducted interviews with plant personnel and reviewed updated information on plant operations and storage conditions. CXY Chemicals collected data on inventory, pressure and temperature in the 300 tonne storage tank in 1997. BOVAR also had discussions with A. D. Little, the peer reviewer retained by the District of North Vancouver to ensure that both consultants were using the same updated information on plant conditions and the risk assessment methodology used in the 1997 report.

The risk analysis has been refined as compared to the 1994 study, taking into account the current plant conditions and other new technical information that has since become available.

Since the focus of the Update Report is public safety, the events with significant potential public consequences have been treated in more detail than events with little or no public consequences.

Exhibit 3

Arthur D. Little Inc.'s independent review of the CXY Chemicals North Vancouver Plant Assessment of Chlorine Safety Risk to the Public 1997 Update Report

Document No: 113804

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Arthur D Little

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July 11, 1997

J. Irwin Torry
Manager of Planning
The Corporation of The District of North Vancouver
355 West Queens Road
North Vancouver
British Columbia
V7N 2K6

Re: ADL Reference No. 30728

Dear Mr. Torry:

Arthur D. Little of Canada Limited is pleased to submit this summary of our independent review of *CXY Chemicals North Vancouver Plant Assessment of Chlorine Safety Risk, 1997 Update Report,* prepared by BOVAR Environmental and dated July 4, 1997. The District of North Vancouver requested an independent review of the risk analysis described in this report because a rezoning application for certain lands in the Maplewood area and future uses depend in part on the placement of the risk contours relative to these areas. Therefore, it is particularly important that the Council be comfortable with the accuracy of the current study's findings and understand its limitations.

The review process started last summer when we reviewed the August 1994 report, *Canadian Oxy North Vancouver Plant Quantitative Assessment of Safety Risks*, as well as additional appendices and addenda associated with that report. In October 1996 we submitted an initial set of detailed comments on the 1994 report. As a result of the numerous design and operational changes instituted by the plant as well as our comments, the 1994 report was updated and totally rewritten. Our latest review is based on that 1997 Update Report, numerous telephone conversations with CXY Chemicals and BOVAR Environmental personnel, and a site visit in early June 1997. These additional sources of information form an integral part of our review, as the 1997 Update Report is not intended to cover all the details of the risk analysis.

Our review efforts focused on the soundness of the methodologies and the reasonableness of simplifications and assumptions, in order to identify inconsistencies, gaps or limitations in the analysis. This also allowed us to comment on the overall results. In general, we have not commented on the text of the 1997 Update Report except for interpretations of the results of the risk analysis.

The material in this letter reflects Arthur D. Little's best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this letter, or any reliance on or decisions to be made based on it, are the responsibility of such third party. Arthur D. Little accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on the information contained in this letter.

J. Irwin Torry
Manager of Planning
The Corporation of The District of North Vancouver

Our review covered:

- the identification of hazards–*what can go wrong?*
- the frequency analysis–*how likely is it to happen?*
- the consequence analysis–*what happens if the undesired event occurs?*
- the overall estimation of risks–which pulls all the previous items together to develop an estimate of the risk to the affected community.

The methodology for each step was reviewed along with the assumptions made. We evaluated: the approach and assumptions used in the consequence modeling, including the credibility/applicability of the selected meteorological conditions; the completeness and soundness of the frequency analysis/approach; the rationale for the frequency values; and the way in which the seismic risk analysis conducted by Hooley & Schubak Ltd. in 1994 was taken into account in the overall frequency analysis. The implications of our findings in each area on the overall risk estimates were also determined to the extent possible without recreating the entire analysis.

Hazard Identification

The primary hazard identification approach used in the report was based on the knowledge of incidents that have occurred in the chlorine industry in the past. This approach gives a general indication of the range of hazards associated with a particular type of operation, but is not always helpful in accounting for site-specific design features that make one location more or less hazardous than another–including consideration of such simple things as the number of loading or unloading operations, the length of piping, etc. It also cannot reflect the risk reduction benefits associated with various modifications or improvements.

Given that the emphasis of this report was on low frequency/high consequence events rather than all events which could have off-site impacts, most of these site-specific factors will not have significant impacts on the overall risk levels. In addition, for newer facilities or those with extensive upgrades or relatively small operations–such as this plant, this approach will generally be conservative (i.e., it will lead to estimates for the frequencies of failure which are higher than would be determined by other approaches). BOVAR Environmental has also taken the scale and condition of the North Vancouver plant into account by adjusting some of the basic historical frequency values.

The 1997 Update Report focuses on the risk from chlorine releases, and does not address potential propane or hydrogen releases or the potential for associated fires or explosions to cause damage to chlorine-containing equipment. In the case of hydrogen, BOVAR Environmental indicated that they believed that any chlorine releases which could result from hydrogen explosions would be included in the historical data set. Given the relocation of the propane tank, it is unlikely that a propane release would lead to a chlorine release.

J. Irwin Torry
Manager of Planning
The Corporation of The District of North Vancouver

The historic-incident-based hazard identification was supplemented with a detailed earthquake analysis for the storage tank and a consideration of other causes of tank failures. Thus, the largest releases have been examined in a more site-specific manner. The identification of those events with the potential to impact the areas of concern to the north of the site is judged to be reasonably comprehensive.

Frequency Analysis

The seismic analysis of the 300-tonne storage tank explicitly considered different fill levels and analyzed the response of the tanks at each level. A separate analysis of the dike indicated that it would be expected to remain intact in the same earthquake events that would fail the tank. Even if this assumption were not accurate, the analysis of other tank failure modes did assume that either the dike would fail or that the release would spew over the edge of the dike. Given the layout of the site, the assumption that such releases would be totally unconfined (that is, they could spread to their maximum extent) is considered very conservative.

The analysis of releases from the rail car based the failure frequency on a 1987 study for Transport Canada, which evaluated chemical transportation risks in rail yards in Toronto. While the results of this earlier study were scaled to account for the level of rail traffic on the site, the Transport Canada study did not include rail car failures which result from causes other than collision and derailment. Given that there are 1735 rail car movements of chlorine from the CXY Chemicals site each year, and that each car may remain on site for two or more days in a filled state, on average there are roughly ten rail cars on site in a full condition over the course of the year. These rail cars are susceptible to earthquakes, corrosion, fatigue, etc. We would have therefore expected a failure frequency at least an order of magnitude higher than was presented in the report. Both the frequency and consequences of rail car releases would still be dominated by the tank failure scenarios, but releases from the rail car would be expected to contribute slightly to the risk contours.

In the area of tank car loading, the report describes the new loading station and all its protective features. However, there has not been any indication that this station would be used either exclusively or preferentially. Thus, the accuracy of the frequency estimates for these loading-related releases is somewhat questionable as they appears to be based on the design of the new station. However, in terms of the overall risk results, these events are not significant.

Considering all of the above, it is possible that the risk in the immediate vicinity of the plant, particularly to the west, could be higher than indicated. No significant changes are expected in the areas of concern to the north of the plant, however.

J. Irwin Torry
Manager of Planning
The Corporation of The District of North Vancouver

Consequence Analysis

The most significant concern we had about the consequence modeling was the original approach used to estimate the amount of mass in the cloud, particularly for the large releases from the storage tank. The approach used in the original analysis tended to underestimate the amount of material in the cloud. Arthur D. Little provided several release modeling results for use in the 1997 Update Report which determined the amount of mass in the cloud based on more realistic physical phenomena. This data was then used as input to BOVAR Environmental's consequence models to predict the dispersion distances and areas shown in the revised report.

The consequence modeling has been performed using COBRA, which is a BOVAR Environmental proprietary model based on a well known and documented public-domain model known as SLAB. Most of the dispersion models in use today (including SLAB, but excluding hydrodynamic codes) are not suitable for performing dispersion calculations at low wind speeds. This is especially true when the surface roughness of the ground (i.e., the irregularities in the surface–picture a smooth surface of a pond versus a gravel driveway) is high enough that it effectively blocks the wind and contains the vapors emitted from liquid pools of materials that are in a cryogenic state or which are heavier than air, limiting further dispersion. Therefore, to limit the conservatism associated with the use of these models at low wind speeds, the 1997 Update Report uses a more complete set of wind speeds and stability classes. However, since all the wind speeds considered are still very low (2 m/s or less), the dispersion model results are likely to be conservative, that is they will over predict the potential areas covered by a chlorine cloud.

Risk Estimation

The development of risk contours is the most meaningful measure for land-use planning purposes and the basic process used for calculating the risk levels appears to be sound. Given the relatively limited distances for the risk contours, a dispersing chlorine cloud would transit these distances in a manner of minutes, making it unlikely that anyone could be evacuated in the event of a release. Thus, it is reasonable to calculate the risk levels without any credit for evacuating portions of the exposed population.

The 1997 Update Report does state that the risk at any location could be expected to be less than indicated in Figure 4 due to the protection afforded by going or staying indoors to reduce one's chlorine exposure. Being indoors would actually reduce the risk to those persons who are indoors, but does not change the potential risk level at a particular location.

J. Irwin Torry
Manager of Planning
The Corporation of The District of North Vancouver

Overall Conclusions

There are a number of factors which have been either over- or underestimated for individual events; however, the overall results are judged to be reasonable representations of the public risk levels associated with current chlorine plant conditions and operations.

While not the focus of the current planning decision, we do believe that it is important to note that the area to the west of the CXY Chemicals plant is at a higher risk level than might be desired. This is not at all surprising given the proximity of the western plant boundary to the storage tanks and rail car loading stations. This is an existing land use which has experienced a significant reduction in risk as a result of the recent changes in plant operations and the plant improvements. It will be important to maintain good communications with the operations to the west of the plant for the purpose of emergency response and proper action in the event of a release.

Please let me know if I can clarify any of these points or if you have additional questions.

Sincerely,

[redacted]

Lisa M. Bendixen
Principal, Safety and Risk

Summary of the Independent Review of *CXY Chemicals North Vancouver Plant Assessment of Chlorine Safety Risk, 1997 Update Report*

Arthur D. Little of Canada Limited has conducted an independent review of *CXY Chemicals North Vancouver Plant Assessment of Chlorine Safety Risk, 1997 Update Report*, prepared by BOVAR Environmental and dated July 4, 1997. Our efforts focused on the soundness of the methodologies and the reasonableness of simplifications and assumptions, in order to identify inconsistencies, gaps or limitations in the analysis. This also allowed us to comment on the overall results. Our review covered:

- the identification of hazards – *what can go wrong?*
- the frequency analysis – *how likely is it to happen?*
- the consequence analysis – *what happens if the undesired event occurs?*
- the overall estimation of risks – which combines all the previous items together to develop an estimate of the risk to the affected community.

A summary of our findings in each area is given below.

Hazard Identification: The primary hazard identification approach used in the report was based on the knowledge of incidents that have occurred in the chlorine industry in the past. For newer facilities or those with extensive upgrades or relatively small operations–such as this plant, this approach will generally be conservative. BOVAR Environmental has also taken the scale and condition of the North Vancouver plant into account by adjusting some of the basic historical frequency values.

The historic-incident-based hazard identification was supplemented with a detailed earthquake analysis for the storage tank and a consideration of other causes of tank failures. The identification of those events with the potential to impact the areas of concern to the north of the site is judged to be reasonably comprehensive.

Frequency Analysis: For the storage tank, the greatest concern was seismic damage and this was looked at in much greater detail than the other potential failure events. The 1997 Update Report also considers other sources of tank failure and is more comprehensive in its treatment of other events than the 1994 report was. The rail car release frequencies given in the report are lower than expected, but should not influence the overall risk levels significantly as the frequency and consequences of such releases would still be dominated by the tank failure scenarios.

Consequence Analysis: The most significant concern we had about the consequence modeling was the original approach used to estimate the amount of mass in the cloud, particularly for the large releases from the storage tank. This has been improved in the 1997 Update Report. A more complete set of wind speed and stability classes has been used in the current report; however, since all the wind speeds considered are very low, the dispersion model results are likely to be conservative (that is they will over predict the potential areas covered by a chlorine cloud).

Risk Estimation: The development of risk contours is the most meaningful measure for land-use planning purposes and the basic process used for calculating the risk levels appears to be sound. Given the relatively limited distances for the risk contours, a dispersing chlorine cloud would transit these distances in a manner of minutes, making

it unlikely that anyone could be evacuated in the event of a release. Thus, it is reasonable to calculate the risk levels without any credit for evacuating portions of the exposed population.

There are a number of factors which have been either over- or underestimated for individual events; however, the overall results are judged to be reasonable representations of the public risk levels associated with current chlorine plant conditions and operations.

While not the focus of the current planning decision, we do believe that it is important to note that the area to the west of the CXY Chemicals plant is at a higher risk level than might be desired. This is not at all surprising given the proximity of the western plant boundary to the storage tanks and rail car loading stations. This is an existing land use which has experienced a significant reduction in risk as a result of the recent changes in plant operations and the plant improvements. It will be important to maintain good communications with the operations to the west of the plant for the purpose of emergency response and proper action in the event of a release.

July 11, 1997

The material in this summary statement reflects Arthur D. Little's best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this statement, or any reliance on or decisions to be made based on it, are the responsibility of such third party. Arthur D. Little accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on the information contained in this statement.

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Exhibit 4

Questions and Answers from September 23, 1997 public information meeting

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CANOXY - Bylaw 6762
September 23, 1997 Public Information Meeting

PUBLIC QUESTIONS/COMMENTS	ANSWER
1. Measurement of chlorine emissions/spills (low level basis around plant) by GVRD	
a) why not put in monitor?	a) CXY already has numerous monitors along the perimeter of the facility. Any GVRD monitor in the existing station would be less than 500m away from an existing monitor and therefore redundant. Only available instruments utilize technology not compatible with existing GVRD monitoring network infrastructure and do not have the very low level of detection required for longer term chlorine monitoring.
b) concern with frequency of monitoring - regular vs. annual?	b) Stack testing of emissions is carried out on a regular basis and is designed to ensure compliance with the permitted emission levels. The frequency is consistent with other such operations in the region for the purpose described above.
2. Riverside intersection and one-way traffic flow proposal	
a) what about traffic by Maplewood Pub, etc. - affect on patrons?	a) Should Riverside Drive West be closed, traffic on Spicer Avenue would increase during business hours. This would affect the patrons of the Maplewood Pub. If parking is permitted on the south side of Spicer Avenue then patrons should have no difficulty crossing the street, although they may have to walk to the nearest intersection and use the crosswalk.

	There would be a nominal increase in traffic during non-business hours. This should not affect patrons. It should be noted that both Spicer Road and Amherst Street would be upgraded to handle the anticipated traffic in a safe, efficient manner. No problems other than normal rush hour congestion are foreseen. This area is under review by the District's traffic consultant.
b) how does traffic interact with CXY, recycling depot, etc.?	b) Traffic from CXY, the recycling depot, and other local businesses would exit via Amherst Street. Amherst Street would be upgraded to handle this traffic in a safe, efficient manner. No problems other than normal rush hour congestion are foreseen.
c) what about railroad tracks?	c) The District has met with BC Rail and CXY to discuss the relocation of the northern set of tracks. Preliminary indications are that this is feasible thus allowing Spicer Road to be reconstructed with additional width for additional travel lanes and possible parking. This is under review by the District's traffic consultant.
d) Maplewood not in favour of one-way; prefer to keep Riverside open.	d) Comments have been received from many people, some of whom do support restricting traffic on Riverside Drive West, while other people do not support this restriction. In the long term, traffic consultants have noted that restricting traffic on Riverside Drive West will provide the safest, most efficient traffic movements through the neighbourhood. No decision has been made on this issue.

3.	Concern with CXY reporting spills		
	a) what are the requirements/regulations?	a)	CXY is required to report any spill of chlorine over 5 kg. to GVRD and the Ministry of the Environment. We also report off-site odour complaints or chlorine spills under 5 kg. that we believe will have an impact beyond our fence line.
	b) who is responsible for damages resulting from spill - CXY or District?	b)	Damages would be assessed by the courts (civil). CXY no doubt would be held accountable.
	c) what about effects of spill on other side of inlet; specifically, systems for alerting residents?	c)	The CANALERT system functions only on the North Shore. This is something Burnaby and CXY could look at in the future if the Municipality was interested.
4.	In the event of a chlorine release		
	a) how should the public react in event of a chlorine release, i.e. what about sheltering, those in vehicles, best advice?	a)	The best advice for personal protection in the event of a chlorine release is to shelter-in-place. That is, go indoors, shut all doors and windows, turn off fans, etc. which draw in outside air, and remain until the "all clear".
	b) if concentration of gas does get high (in your 'shelter'), how do you protect yourself?	b)	As chlorine is heavier than air, moving to an upstairs location will offer you greater protection than going to the basement. However, making your house as airtight as possible will minimize the chance that chlorine would reach a dangerous level in your house.
	c) what is the responsibility of other employers in the area (other than CXY) for training employees for an emergency?	c)	It would be helpful if employers, particularly in the Maplewood area, were to brief their staff on appropriate measures to take in the event of a chemical emergency. The North & West Vancouver Emergency Program would welcome the opportunity to assist employers in developing an awareness program for their businesses.

5. Dollarton realignment a) what is the benefit?	a) The benefit of the Dollarton realignment is three fold: i) removes through traffic out of the Maplewood residential area; ii) eliminates the conflict between through traffic on Dollarton and elementary school age children crossing to Maplewood elementary school; and iii) provides an enhanced entrance to the Maplewood Business Park.
b) why not expropriate CXY land for the highway?	b) The District would rather work in a co-operative fashion with CXY and have them pay for one half the construction costs, as opposed to a costly expropriation process and the District paying the entire cost of constructing a realigned roadway; and
c) what came first - business park or realignment?	c) The realignment of Dollarton Highway preceded the business park.
6. How safe are the valves on the rail cars?	All valves on chlorine cars are contained within a protective dome. The dome is sealed and cannot be opened without a special tool. This secures the valve from exposure or vandalism.
7. a) are the two 600 ton tanks still in place and still in use? b) would the tanks be used again & why?	a) & b) Only the 300 tonne tank is used consistently for liquid storage. One 600 tonne tank is set up for use in an emergency situation or for use when the 300 tonne tank is out of service for maintenance - about 3 weeks every two years. If used, storage in the 600 tonne tank never exceeds the 300 tonne limit. The second 600 tonne tank is used in the manufacturing process and contains only vapours - no liquid chlorine is stored in this tank.
c) what would be the risk?	c) This usage was factored into the risk assessment (QRA). The 600 tonne tank will only contain a small amount of liquid chlorine for a small percentage of the time. As a result, the occasional use of one 600 tonne tanks as backup to the 300 tonne tank will not contribute substantially to the risk.

8.	We should develop better egress into the area before more development, such as another Seymour Crossing, 3rd crossing, dedicated lanes into Cove to avoid bridge line ups. Is there residential development planned for this area?	The Ministry of Highways have investigated a number of options for a Third Crossing of Burrard Inlet, however, they have made no commitments to proceed with this project. The Ministry of Highways have also investigated upgrading the Second Narrows crossing, but have made no commitments to proceed with this project. The District is investigating upgrading the Dollarton Highway bridge over the Seymour River to 4 lanes. This bridge is currently owned by the Ministry of Highways. The District is also having discussions with the Province regarding the proposed Keith Road Fly-Over. The major developers in the area include CXY, the District, and the Vancouver Port Authority. There is a proposal for a 36 unit apartment complex located at 1984, 1988 and 2012 Dollarton Highway.
9.	a) what is the present zoning for Can Oxy? b) would a business licence be approved today for this plant?	a) The Can Oxy owned property is zoned I2 General Industrial Zone. b) Can Oxy has a valid business license from the District of North Vancouver.

10. a) what are the health effects of exposure to chlorine?	a) Health effects of acute exposure: 0.2 - 0.4 ppm — Odour threshold 1 - 3 ppm — Scratchiness and dryness of throat; coughing; minor difficulty breathing 5 - 15 ppm — Stinging and burning sensation of eyes, nose and throat; headache, redness and watering of eyes; coughing; huskiness or loss of voice 30 ppm — Intense coughing; chest pain; vomiting; shortness of breath 40 - 60 ppm — Severe damage to eyes and lungs; fluid in lungs; 60 to 90 minute exposure can be fatal 430 ppm — 30 minutes exposure can be fatal 1000 ppm — Fatal within a few minutes (ppm = parts of chlorine/million parts of air) Source: ASL Analytical Service Laboratories Ltd.

	b) why have we not studied (and presented) information on how chlorine would disperse in a release and what would be the concentrations in different areas (as identified on the map)?	b) The information on how a chlorine release would disperse was taken into account for each of the release scenarios in the calculation of the individual risk scenarios. The dose of chlorine that a receptor experiences includes the estimate of the concentration of chlorine and the time of exposure at a given location. The estimate of concentration and exposure time for different atmospheric conditions. The total effect of the various release scenarios is summarized in the individual risk contours shown in the report. The steps taken to produce these risk contours were not included in the report since the report focuses on the risk acceptability in terms of land use planning.
	c) can that be depicted and illustrated clearly?	c) The profiles of chlorine concentration can be readily and clearly illustrated. These concentration profiles can be shown for individual release scenarios as a function of distance as the plume moves downwind or as a function of time as the plume moves past a given location. This data was not presented because of the land use planning focus of the study.
	d) why is that not here tonight?	d) The information was not available but will be made available (October 30 meeting).
	e) what goes on down at the plant during an incident?	e) The immediate response is to secure the plant, ie., stop the leak.
	f) what is the Corporate response?	f) All reportable incidents are reviewed by the Board of Canadian Occidental Petroleum Ltd.
11.	Has risk assessment included a scenario involving explosion from a propane storage on a neighbouring site or in transit through the area?	The impact of off-site propane explosion would be of no consequence to the plant - very little of the plant can burn.
12.	Concern with integrity of workers. All industrial users could get out of the area and leave residents in peace. It would make a great park.	We are not concerned about the integrity of plant workers - all employees take this concern very seriously. The site is presently zoned for heavy industrial uses. If the residents or the municipality wished to see it reserved for park purposes, it would have to purchase from CanadianOxy.

13.	Safe workplace - worker feels safer in the plant than driving down Mt. Seymour Parkway.		This was an observation made by a plant employee.	
14.	a)	what to do when there is a chemical spill?	a)	The best advice for personal protection in the event of a chlorine release is to shelter-in-place. This means to immediately go indoors, shut all doors and windows, and turn off all fans drawing in outside air. For added protection, make your house as air tight as possible, such as by placing rugs or towels in cracks under doorways, etc. Also, moving to the upper floors may offer more protection as chlorine is heavier than air and gas concentrations would therefore be lower.
	b)	what about an earthquake scenario - when windows may be blown out?	b)	If an earthquake caused a gas release and also broke windows, then those buildings would afford less protection. A quick repair of broken windows with plastic and tape would return those buildings to a better state for personal protection.

15.	a)	who will benefit from the business park?	a)	The District of North Vancouver will benefit through increased employment opportunities for residents and increased revenue through taxation. The Maplewood community will benefit through the provision of ancillary services to existing workers and residents already in Maplewood.
	b)	are there disadvantages?	b)	The one disadvantage is the relocation of people living in single family houses on Dollarton Highway. These individuals will either sell their property to the District and move elsewhere, or be relocated within the Maplewood area through a replot process.
	c)	has it been taken into consideration that new businesses will bring existing staff from outside the community?	c)	New businesses relocating to the business park will bring their employees with them, whether from other parts of the North Shore or south of Burrard Inlet. Over the long term the provision of employment opportunities in Maplewood will lessen the need to commute across the bridge.
	d)	how much more development can we take?	d)	To business park development is not something that will occur over night. Our Economic Development Strategy anticipates an absorption of approximately 3 acres of industrial land per year. With between 25 and 30 acres of developable land in the business park it is estimated that this project will be phased over 8 to 10 years depending on interest rates.

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16.	a) b)	how do risk assessments differ from this community and, for example, Seattle? what about the role of the EPA or other regulatory bodies?	The nature of the risk assessment conducted for the North Vancouver site is very similar to quantitative risk assessments that have been conducted for other facilities (both chlorine and other hazardous materials). All these studies identify the hazard scenarios, quantify the likelihood as well as the potential consequences of each scenario, and then pull that information together to produce an estimate of the overall risk level. The basic techniques and approaches used at each stage are also similar in the various studies. It is important to note that not all hazard or risk analyses are quantitative. In most cases the hazards will be identified and in many cases the potential consequences will also be modeled, but the assessment of likelihood or the overall determination of risk levels is not as common. Various regulatory bodies specify different expectations for the type of analysis to be conducted by companies, but in the United States neither the EPA nor OSHA have made any statements about what levels of risk are tolerable.
17.	a) b)	what is the difference between public meetings/hearing? Is Council here to make a decision on anything tonight?	a) A public meeting provides an opportunity to exchange information and answer questions from the community. A public hearing is a formal meeting of Council mandated under the Municipal Act to hear comments and views expressed by the public regarding proposed changes to official community plans, existing zoning and land use amendments; b) No, some Councillors are in attendance tonight to review the display material and listen to the questions and answers.
18.		Would the District expropriate private residential lands to make way for Business Park/realignment?	The District has attempted over the last 8 years to acquire residential properties along Dollarton Highway for the future business park. If owners do not wish to sell, an option being considered by the Land Department is to replot these few remaining properties to the west end of the park along Riverside Drive.

19.	a)	what is the cost of realignment?	a) The CXY/District Cost Sharing Agreement provides for $7,500,000 to realign the Dollarton Highway and upgrade or construct adjacent streets including Spicer, Amherst, Riverside Drive East (south of the old Dollarton Highway) and Forester. The District's share of the costs is 50% or $3,700,000.
	b)	have options been considered, such as overpass and make improvements to the existing Dollarton?	b) Other options have been considered. However, the realignment of the Dollarton Highway in the location proposed across the CXY lands, seems to best address most of the issues such as an improved traffic system and removal of a major road through an existing community. Upgrading the existing Dollarton Highway would be less effective because of the numerous private driveways. Also the use of pedestrian overpasses at this location is questionable.
20.	a)	what is the ratio of fatalities to injuries in chemical exposure incidents?	a) The ratio of fatalities to injuries in chemical exposure incidents cannot be predicted on a theoretical basis. The outcome depends on the chemical, the potential health effects, exposure concentration and duration of exposure.
	b)	what are the different effects of injuries and the costs of medical care?	b) & c) Chlorine is a strong irritant to the eyes, nose, throat and lungs. After exposure to high, non-lethal concentrations of chlorine longer-lasting effects are related to the injury of the lungs. In most cases, the effects are not permanent. Severe respiratory distress and cough usually subside within 3 to 14 days, and lung function is normal after 3 to 12 months. A few people may suffer irreversible effects producing a permanent reduction in lung capacity which causes shortness of breath. Pneumonia is a potentially fatal complication of exposure to chlorine. People exposed to high concentrations of chlorine would need medical attention to determine the extent of lung injury. Some people would need on-going care to manage their recovery.
	c)	are the effects permanent or irreversible requiring expensive treatments?	

21.	How could the District spend money on the realignment before the public hearing?	A series of Public Meetings were held in 1993 and 1994. In 1994, Council approved funding for the Dollarton Highway as part of the 1994 Capital Budget. In 1995, the District entered into a Cost Sharing agreement with CXY to complete construction of the Dollarton Highway realignment. In 1996 an opportunity arose to obtain a large quantity of gravel from a flood protection project --- gravel which could be used to build the road base for the new Dollarton Highway at a significant cost savings for the project.
22.	a) & c) In what form are the results of the Quantitative Risk Assessment? what does it mean in a nutshell?	a) & c) In a nutshell, the revised QRA confirms that all of the proposed uses, including those on both the "A" list and the "B" list as included in the bylaw are now acceptable using the MIACC guidelines.
	b) are summaries available?	b) There is an executive summary in the 1997 report.
23.	a) would staff recommend use of MIACC guidelines in future land use planning?	a) District staff would recommend the use of the MIACC guidelines for land use planning decisions in the Maplewood area.
	b) is there a frame of reference for "low density"?	b) In the District of North Vancouver we have interpreted the low density guideline to refer to the "RM" Multiple Family Zones which are intended to accommodate residential development at densities ranging from 12 to 24 units per acre.

24.	a)	chlorine is net benefit to society, but why ship it? Produce and use on same site, as in Europe.	a)	The plant was constructed in North Vancouver to provide product to the BC pulp and paper industry. This is still the case today. In the production process, both chlorine and caustic are manufactured simultaneously and in equal amounts - one is shipped to the Gulf Coast (chlorine) - the other largely meets a need in British Columbia.
	b)	don't see margin of error confidence identified in report. Have obscured risks (helicopter crash, sabotage) been considered?	b)	The issue of confidence intervals does not apply to risk assessments or hazard identification projects in that the risk science is not as precise as to be able to determine statistically a level of relative accuracy. The approach one adopts in a risk assessment of a facility is to be conservative and hence overestimate the risks. If by erring on the side of caution, risks are judged to be unacceptable when applying screening level assessment tools, one may apply more quantitative or detailed assessment tools to reduce the level of conservatism and to provide a more accurate estimate. There are too many unknowns in a risk assessment and too many variables to apply the tools of statistical analysis. Obscure events such as sabotage and airplane crashes have an even lower probability of occurrence (than an earthquake) and would not contribute measurably to the individual risk profiles.
	c)	would you put a plant such as this in this location today?	c)	A chemical plant such as a chlor-alkali facility would not be built in North Vancouver today. The facility continues to operate as a legal non-conforming use.
25.	a) b)	how many people were laid off when Squamish plant closed? why not keep it open and close North Vancouver?	About 30. The Squamish plant used old technology (mercury) and the plant was too small.	

26.	a) b)	what are the long term plans for the surrounding areas (Port lands, international College, etc.)east and west of the CXY site? All will produce traffic.	The long term plan for the surrounding area conforms to the Maplewood Official Community Plan. The Can Oxy property situated south of the proposed Dollarton Highway realignment is intended for light industrial operations while their land to the north is divided between limited commercial businesses west of the extension of Riverside Drive, and business park uses to the east. The District is contemplating development of a 55 acre (26 developable acres) business park northeast of the Can Oxy property. The Vancouver Port Corporation property is designated as a "Mixed Use" policy area under the Maplewood OCP.
27.	a) b)	public process for rezoning has been undermined by work to date on realignment. need for improvements to transportation routes, but phase it as follows: phase 1 - bridge; phase 2 - realignment; phase 3 development of Business Park/CXY site.	These were statements and opinions expressed by an individual at the meeting.
28.	a) b)	what is proposed for CXY if rezoning does not proceed? what are the differences between existing and proposed zonings for CXY land?	a) The CXY chemical facility will remain in operation regardless of the rezoning proposal. If the rezoning does not proceed, CXY will either decide to leave their property north of the rail line vacant or proceed with development in conformance with the existing zoning. b) The differences between the existing "I2" General Commercial Zone and the three Comprehensive Development Zones are illustrated in Appendix 1.

29.	a)	what are the factors around risk contours ending at rail line?	a)	The risk contours presented in the report reflect the current configuration and operating practices at the plant. The process safety management improvements reduced the risk profile such that the 10-4 contour now falls in the region of the rail line.
	b)	would staff approve the set up of this operation today?	b)	It is recognized that a plant of this nature would not be permitted under todays zoning regulations. However, when the plant opened 40 years ago, the business was welcomed in the community and the use conformed with the zoning of the day. The plant has continued to operate safely and is a key part of the company's operations. Product is supplied from the plant to the BC market and to the Gulf Coast.
	c)	why not work with CXY to phase out operations?	c)	There is no plan to shut the facility down.

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Exhibit 5

Summary of Questions and Answers from October 30, 1997 meeting

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SUMMARY OF QUESTIONS & ANSWERS

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DISTRICT OF N. VAN.

October 30, 1997

Information Meeting on the QRA

North Vancouver Plant

The following is a list / summary of the questions and answers presented at an information meeting held at the North Vancouver plant of CXY Chemicals on October 30, 1997. Only those questions related to the QRA or plant operations are included. Other questions, such as those relating to plant operations, will be answered directly by the District.

Questions from Angela Trudeau

Q.1 Wind Direction

I have recently spoken with two recreational sailors familiar with the area who state that the wind direction in this section of the narrows has two specific and different patterns, depending on the time of year and weather conditions. Also, that the wind patterns at the section of the site near the plant are different from that at the GVRD station, due to topography and second narrows wind-mixing dynamics.

Obviously, this is colloquial information. Does the available wind data rule this out or indicate that this could be an area for investigation? If so, would the plume modelling require redefinition (as a worst case) until such time as adequate site-specific data is compiled?

A. 1 The risk analysis included the review of data from both the bridge station and a meteorological station on site. The two sets of data were very similar, and the data set for the bridge was used as it was slightly more conservative for the area of particular concern to the north of the site. (The bridge data set showed a slightly higher chance that the wind would blow onshore). Many risk analysis must rely on data for a general area and do not have the advantage of two different weather stations in close proximity.

The risk analysis is not based on just one weather pattern. It uses data collected over a long period of time which means that a range of weather patterns will be included - from the dominant ones mentioned by the recreational sailors to those that only occur a very small percentage of the time.

Q.2 Planning Issues. Are you able to make recommendations to the following questions?

While the risk assessment does not consider other conditions in the

community such as bridge and road access conditions, emergency response planning and response capability, should they be considered by the municipality in land-use planning?

Do you have any additional recommendations to make to the municipality
- other operations which may require risk assessment
- emergency response planning
- land use planning

MIACC does not define the recommended land uses precisely. Given what you know about the risks and the area, what additional limitations would you place on the land use designations within the MIACC definitions, ie.
- number of employees in industrial, commercial operations
- any specific operations to be avoided
- "low density" residential definition?

A. 2 The risk analysis has taken no credit for community emergency response planning or various mitigation strategies (such as sheltering in place). If such factors were to be considered, they would reduce the risk levels from those depicted in the report. The municipality might want to consider such factors in its land use planning.

Trying to fill in the detail in MIACC's land use guidelines is subjective, but a comparison with guidelines established in the United Kingdom by the Health and Safety Executive (HSE) suggests that workplaces might be thought of as those containing less than 100 employees. They view the presence of small industrial developments, offices and warehouses near a facility as being reasonable. It would not make sense to add facilities with sensitive or immobile populations in the immediate vicinity of the plant. In terms of what "low density" residential means, little guidance is available. However, the HSE is currently leaning toward allowing small housing developments in some of the areas that commercial/industrial activities are allowed. Unfortunately, they do not define what they mean by small housing developments.

For the area to the west of the plant, it would be beneficial to ensure that they work closely with the plant in terms of training staff on emergency response and sheltering in place. They could also participate in some of the drills that the plant conducts. There should be an established communication plan for immediate notification by the plant in the event of a release, but this plan should not interfere with communications from the plant to the regional emergency response centre.

Questions from David Sadler

Q.1 I understand the MIACC guidelines consider multi-family condominiums as low density, while here in the District we regard such developments as medium density. You touched upon this fact when discussing the new proposed condo development at 1984, 1988 & 2012

Dollarton Highway. Please supply the range of population density figures for what the MIACC guidelines define for low, medium, high etc.

A.1 believe this has been answered in the response to Angela Trudeau.

Q.2 Seymour's 25,000 residents have only two roads in and out of the area (Dollarton and the Mount Seymour Parkway) and could be potentially trapped in the event of a major accident. Elsewhere, the residents surrounding a plant could probably escape in any number of directions. Has the Risk Assessment incorporated this factor into their calculations.

A.2 The Risk Assessment assumes no credit for evacuation or sheltering in place. The answer therefore is yes, this Assessment did account for this.

Q.3 Please identify other chlorine plants in North America which are located within city limits as I would like to contact them. I attempted to obtain this information from the Chlorine Institute in Washington. However, as I was not a member there is a charge. This information should be readily available to CanOxy since they are a member.

Q.3 Pamphlet has been ordered.

Q.4 What is the time frame in hours (minimum to maximum) that the public would be in danger from a major chlorine release?

A.4 In the event of a major release (worst case scenario) people would be exposed for less than 1 hour and should shelter in place for that period of time.

Q.5 How polluted is the CanOxy site? What are the major contaminants? When the plant closes, could residential housing be permitted on the site because of the pollution?

A.5 There is asbestos land filled on the plant site - this is a licensed waste site. Prior to 1974, chlorinated tars were buried in the same area but the precise location is not known.

Questions from Corrie Kost

Q.1 Since insufficient details were provided in any of the available documents in order for me to feel comfortable that the various chlorine release impacts have been done properly, I have requested that pamphlet 74 be made available. This pamphlet, estimating the area affected by a chlorine release provides colour graphs showing downstream chorine plots at 25 and 10 parts per million (ppm) for 14 different scenarios. This would enable me to cross-check the validity and conclusions of the models which were reviewed in the report of July 4/97. I was informed that pamphlet 74 (currently in revision) would be sent to me in about 1 month. I trust I will be given the

appropriate time so that I can put forth an informed decision on the matter of the validity of the quoted risk assessment.

A.1 Pamphlet has been ordered.

Q.2 In conjunction with the above I should like to submit for the record (and have it verified by the appropriate experts in this field) the calculations submitted below. The question as to what was the maximum that could be covered by 300 tonnes of vapourized chlorine (say to a height of 3 meters above ground level) at the lethal dosage of 1000 ppm is one worthy of consideration. I have calculated this to be about 30 km 2. The calculation was done as follows:

300 tons~3* 10 -8 gms
1 mole of Cl-2 (ie.~70 gms) occupies 22.4 litres in a gas state at STP
300 tons thus occupies a volume of 22.4*3*10-8/70 litres
Diluted in volume to 1000 ppm would expand this by 1000 and since 1m3=1000 litres the two factors cancel nicely to give a volume of 22.4*3*10-8/70m3
Dividing by the height of 3 metres gives an area of 22.4*10-8/70m2 ie. 32*10-6 ie. 32km2

Now one can readily generate the following areas for different densities (ppm)

Parts per Million	Height (meters)	Area (km2)
1000	3	32
1000	10	9.6
1000	30	3.2
300	3	107
300	10	32
300	30	10.7
100	10	96
100	100	9.6
10	10	960
10	100	96

It would be informative to know the mortality rates/times for these proportions (ppm) as well.

A.2 Mr. Kost's estimate of plume extents assumes that the material is uniformly mixed within an enclosed, predefined volume and that no material leaves the cloud. The dispersion models used in this assessment attempt to model turbulent diffusion under specified atmospheric conditions which results in a distribution of concentrations over the area affected by the plume. This distribution is typically characterized by higher concentrations at the

plume centreline and closer to the source of the release, and with concentration dropping off as one moves off centreline and away from the source. Some of the factors the model attempts to account for are as follows:

- The effects of turbulence generated by the interaction of the wind with obstructions on the surface
- The effects of increased turbulence generated by daytime heating of the ground and the suppression of turbulence resulting from nighttime cooling of the ground
- The enhanced mixing clouded by gravity spreading of a dense gas cloud
- The reduced dispersion that results when the cloud is heavier than the ambient air.

The dispersion model SLAB was used to estimate the maximum area within which the concentration will meet or exceed 1000 ppm over the duration of the release taking into account the factors listed above. The release considered was a 289 tonne release from the 300 tonne storage tank. This is a conservative scenario as normal operation does not permit the storage tank to contain that mass. In addition, all of the mass was assumed to go into the plume rather than forming a pool at the release site which increases the cloud area extents. Under poor dispersion conditions (stable atmosphere low wind speed) the cloud area was estimated as approximately 4.5 km.

The table below provides an estimate of the exposure times required to provide a given lethality probability for a specified concentration level.

Concentration (PPM)	Time to a given lethality probability		
	50% lethality	10% lethality	2% Estimated as
1000	2 seconds	1 second	← minutes !?
300	20 minutes	5 minutes	1 min
100	190 minutes	46 minutes	10 min
10	312 hours	70 hours	15 hrs.

The above results are based on the implementation of the probit equation which reflects the dose response relationship of humans to chlorine gas. As noted earlier, very few releases will pose exposure times of 1 hour; most will be of much shorter duration than this.

Q.3 In attempting to understand the factor of 10 reduction in the risk assessment from the previous report I have come to the conclusion that since the earthquake risk multiplied by the volume of chlorine stored on site form by far the major risk components, and that since the earthquake risk remains unchanged, and the volume has been reduced by a factor of only 5, I am

unable to understand where the additional factor of two (to account for the 10) came from. Could I have a simple explanation for this please.

A.3 Some factors other than storage volume that could result in reduced individual risk contours when comparing the 1994 and 1997 assessments can be summarized as follows:

- Release was not assumed to be contained by a dyke in the 1994 report. An unconfined release results in higher consequences and risk.

- In the 1997 report the release physics were modified to reflect Chlorine Institute experiments. The modifications result in a reduced initial fraction of chlorine going into a cloud which reduces the consequence and risk.

- The plant operation of the large storage tank was defined more carefully in the 1997 report in order to refine estimates of the fraction of time that the tank was in a certain fill condition. This impacts the susceptibility of the tank to earthquake damage. The 300 tonne tank also has a lower earthquake risk than the 600 tonne one.

Letters from Cas Bohlken

October 23 Letter

Q.1 In the 1994 QRA, the "Maximum Downwind Extent of 1% Probability of Death" at wind speed of 2 meters/sec. is about 6 km. (figure 6.4). In the 1997 updated report the distance is about the same at this wind speed. However, the 1994 report shows a down wind range of about 8 km at a wind speed of 1m/sec., and the 1994 report shows a range of over 14 km for a wind speed of 1.5 m/s. For comparison purposes what would the 1997 "Maximum Downwind Extent of 1% Probability of Death" be with a 1 m/s wind and why such a large difference between the 199 and 1997 reports?

A.1 Figure 6.4 (1994 QRA) shows the results for a confined release (dyke integrity maintained) under D stability 2 m/s wind speed and E stability 1 m/s wind speed. The 1997 QRA shows unconfined and confined results under C stability 2m/s wind speed and F stability 1.5 m/s wind speed. Both stability and wind speed influence the the downwind distance. In addition to depicting the model results under different weather conditions in the figures presented in the 1994 and 1997 QRAs different storage conditions have also been addressed. Due to the different weather, confinement and storage conditions, care must be taken in comparing results.

The table below summarizes a comparison of results from the 1994 and 1997 QRAs for dispersion over sea of a large storage tank release.

		Downwind distance to 1% lethality (km)			
Stability	wind speed m/s	1994	1997		
			confined	unconfined	confined (full)
		289 tonnes	225 tonnes	225 tonnes	289 tonnes
C	2		3.4	4.8	7.4
D	2	6.2	4.3	6.1	9.2
E	1	8.0	5.5	8.0	12.3
F	1.5		7.6	11.1	16.6

It can be seen from the table that the 1994 and 1997 unconfined results are very similar due to similar release and storage conditions. The capacity release has very different storage conditions which result in the entire mass of chlorine forming a dense vapour/mist cloud (ie. no rain out and no pool formation). As can be seen from the table the consequences resulting from this release are significantly higher than previously analyzed.

The tank is not operated at a capacity greater than 225 tonnes. Routine conditions limit the storage volume to 225 tonnes, and it is often run at volumes considerably lower than this.

Q.2 The 1997 Updated Report did not include the "Worst Case Probability of Death Contour" for 1 m/s winds (see 1994 QRA, Figure 6.6). Other wind directions should also be included eg. west, south-west, south and south-east.

A.2 In the 1997 report the intent was not to show worst-case probability of lethality contours but rather to present a selected release under selected weather conditions as an example of the extents of the probability of lethality contours given a release occurs. Wind direction information is handled implicitly in the derivation of risk contours and is considered in the presentation of consequence contours only to show the difference resulting from land and sea dispersions. Normally the contours are independent of wind direction but in this specific case dispersion varies because of the different surfaces the wind flows over as it approached the source.

Q.3 Since the prevailing winds at the CXY plant are easterly, it seems that even a relative minor spill at the plant would affect traffic at the Second narrows bridge and connecting highways. Driving into a minor cloud at speeds over 80 km/h could temporarily blind drivers which would create a traffic nightmare. Has this scenario been considered in the Risk Assessment calculations?

A.3 The consequences of an individual release are more the domain of an emergency response plan rather than a QRA which combines frequency and consequence information. For illustration purposes, a relatively high

frequency release scenario (hose break release scenario 7a in the 1997 QRA) was examined in the context of a nuisance release to determine what the impact might be on visibility on the Second Narrows bridge. A chlorine plume can be seen at a concentration of about 20 ppm. Figure 1 (attached) shows the extent of the 20 ppm contour as a result of a chlorine release from a hose break for several selected weather conditions.

It can be seen from Figure 1 that the extent of the 20 ppm contour reaches a maximum elevation of approximately 20 m at a downwind distance of about 200 m for the conditions of C stability/ 2 m/s wind speed. The maximum extent of the 20 ppm contour at ground level is about 550 m as shown.

Given that the Second Narrows Bridge is approximately 800 m from the plant, the impact on the bridge in terms of reduced visibility should be minimal.

Q.4 What are the suggested population densities in the MIACC guidelines for the 10-5 to 10-6 risk zone (commercial, offices and low density residential)?

A.4 The MIACC guidelines do not include population densities.

Q.5 There was a lot of discussion at the September 23 pubic meeting (afternoon session) of taking shelter at home during a chlorine spill. Apparently one has a good chance of surviving a chlorine release by staying at home. This was confirmed by different experts present. It was also suggested that a large breach of the 300 tonne storage tank would probably only occur during a large earthquake. It is also well known that the home is not a safe place to be after a large earthquake (gas leaks, falling beams, after shocks etc.). A home without windows wouldn't provide much of a shelter from the chlorine cloud anyway. Was the above considered when calculating the Risk Assessment?

A.5 Yes, all of the risk calculations were performed assuming no one would seek shelter or evacuate from the path of the plume. If sheltering or evacuation were considered the extent of the predicted risk contours would be reduced.

Q.6 Calculations on the "Estimated Consequences" of a chlorine spill would be more useful than Risk Contours. Estimated casualties from chlorine inhalation under different scenarios considering the populations residing in the affected areas and the atmospheric conditions at the time, eg. large breach of the 300 tonne storage tank, a 1 m/s south-west wind, large earthquake (most homes would be damaged) the estimated casualties will be x. Repeat the exercise for a large breach without damage to homes etc. Different atmospheric conditions should also be considered eg. wind directions and wind speed. It could also include a scenario projecting estimated population in the effected areas in the area 2012 (in 15 years).

A.6 The suggested approach, consideration of the chance that a certain number of casualties occurs or the expected number of casualties over a

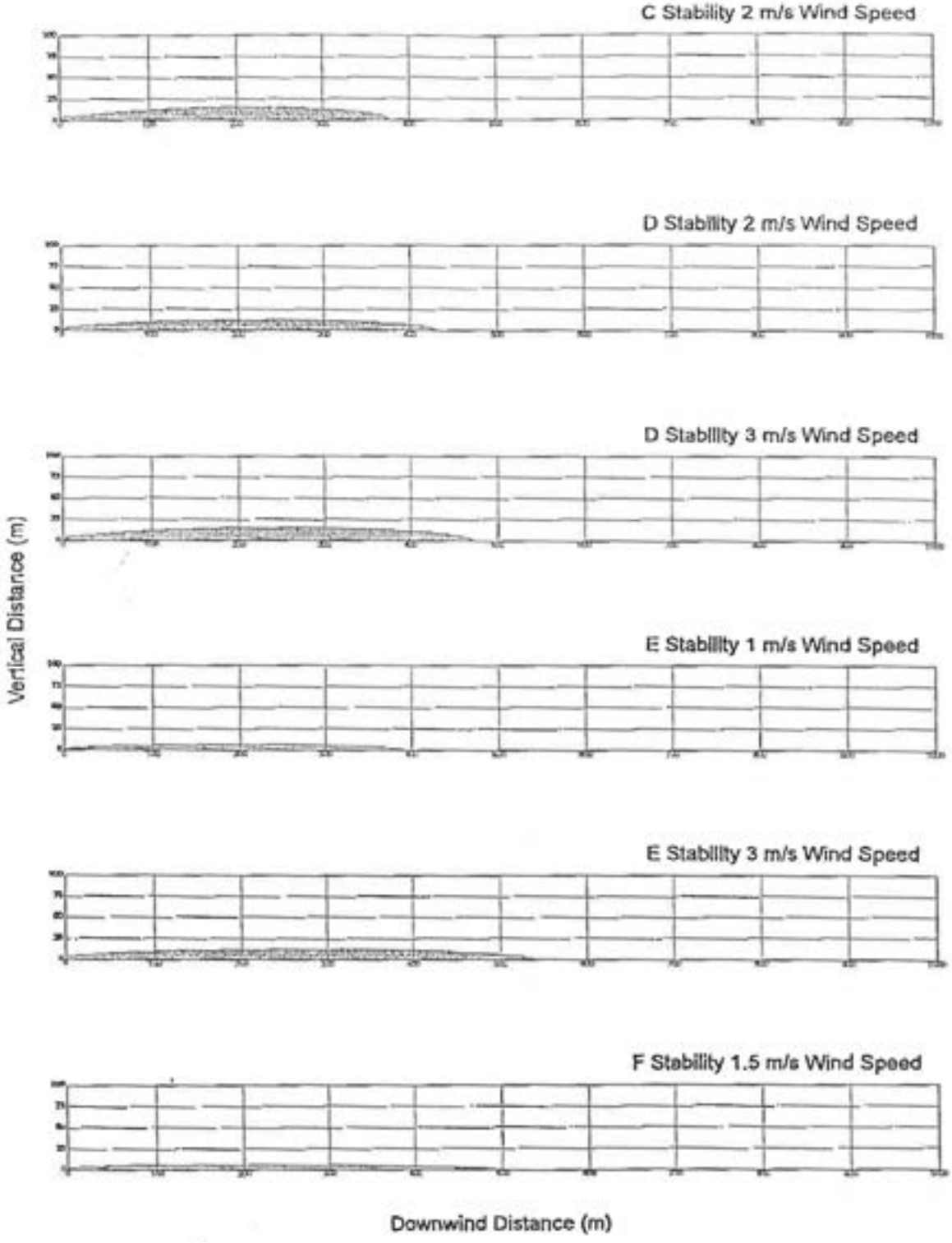

Figure 1. The extents of the 20 ppm chlorine concentration contour resulting from a line break release under selected weather conditions.

certain timeframe, is part of the estimate of societal risk. Societal risk involves the consideration of the chance that a certain number of causalities occurs or the expected number of causalities over certain time frame results in an estimate of the societal risk due to a facility. This was not the focus of this assessment as societal risk is not commonly used for land use planning or setback determination. Future population growth can be important in a societal risk context.

Q.7 If a chlorine spill could be attributed to an act of God (eg. a large earthquake) who will be held responsible to pay for damages, clean-up etc.?

A.7 Refer to the District solicitor.

Q.8 The Bovar report on Risk Assessment is impossible to evaluate without some understanding of what risks were identified and also the estimated frequency of occurrences and estimated consequences. Could these figures be presented in a condensed format?

A.8 The frequencies and consequences of all the release scenarios are presented in the 1997 PHA report. Additional data on consequence distances is provided in the responses to other questions raised by the public.

November 1 Letter

Q.1 The answer to my first question was vague and I am still puzzled why there is such a large difference in "Downwind Probability of Death" estimates. Both 1994 and 1997 reports deal with capacity release of the 300 tonne tank. The 1997 figure at 1.5 m/s wind speed is 14.7 km or 83% larger than the 1994 total of 8 km at 1 m/s. wind speed. The 1997 distance would even have been larger if a 1 m/s wind speed had been used as in 1994. I would like to see this graph redrawn comparing 2 m/s and 1 m/s wind speeds.

A.1 In the 1997 report all of the release material was assumed to go into the plume for the capacity release. This results in a more conservative estimate of the consequences, and as a result cannot be compared directly to the 1994 capacity release which assumed that some of the release would go to a pool.99

The table below summarizes a comparison of results from the 1994 and 1997 QRA for dispersion over sea of a large storage tank release. The numbers that can be compared are shown in bold type.

		Downwind distance to 1% PD (km)			
Stability	wind speed m/s	1994	1997		
			confined	unconfined	capacity
C	2		3.4	4.8	7.4
D	2	**6.2**	4.3	**6.1**	9.2
E	1	**8.0**	5.5	**8.0**	12.3
F	1.5		7.6	11.1	16.6

In the 1994 report the capacity release was modelled as an unconfined release and as such produces quite comparable results to the unconfined 1997 release for similar meteorological conditions.

The table below shows a comparison of the extents of the 1% probability of death contour for the capacity release over land, with 1997 modelling assumptions under 1 and 2 m/s wind speed, E and F stability meteorological conditions.

Stability	Wind speed	Downwind distance to 1% Probability of lethality
	m/s	(km)
E	1	9.8
E	2	9.8
F	1	14.5
F	2	14.9

The table shows that the 2 m/s wind speed provides greater downwind extents to the 1% probability of lethality contour. For the purposes of a risk assessment a decision must be made on how to discretize the continuum that exists in nature; to this end a selected set of meteorological conditions was chosen based on the frequency of occurrence. For very stable conditions (F stability) a wind speed of 1.5 m/s was chosen to represent the range of wind speeds that may occur.

Q.2 My second question dealt with the "Worst Case Probability Contours" for 1 m/s winds (see 1994 QRA, Figure 6.6). This graph was not re-issued in the 1997 report although there should have been some large differences (see 1 above).

A.2 The above table indicates that when considering downwind extents, the worst case contours may not be for 1 m/s. The graph issued for the 1997 report was for a medium release of the storage tank under F stability and 1.5 m/s wind speed, and was presented as an example of probability of death contours and was not intended to be a worst-case. While in actuality an absolute worst-case is difficult to obtain, the risk assessment has accounted for the consequences of a wide range of probable and possible meteorological conditions and release scenarios. The figure attached shows a represenatation of cloud travel for a 225 tonne chlorine release under typical daytime weather conditions. This scenario is estimated to occur once in 750,000 years.

Q.9 It also occurred too me after the meeting that using a cigar shape to represent the plume might work over water or flat terrain, but since most of the community north of the plant is located on a mountain slope the cloud would be more like the shape of a mushroom with higher concentrations and lateral spread at the base of the mountain. This will add to the risk in those areas eg. Maplewood and should have been considered in the model.

A.9 Terrain effects are not typically considered in a risk assessment and in general, other than the case of narrow valleys that can contain a plume's spread, or direct plume impingement, terrain effects tend to enhance turbulence which actually results in reduced concentrations. Wind tunnel studies have shown that in the case of direct plume impingement on a ridge, the concentrations can range from 1.2 to 1.8 times as high as flat terrain predictions within a very short distance (ie. a fraction of the ridge height) from the ridge base.

If all other factors are considered equal this could raise the individual risk to receptors in a very localized region at the base of the ridge. As the predicted risk at the base of the ridge is less than 1 chance in a million this increase should not result in "intolerable" risks at the base of the ridge.

Exhibit 6

Major Industrial Accidents Council of Canada (MIACC) Risk Acceptability Criteria

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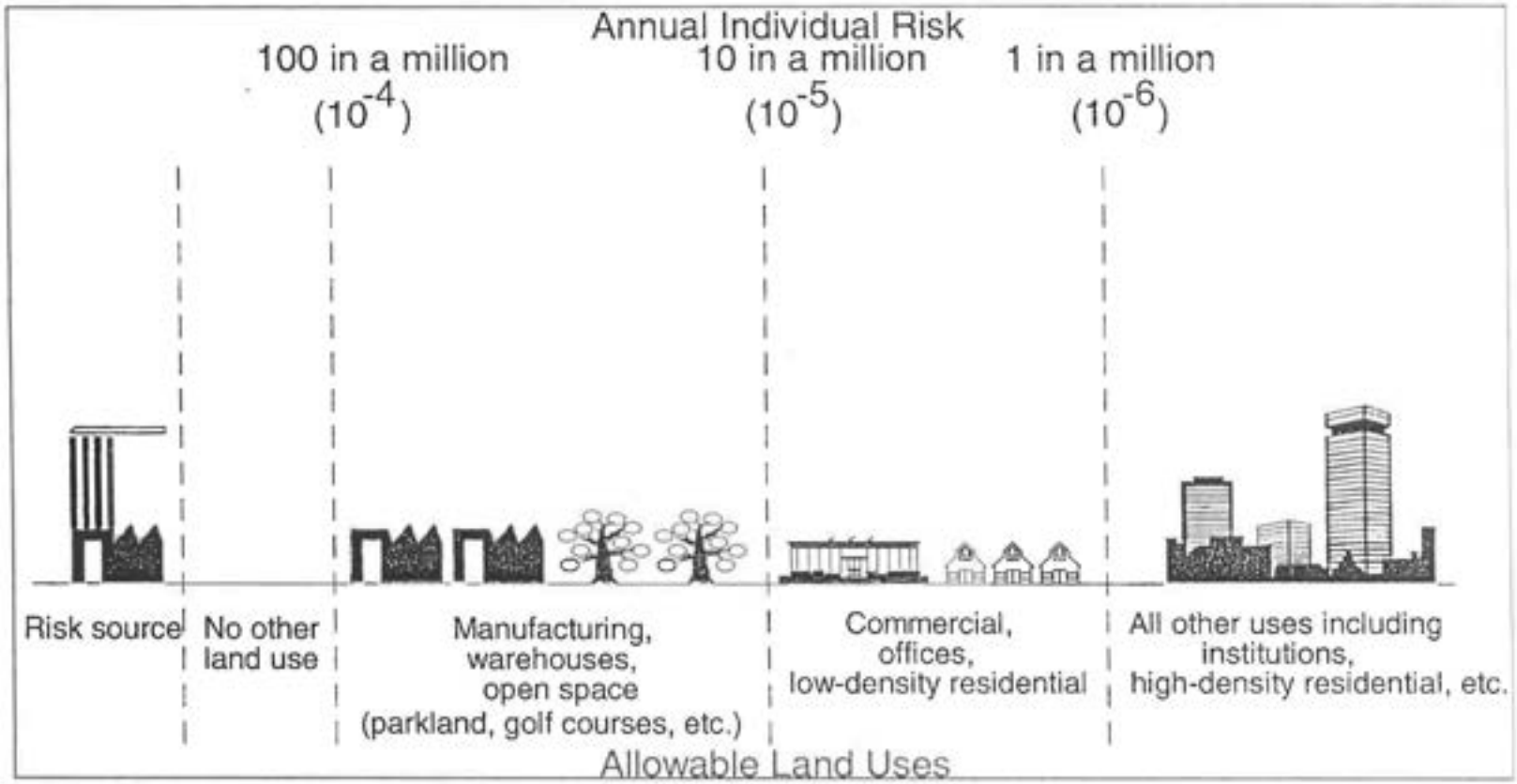

Figure 3 Risk Acceptability Criteria
Major Industrial Accident Council of Canada (MIACC)

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Exhibit 7

Individual Risk Distribution around COPL Chemical Plant - 1997 Operations and Allowable Land Use According to MIACC Risk Acceptability Criteria

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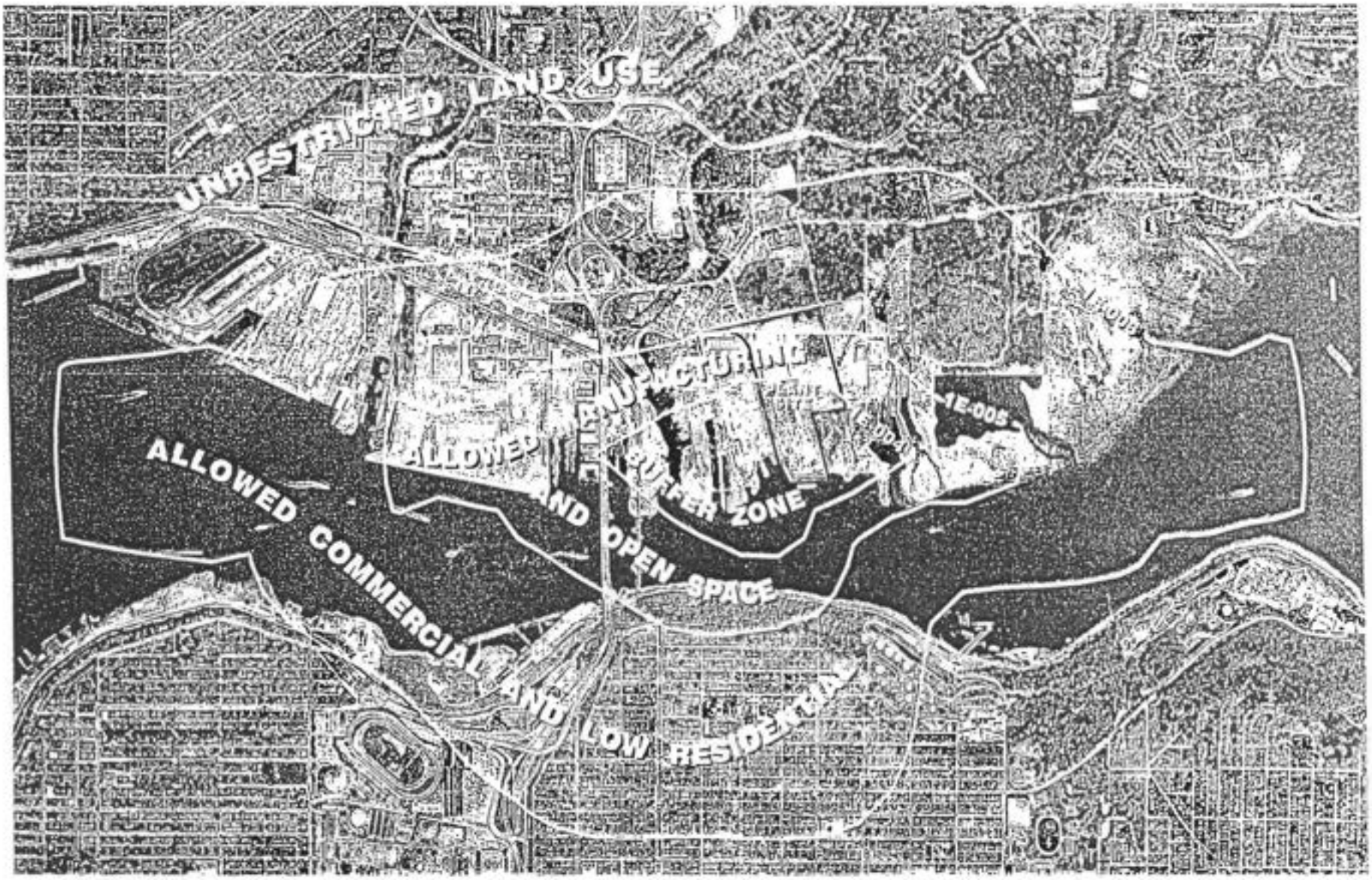

Figure 4 **Individual Risk Distribution Around Plant – 1997 Operations and Allowable Land Use According to MIACC* Guidelines**

*MIACC - Major Industrial Accidents Council of Canada

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Exhibit 8

Original Zoning Bylaw 6762

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THE CORPORATION OF THE DISTRICT OF NORTH VANCOUVER

BYLAW 6762

ABANDONED

A bylaw to amend the "District of North Vancouver Zoning Bylaw, 1965" (Bylaw 3210) pursuant to section 963 of the *Municipal Act* (RSBC 1979, c. 290).
(Comprehensive Development Zones 17, 18 and 19 - Canadian Occidental Petroleum Ltd.)

The Council for The Corporation of the District of North Vancouver, having observed the relevant provisions of the Municipal Act, enacts the following:

Title

1. This bylaw may be cited as "REZONING BYLAW 1027".

Amendments

2. The following amendments are made to the "District of North Vancouver Zoning Bylaw 1965":

a) Part 2 Interpretation is amended by inserting the following definitions in the appropriate alphabetical order:

"ice arena" means land, buildings and structures providing one or more sheets of ice for the purposes of skating and hockey or related activities which may include accessory retail purposes, restaurants, retail food services and lounge facilities";

b) Subsection 301(2) is amended by inserting the following designations:

"Comprehensive Development Zone 17	CD17
Comprehensive Development Zone 18	CD18
Comprehensive Development Zone 19	CD19"

c) Part 4B is amended by adding the following:

4B62 Comprehensive Development Zone 17 (CD17)

Intent

The intent of the Comprehensive Development Zone 17 (CD17) is to provide commercial uses to complement the existing commercial uses in the area and improve the range of services available to the residents and employees in the vicinity.

4B63 Uses

(1) All uses of land, buildings and structures in the CD17 Zone are prohibited except:

Document No: 24229

Principal Uses:

COLUMN A	COLUMN B
auction room	
automotive repair establishment	
	business/office support services
car wash	
	clubs
contractor services	
delivery services	
equipment rental establishment	
	fitness centre
gas bar	
	health service purposes
hobby beer and wine-making establishment	
household repair establishment	
media-related establishment	
	office purposes
parking structure	
	personal service shops
	professional offices
research and development establishments	
	restaurant
	retail food services
	retail purposes, excluding building supply establishments
	school, trade
service station	
	shopping centre
studio	
vehicle sales/rental/leasing establishment	
veterinary clinic	
veterinary hospital	

Accessory Uses:

Permitted accessory uses may include, but are not necessarily limited to:

(a) administrative offices;
(b) display, sales and reception areas;
(c) outdoor customer service areas;
(d) storage

(2) The principal uses listed in Column A will be prohibited until such time as the chlorine storage and shipping procedures at the chlorine production facility (the "Plant") located at 100 Amherst Avenue, North Vancouver (for reference owned as of May 17, 1996 by Canadian Occidental Petroleum Limited) meets the following conditions:

(a) the fixed tank chlorine storage at the Plant, (meaning any storage tank other than a chlorine rail tank car) will be limited to the 300 tonne tank existing as of May 17, 1996, or a replacement tank of an equivalent capacity and standard of safety, except as permitted under paragraph (d) below;

(b) there will be no barge transportation of chlorine produced by the Plant except by way of the barge transportation of rail tank cars;

(c) there will be no chlorine storage at the Plant in rail tank cars except as required for "normal shipping needs" which shall not exceed 160,000 tonnes per annum; and

(d) the two 600 tonne tanks, existing as of May 17, 1996, may be used as part of the in-process chlorine production manufacturing stream at the Plant but may not be used for chlorine storage except:

(i) at any time one of the two 600 tonne tanks may be used for temporary storage, not to exceed 300 tonnes, to facilitate the bi-annual hydrostatic test and inspection of the 300 tonne tank; and

(ii) in the event of an emergency, when public safety is threatened, the 600 tonne tanks may be used for temporary emergency chlorine storage.

(3) The principal uses listed in Column B will be prohibited until such time as the Plant is permanently closed.

4B64 Principal Use Regulations

The following regulations apply to permitted uses:

(1) All operations associated with permitted uses shall be contained within a completely enclosed building except for outdoor customer service areas;

(2) In the case of contractor services, no manufacturing, assembly or fabrication of products is permitted;

(3) In the case of veterinary clinics and hospitals, an outside public entrance is required;

(4) In the case of vehicle sales/rental/leasing establishments, no outside storage of vehicle inventory is permitted.

4B65 Size, Shape and Siting Regulations:

(1) Height:

The height of buildings and structures in the CD17 Zone shall not exceed 12m (40 ft.) except where exempted under Section 407 of this Bylaw;

(2) Building Coverage:

Buildings and structures in the CD17 Zone shall not occupy more than 50% of the lot area;

(3) Site Coverage:

Buildings, structures, parking spaces, loading spaces, driveways and manoeuvring aisles in the CD17 Zone shall not occupy more than 85% of the lot area;

(4) Floor Space Ratio:

The floor space ratio in the CD17 Zone is 1.75;

(5) Building and Parking Setbacks:

(a) Buildings and structures in the CD17 Zone shall be setback a minimum of:

(i) 10m (33 ft.) from the Dollarton Highway property line; and
(ii) 6m (20 ft.) from the Riverside Drive property line;

(b) Parking areas shall be setback a minimum of:

(i) 6m (20 ft.) from the Dollarton Highway property line; and
(ii) 3m (10 ft.) from the Riverside Drive property line;

(6) Lot Area:

(a) In the case of service stations, the minimum lot area shall be 1114.8m^2 (12,000 sq.ft.);

(b) In the case of a car wash not operated in conjunction with a gas bar or service station, the minimum lot area shall be 929m^2 (10,000 sq.ft.) plus 186m^2 (2,000 sq.ft.) for each car wash bay in excess of three and the lanes leading to and from each bay shall be a minimum of 3.1m (10 ft.) in width and 18.3m (60 ft.) in length;

4B66 Landscaping Regulations

(1) All required setback areas shall be landscaped in accordance with an approved landscape plan;

(2) Parking areas containing more than 20 spaces in one row shall incorporate raised landscape planters not less than 1.0m (3.3 ft.) in width and 5.7m (18.7 ft.) in length every 20 spaces;

(3) Double rows of parking spaces shall be separated by a landscaped strip not less than 1.2m (4 ft.) in width;

(4) All garbage and recycling container pads shall be screened with a 2m (6.6 ft.) high screen consisting of a solid wood fence, landscaping or a combination thereof;

(5) All electrical kiosks, not located underground or within a building shall be sited to the rear of the building and screened;

4B67 Parking and Loading Regulations:

(1) Parking and loading spaces shall be provided in accordance with Part 10 of this Bylaw;

(2) In cases where a development permit application is submitted without an identification of specific uses, parking requirements will be assessed on the basis of one space/25m^2 (270 sq.ft.) of gross leasable area and the issuance of business licenses for permitted uses in that building will be dependent upon the availability of parking on the lot or on an adjacent lot in accordance with Sections 1002.3 and 1002.4 of this Bylaw.

4B68 Comprehensive Development Zone 18 (CD18)

Intent

The intent of the Comprehensive Development Zone 18 (CD18) is to accommodate higher quality light manufacturing and warehousing uses which generally require larger sites augmented with a limited range of retail, wholesale and service-oriented uses.

4B69 Uses

(1) All uses of land, buildings and structures in the Comprehensive Development Zone 18 are prohibited except:

Principal Uses:

COLUMN A	COLUMN B
auction room	
automotive repair establishment	
building supply establilshment	
	business/office support services
car wash	
contractor services	
custom manufacturing	
delivery services	
equipment rental establishments	
	fitness centre
garden centre	
gas bar	
gun shop	
hobby beer and wine-making establishment	
household repair services	
ice arena	
industrial product sales establishments	

COLUMN A	COLUMN B
light manufacturing	
mini-warehousing	
parking structure	
	research and development establishments
	retail food services
	school, trade
service station	
specialized light industrial and technological establishments	
veterinary clinic	
veterinary hospital	
warehousing	
wholesaling	

Accessory Uses:

Permitted accessory uses may include, but are not necessarily limited to:

(a) administrative offices;
(b) display, sales and reception areas;
(c) outdoor customer service areas;
(d) servicing, repair or testing of goods normally associated with a principal use;
(e) storage;

(2) The principal uses listed in Column A will be prohibited until such time as the chlorine storage and shipping procedures at the chlorine production facility (the "Plant") located at 100 Amherst Avenue, North Vancouver (for reference owned as of May 17, 1996 by Canadian Occidental Petroleum Limited) meets the following conditions:

(a) the fixed tank chlorine storage at the Plant, (meaning any storage tank other than a chlorine rail tank car) will be limited to the 300 tonne tank existing as of May 17, 1996, or a replacement tank of an equivalent capacity and standard of safety, except as permitted under paragraph (d) below;

(b) there will be no barge transportation of chlorine produced by the Plant except by way of the barge transportation of rail tank cars;

(c) there will be no chlorine storage at the Plant in rail tank cars except as required for "normal shipping needs" which shall not exceed 160,000 tonnes per annum; and

(d) the two 600 tonne tanks, existing as of May 17, 1996, may be used as part of the in-process chlorine production manufacturing stream at the Plant but may not be used for chlorine storage except:

(i) at any time one of the two 600 tonne tanks may be used for temporary storage, not to exceed 300 tonnes, to facilitate the bi-annual hydrostatic test and inspection of the 300 tonne tank; and

(ii) in the event of an emergency, when public safety is threatened, the 600 tonne tanks may be used for temporary emergency chlorine storage.

(3) The principal uses listed in Column B will be prohibited until such time as the Plant is permanently closed.

4B70 Principal Use Regulations

(1) All operations associated with permitted uses shall be contained within a completely enclosed building except in the case of gas bars and service stations and where exterior storage is permitted under Section 4B71(1);

(2) In the case of veterinary clinics and hospitals, an outside public entrance is required;

4B71 Accessory Use Regulations

(1) Exterior Storage:

In the CD18 Zone, exterior storage is subject to the following regulations:

(a) exterior storage is permitted only for:

(i) building supply establishments;
(ii) equipment rental establishments;
(iii) garden centre;
(iv) the storage of fleet vehicles for contractor services and delivery services;
(v) the storage of vehicles for repair at automotive repair shops;

(b) All exterior storage areas except for the display of plant materials at garden centres shall be located to the rear of a building or to the side when adjacent to an interior side lot line and, in the case of a building supply establishment and an equipment rental establishment, shall be enclosed by a solid visual screen;

(c) Land used for exterior storage shall be hardsurfaced with durable materials acceptable to the building inspector;

(2) Retail Sales:

The retail sale of goods is limited to an accessory use except in the case of auction room, building supply establishment, gas bar, garden centre, industrial product sales establishment, retail food services and service stations where retail sales may be a principal use;

(3) Outdoor Customer Service Areas:

Outdoor customer service areas are permitted only on private property in conjunction with retail food services and shall comply with Section 413 of the Zoning Bylaw.

4B72 Size, Shape and Siting Regulations

Buildings and structures in the CD18 Zone shall comply with the following regulations:

(1) Height:

Buildings and structures in the CD18 Zone shall not exceed 12m (40 ft.) except where exempted under Section 407 of this Bylaw;

(2) Building Coverage:

Buildings and structures in the CD18 Zone shall not occupy more than 60% of the lot area.

(3) Site Coverage:

Buildings, structures, parking spaces, loading spaces, driveways, manoeuvring aisles and exterior storage areas in the CD18 Zone shall not occupy more than 90% of the lot area.

(4) Floor Space Ratio:

The floor space ratio in the CD18 Zone is 1.5.

(5) Building and Parking Setbacks:

(a) Buildings and structures in the CD18 Zone shall be setback a minimum of:

(i) 10m (33 ft.) from the Dollarton Highway property line;
(ii) 6m (20 ft.) from the Riverside Drive and Amherst Avenue property lines;

(b) Parking areas shall be setback a minimum of:

(i) 6m (20 ft.) from the Dollarton Highway property line;
(ii) 3m (10 ft.) from the Riverside Drive and Amherst Avenue property lines;

(6) Accessory Floor Space:

The total floor space of all permitted accessory uses shall not exceed 25% of the gross leasable floor area of a business or tenancy in a multi-tenant building;

(7) Building Area:

In the case of a building supply establishment, buildings and structures shall not exceed a gross leasable floor area of 5575m^2 (60,011 sq. ft.).

4B73 Landscaping Regulations

1. All required setback areas shall be landscaped in accordance with an approved landscape plan.

2. Parking areas containing more than 20 spaces in one row shall incorporate raised landscape planters not less than 1.0m (3.3 ft.) in width and 5.7m (18.7 ft.) in length every 20 spaces.

3. Double rows of parking spaces shall be separated by a landscaped strip not less than 1.2m (4 ft.) in width.

4. All garbage and recycling container pads shall be screened with a 2m (6.5 ft.) high screen consisting of a solid wood fence, landscaping or a combination thereof.

5. All electrical kiosks, not located underground or within a building shall be sited to the rear of a building.

4B74 Parking and Loading Regulations

1. Parking and loading spaces for uses in the CD18 Zone shall be provided in accordance with Part 10 of this Bylaw.

2. In cases where a development application is submitted without an identification of specific uses, parking requirements will be assessed on the basis of a minimum of one space/40m^2 (430.5 sq.ft.) of gross leasable area up to a maximum of 25% of the gross leasable area of the building and one space/100m^2 (1076 sq.ft.) of all other gross leasable area and the issuance of business licenses for permitted uses in that building will be dependent upon the availability of parking on the lot or on an adjacent lot in accordance with Sections 1002.3 and 1002.4 of this Bylaw.

3. All loading areas shall be provided to the side or rear of buildings adjacent to an interior lot line. In the case of lots flanking Amherst Avenue or Riverside Drive, all loading areas visible from the street shall be screened.

4B75 Comprehensive Development Zone 19 (CD19)

Intent

The intent of the Comprehensive Development Zone 19 (CD19) is to accommodate uses appropriate in a business park setting. Permitted uses will be oriented primarily to office and limited high quality industrial and light manufacturing uses which are environmentally safe and clean.

4B76 Uses

(1) All uses of land, buildings and structures in the Comprehensive Development Zone 19 are prohibited except:

Principal Uses

COLUMN A	COLUMN B
	business/office support services
custom manufacturing	
contractor services	

COLUMN A	COLUMN B
delivery services	
	fitness centre
	health service purposes
hobby beer and wine-making establishments	
industrial product sales establishments	
media-related establishments	
	office purposes
parking structure	
	personal service shops
	professional offices
research and development establishments	
	restaurant
	retail food services
specialized light industrial and technological establishments	
warehousing	
wholesaling	

Accessory Uses:

Permitted accessory uses may include, but are not necessarily limited to:

(a) administrative offices;
(b) conference, display, sales and reception areas;
(c) outdoor customer service areas;
(d) retail sales;

(2) The principal uses listed in Column A will be prohibited until such time as the chlorine storage and shipping procedures at the chlorine production facility (the "Plant") located at 100 Amherst Avenue, North Vancouver (for reference owned as of May 17, 1996 by Canadian Occidental Petroleum Limited) meets the following conditions:

(a) the fixed tank chlorine storage at the Plant, (meaning any storage tank other than a chlorine rail tank car) will be limited to the 300 tonne tank existing as of May 17, 1996, or a replacement tank of an equivalent capacity and standard of safety, except as permitted under paragraph (d) below;

(b) there will be no barge transportation of chlorine produced by the Plant except by way of the barge transportation of rail tank cars;

(c) there will be no chlorine storage at the Plant in rail tank cars except as required for "normal shipping needs" which shall not exceed 160,000 tonnes per annum; and

(d) the two 600 tonne tanks, existing as of May 17, 1996, may be used as part of the in-process chlorine production manufacturing stream at the Plant but may not be used for chlorine storage except:

(i) at any time one of the two 600 tonne tanks may be used for temporary storage, not to exceed 300 tonnes, to facilitate the bi-annual hydrostatic test and inspection of the 300 tonne tank; and

(ii) in the event of an emergency, when public safety is threatened, the 600 tonne tanks may be used for temporary emergency chlorine storage.

(3) the principal uses listed in Column B will be prohibited until such time as the Plant is permanently closed.

4B77 Principal Use Regulations

The following regulations apply to principal uses:

(1) All operations associated with permitted uses shall be contained within a completely enclosed building except where outdoor customer service areas are permitted.

4B78 Accessory Use Regulations

(1) Outdoor Customer Service Areas:

Outdoor customer service areas are permitted only on private property in conjunction with restaurants and retail food services and shall comply with Section 413 of this Bylaw.

(2) Retail Sales:

The retail sale of goods is limited to an accessory use except in the case of hobby beer and wine-making establishments, restaurants and retail food services for which retail sales may be a principal use.

4B79 Size, Shape and Siting Regulations

Buildings and structures in the CD19 Zone shall comply with the following regulations:

(1) Height:

Buildings and structures in the CD19 Zone shall not exceed a height of 18m (60 ft.) except where exempted under Section 407 of this Bylaw;

(2) Building Coverage:

Buildings and structures in the CD19 Zone shall not occupy more than 60% of the lot area;

(3) Site Coverage:

Buildings, structures, parking spaces, loading spaces and manoeuvring aisles in the CD19 Zone shall not occupy more than 85% of the total lot area;

(4) Floor Space Ratio:

The floor space ratio in the CD19 Zone is 2.0.

(5) Building and Parking Setbacks:

(a) Buildings, structures and parking areas in the CD19 Zone shall be setback a minimum of:

(i) 10m (33 ft.) from any street;
(ii) 5m (16.5 ft.) from any interior rear or side lot line or any lane

(b) Parking areas shall be setback a minimum of:

(i) 6m (20 ft.) from any street;
(ii) 2m (6.5 ft.) from interior side or interior rear lot lines and any lane.

(6) Accessory Floor Space:

Accessory floor space in the CD19 Zone shall not exceed 40% of the gross leasable floor area of a business or tenancy in a multi-tenant building.

4B80 Landscaping Regulations

1. All required setbacks from streets shall be bermed and landscaped in accordance with an approved landscape plan;

2. All setbacks from interior side and rear lot lines shall be landscaped in accordance with an approved landscape plan;

3. Parking areas containing more than 20 spaces in one row shall incorporate raised landscape planters not less than 1.0m (3.3 ft.) in width and 5.7m (18.7 ft.) in length every 10 spaces;

4. Double rows of parking spaces shall be separated by a landscaped strip not less than 1.2m (4 ft.) in width;

5. All garbage and recycling container pads shall be located to the rear or a building and shall be screened with a 2m (6.5 ft.) high solid screen; and

6. All electrical kiosks not located underground or within a building must be sited to the rear of a building and not within a required setback area and when visible from a street, shall be screened with fencing, landscaping or a combination thereof.

4B81 Parking and Loading Regulations

1. Parking and loading spaces shall be provided in accordance with Part 10of this Bylaw;

2. All loading spaces shall be provided to the rear of a building or to the side adjacent to an interior side lot line;

3. Where loading spaces are visible from a flanking street, the loading space shall be screened; and

4. In cases where a development permit application is submitted without an identification of specific uses, parking requirements will be assessed on the basis of one space/40m^2 (430.5 sq.ft.) of gross leasable area and the issuance of business licenses for permitted uses in that building will be dependent upon the availability of parking on the lot or on an adjacent lot in accordance with Sections 1002.3 and 1002.4 of this Bylaw.

c) The Zoning Map is amended in the case of lands outlined on the attached map by rezoning the land from General Industrial (I2) and General Commercial Zone 3 (C3) to Comprehensive Development Zone 17, Comprehensive Development Zone 18, and Comprehensive Development Zone 19.

PUBLIC HEARING held , 19 .

PASSED by the Council on the day of , 19 .

APPROVED by on the day of , 1996.

ADOPTED by the Council on the day of , 19 .

_____

Mayor

_____

Municipal Clerk

128

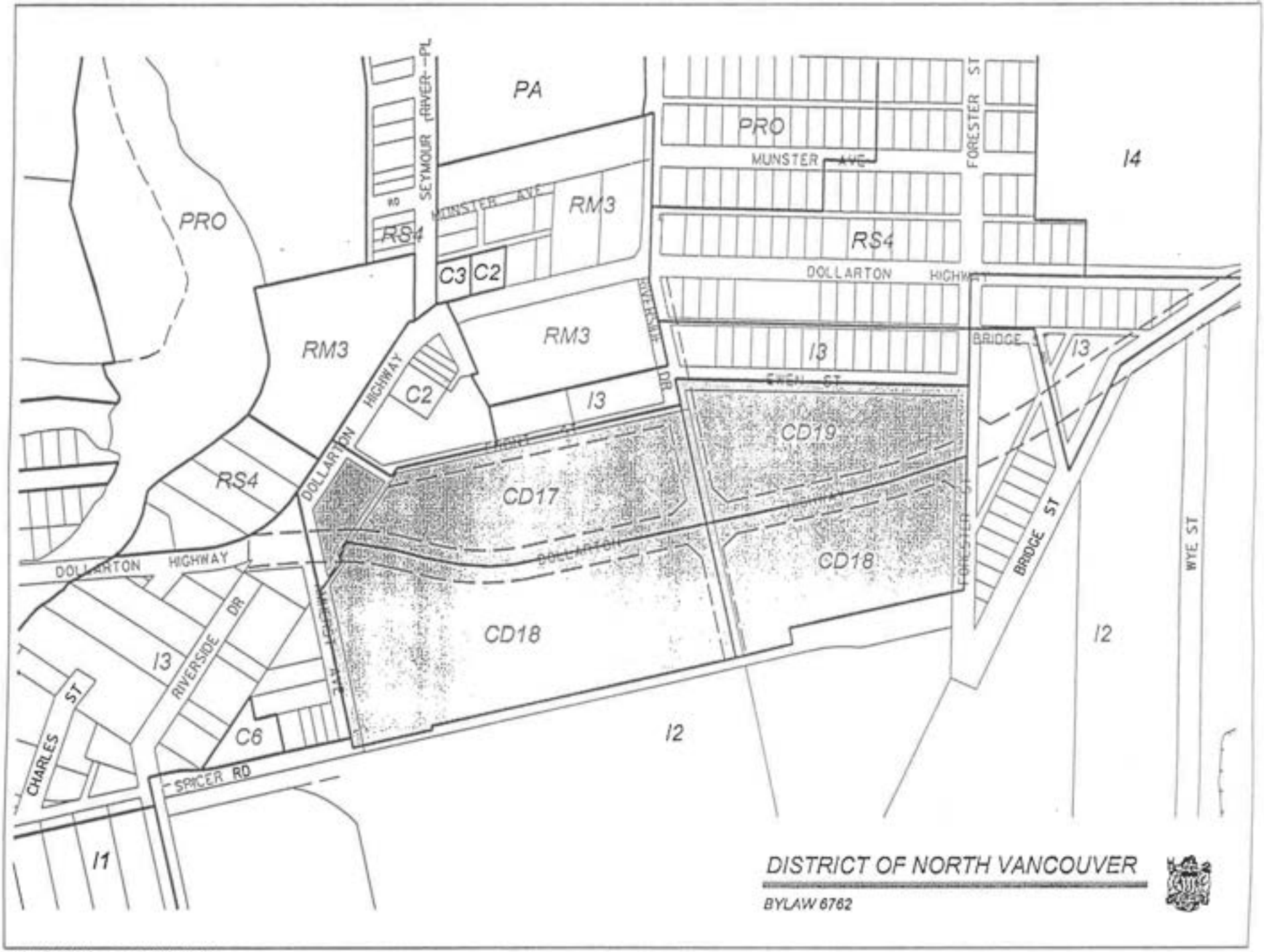

PA
PRO
RM3
RS4
C3
C2
C6
I1
I2
I3
I4
CD17
CD18
CD19
SEYMOUR RIVER PL
MUNSTER AVE
DOLLARTON HIGHWAY
RIVERSIDE DR
FORESTER ST
BRIDGE ST
EWEN ST
WYE ST
CHARLES ST
SPICER RD
DISTRICT OF NORTH VANCOUVER
BYLAW 6762

Exhibit 9

Zoning Bylaw 7008

THE CORPORATION OF THE DISTRICT OF NORTH VANCOUVER

BYLAW 7008

A bylaw to amend the "District of North Vancouver Zoning Bylaw, 1965" (Bylaw 3210) pursuant to section 963 of the *Municipal Act* (RSBC 1979, c. 290). (Comprehensive Development Zones 18 and 19 - CXY Chemicals Ltd.)

The Council for The Corporation of the District of North Vancouver, having observed the relevant provisions of the Municipal Act, enacts the following:

Title

1. This bylaw may be cited as **"REZONING BYLAW 1089"**.

Amendments

2. The following amendments are made to the "District of North Vancouver Zoning Bylaw 1965":

a) Subsection 301(2) is amended by inserting the following designations:

"Comprehensive Development Zone 18	CD18
Comprehensive Development Zone 19	CD19"

b) Part 4B is amended by adding the following:

4B68 Comprehensive Development Zone 18 (CD18)

Intent

The intent of the Comprehensive Development Zone 18 (CD18) is to accommodate higher quality light manufacturing and warehousing uses which generally require larger sites augmented with a limited range of retail, wholesale and service-oriented uses.

4B69 Uses

(1) All uses of land, buildings and structures in the Comprehensive Development Zone 18 are prohibited except:

Principal Uses:

i) arena;
ii) auction room;
iii) automotive repair shop;
iv) building supply establishment;
v) business/office support services;
vi) car wash;
vii) contractor services;
viii) custom manufacturing;
ix) delivery services;
x) equipment rental establishments;
xi) fitness centre;
xii) garden centre;
xiii) gas bar;
xiv) gun shop;
xv) hobby beer and wine-making establishment;
xvi) household repair services;
xvii) industrial product sales establishments;

xviii) light manufacturing;
xix) mini-warehousing;
xx) parking structure;
xxi) research and development establishments;
xxii) retail food services;
xxiii) school, trade;
xxiv) service station;
xxv) specialized light industrial and technological establishments;
xxvi) veterinary clinic;
xxvii) veterinary hospital;
xxviii) warehousing; and
xxix) wholesaling

Accessory Uses:

Permitted accessory uses may include, but are not necessarily limited to:

(i) administrative offices;
(ii) display, sales and reception areas;
(iii) outdoor customer service areas;
(iv) servicing, repair or testing of goods normally associated with a principal use;
(v) storage;

4B70 Principal Use Regulations

(1) All operations associated with permitted uses shall be contained within a completely enclosed building except for:

- outdoor customer service areas in accordance with Section 4B71(3);
- parking structures; and
- exterior storage in accordance with Section 4B71(1);

(2) In the case of veterinary clinics and hospitals, an outside public entrance is required;

4B71 Accessory Use Regulations

(1) Exterior Storage:

In the CD18 Zone, exterior storage is subject to the following regulations:

(a) exterior storage is permitted only for:

(i) building supply establishments;
(ii) equipment rental establishments;
(iii) garden centre;
(iv) the storage of fleet vehicles for contractor services and delivery services;
(v) the storage of vehicles for repair at automotive repair shops;

(b) All exterior storage areas except for the display of plant materials at garden centres shall be located to the rear of a building or to the side when adjacent to an interior side lot line and, in the case of a building supply establishment and an equipment rental establishment, shall be enclosed by a solid visual screen;

(c) Land used for exterior storage shall be hardsurfaced with durable materials acceptable to the building inspector;

(2) Retail Sales:

The retail sale of goods is limited to an accessory use except in the case of auction room, building supply establishment, gas bar, garden centre and industrial product sales establishments where retail sales may be a principal use;

(3) Outdoor Customer Service Areas:

Outdoor customer service areas are permitted only on private property in conjunction with retail food services and shall comply with Section 413 of the Zoning Bylaw.

4B72 Size, Shape and Siting Regulations

Buildings and structures in the CD18 Zone shall comply with the following regulations:

(1) Height:

Buildings and structures in the CD18 Zone shall not exceed 12m (40 ft.) except where exempted under Section 407 of this Bylaw;

(2) Building Coverage:

Buildings and structures in the CD18 Zone shall not occupy more than 60% of the lot area.

(3) Site Coverage:

Buildings, structures, parking spaces, loading spaces, driveways, manoeuvring aisles and exterior storage areas in the CD18 Zone shall not occupy more than 90% of the lot area.

(4) Floor Space Ratio:

The floor space ratio in the CD18 Zone is 1.5.

(5) Building and Parking Setbacks:

(a) Buildings and structures in the CD18 Zone shall be setback a minimum of:

(i) 10m (33 ft.) from the Dollarton Highway property line;
(ii) 6m (20 ft.) from the Riverside Drive and Amherst Avenue property lines;

(b) Parking areas shall be setback a minimum of:

(i) 6m (20 ft.) from the Dollarton Highway property line;
(ii) 3m (10 ft.) from the Riverside Drive and Amherst Avenue property lines;

(6) Accessory Floor Space:

The total floor space of all permitted accessory uses shall not exceed 25% of the gross leasable floor area of a business or tenancy in a multi-tenant building;

(7) Building Area:

In the case of a building supply establishment, buildings and structures shall not exceed a gross leasable floor area of 5575m^2 (60,011 sq. ft.).

(8) Lot Area:

Principal Uses

i) business/office support services; NOT UNDER 6762
ii) custom manufacturing;
iii) contractor services;
iv) delivery services;
v) fitness centre; NOT UNDER 6762
vi) health service purposes; NOT UNDER 6762
vii) hobby beer and wine-making establishments;
viii) industrial product sales establishments;
ix) media-related establishments;
x) office purposes; NOT UNDER 6762
xi) parking structure;
xii) personal service shops; NOT UNDER 6762
xiii) professional offices; NOT UNDER 6762
xiv) research and development establishments;
xv) restaurant; NOT UNDER 6762
xvi) retail food services; NOT UNDER 6762
xvii) specialized light industrial and technological establishments;
xviii) warehousing; and
xix) wholesaling;

Accessory Uses:

Permitted accessory uses may include, but are not necessarily limited to:

(i) administrative offices;
(ii) conference, display, sales and reception areas;
(iii) outdoor customer service areas;
(iv) retail sales;

4B77 Principal Use Regulations

The following regulations apply to principal uses:

(1) All operations associated with permitted uses shall be contained within a completely enclosed building except for:

- outdoor customer services areas in accordance with Section 4B78(1);
- parking structures; and
- the storage of fleet vehicles for contractor services and delivery services;

4B78 Accessory Use Regulations

(1) Outdoor Customer Service Areas:

Outdoor customer service areas are permitted only on private property in conjunction with restaurants and retail food services and shall comply with Section 413 of this Bylaw.

(2) Retail Sales:

The retail sale of goods is limited to an accessory use except in the case of hobby beer and wine-making establishments where retail sales may be a principal use.

4B79 Size, Shape and Siting Regulations

(a) In the case of service stations, the minimum lot area shall be 1114.8m^2 (12,000 sq.ft.);

(b) In the case of a car wash not operated in conjunction with a gas bar or service station, the minimum lot area shall be 929m^2 (10,000 sq.ft.) plus 186m^2 (2,000 sq.ft.) for each car wash bay in excess of three and the lanes leading to and from each bay shall be a minimum of 3.1m (10 ft.) in width and 18.3m (60 ft.) in length;

4B73 Landscaping Regulations

1. All required setback areas shall be landscaped in accordance with an approved landscape plan.

2. Parking areas containing more than 20 spaces in one row shall incorporate raised landscape planters not less than 1.0m (3.3 ft.) in width and 5.7m (18.7 ft.) in length every 20 spaces.

3. Double rows of parking spaces shall be separated by a landscaped strip not less than 1.2m (4 ft.) in width.

4. All garbage and recycling container pads shall be screened with a 2m (6.5 ft.) high screen consisting of a solid wood fence, landscaping or a combination thereof.

5. All electrical kiosks, not located underground or within a building shall be sited to the rear of a building.

4B74 Parking and Loading Regulations

1. Parking and loading spaces for uses in the CD18 Zone shall be provided in accordance with Part 10 of this Bylaw.

2. In cases where a development application is submitted without an identification of specific uses, parking requirements will be assessed on the basis of a minimum of one space/40m^2 (430.5 sq.ft.) of gross leasable area up to a maximum of 25% of the gross leasable area of the building and one space/100m^2 (1076 sq.ft.) of all other gross leasable area and the issuance of business licenses for permitted uses in that building will be dependent upon the availability of parking on the lot or on an adjacent lot in accordance with Sections 1002.3 and 1002.4 of this Bylaw.

3. All loading areas shall be provided to the side or rear of buildings adjacent to an interior lot line. In the case of lots flanking Amherst Avenue or Riverside Drive, all loading areas visible from the street shall be screened.

4B75 Comprehensive Development Zone 19 (CD19)

Intent

The intent of the Comprehensive Development Zone 19 (CD19) is to accommodate uses appropriate in a business park setting. Permitted uses will be oriented primarily to office and limited high quality industrial and light manufacturing uses which are environmentally safe and clean.

4B76 Uses

(1) All uses of land, buildings and structures in the Comprehensive Development Zone 19 are prohibited except:

133
134

MISSING PART — see page 133!

Buildings and structures in the CD19 Zone shall comply with the following regulations:

(1) Height:

Buildings and structures in the CD19 Zone shall not exceed a height of 18m (60 ft.) except where exempted under Section 407 of this Bylaw;

(2) Building Coverage:

Buildings and structures in the CD19 Zone shall not occupy more than 60% of the lot area;

(3) Site Coverage:

Buildings, structures, parking spaces, loading spaces and manoeuvring aisles in the CD19 Zone shall not occupy more than 85% of the total lot area;

(4) Floor Space Ratio:

The floor space ratio in the CD19 Zone is 2.0.

(5) Building and Parking Setbacks:

(a) Buildings, structures and parking areas in the CD19 Zone shall be setback a minimum of:

(i) 10m (33 ft.) from any street;
(ii) 5m (16.5 ft.) from any interior rear or side lot line or any lane

(b) Parking areas shall be setback a minimum of:

(i) 6m (20 ft.) from any street;
(ii) 2m (6.5 ft.) from interior side or interior rear lot lines and any lane.

(6) Accessory Floor Space:

Accessory floor space in the CD19 Zone shall not exceed 40% of the gross leasable floor area of a business or tenancy in a multi-tenant building.

4B80 Landscaping Regulations

1. All required setbacks from streets shall be bermed and landscaped in accordance with an approved landscape plan;

2. All setbacks from interior side and rear lot lines shall be landscaped in accordance with an approved landscape plan;

3. Parking areas containing more than 20 spaces in one row shall incorporate raised landscape planters not less than 1.0m (3.3 ft.) in width and 5.7m (18.7 ft.) in length every 10 spaces;

4. Double rows of parking spaces shall be separated by a landscaped strip not less than 1.2m (4 ft.) in width;

5. All garbage and recycling container pads shall be located to the rear or a building and shall be screened with a 2m (6.5 ft.) high solid screen; and

6. All electrical kiosks not located underground or within a building must be sited to the rear of a building and not within a required setback area and when visible from a street, shall be screened with fencing, landscaping or a combination thereof.

4B81 Parking and Loading Regulations

1. Parking and loading spaces shall be provided in accordance with Part 10 of this Bylaw;

2. All loading spaces shall be provided to the rear of a building or to the side adjacent to an interior side lot line;

3. Where loading spaces are visible from a flanking street, the loading space shall be screened; and

4. In cases where a development permit application is submitted without an identification of specific uses, parking requirements will be assessed on the basis of one space/40m^2 (430.5 sq.ft.) of gross leasable area and the issuance of business licenses for permitted uses in that building will be dependent upon the availability of parking on the lot or on an adjacent lot in accordance with Sections 1002.3 and 1002.4 of this Bylaw.

c) The Zoning Map is amended in the case of lands legally described as: Portion of Lot 5 of Block H, D.L. 193 and 611, Plan 17801 VPC V-1381(4) Parcel "A" Land 550,284sq.ft., Parcel "B" Water 217,766sq.ft. and V-1381(5) Water 21,399sq.ft. (PID: 007-253-265); Lot 1 of Lot B, D.L. 611, Plan 17800 (PID: 007-254-067); and Portion of Lot A, Block B, D.L. 193, Plan 1587 (PID: 014-538-415) as outlined on the attached map by rezoning the land from General Industrial (I2) and General Commercial Zone 3 (C3) to Comprehensive Development Zone 18 and Comprehensive Development Zone 19.

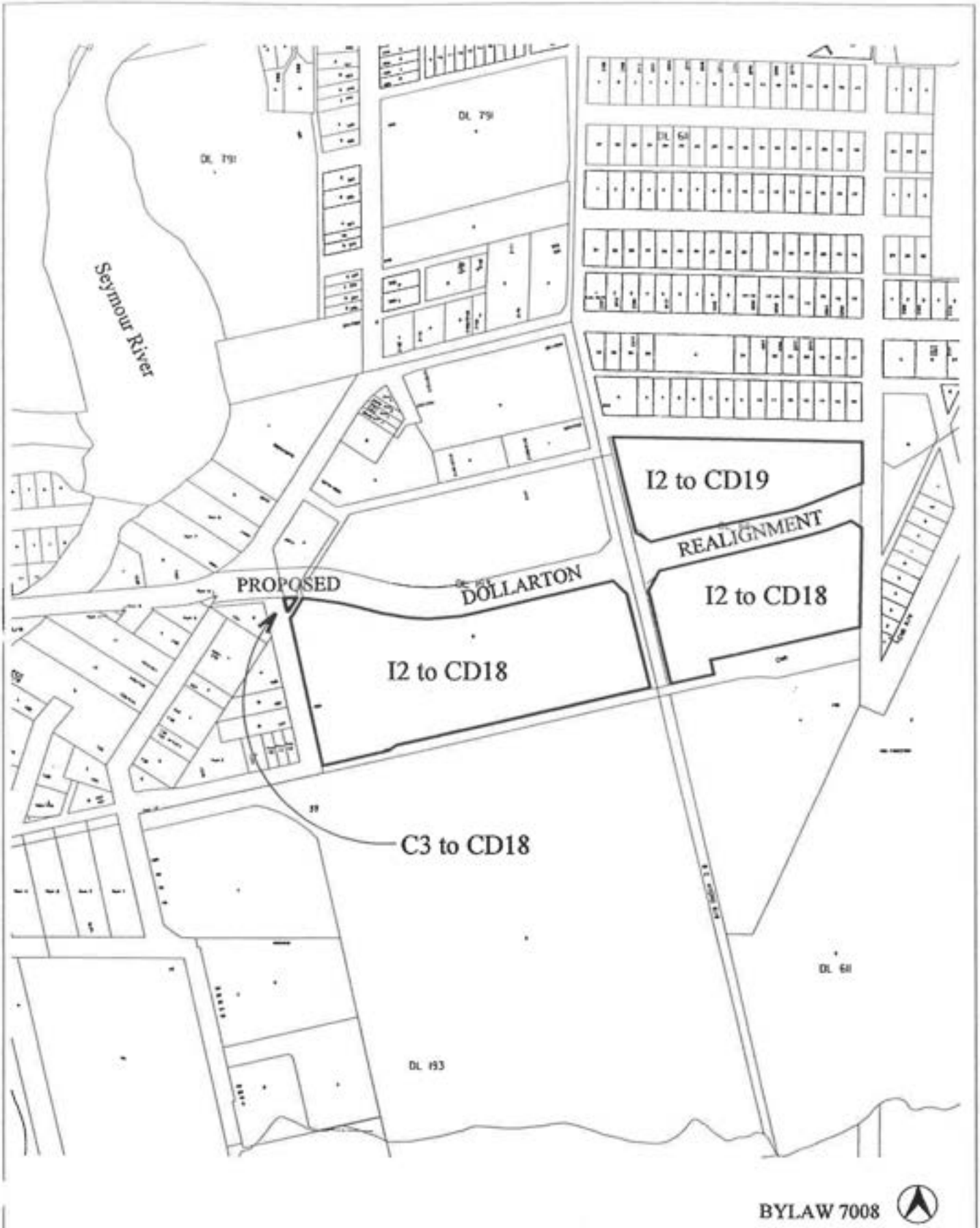
PUBLIC HEARING held , 19 .

PASSED by the Council on the day of , 19 .

ADOPTED by the Council on the day of , 19 .

_____
Mayor

_____
Municipal Clerk


DL 791
DL 791
DL 641
Seymour River
I2 to CD19
REALIGNMENT
PROPOSED
DOLLARTON
I2 to CD18
I2 to CD18
C3 to CD18
DL 641
DL 193

BYLAW 7008

Exhibit 10

Phased Construction of Dollarton Highway Realignment and Funding Options for a New Dollarton Bridge

Document No: 113804

PHASED CONSTRUCTION OF DOLLARTON HIGHWAY REALIGNMENT AND FUNDING OPTIONS FOR NEW DOLLARTON BRIDGE

A. Existing Cost Sharing Agreement:

Can Oxy	DNV
$3,000,000	$3,750,000
$ 750,000 (land)	
$3,750,000	

B. Examine a Phased Construction of Dollarton Realignment (ie., 2 lanes) and other Roadway Improvements:

a) 2 lanes of Dollarton
(50% of 1, 2 & 3 segments shown on attached plan)

Can Oxy	DNV
$700,000	$1,315,000

b) Riverside north of Dollarton:
(7 & 8 shown on attached plan)

Can Oxy	DNV
$293,000	$303,000

c) Forester upgrading:
(10 & 11 shown on attached plan)

Can Oxy	DNV
$205,000	$205,000

d) Amherst improvements:
(5 shown on attached plan)

Can Oxy	DNV
$155,000	$155,000

e) Total Costs for phased construction:

Can Oxy	DNV
$1,353,000	$1,978,000
$ 750,000 (land)	
$2,103,000	

C. Can Oxy's $1,647,000 would be devoted to the other road components identified under the existing cost sharing arrangement as their property develops.

D. Estimated Cost of Dollarton Bridge

$6,000,000

E. Alternate Funding Packages Available for the New Dollarton Bridge include:

a) reallocation of existing funds in conjunction with a loan from the Heritage Fund;

i) reallocation of existing funds;

- diversion of $1,700,000 in DNV funds from the existing cost sharing arrangement with COPL; and
- $2,600,000 from previously approved land development projects (Mystery Crescent and Roche Point); plus

ii) a loan of $1,700,000 from the Heritage Fund to the Development Cost Charge Bylaw (estimated DCC revenue for Dollarton Bridge is $2,619,240); or

b) reallocation of existing funds in conjunction with potential revenue from existing, yet unsold, land development projects;

i) reallocation of existing funds;

- diversion of $1,700,000 in DNV funds from the existing cost sharing arrangement with COPL; and
- $2,600,000 from previously approved land development projects (Mystery Crescent and Roche Point); plus

ii) a loan of $1,700,000 from either:

- the anticipated revenue of $3,080,000 from the sale of 14 lots on Kilmer Avenue; or

- the anticipated revenue of $6,160,000 from the sale of 22 lots on Anne Macdonald Way to the Development Cost Charge Bylaw (estimated DCC revenue for Dollarton Bridge is $2,619,240); or

c) forwarding the $6,000,000 project to the electorate as a referendum item in 1999.

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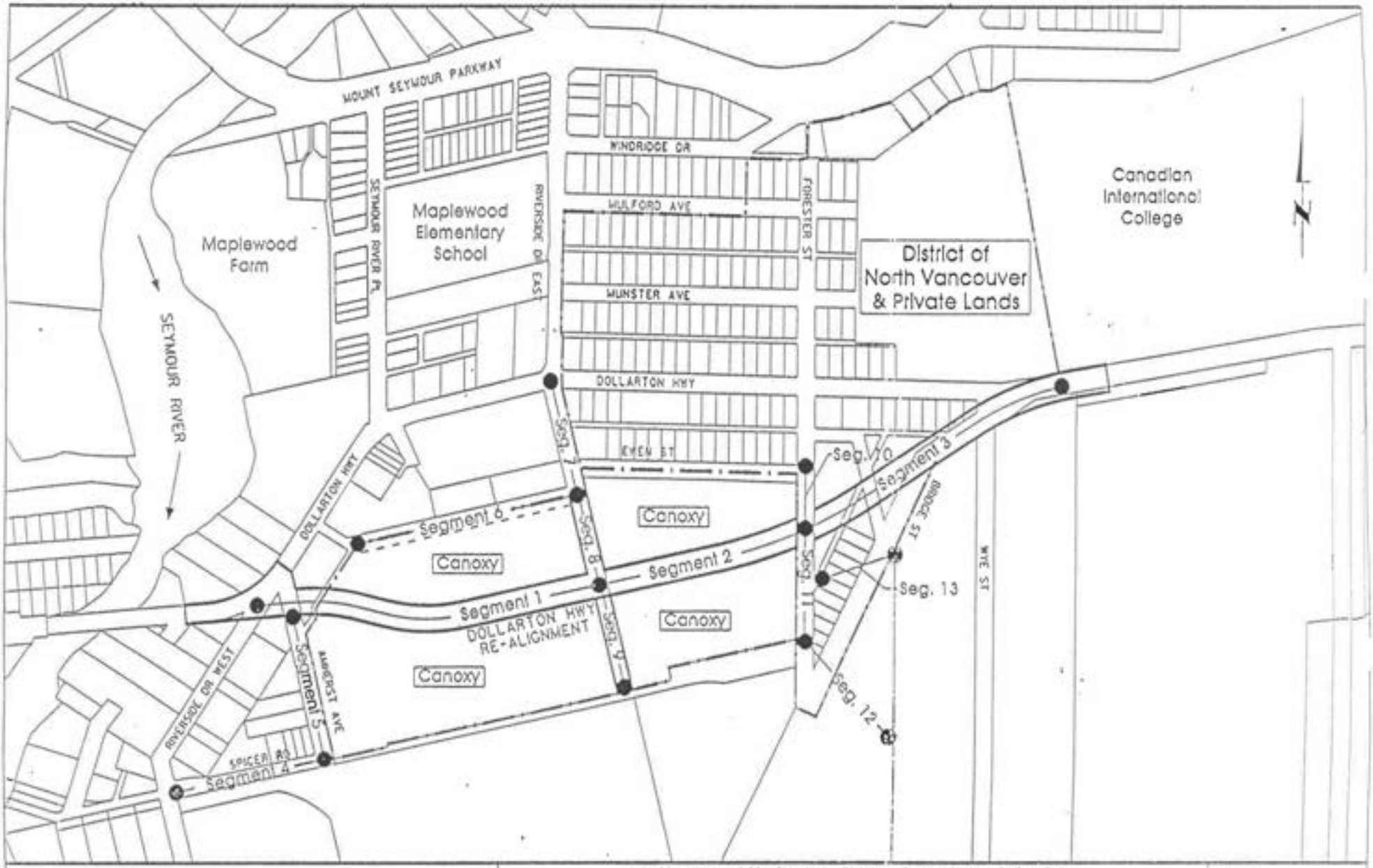


DISTRICT OF NORTH VANCOUVER ENGINEERING DEPARTMENT	Dollarton Highway Re-Alignment Works Road Segments (Seg.)			Plan No.
	Drawn By LW	Approved By	Date 8 MARCH 95	Scale 1:6000	A-163

Dollarton Highway Re-alignment Cost Sharing Project

No.	Segment	Section	Total	Cost Sharing by CanOxy	CanOxy Share	CDNV Share
1	Dollarton	West Of Riverside North	1,786,000	50.00%	893,000	893,000
2	Dollarton	East of Riverside North	1,014,000	50.00%	507,000	507,000
3	Dollarton	East of Forester	1,230,000	0.00%	0	1,230,000
4	Spicer		295,000	0.00%	0	295,000
5	Amherst		310,000	50.00%	155,000	155,000
6	Front		234,000	100.00%	234,000	0
7	Riverside	North Of Front	303,000	0.00%	0	303,000
8	Riverside	North to Front	293,000	100.00%	293,000	0
9	Riverside	South	633,000	100.00%	633,000	0
10	Forester	North to Ewen	227,000	50.00%	113,500	113,500
11	Forester	South	183,000	50.00%	91,500	91,500
12	Forester	Drainage South	160,000	50.00%	80,000	80,000
13	Forester	Access Road	82,000	0.00%	0	82,000
		Construction Cost	**6,750,000**		**3,000,000**	**3,750,000**
14	Land Contribution by CanOxy		750,000	100.00%	750,000	0
		Project Cost	**7,500,000**		**3,750,000**	**3,750,000**

Exhibit 11

Summary of Required Agreements and Covenants

SUMMARY OF REQUIRED AGREEMENTS AND COVENANTS:

1. Require COPL to maintain the conditions of "reduced storage" it has achieved regarding the storage and shipping of chlorine from its plant. Generally, COPL is prohibited from increasing on-site storage capacity over the 300 tonne level and from loading chlorine to on-barge fixed storage tanks.

2. Give both the District and the owners of the development lands the right to enforce by court injunction the storage and shipping limitations.

3. Give both the District and COPL the right to enjoin the use of the development lands:

   (a) at all times, for uses other than those permitted in the rezoning bylaw; and

   (b) during any violation of the specified storage and shipping conditions, for any potential use permitted in the rezoning bylaw but not yet in effect.

4. Require that COPL provide to the District annually a statutory declaration confirming that COPL has met the specified storage and shipping conditions.

5. Permit the District and its representatives a right of access to inspect the development lands to determine whether the applicable use limitations are being met.

6. Permit the District and its representatives a right of access to inspect the plant to determine whether the specified storage and shipping conditions are being met.

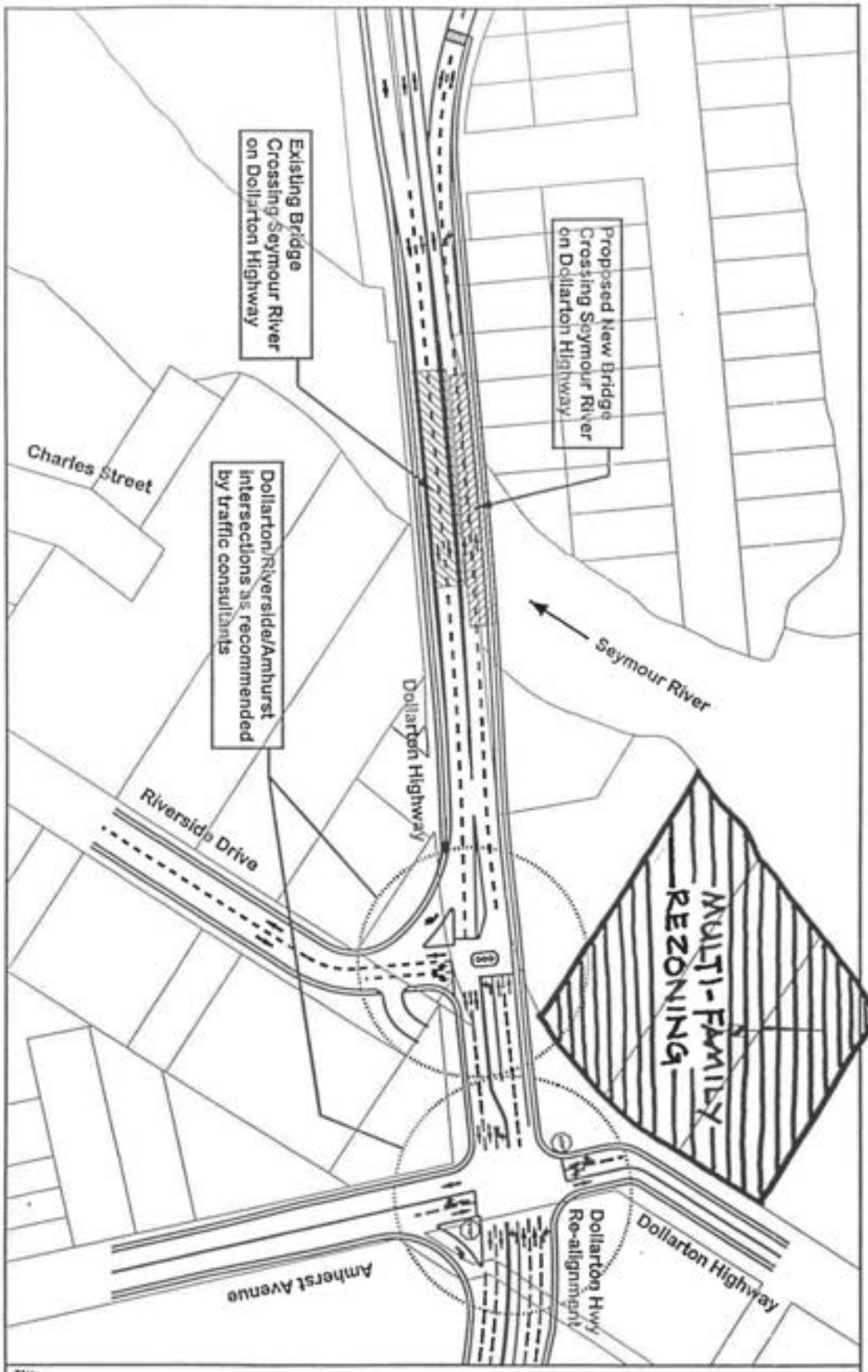
7. Apply the specified storage and shipping conditions to the lands COPL leases from the Vancouver Port Corporation, and give the Vancouver Port Corporation full notice of these agreements.

8. If future guidelines recommend tighter restrictions on the use of the development lands, then except to the extent uses are then grandfathered the development lands can be rezoned and agreements with COPL can be addressed again.

Exhibit 12

Relationship Between Proposed Multi-Family Rezoning Application and Proposed Dollarton Bridge and Dollarton Highway Realignment

Document No: 113804



Title:
Proposed North Alignment Option for New Bridge Crossing Seymour River on Dollarton Highway

DISTRICT OF NORTH VANCOUVER ENGINEERING DEPARTMENT	Approved By	Date JAN 26, 1998	Plan No.
	Drawn By LW/SS	Scale NTS	B-141

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MINUTES of the **Regular Meeting of the Council** for The Corporation of the District of North Vancouver held in the Council Chamber of the Municipal Hall, 355 West Queens Road, North Vancouver, B.C. on Monday, May 5, 1997 commencing at 7:10 p.m.

11. Request for Report: Maplewood Area - Dollarton Highway Realignment

File 3060-20/8.93

Report: Councillor Ernie Crist, April 11, 1997
Mayor Don Bell, May 1, 1997

COUNCILLOR'S RECOMMENDATION

THAT

1) staff be requested to provide an update report on the CanOxy/Dollarton Highway Realignment issues in the Maplewood area; and

2) the report contain all relevant background material including the chemical hazard aspects of CanOxy and its implications for the location of a business park and residential development in the Maplewood area, plus the legal aspects pertaining to the agreement with CanOxy in regards to the Dollarton area, as well as projected costs and monies spent so far.

Moved by Councillor MURI, Seconded by Councillor CRIST and CARRIED

THAT the report from Councillor Crist dated April 11, 1997 be received for information.

3060 20/8/93

Report of the Public Hearing held in the Council Chambers, District Municipal Hall, 355 West Queens Avenue, North Vancouver, B.C. on Tuesday, June 11, 1996 commencing at 8:15 p.m.

PRESENT:

Mayor	J. Murray Dykeman
Councillors:	Don Bell, Ernie Crist, Jim Cuthbert, Pam Goldsmith-Jones, Janice Harris, Pat Munroe
Staff:	Mr. J.I. Torry, Manager - Planning Mr. G. Howie, Municipal Manager Ms R. Tolerton, Assistant Municipal Clerk Ms B. Audette, Committee Clerk

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BYLAW 6762 "Rezoning Bylaw 1027"

Applicant: Canadian Occidental Petroleum Ltd. And Imperial Oil Co. Ltd.

Subject Land: 100 Amherst Avenue (Lot 5, Block H, District Lots 193 and 611, Plan 17801)
2011 Dollarton Highway (Lot A, Block 18, District Lot 193, Plan 1587)

Proposed Amendments:

1. The creation of the Comprehensive Development Zones 17, 18 and 19 (CD17, CD18 and CD19);

2. The application of the CD17, CD18 and CD19 Zones to lands owned by Canadian Occidental Petroleum Ltd. and Imperial Oil Co. Ltd. in Maplewood.

Purpose: The purpose of these amendments is to create three new Comprehensive Development Zones to allow for the future development of the applicant's lands for commercial and light industrial uses in conjunction with the realignment of a portion of Dollarton Highway in Maplewood.

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The Assistant Municipal Clerk advised that the statutory notification and advertising requirements had been met.

The Manager - Planning advised that the Maplewood OCP, which was adopted in 1983 and subsequently amended in 1990, included a concept to divert the existing Dollarton Highway and to create a business park to be located north of the realigned highway.

The District has worked with the applicant for approximately four years to develop the proposed plan. Two significant stages in the development of the plan were the completion of a Quantitative Risk Assessment ("QRA Study") of Canadian Occidental Petroleum Ltd.'s chlorine plant and a cost sharing study on the realignment of the Dollarton Highway.

The proposed Bylaw would create three new Comprehensive Development Zones. Comprehensive Development Zone 17 would allow a limited range of commercial use in the area located of the realignment of the Dollarton Highway. Comprehensive Development Zone 18 would permit light manufacturing and warehouse uses in the area south of the realigned highway. Comprehensive

Development Zone 19 would accommodate high quality light industrial manufacturing and office space in the area east of the extension of Riverside Drive.

The Manager - Planning stated that the proposed Bylaw was structured based on the recommendations in the QRA Study to improve public safety through the reduction of chlorine storage on the site.

The Advisory Planning Commission considered the proposed Bylaw on April 17, 1996 and resolved "that the Advisory Planning Commission supports in principle Bylaw 6762 creating Comprehensive Development Zones 17, 18 and 19 and rezoning lands owned by Canadian Occidental Petroleum Ltd. From I2 to CD17, CD18 and CD19, subject to Council assuring itself that the risks identified in the *Quantitative Risk Assessment* are addressed by the provisos contained in the restrictive covenants which will be registered against these lands.

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REPRESENTATIONS:

1. **Jane FLEMING** **IN FAVOUR**
   c/o Canadian Occidental Petroleum Ltd.

- Employee and representative of Canadian Occidental Petroleum Ltd.
- Noted that the realignment of Dollarton Highway and development of a business park would result in increased traffic and people in the area adjacent to the chlorine plant consequently CanOxy obtained a QRA Study
- The QRA Study examined existing procedures and made recommendations to improve the handling and storage of chlorine at the plant as well as the transportation of the chemical by rail and barge
- The Study confirmed that the most significant risk is an earthquake
- Recommendations included the installation of an improved early warning system; improved monitoring system; upgraded storage tanks; improved design to ensure rail cars can withstand extreme conditions; storage in rail cars which are safer than storage tanks; and the eventual removal of storage tanks from the operating site
- The proposed Bylaw amendments were initiated in response to the request of the District to realign the Dollarton Highway
- Implementation of the QRA Study recommendations will be approximately $700,000 to $1,000,00 this year and approximately $250,000 per annum thereafter
- CanOxy has recognized the need for better community liaison and has established a community advisory panel
- The Company is prohibited from increasing the product capacity of the chlorine plant
- CanOxy has no plans to discontinue this important and profitable operation
- The plant has existed for many years with only minor spills while the residential community has developed around it
- The worst case scenario referred to in the QRA Study would include a major earthquake with the epicenter under the chlorine plant and a calm wind and people trapped outdoors in the area of the plant extending up to the existing Dollarton Highway
- This area would shrink to the boundary of the rail tracks following completion of the recommended changes
- A number of the recommended alterations have been implemented and the remaining improvements would be completed before the proposed redevelopment proceeds

At the request of Councillor Crist, Ms Fleming agreed to provide Council with a copy of her presentation report.

In response to a question from Councillor Crist regarding the reduction of the risk area around the plant, Ms Fleming displayed a map outlining the chlorine plant and the buffer zone which will extend up to the CN Rail Right of Way. She clarified that no development would occur within the buffer zone.

Ms Fleming agreed to provide information requested by Councillor Crist regarding the number of chlorine spills and requests for medical treatment in the past

Councillor Crist asked if the plant could increase product capacity if increased safety measures are implemented. Ms Fleming responded that capacity is restricted to current levels.

In reply to a question from Councillor Crist, Ms Fleming advised that the improvements which would be undertaken in the current year include the relocation of a propane tank; installation of a new monitoring system; and upgrading of storage tanks.

Councillor Crist asked Ms Fleming to comment on the location of the plant where traffic flow is restricted by limited access. Ms Fleming stated that improved transit links would ensure better access.

In response to a question from Councillor Munroe, Ms Fleming explained that the community advisory panel was established early in 1996 and that members were appointed by an independent facilitator. The panel meets approximately once a month and minutes are recorded.

Councillor Bell inquired about the shift of chlorine storage from tanks to railcars. Ms Fleming clarified that fixed tanks create more risk than rail cars and further that overall storage capacity would not be expanded.

In response to a question from Councillor Bell regarding the risk factor for people who are outdoors in the warehouse zone during a spill, Ms Fleming stated that chlorine is a heavy chemical that will disperse quickly if there is wind. Following a spill, people should stay indoors with doors and windows closed and also move upward if possible.

At the request of Councillor Bell, Ms Fleming agreed to provide information regarding the degree of risk that an earthquake could occur with the epicenter in the area of the plant.

Ms Fleming confirmed to Councillor Bell that people should attempt to move uphill if a spill requires evacuation.

Councillor Bell noted that there are residential properties within the present high risk zone and inquired whether the risk had always existed. Ms Fleming replied that it had and displayed a sketch indicating the current buffer zone.

In response to a question from Councillor Harris, Ms Fleming stated her understanding that it is not more hazardous to fill or empty rail cars as opposed to fixed storage tanks and agreed to provide confirmation on this matter.

Councillor Harris asked if consideration had been given to seepage of oil and grit runoff into storm drains and whether the realignment of Dollarton Highway would include services to deal with the runoff. Ms Fleming replied that consideration would be given to this suggestion.

2. **Ross MUIRHEAD** — **OPPOSED**
3096A Paisley Road

- The risk of a leak at the chlorine plant is a serious concern and potential health hazard to the residents of the District
- An earthquake would devastate the plant and have a major impact on residents in the area
- Traffic flow away from the East Seymour area is restricted to Mount Seymour Parkway and Dollarton Highway which is adjacent to the chlorine plant;
- The chlorine plant should not be allowed to continue to operate at this site

3. **Dudley KILL** — **IN FAVOUR**
950 Tollcross Road

- Resides in the East Seymour area
- The proposed realignment of the Dollarton Road will improve traffic flow and benefit the community
- The business and industrial parks will revitalize the area; provide employment for District residents and improve the tax base

4. **Doris STEWART** — **OPPOSED**
233 Riverside Drive

- Lives near the CanOxy chlorine plant
- Residents in the area fear the implications of a major spill or leak
- The only option for Seymour area residents is to remain inside if there is a spill because it would be impossible to evacuate the area

5. **Linda MELVILLE** — **OPPOSED**
2263 Dollarton Highway

- Resident of East Seymour area
- Strongly opposed to CanOxy continuing to operate a chlorine plant at this site
- This is a high risk industry that should not be permitted in a residential community
- Expressed concern for the well being of her family and neighbours and suggested that a tragic accident is inevitable

6. **Dave SADLER** — **OPPOSED**
277 Roche Point Drive

- Read and submitted a written presentation
- This proposal has been in progress for a number of years and it is inappropriate to abruptly schedule a public hearing without allowing adequate time for the public to review the background reports
- There should be a report from District staff on the negative impact of the proposal on the East Seymour area and on the District in general
- Asked Council to adjourn the Public Hearing to allow further public input
- Suggested that a report should be requested from Planning staff
- Asked that a public information meeting be scheduled with Planning staff to provide an opportunity for discussion and review of the application
- The proposed rezoning presents an opportunity to achieve concessions from CanOxy that will ensure that the chlorine plant is safe

- There were two minor spills recently and there is a real risk of a more serious problem with the possibility of an earthquake
- The Dollarton Highway is a bottleneck at the Seymour River and outgoing traffic backs up while waiting to access the Second Narrows Bridge and Upper Levels Highway
- There should be no further development until a new interchange is built at this location
- The proposed business and industrial parks should be restricted to businesses that will generate minimum traffic levels
- The community does not need the Dollarton realignment and taxpayer funds should not be used to pay for it. The applicant will be the real beneficiary of this road and should pay for it with the profits that will be earned from the proposed development

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DISPOSITION:

MOVED by Councillor CRIST, Seconded by Councillor MUNROE, and REPLACED
THAT Bylaw 6762 be returned to the next Regular Meeting of Council for further consideration.

MOVED by Councillor GOLDSMITH-JONES, Seconded by Councillor HARRIS and CARRIED
TO replace the previous motion with the words "THAT the Public Hearing on Bylaw 6762 be adjourned and reconvened after conducting a Public Information Meeting, the purpose of which is to share research findings and clarify the understanding between Canadian Occidental Petroleum Ltd. and the District of North Vancouver" and that staff be requested to provide an information reporting answering questions to be submitted to the Clerk by Council.

Mayor DYKEMAN declared the Public Hearing in respect of Bylaw 6762 **ADJOURNED** at 11:00 p.m.

Certified correct:

R Lubyt

Committee Clerk
B. Audette

MINUTES of the Regular Meeting of the Council for The Corporation of the District of North Vancouver held in the Council Chamber of the Municipal Hall, 355 West Queens Road, North Vancouver, B.C. on Monday, May 27, 1996 commencing at 7:22 p.m.

13. Bylaw 6762 Rezoning Bylaw 1027

File 3060-20/8.93
(Canadian Occidental Petroleum Ltd.)

Report: Senior Development Planner, May 22, 1996

Public Input:

Ms Jane Fleming, on behalf of Canadian Occidental Petroleum Ltd., was in attendance to respond to any questions with respect to the Quantitative Risk Assessment Report.

Moved by Councillor BELL, Seconded by Councillor GOLDSMITH-JONES and CARRIED
THAT Bylaw 6762 be considered.

Moved by Councillor BELL , Seconded by Councillor GOLDSMITH-JONES and CARRIED
THAT Bylaw 6762 be now read a first time.

Moved by Councillor BELL, Seconded by Councillor GOLDSMITH-JONES and CARRIED
THAT a Public Hearing on Bylaw 6762 be held on Tuesday, June 11, 1996.

COUNCIL (NDA/INFORMATION		
☐ In-Camera	Date:	Item #
☒ Regular	Date: May 27/96	Item #
☐ Executive	Date:	Item #
☐ Info Package	Date:	Item #
☐ Agenda Addendum	Date:	Item #

Dept. Manager | Director | Municipal Manager

The Corporation of the District of North Vancouver

REPORT TO COUNCIL

ORIGINAL
File No. 3060-20/8.93
PLANNING DEPARTMENT

May 22, 1996
File: 3060-20/8.93

AUTHOR: Doug Allan, Senior Development Planner

SUBJECT: REZONING APPLICATION - CANADIAN OCCIDENTIAL PETROLEUM LTD.

RECOMMENDATION:

It is recommended that Council:

1. **introduce Bylaw 6762 creating Comprehensive Development Zones 17, 18 and 19 and rezoning lands owned by Canadian Occidental Petroleum Ltd. and Imperial Oil Co. Ltd. from C3 and I2 to CD17, CD18 and CD19; and,**

2. **refer Bylaw 6762 to a Public Hearing on June 11,1996.**

REASON FOR REPORT:

As this application is an amendment to the Zoning Bylaw, Council's consideration is required.

SUMMARY:

In conjunction with the realignment of Dollarton Highway, Canadian Occidental Petroleum Ltd. (COPL) has applied to rezone its lands on either side of the new road to three new Comprehensive Development Zones. The former Esso service station site on Dollarton Highway at Riverside Drive which COPL has agreement to purchase is also included in the rezoning bylaw.

The Company undertook a Quantitative Risk Assessment of its plant to assess the risks of a major industrial accident under the current operational scenario and an alternate scenario. The two scenarios differ in terms of the volume and conditions of chlorine storage on-site. That QRA resulted in the development of a series of risk hazard contours around the plant which were used in conjunction with land use guidelines established by the Major Industrial Accidents Council of Canada (MIACC) to define the permitted land uses within each zone based on the policy designations in the Maplewood OCP.

Notwithstanding the permitted uses which will be allowed in each zone, COPL will be prohibited by agreement from developing its lands until such time as the conditions of the alternate scenario are met. However, even when these conditions are met, some of the permitted uses within the CD Zones will be prohibited by covenant until further changes in plant storage are made, technology changes or the plant closes.

In order to achieve the objective of having the land uses reflect the conclusions of the QRA, COPL and the District must enter into an implementation agreement and a series of restrictive covenants to be registered on the title to the COPL lands. Consequently, staff recommend that Bylaw 6762 be held at third reading until COPL achieves the alternate scenario conditions and those conditions are verified by a qualified independent professional and all agreements are signed and ready for registration. COPL advises that the alternate scenario conditions are likely to be achieved by the end of the year.

BACKGROUND:

In order to facilitate the development of a municipal business park on lands north of Dollarton Highway east of Riverside Drive, COPL has agreed to dedicate a new road allowance through its lands which will permit the realignment of a portion of the existing Dollarton Highway and to contribute to the cost of construction. As the new road will facilitate improved access to their lands, COPL has applied to rezone its property on either side of the realigned roadway. The former Esso service station site on Dollarton Highway is also included in the rezoning (Attachment A).

EXISTING POLICY:

Under the Maplewood OCP, the subject lands are designated as "Commercial", "Light Industrial" and "Mixed Use" (Attachment B).

SITE AND SURROUNDING AREA:

The COPL lands are zoned General Industrial (I2) and are located between a rail spur line to the south, Front Street to the north, Amherst Avenue to the west and Forester Street to the east. The lands are presently vacant and heavily treed. The former Esso service station site (C3) on Dollarton Highway at Riverside Drive is vacant.

Surrounding land use consists of: a mix of light industrial (I3) uses, a neighbourhood pub (C6) and a paper recycling firm (I3) to the west; the waste transfer station (I2) to the southwest; other chemical industries and a lumber company (I1 and I2) to the east and southeast; and, commercial (C2), multi-family residential (RM3) and light industrial (I3) uses to the north .

Attachment C illustrates the proposed municipal business park in relation to the COPL and Imperial Oil lands.

QUANTITATIVE RISK ASSESSMENT:

COPL has undertaken a Quantitative Risk Assessment (QRA Study) as part of its long term risk management program to assess the public safety hazard associated with the operation of its plant and to assist in land use planning in the vicinity of the facility. A summary of the QRA Study is included as Attachment D.

ANALYSIS:

The Proposal: The proposal is to rezone the COPL lands on either side of the realigned Dollarton Highway from General Industrial I2 to three new Comprehensive Development Zones 17, 18 and 19. The bylaw will also rezone the former Esso service station site on Dollarton Highway from C3 to CD17 and 18. Bylaw 6762 (Attachment E) establishes principal and accessory uses; size, shape and siting regulations; landscaping regulations and parking requirements for each CD zone.

a) **Permitted Uses:**

1. **CD 17 Zone:** The CD17 Zone is intended to be a general commercial zone providing a range of services to complement the existing commercial uses for the benefit of the residents and employees in the general area.

2. **CD 18 Zone:** The intent of the CD18 Zone is to accommodate higher quality light manufacturing and warehousing uses which generally require larger sites which are augmented with a limited range of retail, wholesale and service-oriented uses consistent with the OCP.

3. **CD 19 Zone:** The intent of the CD 19 Zone is to accommodate uses which are appropriate in a business park setting with uses oriented to office and high quality light industrial and manufacturing uses which are environmentally safe and clean. A separate CD zone with very similar uses will eventually be placed upon the municipal lands to the north to regulate development within the future business park .

Notwithstanding the intent of each CD Zone relative to the OCP land use designations, the QRA risk contours and the MIACC guidelines will form the basis for the land use decisions within each zone. Since no uses would be permitted on the subject lands under the current operational scenario, the permitted uses in each zone represent the broadest range of allowable uses under the alternate operational scenario. However, even when the conditions of the alternate scenario are met within each of the three zones, there are some uses which would still conflict with the MIACC guidelines and be prohibited until such time as either the chlorine storage at the plant is further reduced; technology changes; or, the plant closes. The uses

Document No: 59045

permitted under the alternate operational scenario and those which would be prohibited by covenant until they would satisfy the MIACC guidelines are identified by zone within Bylaw 6762.

b) **Development Regulations:** The recommended size, shape and siting regulations for each CD zone are generally based on the existing commercial and light industrial zone regulations. A matrix (Attachment F) compares the development regulations for each of the three CD Zones. The Bylaw also establishes landscaping and parking regulations.

REQUIRED AGREEMENTS:

In order for the rezoning and utlimately the development of the realigned highway to proceed, COPL will execute restrictive covenants and covenants under Section 215 of the Land Title Act. These will be registered against title to COPL's development lands and remaining plant lands and are designed to enforce the limits on land use, and the chlorine storage/shipping conditions at the Plant, as identified in the QRA. The overall implementation process for these agreements are set out in an umbrella "Implementation Agreement" which will be signed by the District and COPL. Specifics on the implementation agreement and the series of covenants are outlined in Attachment G.

Timing/Approval Process:

If the rezoning proposal is acceptable to Council, it is recommended that Bylaw 6762 be held at third reading until the conditions of the alternate scenario are achieved and verified and the required agreements are executed and registered. Following compliance with the conditions of the alternate scenario, execution of the agreements and adoption of the zoning bylaw, COPL will advance it's share of the construction costs for a realigned Dollarton Highway.

Public Input:

In May 1994, staff and COPL held three public meetings to outline the proposed realignment of Dollarton Highway, the development of COPL lands and the future municipal business park. The majority of the public concerns expressed at those meetings involved the implications of the road changes and the possibility of "big box" retail uses. Since that time, there have been discussions with the local business and residential communities regarding the road realignment and the other necessary traffic changes in the area. However, the issue of the proposed land uses has not been a point of contention for the area residents and business owners.

SUBJECT LANDS

Advisory Planning Commission:

This proposal was initially reviewed and supported by the APC on April 19, 1995, however, this was without the benefit of the QRA Study. The APC reconsidered the proposal at its meeting on April 17,1996 and recommended support in principle subject to any risk issues being addressed in the restrictive covenants (excerpt is included as Attachment H).

PUBLIC HEARING:

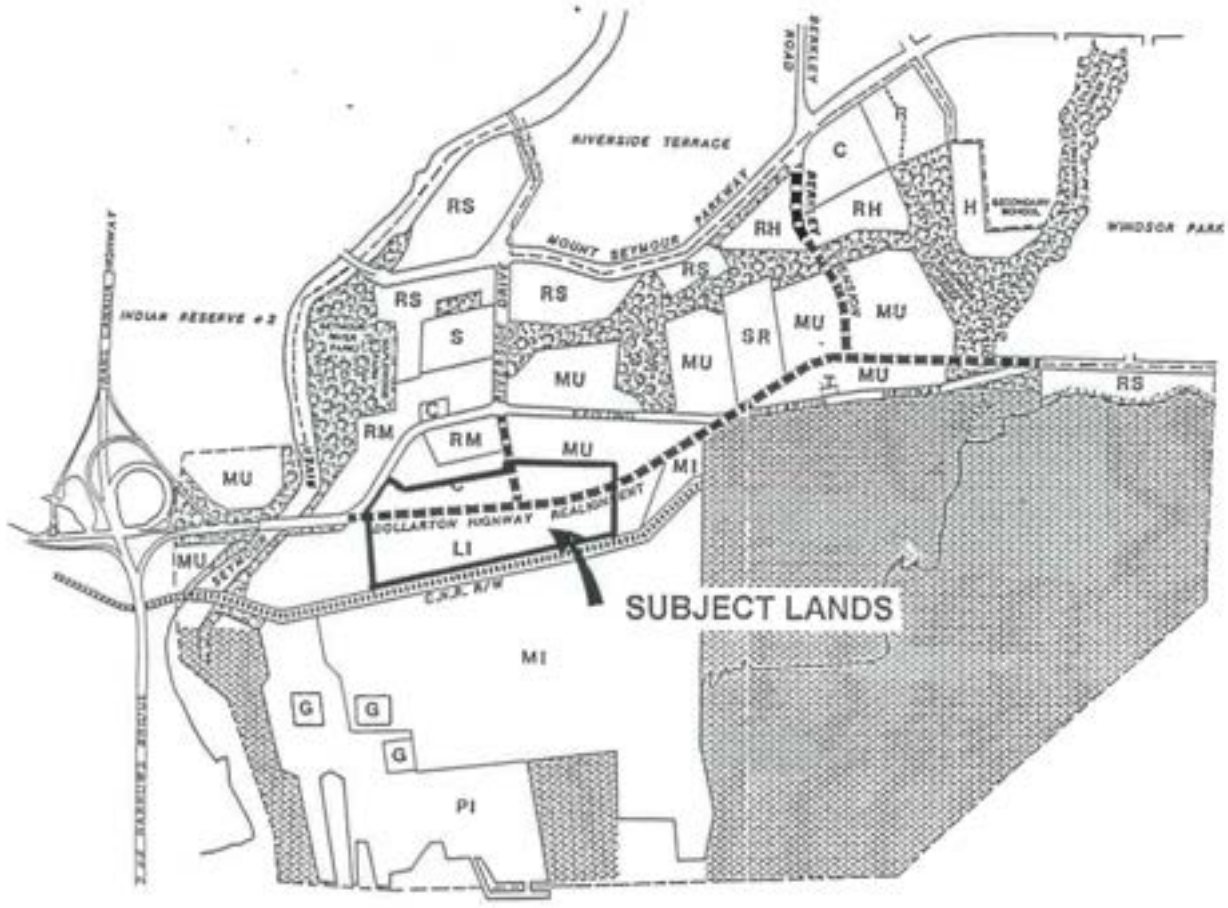
The earliest date for a public hearing is June 11, 1996.

Doug Allan
Registered Planner
Senior Development Planner

DA/d/dw

RECEIVED
MAY 2 1996
MANAGER
CORP. OF THE DIST.
NORTH VANCOUVER

REVIEWED WITH:	REVIEWED WITH:	REVIEWED WITH:	REVIEWED WITH:
☐ Communications	☐ Finance	External Agencies:	Advisory Committees:
☐ Env. Protection	☐ Fire Services	☐ Recreation Commission	☐ _____
☐ Human Resources	☐ Legislative Services	☐ Library Board	☐ _____
☐ Eng. Public Works	☐ Land	☐ Health Dept.	☐ _____
☐ Eng. Admin.	☐ Permits & Licenses	☐ RCMP	
☐ Eng. Parks	☐ Planning	☐ Other: _____	
	☐ Social Planning		



THE MAPLEWOOD
OFFICIAL
COMMUNITY PLAN

PLAN MAP SC-04

LEGEND

RESIDENTIAL:

Residential	RS	RS
Residential	RH	RH
Residential	RH	RH

INSTITUTIONAL:

College	SR
Health	N
Recreation Centre	R
Elementary School	S
.. G.V.R.D.	G

MIXED USE	MU
COMMERCIAL	C

INDUSTRIAL:

Light Industrial	LI
Medium Industrial	MI
Port Industrial	PI

PARKS, RECREATION, & WILDERNESS AREAS:

CONSERVATION AREA

RAILWAY

PLANNING BOUNDARY

TEMPORARY USE PERMIT T

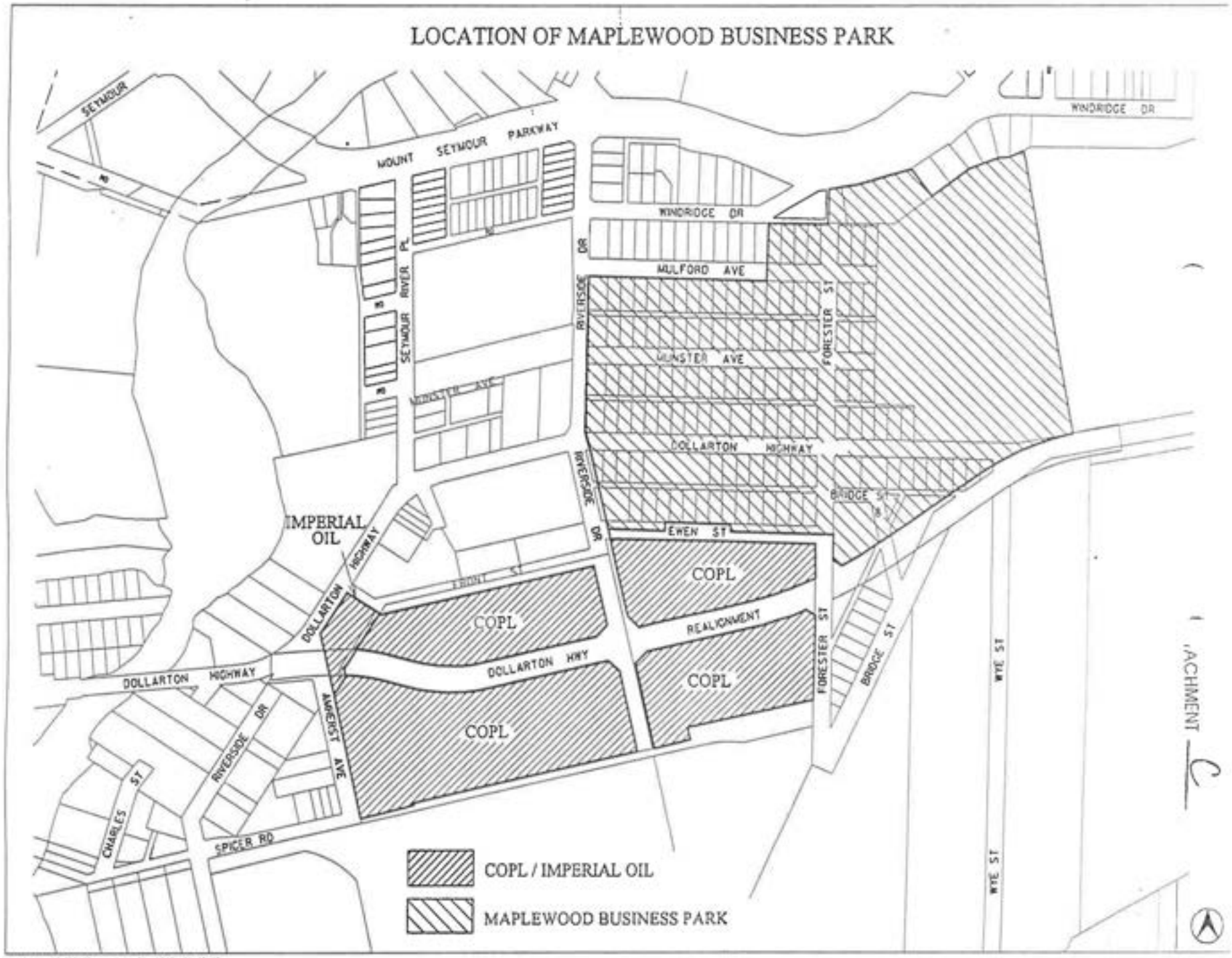
JUNE 1990

NORTH
0 100 200 300m

BYLAW 62

ATTACHMENT B

LOCATION OF MAPLEWOOD BUSINESS PARK



ATTACHMENT C

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ATTACHMENT D

QUANTITATIVE RISK ASSESSMENT SUMMARY

The Quantitative Risk Assessment study undertaken by Bovar Concord Environmental is a tool used to make decisions about safety procedures and land uses, plan emergency response and work co-operatively with other agencies, neighbours and industries.

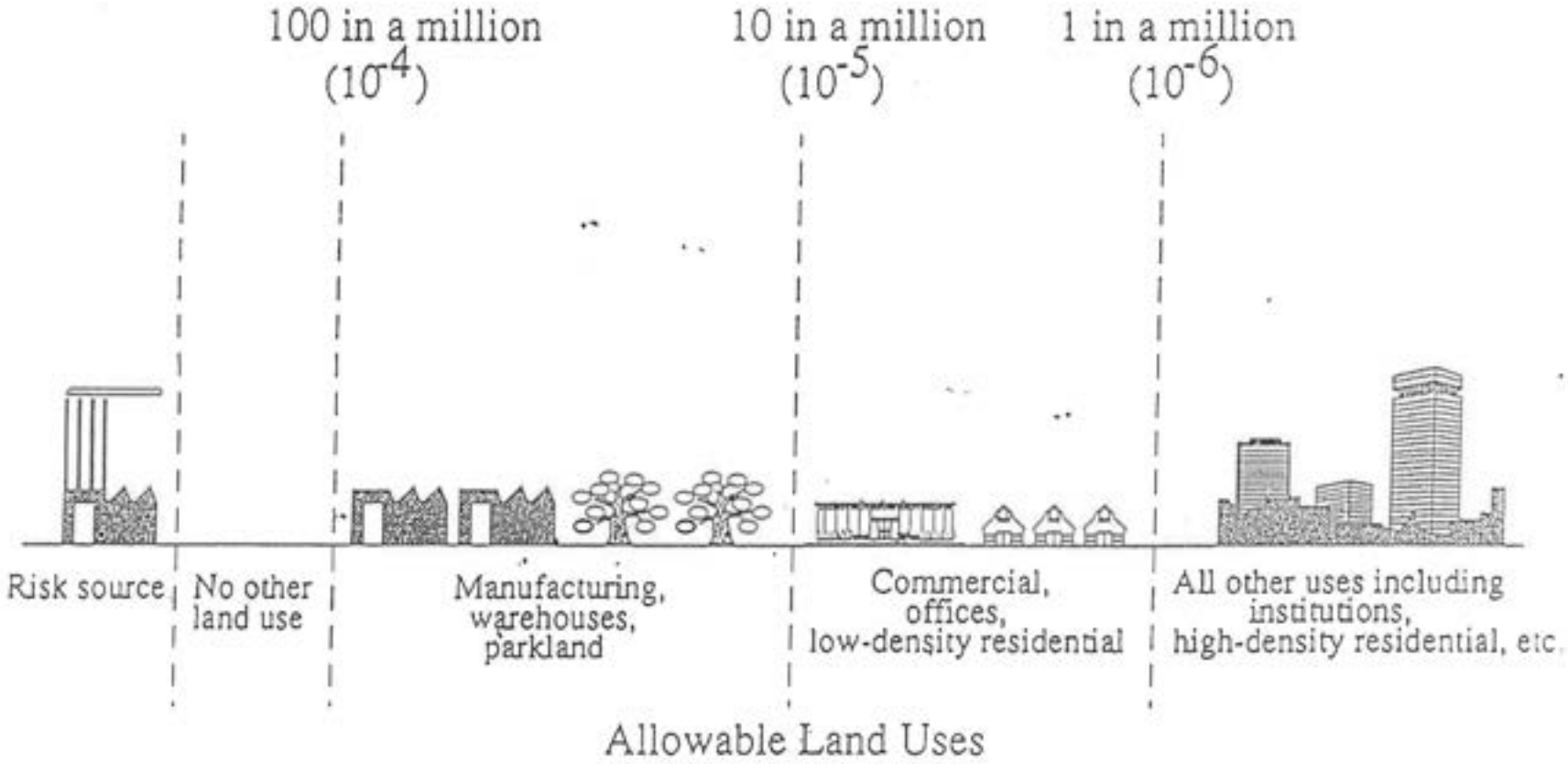
In conducting the QRA study, two operational scenarios were examined: the current operation which includes two 600 tonne chlorine storage tanks, one 300 tonne chlorine storage tank and a barge loading facility; and, an alternate scenario involving a reduced chlorine storage inventory using one 300 tonne storage tank strengthened against earthquakes and no fixed tank storage capacity on any barge. COPL is presently moving towards the alternate scenario and anticipates reaching that target by the end of 1996.

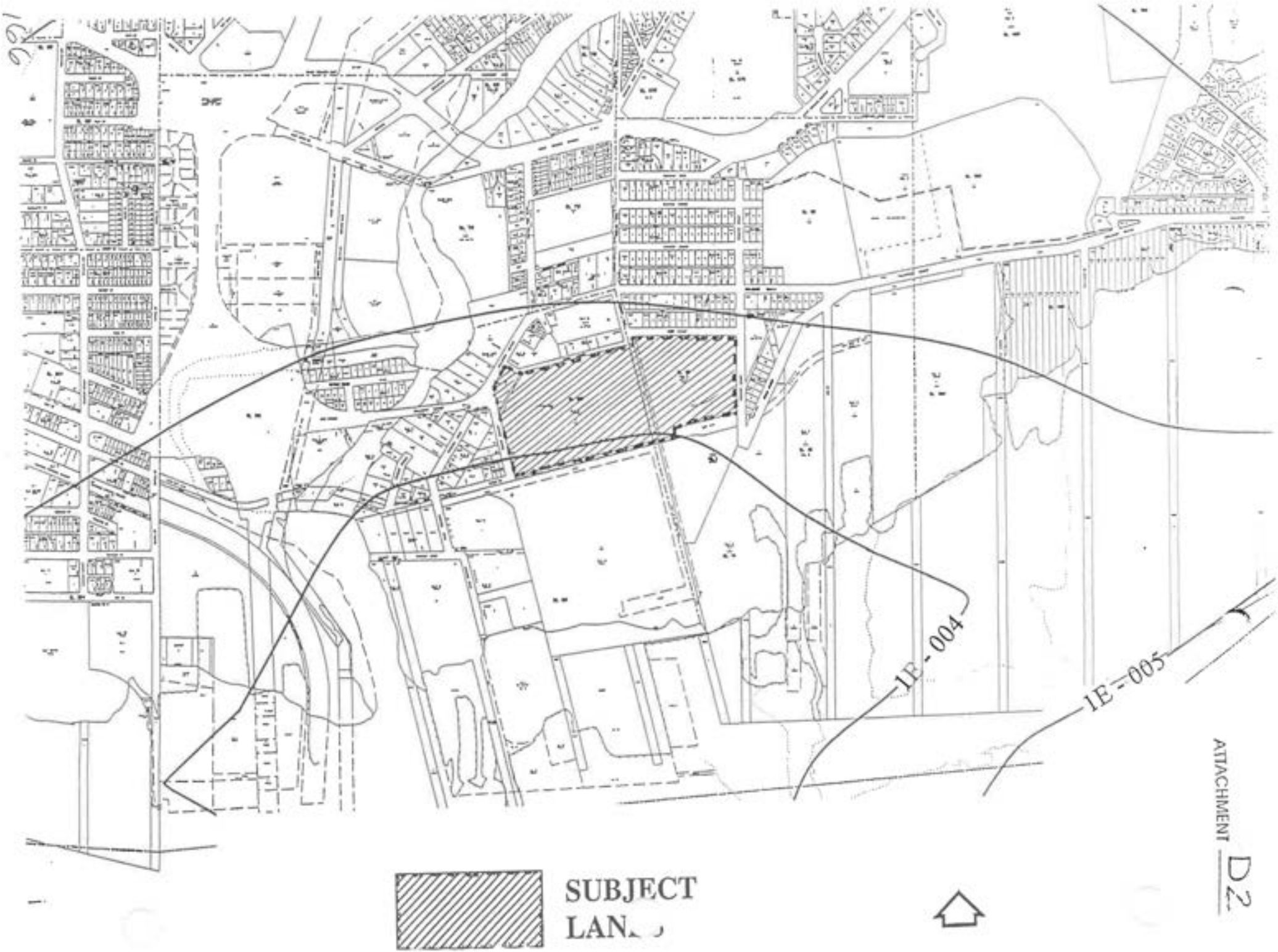
The establishment of standards for planning surrounding areas is based on the Major Industrial Accidents Council of Canada (MIACC) guidelines. In Canada MIACC developed the risk acceptability criteria presented in Attachment D1. These criteria are specified in terms of permitted land uses for specified levels of individual risk.

Combining individual risk due to each release event and taking into account wind direction and weather frequencies results in individual risk contours for various operational scenarios.

Very briefly, under the current operational scenario, all of the Company's lands would be located within the 10^{-4} contour and, therefore, under the MIACC guidelines, no uses would be permitted. Under the alternate operational scenario, all of the subject lands except for a section immediately north of the existing rail line would fall between the 10^{-4} contour and the 10^{-5} contour (Attachment D2). Between these two contours, the MIACC guidelines would limit uses to those generally relating to manufacturing, warehousing and open space, or other similar low intensity uses as to which the public safety risk is sufficiently low as to be deemed acceptable.

FIGURE 2-1 MIACC's Risk Acceptability Criteria (based on Annual Individual Risk)





ATTACHMENT D2

THE CORPORATION OF THE DISTRICT OF NORTH VANCOUVER

BYLAW 6762

A bylaw to amend the "District of North Vancouver Zoning Bylaw, 1965" (Bylaw 3210) pursuant to section 963 of the *Municipal Act* (RSBC 1979, c. 290).
(Comprehensive Development Zones 17, 18 and 19 - Canadian Occidental Petroleum Ltd.)

The Council for The Corporation of the District of North Vancouver, having observed the relevant provisions of the Municipal Act, enacts the following:

Title

1. This bylaw may be cited as **"REZONING BYLAW 1027"**.

Amendments

2. The following amendments are made to the "District of North Vancouver Zoning Bylaw 1965":

a) Part 2 Interpretation is amended by inserting the following definitions in the appropriate alphabetical order:

"ice arena" means land, buildings and structures providing one or more sheets of ice for the purposes of skating and hockey or related activities which may include accessory retail purposes, restaurants, retail food services and lounge facilities";

b) Subsection 301(2) is amended by inserting the following designations:

"Comprehensive Development Zone 17	CD17
Comprehensive Development Zone 18	CD18
Comprehensive Development Zone 19	CD19"

c) Part 4B is amended by adding the following:

4B62 Comprehensive Development Zone 17 (CD17)

Intent

The intent of the Comprehensive Development Zone 17 (CD17) is to provide commercial uses to complement the existing commercial uses in the area and improve the range of services available to the residents and employees in the vicinity.

4B63 Uses

(1) All uses of land, buildings and structures in the CD17 Zone are prohibited except:

Principal Uses:

COLUMN A	COLUMN B
auction room	
automotive repair establishment	
	business/office support services
car wash	
	clubs
contractor services	
delivery services	
equipment rental establishment	
	fitness centre
gas bar	
	health service purposes
hobby beer and wine-making establishment	
household repair establishment	
media-related establishment	
	office purposes
parking structure	
	personal service shops
	professional offices
research and development establishments	
	restaurant
	retail food services
	retail purposes, excluding building supply establishments
	school, trade
service station	
	shopping centre
studio	
vehicle sales/rental/leasing establishment	
veterinary clinic	
veterinary hospital	

Accessory Uses:

Permitted accessory uses may include, but are not necessarily limited to:

(a) administrative offices;
(b) display, sales and reception areas;
(c) outdoor customer service areas;
(d) storage

(2) The principal uses listed in Column A will be prohibited until such time as the chlorine storage and shipping procedures at the chlorine production facility (the "Plant") located at 100 Amherst Avenue, North Vancouver (for reference owned as of May 17, 1996 by Canadian Occidental Petroleum Limited) meets the following conditions:

(a) the fixed tank chlorine storage at the Plant, (meaning any storage tank other than a chlorine rail tank car) will be limited to the 300 tonne tank existing as of May 17, 1996, or a replacement tank of an equivalent capacity and standard of safety, except as permitted under paragraph (d) below;

(b) there will be no barge transportation of chlorine produced by the Plant except by way of the barge transportation of rail tank cars;

(c) there will be no chlorine storage at the Plant in rail tank cars except as required for "normal shipping needs" which shall not exceed 160,000 tonnes per annum; and

(d) the two 600 tonne tanks, existing as of May 17, 1996, may be used as part of the in-process chlorine production manufacturing stream at the Plant but may not be used for chlorine storage except:

(i) at any time one of the two 600 tonne tanks may be used for temporary storage, not to exceed 300 tonnes, to facilitate the bi-annual hydrostatic test and inspection of the 300 tonne tank; and

(ii) in the event of an emergency, when public safety is threatened, the 600 tonne tanks may be used for temporary emergency chlorine storage.

(3) The principal uses listed in Column B will be prohibited until such time as the Plant is permanently closed.

4B64 Principal Use Regulations

The following regulations apply to permitted uses:

(1) All operations associated with permitted uses shall be contained within a completely enclosed building except for outdoor customer service areas;

(2) In the case of contractor services, no manufacturing, assembly or fabrication of products is permitted;

(3) In the case of veterinary clinics and hospitals, an outside public entrance is required;

(4) In the case of vehicle sales/rental/leasing establishments, no outside storage of vehicle inventory is permitted.

4B65 Size, Shape and Siting Regulations:

(1) Height:

The height of buildings and structures in the CD17 Zone shall not exceed 12m (40 ft.) except where exempted under Section 407 of this Bylaw;

(2) Building Coverage:

Buildings and structures in the CD17 Zone shall not occupy more than 50% of the lot area;

(3) Site Coverage:

Buildings, structures, parking spaces, loading spaces, driveways and manoeuvring aisles in the CD17 Zone shall not occupy more than 85% of the lot area;

(4) Floor Space Ratio:

The floor space ratio in the CD17 Zone is 1.75;

(5) Building and Parking Setbacks:

(a) Buildings and structures in the CD17 Zone shall be setback a minimum of:

(i) 10m (33 ft.) from the Dollarton Highway property line; and
(ii) 6m (20 ft.) from the Riverside Drive property line;

(b) Parking areas shall be setback a minimum of:

(i) 6m (20 ft.) from the Dollarton Highway property line; and
(ii) 3m (10 ft.) from the Riverside Drive property line;

(6) Lot Area:

(a) In the case of service stations, the minimum lot area shall be 1114.8m^2 (12,000 sq.ft.);

(b) In the case of a car wash not operated in conjunction with a gas bar or service station, the minimum lot area shall be 929m^2 (10,000 sq.ft.) plus 186m^2 (2,000 sq.ft.) for each car wash bay in excess of three and the lanes leading to and from each bay shall be a minimum of 3.1m (10 ft.) in width and 18.3m (60 ft.) in length;

4B66 Landscaping Regulations

(1) All required setback areas shall be landscaped in accordance with an approved landscape plan;

(2) Parking areas containing more than 20 spaces in one row shall incorporate raised landscape planters not less than 1.0m (3.3 ft.) in width and 5.7m (18.7 ft.) in length every 20 spaces;

(3) Double rows of parking spaces shall be separated by a landscaped strip not less than 1.2m (4 ft.) in width;

(4) All garbage and recycling container pads shall be screened with a 2m (6.6 ft.) high screen consisting of a solid wood fence, landscaping or a combination thereof;

(5) All electrical kiosks, not located underground or within a building shall be sited to the rear of the building and screened;

4B67 Parking and Loading Regulations:

(1) Parking and loading spaces shall be provided in accordance with Part 10 of this Bylaw;

(2) In cases where a development permit application is submitted without an identification of specific uses, parking requirements will be assessed on the basis of one space/25m^2 (270 sq.ft.) of gross leasable area and the issuance of business licenses for permitted uses in that building will be dependent upon the availability of parking on the lot or on an adjacent lot in accordance with Sections 1002.3 and 1002.4 of this Bylaw.

4B68 Comprehensive Development Zone 18 (CD18)

Intent

The intent of the Comprehensive Development Zone 18 (CD18) is to accommodate higher quality light manufacturing and warehousing uses which generally require larger sites augmented with a limited range of retail, wholesale and service-oriented uses.

4B69 Uses

(1) All uses of land, buildings and structures in the Comprehensive Development Zone 18 are prohibited except:

Principal Uses:

COLUMN A	COLUMN B
auction room	
automotive repair establishment	
building supply establilshment	
	business/office support services
car wash	
contractor services	
custom manufacturing	
delivery services	
equipment rental establishments	
	fitness centre
garden centre	
gas bar	
gun shop	
hobby beer and wine-making establishment	
household repair services	
ice arena	
industrial product sales establishments	

COLUMN A	COLUMN B
light manufacturing	
mini-warehousing	
parking structure	
	research and development establishments
	retail food services
	school, trade
service station	
specialized light industrial and technological establishments	
veterinary clinic	
veterinary hospital	
warehousing	
wholesaling	

Accessory Uses:

Permitted accessory uses may include, but are not necessarily limited to:

(a) administrative offices;
(b) display, sales and reception areas;
(c) outdoor customer service areas;
(d) servicing, repair or testing of goods normally associated with a principal use;
(e) storage;

(2) The principal uses listed in Column A will be prohibited until such time as the chlorine storage and shipping procedures at the chlorine production facility (the "Plant") located at 100 Amherst Avenue, North Vancouver (for reference owned as of May 17, 1996 by Canadian Occidental Petroleum Limited) meets the following conditions:

(a) the fixed tank chlorine storage at the Plant, (meaning any storage tank other than a chlorine rail tank car) will be limited to the 300 tonne tank existing as of May 17, 1996, or a replacement tank of an equivalent capacity and standard of safety, except as permitted under paragraph (d) below;

(b) there will be no barge transportation of chlorine produced by the Plant except by way of the barge transportation of rail tank cars;

(c) there will be no chlorine storage at the Plant in rail tank cars except as required for "normal shipping needs" which shall not exceed 160,000 tonnes per annum; and

(d) the two 600 tonne tanks, existing as of May 17, 1996, may be used as part of the in-process chlorine production manufacturing stream at the Plant but may not be used for chlorine storage except:

(i) at any time one of the two 600 tonne tanks may be used for temporary storage, not to exceed 300 tonnes, to facilitate the bi-annual hydrostatic test and inspection of the 300 tonne tank; and

(ii) in the event of an emergency, when public safety is threatened, the 600 tonne tanks may be used for temporary emergency chlorine storage.

(3) The principal uses listed in Column B will be prohibited until such time as the Plant is permanently closed.

4B70 Principal Use Regulations

(1) All operations associated with permitted uses shall be contained within a completely enclosed building except in the case of gas bars and service stations and where exterior storage is permitted under Section 4B71(1);

(2) In the case of veterinary clinics and hospitals, an outside public entrance is required;

4B71 Accessory Use Regulations

(1) Exterior Storage:

In the CD18 Zone, exterior storage is subject to the following regulations:

(a) exterior storage is permitted only for:

(i) building supply establishments;
(ii) equipment rental establishments;
(iii) garden centre;
(iv) the storage of fleet vehicles for contractor services and delivery services;
(v) the storage of vehicles for repair at automotive repair shops;

(b) All exterior storage areas except for the display of plant materials at garden centres shall be located to the rear of a building or to the side when adjacent to an interior side lot line and, in the case of a building supply establishment and an equipment rental establishment, shall be enclosed by a solid visual screen;

(c) Land used for exterior storage shall be hardsurfaced with durable materials acceptable to the building inspector;

(2) Retail Sales:

The retail sale of goods is limited to an accessory use except in the case of auction room, building supply establishment, gas bar, garden centre, industrial product sales establishment, retail food services and service stations where retail sales may be a principal use;

(3) Outdoor Customer Service Areas:

Outdoor customer service areas are permitted only on private property in conjunction with retail food services and shall comply with Section 413 of the Zoning Bylaw.

4B72 Size, Shape and Siting Regulations

Buildings and structures in the CD18 Zone shall comply with the following regulations:

(1) Height:

Buildings and structures in the CD18 Zone shall not exceed 12m (40 ft.) except where exempted under Section 407 of this Bylaw;

(2) Building Coverage:

Buildings and structures in the CD18 Zone shall not occupy more than 60% of the lot area.

(3) Site Coverage:

Buildings, structures, parking spaces, loading spaces, driveways, manoeuvring aisles and exterior storage areas in the CD18 Zone shall not occupy more than 90% of the lot area.

(4) Floor Space Ratio:

The floor space ratio in the CD18 Zone is 1.5.

(5) Building and Parking Setbacks:

(a) Buildings and structures in the CD18 Zone shall be setback a minimum of:

(i) 10m (33 ft.) from the Dollarton Highway property line;
(ii) 6m (20 ft.) from the Riverside Drive and Amherst Avenue property lines;

(b) Parking areas shall be setback a minimum of:

(i) 6m (20 ft.) from the Dollarton Highway property line;
(ii) 3m (10 ft.) from the Riverside Drive and Amherst Avenue property lines;

(6) Accessory Floor Space:

The total floor space of all permitted accessory uses shall not exceed 25% of the gross leasable floor area of a business or tenancy in a multi-tenant building;

(7) Building Area:

In the case of a building supply establishment, buildings and structures shall not exceed a gross leasable floor area of 5575m^2 (60,011 sq. ft.).

4B73 Landscaping Regulations

1. All required setback areas shall be landscaped in accordance with an approved landscape plan.

seems that a 5 year
ident history is not available.

- Risk Management Program
(EPA) - Environmental Protection Agency

the magnitude relates to its strength
not nec. to damage done
gnitude 7 earthquake can, and often
whose more damage than a magnitude 8
- why? - because the nature of the
s + ground have a great influence.
you taken this into account.
you isolated the analysis in
the 4 types of seismic waves
S, Love, Rayleigh)
surface

[illegible]

300 [illegible]
converted to a [illegible]
of 1000 ppm

BUILDINGS HARD
↓
sabotage

deaths vs injuries

ISOLATION AS [illegible]

light plane crash

In [illegible] peer [illegible]
did you look at whether
[illegible] scenarios (especially
multiple coincidence events) were
taken into account? [illegible]
- What about future commercial
potential devel which stores propane
say.

D/ Research injuries/deaths
for Chlorine

2. Parking areas containing more than 20 spaces in one row shall incorporate raised landscape planters not less than 1.0m (3.3 ft.) in width and 5.7m (18.7 ft.) in length every 20 spaces.

3. Double rows of parking spaces shall be separated by a landscaped strip not less than 1.2m (4 ft.) in width.

4. All garbage and recycling container pads shall be screened with a 2m (6.5 ft.) high screen consisting of a solid wood fence, landscaping or a combination thereof.

5. All electrical kiosks, not located underground or within a building shall be sited to the rear of a building.

4B74 Parking and Loading Regulations

1. Parking and loading spaces for uses in the CD18 Zone shall be provided in accordance with Part 10 of this Bylaw.

2. In cases where a development application is submitted without an identification of specific uses, parking requirements will be assessed on the basis of a minimum of one space/40m^2 (430.5 sq.ft.) of gross leasable area up to a maximum of 25% of the gross leasable area of the building and one space/100m^2 (1076 sq.ft.) of all other gross leasable area and the issuance of business licenses for permitted uses in that building will be dependent upon the availability of parking on the lot or on an adjacent lot in accordance with Sections 1002.3 and 1002.4 of this Bylaw.

3. All loading areas shall be provided to the side or rear of buildings adjacent to an interior lot line. In the case of lots flanking Amherst Avenue or Riverside Drive, all loading areas visible from the street shall be screened.

4B75 Comprehensive Development Zone 19 (CD19)

Intent

The intent of the Comprehensive Development Zone 19 (CD19) is to accommodate uses appropriate in a business park setting. Permitted uses will be oriented primarily to office and limited high quality industrial and light manufacturing uses which are environmentally safe and clean.

4B76 Uses

(1) All uses of land, buildings and structures in the Comprehensive Development Zone 19 are prohibited except:

Principal Uses

COLUMN A	COLUMN B
	business/office support services
custom manufacturing	
contractor services	

COLUMN A	COLUMN B
delivery services	
	fitness centre
	health service purposes
hobby beer and wine-making establishments	
industrial product sales establishments	
media-related establishments	
	office purposes
parking structure	
	personal service shops
	professional offices
research and development establishments	
	restaurant
	retail food services
specialized light industrial and technological establishments	
warehousing	
wholesaling	

Accessory Uses:

Permitted accessory uses may include, but are not necessarily limited to:

(a) administrative offices;
(b) conference, display, sales and reception areas;
(c) outdoor customer service areas;
(d) retail sales;

(2) The principal uses listed in Column A will be prohibited until such time as the chlorine storage and shipping procedures at the chlorine production facility (the "Plant") located at 100 Amherst Avenue, North Vancouver (for reference owned as of May 17, 1996 by Canadian Occidental Petroleum Limited) meets the following conditions:

(a) the fixed tank chlorine storage at the Plant, (meaning any storage tank other than a chlorine rail tank car) will be limited to the 300 tonne tank existing as of May 17, 1996, or a replacement tank of an equivalent capacity and standard of safety, except as permitted under paragraph (d) below;

(b) there will be no barge transportation of chlorine produced by the Plant except by way of the barge transportation of rail tank cars;

(c) there will be no chlorine storage at the Plant in rail tank cars except as required for "normal shipping needs" which shall not exceed 160,000 tonnes per annum; and

(d) the two 600 tonne tanks, existing as of May 17, 1996, may be used as part of the in-process chlorine production manufacturing stream at the Plant but may not be used for chlorine storage except:

(i) at any time one of the two 600 tonne tanks may be used for temporary storage, not to exceed 300 tonnes, to facilitate the bi-annual hydrostatic test and inspection of the 300 tonne tank; and

(ii) in the event of an emergency, when public safety is threatened, the 600 tonne tanks may be used for temporary emergency chlorine storage.

(3) the principal uses listed in Column B will be prohibited until such time as the Plant is permanently closed.

4B77 Principal Use Regulations

The following regulations apply to principal uses:

(1) All operations associated with permitted uses shall be contained within a completely enclosed building except where outdoor customer service areas are permitted.

4B78 Accessory Use Regulations

(1) Outdoor Customer Service Areas:

Outdoor customer service areas are permitted only on private property in conjunction with restaurants and retail food services and shall comply with Section 413 of this Bylaw.

(2) Retail Sales:

The retail sale of goods is limited to an accessory use except in the case of hobby beer and wine-making establishments, restaurants and retail food services for which retail sales may be a principal use.

4B79 Size, Shape and Siting Regulations

Buildings and structures in the CD19 Zone shall comply with the following regulations:

(1) Height:

Buildings and structures in the CD19 Zone shall not exceed a height of 18m (60 ft.) except where exempted under Section 407 of this Bylaw;

(2) Building Coverage:

Buildings and structures in the CD19 Zone shall not occupy more than 60% of the lot area;

(3) Site Coverage:

Buildings, structures, parking spaces, loading spaces and manoeuvring aisles in the CD19 Zone shall not occupy more than 85% of the total lot area;

(4) Floor Space Ratio:

The floor space ratio in the CD19 Zone is 2.0.

(5) Building and Parking Setbacks:

(a) Buildings, structures and parking areas in the CD19 Zone shall be setback a minimum of:

(i) 10m (33 ft.) from any street;
(ii) 5m (16.5 ft.) from any interior rear or side lot line or any lane

(b) Parking areas shall be setback a minimum of:

(i) 6m (20 ft.) from any street;
(ii) 2m (6.5 ft.) from interior side or interior rear lot lines and any lane.

(6) Accessory Floor Space:

Accessory floor space in the CD19 Zone shall not exceed 40% of the gross leasable floor area of a business or tenancy in a multi-tenant building.

4B80 Landscaping Regulations

1. All required setbacks from streets shall be bermed and landscaped in accordance with an approved landscape plan;

2. All setbacks from interior side and rear lot lines shall be landscaped in accordance with an approved landscape plan;

3. Parking areas containing more than 20 spaces in one row shall incorporate raised landscape planters not less than 1.0m (3.3 ft.) in width and 5.7m (18.7 ft.) in length every 10 spaces;

4. Double rows of parking spaces shall be separated by a landscaped strip not less than 1.2m (4 ft.) in width;

5. All garbage and recycling container pads shall be located to the rear or a building and shall be screened with a 2m (6.5 ft.) high solid screen; and

6. All electrical kiosks not located underground or within a building must be sited to the rear of a building and not within a required setback area and when visible from a street, shall be screened with fencing, landscaping or a combination thereof.

4B81 Parking and Loading Regulations

1. Parking and loading spaces shall be provided in accordance with Part 10of this Bylaw;

2. All loading spaces shall be provided to the rear of a building or to the side adjacent to an interior side lot line;

3. Where loading spaces are visible from a flanking street, the loading space shall be screened; and

4. In cases where a development permit application is submitted without an identification of specific uses, parking requirements will be assessed on the basis of one space/40m^2 (430.5 sq.ft.) of gross leasable area and the issuance of business licenses for permitted uses in that building will be dependent upon the availability of parking on the lot or on an adjacent lot in accordance with Sections 1002.3 and 1002.4 of this Bylaw.

c) The Zoning Map is amended in the case of lands outlined on the attached map by rezoning the land from General Industrial (I2) and General Commercial Zone 3 (C3) to Comprehensive Development Zone 17, Comprehensive Development Zone 18, and Comprehensive Development Zone 19.

PUBLIC HEARING held , 19 .

PASSED by the Council on the day of , 19 .

APPROVED by on the day of , 1996.

ADOPTED by the Council on the day of , 19 .

Mayor

Municipal Clerk

ATTACHMENT F

COMPARISON OF DEVELOPMENT REGULATIONS

CD 17, 18 AND 19 ZONES

ELEMENT	CD 17 ZONE	CD 18 ZONE	CD 19 ZONE
Height	12m (40ft.)	12m (40ft.)	18m (60ft.)
Building Coverage	50% of lot area	60%	60%
Site Coverage	85% of lot area	90%	85%
Floor Space Ratio	1.75	1.5	2.0
Building Setbacks	10m (33ft.) from Dollarton Highway 6m (20ft.) from Riverside Drive	10m (33ft.) from Dollarton Highway 6m (20ft.) from Riverside Drive and Amherst Avenue	10m (33ft.) from any street 5m (16.5ft.) from interior lot lines
Parking Setbacks	6m (20ft.) from Dollarton Highway 3m (10ft.) from Riverside Drive	6m (20ft.) from Dollarton Highway 3m (10ft.) from Riverside Drive and Amherst Avenue	6m (20ft.) from any street 2m (6.5ft.) from interior side or interior rear lot lines and any lane
Accessory Floor Space	not regulated	25% of gross leasable floor space	40% of gross leasable floor space

ATTACHMENT G

SUMMARY OF REQUIRED AGREEMENTS AND COVENANTS:

1. require COPL to reduce its on-site, fixed tank storage (not including rail car storage) to one existing 300 tonne tank prior to the adoption of any rezoning bylaw, and limit barge shipments to barges carrying rail cars;

2. Prohibit COPL from operating contrary to the storage and shipping limitations as agreed. In particular, the Company is prohibited from increasing its on-site storage over the 300 tonne level or loading chlorine into any fixed tank on barges;

3. give both the District and the owners of the development lands the right to enforce those limitations by way of seeking a court injunction;

4. limit the permitted uses of the development lands to a portion of those listed in the rezoning bylaw, and give COPL the right to enforce those limitations on use. The balance of the uses would be permitted if the chlorine plant is closed, or might be permitted if technology improves so as to make chlorine storage and shipping more safe, or if revised MIACC standards are published relaxing the restrictions on land use;

5. require that the Company give an annual statutory declaration confirming that the specified conditions of storage and shipping have been met.

6. give the District, or an independent expert, right of access to inspect the Plant to see that the specified condiditons of storage and shipping are being met;

7. require COPL to use the lands it leases from the Vancouver Port Corporation with the same limitations as agreed to for its lands, and to give the Vancouver Port Corporation full notice of these agreements;

8. if COPL wishes to sell the development lands to any other party before the rezoning is adopted, require the purchaser first to enter into the Implementation Agreement, and agree to the other related covenants.

9. if future recommendations identify new restrictions on land use then the agreements with COPL can be adjusted accordingly.

EXCERPT of the MINUTES of the Meeting of the District of North Vancouver **ADVISORY PLANNING COMMISSION** held in the Committee Room, District Municipal Hall, 355 West Queens Road, North Vancouver, B.C. on Wednesday, **April 17, 1996** at 7:18 p.m.

4. UNFINISHED BUSINESS

a) Process 8-93, Rezoning from I2 to Comprehensive Development, Canadian Occidential Petroleum Ltd. (COPL) - Maplewood

The Commission received copies of a draft report to Council dated April 9, 1996, subject: Rezoning Application - CXY Chemicals Ltd., file: 3060-20.

Doug Allan provided an overview of the subject lands and above-mentioned report and advised that staff are seeking an updated motion from the Commission

Mr. Allan introduced Ms. J. Fleming of Canadian Occidential Petroleum Ltd. (COPL).

Ms. Fleming provided a brief history to the rezoning application and the company's decision to undertake a Quantitative Risk Assessment (QRA). The QRA, prepared by an outside consultant, was intended to identify what the company could do to improve onsite safety to accommodate a worst case scenario. Ms. Fleming provided an overview of the Major Industrial Accident Council of Canada (MIACC) land use guidelines and their applicability to future land uses on the company's lands. Ms. Fleming noted that many onsite upgrades have been completed as a result of the QRA recommendations.

(Mr. Bruce Gilbert entered the meeting at 7:55 p.m.)

Ms. Fleming then responded to various questions from the Commission on: emergency procedures in the event of an accident; safety concerns with regard to onsite storage tanks, barges and railcars; composition of MIACC; alterations to restrictive covenants should MIACC guidelines become stricter; DNV overseeing compliance with covenants; and, the future of CANOXY operations at this site.

Ms. Fleming agreed to:

- have prepared a detailed inventory of all substances that react hazardously with chlorine; and
- look into having the restrictive covenants prohibit the storage of substances that will interact with chlorine in a manner that would be hazardous to the public within the CD17 and CD18 Zones.

The Chair reviewed all previous APC motions with regard to Process 8-93, following which it was:

A Report to the

DISTRICT OF NORTH VANCOUVER

Economic Development Strategy Study

Final Report

URBAN SYSTEMS
G P Rollo & Associates
Thomas Consultants
Royal LePage

March 1997
6133302.1
970324cl.rpt

"This document represents the views of the author's only, and is not a reflection of District of North Vancouver policy."

MEMORANDUM

URBAN SYSTEMS
Suite 204 - 10711 Cambie Road
Richmond, B.C., V6X 3G5
Telephone: (604) 273-8700
Fax: (604) 273-8752

TO: Irwin Torry
Tamsin Guppy,
Dist. of North Vancouver

DATE: April 7, 1997

FROM: Chris LeTourneur, MCIP

JOB #: 6133302.1

SUBJECT: *Economic Development Strategy Study*

We are very pleased to provide this unbound original and ten copies of the ***District of North Vancouver Economic Development Strategy Study - Final Report.***

As requested, all final comments provided by District staff have been incorporated into the report. The unbound original will allow further copying of the report if required.

We have very much enjoyed working with the District of North Vancouver on this exciting assignment, which will have profound implications on the future land use vision for industrial and commercial lands within the District.

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Executive Overview

The District of North Vancouver has commissioned this study to prepare an industrial and commercial land use strategy that will form the basis for future economic development initiatives and assist the District in achieving complete community objectives. The study focuses on land use choices and opportunities for future industrial and commercial development and associated new employment within the District of North Vancouver.

In light of recent development pressures on the current state of the District's industrial lands, and the changing composition of the demands for industrial and commercial space, this study addresses the following key components:

1. *Assesses existing and future market conditions*, including demand and supply for *industrial* and *commercial* sites.
2. *Compares the merits of alternative land use choices.*
3. *Provides recommendations for land use and policy directions, to guide future development,* and ensure that the quality of life in the District of North Vancouver is maintained and improved.
4. *Provides background on Commercial and Industrial Development trends* to form a basis for the *Economic Development Section of the new OCP.*
5. *Establishes an information base* that can be incorporated into the G.V.R.D.'s Industrial Lands Project.

Study Team

This study was prepared for the District of North Vancouver Planning Department by a multi-disciplinary project team comprised of Urban Systems Ltd., G. P. Rollo and Associates, Thomas Consultants and Royal LePage.

Study Area

The study area encompasses all lands currently designated for the following uses in the District of North Vancouver Official Community Plan (Bylaw 6300), as illustrated in Plan Map DNV 01, or are zoned for industrial or commercial purposes:

- Industrial Land Use.
- Commercial Land Use.
- Mixed (Industrial/Commercial) Land Use.

Context of Commercial Land Uses

There are approximately 2,367,004 square feet of commercially zoned floor area within the District's commercial areas, currently employing as many as 6,000 people. The mix of land uses within the commercial areas and associated existing employment estimates are summarized as follows:

Mix of Land Uses and Employment Estimates for Commercial Areas

Land Use	Area (sq. ft)	% of Total Comm. Floor Area	Employee Estimates[1]
Retail	1,302,078	55.2%	3,720
Service	321,262	13.5%	918
Office	204,753	8.6%	819
Hotel/Motel	149,889	6.3%	150
Light Industrial[2]	389,022	16.4%	389
Total	2,367,004	100%	5,996

Context of Industrial Land Uses

There are approximately 774 acres of industrial land within the District of North Vancouver, on which it is estimated there are as many as 5,432 people employed. The breakdown of this amount across the various industrial neighbourhoods is as follows:

- Pemberton/Welch 275 acres (36% of total)
- Lynnmour 158 acres (20% of total)
- Maplewood 316 acres (41% of total)
- Other Industrial Areas[3] 25 acres (3% of total)

Total 774 acres (100%)

Excluding the Canada Wildlife Conservation Area in Maplewood (which is zoned for industrial purposes and occupies just over 100 acres of land), approximately 408 acres are located on parcels which have waterfront access. Approximately 265 acres are located on non-waterfront lands including the majority of upland light industrial portions of the Pemberton/Welch, Lynnmour and Maplewood industrial areas.

[1] Existing employment estimates are based on application of accepted worker density ratios to various commercial land uses.

[2] Includes integrated light industrial uses in the C-8 (Business Commercial) Zone.

[3] Includes the 5.2 gross acre Dollarton Shipyard (Cates) site, as well as hydro facility sites.

Undeveloped Industrial Lands

Within the total 774 acres of industrial lands, the following are significant consolidated undeveloped/unused portions of lands designated in the OCP for industrial or mixed uses or zoned for industrial use:

• CXY Chemicals Site (North of the CNR)	30 gross acres (25 net acres)
• Proposed Maplewood Business Park	50 gross acres (20 net acres)
• VPC Vacant Lands (North of Dollarton Hwy.)	37 gross acres (25 net acres)
• Tolko Industries Site (soon to be available)	15 gross acres (12 net acres)
• Dollarton Shipyard (Cates) Site	5.2 gross acres (4.2 net acres)
Total	139 gross acres (87 net acres)

Other than the above noted lands, there are approximately 20.3 acres of developable vacant non-waterfront industrial uplands within the District's industrial areas.

There is also a substantial amount of industrial zoned land which is vacant and undevelopable due to environmental concerns or because the parcels are the result of an abandoned road or rail right-of-way. The most significant of these undevelopable industrial lands include the Environment Canada Research Centre (Conservation Area) lands (located on VPC land) south of Dollarton Highway (in Maplewood), and a portion of Mackay Creek Park Marsh, north of West 1st Street (in Pemberton/Welch).

Industrial Zoned Lands

Of the industrial zoned land, the estimated amount of land within each of the District's industrial zones is as follows.

• I1 (Waterfront Industrial Zone)	307 acres
• I2 (General Industrial Zone)	219 acres
• I3 (Light Industrial Zone)	172 acres
• I4 (Interim Industrial Zone)	62 acres
• I5 (Storage Industrial Zone)	3 acres
• Various CD Zones (for industrial purposes)	11 acres
Total	774 acres

Estimates indicate there is a total of approximately 4,681,817 sq. ft. of existing building gross floor area occurring on industrial zoned sites, with an overall mix as follows:

Mix Of Industrial Building Floor Area for All Industrial Areas

Land Use	Floor Area (sq. ft)	% of Total Industrial Floor Are
Port/Heavy Industrial[4]	1,875,134	40.0%
Light Industrial	2,010,113	43.0%
Transportation[5]	64,199	1.4%
Retail	90,300	1.9%
Office	547,670	11.7%
Residential	94,400	2.0%
Total	4,681,817	100%

In addition, to these building floor area estimates, there are approximately 7,974,866 sq. ft. (183 acres) of industrial land used for outdoor storage[6] of bulk commodities (eg. forest products, sulphur, etc.) and vehicles. There is also an additional 2,786,905 sq. ft. (64 acres) of industrial land occupied by rail rights-of-way and transportation terminal (eg. inter-modal truck depot) uses.

Service commercial uses (primarily comprised of auto repair businesses) occupy approximately 2.8 acres of land in the Pemberton/Welch industrial area and 3 acres in the Lynnmour industrial area. These uses involve approximately 189,610 square feet of building gross floor area.

Waterfront port oriented and heavy industrial uses have a strong orientation and connection towards transportation modes including rail, ship and truck.

[4] Port/Heavy Industrial floor area includes any port-oriented or heavy industrial activity occurring in a building or structure (tanks, sheds, etc.), but does not include "Outdoor Storage" or "Transportation" uses.

[5] Transportation includes building floor area occupied by the BC Rail Train Terminal and operations buildings.

[6] Unlike other industrial uses for which floor area is based on gross building floor area, Outdoor Storage floor area is based on site area occupied by outdoor storage activities.

Existing Industrial Employment Characteristics

The following is a summary of existing employment estimates for the various industrial areas throughout the District:

Estimated Existing Employment Estimates

Industrial Neighbourhood	Estimated # of Employees[7]	% Share of Industrial Area Employment
Pemberton/Welch	2,471	45.5%
Lynnmour	2,218	40.8%
Maplewood	704	13.0%
Other Industrial Areas	39	0.7%
Total (All Areas)	5,432	100%

Key Industrial Market Trends & Land Use Implications

Regional Trends

- Pacific Rim and world wide trade with Canada will continue to grow and require continuing investment in the port transshipment sector, requiring additional buildings, storage facilities, equipment and transportation facilities in Burrard Inlet to accommodate their growth. Much of this investment will focus on the District of North Vancouver, both in the Lynnmour area (expansion of Lynnmour Terminals) and south of the Pemberton/Welch industrial areas (expansion of BC Rail and Vancouver Wharves).

- At the same time, many non port related and mostly heavy industrial marine industries (resource based companies, shipbuilding, marine construction and other businesses) will continue to relocate to the Fraser River which offers larger, more affordable sites with less potential conflict with surrounding land uses. The movement of these companies and their continuing search for the most affordable sites to enable them to survive in very competitive industries, will greatly detract from opportunities to create new and larger industrial parks oriented to the North Shore marine sector.

[7] Employment estimates are based on application of worker density ratios to various industrial uses.

Local Trends

- The continuing shift of the regional economy from a goods producing to service sector economy will create a multitude of industrial opportunities to provide specialized equipment, manufacturing, service and repair facilities to the regional service sector, concentrated in the western part of the region (North Shore, Vancouver, Burnaby) and accessible from District of North Vancouver industrial areas.

- The North Shore's limited population and its peripheral location in the region will focus development on companies servicing international and national markets, and nearby (North Shore, Vancouver and Burnaby) markets.

- The impact of the above-noted changes on the District of North Vancouver industrial market will be very visible over the next 5 - 10 years, as new industrial parks and multi-tenant light industrial and flex buildings are pursued in both the District of North Vancouver and the City of North Vancouver.

- The trend towards downsizing industrial space requirements and the integration of industrial business operations (manufacturing, assembly, service and repair, office, warehouse functions) will greatly shift demand for industrial space towards "flex space"[8] buildings and away from traditional light industrial buildings with their single use (manufacturing or distribution) orientation and low office requirements. For the purposes of this study, the following distinctions are made between traditional "Light Industrial" and contemporary "Business Park" land uses:

  Light Industrial - Industrial buildings featuring site coverage of 40% to 60%, office components of 10% to 25%, and accommodating traditional light industrial uses.
  Business Park - Consists of architecturally designed light industrial buildings, often similar in appearance to office buildings, and providing a higher quality of interior finishing that allows users the flexibility to use the space for office, light manufacturing, assembly, repair, service, distribution or storage uses. These spaces often have higher proportions of office use (as high as 100%) than in traditional light industrial areas, and are often designed as high quality "planned employment centres".

- There will be continuing and growing opportunities for the District of North Vancouver to increase industrial employment. While port terminal and support industries will continue to grow at a constant modest rate, the greatest increase in

[8] "Flex Space" is synonymous with the term "Business Park" and means buildings that are architecturally designed (often similar in appearance to office buildings) and provide a higher quality of interior finishing that allows users the flexibility to use space for office, manufacturing, assembly, repair and service plus distribution or storage uses.

District of North Vancouver employment will be derived from the light industrial sector, most particularly from smaller manufacturing, service and distribution companies.

- Examples of the types of industries that will be attracted to the District of North Vancouver include:

  - Marine sector engineering, equipment manufacturing, repair and service;
  - Electric and electronic engineering and equipment manufacture;
  - Telecommunications;
  - Suppliers and providers of services to the North Shore film industry;
  - Machinery manufacturing, service and repair;
  - Fabricated metal products;
  - Precision instruments and related equipment;
  - Computers, software development, service and repair;
  - Manufacture and repair of resource industry equipment; and,
  - Materials handling, transportation equipment manufacture, service and repair.

- The key for attracting new industrial businesses to the District of North Vancouver is new development sites. The development of underutilized or redevelopment sites is limited for the following reasons:

  a) Generally speaking, there is more financial incentive (profit potential) for the development industry to pursue industrial development on vacant industrial lands than on underutilized or redevelopment sites.

  b) Industrial development created on new (vacant) industrial sites can typically offer lower priced land and building space, and is more competitive in the regional industrial market.

  c) The CXY Chemical site and Maplewood Business Park are the most significant of these new development sites and will create attractive planned industrial projects, offering a wide range of site sizes and competitive prices to attract regional oriented industrial businesses.

  d) Land use needs for water dependent industries (port, port support and other marine uses) in the District of North Vancouver will evolve as follows:

     i) The increased demand for port terminal and support industries will be met primarily from more intensive use of their existing lands.

ii) The demand from port support industries for land adjacent to or near port terminals will be minimal as these industries are largely in place, and can accommodate growth on existing sites or often can locate away from the water on more affordable industrial lands.

iii) The demand for land and buildings from other parts of the marine sector (i.e., non port terminal uses) will continue to change. Larger and traditional marine industries will continue to leave the North Shore, while smaller manufacturing, service and repair marine businesses will locate in existing (often older and more affordable) buildings, on small sites or in multi-tenant buildings in new industrial parks.

The limited size of demand from water dependent industries and their frequent inability to pay market rates for land and buildings greatly lessens economic incentives for private developers to create a marine oriented industrial park.

Land Use Implications

Port Industrial (Waterfront)

- **Additional demand for heavy industrial, port industrial and transportation uses** will be accommodated through the intensification of existing waterfront industrial lands in Lynnmour, Pemberton/Welch and Maplewood, at a rate of approximately **27,500 sq. ft. to 37,500 sq. ft. per year for new development**.

- From a market perspective, future demand for port or marine industrial uses on the Dollarton Shipyard (Cates) site are uncertain and lack the economic viability to encourage property owners to retain these types of uses. Therefore, there will be continual pressure from property owners to change the land use. Marine-oriented industries will be more likely attracted to the more centrally located Tolko Industries site in Maplewood, where such industries could be accommodated in the context of an industrial park development.

Light Industrial & Business Park (Non-Waterfront)

- New light industrial and business park development will develop on vacant non-waterfront (upland) light industrial lands and will be developed primarily in the form of owner occupied single tenant or multi-tenant strata-titled buildings.

- The ability of new business park developments to accommodate a flexible mix of users in varying building and site sizes, which permit large proportions of office space, will be the key to capturing North Shore light industrial market demand.

- The forecast annual absorption rate for **new development of non-waterfront (upland) light industrial land for the District of North Vancouver is 2 to 3 gross acres, for the immediate 5 year period.**

- Once vacant lands in Maplewood (including the CXY Chemical site of 25 net acres and proposed Maplewood Business Park site of 20 net acres) come onto the market (which is estimated to begin in the five year horizon), **annual absorption of new non-waterfront light industrial development will increase to 3 to 4 gross acres for the District of North Vancouver for the remainder of the 25 year horizon.**

- Development of vacant lands within the Maplewood industrial area will likely be initiated on the CXY Chemical site, then occur on the proposed Maplewood Business Park and Tolko Industries sites.

- There will not be sufficient demand to develop the VPC vacant lands north of Dollarton Highway with industrial uses until almost 15 years from now. However, there is immediate demand for other uses including residential and/or a mix of residential and business park uses on this site.

Intensification of Existing Light Industrial Areas

- Intensification and redevelopment of existing light industrial uses in already developed non-waterfront portions of the Lynnmour, Pemberton/Welch and Maplewood industrial areas are likely to occur after vacant lands on the CXY Chemical site and proposed Maplewood Business Park have been completed (which could be approximately fifteen years time).

Megastores, Big Box & Warehouse Retail

- There will be limited potential for megastores, big box retail uses and warehouse sales outlets within the District of North Vancouver since other potential sites for these types of uses are planned in the short term on more central North Shore locations including the Fullerton site (in the City of North Vancouver), and on the Squamish Nation inter-river lands (at the northern bridgehead of the Second Narrows Bridge).

Implications of Industrial Market Trends for Employment

- Over the 25 year horizon, market trends indicate there will be between **20 to 25 new employees generated per year by intensification of waterfront and port related heavy industrial uses.** This would result in a **total of an additional 500 to 600 employees over the 25 year horizon.** The majority of these new jobs will be generated in the Pemberton/Welch (66% of new employment) and Lynnmour (33% of new employment) industrial areas. This growth will occur steadily over the 25 year period.

- Demand for **new development of non-waterfront (upland) light industrial and business park uses will generate between 160 to 230 employees per year, for the immediate 5 year period.** This would result in a **total of 800 to 1,150 new employees for this period.** The majority of this new employment will be generated by the development of business park uses in the remaining vacant non-waterfront portions the of Pemberton/Welch industrial area (along Mackay Creek Park), and within the CXY Chemical site in Maplewood.

- Annual employment generated by new non-waterfront light industrial development will increase as a greater share of North Shore light industrial/business park demand is captured by the District of North Vancouver with the development of the CXY Chemical, proposed Maplewood Business Park and Tolko Industries sites in Maplewood. Using the same assumptions as noted above, this **demand for new development will generate between 230 to 310 employees per year, for the 6 to 15 year period.** This would result in a **total of 2,300 to 3,100 employees over this period.**

- Once the CXY Chemical, proposed Maplewood Business Park and Tolko Industries sites have developed, remaining industrial demand not absorbed by the development of these lands which will be taken-up by **intensification and redevelopment of existing non-waterfront light industrial lands** in the Lynnmour (including the Venice Bakery site) and Pemberton/Welch industrial areas **will generate between 230 to 310 employees per year, for the remainder of the 25 year horizon.** This would result in a **total of 2,300 to 3,100 employees over this period.**

- Based on potential full development of the vacant lands in the Maplewood industrial area with Light Industrial and Business Park uses, there could be the potential to generate the following numbers of total new employees (based on 3 employees per 1,000 sq. ft. of building, developed at a density of 0.60):

  - CXY Chemical site: 1,900 to 2,000 employees.
  - Maplewood Business Park: 1,500 to 1,600 employees.
  - Tolko Industries site (if developed with light industrial/business park uses): 900 to 1,000 employees.
  - Tolko Industries site (if developed with waterfront heavy or port industrial uses): 40 to 60 employees.

- Although there is limited market support for the development of light industrial or business park uses on the VPC vacant lands north of Dollarton Highway until almost 15 years from today, if such uses were to eventually develop, they could generate a total of around 1,900 employees. Under a residential land use, these lands would generate only a limited amount employment through home based business, in the order of a total of possibly 50 to 70 employees.

- Similar to the above point, although there is limited economic ability for marine related or other industrial uses on the Dollarton Shipyards (Cates) site, if such uses were to fully develop on this site, they could possibly generate a total of 20 to 30 employees. Under a residential land use, these lands could generate the same number of employees through home based businesses.

- Most new industrial employment will be derived from the light industrial sector, particularly from smaller manufacturing and distribution companies.

Key Commercial Market Trends & Land Use Implications

Retail & Services

- Retail and service uses will infill in existing commercial areas. In some cases there will be a need to accommodate new retail users, which are currently not located in some of the commercial areas, therefore establishing a more balanced mix of retail/service users. **Approximately 50% of North Shore retail/service demand (i.e. 1,397,790 sq. ft.) has the potential to be captured by the District of North Vancouver over the 25 year horizon.**

- The Marine Drive Corridor will continue to strengthen its role as providing retail and service uses for the entire North Shore. Together with vacant First Nations lands, the Marine Corridor will have the potential to capture **28% of North Shore retail/service demand (i.e. 789,580 sq. ft.) over the 25 year horizon.**

- For **community and local commercial areas within the District of North Vancouver**, there will be **demand for approximately 14,000 sq. ft. per year of new retail and service uses over the 25 year horizon**, with close to **330,000 sq. ft. developing over the period 1996 to 2011**, and close to **280,000 sq. ft. developing over the period 2012 to 2021**.

- Of the above demand for community and local retail and service uses within the District of North Vancouver, 10% (61,000 sq.ft.) will be generated within the Edgemont Village trade area (includes Edgemont Village and Delbrook Plaza), 58% (353,800 sq.ft.) will be generated within the Lynn Valley trade area (includes Lynn Valley Centre, Lynnmour and Queensdale/North Lonsdale), and 32% (195,200 sq.ft.) will be generated within the Seymour trade area (includes all commercial areas in the Seymour area).

Mixed Residential/Commercial

- There will be an increase in the demand for the development of mixed-use residential/commercial development along main street corridors, with a focus on key intersections including:

    - Marine Drive/Capilano Road
    - Marine Drive/Pemberton Avenue
    - Main Street/Mountain Highway

- The existing commercial areas of Edgemont Village and Lynn Valley Centre will also face market pressures for the development of mixed residential/commercial buildings and in the case of Lynn Valley Centre, for residential only buildings as well.

Offices

- Estimates forecast an average **demand for new office uses in the District of North Vancouver** (not including town centre office uses located within the City of North Vancouver) of close to **375,000 sq. ft. for the period 1996 to 2011**, and close to **250,000 sq. ft. for the period 2012 to 2021**. This translates into an absorption of **25,000 sq. ft. per year over the 25 year horizon**. It is estimated that 40% (250,000 sq.ft.) of this demand will be captured by new business park development, 35% (218,750 sq.ft.) will be captured by new or intensification of light industrial development and 25% (156,250 sq.ft.) will be captured by intensification of existing commercial areas.

Hotels & Accommodation

- Increasing demand for North Shore accommodation and smaller conference facilities will stimulate densification of existing hotel/motel sites in the "Capilano Triangle" (Capilano Road, Marine Drive, Garden Avenue), and near the Trans Canada Highway at the northern bridgehead of the Second Narrows Bridge.
- Assuming the District's current 81% market share of North Shore hotel/motel accommodation uses continues, the estimated **annual absorption for new hotel/motel accommodation uses for the District of North Vancouver is 15 to 19 rooms (or 5,100 sq. ft.)** per year, with a **demand for as many as 475 rooms by the year 2021**.

Tourism

- Major tourist attractions including the Capilano Suspension Bridge, Grouse Mountain and Deep Cove will have the opportunity to expand their commercial facilities and be a catalyst for new complementary spin-off commercial activities, subject to the availability of land.

Implications of Commercial Market Trends for Employment

- **New retail and service uses within District of North Vancouver *community* and *local* commercial** trade areas (not including the Marine Drive Corridor) **will generate around 70 employees per year, over the 25 year horizon.** This would result in a **total of almost 1,750 new employees over the 25 year period.**

- **Intensification of the Marine Drive Corridor and development of First Nations Lands with regional-orientated retail/service uses will generate around 90 employees per year, over the 25 year horizon, for a total of 2,257 employees over the 25 year period.**

- Of the above community and local commercial employee estimates, 10% of new commercial employment will be generated within the Edgemont Village trade area (includes Edgemont Village and Delbrook Plaza), 58% will be generated within the Lynn Valley trade area (includes Lynn Valley Centre, Lynnmour and Queensdale/North Lonsdale), and 32% will be generated within the Seymour trade area (includes all commercial areas in the Seymour area).

- **New office space in the District of North Vancouver will generate around 100 employees per year over the 25 year horizon.** This would result in a **total of close to 2,500 new employees over this period.** It is estimated that 40% (1,000 employees) of this new employment will occur within new business park development, 35% (875 employees) will occur within new or intensified light industrial development, and 25% (625 employees) will be generated by intensification of existing commercial areas. These business park and light industrial employment estimates form a component of the employment estimates previously noted in the Executive Overview for the demand for future development of non-waterfront (upland) light industrial and business park uses (the mix of which is illustrated in **Table A**).

- It is estimated that demand for **new hotel/motel accommodation development within the District of North Vancouver will generate 5 to 7 employees per year over the 25 year horizon.** This would result in a **total of around 150 new employees over this period.**

Estimates of employment to be potentially generated by industrial and commercial demand are summarized in **Table A.**

Table A

Summary of Additional New District of North Vancouver Industrial and Commercial Employment Estimates, 1996 - 2021*

EMPLOYMENT TYPE	Year			Total
	1 to 5	6 to 15	16 to 25	
NEW INDUSTRIAL EMPLOYMENT:				
Waterfront:				
Intensification	125	250	250	625
Non-Waterfront:				
New Development	1,150	3,100	-	4,250
Intensification/Redevelopment	-	-	3,100	3,100
New Office in Business Parks	200	400	400	1,000
New Office in Light Industrial Buildings	175	350	350	875
New Industrial Employment Sub-Total	1,650	4,100	4,100	9,850
NEW COMMERCIAL EMPLOYMENT:				
** Community & Local Retail/Service	350	700	700	1,750
Marine Dr. Corridor & First Nations Lands Regional Retail/Service	451	903	903	2,257
New Office in Commercial Areas	125	250	250	625
New Hotel/Accommodation	21	41	41	103
New Commercial Employment Sub-Total	947	1,894	1,894	4,735
TOTAL NEW INDUSTRIAL & COMMERCIAL EMPLOYMENT	2,597	5,994	5,994	14,585

Notes:

(*) = *Employment estimates included in table are based on high range of average estimates.*

(**) = *"Community & Local Retail/Service" does not include Marine Drive Corridor commercial areas.*

Recommended Policy Actions and Implications

The following is a summary of recommended policy actions, which respond to findings of the market analysis and evaluation of land use choices identified by the market analysis with complete community objectives (which are summarized in **Figure A**).

1. Pemberton/Welch Industrial Area

A) Waterfront

Recommended Policy Actions:

- The District OCP designation for waterfront industrial areas and adjacent areas south of the BC Rail rights-of-way should be renamed "Port Industrial", to be distinct from non-waterfront upland light industrial areas.

Resulting Policy Implications:

Implementation of the above-noted policy recommendations will allow for the following to occur:

- accommodation and protection of heavy industrial, port/marine and transportation uses on waterfront and adjacent industrial lands, south of the BC Rail over the 25 year time frame.
- steady incremental growth of new jobs over the 25 year horizon.
- maintain a balanced employment base by preserving and encouraging some growth of the number of heavy industrial type jobs.

B) Non-Waterfront

Recommended Policy Actions:

- Establish new OCP land use designations which distinguish between "Light Industrial" and "Business Park" areas within the area currently designated as "Mixed Use" in the OCP.

- On the OCP map, industrial lands between Mackay and Lloyd Avenues should be designated "Business Park", while other non-waterfront portions of the Pemberton/Welch industrial area, north of the BC Rail should be designated "Light Industrial" (except for properties fronting Pemberton Avenue, which should be designated "Commercial Land Use").

Figure A

COMPLETE COMMUNITY OBJECTIVES

The following "***Complete Community***" objectives are discussed in the planning literature and articulated in the GVRD *Livable Region Strategic Plan* (LRSP):

1) WORKING AND HAVING THE ABILITY TO OBTAIN SERVICES CLOSE TO HOME.

2) ACHIEVING AN ECONOMICALLY VIABLE LOCAL ECONOMY.

3) HAVING A LOWER DEPENDENCY ON THE AUTOMOBILE

4) ESTABLISHING A BALANCE BETWEEN LOCAL JOBS AND HOUSING.

5) ENCOURAGING A HIGH QUALITY OF LIFE.

6) PRESERVING ENVIRONMENTAL INTEGRITY.

- Amend the I3 (Light Industrial) Zone to accommodate a wider variety and flexibility of uses, including a minimum of 50% office space as a principal use.

- Prepare a new industrial zone for business parks, on the basis of the provisions of the existing CD9 Zone, with revisions to accommodate a wider variety of uses on a variety of parcel sizes.

- Prepare off-street parking regulations for business parks, which recognize the implementation of transportation alternatives (including public transit, pedestrian/cycling mobility, ride sharing and traffic demand management).

Resulting Policy Implications:

- Implementation of the above-noted policy recommendations will allow for the following to occur:
  - accommodation of short term market demand for the development of flexible business park development, with an opportunity for a large proportion of office space.
  - accommodation of long term intensification of light industrial areas, allowing a flexible mixture of uses, including office functions, catering to businesses that otherwise could not afford to locate in a new business park.
  - creation of some additional employment through the development of remaining business park sites in the short term and intensification of light industrial sites and buildings over the longer term.
  - stabilization and slight improvement of the property tax base over the longer term.

2. Lynnmour Industrial Area

A) Waterfront

Recommended Policy Actions:

- The District OCP designation for the Lynnterm waterfront industrial area south of the CN Rail (west of Harbour Avenue and south of Bay Street) should be renamed "Port Industrial", to be distinct from non-waterfront upland light industrial areas, and consistent with the Lower Lynn OCP.

- Existing "Industrial Policies" within the Lower Lynn OCP can effectively achieve the above-noted policy directions for waterfront and port-oriented industrial lands. However, policies to support and encourage additional road access and multi-jurisdictional co-operation in this regard, should be emphasized throughout the Lower Lynn OCP (including within the "Industrial Policies" section).

Resulting Policy Implications:

- Implementation of the above-noted policy recommendations will allow for the following to occur:
  - accommodation and protection heavy industrial, port/marine and transportation uses on waterfront and adjacent industrial lands, south of the CN Rail within Lynnterm over the 25 year time frame.
  - steady incremental growth of new jobs over the 25 year horizon.
  - maintain a balanced employment base by preserving and encouraging some growth of the number of heavy industrial type jobs.

B) Non- Waterfront

Recommended Policy Actions:

- Establish new OCP land use designations which distinguish between "Light Industrial" and "Business Park" areas within the area currently designated as "Mixed Use" in the OCP.

- On the OCP map, northern portions of the Venice Bakery site and adjacent vacant sites should be designated "Business Park", while other non-waterfront portions of Lynnmour, outside of Lynnterm should be designated "Light Industrial" (except for some properties fronting Main Street and Mountain Highway which are already designated "Commercial Land Use"). Southern portions of the Venice Bakery site, which front Main Street have the capacity to be designated mixed residential/commercial.

- Amend the I3 (Light Industrial) Zone to accommodate a wider variety and flexibility of uses, including a minimum of 50% office space as a principal use.

- Prepare a new industrial zone for business parks, on the basis of the provisions of the existing CD9 Zone, with revisions to accommodate a wider variety of uses on a variety of parcel sizes.

- Prepare off-street parking regulations for business parks, which recognize the implementation of transportation alternatives (including public transit, pedestrian/cycling mobility, ride sharing and traffic demand management).

Resulting Policy Implications:

- Implementation of the above-noted policy recommendations will allow for the following to occur:
  - accommodation of medium term market demand for the development of flexible business park development on available sites (which could include a portion of the Venice Bakery site), with an opportunity for a large proportion of office space.
  - accommodation of medium term market demand for the development of mixed residential commercial development on available sites fronting the north side of Main Street (which could include the southern portion of the Venice Bakery site).
  - accommodation of long term intensification of light industrial areas, allowing a flexible mixture of uses, including office functions, catering to businesses that otherwise could not afford to locate in a new business park.
  - creation of some additional employment through the development of business park sites in the medium term and intensification of light industrial sites and buildings over the longer term.
  - stabilization and improvement of the property tax base over the long term.

3. Maplewood Industrial Area

A) Waterfront

Recommended Policy Actions:

- The District OCP designation for waterfront industrial areas and adjacent areas south of the rail rights-of-way should be renamed "Port Industrial", to be distinct from non-waterfront upland light industrial areas. This designation should encompass the areas shown in the Maplewood OCP as "Port Industrial", as well as portions of the CXY, Mohawk and Sterling Chemical sites, south of the CNR right-of-way.

- The Maplewood OCP land use map should be revised to reflect the above changes, and redesignate portions of the CXY, Mohawk and Sterling Chemical sites, south of the CNR right-of-way from "Medium Industrial" to "Port Industrial".

Resulting Policy Implications:

- Implementation of the above-noted policy recommendations will allow for the following to occur:
  - accommodation and preservation of heavy industrial, port/marine and transportation uses on waterfront and adjacent industrial lands, south of the CN Rail over the 25 year time frame.
  - steady incremental growth of new jobs over the 25 year horizon.
  - maintain a balanced employment base by preserving and encouraging some growth of the number of heavy industrial type jobs.

B) Non-Waterfront

Recommended Policy Actions:

- Establish new District OCP land use designations which distinguish between "Light Industrial" and "Business Park"[9] areas within the area currently designated as "Mixed Use" in the District OCP.

- On the District OCP map, vacant lands located on the CXY site north of the CNR and on the proposed Maplewood Business Park site should be designated "Business Park". The VPC lands north of the Dollarton Highway should incorporate a flexible split designation which allows a mixture of "Business Park", "Residential" and "Parks, Recreation, Open Space". Not including the Maplewood Plaza commercial area, the remaining non-waterfront portions of the Maplewood industrial area (and the Tolko site), north of the CNR should be designated "Light Industrial".

- More definitive policy statements which reflect the policy directions identified above by this study should be incorporated into the Maplewood OCP, to provide clear direction for the development of future land uses.

[9] Generally speaking, business parks should allow most uses that are permitted in light industrial areas, but should have a higher quality and lower density of development than conventional light industrial uses, with many business park users having higher proportions of office space than in traditional light industrial areas.

- Prepare development permit area guidelines which specifically address the development of business park type development.

- Update development permit area guidelines for the protection of natural environment to reflect recent federal and provincial guidelines regarding environmental protection.

- Update development permit area guidelines for protection of development from hazardous conditions to address the potential chemical spill contours associated with the proximity of new development to the existing chemical plants.

- Amend the I3 (Light Industrial) Zone to accommodate a wider variety and flexibility of uses, including the potential for at least 50% office space as a principal use.

- Prepare a new industrial zone for business parks, on the basis of the provisions of the existing CD9 Zone used in the Pemberton/Welch industrial area (east of Lloyd Avenue), with revisions to accommodate a wider variety of uses on a variety of parcel sizes.

- Prepare off-street parking regulations for business parks, which recognize the implementation of transportation alternatives (including public transit, pedestrian/cycling mobility, ride sharing and traffic demand management).

- The District should prepare a servicing strategy for future development in the Maplewood area, to identify servicing costs and establish a strategy for how servicing costs will be recovered. This strategy should involve an assessment of the merits of preparing a Development Cost Charge (DCC) bylaw for new light industrial and business park development, as well as other potential financial strategies.

Resulting Policy Implications:

- Implementation of the above-noted policy recommendations will allow for the following to occur:
  - accommodation of short and medium term market demand for the development of flexible business park uses on existing vacant industrial sites, with an opportunity for a large proportion of office space.
  - creation of significant additional employment through the development of business park uses on existing vacant industrial sites in the short and medium terms.

- a significant improvement of the property tax base in the short and medium terms through the development of business park uses on existing vacant industrial sites.
- accommodation of long term intensification of existing light industrial areas, allowing a flexible mixture of uses, including office functions, catering to businesses that otherwise could not afford to locate in a new business park.
- creation of some additional employment through the intensification of existing light industrial areas over the medium term and longer terms.
- use of some or all of the VPC lands north of Dollarton Highway (which are not required to fulfill short or medium term industrial market demand) for other land uses.
- development of recreation facilities including aquatic centres, ice rinks, libraries, etc., as well as retail services for local employees within the context of a business park, in order to create a balanced employment centre.
- a community land use structure which is compatible and supportive of public transit services and mobility alternatives (including public transit, pedestrian/cycling mobility, ride sharing and traffic demand management).
- financially sound development of new land uses, which will have the ability to recover the costs of major infrastructure servicing improvements.
- a community structure which has little or no impact on the natural environment.

4. Dollarton Shipyard (Cates) Site

Recommended Policy Actions:

Unlike other industrial areas, recommended policy actions for the Dollarton Shipyard (Cates) site are presented as options, as follows:

Option A - Mixed Residential/Commercial/Open Space

- Redesignate the upland portions of the Dollarton Shipyard (Cates) site for a mixture of residential and some complementary waterfront commercial uses including outdoor recreation (canoe/kayak rental, etc.) and marine pub/restaurant.

- Designate waterfront portions, as well as a significant component of the upland portions of the site for natural and usable open space purposes, recognizing the opportunity for waterfront recreation activities, and to encourage public access to and along the water's edge, with a potential linkage to Cates Park.

- Encourage existing marine industrial uses to relocate to other waterfront industrial locations within the District including the Tolko Industries site in Maplewood.

- Encourage improved public transit service to the site and that buildings are designed in a manner that is supportive of transit service.

- Establish a development permit area with guidelines that will protect natural features, ensure a high quality of design which responds to the sloping waterfront location and recognizes adjacent existing residential uses.

- Establish infrastructure servicing and associated cost recovery strategies for servicing potential new development of the site.

Option B - Waterfront Industrial Reserve

- Re-Designate the upland and waterfront portions of the Dollarton Shipyard (Cates) site for "Industrial Reserve" to accommodate existing and future potential marine industrial, light industrial or other industrial uses.

- Consider the preservation of existing shipyard buildings which have historical significance, and where possible, encourage public viewing areas of the industrial and waterfront activity along Dollarton Highway, and along the eastern edges of the property, with a potential linkage to Cates Park.

- Ensure that development permit area with guidelines will protect natural features, ensure good design for any new buildings, which responds to the sloping waterfront location, recognizes adjacent existing residential uses, and maintains existing views of Burrard Inlet from Dollarton Highway and existing adjacent residences.

- Establish infrastructure servicing and associated cost recovery strategies for servicing any potential new development of the site.

Resulting Policy Implications:

Option A - Mixed Residential/Commercial/Open Space

Implementation of the above-noted Option A policy recommendations will allow for the following to occur:

- new development will significantly improve the taxable value of the land;

- new development will provide additional housing choices for District residents;
- new development will allow for greater public access to the waterfront;
- new development will generate some new employment by both commercial development and through home based business, therefore helping to improve the jobs/housing balance;
- new development will have minimal environmental impacts on natural features.
- new development will result in a substantial investment in new municipal infrastructure and services.

Option B - Waterfront Industrial Reserve

Implementation of the above-noted Option B policy recommendations will allow for the following to occur:

- new development will have a limited ability to improve the taxable value of the land;
- new development will generate a small number of new jobs, therefore providing some employment opportunities for local residents;
- existing and new development will have some potential impacts on the natural environment.
- there may be an opportunity to preserve exiting historical buildings.

5. Commercial Areas with Redevelopment/Intensification Potential

Evaluation Findings & Consistency with Complete Community Objectives:

- Intensification and redevelopment of commercial lands within the **Marine Drive Corridor, Lynn Valley Centre and Lynnmour (Main Street/Mountain Highway area)** with "mixed residential/commercial" best achieves complete community objectives.

- Intensification and redevelopment of community commercial areas (including **Edgemont Village, Maplewood Plaza and the proposed Windridge Centre**) with additional retail, service and service-related office uses will moderately achieve complete community objectives.

Consistency with Existing DNV Policies & Recommended Policy Actions:

For the most part, existing District of North Vancouver policies contained within the District Official Community Plan (OCP), various OCP Area Plans and the District Zoning Bylaw effectively provide direction and regulation for the development of commercial lands, with the exception of the following:

- Section 9 of the District OCP should incorporate a policy statement that encourages the development of mixed residential/commercial buildings and uses within the identified centres of:
  - Marine Drive Corridor (with an emphasis on higher density development at the intersections of Marine Drive with Capilano Road and Pemberton Avenue).
  - Lynn Valley Centre.

- The recently prepared Lower Capilano OCP provides policy statements which support the above noted District OCP policy directions for the Marine Drive corridor.

- The Lynn Valley Core Area and Lower Lynn OCP's should be revised to include policy statements which specifically allow and encourage mixed residential/commercial development (using policy statements similar to those recently incorporated into the Lower Capilano OCP).

- The Lynn Valley Core Area and Lower Lynn OCP's should be revised to specifically identify an area for "Core Commercial" land uses, which could include mixed residential/commercial and office development (using policy statements similar to those recently incorporated into the Lower Capilano OCP).

- The Maplewood and Seymour OCP's should be revised to include policy statements which encourage some redevelopment with mixed residential/commercial uses for the Windridge and Maplewood Plaza commercial areas (using policy statements similar to those used in the North Lonsdale-Delbrook OCP).

- The C4 (Tourist Commercial) Zone should be modified to allow greater building site coverage and additional development density for properties fronting Capilano Road, and encourage development which will capture much of the currently uncaptured hotel market demand on the North Shore.

- Consideration should be given to creating a new mixed residential/commercial zone which is similar to the C2 (General Commercial) Zone and C3 (General Commercial) Zone, but which allows increased building site coverage and density.

Resulting Policy Implications:

Implementation of the proposed policy directions and recommendations will allow for the following to occur:

- generate new employment.
- improve the jobs/housing balance and variety of employment types.
- create focused population centres of employment and service growth.
- serve local residents and employees and benefit from proximity to these potential customers.
- provide additional housing choices (which would allow seniors and others to live close to commercial and community facilities).
- improve the taxable value of the land.
- provide alternatives to the motor vehicle for the journey to work (by "working close to home" or "living close to work") or to access retail and commercial services.
- support public transit services.
- result in little or no environmental impacts.

Home Based Business

Growth prospects for home based businesses on the North Shore are excellent and it is expected that they will have minimal adverse impacts on existing office and retail markets. By maintaining regulations to minimize any adverse impacts to adjacent residences, these businesses will continue to provide substantial employment income, have positive spin-off benefits for other businesses, will reduce commuting and greatly assist the District in meeting its goals to create a more "complete community."

Given the continuing trend towards down sizing and the shift towards service sector employment, it is expected that the trend towards home based businesses in the District will continue to grow, likely to soon surpass an additional 200 businesses per annum, supporting more than 10% of the District's labour force and between 20% to 25% of jobs within the District. Following the regional trend towards a service sector economy, it is expected that in excess of 50% of these new businesses, and perhaps as much as 60% to 70% of these businesses will be service oriented businesses.

Policy Directions:

- Currently, the District's single family dwelling zones, as well as the RL (Residential Low Rise) and RH (Residential High Rise) zones permit home occupations. Home occupations are defined by Section 405 of the District's Zoning Bylaw. The District should consider permitting home occupations to also occur within the RM (Multiple-Family Residential) zones.

- As well, the District should consider how Section 405 of the Zoning Bylaw should be amended to address home occupations occurring within multiple-family residential and mixed residential/commercial buildings, in order to establish guidelines and regulations regarding the types of home occupations or home based businesses that are appropriate within different residential contexts.

Next Steps

In order to implement the policy actions recommended by this study, various "next steps" have been identified. These steps are summarized as follows:

1) Incorporate the "recommended policy actions" into the District of North Vancouver's policy and regulation documents including:

   - District of North Vancouver Official Community Plan (OCP), Bylaw #6300.
   - Various District of North Vancouver Area Plans (OCP's).
   - District of North Vancouver Zoning Bylaw, Bylaw #1965.

2) Further consider short and long range planning decisions with regard to the land use and policy options identified for the Dollarton Shipyard (Cates) site, using the results of this study as a technical basis.

3) Further consider short and long range planning decisions with regard to the land use options identified for the Vancouver Port Corporation (VPC) lands located north of Dollarton Highway, using the results of this study as a technical basis.

4) Include the technical analyses and findings of this study in future OCP Area Planning exercises and public planning processes, which will be undertaken to update existing OCP Area Plans and prepare plans for new areas.

5) Resolve issues relating to environmental implications associated with a potential chemical spill from the chemical plants located within the Maplewood area, as well as issues relating to any other environmental impacts resulting from new development.

6) Establish a District-wide phasing strategy for the development and redevelopment of industrial and commercial lands, which reflects market trends identified by this study, in order to forecast where municipal investments in planning, roads and infrastructure should be focused, especially in the five year horizon.

7) Use the phasing strategy (noted in the above point) to make decisions regarding when to bring undeveloped industrial land onto the market.

8) Consider traffic implications associated with the land use opportunities identified by this report, including an understanding of how new industrial areas (such as Maplewood) will connect with the regional transportation system.

9) Investigate the need for infrastructure improvements to service the land use and development opportunities identified by this study.

10) Undertake an evaluation of the merits of a Development Cost Charge (DCC) strategy for industrial sites.

11) Consider other financial cost recovery strategies for the provision of infrastructure services and major road improvements to service new industrial lands and intensify existing industrial and commercial lands.

12) Further consider inter-jurisdictional issues relating to the servicing and mobility of the District's industrial and commercial lands with the City of North Vancouver, the District of West Vancouver, GVRD, VPC, the Ministry of Transportation & Highways, the BC Transportation Finance Authority, the Squamish and Burrard First Nations bands, among others. These issues include:

- completion of the Lower Level Route in Pemberton/Welch;
- completion of the Dollarton Highway Re-Alignment in Maplewood;
- consideration of better access in/out of Lower Lynnmour/Lynnterm; and,
- better access to/from the Trans Canada Highway 1.

13) Incorporate the District of North Vancouver's new industrial and commercial land strategy into regional planning studies, including the GVRD's Industrial Land Project and initiatives of the Vancouver Port Corporation (VPC).

14) Incorporate the District of North Vancouver's new industrial and commercial land strategy into the objectives and directions of the North Shore Economic Development Commission.

1. Introduction

As the District of North Vancouver approaches the year 2000, it faces challenges to meet goals of attaining sustainability and establishing a "*complete community*". These challenges are fueled by the following complex issues relating to growth management:

- Regional growth management initiatives articulated in the Livable Region Strategic Plan and Transport 2021 Plan;
- Transportation, mobility and linkages to the Lower Mainland;
- Changing character of the port lands over the next twenty-five years;
- Changing nature of industrial and commercial land uses to reflect current market demands;
- Pressure of commercial development to expand into industrial lands;
- Need to provide continued employment opportunities for District of North Vancouver residents;
- Need to provide local commercial services to North Shore residents;
- Increasing influence of international investment on new development; and,
- Increasing influence of international market trends and demands on the composition of industrial and commercial development.

To address some of these issues, the District of North Vancouver has commissioned this study to prepare an industrial and commercial land use strategy that will form the basis for future economic development initiatives. The study focuses on land use choices and opportunities for future industrial and commercial development within the District of North Vancouver, and how these components will affect the District's ability to become a complete community.

In light of recent development pressures on the District's industrial lands, and the changing demands for industrial and commercial space, this study addresses the following key components:

1. *Assesses existing and future market conditions*, including demand and supply for *industrial* and *commercial* sites.

2. *Compares the merits of alternative land use choices.*

3. *Provides recommendations for land use and policy directions, to guide future development,* and ensure that the quality of life in the District of North Vancouver is maintained and improved.

4. *Provides background on Commercial and Industrial Development trends* to form a basis for the *Economic Development Section of the new OCP.*

5. *Establishes an information base* that will enable the District of North Vancouver to continue to analyze the industrial land base, and share this information with the G.V.R.D. for use in their Industrial Lands Project.

1.1 Study Team

This study was prepared by a multi-disciplinary project team comprised of the following firms:

- **Urban Systems Ltd.:**

  - Land use analysis.
  - Database preparation.
  - Policy analysis.
  - Project coordination.

- **G. P. Rollo and Associates:**

  - Industrial market analysis.
  - Home based business analysis.
  - Policy analysis.

- **Thomas Consultants:**

  - Commercial market analysis.

- **Royal LePage:**

  - Information on office, business park and real estate trends.

1.2 Study Area

The study area encompasses all lands which are currently designated for the following uses by the District of North Vancouver Official Community Plan (Bylaw 6300) as illustrated in Plan Map DNV 01, or are zoned for industrial or commercial purposes:

- Industrial Land Use.
- Commercial Land Use.
- Mixed (Industrial/Commercial) Land Use.

Figures 1.1 and 1.2 generally illustrate the location of these areas (Mixed use areas are shown as industrial areas, since the majority of these areas are zoned for either general or light industrial uses). **Figures 1.3, 1.4 and 1.5** illustrate the District's major industrial areas.

1.3 Report Structure

This report represents a summary of study findings resulting from preparation of the following components of detailed background information:

- A comprehensive *Commercial Database*, which presents information on a commercial area basis, and has been submitted to the District of North Vancouver under separate cover within Appendix B, *Background Report: Industrial and Commercial Databases*.

- A comprehensive *Industrial Database*, which presents information on a site by site basis, and has been submitted to the District of North Vancouver under separate cover within Appendix B, *Background Report: Industrial and Commercial Databases*.

- An analysis of key database findings and land use trends, which are documented in Appendix B, *Background Report: Industrial and Commercial Databases*.

- An analysis of industrial and commercial trends, which are documented in Appendix C, *Background Report: Market Trends and Analysis*, which has been submitted to the District of North Vancouver under separate cover.

The study is primarily focused on the future potential use of the District's industrial lands. As well, commercial areas have been examined to provide insights for future commercial development prospects and assess if these will have impacts on or by the future development of industrial lands. To establish a context for the scope of market land use demands for commercial and industrial development, the initial five chapters of the study examine commercial areas and associated market trends then industrial areas and their associated market trends. Chapters six and seven look more closely at land use choices and policy directions for industrial areas, then generally examine opportunities and policies for commercial areas. The *Final Report* structure is illustrated in **Figure 1.6**.

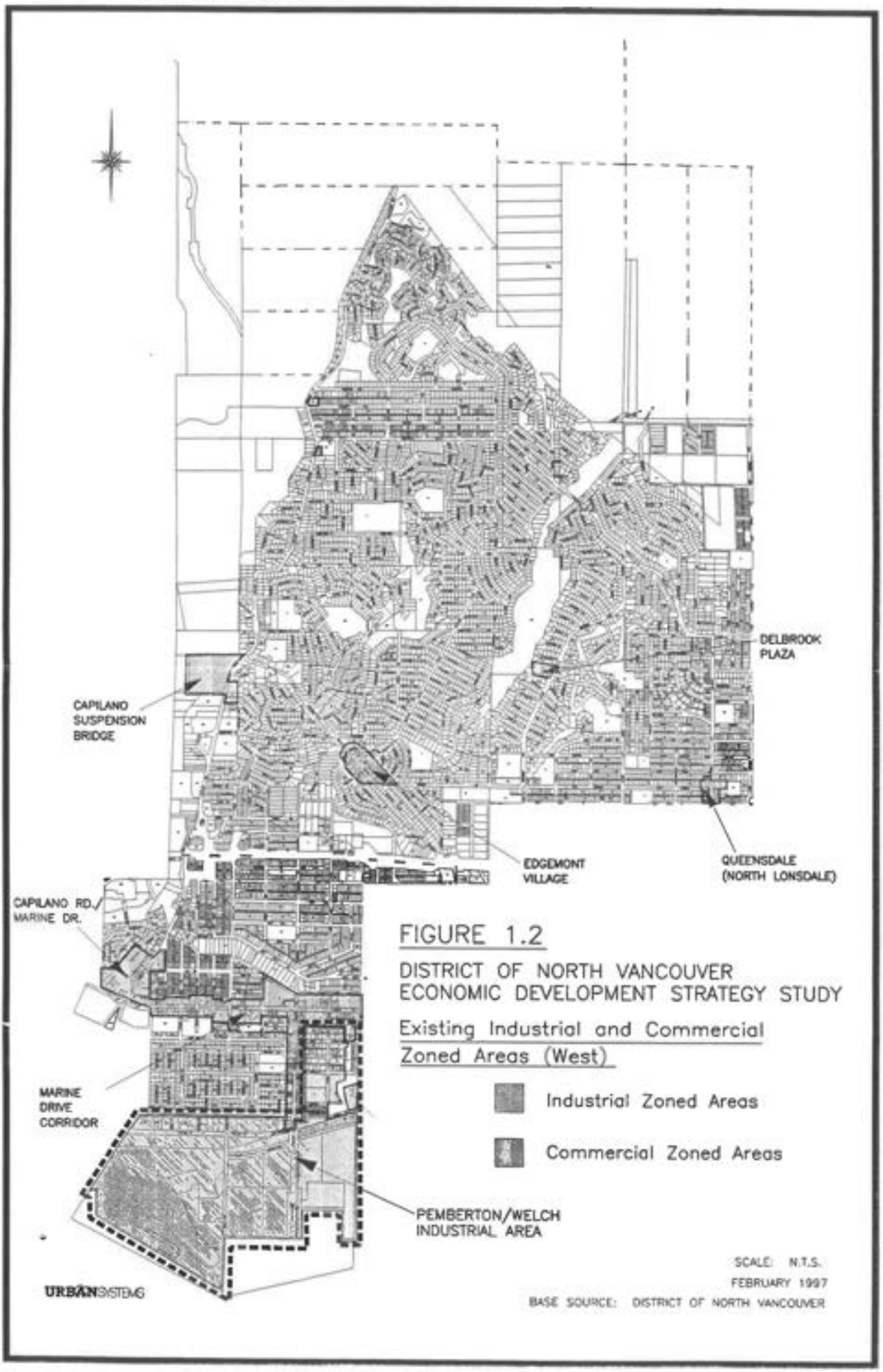


FIGURE 1.2

DISTRICT OF NORTH VANCOUVER
ECONOMIC DEVELOPMENT STRATEGY STUDY

Existing Industrial and Commercial Zoned Areas (West)

Industrial Zoned Areas

Commercial Zoned Areas

SCALE: N.T.S.

FEBRUARY 1997

BASE SOURCE: DISTRICT OF NORTH VANCOUVER

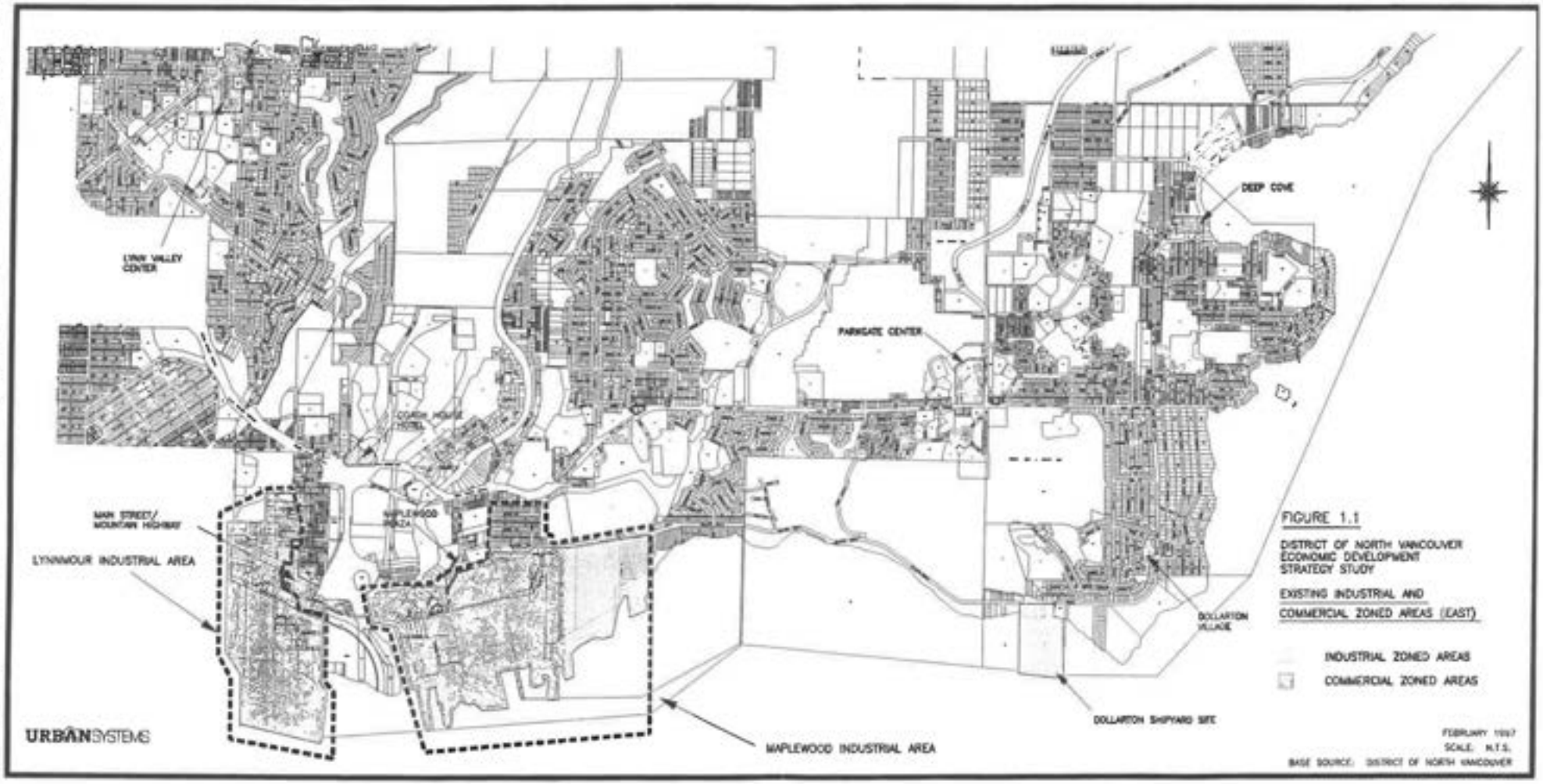
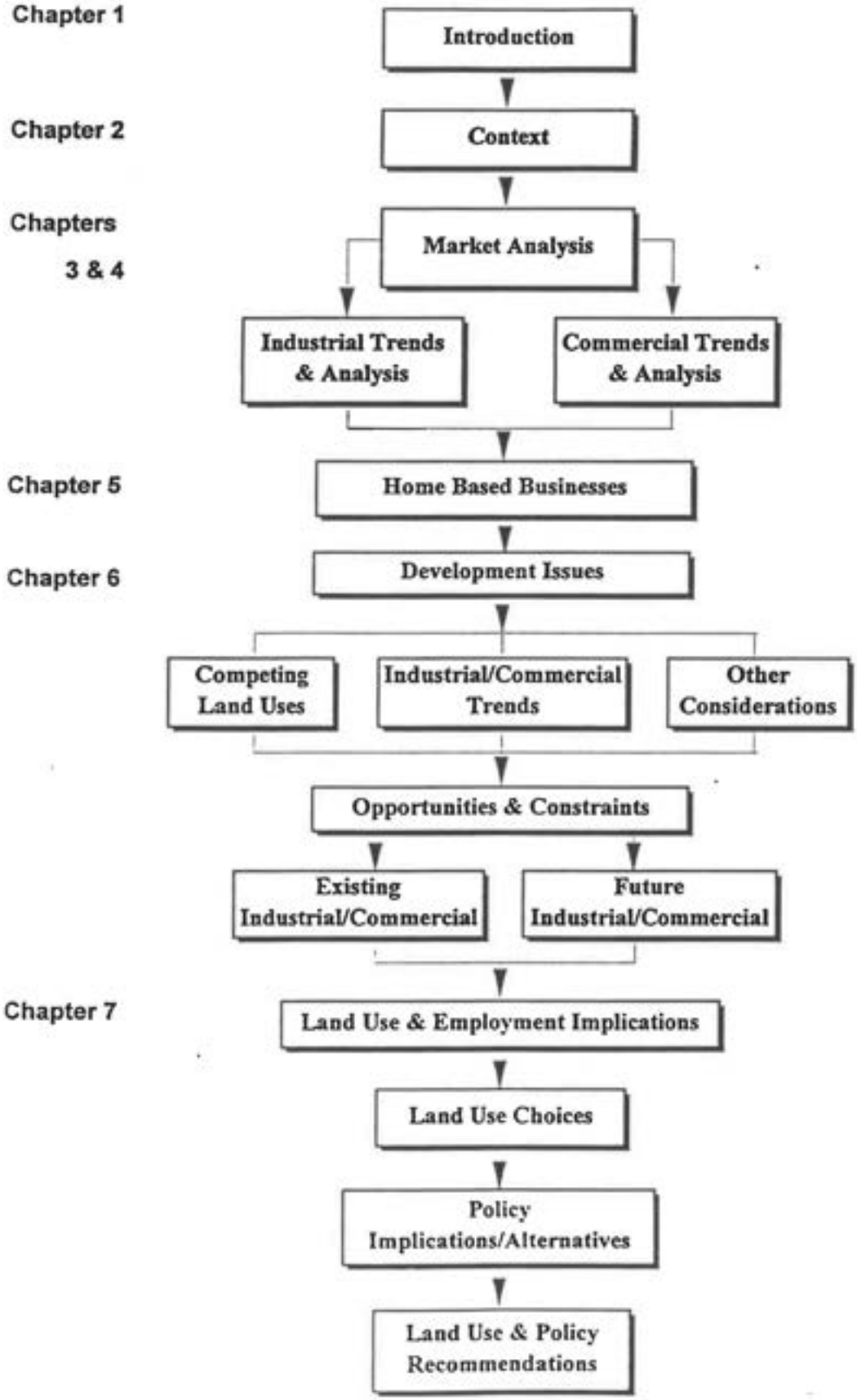

LYNN VALLEY CENTER
LYNNMOUR INDUSTRIAL AREA
MAIN STREET/ MOUNTAIN HIGHWAY
MAPLEWOOD PLAZA
PARKGATE CENTER
DEEP COVE
DOLLARTON VILLAGE
DOLLARTON SHIPYARD SITE
MAPLEWOOD INDUSTRIAL AREA
URBAN SYSTEMS
FIGURE 1.1
DISTRICT OF NORTH VANCOUVER ECONOMIC DEVELOPMENT STRATEGY STUDY
EXISTING INDUSTRIAL AND COMMERCIAL ZONED AREAS (EAST)
INDUSTRIAL ZONED AREAS
COMMERCIAL ZONED AREAS
FEBRUARY 1992
SCALE: N.T.S.
BASE SOURCE: DISTRICT OF NORTH VANCOUVER

Figure 1.6

District of North Vancouver
Economic Development Strategy Study
Final Report Structure



The *Final Report* structure is illustrated in **Figure 1.6**, and is presented in the following manner:

Chapter One - Introduction

- Introduces the purpose for the study, as well as broad study objectives.
- Introduces the study team.
- Defines the study area.
- Presents how the report is structured.

Chapter Two - Existing Industrial/Commercial Land Use Context

- Provides a historical account of economic development, commerce and industrial activity for the North Shore and the District of North Vancouver.
- Identifies the existing polices which define and regulate industrial and commercial land uses.
- Summarizes characteristics of existing industrial and commercial land uses within the District of North Vancouver.

Chapter Three - Commercial Market Trends & Analysis

- Summarizes significant regional commercial market trends.
- Summarizes significant local commercial market trends.
- Forecasts commercial land use supply and demand for the District of North Vancouver for the immediate and the 25 year horizons.
- Identifies implications of commercial market trends for the District of North Vancouver.
- Identifies opportunities for the development or intensification of existing and new commercial land uses.
- Assesses implications of commercial development trends on industrial lands, and of industrial trends on commercial lands.

Chapter Four - Industrial Market Trends & Analysis

- Summarizes significant regional industrial market trends.
- Summarizes significant local industrial market trends.
- Analyses each of the industrial sectors.
- Analyses the distinctions between waterfront and non-waterfront industrial land uses.

- Analyses the changing nature of industrial land uses, especially with respect to the overlap with commercial office and retail uses.
- Forecasts industrial land use supply and demand for the District of North Vancouver for the immediate and the 25 year horizons.
- Identifies implications of commercial market trends for the District of North Vancouver.
- Identifies opportunities for the development, redevelopment or intensification of existing and new industrial land uses.

Chapter Five - Home Based Businesses Trends & Analysis

- Summarizes key trends of home based businesses.
- Assesses the implications of the home based sector on employment and existing commercial and industrial land use trends.
- Identifies prospects for growth of the home based business sector for the District of North Vancouver.

Chapter Six - Land Use Choices & Industrial/Commercial Development Issues

- Synthesizes the industrial and commercial trend and analysis information.
- Summarizes the various existing and potential new land uses which will demand locations on existing industrial and commercial lands.
- Identifies and assesses compatibility of land uses competing for locations on industrial and commercial lands.
- Assesses the effects of key market trends on industrial and commercial development.
- Assesses the effects of key market trends on employment.
- Identifies and assesses other considerations which will effect future development of industrial and commercial lands.
- Summarizes opportunities and constraints for the future development of industrial and commercial lands.
- Summarizes key issues and implications resulting from the assessment of opportunities and constraints.

Chapter Seven - Evaluation of Land Use Choices & Policy Recommendations

- Evaluates the land use choices, identified by the market analysis and summarized in Chapter six, with complete community planning objectives.
- Identifies key policy directions for the future development of industrial and commercial lands.
- Reviews these policy directions against existing policies, and suggests where changes are required.
- Presents land use and policy recommendations for the *District of North Vancouver Official Community Plan* and changes to the *District of North Vancouver Zoning Bylaw*.
- Presents recommendations for changes to existing land use designations. Summarizes economic development implications resulting from the policy recommendations.
- Reviews these policy directions against the directions articulated in the Greater Vancouver Regional District's *Livable Region Strategic Plan*, and the Vancouver Port Corporation's *Port 2010 Plan*.
- Identifies future steps the District should consider to implement the recommended policy actions and land based economic development strategy.

Appendix A, *Glossary of Terms*, which is attached to the *Final Report*, contains definitions for industry and technical terms which are used throughout the report. In some cases these definitions are also mentioned in the footnotes on relevant pages of the report where such terms appear.

2. Existing Context

In order to establish a basis for preparing a land use strategy for the future use of industrial and commercial lands, this chapter examines the existing context of industrial and commercial uses by:

- Providing a historical account of economic development, commerce and industrial activity for the North Shore and the District of North Vancouver.
- Identifying existing polices which define and regulate industrial and commercial land uses.
- Summarizing characteristics of existing industrial and commercial land uses within the District of North Vancouver.

2.1 Historical Perspective

Economic development and industrial development on the North Shore and in the District of North Vancouver commenced in the late 1800's and has progressed through several stages of growth.

2.1.1 Early History

Early industrial development on the North Shore emerged in the 1860's and centered on the forest sector. Subsequent growth centered on heavy industrial users including the forest sector, shipbuilding (given a great boom by World War I) and other water dependent industries including coastal and deep sea port facilities.

By the 1930's the North Shore waterfront was home to seven shipbuilding companies, five lumber shingle mills; a creosote company, a pressure pipe company, the main oil plants for Imperial Oil and Home Oil distributors, a fish cannery and a grain elevator. World War II brought a further boom to the shipbuilding industry, suppliers of products and services to the shipbuilding industry and the growth of small population serving industrial companies in the Lynnmour and Pemberton/Welch areas.

Strong post war economic growth, continuing through the 1950's to the 1960's led to continuing growth and diversification of North Shore industrial and economic activities. Many present day port terminals were developed during this period to facilitate the export of Canadian resources.

2.1.2 Recent History

Changes to the North Shore industrial market during the 1970's and 1980's featured more rapid expansion of port terminal, port services and transportation industries. This era is also characterized by decline of the shipbuilding industry, greater demand for Maplewood waterfront sites and the emergence of a light industrial sector driven by diverse manufacturing companies serving national and international markets.

2.1.3 Past Decade

Over the past decade, the North Shore industrial market has experienced even more rapid changes. The Port of Vancouver's "gateway" position to growing Pacific Rim trade has created new market opportunities (e.g. pursuing value added markets) for port terminal operators that has driven the growth for larger and more diversified terminal facilities.

Many new technology based manufacturing and service/repair companies have located on the North Shore and been the foundation of recent growth of the light industrial market. Most traditional water dependent industries (fishing, forestry, marine construction, aggregates and transportation) have either moved off the North Shore, or greatly shrunk in size and prominence.

2.2 Existing Policy Context

The following policy documents currently provide directions and regulation for the development of industrial and commercial lands within the District of North Vancouver.

2.2.1 District of North Vancouver Policies

The following District of North Vancouver policy documents provide land use policies, objectives and regulations for industrial lands within the District:

- District of North Vancouver OCP;
- Lower Capilano OCP;
- Lower Lynn OCP;
- Maplewood OCP;
- Seymour OCP;
- District of North Vancouver Zoning Bylaw.

The following District of North Vancouver policy documents provide land use policies, objectives and regulations for commercial lands within the District:

- District of North Vancouver OCP;
- Lower Capilano OCP;
- North Lonsdale/Delbrook OCP;
- Lynn Valley Core Area OCP;
- Lower Lynn OCP;
- Central Inter-River OCP;
- Maplewood OCP;
- Seymour OCP;
- Deep Cove OCP; and,
- District of North Vancouver Zoning Bylaw.

2.2.2 Regional Policies and Objectives

The following Greater Vancouver Regional District (GVRD) documents provide regional policies and objectives for land use and transportation planning within the Greater Vancouver Region for the twenty-five year horizon:

- Livable Region Strategic Plan (LRSP); and,
- Transport 2021 Plan.

2.2.3 Other Policies and Objectives

In addition to the District of North Vancouver and GVRD policy documents, the following documents also provide direction for the development of industrial and commercial lands within the District:

- Port 2010 Plan; and,
- North Shore Economic Development Commission's, "Strategic Directions".

2.3 Characteristics of Existing Industrial & Commercial Land Uses

2.3.1 Commercial Land Uses

There are approximately 2,367,004 square feet of commercially zoned floor area within the District's commercial areas, currently employing as many as 6,000 people. The mix of floor area/uses within the commercial areas and associated existing employment estimates are summarized as follows:

Mix of Land Uses and Employment Estimates for Commercial Areas

Land Use	Area (sq. ft)	% of Total Comm. Floor Area	Employee Estimates[10]
Retail	1,302,078	55.2%	3,720
Service	321,262	13.5%	918
Office	204,753	8.6%	819
Hotel/Motel	149,889	6.3%	150
Light Industrial[11]	389,022	16.4%	389
Total	2,367,004	100%	5,996

2.3.2 Industrial Land Uses

There are approximately 774 acres of industrial land within the District of North Vancouver, on which it is estimated there are as many as 5,432 people employed. The breakdown of this amount across the various industrial neighbourhoods is as follows:

- Pemberton/Welch 275 acres
- Lynnmour 158 acres
- Maplewood 316 acres
- Other Industrial Areas[12] 25 acres

Total 774 acres

[10] Existing employment estimates are based on application of accepted worker density ratios to various commercial land uses.

[11] Includes integrated light industrial uses in the C-8 (Business Commercial) Zone.

[12] Includes the Dollarton Shipyard (Cates) site, as well as hydro facility sites.

Excluding the Canada Wildlife Conservation Area in Maplewood (which is zoned for industrial purposes and occupies just over 100 acres of land), approximately 408 acres are located on parcels which have waterfront access. Approximately 265 acres are located on non-waterfront lands including the majority of upland light industrial portions of the Pemberton/Welch, Lynnmour and Maplewood industrial areas.

2.3.3 Undeveloped Industrial Lands

Within the 774 acres of industrial lands, the following are significant consolidated undeveloped/unused portions of lands designated in the OCP for industrial or mixed uses or zoned for industrial use:

• CXY Chemicals Site (North of the CNR)	30 gross acres (25 net acres)
• Proposed Maplewood Business Park	50 gross acres (20 net acres)
• VPC Vacant Lands (North of Dollarton Hwy.)	37 gross acres (25 net acres)
• Tolko Industries Site (soon to be available)	15 gross acres (12 net acres)
• Dollarton Shipyard (Cates) Site	5.2 gross acres (4.2 net acres)
Total	139 gross acres (87 net acres)

Other than the above noted lands, there are approximately 20.3 acres of developable vacant non-waterfront industrial uplands within the District's industrial areas.

There is also a substantial amount of industrial zoned land which is vacant and undevelopable due to environmental concerns or because the parcels are the result of an abandoned road or rail right-of-way. The most significant of these undevelopable industrial lands include the Environment Canada Research Centre (Conservation Area) lands (located on VPC land) south of Dollarton Highway (in Maplewood), and a portion of Mackay Creek Park Marsh, north of West 1st Street (in Pemberton/Welch).

2.3.4 Industrial Zoned Lands

Of the industrial zoned land, the estimated amount of land within each of the District's industrial zones is as follows:

• I1 (Waterfront Industrial Zone)	307 acres
• I2 (General Industrial Zone)	219 acres
• I3 (Light Industrial Zone)	172 acres
• I4 (Interim Industrial Zone)	62 acres
• I5 (Storage Industrial Zone)	3 acres
• Various CD Zones (for industrial purposes)	11 acres
Total	774 acres

Estimates indicate there is a total of approximately 4,681,817 sq. ft. of existing building gross floor area occurring on industrial zoned sites, with an overall mix as follows:

Mix Of Industrial Building Floor Area for All Industrial Areas

Land Use	Floor Area (sq. ft)	% of Total Industrial Floor Area
Port/Heavy Industrial[13]	1,875,134	40.0%
Light Industrial	2,010,113	43.0%
Transportation[14]	64,199	1.4%
Retail	90,300	1.9%
Office	547,670	11.7%
Residential	94,400	2.0%
Total	4,681,817	100%

In addition, to these building floor area estimates, there are approximately 7,974,866 sq. ft. (183 acres) of industrial land used for outdoor storage[15] of bulk commodities (eg. forest products, sulphur, etc.) and vehicles. There is also an additional 2,786,905 sq. ft. (64 acres) of industrial land occupied by rail rights-of-way and transportation terminal (eg. inter-modal truck depot) uses.

Service commercial uses (primarily comprised of auto repair businesses) occupy approximately 2.8 acres of land in the Pemberton/Welch industrial area and 3 acres in the Lynnmour industrial area. These uses involve approximately 189,610 square feet of building gross floor area (which is included in the Light Industrial row of the table noted above).

Waterfront port oriented and heavy industrial uses have a strong orientation and connection towards transportation modes including rail, ship and truck.

[13] Port/Heavy Industrial floor area includes any port-oriented or heavy industrial activity occurring in a building or structure (tanks, sheds, etc.), but does not include "Outdoor Storage" or "Transportation" uses.

[14] Transportation includes building floor area occupied by the BC Rail Train Terminal and operations buildings.

[15] Unlike other industrial uses for which floor area is based on gross building floor area, Outdoor Storage floor area is based on site area occupied by outdoor storage activities.

2.3.5 Existing Industrial Employment Characteristics

The following is a summary of existing industrial employment estimates for the various industrial areas throughout the District:

Estimated Existing Employment Estimates

Industrial Neighbourhood	Estimated # of Employees[16]	% Share of Employment
Pemberton/Welch	2,471	45.5%
Lynnmour	2,218	40.8%
Maplewood	704	13.0%
Other Industrial Areas	39	0.7%
Total (All Areas)	5,432	100%

[16] Employment estimates are based on application of worker density ratios to various industrial uses.

3. Commercial Market Trends and Analysis

This chapter of the study examines commercial development trends, issues and opportunities on the North Shore and in the District of North Vancouver. In order to prepare a commercial development strategy that meets the needs and expectations of the District of North Vancouver, consumer trends and the prevailing development patterns were examined. Detailed commercial market trends and analysis are contained in Appendix C, Background Report: Market Trends and Analysis. This chapter summarizes highlights from this analysis.

3.1 Regional/International Commercial Market Trends

3.1.1 Consumer Trends

Consumption trends of the 1990's are the driving force behind the retail and hospitality revolution currently underway. The new consumer of today is skeptical, cautious, frugal, value-oriented and very discerning. Successful retailing and commercial development in the 21st century must recognize these characteristics and satisfy these needs and wants or face elimination from an increasingly competitive marketplace.

3.1.2 Retail Trends

The intense competition amongst all retailers has provided the impetus to continuously evolve new retail concepts and store types. Regional and international trends in the evolution of retail formats over the past decade have included:

- Decline of anchor stores.
- Inappropriate tenant mixes.
- Rising occupancy costs.
- The rise of Megastores and Big Box stores.
- Mall "sameness".
- Return to "Main Streets".
- Non-Traditional shopping environments, including factory outlets.
- The rise of "Town Centres".
- The flourish of "Mixed Commercial/Residential" development.

3.1.3 Evolution Of Retail Formats

Consumer and retail trends noted above have significantly affected the development of shopping centres away from traditional formats. Competition and retail focus have produced the key results of specialization and segmentation of the retail industry. Specifically, the traditional formats of strip, neighborhood, community and regional shopping centres are now competing with the following retail hybrids:

- Festival/Public Markets.
- Super Convenience Centres.
- Super Regional Town Centres.
- Warehouse Precincts.
- Power Centres.
- Factory Outlet Malls.
- Power Entertainment Centres.
- Value Centres.

3.1.4 Other Commercial Trends

Trends affecting the regional office and tourism commercial markets can be summarized as follows:

1. With present high land values, there is less speculative development and increasingly more build to suit development.

2. The low mortgage interest rates have stimulated the demand for strata office and retail service space.

3. Due to high land value, mixed use development including retail, office and/or residential uses are becoming increasingly more cost effective in matching economic and consumer forces with planning factors.

4. There is a shift from traditional office facilities to home based office and businesses.

5. Office spaces are typically becoming smaller in size.

6. In the hotel industry, there is an increasing preference towards recognized hotel/accommodation chain operators as patrons are drawn to names that offer guaranteed value, service and quality.

3.1.5 Regional Commercial Supply and Demand

Due to geography and topography, many of the commercial uses within the District of North Vancouver have a trade area which spans across the entire North Shore.

Retail/Service Market

Table 3.1 illustrates 1985 and 1991 data for the relationship between retail/service and office floorspace and population for selected parts of the Greater Vancouver region.

As outlined in **Table 3.1**, the North Shore had approximately 43.7 sq. ft. of retail/service space per capita in 1985 which was considerably higher than the regional average (excluding downtown) of 36.4 sq. ft. and significantly higher than the ratio of other suburban parts of Greater Vancouver. Since 1985, this ratio has decreased to 36.9 sq. ft. per capita below the GVRD average of 39.2 sq. ft. in 1991.

Similarly, **Table 3.1** outlines that the North Shore had about 16.7 sq. ft. office space per capita in 1985 which declined to 15.7 sq. ft. per capita in 1991. Both of these are lower than the regional suburban averages. While the North Shore had a higher ratio than the outer suburbs, it has a significantly lower ratio than Richmond, whose office base is partially supported by the airport and Burnaby/New Westminster which comprised two regional town centres and major office/business park locations and the Trans Canada Highway and Canada Way corridors.

Historically, the North Shore and the District of North Vancouver have had higher ratios of regional and community commercial retail/service floorspace per capita and lower ratios of neighbourhood scale commercial floorspace per capita than the GVRD for the following reasons:

1) Residents have higher than average incomes in the GVRD and thus, have a higher propensity to consume luxury items which are predominately purchased in regional and community scale shopping centres and precincts.

TABLE 3.1
COMPARISON BETWEEN 1985 AND 1991 RETAIL/SERVICE AND OFFICE FLOORSPACE PER CAPITA (SQ.FT.)

Region	Retail/Service			Office			Total Commercial		
	Sq.ft.	Population	Sq.ft. Per Capita	Sq.ft.	Population	Sq.ft. Per Capita	Sq.ft.	Population	Sq.ft. Per Capita
City of North Vancouver District of North Vancouver									
1991	3,511,578	116,895	30.0	1,936,850	116,895	16.6	**5,448,428**	**116,895**	**46.6**
1985	4,092,764	101,276	40.4	1,690,223	101,276	16.7	**5,782,987**	**101,276**	**57.1**
City of North Vancouver District of North Vancouver West Vancouver									
1991	5,792,501	156,805	36.9	2,461,425	156,805	15.7	**8,253,926**	**156,805**	**52.6**
1985	5,974,848	136,804	43.7	2,194,203	136,804	16.0	**8,169,051**	**136,804**	**59.7**
Coquitlam/Pt Coquitlam Pt Moody									
1991	4,613,543	142,527	32.4	1,108,500	142,527	7.8	**5,722,043**	**142,527**	**40.1**
1985	3,934,118	111,552	35.3	1,269,284	111,552	11.4	**5,203,402**	**111,552**	**46.6**
Burnaby/New Westminster									
1991	8,965,557	208,328	43.0	6,168,604	208,328	29.6	**15,134,161**	**208,328**	**72.6**
1985	6,742,712	184,126	36.6	6,173,129	184,126	33.5	**12,915,841**	**184,126**	**70.1**
Richmond									
1991	3,563,106	130,305	27.3	4,232,167	130,305	32.5	**7,795,273**	**130,305**	**59.8**
1985	3,648,993	104,094	35.1	3,798,670	104,094	36.5	**7,447,663**	**104,094**	**71.5**
Surrey/White Rock									
1991	8,152,882	269,089	30.3	4,003,008	269,089	14.9	**12,155,890**	**269,089**	**45.2**
1985	6,819,751	188,104	36.3	1,956,264	188,104	10.4	**8,776,015**	**188,104**	**46.7**
GVRD									
1991	62,173,869	1,587,590	39.2	* 30,551,061	1,587,590	19.2	**92,724,930**	**1,587,590**	**58.4**
1985	44,975,059	1,234,864	36.4	* 25,405,795	1,234,864	20.6	**70,380,854**	**1,234,864**	**57.0**

Source: GVRD Industrial & Commercial Floorspace Inventory, 1985,1991. B.C. Municipal Population Estimates, B.C. Ministry of Economic Development (1985).
**Does not include the Downtown Vancouver office space.*

2) The topography and road patterns on the North Shore typically do not support concentric trade areas to develop around commercial facilities. As a result, consumers residing in areas adjacent to community and regional commercial facilities tend to use the facilities for their convenience or neighbourhood type shopping as well as their characteristic comparison shopping.

Office Market

The City of Vancouver and the downtown core, in particular, has historically accounted for the majority of office space growth within the Greater Vancouver region. Despite the fact that growth in the office floorspace inventory in downtown Vancouver over the 70's and 80's decades was greater than all other municipalities combined, its share of the total office in the Greater Vancouver Regional District had declined from 65.2% in early 1970's to approximately 57% in the mid 1990's. This is expected to further decline in the future as more office development is expected to be completed in the suburbs over and above the additions to downtown.

The decrease in downtown Vancouver's share of the total regional office inventory is symbolic of a major office decentralization trend to suburban locations for a variety of office tenants many of which are relevant to the North Shore market. Factors responsible for certain office users to decentralize away from urban locations can generally be summarized as follows:

Push Factors (from centralized locations):

- office expansion opportunities limited;
- parking inadequate;
- desire to consolidate operations; and
- desire to enhance the work environment.

Pull Factors (to decentralized locations):

- reduced lease and parking rates;
- plentiful labour supply;
- proximity to the residences of decision makers;
- proximity to support services;
- expansion opportunity;
- prestige of an amenity location; and,
- benefit of having a new building designed specifically for the user's needs.

Table 3.2, illustrates the distribution of the office inventory by geographical area. The region is divided into large sub-regions that are geographically distinct and function as trade areas for many commercial uses. For the most part, much of the commercial within the District of North Vancouver trades from the entire North Shore.

Comparing the North Shore to the regional average, the office inventory per capita is very close to the regional average at 16.0 sq. ft. for the North Shore compared to almost 20 sq. ft. for regional average excluding the CBD. This is largely due to the presence of large crown corporations such as ICBC and BC Rail located in the Lonsdale area of the City of North Vancouver. The North Shore benefits from its proximity to downtown Vancouver and the development of the lower Lonsdale area with its SeaBus and bus transit centre located close to these major offices. The North Shore's share of the total region of office space has increased during the last couple of decades from approximately 3.7% in 1982 compared to 4.6% in 1991.

Historically, suburban office space demand including the North Shore, has been dominated by smaller space users comprised primarily of branch offices or regional tenants and smaller space users consisting of various professional services oriented to meet the demands of the local population base. Other than provincial crown agencies such as ICBC and BC Rail, regional oriented tenants include other government agencies, insurance companies, real estate firms and bank lending agencies while smaller office space users of a local nature dentists, lawyers, medical services, engineers, accountants and other professionals. Many of these service office uses are located on street levels and within shopping centres.

Key Factors Affecting Office Space

Several factors are most likely to effect the future distribution of office space by type of space and by area in both the GVRD as well as specifically on the North Shore and the District of North Vancouver:

- The size and distribution of population across the GVRD, North Shore and District of North Vancouver are expected to be significant influences on the office inventory due to the fact that many new office users are businesses that serve local populations.

- Growth and structural changes in the provincial and regional economy will positively stimulate growth in the office sector. The service/professional/managerial components of the economy will further increase and the Greater Vancouver Region will continue to strengthen its role as a North American and Pacific Rim business centre.

TABLE 3.2
REGIONAL OFFICE FLOORSPACE INVENTORY AND POPULATION BY SUBREGION - 1991

Subregion (1)	1991 Office Inventory (Sq.ft.)	Share of Total Region	1991 Regional Population	Share of Total Region	Office Inventory Per Capita
Burrard Peninsula (Excluding CBD)	17,041,928	31.9%	674,287	44.1%	25.3
Northshore	2,461,425	4.6%	153,704	10.1%	16.0
Richmond	4,232,167	7.9%	126,624	8.3%	33.4
Northeast Sector	1,108,500	2.1%	139,092	9.1%	8.0
South of the Fraser River					
Surrey/Delta/White Rock	4,634,531	8.7%	350,465	22.9%	13.2
Township & City of Langley	1,085,055	2.0%	85,805	5.6%	12.7
Sub-Total South of Fraser River	5,719,586	10.7%	436,270	28.5%	13.1
CBD (Downtown Vancouver)	22,806,945	42.7%	n/a	n/a	n/a
Total Regional Average Excluding CBD	30,563,606	57.3%			20.0
Total Region	53,370,551	100.0%	1,529,977	100.0%	34:9

Notes:

(1) Burrard Peninsula subregion includes the Municipalities of Vancouver, Burnaby, & New Westminster
North Shore subregion includes the Municipalities of West Vancouver and the City and District of North Vancouver.
Richmond subregion includes the Municipality of Richmond.
Northeast Sector subregion includes the Municipalities of Coquitlam, Port Coquitlam, and Port Moody.
South of Fraser River subregion includes the Municipalities of Surrey, Delta, White Rock, and the Township and City of Langley

Source: Commercial and Industrial Floorspace Inventory in the GVRD - 1991. Statistics Canada, 1991 Census.

- Communications and computer technology is expected to lend to mixed trends in office requirements and locations. Overall communications and computer technology will likely result in total office requirements of approximately 5 - 10% less than what otherwise would have been during the next 20 years or so.

- The availability of business park and industrial park land is expected to influence the distribution of office space. Increasingly, business parks will play a greater role in the total office market and many office businesses will follow the distribution of industrial users, who are users of specialized business services. This is particularly relevant for Maplewood, Lynnmour and to a lesser extent the Pemberton/Welch areas of the District.

- As companies continue to restructure and become more price driven, occupancy costs will continue to be a major factor in office locational decisions which reinforces why business parks will account an increasing share of space. The greatest savings compared to either downtown and regional town centres are achieved in business parks which have lower rents, property taxes and more reasonable or free parking.

- Vehicular accessibility is expected to continue to have a significant effect on office distribution. Thus, locations such as Maplewood and Lynnmour areas are expected to be more popular as business park locations on the North Shore in the future due to their greater accessibility from the region via the Trans Canada Highway and the Second Narrows Bridge crossing. The availability of transit has historically not been a high priority in office locational decisions in the region. However, it is noted that it has been a concern by recent surveys of companies on the North Shore or those that are seeking North Shore business park locations.

- Many North Shore office users will be associated with activities occuring on light industrial and heavy port industrial lands on the North Shore, many of which are tied to national and international markets.

- The majority of office development that is expected to take place in the immediate to medium term within the District of North Vancouver is expected to be the business park type. The regional distribution of business park space is not particularly linked to population distribution patterns as **Table 3.3** indicates. It has been governed by the availability of land as well as a centralizing tenancy as evidenced by the high Burrard Peninsula (47.6%) and Richmond (44.1%) shares. Nevertheless, it is expected that the District of North Vancouver will likely gain slightly in share as there are lands available in the Maplewood industrial area.

TABLE 3.3
NON-CBD/BROADWAY SUBREGIONAL COMPARISON OF OFFICE TYPES - 1991

Subregion (1)	Total Inventory By Sub-Region		Major Centres		Other Significant Commercial Centres (2)		Business Parks (3)		All Other Areas	
	Office Inventory (Sq.ft.)	% Share of GVRD	Office Inventory (Sq.ft.)	% Share of GVRD	Office Inventory (Sq.ft.)	% Share of GVRD	Office Inventory (Sq.ft.)	% Share of GVRD	Office Inventory (Sq.ft.)	% Share of GVRD
Burrard Peninsula (4) (Excluding CBD)	11,157,643	46.6%	2,372,296	36.1%	2,387,337	49.7%	2,833,421	47.6%	3,564,580	54.0%
Northshore	2,384,064	10.0%	1,249,307	19.0%	448,212	9.3%	87,405	1.5%	599,140	9.1%
Richmond	4,222,684	17.6%	1,192,536	18.1%	0	0.0%	2,625,424	44.1%	404,724	6.1%
Northeast Sector	1,080,641	4.5%	107,195	1.6%	561,309	11.7%	0	0.0%	412,137	6.2%
South of the Fraser River										
Surrey/Delta/White Rock	4,068,370	17.0%	990,378	15.1%	1,403,705	29.2%	275,588	4.6%	1,398,699	21.2%
Township & City of Langley	1,022,204	4.3%	658,841	10.0%	0	0.0%	136,044	2.3%	227,319	3.4%
Sub-Total South of Fraser River	5,090,574	21.3%	1,649,219	25.1%	1,403,705	29.2%	411,632	6.9%	1,626,018	24.6%
Total GVRD Inventory Excluding CBD and Broadway	23,935,606	100.0%	6,570,553	100.0%	4,800,563	100.0%	5,957,882	100.0%	6,606,608	100.0%
Total Region										
CBD and Broadway Corridor	27,460,697									
Total GVRD	**51,396,303**									

Notes:

(1) Burrard Peninsula subregion includes the Municipalities of Vancouver, Burnaby, & New Westminster
North Shore subregion includes the Municipalities of West Vancouver and the City and District of North Vancouver.
Richmond subregion includes the Municipality of Richmond.
Northeast Sector subregion includes the Municipalities of Coquitlam, Port Coquitlam, and Port Moody.
South of Fraser River subregion includes the Municipalities of Surrey, Delta, White Rock, and the Township and City of Langley.

(2) Includes the areas of: Park Royal, Marine Drive (North Vancouver, East Broadway, Oakridge, Kerrisdale, Lougheed Mall (Burnaby and Coquitlam, Brentwood Mall, Uptown New Westminster, Newton, Semiahmoo, Central Port Coquitlam, Port Moody, Scott Rd. (Delta and Surrey, Ladner, Tsawwassen, 104th Avenue (Surrey), Kingsway Corridor (Vancouver and Burnaby).

(3) Includes the areas of: Pemberton Industrial area, South of Marine Drive (Vancouver), Willingdon, Big Bend (Burnaby, North Burnaby, Central Burnaby, Sea Island, North Richmond, Riverside, Annacis Island, Tilbury, and North West Langley (Township of Langley).

(4) Excludes the CBD and Broadway Corridor.

Source:

GVRD Commercial and Industrial Floorspace Inventory - 1991, by Traffic Zone.
The GVRD Office Inventory by Traffic Zone is calculated using BCAA information. It may differ slightly from the GVRD annual survey summary for the following reasons: there is a lag between the creation of a new title and there property being coded; demolitions and conversions are not updated and monitored on a regular basis; some of the BCAA records do not specify either a civic address, floorspace data or type of use, and have therefore not been included.

Overall, it is likely that the business park share of the total regional inventory will increase, for several reasons including:

- Traffic congestion is increasing within town centres (which tend to be oriented linearly along arterial roads).
- There is an increasing trend for some types of head offices to choose high access, business park locations.
- Technology allows use dispersion to occur.
- Business parks offer lower total occupancy costs.
- Business parks offer the potential to combined office functions with some retail, service, storage, research, light manufacturing.

Due to the preceding factors, the North Shore is expected to increase its capture of 5% of regional business park office space additions over the next fifteen years, a recognizable increase over its current share of supply estimated to be 1.5% in 1991. Much of this growth will likely occur within the District of North Vancouver, where there are undeveloped sites which could accommodate new business park development.

Types of Office/Business Park Users Likely to Locate in the North Shore

Based on the 1993 Greater Vancouver Office Users Survey and Development Prospects Report as well as discussions with various Realtors serving the North Shore market, a wide variety of firms are expected to be drawn to locations outside of downtown Vancouver including the North Shore. These include:

- Satellite offices of professional services such as lawyers, accountants, insurance agents, engineering and architectural firms and brokerage firms.
- Government agencies or crown corporations some of which already exist but may choose either smaller or larger spaces depending on the degree and type of structuring happening at the federal and provincial levels.
- Professionals with large support or clerical staff, such as engineering firms.

- Companies that are large and need to be self sufficient in terms of amenities and services.

- The key motivation behind these firms moving to the suburbs will largely evolve around reducing cost, getting closer to customers as well as to employees' residences.

Comparative Advantages/Disadvantages of the North Shore

In a study conducted in 1992 by Coriolis Consulting, the North Shore ranked relatively low compared to other sub-regions within the GVRD with regard to a variety of locational criteria. This study indicated that the North Shore ranks fourth behind the Burrard, South of Fraser, and Richmond sub-regions, and slightly ahead of the Northeast Sector sub-region. In the long run, it is anticipated that the Northeast Sector will likely become more attractive as this area becomes increasingly better serviced by rapid transit links.

This same study identified the following comparative advantages for North Shore office locations:

- Close to the Vancouver CBD;
- Transit access by means of SeaBus and bus is widely available (particularly in the Lower Lonsdale area of the City of North Vancouver); and,
- The availability of attractive office locations.

Implications for the District of North Vancouver

The North Shore's share of the total regional office space has increased during the last couple of decades from approximately 3.7% in 1982 compared to 4.6% in 1991.

The majority of office development expected to take place in the immediate to medium term within the District of North Vancouver is to be of the business park type. It is expected the North Shore will slightly gain in its share of office development as there are lands in the western Seymour area (i.e. CXY Chemical site and the proposed Maplewood Business Park), and the Fullerton site in the City of North Vancouver, all of which are likely to become available for development in the short to medium term (i.e. over the next ten years).

3.2 Local Commercial Market Analysis

3.2.1 Profile Of the North Shore Commercial Market

Given the unique character of the North Shore trading area as a commercial market, the commercial and retail context effectively includes both the competition and markets of the City of North Vancouver and the District of West Vancouver. For the North Shore market **Tables 3.4 and 3.5** outline the hierarchy of North Shore commercial retail infrastructure, including the amount of floorspace and major anchors by retail type. This is documented for the last two decades using 1986 and 1996 as benchmarks for comparison. The following market characteristics are summarized from these tables.

Retail/Service Market

- Most types of shopping centres and office development are presently available on the North Shore.
- The largest growth in commercial space during the last decade has been in neighbourhood shopping centres or precincts including the development of Parkgate (in the District of North Vancouver), Park and Tilford (in the City of North Vancouver), and Caulfield (in the District of West Vancouver).
- The District of North Vancouver has the largest portion of North Shore retail/service development, with 2.05 million sq. ft. of retail/service and service-related office space[17] or 40.5% of the total North Shore retail/service office space. This is followed by the City of North Vancouver and District of West Vancouver with 1.6 million sq. ft. and 1.41 million sq. ft. or 31.5% and 27.9% respectively.
- For the other shopping centre space and retail precincts on the North Shore, service and service-related office space (i.e., banks, insurance agents, Realtor, etc.) typically accounts between 20% to 25% of the floorspace within a shopping environment.

[17] "Service-related office space" includes the space occupied by financial institutions, insurance and travel agencies, etc., located at street level or in a shopping centre.

TABLE 3.4
HIERARCHY OF NORTH SHORE COMMERCIAL RETAIL INFRASTRUCTURE

Type of Retail Centre	Name of Retail Centre and Location	1986 Retail/Service Office Floorspace (sq. ft.)	1986 Percentage of Total Floorspace	Anchor Tenants	1996 Retail/Service Office Floorspace (sq. ft.)	1996 Percentage of Total Floorspace	Anchor Tenants
REGIONAL	Park Royal Taylor Way & Marine Drive	900,000	21.4%	The Bay, Eaton's	910,000	18.3%	The Bay, Eaton's, Future Shop, London Drugs, SportChek, SuperValu, Zellers
	Lonsdale Quay	43,000	1.0%	---	91,800	1.8%	None
	Pemberton/Welch (Between Marine Dr. & Welch St.)	90,000	2.1%		97,000	1.9%	
	Marine Drive Corridor						
	District-Marine Dr. & Capilano to MacKay R	578,000	13.7%	Save-On Foods	657,676	13.2%	Save-On Foods
	City-Marine Dr. (MacKay to Bewick Area.)	263,000	6.3%		263,000	5.3%	
	Lynnmour/Main St.	96,000	2.3%	Canadian Tire	162,000	3.3%	Canadian Tire
COMMUNITY	Capilano Mall	420,000	10.0%		405,300	8.1%	
	Lynn Valley Centre	412,419	9.8%	Zellers, SuperVal	492,495	9.9%	IGA Plus, Zellers, Safeway
REGIONAL/COMMUNITY SUB-TOTAL:		2,802,419	66.6%		3,079,271	61.8%	
NEIGHBOURHOOD	Caulfield	Not Developed	---	N/A	69,600	1.4%	Safeway, Pharmasave, Liquor store
	Westview Shopping Centre Hwy. #1 & Westview Drive	74,000	1.8%	Safeway	102,300	2.1%	Safeway Liquor Store
	Delbrook Plaza	31,646	0.8%	None	31,646	0.6%	None
	Park & Tilford	Not Developed	---	N/A	176,000	3.5%	Save-On Foods, Ed's Linens, Cineplex Odeon
	Parkgate	Not Developed	---	N/A	111,000	2.2%	Safeway, Shoppers Drug Mart
	Dollarton Shopping Centre Dollarton Hwy. & Dollar Road	36,000	0.9%	Stong's	42,000	0.8%	SuperValu
NEIGHBOURHOOD SUB-TOTAL:		141,646	3.4%		532,546	10.7%	
NEIGHBOURHOOD STRIP/ SPECIALTY STRIP	Horseshoe Bay	50,000	1.2%	Restaurants	52,000	1.0%	Restaurants
	Ambleside/Dundarave Marine Drive & 13th - 26th Sts. West Vancouver	369,000	8.8%	Safeway, Stongs	381,200	7.7%	Safeway, Liquor Store IGA, Capers
	Edgemont Village Edgemont Blvd. & Ridgewood	120,000	2.9%	SuperValu	160,911	3.2%	SuperValu
	Upper & Lower Lonsdale	557,000	13.2%	uperValu, Safewa	557,000	11.2%	Extra Foods, Safeway London Drugs
	Queensdale	41,980	1.0%	SuperValu	41,980	0.8%	Queensdale Produce
	Maplewood	30,000	0.7%		51,900	1.0%	
	Deep Cove Gallant Ave. & Panorama	33,000	0.8%	---	49,052	1.0%	
	Other (ie. Cpilano Bridge, Coach House Inn, etc.)	60,000	1.4%		75,000	1.5%	
NEIGHBOURHOOD STRIP/ SPECIALTY STRIP SUB-TOTAL:		1,260,980	30.0%		1,369,043	27.5%	
TOTAL FOR ALL NORTH SHORE COMMERCIAL AREAS:		4,205,045	100.0%		4,980,860	100.0%	

Source: Thomas Consultants Inc., 1987 and 1996 Directory of Shopping Centers, The Greater Vancouver Real Estate Board, North Shore Economic Development Commission

TABLE 3.5
COMMERCIAL FLOORSPACE BY NORTH SHORE MUNICIPALITY AND DISTRICT

Name of Retail Centre and Location	1986 Retail/Service Office Floorspace (sq. ft.)	1986 Percentage of Total Floorspace	1996 Retail/Service Office Floorspace (sq. ft.)	1996 Percentage of Total Floorspace
DISTRICT OF NORTH VANCOUVER				
Marine Drive Corridor				
District-Marine Dr. & Capilano to MacKay Rds.	578,000	13.7%	657,676	13.2%
Edgemont Village	120,000	2.9%	160,911	3.2%
Edgemont Blvd. & Ridgewood				
Marine Drive & Bridgeman Ave				
Pemberton/Welch	90,000	2.1%	97,000	1.9%
Delbrook Plaza	31,646	0.8%	31,646	0.6%
Queensdale	41,980	1.0%	41,980	0.8%
Lynn Valley Centre	412,419	9.8%	492,495	9.9%
Lynnmour/Main St.	96,000	2.3%	162,000	3.3%
Maplewood	30,000	0.7%	51,900	1.0%
Parkgate	Not Developed	---	111,000	2.2%
Dollarton Shopping Centre	36,000	0.9%	42,000	0.8%
Dollarton Hwy. & Dollar Road				
Deep Cove	33,000	0.8%	49,052	1.0%
Gallant Ave. & Panorama				
Other (ie. Capilano Bridge, Coach				
House Inn Other)	60,000	1.4%	75,000	1.5%
DISTRICT OF NORTH VANCOUVER TOTAL:	1,529,045	36.4%	1,972,660	39.6%
CITY OF NORTH VANCOUVER				
Capilano Mall	420,000	10.0%	405,300	8.1%
935 Marine Drive				
City - Marine Dr. (MacKay to Berwick Aves.)	263,000	6.3%	263,000	5.3%
Westview Shopping Centre	74,000	1.8%	102,300	2.1%
Hwy. #1 & Westview Drive				
Upper & Lower Lonsdale	557,000	13.2%	557,000	11.2%
Lonsdale Quay	43,000	1.0%	91,800	1.8%
Park & Tilford	Not Developed	---	176,000	3.5%
CITY OF NORTH VANCOUVER TOTAL:	1,357,000	32.3%	1,595,400	32.0%
DISTRICT OF WEST VANCOUVER				
Horseshoe Bay	50,000	1.2%	52,000	1.0%
Caulfield	Not Developed	---	69,600	1.4%
Ambleside/Dundarave	369,000	8.8%	381,200	7.7%
Marine Drive & 13th - 26th Sts.				
West Vancouver				
Park Royal	900,000	21.4%	910,000	18.3%
Taylor Way & Marine Drive				
DISTRICT OF WEST VANCOUVER TOTAL:	1,319,000	31.4%	1,412,800	28.4%
TOTAL FOR ALL NORTH SHORE COMMERCIAL AREAS	4,205,045	100.0%	4,980,860	100.0%

The North Shore Consumer

According to the North Shore Economic Development Commission (EDC), previous surveys conducted by the EDC (1991) have revealed that the general "North Shore" consumer displays the following characteristics or tendencies:

1. For the convenience of one-stop shopping, consumers from all parts of the North Shore patronize Park Royal Shopping Centre.

2. For grocery and convenience items, consumers will tend to use the retail centre closest to their residence, though many will travel further for better prices.

3. Convenience, variety and parking availability are the most significant reasons in a consumers choice of shopping location; availability and access by public transit is generally least relevant as the majority of consumers use their cars to do their shopping, particularly for comparison purchases. Nevertheless, residents who live close to the neighbourhood villages often walk to purchase their small convenience items and complete their banking, insurance and other service requirements. For some purchasers, particularly the elderly, some stores like supermarkets and produce stores provide delivery services.

4. When deciding where to shop, most North Shore consumers are informed by: word of mouth, flyers included with newspapers and the North Shore News.

5. According to a recent Economic Development Commission study, the majority of consumers spend 85 - 90% of their total annual purchases on the North Shore.

Office Market

Table 3.6 summarizes the growth of office floorspace in buildings of 10,000 sq. ft. or larger on the North Shore. The majority of the office space under 10,000 sq. ft. is situated either on the major commercial arterial roads or shopping centres which are summarized in the previous table under retail/service office space. Some of the salient characteristics of the North Shore office market as follows:

- Overall, the total inventory of office space increased from approximately 714,000 sq. ft. in 1985 to 1,143,000 sq. ft. in 1996 an average annual increase of approximately 3%.
- Average annual absorption was approximately 36,000 sq. ft. during the 1985 to 1996 period.
- The majority of the office buildings have historically been developed in the City of North Vancouver (i.e., over 60%) and to a lesser extent in the District of North Vancouver.
- During the last ten years, two office complexes over 10,000 sq. ft. have been developed in the District of North Vancouver; the Lynn Valley Professional Centre (32,000 sq. ft.) and most recently the Mountain View Village (18,400 sq. ft.).
- The North Shore office market continues to be one of the most stable in the Greater Vancouver region.
- The majority of the 1.1 million sq. ft. of inventory is in the "A" and "B" class categories (see Glossary for definition).
- There is an estimated 205,000 sq. ft. of office space in the commercial neighbourhoods and an estimated 548,000 sq. ft. of ancillary office space in the industrial neighbourhoods of the District of North Vancouver.

TABLE 3.6
NORTH SHORE OFFICE BUILDING SPACE MARKET SUMMARY *

Year		New Construction (sq.ft.)	Total Inventory (sq.ft)	Net Absorption (sq.ft)	Vacant Space (sq.ft)	Vacant Rate
1985		0	714,078	34,500	98,500	13.8%
1986		158,000	872,078	101,500	155,000	17.8%
1987		32,000	904,078	68,000	119,000	13.2%
1988		33,000	937,078	54,000	98,000	10.5%
1989		20,000	957,078	50,800	67,200	7.0%
1990		24,000	981,078	-16,740	107,940	11.0%
1991		65,000	1,043,321	26,804	143,379	13.7%
1992		80,000	1,126,621	80,465	142,914	12.7%
1993		0	1,046,621	53,273	89,641	8.6%
1994		60,000	1,166,621	51,611	98,030	8.4%
1995		12,000	1,094,621	35,664	74,366	6.8%
1996	*	0	1,094,621	15,719	58,647	5.4%
1996	(F)	48,400	1,143,021	63,000	59,766	5.2%

* Only indicates buildings with 10,000 sq. ft. or larger floorspace.
(F) Third Quarter 1996 Year End Forecast

Source: Royal LePage 1996

Hotel Market

Table 3.7 reveals there are 655 hotel and motel units on the North Shore. The majority or approximately 81% of the units are situated within the District of North Vancouver and have limited service associated with them. Overall, there is approximately 150,000 sq. ft. of hotel/motel uses ranging from a development density between approximately 0.31 to 0.51 (floor area ratio). Conference and meeting facilities that have the capacity to hold more than 200 people are significantly lacking on the North Shore.

TABLE 3.7
NORTH SHORE HOTELS & MOTELS

	Number of Rooms
West Vancouver	
Park Royal Hotel	30
Horseshoe Bay Motel	22
Sub-Total	52
District of North Vancouver	
Avalon	45
Best Western Capilano Inn	71
Canyon Court	88
Grouse Inn	75
Holiday Inn Express	73
Travelodge	61
Lynnwood Inn	30
Coach House Inn	90
Sub-Total	533
City of North Vancouver	
Lonsdale Quay Hotel	70
TOTAL	655

Source: 1996 BC Accommodations Guide

3.2.2 Commercial Neighbourhood Profiles

This subsection describes opportunities for development of each commercial neighbourhood within the District of North Vancouver. Detailed profiles of strengths and weaknesses of these neighbourhoods are contained in Appendix C; *Background Report: Market Trends and Analysis*.

Marine Drive Corridor

- Opportunity to create a commercial gateway node featuring commercial uses including mixed use commercial/residential, hotel, and anchor retail at the intersections of Capilano Road/Marine Drive and Pemberton Avenue/Marine Drive.
- Densification and pedestrianization of pockets along Marine Drive by encouraging mixed use and narrowing street, etc. This will require more traffic using Welch Street and the proposed "Lower Level Route," south of Welch Street.
- Attraction of specialty retailers, megastores (including big box grocery stores, furniture/appliances, office supplies, sporting goods, crafts, etc.) and hotel operators.
- Over the longer term some of the above-noted opportunities will require the relocation of existing auto dealerships and selected retail and services to other areas of the North Shore (possibly including the Native lands).

Pemberton Avenue

- Infill and intensification of retail and commercial services oriented to serving local employees.
- Ancillary light industrial uses including auto service, repair and sale of parts.

Edgemont Village

- Increasing densification of village core itself with mixed use including residential and/or office above streetfront retail.
- Introduction of new retail businesses (which are in higher demand), including bookstore, wine/liquor store, sidewalk cafes, health food, pub, larger supermarket.

Lynn Valley

- Create a more pedestrian friendly street-oriented shopping environment, as majority of consumers display a regular tendency to walk or cycle to this area.
- Need for more green space interspersed into commercial core.
- Attention to outdoor appearances and comfort (such as seating, water fountains and street furniture).
- More "sit down" places, including restaurants, cafes, a pub and outdoor seating.
- Introduce potential businesses, including hardware store, laundromat, arts, crafts and fabric store, high end clothing store for teens and women, high end department store merchandiser, major name "anchors", movie theatre or family entertainment (other than arcade).
- Improve the character and appeal of core area including the need to promote an invitation to walking, shopping and socializing.
- Inject more variety of appeal to existing storefronts to create more store and streetfront experiences.
- Increase density in the core with moderate, vertical expansion.
- Promote a unique sense of history and place.
- Need for a more effective retail mix.
- Demand and preference for the development of mixed use buildings (commercial /residential) - 64% of the residents recently surveyed in a North Shore Economic Development Commission Study approve of this type of development.

Lynnmour/Main Street

- Mixed use development opportunities similar to those which have already been approved with the development of Mountain View Village. Designs will need to ensure better exposure and visibility to Main Street corridor at least for the retail component.
- Opportunity to create a commercial gateway to the North Shore along Main Street, benefitting from proximity to the Trans Canada Highway (pending resolution of traffic congestion and parking/access issues associated with peak hour Main Street traffic, approaching the Second Narrows Bridge).

Maplewood Plaza

- Area to the south of existing Maplewood Plaza has the opportunity to create a major business park presence and possibly attract a limited amount of destination retailers.
- Opportunity to remerchandise existing retailers into more service oriented mix.

Windridge Centre

- Potential to service some of the uncaptured western Seymour area retail/service demand.

Parkgate Centre

- Potential to service some of the uncaptured eastern Seymour area potential retail/service demand.

Dollarton Village

- Increase personalized service by existing tenants or new tenants to retain existing patrons and service the relatively stable trade area population.

Deep Cove

- Some opportunity for additional mixed use development by densifying some of the under-developed existing parcels along Gallant Avenue, subject to availability of these sites.

- Opportunity for a focal point of Arts and Cultural events. However, due to lack of land availability, these opportunities are limited, perhaps for temporary cultural events, festivals and sidewalk/street market and craft fair activities.

3.2.3 Demand For Commercial Floorspace

Commercial Development Outlook

With the exception of business park office and hotel space, 1996 GVRD population forecasts were used as the basis for preparing a commercial development forecast. (Details of the commercial demand forecast are contained in Appendix C, *Background Report: Market Trends and Analysis*).

Warranted Retail/Service Floorspace Growth

Table 3.8 summarizes an analysis of the supportable retail and service retail/office floorspace growth on the North Shore and the District of North Vancouver between 1996 to 2021, and identifies the potential demand for community retail/service uses in the three distinct District of North Vancouver trade areas of Edgemont Village, Lynn Valley and Seymour).

- Overall, an estimated **2.33 million sq. ft. of additional new retail and 465,930 sq. ft. of service floorspace is warranted on the North Shore by the year 2021.** It is important to note that if new stores such as a big box retail or megastores enter the market, this would decrease the consumer outflow from the North Shore. Thus, some additional floorspace could be warranted in the short term.
- Retail and service uses will infill in existing commercial areas. In some cases there will be a need to accommodate new retail users, which are currently not located in some of the commercial areas, therefore establishing a more balanced mix of retail/service users. **Approximately 50% of North Shore retail/service demand (i.e. 1,397,790 sq.ft.) has the potential to be captured by the District of North Vancouver over the 25 year horizon.**
- The Marine Drive corridor will continue to strengthen its role as providing retail and service uses for the entire North Shore. Together with vacant First Nations lands, the Marine Corridor will have the potential to capture **28% of North Shore retail/service demand (i.e. 789,580 sq. ft.) over the 25 year horizon.**
- For the community and local commercial areas within the District of North Vancouver (not including the Marine Drive Corridor), there will be a demand for approximately 14,000 sq.ft. per year of new retail and service uses per year over the 25 year horizon resulting in a demand for a total of, close to 330,000 sq. ft. of new retail and service floorspace over the period 1996 to 2011, and close to 280,000 sq. ft. over the period 2012 to 2021.
- Of the above demand for community and local retail and service uses within the District of North Vancouver, 10% (61,000 sq. ft.) will be generated within the Edgemont Village trade area (includes Edgemont Village and Delbrook Plaza), 58% (353,800 sq. ft.) will be generated within the Lynn Valley trade area (includes Lynn Valley Centre, Lynnmour and Queensdale/North Lonsdale), and 32% (195,200 sq. ft.) will be generated within the Seymour trade area (includes all commercial areas in the Seymour area).

TABLE 3.8

NORTH SHORE and DISTRICT OF NORTH VANCOUVER COMMERCIAL LAND DEMAND 1996 - 2021

TYPE OF USE	Commercial Floor Area (sq.ft.) 1996-2011	2012-2021	Annual Absorption	Estimated Employment Generated
TOTAL NORTH SHORE (1)				
Total Retail/Service	1,568,308	1,227,272	111,823	7,987
Total Hotel	84,825	72,475	6,292 or 19 rooms	157
DISTRICT OF NORTH VANCOUVER				
DNV RETAIL/SERVICE:				
DNV Community Commercial: Edgemont	27,691	31,041	2,349	168
Lynn Valley	188,324	164,102	14,097	1,007
East Seymour	112,578	84,093	7,867	562
Marine Drive Corridor & First Nations Lands	442,378	347,583	31,598	2,257
DNV OFFICE (2): Office in Business Parks	150,000	100,000	10,000	1,000
Office in Light Industrial Buildings	131,250	87,500	8,750	875
Office in Existing Commercial Areas	93,750	62,500	6,250	625
DNV HOTEL (3)	68,708	58,705	5,097 or 15 rooms	103

Source: Thomas Consultants Inc., Urban Systems, November 1996.

Notes:

(1) *"Total North Shore" includes all District of North Vancouver commercial areas, as well as other North Shore commercial areas.*

(2) *Assumes all new office additions in business parks, light industrial buildings and existing commercial areas will occur within the District of North Vancouver (where there is vacant land available), while new "town centre" office additions (not shown) will occur within the City of North Vancouver.*

(3) *Hotel demand is estimated for the entire North Shore. Historic trends identify that the District of North Vancouver's share of this demand would be 81%.*

Forecasted Office Demand

This study assumes the majority of new North Shore Town Centre office additions will occur within the City of North Vancouver (Lower Lonsdale area) while the majority of new North Shore office additions in business parks, light industrial buildings and other office in commercial areas will occur within the District of North Vancouver (due to the availability of industrial land in the District). **Table 3.8** identifies the total demand for new office space in business parks, light industrial buildings and commercial areas forecasted for the District of North Vancouver. This amount ranges between 349,094 to 1,073,540 sq.ft. or 11,636 to 35,784 sq.ft. on an annual basis between 1991 to 2021. For the purposes of land use calculations, we have assumed **an average annual absorption of 25,000 sq. ft. between 1996 and 2021.** It is important to note that these figures do not include the majority of service-related office space that typically located in shopping centres or retail street environments (including banks, insurance and travel agencies, etc.). These types of space are included in the previous retail/service demand forecast.

It is estimated that the demand for new office additions in business parks, light industrial buildings and commercial areas will be allocated as follows over the 25 year horizon:

- 40% (250,000 sq.ft.) will be captured by new business park development;
- 35% (218,750 sq.ft.) will be captured by new or intensification of light industrial development; and,
- 25% (156,250 sq.ft.) will be captured by intensification of existing commercial areas.

Forecasted Hotel/Motel Demand

- There is a present available demand for approximately 100 rooms which increases to 585 rooms by the year 2021. This demand is illustrated in **Table 3.9**. Based on the District's historical share of hotel and accommodation demand, there is
- These forecasts further assume that a full service hotel complete with conference facilities and budget oriented or all suite hotels would assist in satisfying this demand.
- If a casino hotel is developed in the First Nations lands, then these estimates would be conservative.

Summary of Demand for Commercial Floor Area

Space requirements to accommodate commercial land use demand over the 25 year horizon within the District of North Vancouver are forecast in **Table 3.8** and summarized as follows at the top of page 46:

TABLE 3.9

SUPPLY AND DEMAND PROJECTIONS, NORTH SHORE B.C.
COMPETITIVE PROPERTIES

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
NUMBER OF ROOMS (at year end)	655	655	655	655	655	655	655	655	655	655	655	655	655
TOTAL AVAILABLE ROOM NIGHTS (000's)	239	239	239	239	239	239	239	239	239	239	239	239	239
TOTAL ROOM NIGHTS DEMANDED (000's)	179	183	187	190	194	198	202	206	210	214	219	223	227
DEMAND GROWTH (%)	N/A	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
AREA-WIDE OCCUPANCY (%)	75.0%	76.5%	78.0%	79.6%	81.2%	82.8%	84.5%	86.2%	87.9%	89.6%	91.4%	93.3%	95.1%
(OVER)/SHORT ROOMS AT 65% PRO-RATA	101	116	131	147	163	179	196	213	231	248	200	218	235

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
NUMBER OF ROOMS (at year end)	655	655	655	655	655	655	655	655	655	655	655	655	655
TOTAL AVAILABLE ROOM NIGHTS (000's)	239	239	239	239	239	239	239	239	239	239	239	239	239
TOTAL ROOM NIGHTS DEMANDED (000's)	232	237	241	246	251	256	261	266	272	277	283	288	294
DEMAND GROWTH (%)	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
AREA-WIDE OCCUPANCY (%)	97.0%	99.0%	100.9%	103.0%	105.0%	107.1%	109.3%	111.4%	113.7%	115.9%	118.3%	120.6%	123.0%
(OVER)/SHORT ROOMS AT 65% PRO-RATA	253	271	362	383	403	424	446	468	490	513	537	561	585

Source: Thomas Consultants Inc., November 1996.

Office (other than Town Centre office uses)	**625,000 sq.ft.**
Community/Local Commercial (includes Edgemont Village, Delbrook Plaza, Lynn Valley Centre, Lynnmour/Main Street, and all commercial areas in Seymour area)	**607,829 sq.ft.**
Hotel	**157,300 sq.ft.** **(475 rooms)**

3.2.4 Adequacy of Commercial Land Supply

The amount of commercial land that is typically necessary for various types of retail, service and office uses is primarily dependent upon the efficiency of use. This efficiency factor is further based on zoning regulations such as floor area, ratio, building height, site coverage, setback requirements, etc.

For the purpose of calculations, it is assumed that average densities will continue to be in the range of a Floor Area Ration (FAR) of 0.35 to 0.45 for retail/service and service-related office use, 0.60 for business park and at least 2.0 to 3.0 for hotel and motel use. In the 15 to 25 year time frame, there will likely be an opportunity to increase the average retail/service and service-related office to the 1.0 to 1.5 FAR level through the potential infill and redevelopment with mixed residential/commercial developments, especially in the context of the Marine Drive Corridor, along the north side of Main Street and within the parking areas of Lynn Valley Centre. To a lesser degree, this type of redevelopment will also likely occur in portions of Edgemont Village.

Other than the proposed Windridge Centre, a small amount of commercial land at Maplewood Plaza, the majority of the District's commercially designated or zoned lands are already developed with commercial uses (at the average densities noted above). Except for these two areas, new commercial or mixed residential/commercial development will have to occur through redevelopment of existing commercial properties, and infilling of parking areas, with higher density development (which utilizes parking structures or garages either at-grade, below or above grade to accommodate off-street parking, as is seen occurring in along Broadway and Fourth Avenues in Vancouver and along No. 3 Road in Richmond).

3.2.5 Impacts Of Potential New Commercial Development

Due to the moderate amount of demand for the Edgemont, Lynn Valley and Seymour commercial areas, there will likely be some impacts to adjacent lands within these areas. Increasing densification of many of the neighbourhood core areas will be required to accommodate the forecasted demand while providing minimum impact.

The majority of the larger scale retail (non-neighbourhood) and office/business park demand is likely to be filled by development of the four major available land parcels on the North Shore, including:

(1) 30 gross acres (25 net acre) Canadian Occidental Petroleum (CXY Chemical) lands (north of the CNR) in Seymour;
(2) 50 gross acre (20 net acre) Maplewood Business Park land in west Seymour;
(3) 37 gross acre (25 net acre) Port of Vancouver lands in Maplewood, in west Seymour;
(4) 67 gross acre Fullerton Fill lands, including buffer lands, in the City of North Van.

In addition to these lands, there is a significant amount of land available on the Squamish Nation Band Indian Reserves. (At the time of this study, the Indian Bands were not willing to provide comment on their future development initiatives. District staff have indicated there is a proposal to develop a 114,000 sq.ft. Real Canadian Superstore on native lands at the northern bridgehead of the Second Narrows Bridge.)

3.2.6 Key Commercial Market Issues

The significant factors that have historically limited commercial development on the North Shore are:

- Geographical constraints for accessibility to the rest of the region.
- Traffic congestion and parking.
- High land values.
- Scarcity of land parcels for large developments.
- Limited local examples of existing mixed residential/commercial development.
- Establishing a protocol for development on First Nation Lands.
- Existing low developed density of commercial development.
- Anti-development public views.
- Awareness of local residents as to value of economic development.
- Zoning policies including the maximum permitted density of uses in some commercial zones.
- Limited public transit services.

3.3 Implications for the District of North Vancouver

Based on the regional and local commercial market analysis for the North Shore and specifically for the District of North Vancouver, this subsection summarizes the implications of the market findings for the District of North Vancouver.

3.3.1 Implications for Commercial Areas

- Consumers desire for value and popularity of megastores will continually draw people away from the North Shore and outside the District of North Vancouver if some of these formats cannot be accommodated.
- Megastores, and to a lesser extent, big box stores will likely not be appropriate for the Maplewood and Lynnmour areas due to their limited highway visibility and presence of more attractive alternatives (i.e. Native lands, Fullerton site).
- Although factory outlet malls will not be viable on the North Shore due to sensitivity of most tenants being situated in close proximity to regional and community malls situated on the North Shore, factory outlet stores situated within industrial/business park areas and in some cases in commercial neighbourhoods within the District of North Vancouver hold some potential.
- There will be an increase in mixed use commercial/residential development particularly along main street corridors due to high land costs, scarcity of land and consumers embracing main street environments.
- Due to their captive markets, major tourist attractions (including Capilano Suspension Bridge, Grouse Mountain, Mt. Seymour and Deep Cove) within the District of North Vancouver have the opportunity to expand their commercial facilities subject to the availability of land.
- Densification of motel/hotel uses particularly in the Capilano triangle area (Capilano Road/Marine Drive/Garden Avenue) and Western Seymour area near the Trans Canada Highway can occur if building heights are expanded to allow this to become economically viable.
- The availability of business park and industrial park land is expected to influence the distribution of office space in the District of North Vancouver. This is particularly relevant for the Maplewood, Lynnmour and to a lesser extent Pemberton/Welch areas within the District.
- As the type of commercial uses on the industrial lands will be of a very limited ancillary nature primarily servicing industrial land users, there will be very minimal demand for commercial uses to occupy sites in existing industrial areas.
- Similarly, the limited demand for new commercial development to occupy sites in industrial areas will have little impact on existing commercial areas.

3.3.2 Implications for Industrial Areas

- The majority of office development that is expected to take place in the short to medium term in the District of North Vancouver is expected to be business park type.
- Due to the availability of land and expected demand, the District of North Vancouver is expected to increase its market share of business park development in the Greater Vancouver regional market.
- Zoning for business parks is increasingly being designed to create planned employment centres that are not only places to work, but also feature complementary commercial retail and recreation services, including hotels, health clubs, restaurants, printing/copying services, increased open space and amenities, and public transit services, all to support the needs of local employees.[18] The District should consider such policies and regulations to remain competitive in the development of business parks.
- As part of the above trend, the variety of permitted uses is being expanded to account for two inter-related trends: (1) the changing nature of industrial business that require offices, manufacturing, assembly, storage and computer facilities all under one roof; and (2) permitting the additions of business and employee services in these areas. These trends have implications to the Lynnmour, Maplewood and Pemberton/Welch areas within the District of North Vancouver.
- A review of zoning regulations for business parks should consider:
  - increased density and site coverage;
  - broader mix land uses, such as commercial, office, and residential buildings with manufacturing, R & D, and warehouse facilities in the same area; and
  - flexibility in parcel sizes and the proportion of a site to be used for industrial or commercial purposes, in order to accommodate a variety of users in development and subdivision planning.
- Although permitted uses in business parks often include retail, residential, hotel and commercial services, limited retail services will be primarily warranted for the Pemberton and Maplewood industrial areas.

[18] "Planned Employment Centres": a well designed business park type environment that not only is a place to work, but also features complementary commercial retail and recreation services, including hotels, health clubs, restaurants, printing/copying and support services, often has increased open space and amenities, and is transit friendly, all to support the needs of local employees.

- Land uses typically prohibited in business parks include heavy industry and noxious uses as well as other uses incompatible with the surrounding community. These include trailer parks, liquor store, gasoline stations and certain retail goods (hard/comparison goods) rather than those that provide daily convenience/personal and business services (i.e. photocopy, business supplies, convenience/drug stores, hair salons, restaurants, fast food, etc.).
- As the type of commercial uses on the industrial lands will be of a very limited complementary and ancillary nature primarily servicing industrial land users, there will be very minimal demand for commercial uses to occupy sites in existing industrial areas.

4. Industrial Market Trends and Analysis

This chapter of the study examines economy, employment and industrial development trends, issues and opportunities on the North Shore and in the District of North Vancouver. Detailed analyses of regional, North Shore and District of North Vancouver economy, employment and industrial development trends have been undertaken and are contained in Appendix C, *Background Report: Market Trends and Analysis*. The following is a summary of the findings and implications of these analyses for the District of North Vancouver industrial market.

4.1 Regional Industrial Market Trends

Whereas the demand for commercial retail uses is determined by considering demand from surrounding or local "trade area population", the demand for industrial uses is more often shaped by regional market forces. The following summarizes the impact of major regional industrial market trends for the District of North Vancouver industrial market.

Trade

1. Growth of Pacific Rim and world wide trade with Canada will continue to grow and require continuing investment in the port transshipment (see definition in Glossary) sector, requiring additional buildings, storage facilities, equipment and transportation facilities in Burrard Inlet to accommodate their growth. Much of this investment will focus on the District of North Vancouver, both in the Lynnmour area (expansion of Lynnmour Terminals) and south of the Pemberton/Welch industrial areas.

Heavy Industry

2. At the same time, many non port related and mostly heavy industrial marine industries (resource based companies, shipbuilding, marine construction and other businesses) will continue to relocate to the Fraser River which offers larger, more affordable sites with less potential conflict with surrounding land uses. The movement of these companies and their continuing search for the most affordable sites to enable them to survive in very competitive industries, will greatly detract from opportunities to create larger industrial parks oriented to the North Shore marine sector.

Shift of Regional Economic Base

3. The shift in the region's economic base from resource based exports and manufacturing to value added manufacturing, knowledge based industries and the service sector will benefit the growth of the District of North Vancouver's industrial sector.

   a) The North Shore's limited population and its peripheral location in the region will focus development on companies servicing international/national markets, the nearby (North Shore, Vancouver and Burnaby) markets.

   b) The impact of these changes on the District of North Vancouver industrial market will be very visible over the next 5 - 10 years, as new industrial parks and multi-tenant light industrial and flex buildings are pursued in both the District of North Vancouver and the City of North Vancouver.

Regional Manufacturing/Warehousing

4. The District of North Vancouver is generally not a suitable location for large warehouse developments, regional trucking/storage companies and manufacturers of more traditional goods such as food products manufacturing, apparel and textile manufacturing, lumber and wood products, wholesale durable goods to name a few. These types of industries either require more central regional locations or larger more affordable sites than are available in the District of North Vancouver and are highly unlikely to consider a North Shore location to be appropriate and competitive.

Structural Changes in Industrial Space

5. The trend towards downsizing industrial space requirements and the integration of industrial business operations (manufacturing, assembly, service and repair, office, warehouse functions) will greatly shift demand for industrial space towards flex space buildings and away from traditional light industrial buildings with their single use (manufacturing or distribution) orientation and low office requirements.

6. The District of North Vancouver has an opportunity to attract more industrial businesses and employment by allowing flex space development (see definition in Glossary) with the high (50% - 100%) office component required by a growing number of industrial businesses.

4.2 District of North Vancouver Industrial Market Trends

The District of North Vancouver's industrial market activity will continue to grow and diversify.

District of North Vancouver's Current Position

1. The District of North Vancouver's current position in the North Shore industrial market is described as follows:

   a) The distribution of North Shore employment by employment sector and municipality is illustrated in **Table 4.1**, North Shore and GVRD Employment Comparisons, 1991. The District of North Vancouver contains the greatest share of industrial employment (manufacturing, construction, transportation, communication, utilities and wholesale trade sectors).

   b) More industrial employment and development is located in the District of North Vancouver than in the City of North Vancouver. The District of North Vancouver's greater industrial employment underlies its larger industrial building inventory which in 1991, was 2,961,000 sq.ft. compared to the City of North Vancouver's inventory of 1,805,000 sq.ft.[19].

   c) **Table 4.2**, Selected Characteristics of North Vancouver Industrial Areas, describes the amount of land, building development (heavy, light, retail, office and total building area) and FAR (floor area ratio) for the Pemberton, Lynnmour and Maplewood industrial areas[20].

   d) During 1992 to mid 1996, over 900,000 sq.ft. of industrial space have been built on the North Shore (an average of 203,000 sq.ft. per annum). Light industrial buildings comprised 487,000 sq.ft. or 53% of total North shore industrial construction. Heavy industrial buildings related to port, marine and rail industries during this period comprised 430,000 sq.ft. or 47% of total building construction.

[19] From Appendix C, Table 5.2, Regional Industrial Building Space, GVRD, 1991.

[20] The 1996 estimate of District of North Vancouver industrial space produced by Urban Systems indicates a total of 4,405,400 sq.ft. of industrial space, 1,444,000 sq.ft. greater than the GVRD's 1991 estimate of industrial space. The difference is attributable to the GVRD's inventory not including all specialty heavy industrial buildings in their 1991 inventory.

Table 4.1

North Shore & GVRD Employment Comparisons, 1991

Employment Sector	North Van District		North Van City		West Vancouver		North Shore		GVRD		North Shore as % of GVRD	
	Number of Employees	%	Number of Employees	%	Number of Employees	%	Number of Employees	%	Number of Employees	%	Number of Employees	%
Primary	285	1.33	130	0.57	135	1.13	550	0.98	22,260	2.55	550	0.98
Manufacturing	2,955	13.79	1,370	6.00	320	2.68	4,645	8.26	96,662	11.09	4,645	8.26
Construction	1,555	7.26	1,315	5.76	785	6.57	3,655	6.50	55,389	6.35	3,655	6.50
TCU (*)	1,920	8.96	2,190	9.60	545	4.56	4,655	8.28	80,541	9.24	4,655	8.28
Wholesale Trade	1,240	5.79	750	3.29	345	2.89	2,335	4.15	51,434	5.90	2,335	4.15
Retail Trade	2,885	13.46	3,285	14.40	1,595	13.34	7,765	13.82	114,062	13.08	7,765	13.82
FIRE (**)	1,235	5.76	2,885	12.65	1,215	10.16	5,335	9.49	66,634	7.64	5,335	9.49
Non Commercial Services	3,005	14.02	4,490	19.68	2,020	16.90	9,515	16.93	137,663	15.79	9,515	16.93
Commercial Services	5,583	26.05	5,235	22.95	4,315	36.09	15,133	26.93	198,325	22.75	15,133	26.93
Government	770	3.59	1,165	5.11	680	5.69	2,615	4.65	48,810	5.60	2,615	4.65
Employed Labour Force	21,433	100.00	22,815	100.00	11,955	100.00	56,203	100.00	871,780	100.00	56,203	100.00

Notes:

(*) TCU = transportation, communication and utilities.

(**) FIRE = finance, insurance and real estate.

Source: The Employed Labour Force by Industry Sector and Place of Work, Metropolitan Vancouver, GVRD, 1995

Table 4.2

Characteristics of Selected North Vancouver District Industrial Areas *(1)

	Industrial Land	Building Use (sq.ft.)				
Industrial Area	**Area (acres)**	**Port/Heavy *(2)**	**Light**	**Retail**	**Office**	**Total**
Pemberton	275	1,034,000	609,000	53,000	308,000	2,004,000
Lynmour	158	207,000	1,066,000	23,000	202,000	1,498,000
Maplewood	316	533,000	318,000	14,400	38,000	903,400
TOTAL	**749**	**1,774,000**	**1,993,000**	**90,400**	**548,000**	**4,405,400**

Source: Urban Systems Ltd.

Notes:

(1) Numbers have been rounded to nearest 1,000 sq. ft.

(2) "Port/Heavy" includes all buildings and structures (e.g. sheds, tanks, etc.) on sites used for port and heavy industrial activities.

e) Approximately 60% (500,000 sq.ft.) of North Shore light industrial building activity building during the past decade has taken place in the City of North Vancouver and 40% (300,000 sq.ft.) in the District of North Vancouver.

f) New industrial business growth in the District of North Vancouver is dominated by small manufacturing businesses.

Regional Real Estate Market Characteristics

2. Real estate market characteristics and conditions have had an adverse impact upon attracting industrial businesses to the District of North Vancouver. Industrial businesses give greatest consideration to price, land availability/suitability, accessibility and travel time/costs in making their location decision. These factors collectively constrain regional industrial businesses' interest in a District of North Vancouver location and account for the small share (3.47%) of regional industrial building construction that has occurred on the North Shore during 1992 to 1996.

Shift of Industrial Development from City to District of North Vancouver

3. While more industrial development has occurred in the City of North Vancouver than the District of North Vancouver over the past 15 years, this situation will reverse past the turn of the century as the CXY Chemical lands and Maplewood Business Park enter the market and position the District of North Vancouver to be a focal point of new industrial development and employment growth on the North Shore past the turn of the century.

Industrial Demand and Supply

4. A demand and supply analysis has been prepared to illustrate the magnitude of demand that can be expected for industrial land in the District of North Vancouver.

a) **Demand for Industrial Land**

i) **Port and Heavy Industrial Uses:** based upon the amount of development that has taken place on the waterfront during 1991 to 1996, and the prospects for continuing construction during the 1990s and beyond, it is expected that 500,000 to 600,000 sq.ft. (50,000 to 60,000 sq.ft. per annum) of heavy industrial building space per decade will be constructed on the North Shore waterfront. This

development will take place on existing waterfront or rail lands plus possible land fills in Burrard Inlet. Approximately two thirds (275,000 to 375,000 sq.ft. per decade or 27,500 to 37,500 sq.ft. per annum) is expected to occur on District of North Vancouver lands - primarily on waterfront and BCR lands south of Pemberton/Welch.

ii) **Non-Waterfront (Upland) Light Industrial Uses:** annual demand for the entire North Shore is expected to increase from 113,000 sq.ft. per annum in early 1990's to 130,000 sq.ft. per annum beyond the turn of the century. This demand is illustrated in **Table 4.3**. Assuming a Floor Area Ratio (FAR) of 0.6 and with 20% of new space being located in serviced existing industrial areas and 80% of new space being located in new industrial areas that will lose 20% of gross site area for roads and parks, the light industrial land demand for the entire North Shore will, on average, be 5 - 6 gross acres (4 to 4.8 net acres) per annum over the 25 year forecast period (equaling a total of 125 - 130 gross acres over this period). Two thirds of annual demand over the next 5+/- years is expected to occur in the City of North Vancouver. Beyond 5 years, this ratio will reverse and two thirds of industrial development will occur on District of North Vancouver lands (assumes that CXY Chemical and Maplewood Business Park enter the market past the turn of the century).

b) **Supply of Industrial Land**

i) There is sufficient land to accommodate the growth of both water dependent industries and upland light industrial businesses on the North Shore.

ii) **Table 4.4**, Potential Supply of North Shore Industrial Lands, illustrates that there are approximately 190 acres of net developable industrial lands to accommodate the growth of the North Shore industrial sector.

iii) This estimate of supply does not include a further possible 150 acres of Squamish Indian Band lands in the District of North Vancouver (40 acres) and the District of West Vancouver (110 acres), nor does it include waterfront and upland sites with the potential to accommodate additional industrial development through more intense use of existing developed lands.

Table 4.3
North Shore Light Industrial Land Demand

Absorption Based Forecast - Light Industrial Space		1991 - 2001	2001 - 2011	2011 - 2021
Annual Building Absorption (sq.ft.)		125,000	130,000	125,000
Ten Year Building Absorption (sq.ft.)		1,250,000	1,300,000	1,250,000
FSR		0.60	0.60	0.60
Net Land Area		47.83	49.74	47.83
Adjust for Roads and Parks		56.79	59.07	56.79
AVERAGE ANNUAL LAND REQUIREMENT (ACRES)		**5.68**	**5.91**	**5.68**
Building Space Per Capita Forecast	**1991**	**2001**	**2011**	**2021**
Population--North Vancouver District	75,155	83,600	93,100	104,000
Population--North Vancouver City	38,436	41,802	45,464	49,446
Total Population	113,591	125,402	138,564	153,446
Per Capita Industrial Space - NVD+NVC	42	52	60	66
NVD Industrial Building Space (sq.ft.)	4,770,822	6,520,904	8,313,840	10,127,436
Ten Year Growth		1,750,082	1,792,936	1,813,596
Less Port and Waterfront		700,000	500,000	500,000
Equals Ten Year Net Light Industrial		1,050,082	1,292,936	1,313,596
FSR		0.60	0.60	0.60
Net Additional Acres Required		40.18	49.47	50.26
Gross Up for Roads+Parks		47.71	58.75	59.68
AVERAGE ANNUAL LAND REQUIREMENT (ACRES)		**4.77**	**5.87**	**5.97**
Employment Based Forecast	**1991**	**2001**	**2011**	**2021**
Total Industrial Employees	15,290	19,100	22,607	26,758
Less Waterfront Employees	1,750	1,933	2,243	2,604
Equals Upland Employees	13,540	17,167	20,364	24,155
Land Requirement Upland Employees(acres)		0.0620	0.0549	0.0485
Total Land Area (acres)	1,015	1,064	1,117	1,173
Additional Acres Required (10 year period)		49.04	52.98	55.57
Gross Up for Roads+Parks (acres)		58.23	62.92	65.99
AVERAGE ANNUAL GROWTH (ACRES)		**5.82**	**6.29**	**6.60**

Other Absorption Indicators

1. **MTR Consultants, Maplewood Business Park Market Analysis:**
   Annual demand for 130,000 to 160,000 sq.ft. of industrial space on the North Shore.
   40% to 45% of demand is for port related.
   Net demand for light industrial space is 80,000 to 90,000 sq.ft. per annum
   Indicates that 15% to 25% of new light industrial space is office space.

2. **Coriolis Consulting, Commercial and Industrial Development Prospects and Issues,**
   1988 Study: 30,000 to 70,000 sq.ft. of industrial demand (all light industrial, minimal heavy industrial).

3. Actual port and heavy absorption from 1992 to mid 1996 = 450,000 or 100,000 sq.ft. per year.

4. Actual light industrial absorption from 1992 to mid 1996 = 511,000 sq.ft. or 113,000 sq.ft. per year.

Table 4.4
Potential Supply (acres) of Currently Vacant or Developable North Shore Industrial Lands (1,2)

Type of Land	District(3)	City(4)	Total
Smaller, Vacant and Serviced Sites		9.00	9.00
Pemberton/Welch	9.40		9.40
Lynnmour	3.70		3.70
Maplewood (excluding large sites below)	0.80		0.80
Larger Sites with Industrial Potential			
CXY Chemical Development Site	25.00		25.00
Maplewood Business Park	26.00		26.00
Dollarton Shipyard Site	5.17		5.17
VPC, estimated net area north of Dollarton	20.00		20.00
Lower Lonsdale Buffer		2.00	2.00
Fullerton, upland (estimated net area)		46.00	46.00
Fullerton, waterlot fill		30.00	30.00
Tolko Industries	15.00		15.00
Total Potential Industrial Lands	**105.07**	**87.00**	**192.07**
(% Distribution)	**54.70 %**	**45.30 %**	**100.00 %**

Notes:

(1) Supply is estimated "net" development areas.

(2) Does not include First Nations Lands (possible 150+ acres) plus potential to achieve increased density of development on underutilized waterfront and upland sites.

(3) Source: Urban Systems Ltd. Data Base, District of North Vancouver

(4) Source: City of North Vancouver

iv) The District of North Vancouver contains 54.5% or 104 acres of the North Shore's supply of industrial lands (net acres). This proportion could be higher if the Fullerton site is developed to feature high amounts of commercial retail uses.

4.3 Key Implications for the District of North Vancouver

Current and expected industrial market trends will have the following impacts for the growth of employment and industrial development in the District of North Vancouver:

1. There will be continuing and growing opportunities for the District of North Vancouver to increase industrial employment. While port terminal and support industries will continue to grow, the greatest increase in District of North Vancouver employment will be derived from the light industrial sector, most particularly from smaller manufacturing, service and distribution companies.
   Examples of the types of industries that will be attracted to the District of North Vancouver include:

   - Marine sector engineering, equipment manufacturing, repair and service.
   - Electric and electronic engineering and equipment manufacture.
   - Telecommunications.
   - Providers of services and supplies to the North Shore film industry.
   - Machinery manufacturing, service and repair.
   - Fabricated metal products.
   - Instruments and related equipment.
   - Computers and software development, service and repair.
   - Manufacture/repair of resource industry equipment.
   - Materials handling and transportation equipment manufacture, service and repair.

2. The key for attracting new industrial businesses to the District of North Vancouver is new development sites, not the development of underutilized or redevelopment sites.

   a) Generally speaking, there is more financial incentive (profit potential) for the development industry to pursue industrial development on vacant industrial lands than on underutilized or redevelopment sites.

b) Industrial development created on new (vacant) industrial sites can typically offer lower priced land and building space, and is more competitive in the regional industrial market.

3. The CXY Chemical site and Maplewood Business Park are the most significant of these new development sites and could create attractive planned industrial projects, offering a wide range of site sizes and competitive prices to attract regional oriented industrial businesses.

   a) Development of the CXY Chemical and Maplewood Business Park sites will attract more regional oriented businesses, increasing the demand for industrial land in the District of North Vancouver to an average of 3 - 4 gross acres (2.4 - 3.2 net acres) per year, from the 5 to 25 year time frame (therefore capturing two-thirds of the North Shore light industrial demand).

   b) Development of the CXY Chemical and Maplewood Business Park sites will, past the turn of the century, make the Maplewood industrial area the focal point of future industrial development on the North Shore.

4. In order to maximize its market share of a very small annual demand for North Shore industrial land/buildings, the District of North Vancouver should ensure that its zoning bylaw encourages the widest acceptable range of industrial (traditional light industrial as well as business park users) plus non-industrial uses (e.g. big box retail, recreational). To do otherwise, especially at Maplewood Business Park, will shift market demand to City of North Vancouver, greatly lengthen the time required to market land and adversely affect the economic viability of Maplewood Business Park.

5. There is much less potential to attract industrial businesses to upland underutilized and/or redevelopment sites than to new industrial developments on vacant sites.

   a) High land costs, difficulty of acquiring development parcels of adequate size, parking requirements for small sites and low proportions of permitted office space impair the economic viability of development on many of these sites.

   b) The limited development that does occur on these sites will be owner occupied or small multi-tenant strata buildings.

   c) The development of the CXY Chemical site, Maplewood Business Park and the Fullerton site will divert interest from pursuing industrial development on underutilized and/or redevelopment sites in areas such as Pemberton/Welch and Lynnmour.

6. Land use needs for water dependent industries (port, port support and other marine uses) in the District of North Vancouver will evolve as follows:

   a) The increased demand for port terminal and support industries will be met primarily from more intensive use of their existing lands

   b) The demand from port support industries for land adjacent to or near port terminals will be minimal as these industries are largely in place, can accommodate growth on existing sites or often can locate away from the water on more affordable industrial lands.

   c) The demand for land and buildings from other parts of the marine sector (i.e., non port terminal uses) will continue to change. Larger and traditional marine industries will continue to leave the North Shore, while smaller manufacturing, service and repair marine businesses will locate in existing (often older and more affordable) buildings, on small sites or in multi-tenant buildings in new industrial parks, not requiring waterfront access.

   d) The limited size of demand from water dependent industries and their frequent inability to pay market rates for land and buildings greatly lessens economic incentives for private developers to create a marine oriented industrial park. The most appropriate site to consider for water dependent uses in the District of North Vancouver is the Tolko Industries site in the Maplewood industrial area.

7. Development lands in the City of North Vancouver will remain attractive to industrial businesses and offer serious competition to District of North Vancouver industrial lands. The Fullerton site, located in the City of North Vancouver is being considered for a mix of business park, commercial retail and marine uses and demonstrate the developer's (Greystone Development) awareness of the need for flexibility to pursue mixed uses to create a successful industrial development.

8. District of North Vancouver industrial neighborhoods will experience the following changes over the next two decades:

   a) **Waterfront (Port & Heavy Industrial) Areas:**
      - The heavy industrial character of industrial areas between First and Second Narrows Bridges will increase, primarily as a result of terminal expansions. Development will be facilitated primarily from more intensive use of existing lands. Heavy industrial development on adjacent lands will continue to decline, being replaced by light industrial use.

- East of Second Narrows Bridge will be characterized by very limited growth of water dependent industries, possible long term decline of major water dependent industries (relocating away from the North Shore) and the movement of non water dependent industries into waterfront areas.

b) **Pemberton/Welch, Non Waterfront Area:**
- following the development of the few remaining vacant sites in the east of Lloyd Avenue, the area will remain largely as it is, with a mixture of light industrial and service commercial (auto repair) uses.
- more retail development with a focus on low rent retail activities (auto parts and services and retail services for employees in the area) will emerge in the Pemberton C8 zone.
- redevelopment of existing industrial sites will be minimal, due to the high costs and difficulty of assembling sites of sufficient size.
- development interest in this area will slow over the next decade as a result of new industrial lands that will be available at the nearby Fullerton site.
- minimal industrial employment growth will emerge in this area.

c) **Lynnmour, Non Waterfront Area:**
- limited redevelopment of underutilized sites will occur over the next decade, due to high land costs, difficulties of acquiring sites and competition from new industrial park sites (e.g. CXY Chemical and Maplewood Business Park site)
- only significant industrial development likely to occur in this area could be through redevelopment of a portion (likely the northern portion) of the Venice Bakery site for business park uses and mixed residential/retail commercial uses (on the southern portions fronting Main Street).

d) **Maplewood, Non Waterfront Area:**
- will experience major changes in the character of the area from development of the CXY Chemical and Maplewood Business Park sites
- the character of the Maplewood industrial area will be greatly improved by these two new developments which will become the focal point of new employment growth in the District of North Vancouver.

9. There is more than a sufficient industrial land supply in the District of North Vancouver to permit the Dollarton Shipyard site and Vancouver Port Corporation's Dollarton Highway site to be considered for non-industrial uses:

a) **Dollarton Shipyard (Cates) Site:**

- the site's small size, isolated location, potential for conflict of industrial versus nearby residential uses, limited demand from traditional marine industries and the better suitability of sites such as the Fullerton and Versatile sites for multi-tenant marine uses gives this site limited appeal for marine industrial redevelopment.
- marine uses are more appropriately suited to the Tolko Industries site than the Dollarton (Cates) Shipyard site.
- considering the potential availability of the Tolko site for marine uses and the much greater conflict between residential and industrial uses at the Dollarton Shipyard (Cates) site, from a market perspective there is minimal market potential and financial incentives to pursue industrial development (i.e. intesified heavy industry, light industry or business park development) of this site.

b) **Port of Vancouver Development Site (north of the Dollarton Highway):**

- the demand for light industrial development at this site will not emerge until the completion of both the CXY Chemical and Maplewood Business Park sites, i.e., in 15+ years.
- given the adequacy of long term supplies of underutilized port and heavy industrial land which could be intensified within the District of North Vancouver, it is felt that this site could be considered for non-industrial use.

4.4 Identification of Areas with Potential for Development, Redevelopment or Intensification

The following summarizes areas with potential for development, redevelopment or intensification of industrial lands that could occur in the District of North Vancouver:

1. **Waterfront Industrial Areas:**

- port terminal, heavy industry and major support industries (rail and shipbuilding/repair/service) growth will be accommodated through the intensification of development on existing waterfront industrial lands.

2. **Pemberton/Welch Non-Waterfront (Upland) Industrial Area:**
   - after remaining undeveloped lands in the MacKay Avenue and Lloyd Avenue areas (including Churchill Avenue) are developed, there will be very limited potential to accommodate new light industrial development through either redevelopment or more intense use of under-utilized industrial lands.
   - the potential for redevelopment and intensification of land use will increase after the Fullerton site and large under-utilized sites in the City of North Vancouver's central industrial area are developed (i.e., in 10+ years).

3. **Lynnmour Non-Waterfront (Upland) Industrial Area:**
   - area has limited potential for redevelopment over next 5-10 years due to high land use and availability of competitive industrial sites as CXY Chemical and Maplewood Business Park.
   - the potential for redevelopment of Lynnmour industrial lands will increase beyond 11 - 15 years as the supply of developable industrial lands in the District of North Vancouver decreases.

4. **Maplewood Non-Waterfront (Upland) Industrial Area:**
   - new development in this area will result from more intense use of essentially vacant and under-utilized CXY Chemical and Maplewood Business Park lands.
   - similarly, there is an opportunity to redevelop the Tolko Industries site to accommodate light industrial and/or marine (heavy and light) industrial uses.

5. Home Based Business Trends and Analysis

Home based businesses are an integral part of the North Shore economy providing jobs for 7.7% of the North Shore's employed labour force and accounting for 11% of North Shore employment.

The following describes forces underlying the growth of the home based sector, the extent of home based businesses throughout the region and North Shore and the impacts of these businesses on the District of North Vancouver.

5.1 Self Employment and Home Based Business

The following trends and characteristics summarize the rise of self employment and home based businesses (characteristics are further illustrated in **Table 5.1**):

1. The growth of home based businesses is a national phenomenon evolving from the trend towards self-employment.

2. Self employment accounts for 14.9% of Canadian employment, 16.7% of BC employment and 19.1% of North Shore employment. In 1991, 251,000 persons in BC were self employed. During 1981 - 1991, 85% of new jobs in BC were created by small business[21].

3. The underlying causes of the increase in self-employment and home based business include:

    a) The shift from a manufacturing to a service economy, high unemployment, continuing specialization of employment, and corporate restructuring (resulting in substantial employee lay-offs) from the drive to increase competitiveness.

    b) The continuing long term decline of full term employment and recognition of the role of self-employment and part time work as an alternative to full time employment.

[21] Source: North Shore Canada Employment Centre.

Table 5.1
Characteristics of At Home Employment, GVRD Cities and Municipalities, 1991

		Employed Labour Force (1)			Actual Employment (2)	
	Work at Home	Total # of People	% Working at Home		Total # of People	% Home of Actual Empl.
Burnaby	4,165	81,560	5.11 %		93,495	4.45 %
Coquitlam	2,685	43,920	6.11 %		25,925	10.36 %
Delta	3,045	47,060	6.47 %		29,080	10.47 %
Langley City	570	9,215	6.19 %	Both	34,690	1.64 %
Langley District	3,870	32,975	11.74 %	Langleys		
New Westminster	1,105	22,840	4.84 %		26,985	4.09 %
North Vancouver City	1,380	21,410	6.45 %		22,800	6.05 %
North Vancouver District	3,845	41,285	9.31 %		21,435	17.94 %
Port Coquitlam	1,085	19,110	5.68 %		13,045	8.32 %
Port Moody	670	9,960	6.73 %		5,455	12.28 %
Richmond	4,415	66,470	6.64 %		85,695	5.15 %
Surrey	8,725	114,750	7.60 %		77,360	11.28 %
Vancouver	16,040	241,415	6.64 %		321,450	4.99 %
West Vancouver	3,000	19,500	15.38 %		11,950	25.10 %
	54,600	771,470	7.08 %		769,365	7.10 %

Source: Changes in Journey to Work Patterns in Metropolitan Vancouver: 1971 to 1991, Strategic Planing Department, GVRD, 1994

Notes:

(1) Employed Labour Force = the number of residents of a city/municipality who are employed in that or other cities/municipalities.

(2) Actual Employment = the number of "jobs" in a city/municipality. These jobs are held by the employed labour force of that city and other cities/municipalities throughout the GVRD.

c) The impact of the electronic age and technological advances in communications which are making more home occupations viable and permitting more businesses and professionals to work at home.

4. Self-employment and home based businesses will continue to increase over the next decade and will be recognized as one of the principal generators of new jobs for the Canadian economy.

5.2 Regional Home Business Trends

Home based businesses provide a substantial amount of employment throughout the region.

1. The extent of home based business throughout the region is illustrated in **Table 5.1**, Characteristics of Home Employment, GVRD, 1991.

   a) Home based businesses provide employment for between 4.84% to 15.4% of labour forces with GVRD municipalities, an average of 7.1% for the GVRD's major cities and municipalities.

   b) Home based businesses account for between 1.6% to 25% of actual employment within GVRD municipalities, an average of 7.1% for the GVRD's major cities and municipalities.

2. There are three main groups of home based businesses[22]:

   a) The most common types of home based businesses are offices, general building and trucking contractors, contractors, accounting services, professional services, secretarial services and consultants.

   b) The second most common forms of home based businesses are day cares, manufacturers' distributor agents, wholesale dealers and import/exporters.

   c) The next most common form of home based businesses are clothing manufacturers, hairdressers, janitor services, small group education, arts and crafts.

[22] Home Based Businesses in Greater Vancouver Regional District: Their Impact On Municipalities, Penny Gurstein, School of Community and Regional Planning, UBC, 1993.

3. Municipal concerns regarding home based businesses include[23]:

   a) Adverse impact on adjacent homes.

   b) Unfair competition with businesses in established commercial areas.

   c) Public safety, i.e., increase in noise, lack of security from people entering multiple family buildings, and hours of operation.

   d) Loss of business license revenues from unlicensed businesses.

4. The advantages of home based businesses are numerous, and when these businesses are properly regulated, it is felt the advantages far outweigh their disadvantages. Principal advantages of home based businesses include:

   a) They provide an avenue for small businesses to incubate and test the market before having to make large financial commitments.

   b) They provide a convenient outlet for operating on a part time basis.

   c) They allow for lower operating costs and allow small businesses to build, gain momentum and move into traditional commercial areas .

   d) They lessen commuting and traffic problems associated with commuting during peak traditional travel periods.

   e) They are substantial generators of income and have positive impacts on their local economies.

   f) Home based businesses are one tool for municipal governments to pursue in achieving goals of "complete community" articulated in the GVRD's Livable Region Strategic Plan.

[23] Ibid.

5.3 Home Based Businesses in the District of North Vancouver

Implications of home based businesses for the District of North Vancouver are summarized as follows:

1. There are a total of 2,227 licensed home based businesses on the North Shore[24] with 1,143 located in the District of North Vancouver. Assuming that 20%[25] of home based businesses are not licensed, then the actual total of home based businesses could be as high as 2,800 businesses and District of North Vancouver home-based businesses as high as 1,430 businesses.

2. Current District of North Vancouver zoning regulations governing home based businesses include:

   a) The residential character of homes and neighborhoods in which home based businesses are located must be maintained.

   b) No noise disturbance, excessive traffic or air pollution is allowed.

   c) Minimal signage is allowed: name plates not more than one square foot in size.

   d) The occupation shall be conducted by a resident of the dwelling unit, and a total or not more than two persons shall be engaged in the occupation on the premises.

   e) No commodity shall be sold on the premises except that which is made on the premises.

3. The number and type of licensed home based businesses in the District of North Vancouver is illustrated in **Table 5.2**, Licensed Home Based Businesses, District of North Vancouver, 1996. The majority (68%) of these businesses are "service" related and 24% are contractors.

[24] North Vancouver District: 1,143, North Vancouver City: 384, West Vancouver: 700.

[25] Penny Gurstein of the School of Community and Regional Planning, UBC, in a report "Home Based Businesses in the GVRD: Their Impact on Municipalities, 1993, that as much as 20% of home-based businesses are not licensed.

Table 5.2
Licensed Home Based Businesses, District of North Vancouver, 1996

	#	%
Property Rental/Admin	37	3.24 %
Contractors	271	23.71 %
General(1)	205	17.94 %
Miscellaneous	14	1.22 %
Professional Service(2)	57	4.99 %
Services(3)	514	44.97 %
Shops/Stores	27	2.36 %
Unclassified	18	1.57 %
	1,143	100.00 %

Notes:

(1) General includes uses such as child care, appliance repair, manufacturing, homecrafts, janitorial

(2) Professional services includes uses such as architects, engineers, lawyers, accountants.

(3) Services includes uses such as manufacturers agents, commercial artists, photographer, consultants, computer consultants and services.

Source: District of North Vancouver

4. Home based businesses in the District provide employment to a much higher proportion of the local labour force and account for a considerably higher proportion of municipal employment than most other cities and municipalities throughout the region.

   a) In 1991, home based businesses employed 9.31% of the District of North Vancouver's labour force and accounted for almost 18% of District of North Vancouver employment.

   b) Only the Township of Langley (11.74%) and the District of West Vancouver (15.38%) surpass the District of North Vancouver in terms of the proportion of the local labour force employed in home based businesses.

   c) Only the District of West Vancouver (25.1%) surpasses the District in terms of the proportion of employment within the municipality comprised by home based businesses.

5. The number of home based businesses in the District of North Vancouver continues to grow. During 1993 to 1996, the number of home based industries grew by 93, 107, 154 and 166 businesses respectively([26]). Home based industries are now growing at approximately 15% per annum.

6. The income generated by home based businesses on the North Shore is substantial:

   a) North Shore home based businesses generate an estimated $112 million of annual income.

   b) District of North Vancouver businesses are estimated to produce $56 million or half of this amount.

[26] Assuming an average of 2 employees per business, home based businesses provided additional employment for an additional 1,040 persons in the District over this period.

7. Home based businesses do not have adverse impacts on District of North Vancouver and North Shore office and commercial retail markets:

a) The impact of home based business on the North Shore office market is illustrated in **Table 5.3**, Impact of Home Based Business on the North Shore Economy. This analysis identifies the amount of "lost" commercial office space demand that could be associated with home based industries. These impacts are based on the following assumptions:

i) Total home based employment is based upon adjusting licensed home based businesses for 20% under-reporting and an average size of two employees per business.
ii) Only 50% of total home based businesses would be suitable candidates for locating in commercial office space (reflects type of business).
iii) Only 15% to 25% of these potential candidates for commercial office space would ever consider locating in commercial office space (primarily reflecting ability and willingness to pay).

Based on these assumptions, total office demand potentially "lost" from the North Shore's commercial office market could range from 51,000 to 85,000 sq.ft. or only 4.5% to 7.4% of total North shore office inventory of 1,143,000 sq.ft. This is considered to be a minimal impact on the local office market.

b) Similarly, home based retail businesses have an almost negligible impact upon District retail businesses.

There are only 27 home based businesses classified as "shops/stores" in the District and each is allowed to sell only goods that are made on the premises. Most of these businesses are very small and craft oriented therefore posing little competitive threat to retailers in established commercial retail areas. These home based retail businesses have little opportunity and ability to attract retail shoppers from established commercial areas. Home based retail businesses are small, specialty "niche" operations that not only create employment that could not be supported in established commercial areas (these businesses typically cannot support commercial rental rates), but also add to the diversity and richness of District retail businesses.

Table 5.3
Impact of Licensed Home Based Business on North Shore Economy

Home Based Employment	District of North Vancouver	City of North Vancouver	District of West Vancouver	Total North Shore
Home Based Businesses(1)	1,143	384	700	2,227
Average # Employees(2)	1.95	1.95	1.95	
Total Employees	2,229	749	1,365	4,343
% Under Reported	20	20	20	
Total Employees	2,786	936	1,706	5,428
Impact on North Shore Office Market				
% Suitable for Office	50	50	50	50
Potential for "office" employment	1,393	468	853	2,714
Office sq.ft. per employee	125	125	125	125
Lost commercial office demand @ 15% (3)	26,119 sq. ft.	8,775 sq.ft.	15,996 sq.ft.	50,890 sq.ft.
Lost commercial office demand @ 25% (3)	43,532 sq. ft.	14,625 sq.ft.	26,660 sq.ft.	84,817 sq.ft.
Total North Shore Office Market				1,143,000 sq.ft.
Lost office demand as % North Shore Office Market				
Lost Office @ 15%				4.45 %
Lost Office @ 25%				7.42 %

Income Generated by Home Based Businesses	
North Shore Home Based Employment	5,428
Average Income	40,000 (4)
Total Income Generated	217 million

Notes:

(1) Building Permit Departments, each municipality.

(2) Based on GVRD data for North Shore home based employment.

(3) Assumption by G.P. Rollo & Associates Ltd.

(4) Based upon an analysis of the impact of home based business in B.C. and the District of West Vancouver Bonnie Pyplacy, 1994, with income estimates adjusted to 1996 by G.P. Rollo & Associates Ltd.

5.4 Implications/Prospects of Home Based Business for the District of North Vancouver

Growth prospects for home based businesses on the North Shore are excellent and it is expected that they will have minimal adverse impacts on existing office and retail markets. By maintaining regulations to minimize any adverse impacts to adjacent residences, these businesses will continue to provide substantial employment income, have positive spin-off benefits for other businesses, will reduce commuting and greatly assist the District in meeting its goals to create a more "complete community."

Currently, the District's single family dwelling zones, as well as the RL (Residential Low Rise) and RH (Residential High Rise) zones permit home occupations. Home occupations are defined by Section 405 of the District's Zoning Bylaw. The District should consider permitting home occupations to also occur within the RM (Multiple-Family Residential) zones. As well, the District should consider how Section 405 of the Zoning Bylaw should be amended to address home occupations occurring within multiple-family residential and mixed residential/commercial buildings, in order to establish guidelines and regulations regarding the types of home occupations or home based businesses that are appropriate within different residential contexts.

Given the continuing trend towards downsizing and the shift towards service sector employment, it is expected that the trend towards home based businesses in the District will continue to grow, likely to soon surpass an additional 200 businesses per annum, supporting more than 10% of the District's labour force and between 20% to 25% of District employment. Following the regional trend towards a service sector economy, it is expected that in excess of 50% of these new businesses, and perhaps as much as 60% to 70% of these businesses will be service oriented businesses.

6. Land Use Choices and Industrial/Commercial Development Issues

This chapter provides a synthesis of the commercial and industrial market findings, for areas which have been identified in chapters three and four as having potential for development, redevelopment or intensification. The various findings summarized in this chapter are based on the detailed analyses summarized in chapters three and four and documented in Appendix C, *Background Report: Market Trends and Analysis*. The purpose of this chapter is to:

a) Identify and assess land uses competing for industrial and commercial lands.
b) Summarize and assess effects of industrial and commercial trends on industrial lands, commercial lands and employment.
c) Summarize, assess and note effects of other planning considerations on industrial lands, commercial lands and employment.
d) Identify opportunities and constraints for existing and potential future land uses for industrial lands, and comment on opportunities for commercial lands.
e) Summarize key land use and employment implications.

The above information is summarized by using matrix charts staring with Figure 6.1 (which identifies the various land use choices for industrial and commercial areas), then continuing through to Figure 6.12, to illustrate and begin evaluating each of the potential land use choices. Using this format, the industrial and commercial market findings are merged together and presented in a land use planning context. Outcomes of this chapter form the basis for the land use choices presented in the following Chapter Seven.

Unlike previous chapters, which examined commercial market trends then industrial market trends, in order to establish a context for the cross-over between commercial and industrial uses, this chapter and Chapter 7 first examine the land use choices for the various industrial areas in detail, then look at the commercial areas in a more general sense.

6.1 Competing Land Uses

Figure 6.1 provides a summary of existing and potential land uses for industrial and commercial areas and sub-areas which have been identified (by the market and planning analysis) in chapters 3 and 4 of this report, as having potential for development, redevelopment or intensification. Industrial sub-areas identified in **Figure 6.1** are illustrated in **Figures 6.2 through 6.4.**

From **Figure 6.1**, the following general conclusions are drawn:

Industrial Areas

- Land uses types in the majority of the Lynnmour and Pemberton/Welch industrial areas (both waterfront and non-waterfront) will remain much the same, with little or no pressure from new land uses.

- Portions of the Maplewood industrial area, as well as the Dollarton Shipyard (Cates) industrial site will face pressures from new land uses, including residential.

- In the Maplewood industrial area, where there are supplies of vacant land, future development of these lands will attract new land uses.

- There will be market pressures to redevelop the Dollarton Shipyard (Cates) with new land uses.

Commercial Areas

- In the Marine Drive Corridor, new land uses will place pressure on existing commercial properties to infill or redevelop, especially in the direct vicinity of the intersections of Marine Drive with Pemberton Avenue and with Capilano Road.

- Edgemont Village and Lynn Valley Centre will face pressures to further densify.

- The proposed Windridge commercial area will likely develop with commercial retail and service uses, to serve the local western Seymour area.

Figure 6.1

District of North Vancouver - Economic Development Strategy Study

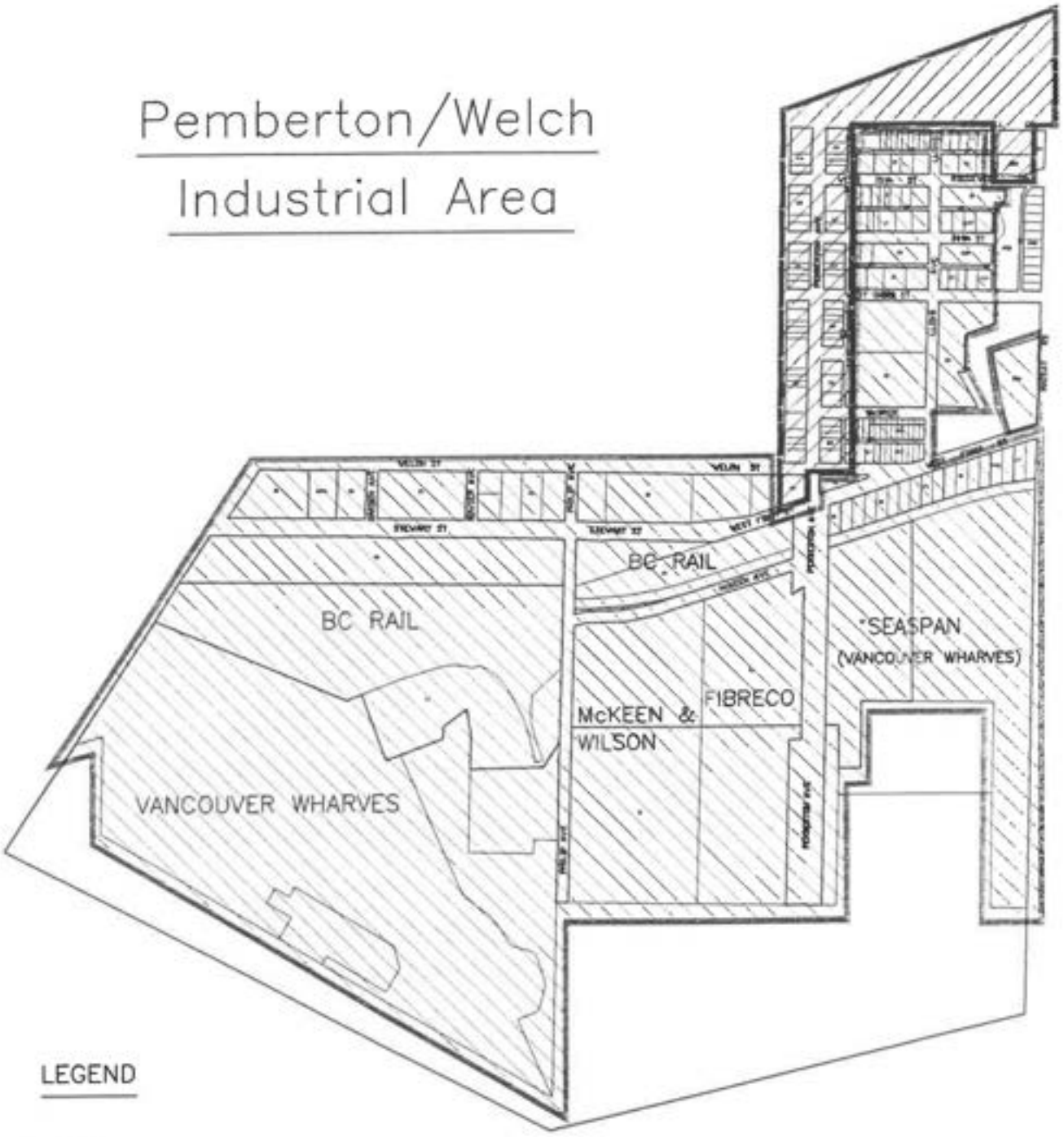
EXISTING & POTENTIAL NEW LAND USES

AREA	LAND USE																
	Commercial					Industrial						Other					
	Retail	Office	Service	Big Box Retail	Hotel/Accommodation	Heavy Industrial	Port/Marine Industrial	Transportation	Outdoor Storage	Light Industrial	Business Park	Residential	Mixed Residential/Commercial	Institutional (Library, School, etc.)	Recreation Facility (Ice Rink, Pool, etc.)	Vacant
INDUSTRIAL AREAS:																
Pemberton/Welch																
Waterfront & Port Related South of BCR						▒	▒	▒	▒							
Non-Waterfront: North of BCR and East of Lloyd Ave.		▒	▒						▒	▒	▒					
Non-Waterfront: West of Lloyd/East of Pemberton Ave.	▒	▒	▒							▒						
Non-Waterfront: Flanking Pemberton Ave.	▒	▒	▒							▒						
Lynnmour (Lower Lynn)																
Waterfront & Port Related						▒	▒	▒	▒							
Non-Waterfront: South of CNR								▒	▒	▒						
Non-Waterfront: North of CNR	▒	▒	▒		▒				▒	▒	•		▒			
Venice Bakery Site										▒	•		•			
Maplewood																
Waterfront & Port Related South of CNR						▒	▒	▒	▒	▒						
Non-Waterfront: North of CNR, west of Amherst Ave.									▒	▒						
CXY Vacant Lands		•		•			•			•	•				•	▒
Proposed Maplewood Business Park		•								•	•	▒				▒
VPC Vacant Lands North of Dollarton Hwy.										•	•	•		▒	•	▒
Tolko Industries Site						▒	▒	▒	▒	•	•				•	▒
Dollarton Shipyard (Cates)						▒	▒	▒	▒	•		•	•			
COMMERCIAL AREAS:																
Marine Drive Corridor																
Marine Dr./Pemberton Ave. Node	▒	▒	▒										•			
Marine Dr./Capilano Rd. Node	▒	•	▒		▒								▒			▒
Marine Dr. Corridor Between Mackay Ave. & Capilano Rd.	▒	▒	▒		▒								•			
Edgemont Village	▒	▒	▒										•	▒		
Lynn Valley																
Lynn Valley Mall	▒	▒	▒										•			
Lynn Valley Centre Area	▒	▒	▒										•	▒		
Maplewood Plaza	▒	•	▒										▒			
Proposed Windridge Centre	•	•	•									▒	•			▒

Existing Land Uses = ▒

Potential New Land Uses = •

Pemberton/Welch Industrial Area



LEGEND

INDUSTRIAL ZONED AREAS

COMMERCIAL ZONED AREAS

FIGURE 1.3

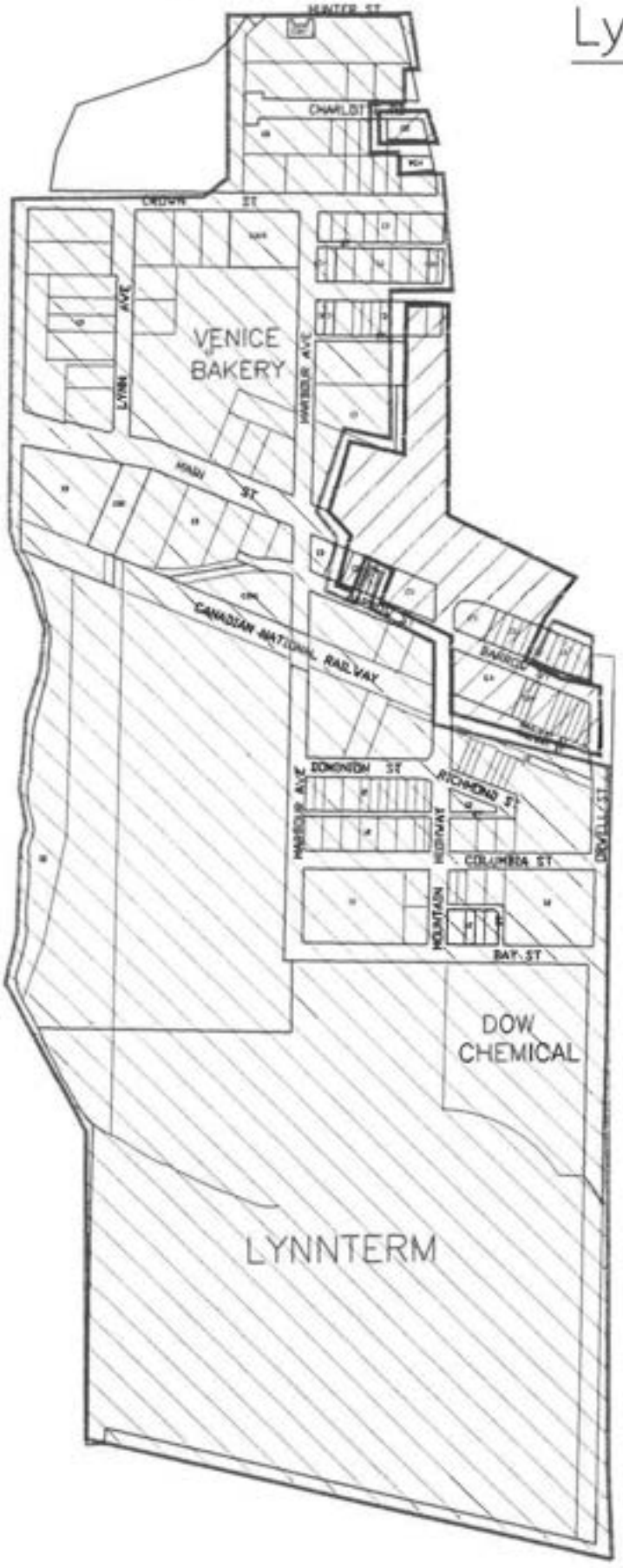
DISTRICT OF NORTH VANCOUVER
ECONOMIC DEVELOPMENT
STRATEGY STUDY

FEBRUARY 1997
SCALE: N.T.S.

BASE SOURCE: DISTRICT OF NORTH VANCOUVER

URBANSYSTEMS

Lynnmour Industrial Area



LEGEND

COMMERCIAL ZONED AREAS

INDUSTRIAL ZONED AREAS

FIGURE 1.4

DISTRICT OF NORTH VANCOUVER
ECONOMIC DEVELOPMENT
STRATEGY STUDY

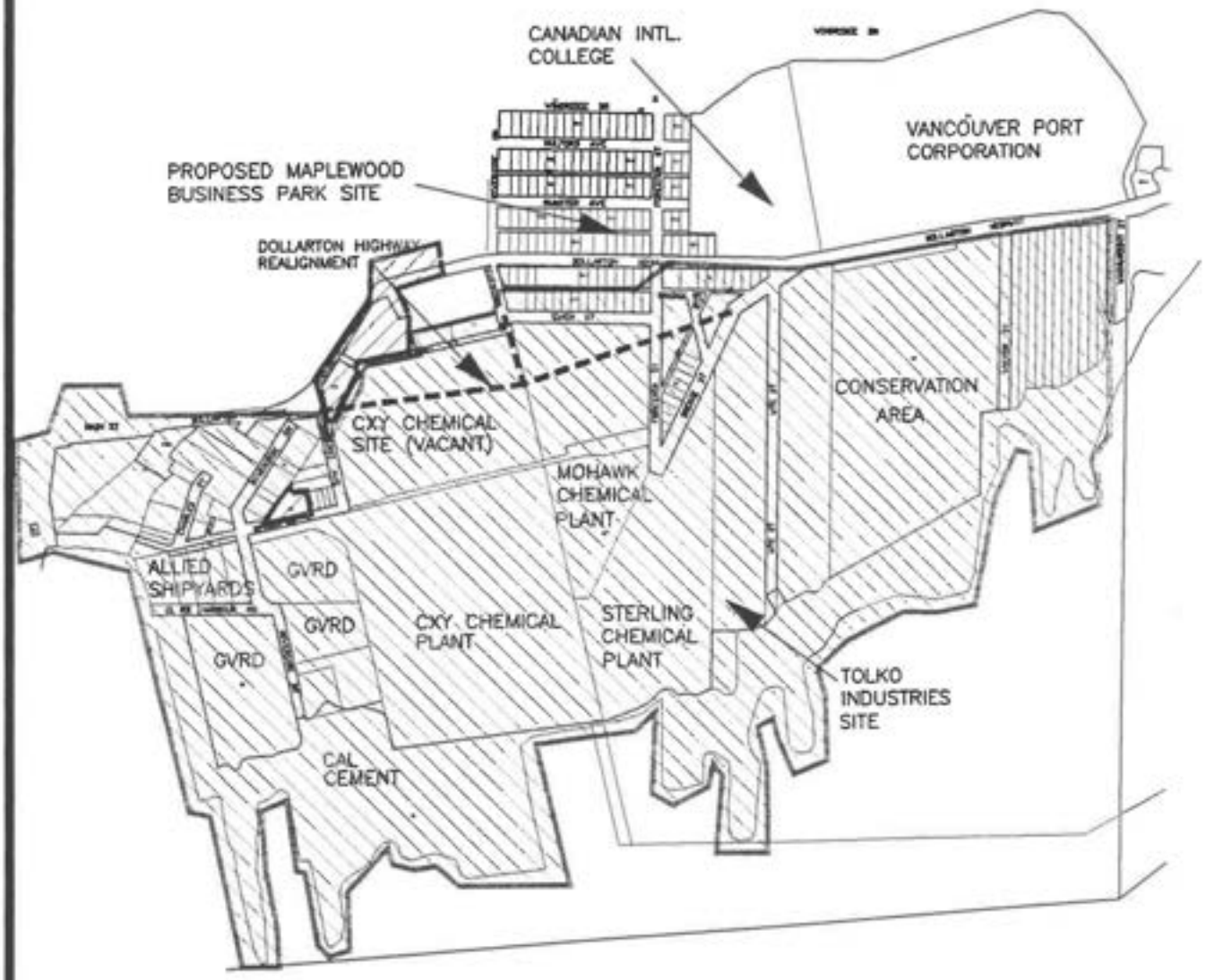
FEBRUARY 1997
SCALE: 1:7000 approx.

BASE SOURCE: DISTRICT OF NORTH VANCOUVER

URBAN SYSTEMS

61333002.1 L-AREA.PLT

Maplewood Industrial Area



LEGEND

INDUSTRIAL ZONED AREAS

COMMERCIAL ZONED AREAS

FIGURE: 1.5

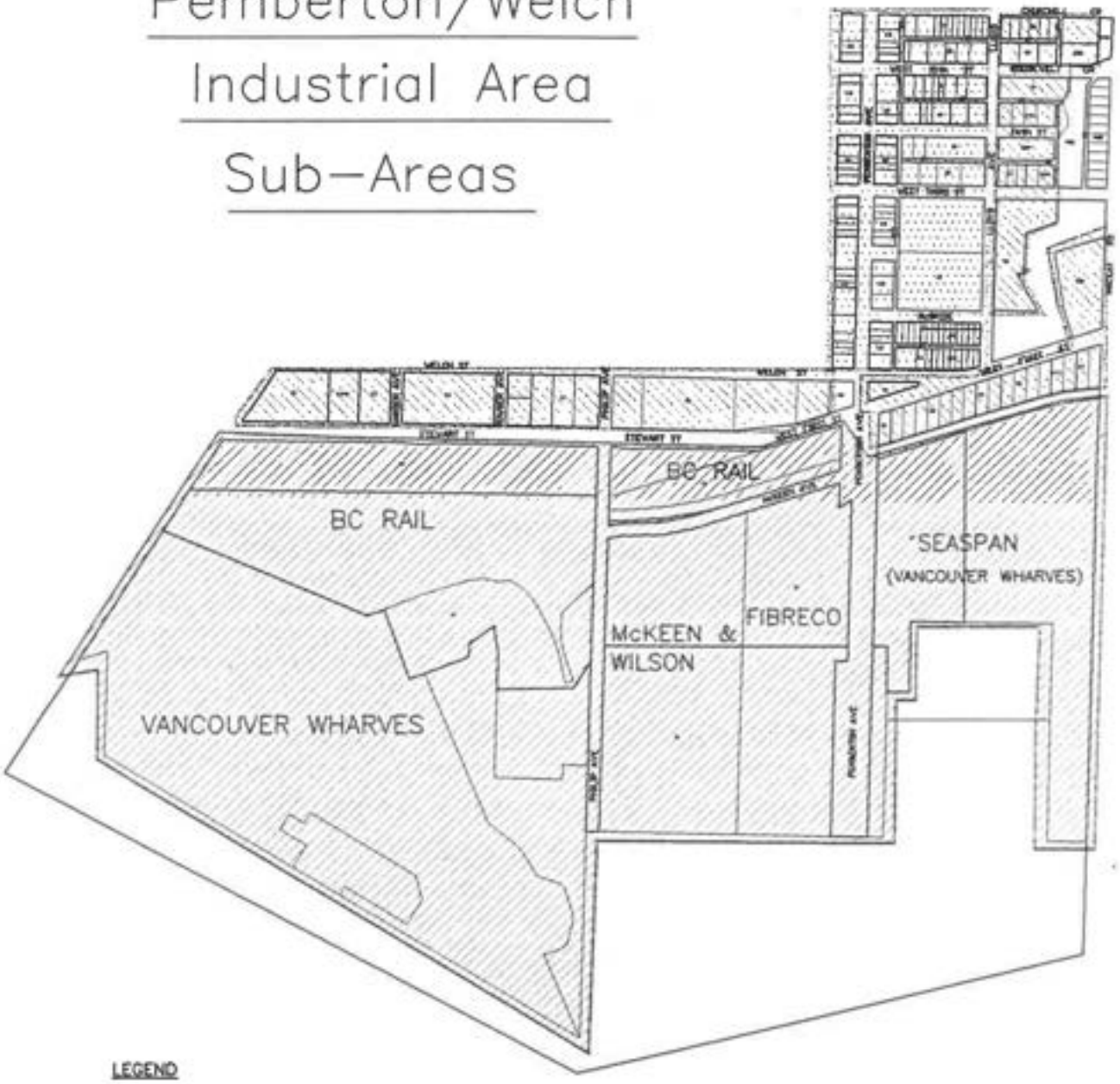
DISTRICT OF NORTH VANCOUVER
ECONOMIC DEVELOPMENT
STRATEGY STUDY

FEBRUARY 1997
SCALE: N.T.S.

BASE SOURCE: DISTRICT OF NORTH VANCOUVER

URBAN SYSTEMS

Pemberton/Welch Industrial Area Sub–Areas



LEGEND

- WATERFRONT AND PORT RELATED: SOUTH OF BCR
- NON–WATERFRONT– NORTH OF BCR AND EAST OF LLOYD AVE.
- NON–WATERFRONT–WEST OF LLOYD AVE. AND EAST OF PEMBERTON AVE.

FIGURE 6.2

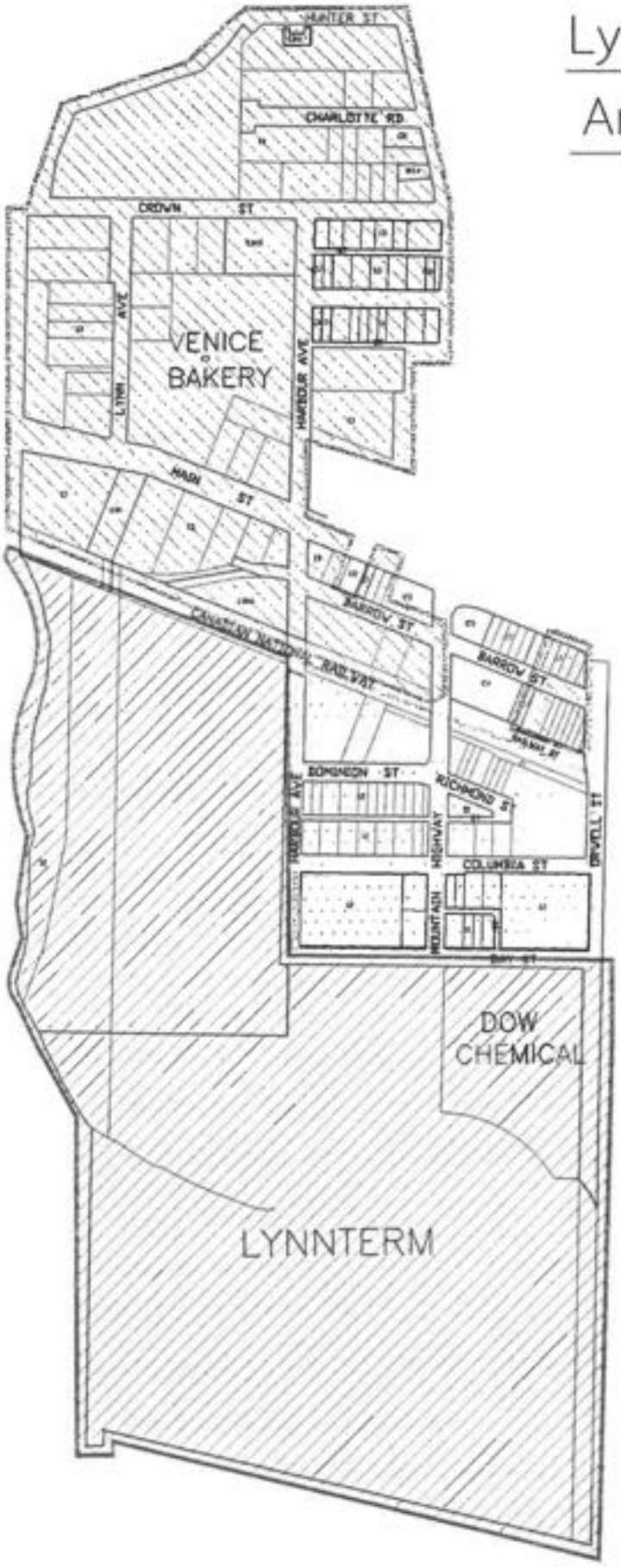
DISTRICT OF NORTH VANCOUVER
ECONOMIC DEVELOPMENT
STRATEGY STUDY

FEBRUARY 1997
SCALE: N.T.S.

BASE SOURCE: DISTRICT OF NORTH VANCOUVER

URBAN SYSTEMS

Lynnmour Industrial Area Sub-Areas



LEGEND

- WATERFRONT AND PORT RELATED
- NON-WATERFRONT: SOUTH OF CNR
- NON-WATERFRONT: NORTH OF CNR

FIGURE 6.3

DISTRICT OF NORTH VANCOUVER
ECONOMIC DEVELOPMENT
STRATEGY STUDY

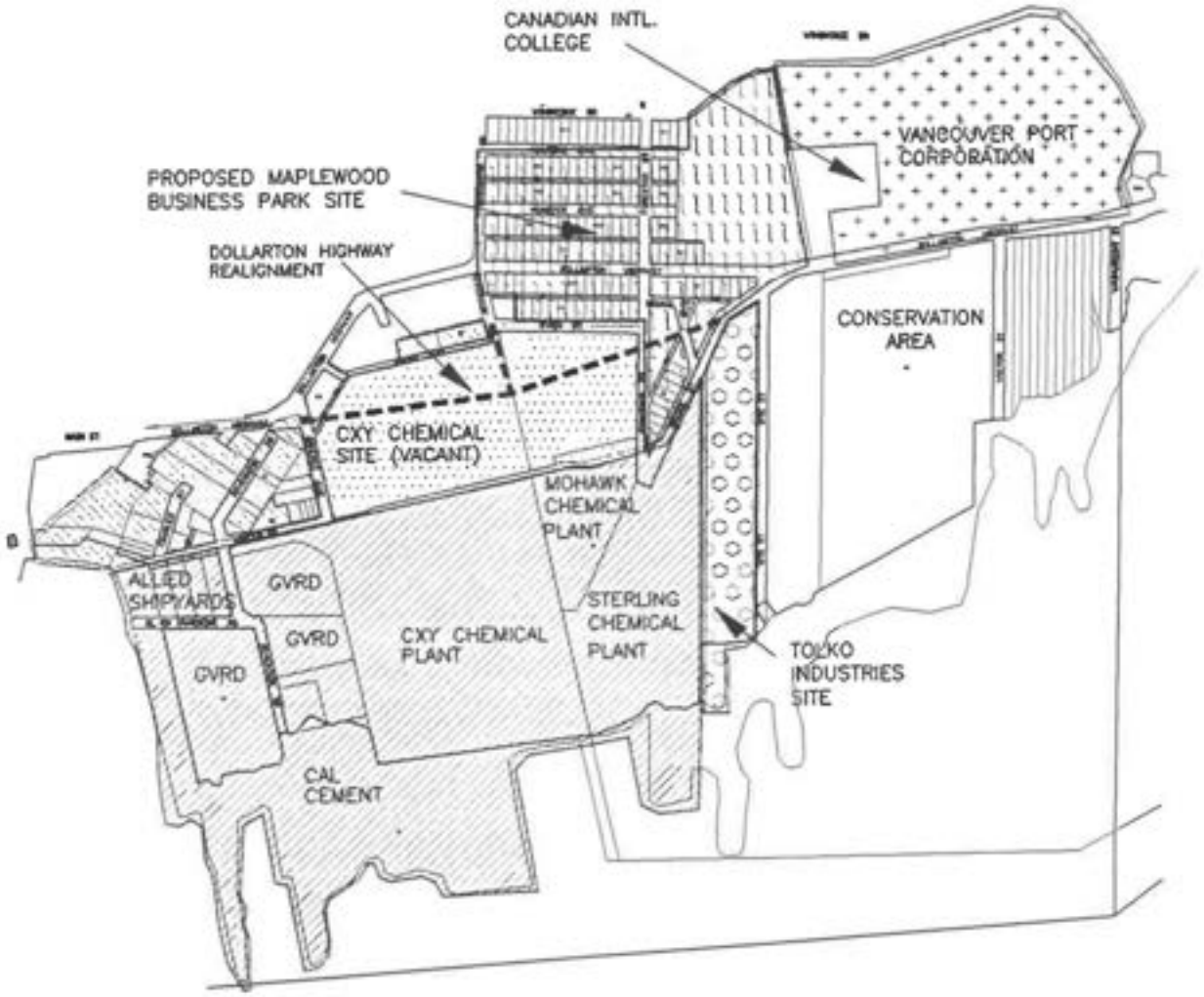
FEBRUARY 1997
SCALE: 1:7000 approx.

BASE SOURCE: DISTRICT OF NORTH VANCOUVER

URBAN SYSTEMS

6133302.1 L-SUB.DWG

Maplewood
Industrial Area & Sub-Areas



LEGEND

- WATERFRONT AND PORT RELATED SOUTH OF CNR
- NON-WATERFRONT: NORTH OF CNR/ WEST OF AMHERST AVE.
- CXY CHEMICAL VACANT LANDS
- PROPOSED MAPLEWOOD BUSINESS PARK
- VPC VACANT LANDS NORTH OF DOLLARTON HWY
- TOLKO INDUSTRIES SITE

FIGURE: 6.4

DISTRICT OF NORTH VANCOUVER
ECONOMIC DEVELOPMENT
STRATEGY STUDY

FEBRUARY 1997
SCALE: N.T.S.

BASE SOURCE: DISTRICT OF NORTH VANCOUVER

URBAN SYSTEMS

6.1.1 Identification of Competing Land Uses

Figure 6.5 identifies specific sites which will experience pressure for the development of new land uses, which in some cases may compete with each other or with existing land uses to occupy a site in the future. From **Figure 6.5**, the following conclusions are drawn regarding sites with new and potential competing land uses:

Industrial Areas

- Vacant undeveloped lands in the Maplewood industrial area, including the CXY Chemical site (30 gross acres/25 net acres) and proposed Maplewood Business Park (55 gross acres/20 net acres) will attract future development of the following flexible mix of land uses:

  - Business Park.
  - Light Industrial.
  - Office in a Business Park setting.
  - Big Box Retail (to a limited extent, and pending any safety impacts associated with proximity to the chemical plants).
  - Recreation Facilities (Ice Rink, Pool, etc.).

- The Venice Bakery site in Lynnmour will experience pressure to redevelop from demand for both new business park development (throughout the site) and/or for mixed residential/commercial uses (along the Main Street frontage).

- Residential and industrial uses will compete for vacant portions of the Vancouver Port Corporation's (VPC's) lands (approximately 37 gross acres/25 net acres), located north of Dollarton Highway in Maplewood.

- Existing heavy industrial, port industrial, transportation and outdoor storage uses will be pressured by competing light industrial, light industrial/office and business park uses on the Tolko Industries site (approximately 15 gross acres/12 net acres east of Forester Avenue) in Maplewood.

- There will continue to be pressure to redevelop the Dollarton Shipyard (Cates) site (approximately 5.2 gross acres/4.2 net acres) with uses other than port or marine industrial, including residential or mixed residential/commercial, and to a lesser degree light industrial (due to the sites remote location).

Figure 6.5

District of North Vancouver - Economic Development Strategy Study

SITES WITH LAND USES POTENTIALLY COMPETING FOR THESE SITES

AREA	LAND USE														
	Commercial					Industrial						Other			
	Retail	Office	Service	Big Box Retail	Hotel/Accommodation	Heavy Industrial	Port/Marine Industrial	Transportation	Outdoor Storage	Light Industrial	Business Park	Residential	Mixed Residential/Commercial	Institutional (Library, School, etc.)	Recreation Facility (Ice Rink, Pool, etc.)
INDUSTRIAL AREAS:															
Lynnmour (Lower Lynn)															
Non-Waterfront: North of CNR	▒	▒	▒		▒				▒	▒	●		▒		
Maplewood															
Waterfront & Port Related South of CNR						▒	▒	▒	▒	▒					
CXY Vacant Lands		●		●			●			●	●				●
Proposed Maplewood Business Park		●								●	●	▒			
VPC Vacant Lands North of Dollarton Hwy.										●	●			▒	●
Tolko Industries Site						▒	▒	▒	▒	●	●				●
Dollarton Shipyard (Cates)						▒	▒	▒	▒	●		●	●		
COMMERCIAL AREAS:															
Marine Drive Corridor															
Marine Dr./Pemberton Ave. Node	▒	▒	▒										●		
Marine Dr./Capilano Rd. Node	▒	●	▒		▒								▒		
Marine Dr. Corridor Between Mackay Ave. & Capilano Rd.	▒	▒	▒		▒								●		
Edgemont Village	▒	▒	▒										●	▒	
Lynn Valley															
Lynn Valley Mall	▒	▒	▒										●		
Lynn Valley Centre Area	▒	▒	▒									▒	●	▒	
Maplewood Plaza	▒	●	▒									▒	▒		
Proposed Windridge Centre	●	●	●									▒	●		

Existing Land Uses = ▒

Potential New Land Uses = ●

Commercial Areas

- In the Marine Drive Corridor, new mixed commercial (retail, office)/residential buildings land uses will place pressure on existing commercial properties to infill or redevelop. This development will be especially noticeable in the direct vicinity of the intersections of Marine Drive with Pemberton Avenue and with Capilano Road.

- Edgemont Village and Lynn Valley Centre will face pressures to densify with mixed commercial (retail, office)/residential buildings, and additional new potential retail businesses, which are not currently located in these areas.

- Similar development pressures to those affecting the Marine Drive Corridor will affect redevelopment and densification of new mixed (commercial/residential) uses near the intersection of Main Street and Mountain Highway in the Lynnmour area.

- The proposed Windridge commercial area will likely be developed with commercial retail and service uses, to serve the western Seymour area. Other than local medical/professional offices, other office uses will not likely be attracted to Windridge since nearby Business Parks within Maplewood will be more attractive for offices.

- There will primarily be no pressure for industrial uses to develop on commercial lands. To a small degree, additional ancillary light industrial uses may infill and complement existing commercial uses along Pemberton Avenue in the Pemberton/Welch area. Development of the CXY Chemical site and proposed Maplewood Business Park in the Maplewood industrial area will provide a catalyst for development of the proposed Windridge commercial centre and densification of Maplewood Plaza, both as commercial service centres for local employment.

6.1.2 Assessment of Compatibility of New and Competing Land Uses

Figures 6.6 and 6.7 summarize existing land uses, intensification of additional existing land uses and assess potential conflict between future land use choices which could occur on industrial and commercial lands. From this summary, these figures assess the compatibility and pressure of potential future land uses to occupy existing industrial and commercial lands.

Industrial Areas

From **Figure 6.6**, the following observations are made:

- Forecast future intensification of heavy industrial, port industrial, transportation uses on waterfront and port related sub-areas of Lynnmour, Pemberton/Welch and Maplewood would be consistent and compatible with existing uses, which are of the same type.

- Any future intensification or redevelopment of the non-waterfront sub-areas of the Lynnmour and Pemberton/Welch industrial areas would be compatible with existing land uses of the same type.

- Development of a flexible mix of new land uses including business park light industrial, light industrial/office in a business park setting, and recreation facilities (Ice Rink, Pool, etc.) on vacant lands within the Maplewood industrial area would be compatible.

- Any potential big box retail uses would be compatible (in limited amounts) with existing and other potential future land uses in the Maplewood industrial area, pending the impacts of the potential chemical spill contours associated with proximity to the chemical plants (which could limit the types of big box retail activities).

- Potential new business park and light industrial or light industrial/office uses to develop on the Tolko site could potentially conflict with existing heavy industrial, port industrial and transportation uses.

- Potential new residential uses on the Maplewood VPC vacant lands (located north of Dollarton Highway) would potentially conflict with adjacent existing heavy industrial development and potential future business park or light industrial development.

Fig 6.6

District of North Vancouver - Economic Development Strategy Study

ASSESSMENT OF POTENTIAL CONFLICT OF LAND USE CHOICES FOR INDUSTRIAL AREAS WITH EXISTING LAND USES

LAND USE CHOICES	AREA														
	Pemberton/Welch				Lynnmour (Lower Lynn)				Maplewood						Other
	Waterfront & Port Related South of BCR	Non-Waterfront: North of BCR and East of Lloyd Ave.	Non-Waterfront: West of Lloyd Ave./East of Pemberton Ave.	Non-Waterfront: Flanking Pemberton Ave.	Waterfront & Port Related	Non-Waterfront: South of CNR	Non-Waterfront: North of CNR	Venice Bakery Site	Waterfront & Port Related South of CNR	Non Waterfront: North of CNR, west of Amherst Ave.	CXY Vacant Lands	Proposed Maplewood Business Park	VPC Vacant Lands North of Dollarton Hwy.	Tolko Industries Site	Dollarton Shipyard (Cates)
Existing Land Uses															
Heavy Industrial	●				●				●					●	●
Port/Marine Industrial	●				●				●					●	●
Transportation	●				●	●			●					●	●
Outdoor Storage	●	●			●	●			●	●				●	●
Light Industrial		●	●	●		●	●	●	●	●					
Business Park		●													
Office		●	●	●			●								
Service		●	●	●			●								
Institutional (Library, School, etc.)													●		
Intensification of Existing Land Uses or Development of Potential New Land Uses:															
Heavy Industrial	●				●				●					●	●
Port/Marine Industrial	●				●				●		●			●	●
Transportation	●				●				●						
Outdoor Storage	●								●					●	
Light Industrial		●	●			●	●	●		●	●	●	●	●	○
Business Park		●						●			●	●	●	●	
Office											●	●			
Big Box Retail											●				
Mixed Residential/Commercial							○	○							●
Residential												○	○		●
Recreation Facility (Ice Rink, Pool, etc.)											●		●	●	

Existing Land Uses = ●

Little or No Conflict with = ● Existing Adjacent Land Uses

Potential Conflict with = ○ Existing Adjacent Land Uses

- Potential new residential development on the Dollarton Shipyards (Cates) industrial site would conflict with existing marine oriented heavy industrial, port industrial, transportation and outdoor storage uses.

- Other than limited potential for future development of big box retail in Maplewood, the only commercial uses to choose locations on industrial lands would include:
  - business park and light industrial office uses;
  - small scale retail and service uses which are oriented towards serving local employees; and,
  - ancillary commercial storefront uses associates with a primary light industrial use (which occupies the majority of the property or unit).
  - The development of these commercial uses on industrial lands will have very limited or no impact on other commercial areas throughout the District of North Vancouver.

Commercial Areas

From **Figure 6.7**, the following observations are made:

- Intensification and redevelopment of existing retail, office, and service uses, as well as potential future development of mixed use commercial/residential uses will be compatible within all commercial areas identified as having development, redevelopment or intensification potential.

- Intensification of hotel and accommodation development along Capilano Road near Marine Drive will be compatible with existing hotel and commercial retail/service uses.

- Outright multiple-family residential (i.e. no commercial component) development pressures near the intersection of Marine Drive and Capilano Road, as well as at Lynn Valley Centre could reduce the opportunity for expansion of existing commercial retail/service uses.

Figure 6.7

District of North Vancouver - Economic Development Strategy Study

ASSESSMENT OF POTENTIAL CONFLICT OF LAND USE CHOICES FOR COMMERCIAL AREAS WITH EXISTING LAND USES

LAND USE CHOICES	AREA									
	Pemberton Ave. Corridor	Marine Dr./Pemberton Ave. Node	Marine Dr./Capilano Rd. Node	Marine Dr. Corridor (Mackay Ave. to Capilano Rd.)	Edgemont Village	Lynnmour; Main St./Mountain Hwy. Node	Lynn Valley Mall	Lynn Valley Centre Area	Maplewood Plaza	Proposed Windridge Centre
Existing Land Uses:										
Retail	●	●	●	●	●	●	●	●	●	
Office	●	●		●	●	●	●	●		
Service	●	●	●	●	●	●	●	●	●	
Hotel/Accommodation			●	●		●				
Light Industrial	●									
Institutional (Library, School, etc.)					●			●		
Mixed Residential/Commercial			●						●	
Residential										●
Intensification of Existing Land Uses or Development of Potential New Land Uses:										
Retail	●		●							●
Office		●	●						●	●
Service	●		●							●
Hotel/Accommodation			●							
Light Industrial										
Institutional (Library, School, etc.)										
Mixed Residential/Commercial									●	
Big Box Retail										
Residential										●
Mixed Residential/Commercial		●	●	●	●	●	●	●		●

Existing Land Uses = ●

Little or No Conflict with = ●
Existing Adjacent Land Uses

Potential Conflict with = ●
Existing Adjacent Land Uses

6.2 Effects of Key Market Trends

Reflecting on the key market trends identified in chapters three and four, this section summarizes the significant effects these trends will have on future development of industrial and commercial land uses, and employment.

6.2.1 Effects of Key Market Trends on Industrial and Commercial Development & Land Use Choices

The following is a summary of the effects of key market trends on industrial and commercial development.

Industrial Areas

Port Industrial (Waterfront)

- Additional **demand for heavy industrial, port industrial and transportation uses** will be accommodated through the intensification of existing waterfront industrial lands in Lynnmour, Pemberton/Welch and Maplewood, at an annual rate of approximately **27,500 sq. ft. to 37,500 sq. ft. per year for new development.**

- From a market perspective, future demand for port or marine industrial uses on the Dollarton Shipyard (Cates) site are uncertain and lack the economic viability to encourage property owners to retain these types of uses. Therefore there will be continual pressure from property owners to change the land use. Marine-oriented industries will be more likely attracted to the more centrally located Tolko Industries site in Maplewood, where such industries could be accommodated in the context of an industrial park development.

Light Industrial (Non-Waterfront)

- New non-waterfront light industrial development activity on the North Shore will be attracted to the Fullerton site and Capilano Business Park area in the City of North Vancouver in the immediate term, then will shift to vacant lands in the Maplewood industrial area in the District of North Vancouver.

- Development of the small amount of remaining vacant lands, east of Lloyd Avenue, along Mackay Creek Park in the Pemberton/Welch industrial area will infill with business park development (similar to that which has recently developed in the area) in the immediate term.

- New light industrial and business park development will develop on vacant non-waterfront (upland) light industrial lands and will be developed primarily in the form of owner occupied single tenant or multi-tenant strata-titled buildings.

- The ability of new business park developments to accommodate a flexible mix of users in varying building and site sizes, which permit large proportions of office space, will be the key to capturing North Shore light industrial market demand.

- The forecast annual absorption rate for new development of **non-waterfront (upland) light industrial land for the District of North Vancouver is 2 to 3 gross acres, for the immediate 5 year period.**

- Once vacant lands in the Maplewood area (including the CXY Chemical site of 25 net acres and proposed Maplewood Business Park site of 20 net acres) come onto the market (which is estimated to begin in the five year horizon), **annual absorption of new non-waterfront light industrial development will increase to 3 to 4 gross acres for the District of North Vancouver for the remainder of the 25 year horizon.**

- Development of vacant lands within the Maplewood industrial area will be initiated on the CXY Chemical site, then occur on the proposed Maplewood Business Park and Tolko Industries sites. Only after the 10 to 15 year horizon, once these sites have fully developed, will there be further demand for the development of industrial uses on the VPC vacant lands north of Dollarton Highway.

- Since there will not be sufficient demand to develop the VPC vacant lands north of Dollarton Highway with industrial uses until almost 15 years from now, it is likely that the immediate demand for multiple-family residential uses will develop on this site.

Intensification of Existing Light Industrial

- Intensification and redevelopment of existing light industrial uses in already developed non-waterfront portions of the Lynnmour, Pemberton/Welch and Maplewood industrial areas are likely to occur after vacant lands on the CXY Chemical site and proposed Maplewood Business Park have been completed (which could be approximately fifteen years time). This intensification will attract smaller manufacturing and distribution companies, who can not afford to locate within new business parks.

Megastores, Big Box & Warehouse Retail

- There will be limited potential for megastores, warehouse sales outlets and big box retail uses within the District of North Vancouver since other potential sites for these types of uses are planned in the short term on more central North Shore locations including the Fullerton site (in the City of North Vancouver), and potentially on the Squamish Nation inter-river lands (at the northern bridgehead of the Second Narrows Bridge).

- In light of the above observation, the Maplewood industrial area holds some potential to attract big box retail stores due to its proximity to Trans Canada Highway 1 and large lot availability. The industrial analysis found that it may be beneficial to incorporate a small amount of big box retail uses into the future mix of use for business park development within Maplewood, to enhance the economics of future development, pending the safety impacts of proximity to the chemical plants.

Commercial Areas

Retail & Services

- Retail and service uses will infill in existing commercial areas. In some cases there will be a need to accommodate new retail users, which are currently not located in some of the commercial areas, therefore establishing a more balanced mix of retail/service users. **Approximately 50% of North Shore retail/service demand (i.e. 1,397,790 sq.ft.) has the potential to be captured by the District of North Vancouver over the 25 year horizon.**

- The Marine Drive corridor will continue to strengthen its role as providing retail and service uses for the entire North Shore. Together with vacant First Nations lands, the Marine Drive Corridor will have the potential to capture **28% of North Shore retail/service demand (i.e. 789,580 sq.ft.) over the 25 year horizon.**

- For community and local commercial areas within the District of North Vancouver, there will be demand for approximately **14,000 sq. ft. per year of new retail and service uses over the 25 year horizon**, with close to **330,000 sq. ft. developing over the period 1996 to 2011**, and close to **280,000 sq. ft. developing over the period 2012 to 2021.**

- Of the above demand for community and local retail and service uses within the District of North Vancouver, 10% (61,000 sq. ft.) will be generated within the Edgemont Village trade area (includes Edgemont Village and Delbrook Plaza), 58% (353,800 sq. ft.) will be generated within the Lynn Valley trade area (includes Lynn Valley Centre, Lynnmour and Queensdale/North Lonsdale), and 32% (195,200 sq. ft.) will be generated within the Seymour trade area (includes all commercial areas in the Seymour area).

Mixed Residential/Commercial

- There will be an increase in the demand for the development of mixed-use residential/commercial development along main street corridors, with a focus on key intersections including:

  - Marine Drive/Capilano Road
  - Marine Drive/Pemberton Avenue
  - Main Street/Mountain Highway

- The existing commercial areas of Edgemont Village and Lynn Valley Centre will also face market pressures for the development of mixed residential/commercial buildings and in the case of Lynn Valley Centre, for residential only buildings as well.

Offices

- Estimates forecast an average demand for new office additions in business parks, light industrial buildings and commercial areas in the District of North Vancouver (not including town centre office uses located within the City of North Vancouver) of close to **375,000 sq. ft. for the period 1996 to 2011**, and close to **250,000 sq. ft. for the period 2012 to 2021**. This translates into an absorption of **25,000 sq. ft. per year over the 25 year horizon.** It is estimated that 40% (250,000 sq.ft.) of this demand will be captured by new business park development, 35% (218,750 sq.ft.) will be captured by new or intensification of light industrial development and 25% (156,250 sq.ft.) will be captured by intensification of existing commercial areas.

Hotels & Accommodation

- Increasing demand for North Shore accommodation and smaller conference facilities will stimulate densification of existing hotel/motel sites in the "Capilano Triangle" (Capilano Road, Marine Drive, Garden Avenue), and near the Trans Canada Highway at the northern bridgehead of the Second Narrows Bridge.
- Assuming the District's current 81% market share of North Shore hotel/motel accommodation uses continues, the estimated **annual absorption for new hotel/motel accommodation uses for the District of North Vancouver is 15 to 19 rooms (or 5,100 sq. ft.) per year, with a demand for as many as 475 rooms by the year 2021.**

Tourism

- Major tourist attractions including the Capilano Suspension Bridge, Grouse Mountain and Deep Cove will have the opportunity to expand their commercial facilities and be a catalyst for new complementary spin-off commercial activities, subject to the availability of land.

6.2.2 Effects of Key Market Trends on Employment

The following is a summary of the effects of key market trends on future employment.

Industrial Areas

Port Industrial (Waterfront)

- Over the 25 year horizon, market trends indicate there will be between **20 to 25 new employees generated per year by intensification of waterfront and port related heavy industrial uses.** This would result in a **total of an additional 500 to 600 employees over the 25 year horizon.** The majority of these new jobs will be generated in the Pemberton/Welch (66% of new employment equaling a total of 330 to 400 jobs) and Lynnmour (33% of new employment equaling 170 to 200 jobs) industrial areas. This growth will occur steadily over the 25 year period.

Light Industrial (Non-Waterfront)

- On the basis of an average of 3 employees per 1,000 square feet of new development (with new development occurring at a density of 0.60 floor area ratio), demand for new development of non-waterfront (upland) **light industrial, light industrial/office and business park uses will generate between 160 to 230 employees per year, for the immediate 5 year period.** This would result in a **total of 800 to 1,150 new employees for this period.** The majority of this new employment will be generated by the development of business park uses in the remaining vacant non-waterfront portions the of Pemberton/Welch industrial area (along Mackay Creek Park), and within the CXY Chemical site in Maplewood.

- Annual employment generated by new non-waterfront light industrial development will increase as a greater share of North Shore light industrial/business park demand is captured by the District of North Vancouver with the development of the CXY Chemical, proposed Maplewood Business Park and Tolko Industries sites in Maplewood. Using the same assumptions as noted above, this **demand for new light industrial development will generate between 230 to 310 employees per year, for the 6 to 15 year period.** This would result in a **total of 2,300 to 3,100 employees over this period.**

- Once the CXY Chemical, proposed Maplewood Business Park and Tolko Industries sites have developed, remaining industrial demand not absorbed by the development of these lands which will be taken-up by **intensification and redevelopment of existing non-waterfront light industrial lands** in the Lynnmour (including the Venice Bakery site) and Pemberton/Welch industrial areas **will generate between 230 to 310 employees per year, for the remainder of the 25 year (i.e. 16 to 25 years) horizon.** This would result in a **total of 2,300 to 3,100 employees over this period.**

- Based on potential full development of vacant lands in the Maplewood industrial area with Light Industrial and Business Park uses, there could be the potential to generate the following numbers of total new employees (based on 3 employees per 1,000 sq. ft. of building, developed at a density of 0.60):

    - CXY Chemical site: 1,900 to 2,000 employees.
    - Maplewood Business Park: 1,500 to 1,600 employees.
    - Tolko Industries site (if developed with light industrial/business park uses): 900 to 1,000 employees.
    - Tolko Industries site (if developed with waterfront heavy/port industrial uses): 40 to 60 employees.

- Although there is limited market support for the development of light industrial or business park uses on the VPC vacant lands north of Dollarton Highway until almost 15 years from today, if such uses were to eventually develop, they could generate a total of around 1,900 employees. Under a residential land use, these lands would generate only a limited amount of through home based business, in the order of a total of possibly 50 to 70 employees.

- Similar to the above point, although there is limited economic ability for marine related or other industrial uses on the Dollarton Shipyards (Cates) site, if such uses were to fully develop on this site, they could possibly generate a total of 20 to 30 employees. Under a residential land use, these lands may be able to generate the same number of employees by home based businesses.

- Most new industrial employment will be derived from the light industrial sector, particularly from smaller manufacturing and distribution companies. Examples of the types of industries that will be attracted to the District of North Vancouver include:

  - Marine sector engineering, equipment manufacturing, repair and service;
  - Electric and electronic engineering and equipment manufacture;
  - Telecommunications;
  - Suppliers and providers of services to the North Shore film industry;
  - Machinery manufacturing, service and repair;
  - Fabricated metal products;
  - Precision instruments and related equipment;
  - Computers, software development, service and repair;
  - Manufacture and repair of resource industry equipment;
  - Materials handling, transportation equipment manufacture, service and repair.

  Table 6.1 provides a summary of incremental industrial and commercial employment growth estimates over the 25 year horizon, based on industrial and commercial market demand forecasts.

Table 6.1

Summary of Additional New District of North Vancouver Industrial and Commercial Employment Estimates, 1996 - 2021*

EMPLOYMENT TYPE	Year			Total
	1 to 5	6 to 15	16 to 25	
NEW INDUSTRIAL EMPLOYMENT:				
Waterfront:				
Intensification	125	250	250	625
Non-Waterfront:				
New Development	1,150	3,100	-	4,250
Intensification/Redevelopment	-	-	3,100	3,100
New Office in Business Parks	200	400	400	1,000
New Office in Light Industrial Buildings	175	350	350	875
New Industrial Employment Sub-Total	1,650	4,100	4,100	9,850
NEW COMMERCIAL EMPLOYMENT:				
** Community & Local Retail/Service	350	700	700	1,750
Marine Dr. Corridor & First Nations Lands Regional Retail/Service	451	903	903	2,257
New Office in Commercial Areas	125	250	250	625
New Hotel/Accommodation	21	41	41	103
New Commercial Employment Sub-Total	947	1,894	1,894	4,735
TOTAL NEW INDUSTRIAL & COMMERCIAL EMPLOYMENT	2,597	5,994	5,994	14,585

Notes:

(*) = *Employment estimates included in table are based on high range of average estimates.*

(**) = *"Community & Local Retail/Service" does not include Marine Drive Corridor commercial areas.*

Commercial Areas

- Using an average worker density of 350 square feet of new retail/service development per employee, market demand for the development of **new retail and service uses within District of North Vancouver community and local commercial trade areas will generate around 70 employees per year,** over the 25 year horizon. This would result in a **total of almost 1,750 new employees over the 25 year period.**

- **Intensification of the Marine Drive Corridor and development of First Nations lands with regional-orientated retail/service uses will generate around 90 employees per year, over the 25 year horizon, for a total of 2,257 employees over the 25 year horizon.**

- Of the above community and local commercial employee estimates, 10% of new commercial employment will be generated within the Edgemont Village trade area (includes Edgemont Village and Delbrook Plaza), 58% will be generated within the Lynn Valley trade area (includes Lynn Valley Centre, Lynnmour and Queensdale/North Lonsdale), and 32% will be generated within the Seymour trade area (includes all commercial areas in the Seymour area).

- Using an average worker density of 250 square feet of new office development per employee, market demand for the development of **new office space in the District of North Vancouver will generate around 100 employees per year over the 25 year horizon.** This would result in a **total of around 2,500 new employees over this period.** It is estimated that 40% (1,000 employees) of this new employment will occur within new business park development, 35% (875 employees) will occur within new or intensified light industrial development, and 25% (625 employees) will be generated by intensification of existing commercial areas. These business park and light industrial office employment estimates form a component of the employment estimates previously noted for the demand for future development of non-waterfront (upland) light industrial and business park uses (the mix of which is illustrated in **Table 6.1**).

- It is estimated that demand for **new hotel/motel accommodation development within the District of North Vancouver will generate 5 to 7 employees per year** over the 25 year horizon. This would result in a **total of around 150 new employees over this period.**

6.3 Other Considerations

In order to better understand the planning context within which development opportunities identified by the market analysis must operate, this section of the report identifies other considerations which will effect the future development of industrial and commercial lands. These considerations involve the following topics:

- Transportation, mobility, and access.
- Existing or adjacent land uses.
- Inter-jurisdictional issues.
- Environmental concerns.

6.3.1 Summary and Assessment of Other Considerations

The following is a summary of other considerations which may effect future industrial and commercial development.

Industrial Areas

1. Pemberton/Welch:

Transportation, Mobility and Access

- Completion of the proposed "Lower Level Route" will be vital for providing an alternative to Marine Drive for industrial and commercial traffic, and reducing potential additional traffic capacity at the intersection of Pemberton Avenue and Marine Drive generated by intensification of the Pemberton/Welch area.

- Traffic congestion is severe at the unsignalized intersection (four-way stop) of Pemberton Avenue and Welch Street. This traffic is further complicated by trains at the Pemberton Avenue crossing of the BCR.

- There are only two crossings of the BCR, at Pemberton Avenue and at Philip Avenue, which limits access to and from the waterfront areas. The Philip Avenue crossing is often occupied by trains, since it crosses through the centre of the rail yard over numerous tracks.

- Parking is a problem both on and off the street.

- Existing pedestrian facilities are poor.

Existing or Adjacent Land Uses

- Small lots complicate redevelopment or intensification of non-waterfront light industrial areas.

- Existing and proposed development in the nearby Capilano Business Park and on the Fullerton site, directly east in the City of North Vancouver will provide a focus of attention over the next 5 to 10 year period.

- Many light industrial sites are fully developed, therefore limiting redevelopment and intensification opportunities.

Inter-Jurisdictional Issues

- Construction of the proposed "Lower Level Route", thus establishing an alternative route for industrial traffic, will require cooperation of the District of North Vancouver, City of North Vancouver, District of West Vancouver, BC Ministry of Transportation & Highways, BC Transportation & Finance Authority and Squamish Nation Band, to ensure the road and associated improvements are completed within each jurisdiction. Completion of this route will have profound implications for the future intensification of port and heavy industrial lands south of the BC Rail.

- The District of North Vancouver, City of North Vancouver and District of West Vancouver will need to cooperate in establishing a hierarchy of roads to accommodate new development and the proposed "Lower Level Route".

Environmental Concerns

- Development setbacks established by BC Environment and the federal Department of Fisheries and Oceans would need to be respected by development proposed in the vicinity of Mackay Creek Park, therefore limiting some development potential here.

- Elements of the port and rail activities will not be conducive to the development of business park uses south of Stewart Street and the BCR.

2. Lynnmour:

Transportation, Mobility & Access

- Traffic congestion at the signalized intersection of Main Street and Mountain Highway will limit accessibility to the Lynnmour industrial area, especially the southern portion of the area, therefore profoundly impacting attraction for industrial users to the Lynnmour area.

- The above mentioned traffic congestion is intensified during peak travel hours due to the southbound on-ramp (from Main Street eastbound) to the Second Narrows Bridge. Resulting grid-lock traffic along Main Street during peak periods severely limits access in and out of both the southern and northern portions of the Lynnmour industrial area.

- Access on and off of Mountain Highway from the northern portions of Lynnmour is also complicated by peak hour traffic.

- Due to the funnel of industrial, commercial and other traffic onto Main Street, there is currently no alternative hierarchy of roads available to separate industrial and commercial traffic from other traffic.

- Traffic circulation is complicated by dead-end streets.

- Parking is a problem both on and off the street.

- Existing pedestrian facilities are poor.

- There is only one rail crossing (underpass) at Mountain Highway to provide access in and out of South Lynnmour.

- There is no direct connection between the port and heavy industrial uses occurring in Lynnterm (in the District of North Vancouver) and other port terminals to the west (in the City of North Vancouver).

Existing or Adjacent Land Uses

- A variety of existing building sizes and shapes on small lots complicates redevelopment or intensification of non-waterfront light industrial areas.

- There is no distinct definition between the edge of the commercial and light industrial areas of North Lynnmour within the District of North Vancouver, especially close to the intersection of Mountain Highway and Main Street.

Inter-Jurisdictional Issues

- Construction of a new crossing of Lynn River to connect the Lynnterm with other port terminal lands to the west, thus establishing an alternative route for industrial traffic would require cooperation of the District of North Vancouver, City of North Vancouver, BC Ministry of Transportation & Highways, BC Transportation & Finance Authority and Vancouver Port Corporation.

- Improvements to the Second Narrows Bridge approach and to improve connections between Lynnmour and the Maplewood and Seymour areas to the east would require cooperation of the District of North Vancouver, City of North Vancouver, BC Ministry of Transportation & Highways, and potentially the Squamish Nation Band.

Environmental Concerns

- Development setbacks established by BC Environment and the federal Department of Fisheries and Oceans would need to be respected by development proposed in the vicinity of the rivers passing through the area, therefore limiting expansion of port facilities.

- Noise (from rail and port operations) and truck traffic associated with port and rail activities will not be conducive to the development of business park uses south of Main Street.

3. Maplewood:

Transportation, Mobility & Access

- Completion of the proposed re-alignment of Dollarton Highway and associated road improvements will be essential before new business park development can occur. This will involve support and commitments from the District of North Vancouver, as well as from the developers of significant properties including the CXY Chemical site, Tolko Industries site and VPC vacant lands north of Dollarton Highway.

- The above consideration will also hold true for providing infrastructure services to new development parcels.

- Alternative from the funneling of traffic from the Maplewood area into Main Street (to the west) and the Second Narrows Bridge approach could involve improvements to Riverside Drive as an alternative access point to the area.

- The local street pattern south of Main Street/Dollarton Highway, west of Riverside Drive, which has numerous dead-end streets, will limit opportunities for redevelopment and intensification of existing developed light industrial properties.

- A traffic assessment of impacts of future development will be essential to determine the need for road, intersection and signal improvements, especially where the proposed re-alignment of Dollarton Highway and Riverside Drive cross.

- Efficient public transit services will be essential to service future business park development.

Existing or Adjacent Land Uses

- New development will need to consider potential impacts on adjacent residential and private school/college uses.

- A hierarchy of transition and buffering between heavy/port industrial uses, light industrial uses, business park uses and residential uses will need to be established.

Inter-Jurisdictional Issues

- Determining what development activity will occur on the Squamish Nation Band lands and to what degree will the Band participate with the District of North Vancouver and potentially the province in significant road improvements.

- The above consideration will also hold true for the construction and provision of infrastructure services.

Environmental Concerns

- Preservation of the Environmental Conservation Reserve area on VPC lands east of the Tolko Industries site and south of Dollarton Highway prohibit any future industrial development on within the conservation area lands for at least 49 years, if not longer.

- Protection and buffering from a potential Chlorine spill or other chemical accident from one of the chemical plants within the heavy industrial waterfront area. This protection may limit the location of future business park development, especially on the CXY Chemical and other vacant lands south of the re-aligned Dollarton Highway.

- Tree removal within the proposed Maplewood Business Park and on the CXY Chemical lands may impact view preservation for residences along Windridge Drive.

4. Dollarton Shipyard (Cates) Site:

Transportation, Mobility & Access

- Site is remote from other industrial areas and major roads/highways.

- Any future intensification of industrial development on the site may result in industrial and commercial traffic impacts on Dollarton Highway, adjacent to existing residential uses.

Existing or Adjacent Land Uses

- Any future intensification of industrial development on the site could impact adjacent residential neighbourhoods. There has been pressure from existing area residents to keep the site in its current use.

Commercial Areas

The following summarizes general considerations identified for the commercial areas identified in chapter three as having potential for development, redevelopment or intensification.

- In all commercial areas, a movement towards traffic calming and the provision of a better pedestrian-orientated street environment will affect the types of commercial users which will be attracted to these centres.

- There will be greater opportunities to provide eyes on the street and a twenty-four hour community in the Marine Drive Corridor, Lynn Valley Centre, portions of Lynnmour and Edgemont Village commercial areas, as pressure to intensify existing retail sites with mixed commercial/residential development occurs.

- As a mix of commercial/residential uses occurs in the above-noted commercial areas, there will be an increase in the number of people walking versus driving to nearby community or local commercial centres. Having a full-time population in these commercial areas will also have implications on the mix of retail service users, in order to better service area residents.

- Land intensive existing retailers including automobile sales lots and service stations will face pressure to redevelop with higher density mixed commercial/residential uses, thus being forced to either concentrate their facilities into smaller sites or relocate elsewhere, perhaps on Squamish Nation Band lands in an automall format.

- In the case of the Marine Drive Corridor, the uses noted in the above consideration may also be displaced by a limited amount of megastores or big box retailers.

- Although intensification of the existing commercial areas will allow more people to live closer to retail and service uses, there will likely be additional traffic generated by residential populations, and additional businesses.

- Intensification of existing commercial areas will result in less readily available public off-street parking. Although new buildings will be required to provide off-street parking, much of this parking will be occupied by mixed commercial/residential building residents and business operators, therefore limiting customer parking opportunities.

- Expansion of smaller commercial areas including Dollarton Village, Delbrook Plaza and Deep Cove will be limited by the lack of availability of adjacent developable or vacant land. Once parking is considered, these sites are already developed close to their maximum under current zoning policies.

- Additional development of hotel/motel accommodation within the "Capilano Road Triangle" may result in additional traffic demands for Capilano Road and the intersection of Marine Drive and Capilano Road.

6.4 Summary of Opportunities, Constraints and Implications

In the following pages, the **Figures 6.8 through 6.12** provide a summary overview of opportunities and constraints for each of the existing and future land use choices for areas identified as having potential for development, redevelopment or intensification.

Issues and implications associated with the opportunities and constraints are also noted in the matrix figures, which will be used in Chapter 7 to review existing policies and establish new policy directions for industrial and commercial development.

Figures have been prepared for each of the industrial areas, as well as a on overall figure for commercial areas which have been identified as having development, redevelopment or intensification potential, as follows:

Figure 6.8 - Pemberton/Welch.

Figure 6.9 - Lynnmour.

Figure 6.10 - Maplewood.

Figure 6.11 - Dollarton (Cates) Shipyard.

Figure 6.12 - Commercial Areas.

Figure 5.

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DEVELOPMENT OPPORTUNITIES, CONSTRAINTS & IMPLICATIONS
COMMERCIAL AREAS

LAND USE CHOICES	OPPORTUNITIES	CONSTRAINTS	ISSUES/IMPLICATIONS
Marine Drive Corridor Retail, Service, Office, Mixed Use Residential/Commercial, Hotel	• Intensification and redevelopment of existing commercial properties. • Excellent vehicle access and public transit facilities via Marine Drive. • Focus of higher density development, including mixed residential/commercial and office uses at the intersections of Marine Drive with Capilano Road and Pemberton Ave.	• Pressure by other commercial uses to relocate auto dealerships elsewhere. • Increasing traffic congestion along Marine Drive.	• Need to consider where commercial uses displaced by new commercial and residential/commercial development may go. • Need to consider how to encourage nodes of pedestrian pocket type higher density mixed residential/commercial development at key intersections. • This commercial area will likely continue to service not only local residents but also residents from all over the North Shore.
Edgemont Village **Retail, Service, Office, Mixed Use Residential/Commercial**	• Redevelopment of some commercial properties with mixed residential/commercial uses. • Existing residential community and public facilities in direct vicinity, within walking distance. • Strong pedestrian-oriented street shopping environment is already in place. • Good public transit facilities and pedestrian facilities.	• Variety of existing building shapes and sizes on small lots. • Variety of businesses is limited. • Perception that there is limited parking available. • Intersection of Edgemont Boulevard and Highland Drive (controlled by stop signs) is becoming congested.	• New development should reinforce the existing pedestrian-oriented street shopping environment. • There is room for expansion of the types of businesses within this commercial area. • Need to maintain pedestrian safety and mobility throughout Edgemont Village.
Lynn Valley Retail, Service, Office, Mixed Use Residential/Commercial	• Intensification and redevelopment of existing commercial properties, and development of medium density mixed residential/commercial buildings. • Existing residential community and public facilities in direct vicinity, within walking distance. • Close to Trans Canada Highway. • Good public transit facilities.	• Other than within Lynn Valley Centre Mall, there are limited pedestrian facilities connecting different commercial developments. • Surface parking lots for Lynn Valley Centre Mall occupy much of the street southern street frontage along Lynn Valley Road. • Intersection of Mountain Highway and Lynn Valley Road comprises a mixture of off-set roads, making difficult for cars and pedestrians to circulate. • Variety of businesses could be expanded.	• Opportunities for adjusting the density and off-street parking provision for Lynn Valley Centre should be considered to investigate the possibilities of intensification of the property with higher density mixed residential/commercial uses. • Road system and pedestrian facilities should be reconsidered to encourage more of a commercial street orientation, especially near the intersection of Mountain Highway and Lynn Valley • Zoning should be flexible enough to allow the development of a wide range of commercial uses that aren't currently available.
Lynnmour (Main St./Mountain Hwy.) Retail, Service, Office, Mixed Use Residential/Commercial	• Intensification and redevelopment of existing commercial properties, and development of medium density mixed residential/commercial buildings. • Close to Trans Canada Highway. • Public transit loop in located nearby.	• Traffic congestion at the intersection of Main Street/Mountain Highway impedes access to existing and potential future commercial development. • Pedestrian facilities are limited. • Area is surrounded by existing light industrial areas, and a railway.	• Commercial and mixed residential/commercial development may be discouraged by the poor access in/out of the area. • The variety of commercial businesses to locate within this area will likely be influenced by the surrounding light industrial area.
Maplewood Plaza Retail, Service, Office, Mixed Use Residential/Commercial	• Intensification and redevelopment of existing commercial properties. • Close to existing residential and industrial uses and to potential future business park uses. • Direct access to Dollarton Highway and close to Trans Canada Highway. • At the cross-roads of Riverside Drive and Dollarton Highway.	• No consistency of streetscape or pedestrian facilities, most commercial development is "strip" style, setback from the road. • Variety of businesses is very limited, and there are limited public transit facilities. • Access/egress is made difficult by traffic on Dollarton Highway. • Site remediation may be necessary for the redevelopment of any of the existing gas station sites.	• Connections (for vehicles, pedestrian, public transit and continuity of buildings) should be established between development in Maplewood Plaza and adjacent potential future business park or light industrial development. • Alternative opportunities for access in/out of the commercial developments needs to be considered in the configuration of the future road system.
Proposed Windridge Centre Retail, Service, Office, Mixed Residential/Commercial	• Development with commercial retail and service uses. • Existing residential community and public facilities in direct vicinity, within walking distance. • Close to potential future business park uses.	• May impact nearby existing residents along Windridge Drive. • May capture some of the commercial market demand which would otherwise be absorbed by Maplewood Plaza and other commercial areas in the Seymour area.	• Will need to ensure that pedestrian linkages between new development and existing residential areas, as well as potential future business park or residential development are established. • Will need to ensure that efficient vehicle access in/out of Mount Seymour Parkway is achieved, with impacting nearby residences.

* = Additional Opportunities, Constraints and Implications for commercial areas are documented in Chapters 3 and 4 of Appendix C, "Market Trends and Analysis".

Figure 6.11

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DEVELOPMENT OPPORTUNITIES, CONSTRAINTS & IMPLICATIONS
DOLLARTON SHIPYARD (CATES)

LAND USE CHOICES	OPPORTUNITIES	CONSTRAINTS	ISSUES/IMPLICATIONS
Heavy Industrial, Port/Marine Industrial **& Transportation**, Light Industrial	• Waterfront location with excellent access for coastal vessels. • Buildings and facilities already exist on the site to accommodate port related and marine industrial uses. • Opportunity to intensify site with additional port and marine related uses, however demand for this activity is limited and likely a long term prospect.	• Remote location, not connected to other waterfront industrial areas. • Not near major roads. Groundside industrial traffic (trucks) would have to pass through residential areas adjacent to Dollarton Highway to access site. • Relatively small site, which is constrained by slope and foreshore development considerations.	• Other more accessible sites, located in Maplewood will likely be selected by new industries before the Dollarton Shipyard (Cates) site is considered. • Groundside industrial traffic would have to pass through existing residential areas to access site. • Employment generated by any future intensification of port and marine related uses would be very limited.
Residential, Mixed **Residential/Commercial**	• Sloped waterfront amenity location. • Community facilities are available nearby. • Adjacent to existing residential uses. • Opportunity to improve the taxable value of the land.	• Waterfront views of existing adjacent residences could be impacted. • Only one road (Dollarton Highway) provides access to the site. • Relatively small site, which is constrained by slope and foreshore development considerations. • Potential site contamination by previous uses of the site.	• Residential development will generate little (by home based business) or no employment activity. • Multiple-family residential development will generate noticeable additional traffic on Dollarton Highway. • Some existing adjacent residents are of the view that the site should remain in its current state. • Remediation of any site contaminants would be necessary to allow residential development.

Figure 6.10

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DEVELOPMENT OPPORTUNITIES, CONSTRAINTS & IMPLICATIONS
MAPLEWOOD

LAND USE CHOICES	OPPORTUNITIES	CONSTRAINTS	ISSUES/IMPLICATIONS
Non-Waterfront: Proposed Maplewood Business Park			
Business Park	• Close proximity to Trans Canada Highway, as well as Dollarton Highway, Main Street and Mount Seymour Parkway. • There is demand for business park uses on the North Shore. • Maplewood Plaza provides existing commercial services for potential future employees. • A topographical escarpment separates potential business park uses from adjacent existing residences along Windridge Drive.	• Some private properties located within the site. • Site is currently treed. • Existing access to/from the Trans Canada Highway although available, is limited and will likely become more congested with the potential development of business park and other uses in the Maplewood area. • District of North Vancouver must confirm its commitments to move forward with servicing this site. These commitments will likely be contingent on the development of the adjacent CXY Chemical site.	• Any outstanding private properties within the site area need to be acquired. • Improvements to/from the Trans Canada Highway either via Riverside Drive to Mount Seymour Parkway or along Dollarton Hwy./Main Street will provide better access to potential • Timing of development of the adjacent CXY Chemical site will influence the timing of development of the proposed Maplewood Business Park site. • Should the development of the CXY Chemical site not proceed, the District will need to consider other strategies for the provision of services and road improvements for the proposed Maplewood Business Park site.
Non-Waterfront: VPC Vacant Lands (north of Dollarton Hwy.)			
Business Park, Light Industrial & Light Industrial/Office	• Site is located in close proximity to other future potential light industrial and business park land uses. • Site is located in proximity to Trans Canada Highway and has direct access onto Dollarton Highway.	• VPC Port 2010 Plan identifies this site as one which could potentially rezone to other land uses including residential use. • The existing Canadian International College occupies a significant central portion of the site.	• Although the market analysis suggests there will be demand for light industrial and business park uses on this site once the CXY Chemical and Maplewood Business Park sites have been developed (which could take over ten to fifteen years), there is immediate demand for residential uses (as suggested by a recent development proposal).
Residential	• VPC Port 2010 Plan identifies this site as one which could potentially rezone to other land uses including residential use. • Proximity to the waterfront could be seen as an amenity (especially if the Tolko Industries site redevelops with lighter industrial uses)	• The existing Canadian International College occupies a significant central portion of the site. • Proximity of the Stella, Mohawk and CXY chemical plants could be seen as a negative component for potential new residential uses.	• There is immediate demand for residential uses on this site, however development of such uses would pre-empt any future preservation of vacant industrial lands for the 15 to 25 year horizon. • There would be little new employment (by home based businesses) or no new employment generated by residential uses.
Tolko Industries Site			
Heavy Industrial, Port/Marine Industrial & Transportation	• There is limited demand for these uses on this site. • Site has limited waterfront access. • Site will benefit from direct access to the proposed re-alignment of the Dollarton Highway.	• There will be pressure by other lighter industrial non-water dependant industries to develop on this site. • Waterfront does not have deep-sea terminal capabilities due to the mudflats. • Established Canada Wildlife Conservation Area to the east of the site will limit the spread of development to the east.	• Development and intensification of site with waterfront industrial uses will generate only a small number of new employees. • Development or uses on this site will for the eastern edge of the Maplewood industrial area, and should be designed to respect the adjacent Conservation Area.
Business Park, Light Industrial & Light Industrial/Office	• Site will benefit from direct access to the proposed re-alignment of the Dollarton Highway. • Waterfront location could be seen as an amenity for new development. • Opportunity exists for marine-related industries to develop in a larger business park setting, which may or may not make use of adjacent waterfront access or trickle down activity from adjacent waterfront port-related heavy industrial uses (including ship building and repair).	• Established Canada Wildlife Conservation Area to the east of the site will limit the spread of development to the east. • Marine-related industries may not have the ability to afford locations within a potential new light industrial park or business park. • Development of this site may be contingent on the timing of development of the CXY Chemical and proposed Maplewood Business Park sites. • Site contamination issues may need to be addressed before development of new land uses can occur.	• Development of light industrial, light industrial/office and business park uses would generate a significantly higher number of new employees than would intensification of the site with waterfront heavy industrial uses. • Development or uses on this site will for the eastern edge of the Maplewood industrial area, and should be designed to respect the adjacent Conservation Area. • Timing of development of this site will be influenced by the timing of development of the CXY Chemical and proposed Maplewood Business Park sites, especially with regard to road • If the site is found to be contaminated, site remediation may be necessary, which could affect the timing of any potential development.

Figure 6.10

District of North Vancouver - Economic Development Strategy Study

DEVELOPMENT OPPORTUNITIES, CONSTRAINTS & IMPLICATIONS
MAPLEWOOD

LAND USE CHOICES	OPPORTUNITIES	CONSTRAINTS	ISSUES/IMPLICATIONS
Waterfront & Port Related: **Heavy Industrial, Port/Marine** Industrial & Transportation	• There is demand for the intensification of port oriented heavy industrial uses will occur over 5 to 10 year horizon. • Proposed "Dollarton Hwy. Re-Alignment" will provide more direct access to waterfront areas along Forester Ave. and Amherst Ave. • Most sites benefit from waterfront and rail access. • There is some demand for the Allied Shipyard site to continue serving the coastal shipping and maritime industry. • There are plans to develop the GVRD log storage site with a public works yard.	• Environmental conservation areas established by DFO, MoELP and VPC impact the ability of waterfront access for portions of some waterfront industrial sites. • Mudflats and shallow draft limit the capability of the waterfront to accommodate "deep sea terminal" uses. The VPC Port 2010 Plan does not identifies only the Canadian Occidental Petroleum (CXY) waterfront site for "deep sea terminal uses". • Groundside traffic accessing the waterfront areas must pass through the light industrial areas, and cross the CNR.	• Properties not owned or operated by VPC or port/terminal operators will be vulnerable to intensification by industries other than water-dependent heavy industries. • Consideration should be made to preserve opportunities for intensification of waterfront sites. • Consideration will need to be given to the mixing of waterfront industrial groundside traffic and traffic associated with light industrial areas and potential new business park areas.
Non-Waterfront: North of CNR/west of Amherst Ave. **Light Industrial**	• Development of owner occupied office space, in strata titled multi-tenant buildings. • Proximity to waterfront industrial activities allow trickle down industries to locate close to these activities. • There are some large properties, which offer redevelopment potential. • Maplewood Plaza and the Maplewood Pub provide some existing commercial services for employees.	• Too expensive to renovate or add on or strata title existing Light Industrial buildings. • New development must respect environmental setback requirements from Seymour River & conservation areas. • Most traffic is channeled onto Riverside Drive, then enters Dollarton Highway. Amherst Avenue provides only a limited alternative for access into the area. • Poor pedestrian facilities.	• Existing light industrial buildings will not likely intensify or redevelop until nearby vacant lands have been developed. • Road improvements will be necessary at the intersection of Riverside Drive and the proposed re-alignment of Dollarton Highway. A secondary access (such as Amherst Ave. should also be maintained). • Employees will likely continue to drive to and from work, as well as to commercial services, until better pedestrian facilities are constructed and more services are available within proximity. •
Non-Waterfront: CXY Chemical Site [north of CNR] **Business Park, Light Industrial & Light Industrial/Office**	• New development will provide a buffer and transition area between northern business park & residential uses and waterfront Heavy Industrial & Port/Marine Industrial development south of the CNR. • There is demand for business park uses on the North Shore. • Close proximity to Trans Canada Highway, as well as Dollarton Highway/Main Street and Mount Seymour Parkway. • The proposed re-alignment of Dollarton Highway will provide excellent road access to this site and define good development parcels. • CNR defines a boundary between existing waterfront heavy/port related industrial uses, and potential future light industrial and business park uses.	• Implications of proximity to the CXY Chemical plant and the associated impacts of a potential chlorine spill need to be determined. • Access on/off of Trans Canada Highway is not optimal and would likely require • Site is currently heavily treed.	• Special setbacks which recognize the hazard of a potential chemical or chlorine spill could limit the location and type of future new land uses and development for this site. • Removal of trees could result in environmental impacts as well as impacting the views of existing residents along Windridge Drive. • Completion of the proposed re-alignment of Dollarton Highway is essential to the development of this site proceeding. • Improvements to/from the Trans Canada Highway either via Riverside Drive to Mount Seymour Parkway or along Dollarton/Main Street will provide better access to potential development of this site. • Cooperation of property owners, developers and the District of North Vancouver will be essential to ensure services

Figure 6.9

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DEVELOPMENT OPPORTUNITIES, CONSTRAINTS & IMPLICATIONS
LYNNMOUR (LOWER LYNN)

LAND USE CHOICES	OPPORTUNITIES	CONSTRAINTS	ISSUES/IMPLICATIONS
Waterfront & Port Related			
Heavy Industrial, Port/Marine Industrial & Transportation	• Intensification of Lynnterm, with the construction of more "value added" buildings. • Excellent access by water and by rail. • Intensification of Marine Industries (fisheries, marina, boat repair) will occur to east on First Nation's lands.	• Limited road access through one point of entry on Mountain Hwy. • Greater interaction needed between Lynnterm (in DNV) and Seaboard Terminals (in CNV) by crossing Lynn Creek. • Expansion of Lynnterm to the west must respect environmental setback requirements for Lynn Creek.	• Alternative rail crossings are required, or alternatively, additional capacity needs to be built into existing crossing, and Main St./Mountain Hwy. intersection to foster intensification of port lands. • If above is not undertaken, alternative is for various jurisdictions to develop a connection, but this may have environmental impacts on Lynn River. • Watercourse setbacks may limit some development activity, but will preserve riparian features.
Non-Waterfront: South of CNR			
Light Industrial & Light Industrial/Office	• Some redevelopment of underutilized sites with free-hold strata titled multi-tenant buildings rather than rental buildings. • Proximity to Lynnterm port activities allow trickle down industries to locate close to these activities.	• Limited road access through one point of entry on Mountain Hwy. • Road access is further paralyzed by congestion at the intersection of Mountain Hwy. and Main St., caused by the approach to the Second Narrows Bridge. • In order to allow a greater density of development, an additional crossing or improvement of the Mountain Hwy. crossing of the railway will likely be required to facilitate increased vehicle traffic. • Due to the road system constraints noted above, business park development will not be attracted to this area. • High land values and small parcel configuration limit the size of buildings and types of users that will have the ability to afford this location.	• Development or redevelopment of area will be retarded by poor access. • District may need to further consider alternative configurations for getting in and out of this sub-area. • An additional crossing would be an expensive prospect. It may be difficult to fund such improvements from development revenues. Funding will have to come from other sources. • Business park development will be attracted to cheaper, more accessible vacant industrial lands in Maplewood or Fullerton/Capilano Business Park area. • Unavailability of developable parcels and high property values will cause timing of any redevelopment initiatives to be long term.
Non-Waterfront: North of CNR			
Light Industrial & Light Industrial/Office	• Limited redevelopment of underutilized sites, likely with free-hold strata titled multi-tenant buildings rather than rental buildings. • Close proximity to Second Narrows Bridge and access to other municipalities. • Close proximity to North Shore studios (in CNV), thus opportunity for trickle down users.	• High land values and small parcel configuration limit the size of buildings and types of users that will have the ability to afford this location. • Poor pedestrian facilities for linkages to northern Second Narrows Bridgehead. • Traffic congestion at intersection of Mountain Hwy./Main St.	• Unavailability of developable parcels and high property values will cause timing of any redevelopment initiatives to be long term. • Will discourage business park development. Light industrial employees will continue to drive to/from work and to retail services. • Will constrain access to properties near this intersection for vehicle loading/unloading uses.
Mixed Commercial Retail/Office	• Opportunity for a mixed-use gateway from the northern Second Narrows Bridgehead into Lynnmour. • Intensification and/or redevelopment of the Lynnmour Note site with mixed commercial retail/office use.	• Poor pedestrian facilities for linkages to northern Second Narrows Bridgehead. • Traffic congestion at intersection of Mountain Hwy./Main St.	• Improvements to the bridge approach from eastbound Main Street will be necessary, for vehicles and pedestrians (including linkages to the transit loop).
Mixed Residential/Commercial	• Intensification and/or redevelopment of the northwest corner of Mountain Hwy./Main St. with Mixed Residential/Commercial development, in 5 to 10 year horizon.	• Poor pedestrian facilities for linkages to northern Second Narrows Bridgehead. • Traffic congestion at intersection of Mountain Hwy./Main St.	• Improvements to the bridge approach from eastbound Main Street will be necessary, for vehicles and pedestrians (including linkages to the transit loop).
Vanine Bakery Site			
Light Industrial & Light Industrial/Office	• Same as for "Non-Waterfront: North of CNR" area noted above.	• Same as for "Non-Waterfront: North of CNR" area noted above.	• Same as for "Non-Waterfront: North of CNR" area noted above.
Mixed Residential/Commercial	• Redevelopment of Main St. frontage with Mixed Residential/Commercial development, in 5 to 10 year horizon.	• Same as for "Non-Waterfront: North of CNR" area noted above. • Limited public facilities (schools, parks, community centres) in direct vicinity.	• Same as for "Non-Waterfront: North of CNR" area noted above. • Will influence the type of mixed commercial residential uses that might develop along Main St.
Main Street Corridor			
Retail	• Intensification of additional retail uses along underutilized sites along Main Street, west of Mountain Hwy. in 1 to 5 year horizon.	• Traffic congestion along Main St. limits opportunities for street parking and driveway accesses. • Many properties are narrow and deep, therefore having small lots layout onto Main St.	

7. Evaluation of Land Use Choices & Policy Recommendations

This chapter further evaluates the land use choices (identified by the market analysis in Chapters 3, 4 and 6) on the basis of their ability to achieve "complete community" objectives. From this evaluation policy directions are established and compared against existing District of North Vancouver policies. Where necessary, amendments to existing policies are proposed.

Figure 7.1 summarizes the various land use choices identified by the market analysis, for each of the industrial and commercial sub-areas, including both existing and future potential land uses. The locations of the various sub-areas are illustrated in the previous chapter, in **Figures 6.2 through 6.4.**

7.1 Evaluation of Land Use Choices

7.1.1 Evaluation Criteria

Criteria were established to evaluate the ability of land use choices for industrial and commercial lands to meet complete community objectives. These criteria were selected on the basis of current accepted complete community objectives as articulated in the Livable Region Strategic Plan (LRSP) and the District of North Vancouver terms of reference for this study. The following components of a complete community are identified in these documents:

- Working, and having the ability to obtain services, close to home;
- Achieving an economically viable local community;
- Having a lower dependency on the automobile;
- Establishing a balance between local jobs and housing;
- Encouraging a high quality of life; and,
- Preserving environmental integrity.

Based upon these complete community attributes, the following evaluation criteria were identified for industrial and commercial lands:

Figure 7.1

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EXISTING & POTENTIAL NEW LAND USES

AREA	LAND USE																
	Commercial					Industrial						Other					
	Retail	Office	Service	Big Box Retail	Hotel/Accommodation	Heavy Industrial	Port/Marine Industrial	Transportation	Outdoor Storage	Light Industrial	Business Park	Residential	Mixed Residential/Commercial	Institutional (Library, School, etc.)	Recreation Facility (Ice Rink, Pool, etc.)	Vacant
INDUSTRIAL AREAS:																
Pemberton/Welch																
Waterfront & Port Related South of BCR						■	■	■	■							
Non-Waterfront: North of BCR and East of Lloyd Ave.		■	■						■	■	■					
Non-Waterfront: West of Lloyd/East of Pemberton Ave.	■	■	■							■						
Non-Waterfront: Flanking Pemberton Ave.	■	■	■							■						
Lynnmour (Lower Lynn)																
Waterfront & Port Related						■	■	■	■							
Non-Waterfront: South of CNR								■	■	■						
Non-Waterfront: North of CNR	■	■	■		■				■	■	●		■			
Venice Bakery Site										■	●		●			
Maplewood																
Waterfront & Port Related South of CNR						■	■	■	■	■						
Non-Waterfront: North of CNR, west of Amherst Ave.									■	■						
CXY Vacant Lands		●		●			●			●	●				●	■
Proposed Maplewood Business Park		●								●	●	■				■
VPC Vacant Lands North of Dollarton Hwy.										●	●	●		■	●	■
Tolko Industries Site						■	■	■	■	●	●				●	■
Dollarton Shipyard (Cates)						■	■	■	■	●		●	●			
COMMERCIAL AREAS:																
Marine Drive Corridor																
Marine Dr./Pemberton Ave. Node	■	■	■										●			
Marine Dr./Capilano Rd. Node	■	●	■		■								■			■
Marine Dr. Corridor Between Mackay Ave. & Capilano Rd.	■	■	■		■								●			
Edgemont Village	■	■	■										●	■		
Lynn Valley																
Lynn Valley Mall	■	■	■										●			
Lynn Valley Centre Area	■	■	■										●	■		
Maplewood Plaza	■	●	■										■			
Proposed Windridge Centre	●	●	●									■	●			■

Existing Land Uses = ■

Potential New Land Uses = ●

Employment Criteria:

- Create additional local employment opportunities;
- Improve the housing/jobs balance within the District; and,
- Improve the variety of employment types within the District.

Environmental Criteria:

- Maintain environmental integrity (i.e. minimize negative impacts).

Transportation Criteria:

- Reduce vehicle use for commuting out of the District;
- Proximity to major transportation routes (i.e. highways & arterial roads); and,
- Compatible and supportive of public transit services.

Development Criteria:

- Improve taxable value of the land;
- Ability to service local customers (Residents & Employees); and,
- Benefit from proximity of adjacent land uses.

7.1.2 Evaluation Method

Using the above criteria, matrices were prepared to evaluate each of the existing and potential new land uses for the industrial and commercial sub-areas. These matrices are illustrated in **Figures 7.2 and 7.3**, entitled, "*Evaluation of Land Use Choices for Industrial Areas Against Complete Community Planning Objectives*" and "*Evaluation of Land Use Choices for Commercial Areas with Complete Community Planning Objectives*", respectively.

The matrices were evaluated on the basis of findings in previous chapters. Land use choices were rated as "High", "Moderate" or "Low" in addressing each of the criteria. Each land use was examined in term of its ability to achieve all of the complete community objectives. Numerical scores were attributed on the following basis:

High (H)	=	3
Moderate (M)	=	2
Low (L)	=	1
Not Applicable	=	0

As well, the evaluation criteria have been weighted to reflect the importance of the various complete community objectives. A weighting factor based upon criteria significance (as shown in **Figures 7.2 and 7.3**) has been applied to the High, Moderate, Low evaluation scores for these criteria (for example a High evaluation score of 3 multiplied by a weighting factor of 3 equals a total score of 9 for an individual criterion). The weighting is as follows:

Criteria	Weight Factor
Employment Criteria:	
• Create additional local employment opportunities.	4
• Improve the housing/jobs balance within the District.	3
• Improve the variety of employment types within the District.	2
Environmental Criteria:	
• Maintain environmental integrity (i.e. minimize negative impacts).	3
Transportation Criteria:	
• Reduce vehicle use for commuting out of the District.	3
• Proximity to major transportation routes.	1
• Compatible and supportive of public transit services.	1
Development Criteria:	
• Improve taxable value of the land.	2
• Ability to service local customers (Residents & Employees).	2
• Benefit from proximity of adjacent land uses.	1

Ranges of "Total Rating" scores were established as follows in order to determine an "Average Overall Rating" of each land use to achieve all of the complete community objectives:

High (H)	=	Total Score of 56 to 66.
Moderate (M)	=	Total Score of 34 to 55.
Low (L)	=	Total Score of 0 to 33.

The "Total Rating" and "Average Overall Rating" for each of the industrial and commercial land use choices are shown in the last two columns (which are highlighted) of **Figures 7.2 and 7.3.**

Figure 7.2

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EVALUATION OF LAND USE CHOICES FOR INDUSTRIAL AREAS WITH COMPLETE COMMUNITY PLANNING OBJECTIVES

AREA/LAND USE	EVALUATION CRITERIA											
	Employment			Envir.	Transportation			Development				
	Create Additional Local Employment Opportunities	Improve the Housing/Jobs Balance within the District	Improve Variety of Employment Types within the District	Maintain Environmental Integrity (ie. minimize negative impacts)	Potentially Reduce Vehicle Use by Reducing Commuting Out of District	Proximity to Major Transportation Routes	Compatible and Supportive of Public Transit Services	Improve Taxable Value of Land	Ability to Service Local Customers (Residents & Employees)	Benefit from Proximity of Adjacent Existing Uses	* Total Rating	** Average Overall Rating
Criteria Weight Factor	4	3	2	3	3	1	1	2	2	1		
Pemberton/Welch												
Waterfront & Port Related:												
Intensification of Existing Land Uses:												
Heavy Industrial	M	L	M	L	H	L	L	L	-	H	34	M
Port/Marine Industrial	M	L	M	L	H	L	L	L	-	H	34	M
Transportation	M	L	M	L	H	L	L	L	L	H	36	M
Outdoor Storage	L	L	L	M	L	M	L	L	-	H	28	L
Non-Waterfront - All Sub-Areas:												
Intensification of Existing Land Uses:												
Light Industrial	H	M	H	M	H	L	L	M	M	M	51	M
Commercial	H	M	H	H	H	L	M	H	M	M	57	H
Business Park	H	M	H	H	H	L	M	H	M	H	58	H
Lynnmour (Lower Lynn)												
Waterfront & Port Related:												
Intensification of Existing Land Uses:												
Heavy Industrial	M	L	L	L	H	L	L	L	-	H	32	L
Port/Marine Industrial	M	L	L	L	H	L	L	L	-	H	32	L
Transportation	M	L	L	L	H	L	L	L	-	H	32	L
Outdoor Storage	L	L	L	M	L	M	L	L	-	H	28	L
Non-Waterfront - All Sub-Areas:												
Intensification of Existing Land Uses:												
Light Industrial	H	M	H	M	H	M	M	M	M	M	53	M
Future Potential Land Uses:												
Business Park	H	M	H	H	H	M	H	H	M	H	60	H
Mixed Residential/Commercial	M	H	H	H	M	M	H	H	H	L	56	H
Maplewood												
Waterfront & Port Related:												
Intensification of Existing Land Uses:												
Heavy Industrial	M	H	M	L	H	M	L	L	-	H	41	M
Port Marine Industrial	M	H	M	L	H	M	L	L	-	H	41	M
Transportation	M	H	M	L	H	M	L	L	-	H	41	M
Outdoor Storage	L	L	L	M	L	M	L	L	-	H	28	L
Non-Waterfront: North of CNR/west of Amherst:												
Intensification of Existing Land Uses:												
Light Industrial	M	M	H	M	H	M	L	M	M	H	49	M
CXY Vacant Lands												
Future Potential Land Uses:												
***Big Box Retail	H	M	M	H	H	H	M	H	H	L	58	H
Port/Marine Industrial	M	M	M	L	M	H	M	L	L	H	39	M
Light Industrial	H	H	H	M	H	H	M	H	M	H	60	H
Business Park/Office	H	H	H	H	H	H	H	H	M	M	63	H
Recreational Facility (Ice Rink, Pool, etc.)	M	M	H	H	H	H	M	L	H	-	51	M

Figure 7.2

District of North Vancouver - Economic Development Strategy Study

EVALUATION OF LAND USE CHOICES FOR INDUSTRIAL AREAS WITH COMPLETE COMMUNITY PLANNING OBJECTIVES

AREA/LAND USE	EVALUATION CRITERIA											
	Employment			Envir.	Transportation			Development				
	Create Additional Local Employment Opportunities	Improve the Housing/Jobs Balance within the District	Improve Variety of Employment Types within the District	Maintain Environmental Integrity (ie. minimize negative impacts)	Potentially Reduce Vehicle Use by Reducing Commuting Out of District	Proximity to Major Transportation Routes	Compatible and Supportive of Public Transit Services	Improve Taxable Value of Land	Ability to Service Local Customers (Residents & Employees)	Benefit from Proximity of Adjacent Existing Uses	* Total Rating	** Average Overall Rating
Criteria Weight Factor	4	3	2	3	3	1	1	2	2	1		
Proposed Maplewood Business Park												
Intensification of Existing Land Uses:												
***Residential	-	-	-	H	-	H	L	L	-	-	15	L
Future Potential Land Uses:												
Light Industrial	H	H	H	M	H	H	M	H	M	M	59	H
Business Park/Office	H	H	H	H	H	H	H	H	M	M	63	H
VPC Vacant Lands North of Dollarton Hwy.												
Intensification of Existing Land Uses:												
Institutional (Library, School, etc.)	M	M	H	H	H	M	H	L	H	H	54	M
Future Potential Land Uses:												
Light Industrial	H	H	H	M	H	M	M	H	M	M	58	H
Business Park	H	H	H	H	H	M	H	H	M	M	62	H
***Residential	-	-	-	H	-	M	M	M	-	-	17	L
Recreational Facility (Ice Rink, Pool, etc.)	M	M	H	H	H	M	M	L	H	M	52	M
Teiko Industries Site												
Intensification of Existing Land Uses:												
Heavy Industrial	M	H	M	L	M	M	L	L	L	H	40	M
Port/Marine Industrial	M	H	M	L	M	M	L	L	L	H	40	M
Outdoor Storage	L	L	L	M	L	M	L	L	L	H	28	L
Future Potential Land Uses:												
Light Industrial	H	H	H	M	H	M	M	H	M	H	59	H
Business Park	H	H	H	H	H	M	H	H	M	M	62	H
Recreational Facility (Ice Rink, Pool, etc.)	M	M	H	H	H	M	M	L	H	-	50	M
Dollarton Shipyard (Cates)												
Intensification of Existing Land Uses:												
Heavy Industrial	L	M	M	L	M	L	L	L	L	-	29	L
Port/Marine Industrial	M	M	M	L	M	L	L	L	L	-	33	L
Future Potential Land Uses:												
Light Industrial	H	H	H	M	H	L	M	H	M	L	56	H
Mixed Residential/Commercial	L	H	M	H	M	L	H	H	M	L	47	M
Residential	-	-	-	H	-	L	H	H	-	-	19	L

High = H Moderate = M Low = L

* = In order to rate the various land use choices, a score of L=1, M=2 and H=3 has been applied to each of the criteria. In some cases, criteria are weighted, as noted in the row beneath the criteria descriptions. The "Total Rating" column equals the total of these weighted scores for each land use choice.

** = The "Average Overall Rating" column averages the overall rating of L, M, or H over all of the criteria for each land use choice. The ranges are based on a the following "Total Rating" scores: L = 0-33, M=34-55, H=56-66.

*** = These land use choices may be limited by the chemical spill contours for the chemical plants. However, if in the future the chemical plant uses change, market support for these uses has been identified.

Figure 7.3

District of North Vancouver - Economic Development Strategy Study

EVALUATION OF LAND USE CHOICES FOR COMMERCIAL AREAS WITH COMPLETE COMMUNITY PLANNING OBJECTIVES

AREA/LAND USE	EVALUATION CRITERIA											
	Employment			Envir.	Transportation			Development				
	Create Additional Local Employment Opportunities	Improve the Housing/Jobs Balance within the District	Improve Variety of Employment Types within the District	Maintain Environmental Integrity (ie. minimize negative impacts)	Reduce Vehicle Use for Commuting Out of District	Proximity to Major Transportation Routes	Compatible and Supportive of Public Transit Services	Improve Taxable Value of Land	Ability to Service Local Customers (Residents & Employees)	Benefit from Proximity of Adjacent Uses	* Total Rating - Land Use Choice	** Average Overall Rating - Land Use Choice
Criteria Weight Factor	4	3	2	3	3	1	1	2	2	1		
Marine Drive Corridor												
Marine Dr./Pemberton Ave. Node												
Existing Land Uses:												
Retail	M	H	M	H	H	H	H	M	M	H	66	H
Office	H	H	H	H	H	H	H	H	M	H	64	H
Service	M	H	M	H	H	H	H	M	M	H	56	H
Future Potential Land Uses:												
Mixed Residential/Commercial	M	H	M	H	H	H	H	H	H	H	60	H
Marine Dr./Capilano Rd. Node												
Existing Land Uses:												
Retail	M	H	M	H	H	H	H	M	M	H	56	H
Service	M	H	M	H	H	H	H	M	M	H	56	H
Hotel/Accommodation	H	H	H	H	M	H	H	H	L	H	59	H
Future Potential Land Uses:												
Office	H	H	H	H	H	H	H	H	M	H	64	H
Mixed Residential/Commercial	M	H	M	H	H	H	H	H	H	H	60	H
Marine Dr. from Mackay Ave. & Capilano Rd.												
Existing Land Uses:												
Retail	M	H	M	H	H	H	H	M	M	H	58	H
Service	M	H	M	H	H	H	H	M	M	H	56	H
Office	H	H	H	H	H	H	H	H	M	H	64	H
Hotel/Accommodation	H	H	H	H	M	H	H	H	M	H	61	H
Future Potential Land Uses:												
Mixed Residential/Commercial	M	H	M	H	H	H	H	H	H	H	60	H
Edgemont Village												
Existing Land Uses:												
Retail	L	H	L	H	H	L	H	L	H	H	48	M
Service	L	H	L	H	H	L	H	L	H	H	48	M
Office	L	H	L	H	H	L	H	L	H	H	48	M
Institutional (Library, School, etc.)	L	M	L	H	L	L	H	L	H	H	39	M
Future Potential Land Uses:												
Mixed Residential/Commercial	M	H	L	H	M	L	H	H	H	H	53	M
Lynn Valley												
Existing Land Uses:												
Retail	M	H	M	H	H	M	H	M	H	H	57	H
Service	M	H	M	H	H	M	H	M	H	H	57	H
Office	H	H	H	H	H	M	H	H	H	H	65	H
Future Potential Land Uses:												
Mixed Residential/Commercial	M	H	M	H	H	M	H	H	H	H	59	H

Figure 7.3

District of North Vancouver - Economic Development Strategy Study

EVALUATION OF LAND USE CHOICES FOR COMMERCIAL AREAS WITH COMPLETE COMMUNITY PLANNING OBJECTIVES

AREA/LAND USE	EVALUATION CRITERIA											
	Employment			Envir.	Transportation			Development				
	Create Additional Local Employment Opportunities	Improve the Housing/Jobs Balance within the District	Improve Variety of Employment Types within the District	Maintain Environmental Integrity (ie. minimize negative impacts)	Reduce Vehicle Use for Commuting Out of District	Proximity to Major Transportation Routes	Compatible and Supportive of Public Transit Services	Improve Taxable Value of Land	Ability to Service Local Customers (Residents & Employees)	Benefit from Proximity of Adjacent Uses	* Total Rating - Land Use Choice	** Average Overall Rating - Land Use Choice
Lynnmour at Main St./Mountain Hwy.												
Existing Land Uses:												
Retail	M	L	M	H	M	H	H	H	M	M	48	M
Service	M	L	M	H	M	H	H	H	M	M	48	M
Office	H	M	H	H	M	H	H	H	M	H	58	H
Mixed Residential/Commercial	M	L	M	H	M	H	H	H	M	L	47	M
Maplewood Plaza												
Existing Land Uses:												
Retail	M	H	M	H	H	H	M	M	H	H	57	H
Service	M	H	M	H	H	H	M	M	H	H	57	H
Residential	-	H	-	H	L	H	M	L	H	H	37	M
Mixed Residential/Commercial	M	H	M	H	M	H	M	M	H	H	54	M
Future Potential Land Uses:												
Office	H	H	M	H	H	H	M	H	H	M	62	H
Proposed Windridge Centre												
Existing Land Uses:												
Residential	-	-	-	H	-	H	M	H	L	L	23	L
Future Potential Land Uses:												
Retail	M	H	M	H	M	H	M	H	H	M	55	M
Service	M	H	M	H	M	H	M	H	H	M	55	M
Office	H	H	H	H	H	H	M	H	H	H	65	H
Mixed Residential/Commercial	M	H	M	H	M	H	M	H	H	H	56	M

High = H Moderate = M Low = L

* = In order to rate the various land use choices, a score of - =0, L=1, M=2 and H=3 has been applied to each of the criteria. In some cases, criteria are weighted, as noted in the row beneath the criteria descriptions. The "Total Rating" column equals the total of these weighted scores for each land use choice.

** = The "Average Overall Rating" column averages the overall rating of L, M, or H over all of the criteria for each land use choice. The ranges are based on a the following "Total Rating" scores: L = 0-33, M=34-55, H=56-66.

*** = These land use choices may be limited by the chemical spill contours for the chemical plants. However, if in the future the chemical plant uses change, market support for these uses has been identified.

7.2 Evaluation Findings & Policy Implications

This section summarizes significant evaluation findings (from the evaluation matrices in **Figures 7.2 and 7.3)** and suggests policy directions, which would accommodate land use choices which **achieve complete community objectives and respond to market demands**. These policy directions are compared against existing District of North Vancouver policies. Where necessary, required policy actions are recommended to amend existing policies.

7.2.1 Industrial Areas

This sub-section presents overall observations, as well as specific observations and policy implications for each of the industrial sub-areas.

Overall Observations

- Potential new business park land uses stand out as having the greatest potential to achieve all of the complete community objectives, with "High" Average Overall Ratings. This is especially so for the following sub-areas:

  - CXY Chemical site in Maplewood;
  - Proposed Maplewood Business Park;
  - VPC vacant lands north of Dollarton Highway in Maplewood; &
  - Tolko Industries site (east of Forester Ave.) in Maplewood.

- Potential new light industrial land uses also closely meet the complete community objectives, with Average Overall Ratings in the upper "Moderate" range. This is especially noticeable for the following sub-areas:

  - CXY Chemical site in Maplewood;
  - Proposed Maplewood Business Park;
  - VPC vacant lands north of Dollarton Highway in Maplewood; &
  - Tolko Industries site (east of Forester Ave.) in Maplewood.

- Intensification of existing light industrial uses have a "Moderate" capacity to achieve complete community objectives.

- Development of potential new industrial development and intensification of existing industrial areas will reduce the need for commuting out of the District by providing greater employment opportunities within the District.

- Poor proximity and access to existing public transit services is an impediment to the development or intensification of all of the industrial areas.

- By and large, the market analysis findings and complete community objectives evaluation identified that industrial areas will not noticeably have the ability to attract development or redevelopment for commercial or residential land uses.

Sub-Area Observations & Policy Implications

7.2.1.1 Pemberton/Welch

A) Waterfront Industrial Areas

Evaluation Findings:

- Intensification with additional heavy industrial, port/marine and transportation uses will "Moderately" achieve complete community objectives for the following reasons:
  - new development will generate only a limited amount of new employment;
  - new development will have some environmental impacts (relating to noise, emissions, potential cargo spill or fire accidents, etc.);
  - new development will provide some opportunities for local residents to work within the District;
  - these uses are not compatible and supportive of public transit services, rail line separation complicates any potential for transit service;
  - new development will greatly benefit from proximity to existing uses of a similar type, including transportation and port facilities;
  - new development will have a very small capacity to generate additional property tax revenue.

Consistency of Complete Community Objectives with Market Findings:

- Although intensification with additional heavy industrial, port/marine and transportation uses will only "Moderately" achieve complete community objectives, market findings indicate there is long term demand to intensify these areas with development of heavy industrial, port/marine and transportation uses. Therefore, this type of development will ensure a consistent base of heavier industrial uses in the District over the twenty five year horizon. This diversity will be important for the long term employment base of the District.

Proposed Policy Directions:

- Policies and regulations should encourage preservation and intensification of existing waterfront port-oriented industrial areas for the development of additional heavy industrial, port/marine and transportation type uses.

- A distinct District Official Community Plan (OCP) land use designation for waterfront port-oriented industrial areas which distinguishes these areas from other light industrial or business park areas should be considered.

- Improved road access to heavy industrial, port and transportation type uses in existing waterfront port-oriented industrial areas should be supported, and the District of North Vancouver should continue to be proactive in the planning of these facilities with cooperation from provincial highways authorities, terminal operators, adjacent municipalities and the railways.

Consistency with Existing District Policies:

- The District OCP designates waterfront industrial lands as well as adjacent uplands located south of the BC Rail rights-of-way for "Industrial" uses, but does not distinguish waterfront industrial uses from upland industrial uses, or heavy industrial uses from light industrial uses.

- Land use designations in the recently prepared Lower Capilano OCP, which encompasses the Pemberton/Welch industrial area, are not consistent with the District OCP designations. The Lower Capilano OCP identifies designations for "Port Industrial" for areas designated "Industrial" in the District OCP.

- The existing I1 - Waterfront Industrial Zone - effectively regulates the scope of heavy industrial uses which the market analysis has identified as having potential for long term intensification of the waterfront industrial areas.

- Existing policies are supportive of improving road access to heavy industrial, port and transportation type uses in existing waterfront port-oriented industrial areas, and should be emphasized.

Recommended Policy Actions:

- The District OCP designation for waterfront industrial areas and adjacent areas south of the BC Rail rights-of-way should be renamed "Port Industrial", to be distinct from non-waterfront upland light industrial areas.

Resulting Policy Implications:

Implementation of the above-noted policy recommendations will allow for the following to occur:

- accommodation and protection of heavy industrial, port/marine and transportation uses on waterfront and adjacent industrial lands, south of the BC Rail over the 25 year time frame.
- steady incremental growth of new jobs over the 25 year horizon.
- maintain a balanced employment base by preserving and encouraging some growth of the number of heavy industrial type jobs.

B) Non-Waterfront Industrial Areas

Evaluation Findings:

- Intensification of existing non-waterfront light industrial areas with additional light industrial uses will have a "Moderate" capacity to achieve complete community objectives for similar reasons to those for the waterfront industrial areas noted above, except for the following:
  - new development may have limited environmental impacts;
  - new development will have a limited capacity to support public transit services; and,
  - new development will maintain or only marginally increase the capacity to generate additional property tax revenue.

- Intensification of existing non-waterfront light industrial areas with business park and commercial uses will have the "Highest" capacity to achieve complete community objectives for the following reasons:
  - new development will have the ability to create a high proportion of additional employment;
  - new development will have little or no environmental impacts;
  - new development will provide opportunities for local
  - residents to work and obtain services within the District;
  - these uses will be partially supportive of public transit services;
  - employment opportunities generated by new development will provide alternatives for commuting out of the District; and,
  - new development will have an increased capacity to generate additional property tax revenue.

Consistency of Complete Community Objectives with Market Findings:

- Although intensification of existing non-waterfront light industrial areas with additional light industrial uses and new business park will have a "Moderate" to "High" ability to achieve complete community objectives, market findings indicate there is demand to intensify these areas with additional development of light industrial, commercial and some business park uses (subject to the property availability). Therefore, development of this type will strengthen the balance of employment and industrial/commercial land use types in the District.

Proposed Policy Directions:

Light Industrial Uses

- Encourage a greater proportion of office use in existing and potential future light industrial areas, but limit the amount of retail and service uses as accessory uses.

- Have the flexibility to accommodate a wide variety of industries.

- Encourage the development of multi-tenant strata titled light industrial buildings.

Business Park Uses

- Encourage integration of light industrial and business park areas.
- Have the flexibility to accommodate a wide variety of industries.
- Allow a wide range of parcel sizes, which have the ability to accommodate a variety of potential business park users.
- Allow a broad scope of permitted principal uses, including manufacturing, warehousing, and allowing large proportions of office.
- Have an ability to accommodate a proportion of office space ranging from 50% to 100% of the uses on any given site.
- Prohibit any form of heavy industry, or light industries that produce negative impacts for the community.
- Recognize the role of marine-related industries, but encourage these uses to locate in the greater diverse context of industrial and business park developments, where they could potentially act as a catalyst for other integrated uses including high technology.
- Focus on the ability of development and redevelopment of industrial lands to accommodate a flexible diverse mixture of integrated uses and industries, to foster cross-industry relationships and economies of scale for generation of local employment opportunities.
- Consider revised off-street parking requirements, which recognize the implementation of transportation alternatives (including public transit, pedestrian/cycling mobility, ride sharing and traffic demand management) and complete community objectives to encourage and attract business park users and development.
- Support improved public transit services and pedestrian facilities for light industrial and business park areas.

Consistency with Existing District Policies:

- The non-waterfront areas of Pemberton/Welch are currently designated in the District OCP for "Mixed Use". This designation does not distinguish between light industrial areas, commercial areas and business park areas.

- Land use designations in the recently prepared Lower Capilano OCP, which encompasses the Pemberton/Welch industrial area, are not consistent with the District OCP designations. The Lower Capilano OCP identifies designations of "Light Industrial", "Business Park" and "Mixed Use" for areas designated "Mixed Use" in the District OCP.

- Policies relating to "Business and Industry" within the Lower Capilano OCP effectively achieve most of the policy directions noted above with the exception of some consideration for limited retail or retail/service uses in the light industrial and business park areas, to service local employees.

- Most of the above-noted policy directions can be achieved by existing District policies and the regulations contained within the I2 (General Industrial) Zone, I3 (Light Industrial) Zone, CD13 Zone (which allows a mixture of limited office with a principal light industrial use), C8 (Commercial Business) Zone, CD3 and CD9 (for business park/office) Zones, and CD6 (for some business park and warehouse retail uses) Zone with the exception of the following:

  Light Industrial (I3):
  - Encourage a greater proportion of office use in existing and potential future light industrial areas; and,
  - Have the flexibility to accommodate a wide variety of industries.

  Business Park (CD3 and CD9):
  - Have the flexibility to accommodate a wide variety of industries.
  - Allow a wide range of parcel sizes, which have the ability to accommodate a variety of potential business park users.
  - Allow a broad scope of permitted principal uses, including manufacturing, warehousing, and allowing large proportions of office.
  - Consider revised off-street parking requirements, which recognize the implementation of transportation alternatives (including public transit, pedestrian/cycling mobility, ride sharing and traffic demand management) and complete community objectives to encourage and attract business park users and development.

Recommended Policy Actions:

- Establish new District OCP land use designations which distinguish between "Light Industrial" and "Business Park"[27] areas within the area currently designated as "Mixed Use" in the District OCP.

- On the District OCP map, industrial lands between Mackay and Lloyd Avenues should be designated "Business Park", while other non-waterfront portions of the Pemberton/Welch industrial area, north of the BC Rail should be designated "Light Industrial" (except for properties fronting Pemberton Avenue, which should be designated "Commercial Land Use").

- The Lower Capilano OCP should be refined to reflect the above-noted land use designations.

- The Lower Capilano OCP should establish development permit area guidelines which specifically address business park development, as well as the integration of business park, light industrial and commercial uses.

- Amend the I3 (Light Industrial) Zone to accommodate a wider variety and flexibility of uses, including the potential for at least 50% office space as a principal use.

- Prepare a new industrial zone for business parks, on the basis of the provisions of the existing CD3 and CD9 Zones, with revisions to accommodate a wider variety of uses on a variety of parcel sizes.

- Prepare off-street parking regulations for business parks, which recognize the implementation of transportation alternatives (including public transit, pedestrian/ cycling mobility, ride sharing and traffic demand management).

[27] Generally speaking, business parks should allow most uses that are permitted in light industrial areas, but should have a higher quality and lower density of development than conventional light industrial uses, with many business park users having higher proportions of office space than in traditional light industrial areas.

Resulting Policy Implications:

- Implementation of the above-noted policy recommendations will allow for the following to occur:
  - accommodation of short term market demand for the development of flexible business park development, with an opportunity for a large proportion of office space.
  - accommodation of long term intensification of light industrial areas, allowing a flexible mixture of uses, including office functions, catering to businesses that otherwise could not afford to locate in a new business park.
  - creation of some additional employment through the development of remaining business park sites in the short term and intensification of light industrial sites and buildings over the longer term.
  - stabilization and slight improvement of the property tax base over the longer term.

7.2.1.2 Lynnmour

A) Waterfront Industrial Areas

Evaluation Findings:

- Intensification with additional heavy industrial, port/marine and transportation uses will "Moderately" achieve complete community objectives for the following reasons:
  - new development will generate only a limited amount of new employment;
  - new development will have some environmental impacts (relating to noise, emissions, potential cargo spill or fire accidents, etc.);
  - new development will provide some opportunities for local
  - residents to work within the District;
  - these uses are not compatible and supportive of public transit services, rail line separation complicates any potential for transit service;
  - new development will greatly benefit from proximity to existing uses of a similar type, including transportation and port facilities;
  - new development will have a very small capacity to generate additional property tax revenue.

Consistency of Complete Community Objectives with Market Findings:

- Although intensification with additional heavy industrial, port/marine and transportation uses will only "Moderately" achieve complete community objectives, market findings indicate there is long term demand to intensify these areas with development of heavy industrial, port/marine and transportation uses. Therefore, this type of development will ensure a consistent base of heavier industrial uses in the District over the twenty five year horizon. This diversity will be important for the long term employment base of the District.

Proposed Policy Directions:

- Policies and regulations should encourage preservation and intensification of existing waterfront port-oriented industrial areas for the development of additional heavy industrial, port/marine and transportation type uses.

- A distinct District Official Community Plan (OCP) land use designation for waterfront port-oriented industrial areas which distinguishes these areas from other light industrial or business park areas should be considered.

- Improved road access to heavy industrial, port and transportation type uses in existing waterfront port-oriented industrial areas should be supported, and the District of North Vancouver should continue to be proactive in the planning of these facilities with cooperation from provincial highways authorities, terminal operators, adjacent municipalities and the railways.

Consistency with Existing District Policies:

- As with the Pemberton/Welch industrial area, the District OCP designates waterfront industrial lands within Lynnterm for "Industrial" uses, but does not distinguish waterfront industrial uses from upland industrial uses, or heavy industrial uses from light industrial uses.

- Land use designations in the Lower Lynn OCP, which encompasses the Lynnmour industrial area, are not consistent with the District OCP designations. The Lower Lynn OCP identifies designations for "Port Industrial" for areas designated "Industrial" in the District OCP.

- The existing I1 - Waterfront Industrial Zone - effectively regulates the scope of heavy industrial uses which the market analysis has identified as having potential for long term intensification of the Lynnterm waterfront industrial area.

- Existing policies are supportive of improving road access to heavy industrial, port and transportation type uses in existing waterfront port-oriented industrial areas.

Recommended Policy Actions:

- The District OCP designation for the Lynnterm waterfront industrial area south of the CN Rail (west of Harbour Avenue and south of Bay Street) should be renamed "Port Industrial", to be distinct from non-waterfront upland light industrial areas, and consistent with the Lower Lynn OCP.

- Existing "Industrial Policies" within the Lower Lynn OCP can effectively achieve the above-noted policy directions for waterfront and port-oriented industrial lands. However, policies to support and encourage additional road access and multi-jurisdictional co-operation in this regard, should be emphasized throughout the Lower Lynn OCP (including within the "Industrial Policies" section).

Resulting Policy Implications:

- Implementation of the above-noted policy recommendations will allow for the following to occur:
  - accommodation and protection heavy industrial, port/marine and transportation uses on waterfront and adjacent industrial lands, south of the CN Rail within Lynnterm over the 25 year time frame.
  - steady incremental growth of new jobs over the 25 year horizon.
  - maintain a balanced employment base by preserving and encouraging some growth of the number of heavy industrial type jobs.

B) Non-Waterfront Industrial Areas

Evaluation Findings:

- Intensification of existing non-waterfront light industrial areas with additional light industrial uses will have a "Moderate" capacity to achieve complete community objectives for similar reasons to those for waterfront industrial uses noted above, except for the following:
  - new development may have limited environmental impacts;
  - new development will have a limited capacity to support public transit services;
  - new development will maintain or only marginally increase the capacity to generate additional property tax revenue.

- Intensification of existing non-waterfront light industrial areas with business park uses will have the "Highest" capacity to achieve complete community objectives for the following reasons:
  - new development will have the ability to create a high proportion of additional employment;
  - new development will have little or no environmental impacts;
  - new development will provide opportunities for local residents to work and obtain services within the District;
  - these uses will be partially supportive of public transit services;

- employment opportunities generated by new development will provide alternatives for commuting out of the District; and,
- new development will have an increased capacity to generate additional property tax revenue.

- Re-development with mixed residential/commercial uses on some sites fronting the north side of Main Street, including the Venice Bakery site, will also have the "High" capacity to achieve complete community objectives for the same reasons as those noted for business park uses, as well as for the ability to service local customers.

Consistency of Complete Community Objectives with Market Findings:

- Market findings indicate there is demand to intensify these areas with additional development of light industrial and some business park uses, as well as some mixed commercial/residential uses fronting the north side of Main Street (subject to the property availability). For the reasons noted above, this type of development will have a "Moderate" to High" ability to achieve complete community objectives, and strengthen the balance of employment and industrial/commercial land use types in the District.

Proposed Policy Directions:

Light Industrial Uses

- Encourage a greater proportion of office use in existing and potential future light industrial areas, but limit the amount of retail and service uses as accessory uses.

- Have the flexibility to accommodate a wide variety of industries.

- Encourage the development of multi-tenant strata titled light industrial buildings.

Business Park Uses

- Encourage integration of light industrial and business park areas.

- Have the flexibility to accommodate a wide variety of industries.

- Allow a wide range of parcel sizes, which have the ability to accommodate a variety of potential business park users.

- Allow a broad scope of permitted principal uses, including manufacturing, warehousing, and allowing large proportions of office.

- Have an ability to accommodate a proportion of office space ranging from 50% to 100% of the uses on any given site.

- Prohibit any form of heavy industry, or light industries that produce negative impacts for the community.

- Recognize the role of marine-related industries, but encourage these uses to locate in the greater diverse context of industrial and business park developments, where they could potentially act as a catalyst for other integrated uses including high technology.

- Focus on the ability of development and redevelopment of industrial lands to accommodate a flexible diverse mixture of integrated uses and industries, to foster cross-industry relationships and economies of scale for generation of local employment opportunities.

- Consider revised off-street parking requirements, which recognize the implementation of transportation alternatives (including public transit, pedestrian/cycling mobility, ride sharing and traffic demand management) and complete community objectives to encourage and attract business park users and development.

- Support improved public transit services and pedestrian facilities for light industrial and business park areas.

Other Uses

- Consider re-development with mixed residential/commercial uses on some sites fronting the north side of Main Street, including the southern portion of the Venice Bakery site.

Consistency with Existing District Policies:

- The non-waterfront industrial areas of Lynnmour (not including areas designated for "Commercial Land Use") are currently designated in the District OCP for "Mixed Use". This designation does not distinguish between light industrial areas, commercial areas and business park areas.

- Land use designations in the Lower Lynn OCP, which encompasses the Lynnmour industrial area, are not consistent with the District OCP designations. The Lower Lynn OCP identifies designations of "Light Industrial", "General Industrial" and in some cases "Commercial" for areas designated "Mixed Use" in the District OCP. As well, the Lower Lynn OCP does not identify a "Business Park" land use designation, or a "Mixed Residential/Commercial" designation.

- The Lower Lynn OCP does not provide definitive policy statements to reflect the policy directions for light industrial, business park and mixed residential uses identified above by this study.

- The Lower Lynn OCP sets out development permit area guidelines for industrial and commercial development. However, these guidelines do not specifically address the development of business park type development, which typically is of a higher quality of urban and architectural design than conventional light industrial development.

- The Lower Lynn OCP does not set out development permit area guidelines for mixed residential/commercial development.

- There are currently no zoning districts to regulate potential business park development in Lynnmour. Some of the above-noted policy directions for light industrial uses can be achieved by existing District policies and the regulations contained within the I2 (General Industrial) Zone and I3 (Light Industrial) Zone, as well as in the CD5, CD11 and CD16 Zones (which allow a mixture of limited office with a principal light industrial use), and CD15 Zone (which allows an ice rink), with the exception of the following:

  Light Industrial (I3):
  - Encourage a greater proportion of office use in existing and potential future light industrial areas; and,
  - Have the flexibility to accommodate a wide variety of industries.

- The I2 (General Industrial) Zone is adequate for regulating light industrial land uses south of the CNR.

Recommended Policy Actions:

- Establish new District OCP land use designations which distinguish between "Light Industrial" and "Business Park"[28] areas within the area currently designated as "Mixed Use" in the District OCP.

- On the District OCP map, northern portions of the Venice Bakery site and adjacent vacant sites should be designated "Business Park", while other non-waterfront industrial portions of Lynnmour, outside of Lynnterm should be designated "Light Industrial" (except for some properties fronting Main Street and Mountain Highway which are already designated "Commercial Land Use"). Southern portions of the Venice Bakery site, which front Main Street, have the capacity to be designated for a mixed residential/commercial use.

- The Lower Lynn OCP map should be refined to incorporate the above-noted land use designations.

- Lower Lynn OCP policies regarding light industrial uses should be refined to reflect the policy directions for light industrial identified above by this study.

- Policies should be prepared for the Lower Lynn OCP to specifically address the potential development of business park and mixed residential/commercial uses.

- Development permit area guidelines should be prepared for business park industrial and mixed residential/commercial development.

- Strengthen existing industrial development permit guidelines to address the policy directions noted above and encourage an integration of light industrial and business park areas.

- Amend the I3 (Light Industrial) Zone to accommodate a wider variety and flexibility of uses, including the potential for at least 50% office space as a principal use.

[28] Generally speaking, business parks should allow most uses that are permitted in light industrial areas, but should have a higher quality and lower density of development than conventional light industrial uses, with many business park users having higher proportions of office space than in traditional light industrial areas.

- Prepare a new industrial zone for business parks, on the basis of the provisions of the existing CD3 and CD9 Zones, with revisions to accommodate a wider variety of uses on a variety of parcel sizes.

- Prepare off-street parking regulations for business parks, which recognize the implementation of transportation alternatives (including public transit, pedestrian/cycling mobility, ride sharing and traffic demand management).

Resulting Policy Implications:

- Implementation of the above-noted policy recommendations will allow for the following to occur:
  - accommodation of medium term market demand for the development of flexible business park development on available sites (which could include a portion of the Venice Bakery site), with an opportunity for a large proportion of office space.
  - accommodation of medium term market demand for the development of mixed residential commercial development on available sites fronting the north side of Main Street (which could include the southern portion of the Venice Bakery site).
  - accommodation of long term intensification of light industrial areas, allowing a flexible mixture of uses, including office functions, catering to businesses that otherwise could not afford to locate in a new business park.
  - creation of some additional employment through the development of business park sites in the medium term and intensification of light industrial sites and buildings over the longer term.
  - stabilization and improvement of the property tax base over the long term.

7.2.1.3 Maplewood

A) Waterfront Industrial Areas

Evaluation Findings:

- Intensification with additional heavy industrial, port/marine and transportation uses will "Moderately" achieve complete community objectives for the following reasons:
  - new development will generate only a limited amount of new employment;
  - new development will have some environmental impacts (relating to noise, emissions, potential chemical spill, fire or bulk cargo accidents, etc.);
  - new development will provide some opportunities for local
  - residents to work within the District;
  - these uses are not compatible and supportive of public transit services, rail line separation complicates any potential for transit service;
  - new development will greatly benefit from proximity to existing uses of a similar type, including transportation and port facilities;
  - new development will have a very small capacity to generate additional property tax revenue.

Consistency of Complete Community Objectives with Market Findings:

- Although intensification with additional heavy industrial, port/marine and transportation uses will only "Moderately" achieve complete community objectives, market findings indicate there is long term demand to intensify these areas with development of heavy industrial, port/marine and transportation uses. Therefore, this type of development will ensure a consistent base of heavier industrial uses in the District over the twenty five year horizon. This diversity will be important for the long term employment base of the District.

Proposed Policy Directions:

- Policies and regulations should encourage preservation and intensification of existing waterfront port-oriented industrial areas for the intensification of additional heavy industrial, port/marine and transportation type uses.

- A distinct District Official Community Plan (OCP) land use designation for waterfront port-oriented industrial areas which distinguishes these areas from other light industrial or business park areas should be considered.

- Improved road access to heavy industrial, port and transportation type uses in existing waterfront port-oriented industrial areas should be supported, and the District of North Vancouver should continue to be proactive in the planning of these facilities with cooperation from provincial highways authorities, terminal operators, adjacent municipalities and the railways.

Consistency with Existing District Policies:

- The District OCP designates waterfront industrial lands as well as adjacent uplands located south of the rail rights-of-way for "Industrial" uses, but does not distinguish waterfront industrial uses from upland industrial uses, or heavy industrial uses from light industrial uses.

- The Maplewood OCP identifies these same waterfront industrial areas for either "Port Industrial" or "Medium Industrial" uses, but includes the CXY, Mohawk and Sterling Chemical plants in the "Medium Industrial" area.

- The existing I1 - Waterfront Industrial Zone - effectively regulates the scope of heavy industrial uses which the market analysis has identified for long term intensification of the waterfront area.

- Existing policies are supportive of improving road access to heavy industrial, port and transportation type uses in existing waterfront port-oriented industrial areas, and should be emphasized.

Recommended Policy Actions:

- The District OCP designation for waterfront industrial areas and adjacent areas south of the rail rights-of-way should be renamed "Port Industrial", to be distinct from non-waterfront upland light industrial areas. This designation should encompass the areas shown in the Maplewood OCP as "Port Industrial", as well as portions of the CXY, Mohawk and Sterling Chemical sites, south of the CNR right-of-way.

- The Maplewood OCP land use map should be revised to reflect the above changes, and redesignate portions of the CXY, Mohawk and Sterling Chemical sites, south of the CNR right-of-way from "Medium Industrial" to "Port Industrial".

Resulting Policy Implications:

- Implementation of the above-noted policy recommendations will allow for the following to occur:
  - accommodation and preservation of heavy industrial, port/marine and transportation uses on waterfront and adjacent industrial lands, south of the CN Rail over the 25 year time frame.
  - steady incremental growth of new jobs over the 25 year horizon.
  - maintain a balanced employment base by preserving and encouraging some growth of the number of heavy industrial type jobs.

B) Non-Waterfront Industrial Areas

Evaluation Findings:

Existing Light Industrial Areas

- Intensification of existing non-waterfront light industrial areas with additional light industrial uses will have a "Moderate" capacity to achieve complete community objectives for similar reasons to those for waterfront industrial areas noted above, except for the following:
  - new development may have limited environmental impacts;
  - new development will have a limited capacity to support public transit services;
  - new development will maintain or only marginally increase the capacity to generate additional property tax revenue.

CXY Chemical Site in Maplewood

- Greatest potential for achieving complete community objectives rests with considering potential future new development of vacant lands with business park and/or light industrial uses, which both demonstrated a "High" capacity to achieve most of the complete community objectives for the following reasons:
  - new development will have the ability to create a high proportion of additional employment;
  - new development will have little or no environmental impacts;

- new development will provide opportunities for local
- residents to work and obtain services within the District;
- these uses will be partially supportive of public transit services;
- employment opportunities generated by new development will provide alternatives for commuting out of the District; and,
- new development will have an increased capacity to generate additional property tax revenue.

- For similar reasons to those noted above for business park uses, development of big box retail uses (notwithstanding the delineation of the potential chemical spill contours of the chemical plants) also demonstrated a "High" capacity to achieve complete community objectives.

- Development of a recreation facility demonstrated a "Moderate" capacity to achieve complete community objectives for the following reasons:
  - strong ability to reduce the need for commuting out of the District, and good proximity to major transportation routes;
  - strong ability to service local residents and employees;
  - strong ability to improve variety employment types; and,
  - low capacity to increase the taxable value of the land.

- Development of port/marine uses demonstrated a lower range of "Moderate" capacity to achieve the complete community objectives for the following reasons:
  - new development will have only a limited ability to create additional employment;
  - new development may have some negative environmental impacts; and,
  - new development will not significantly enhance the property taxation base.

Proposed Maplewood Business Park

- Greatest potential for achieving complete community objectives rests with considering potential future new development of vacant lands with business park and/or light industrial uses, which both demonstrated a "High" capacity to achieve most of the complete community objectives for the same reasons as those experienced for the adjacent CXY Chemical site.

- Notwithstanding safety restrictions on land use attributed to the potential chemical spill contours, development of any residential uses on the proposed Maplewood Business Park site would have a very low ability to achieve complete community objectives for the following reasons:
  - There would be little (generated by potential home based business) or no employment generated by residential development;
  - There would be little impact on reducing the need for District residents to commute out of the District for the journey to work;
  - From a commercial or industrial perspective, residential development would not service local customers, and would detract from the potential supply of industrial/commercial land.

VPC Vacant Lands (North of Dollarton Hwy.)

- Although the market findings indicate an immediate demand for residential uses for this site, the greatest potential for achieving complete community objectives rests with considering potential future new development of vacant lands with business park and/or light industrial uses, which both demonstrated a "High" capacity to achieve most of the complete community objectives, for the same reasons as those experienced for the nearby CXY Chemical and proposed Maplewood Business Park sites.

- Notwithstanding safety restrictions on land use attributed to the potential chemical spill contours, development of any residential uses on the proposed VPC lands north of Dollarton Highway would have a very low ability to achieve complete community objectives for the following reasons:
  - There would be little (generated by potential home based business) or no employment generated by residential development;
  - There would be little impact on reducing the need for District residents to commute out of the District for the journey to work;
  - From a commercial or industrial perspective, residential development would not service local customers, and would detract from the potential supply of industrial/commercial land.

- Development of a recreation facility demonstrated a "Moderate" capacity to achieve complete community objectives for the same reasons as those experienced for the nearby CXY Chemical site.

Tolko Industries Site

- Notwithstanding safety restrictions on land use attributed to the potential chlorine spill contours, the greatest potential for achieving complete community objectives rests with considering potential future new development of vacant lands with marine industrial, light industrial and/or business park uses, for the same reasons as those experienced for the nearby CXY Chemical and Maplewood Business Park sites.

- Intensification of existing heavy industrial uses only "Moderately" achieves complete community objectives for the following reasons:
  - new development will have only a limited ability to create additional employment;
  - new development may have some negative environmental impacts; and,
  - new development will not significantly enhance the property taxation base.

- Development of a recreation facility demonstrated a "Moderate" capacity to achieve complete community objectives for the same reasons as those experienced for the nearby CXY Chemical site.

Consistency of Complete Community Objectives with Market Findings:

- Market demand for the short term (0 to 5 year) and medium term (6 to 15 year) development of the vacant CXY Chemical, proposed Maplewood Business Park, and Tolko Industries sites with business park or light industrial uses is consistent with complete community objectives for the reasons noted for each sub-area above.

- Notwithstanding safety restrictions on land use attributed to the potential chemical spill contours, although there is short term market demand for residential development on the VPC vacant lands north of the Dollarton Highway, residential land use is not consistent with complete community objectives for the reasons noted in the sections above.

- Limited long term (16+ years) market demand for intensification of existing heavy industrial uses or development of port/marine uses only "Moderately" achieves complete community objectives for the reasons noted in the sections above.

Proposed Policy Directions:

Light Industrial Uses

- Encourage a greater proportion of office use in existing and potential future light industrial areas, but limit the amount of retail and service uses as accessory uses.
- Have the flexibility to accommodate a wide variety of industries.
- Encourage the development of multi-tenant strata titled light industrial buildings.
- Recognize the role of marine-related industries, but encourage these uses to locate in the greater diverse context of industrial and business park developments, where they could potentially act as a catalyst for other integrated uses including high technology.
- Allow for the limited development of recreation facilities including aquatic centres, ice rinks, etc.
- Focus on the ability of development and redevelopment of light industrial lands to accommodate a flexible diverse mixture of integrated uses and industries, to foster cross-industry relationships and economies of scale for generation of local employment opportunities.
- Should support improved public transit services and pedestrian facilities.
- Ensure there is a transition between waterfront heavy industries, light industries, business parks, commercial areas and residential areas.

Business Park Uses

- Encourage integration of light industrial and business park areas.
- Have the flexibility to accommodate a wide variety of industries.
- Allow a wide range of parcel sizes, which have the ability to accommodate a variety of potential business park users.

- Allow for a broad scope of permitted principal uses, including manufacturing, warehouses, and allowing high proportions of office and a limited amount of complementary retail services and recreation facilities/amenities orientated towards serving local employees.

- Have an ability to accommodate a proportion of office space ranging from 50% to 100% of the uses on any given site.

- Prohibit any form of heavy industry, or light industries that produce negative impacts for the community.

- Recognize the role of marine-related industries, but place these uses in the greater diverse context of business park development, as a catalyst for other integrated uses, including high technology.

- Focus on the ability of business park to accommodate a flexible diverse mixture of integrated uses and industries, to foster cross-industry relationships and economies of scale for generation of local employment opportunities.

- Consider revised off-street parking requirements, which recognize the implementation of transportation alternatives (including public transit, pedestrian/cycling mobility, ride sharing and traffic demand management) and complete community objectives to encourage and attract business park users and development.

- Should support improved public transit services and pedestrian facilities.

Other Uses

- Consideration should be given to allow residential or other uses, or a mixture of residential and business park uses on the VPC lands north of Dollarton Highway.

Consistency with Existing District Policies:

- The non-waterfront industrial areas of Maplewood are currently designated in the District OCP for either "Industrial", south of the CNR or "Mixed Use", north of the CNR. These designations do not distinguish between heavy industrial, light industrial, and business park areas.

- Land use designations identified in the Maplewood OCP, which encompasses the Maplewood industrial area, are not consistent with the District OCP land use designations. The Maplewood OCP distinguishes between "Port Industrial", "Medium Industrial", "Light Industrial" and "Mixed Use" for areas shown as either "Industrial" or "Mixed Use" in the District OCP, but does not identify a "Business Park" land use designation.

- The Maplewood OCP does not provide definitive policy statements to reflect the policy directions identified above by this study.

- The Maplewood OCP sets out development permit area guidelines for protection of the natural environment, protection of development from hazardous conditions and commercial, industrial and multi-family residential development. However, these guidelines do not specifically address the development of business park type development, which typically is of a higher quality of urban and architectural design than conventional light industrial development.

- Existing Maplewood OCP development permit area guidelines for the protection of natural environment are not current with recent federal and provincial guidelines regarding environmental protection. As well, guidelines for protection of development from hazardous conditions do not address the potential chemical spill contours associated with the proximity of new development to the existing chemical plants.

- There are currently no zoning districts to regulate potential business park development in Maplewood. A draft Comprehensive Development Zone has been considered for the CXY Chemical site as well as for the Maplewood Business Park site (based on a business park land use module in both cases). Some of the above-noted policy directions for light industrial uses can be achieved by existing District policies and the regulations contained within the I2 (General Industrial) Zone and I3 (Light Industrial) Zone, with the exception of the following:

  Light Industrial (I3):
  - Encourage a greater proportion of office use in existing and potential future light industrial areas; and,
  - Have the flexibility to accommodate a wide variety of industries.
  - Allow for the limited development of recreation facilities including aquatic centres, ice rinks, etc.

- To date, a detailed assessment of servicing strategies for new development in Maplewood and associated servicing costs has not been undertaken. As well, there is currently no Development Cost Charge (DCC) in place for industrial development.

Recommended Policy Actions:

- Establish new District OCP land use designations which distinguish between "Light Industrial" and "Business Park"[29] areas within the area currently designated as "Mixed Use" in the District OCP.

- On the District OCP map, vacant lands located on the CXY site north of the CNR and on the proposed Maplewood Business Park site should be designated "Business Park". The VPC lands north of the Dollarton Highway should incorporate a flexible split designation which allows a mixture of "Business Park", "Residential" and "Parks, Recreation, Open Space". Not including the Maplewood Plaza commercial area, the remaining non-waterfront portions of the Maplewood industrial area (and the Tolko site), north of the CNR should be designated "Light Industrial".

- More definitive policy statements which reflect the policy directions identified above by this study should be incorporated into the Maplewood OCP, to provide clear direction for the development of future land uses.

- Prepare development permit area guidelines which specifically address the development of business park type development.

- Update development permit area guidelines for the protection of natural environment to reflect recent federal and provincial guidelines regarding environmental protection.

- Update development permit area guidelines for protection of development from hazardous conditions to address the potential chemical spill contours associated with the proximity of new development to the existing chemical plants.

- Amend the I3 (Light Industrial) Zone to accommodate a wider variety and flexibility of uses, including the potential for at least 50% office space as a principal use.

[29] Generally speaking, business parks should allow most uses that are permitted in light industrial areas, but should have a higher quality and lower density of development than conventional light industrial uses, with many business park users having higher proportions of office space than in traditional light industrial areas.

- Prepare a new industrial zone for business parks, on the basis of the provisions of the existing CD9 Zone used in the Pemberton/Welch industrial area (east of Lloyd Avenue), with revisions to accommodate a wider variety of uses on a variety of parcel sizes.

- Prepare off-street parking regulations for business parks, which recognize the implementation of transportation alternatives (including public transit, pedestrian/cycling mobility, ride sharing and traffic demand management).

- The District should prepare a servicing strategy for future development in the Maplewood area, to identify servicing costs and establish a strategy for how servicing costs will be recovered. This strategy should involve an assessment of the merits of preparing a Development Cost Charge (DCC) bylaw for new light industrial and business park development, as well as other potential financial strategies.

Resulting Policy Implications:

- Implementation of the above-noted policy recommendations will allow for the following to occur:
  - accommodation of short and medium term market demand for the development of flexible business park uses on existing vacant industrial sites, with an opportunity for a large proportion of office space.
  - creation of significant additional employment through the development of business park uses on existing vacant industrial sites in the short and medium terms.
  - a significant improvement of the property tax base in the short and medium terms through the development of business park uses on existing vacant industrial sites.
  - accommodation of long term intensification of existing light industrial areas, allowing a flexible mixture of uses, including office functions, catering to businesses that otherwise could not afford to locate in a new business park.
  - creation of some additional employment through the intensification of existing light industrial areas over the medium term and longer terms.
  - use of some or all of the VPC lands north of Dollarton Highway (which are not required to fulfill short or medium term industrial market demand) for other land uses.
  - development of recreation facilities including aquatic centres, ice rinks, libraries, etc., as well as retail services for local employees within the context of a business park, in order to create a balanced employment centre.

- a community land use structure which is compatible and supportive of public transit services and mobility alternatives (including public transit, pedestrian/cycling mobility, ride sharing and traffic demand management).
- financially sound development of new land uses, which will have the ability to recover the costs of major infrastructure servicing improvements.
- a community structure which has little or no impact on the natural environment.

7.2.1.4 Dollarton Shipyard (Cates) Site

It should be noted that these findings are based only on the market analysis and complete community evaluation of land use choices identified by the technical analysis within this study. These findings do not take into account public, political or private opinions.

Evaluation Findings:

- Potential intensification of the Dollarton Shipyard (Cates) site with either heavy and/or port/marine industrial uses does not achieve complete community objectives. These industrial uses scored in the "Low" category for the following reasons:

  - existing or new development will generate little additional new employment;
  - existing or new development will have some environmental impacts (relating to noise, emissions, foreshore activity, potential cargo spill or fire accidents, etc.);
  - existing or new development will provide very few opportunities for local residents to work within the District;
  - the site is far removed from major ground transportation routes.
  - these uses are not compatible or supportive of public transit services, and although a public transit route passes the site along Dollarton Highway, buses travel this route only once every half hour;
  - since the site is far away from other industrial areas, other than its waterfront location, new development will have no benefit from proximity to existing adjacent uses; and,
  - existing or new development will have a small capacity to generate additional property tax revenue.

- Potential redevelopment of the Dollarton Shipyard (Cates) site with residential uses would improve the tax value of the land but would not achieve complete community objectives for the following reasons:

  - new development will generate little (through home based business) or no new employment, and therefore will not help the jobs/housing balance, but have an opposite affect;
  - although a public transit route passes the site along Dollarton Highway, buses travel this route only once every half hour, therefore potential future residents may still be heavily dependent on their automobiles to get around; and,
  - new development will not provide any service for local residents, other than providing additional housing choices.

- Potential redevelopment of the Dollarton Shipyard (Cates) site with mixed residential/commercial uses would "Moderately" achieve complete community objectives for the following reasons:

  - new development would generate some new employment, and have a positive affect on improving the jobs/housing balance;
  - new development would be compatible and supportive of public transit services;
  - new development would improve the taxable value of the land; and,
  - new development would service local residents.

- Although there is little market demand for potential redevelopment of the Dollarton Shipyard (Cates) site with light industrial uses, these uses would "Highly" achieve complete community objectives for the following reasons:

  - new development would generate new employment and have a positive affect on improving the jobs/housing balance;
  - new development would provide a variety of employment types for local residents;
  - new development would improve the taxable value of the land;
  - new development may have some ability to service local residents; and,
  - new development would provide alternatives for local residents from commuting out of the District.

Consistency of Complete Community Objectives with Market Findings:

- Although redevelopment of the Dollarton Shipyard (Cates) site with light industrial uses best achieves complete community objectives, future for marine or other industrial uses on the Dollarton Shipyard (Cates) site is uncertain and lacks the economic viability to encourage property owners to retain these industrial uses. Therefore, there will be continual pressure from property owners to change the land use on this site.

- Although there is short term market demand for residential development on the Dollarton Shipyard (Cates) site, residential uses alone do not achieve complete community objectives.

- There is short term market demand for mixed residential/commercial development on the Dollarton Shipyard (Cates) site. These uses would "Moderately" achieve complete community objectives.

Consistency with Existing District Policies:

- Although the Dollarton Shipyard (Cates) site is currently zoned I1 (Waterfront Industrial) Zone, the District Official Community Plan (OCP) does not clearly identify the site as being located within the "Industrial" or "Mixed Use" land use designations (in fact the site is currently designated "Parks, Recreational & Wilderness") .

- Similarly, the Seymour OCP does not clearly identify the site as being located within the "Industrial" or "Mixed Use" land use designations.

- Recently, a proposal to rezone the site from I1 (Waterfront Industrial) Zone to Comprehensive Development Zone for mixed residential/commercial and open space uses was rejected during the public hearing process.

- The waterfront half of the Dollarton Shipyard (Cates) site lies within the jurisdiction of the Vancouver Port Corporation (VPC). The VPC *Port 2010 Plan* notes that VPC will consider rezoning of private upland industrial sites for urban-related development, which could involve residential uses. Since VPC has indicated it will not require deep-sea use for the waterfront (and water lot) portion of the Dollarton

Shipyard (Cates) site, the VPC *Port 2010 Plan* also notes that VPC may consider redesigation of these waterfront areas from "Marine Use & Port Services" to "Port Recreation", in order to permit use compatible with the upland uses, if rezoning of the upland sites occurs in the future.

Recommended Policy Actions:

Unlike other industrial areas, recommended policy actions for the Dollarton Shipyard (Cates) site are presented as options, as follows:

Option A - Mixed Residential/Commercial/Open Space

- Redesignate the upland portions of the Dollarton Shipyard (Cates) site for a mixture of residential and some complementary waterfront commercial uses including outdoor recreation (canoe/kayak rental, etc.) and marine pub/restaurant.

- Designate waterfront portions, as well as a significant component of the upland portions of the site for natural and usable open space purposes, recognizing the opportunity for waterfront recreation activities, and to encourage public access to and along the water's edge, with a potential linkage to Cates Park.

- Encourage existing marine industrial uses to relocate to other waterfront industrial locations within the District including the Tolko Industries site in Maplewood.

- Encourage improved public transit service to the site and that buildings are designed in a manner that is supportive of transit service.

- Establish a development permit area with guidelines that will protect natural features, ensure a high quality of design which responds to the sloping waterfront location and recognizes adjacent existing residential uses.

- Establish infrastructure servicing and associated cost recovery strategies for servicing potential new development of the site.

Option B - Waterfront Industrial Reserve

- Designate the upland and waterfront portions of the Dollarton Shipyard (Cates) site for "Industrial Reserve" to accommodate existing and future potential marine industrial, light industrial or other industrial uses.

- Consider the preservation of existing shipyard buildings which have historical significance, and where possible, encourage public viewing areas of the industrial and waterfront activity along Dollarton Highway, and along the eastern edges of the property, with a potential linkage to Cates Park.

- Ensure that development permit area with guidelines will protect natural features, ensure good design for any new buildings, which responds to the sloping waterfront location, recognizes adjacent existing residential uses, and maintains existing views of Burrard Inlet from Dollarton Highway and existing adjacent residences.

- Establish infrastructure servicing and associated cost recovery strategies for servicing any potential new development of the site.

Resulting Policy Implications:

Option A - Mixed Residential/Commercial/Open Space

Implementation of the above-noted Option A policy recommendations will allow for the following to occur:

- new development will significantly improve the taxable value of the land;
- new development will provide additional housing choices for District residents;
- new development will allow for greater public access to the waterfront;
- new development will generate some new employment by both commercial development and through home based business, therefore helping to improve the jobs/housing balance;
- new development will have minimal environmental impacts on natural features.
- new development will result in a substantial investment in new municipal infrastructure and services.

Option B - Waterfront Industrial Reserve

Implementation of the above-noted Option B policy recommendations will allow for the following to occur:

- new development will have a limited ability to improve the taxable value of the land;
- new development will generate a small number of new jobs, therefore providing some employment opportunities for local residents;
- existing and new development will have some potential impacts on the natural environment.
- there may be an opportunity to preserve exiting historical buildings.

7.2.2 Commercial Areas

Evaluation of land use choices for commercial areas (which have potential for development, redevelopment or intensification) with complete community objectives appears in Figure 7.3 of this chapter. This section presents the findings of this evaluation.

Evaluation Findings & Consistency with Complete Community Objectives:

- Intensification and redevelopment of commercial areas (which have development or redevelopment potential, as noted by the market findings summarized in Chapter 6) with retail, service, office and in some cases mixed residential/commercial uses have a strong ability to achieve complete community objectives, for the following reasons:
  - Ability to potentially generate employment through office uses.
  - Strong ability to improve the jobs/housing balance and variety of employment types.
  - Since most commercial areas are already developed, there would be few environmental impacts associated with redevelopment or intensification.
  - Most of the commercial areas (especially the Marine Drive Corridor, Lynn Valley Centre and Lynnmour at Main Street/Mountain Highway) are located along major transportation routes and are compatible with public transit services.
  - Commercial areas have the ability to serve local residents and employees and benefit from proximity to these potential customers.
  - Have the ability to improve the taxable value of the land.

- Intensification and redevelopment of commercial lands within the **Marine Drive Corridor, Lynn Valley Centre and Lynnmour (Main Street/Mountain Highway area)** with "mixed residential/commercial" uses particularly scored "High" in achieving compete community objectives for the same reasons as those noted above, and for the following additional reasons:
  - Recognizably improve the taxable value of the land.
  - Ability to create focused population centres of employment and service growth.
  - Ability to accommodate office uses, which generate higher numbers of employment than conventional retail services.
  - Ability to provide alternatives to the motor vehicle for the journey to work (by "working close to home" or "living close to work") or to access retail and commercial services.
  - Highly supportive of public transit services, and located along major transportation routes.

- Intensification and redevelopment of community commercial areas (including **Edgemont Village, Maplewood Plaza and the proposed Windridge Centre**) with additional retail, service and office uses demonstrated an upper "Moderate" capacity to achieve complete community objectives for similar reasons to those noted above for all commercial areas, but having a slightly lower ability to generate new employment opportunities due to the lack of availability of sizable development parcels which could be developed with mixed residential/commercial buildings.

Proposed Policy Directions:

Marine Drive Corridor

- Intensification and redevelopment of existing commercial properties, especially those with existing low development densities (such as the automobile dealerships) with mixed residential/commercial uses, which offer a mixture of retail, service and office commercial activities should be encouraged.

- Potential higher density commercial and mixed residential/ commercial development should be focused around the intersections of Marine Drive with Capilano Road and with Pemberton Avenue, to create distinct focal points.

- The C4 (Tourist Commercial) Zone should be modified to allow greater building site coverage and additional development density for properties fronting Capilano Road, and encourage development which will capture much of the currently uncaptured hotel market demand on the North Shore.

- Policies should address market pressures for the development of megastores and big box retailers (currently high land values and lack of large available properties constrain this opportunity).

Edgemont Village

- Encourage the preservation of the existing scope of commercial uses, and encourage some redevelopment for mixed residential/commercial development on significant sized parcels.

Lynn Valley Centre

- Encourage more efficient utilization of parking areas and building siting to incorporate intensification of commercial (retail, service and service-related office) uses as well as to introduce the opportunity to develop a mixed use residential/commercial/service centre population focal point.

- Encourage new buildings on commercial properties to create a street presence along the major roads, and to incorporate a pedestrian friendly system of sidewalks and crossings.

Lynnmour (Main St./Mountain Hwy.)

- Encourage more efficient utilization of properties fronting Main Street.

- Consider development of mixed residential/commercial uses along the north side of Main Street, especially in the case of the Venice Bakery site.

- Ensure there is a transition and integration between commercial and adjacent light industrial areas.

- Support road improvements to Main Street and the approaches to the Second Narrows Bridge and Trans Canada Highway #1.

- Improve pedestrian connections to the public transit loop near the bridgehead.

Maplewood Plaza

- Notwithstanding the implications of the nearby chemical plant, encourage future potential intensification with retail and service uses and some mixed residential/commercial uses.

- Encourage a transition and integration of commercial and light industrial activities.

- Encourage pedestrian connections between Maplewood Plaza and potential future business parks in Maplewood.

APPENDIX A

GLOSSARY of TERMS

Glossary

Several industry terms and acronyms are used in the course of this study and are defined as follows:

Commercial Land Use Terms

CMA
Census Metropolitan Area: the boundaries of a large urban area defined by Statistics Canada (i.e. Vancouver, Edmonton).

CRU
Commercial Retail Uses
The leasable retail area in a shopping centre which is not an anchor (department store or supermarket).

DSTM
Department Store Type Merchandise
Merchandise which is sold in department stores and smaller specialty outlets. The merchandise includes: apparel/accessories, household/hardware, specialty retail, and personal accessories.

Gateway Node
A focus of higher density development featuring a mixture of commercial and residential, hotel and flagship retail used, centered around a key intersection.

GLA
Gross Leasable Area
The measurement used for uniform comparison and accurate measurement. It is the total floor area designed for the tenant's occupancy and exclusive use.

Inflow
Represents random sales from outside of a centre's trade area (i.e. tourist activity).

Outflow
Represents random sales that flow out of a centre's trade area (i.e. destination retailers outside of trade area).

PDI
Personal Disposable Income
Total income less taxes.

PTA
Primary Trade Area
The area immediately surrounding a site/centre where the majority of a centre's sales are derived.

STA
Secondary Trade Area
The area beyond the PTA where the majority of the remainder of a centre's sales are derived.

Shopping Centres Definitions

Community Shopping Centre
One promotional department store and a supermarket and a scale of 100,000 to 300,000 sq. ft.

Convenience Centre
Sometimes this centre may range in size up to 80,000 sq. ft.

Megastores
Retailers that dominate their merchandising category. Due to their extensive selection in their merchandise category, they range in size significantly from approximately 5,000 sq. ft. to well over 100,000 sq. ft. They offer low margins, high volume, brand goods in a large store size setting. For example, Toys 'R' Us, Office Depot, Home Depot and Future Shop.

Neighbourhood Centre
Typically anchored by a supermarket or drugstore, it has a range between 80,000 to 150,000 sq. ft.

Regional Shopping Centre
Two full-line department store anchors and a scale of 400,000 sq. ft. to 850,000 sq. ft.

Sub-Regional Shopping Centre
One full-line department store and one promotional store (Zellers or Kmart) and a scale of 300,000 to 500,000 sq. ft.

Power Centre
These centres range in size from 100,000 to 300,000 sq. ft. or more and are usually anchored by retail category killer type tenants and a complementary range of big box category stores.

Office Terms

Business Park (Flex) Space
Business Park (Flex) Space consists of architecturally designed industrial buildings, often similar in appearance to office buildings, and providing a higher quality of interior finishing that allows users the flexibility to use space for office, manufacturing and assembly, repair and service plus distribution or storage uses. These spaces often have higher proportions of office use (as high as 100%) than in traditional light industrial areas, and are often designed as high quality "planned employment centres".

Class A
Most prestigious buildings competing for premier office users with rents above average for the area. Buildings have high quality standard finishes, state-of-the-art systems.

Class B
Buildings competing for a wide range of users with rents in the average range for the area. Buildings finishes are fair to good for the area and systems are adequate, but the building does not compete with Class A at the same price.

lass C
ildings competing for tenants requiring functional space at rents below the average for area.

Industrial Terms

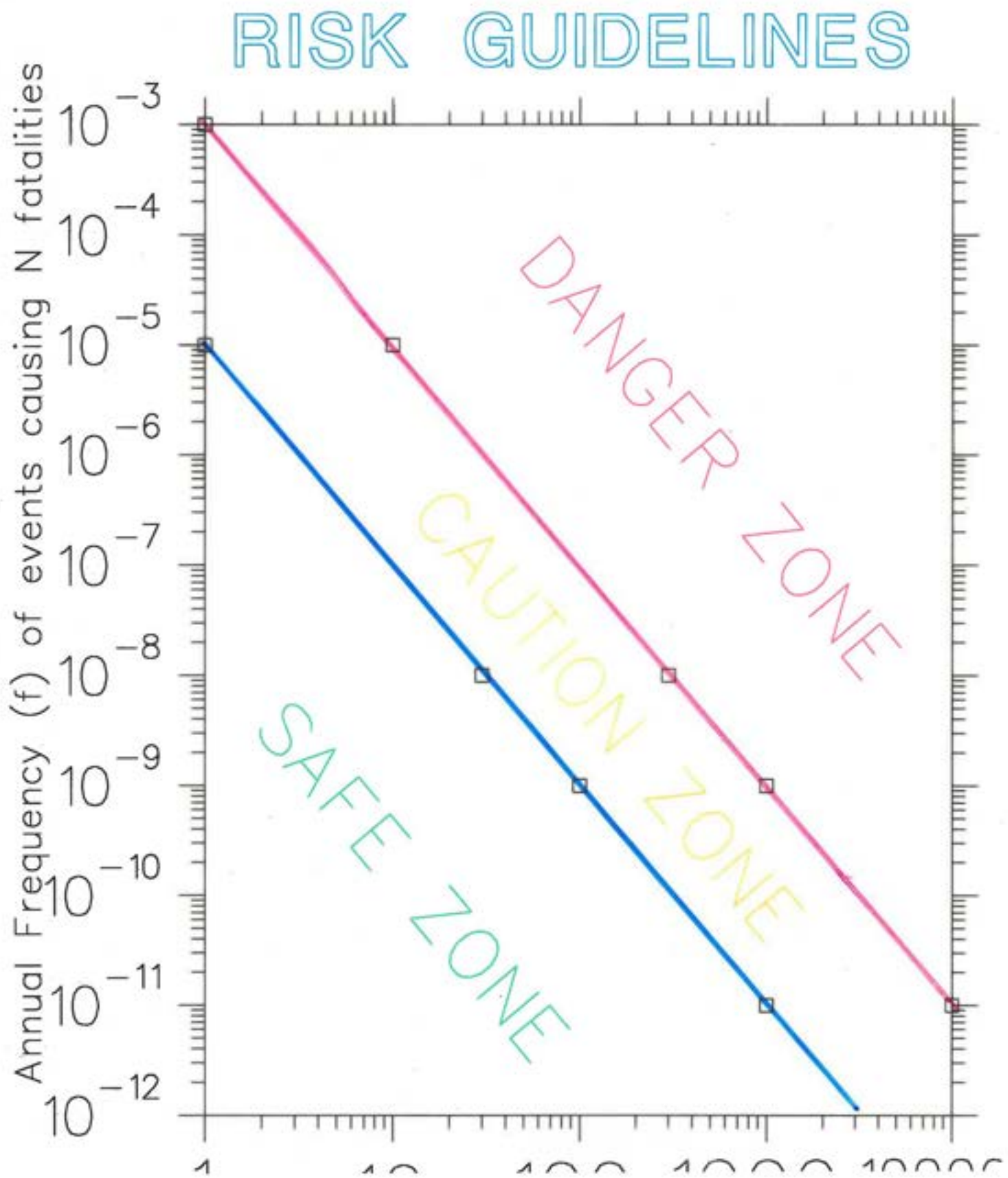
Business Park (Flex) Space
Business Park (Flex) Space consists of architecturally designed light industrial buildings, often similar in appearance to office buildings, and providing a higher quality of interior finishing that allows users the flexibility to use space for office, light manufacturing, assembly, repair, service, distribution or storage uses. These spaces often have higher proportions of office use (as high as 100%) than in traditional light industrial areas, and are often designed as high quality "planned employment centres".

Just-in-time Delivery Systems
Rather than maintain large inventories of parts/supplies on site, inventories are ordered from suppliers to arrive only when required, i.e., "just-in-time."

Light Industrial Space
Industrial buildings featuring a site coverage of 40% to 60%, office component of 10% to 25%, and accommodating traditional light industrial uses including manufacturing of processed materials, assembly, storage, and the servicing of goods, machinery and equipment (including automobiles and other vehicles). These uses are predominately within an enclosed building from which there are no external nuisances or impacts.

Planned Employment Centre
A well designed business park-type environment that not only is a place to work, but also features complementary commercial, retail and recreation services, including hotels, health clubs, restaurants, printing/copying and support services. Often these centres have an increased amount of open space and amenities, and are designed to be pedestrian and public transit friendly. All of these components are incorporated in order to support the needs of local employees.

Transshipment
Refers to the movement, import and export of goods through the port of Vancouver to/from other destinations and points of origin.


RISK GUIDELINES
Annual Frequency (f) of events causing N fatalities
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
10^{-8}
10^{-9}
10^{-10}
10^{-11}
10^{-12}
DANGER ZONE
CAUTION ZONE
SAFE ZONE

- Confidence level of risk not provided

What are margins of error for quoted risks?

"Most of the margin of error are called 95% confidence intervals, meaning that there is a 95% probability that the risk will be no higher or lower than the extreme of the interval",

- In Europe 84% of all chlorine produced is consumed on the same manufacturing site

- Why have you not done a worst-case release scenario as required by current US regulation?

300 TONS $\sim 300 * 10^3$ KG $\sim 3 * 10^8$ gms

1 mole Cl^2 $\rightarrow$ 22.4 liters of gas

$\downarrow$

70 gms $\rightarrow$ 22.4 l

$3 * 10^8$ gm $\rightarrow 22.4 * \frac{3 * 10^8}{70}$ l

mix with an 1000 parts / million would occupy

$22.4 * \frac{3 * 10^8}{70} * 1000$ liters

$1\ m^3 = 1000$ liters

$\rightarrow 22.4 * \frac{3 * 10^8}{70}\ m^3$

say 3 mtrs * Area

thus AREA $= \frac{22.4 * 3 * 10^8}{70 * 3} \approx 30 * 10^6\ m^2$

$\approx 30\ km^2$

CHLORINE

The following information relates to a chlorine spill as this chemical is manufactured, transported and used on the North Shore.

Neither the gas nor the liquid is explosive or flammable, however both react chemically with many substances. Chlorine gas at high concentrations is greenish yellow in colour and may be fatal if inhaled. It has a penetrating odour and is two and one half times heavier than air.

IN THE EVENT OF A CHLORINE EMERGENCY

A closed building is the best protection. Close windows and doors – turn off air conditioners (in the car, too) so gases cannot easily enter. Stay in upper stories of houses and buildings. Chlorine gas is heavier than air, and upper stories are generally a safer place.

AVOID LOW LYING AREAS

If you find yourself in the open seek the highest ground. Breathing protection from chlorine gas however, can only be assured by the use of self-contained breathing apparatus.

NORTH & WEST VANCOUVER
EMERGENCY PROGRAM
165 East 13th Street, North Vancouver, B.C. V7L 2L3 • Phone 985-1311 – local 459 (24 hours)

HAZARDO
CHEMICA
EMERGEN

WHA
TO
DO

Photo C

COURTESY OF
Canadian Occidental P

DEAR CITIZENS

The purpose of this brochure is to inform you about effective measures you can take in the event of a hazardous chemicals incident.

Despite all safety precautions it is not impossible that some day an accident could create annoying or hazardous conditions for those people in close proximity to a chemical spill.

If you are reporting an emergency to fire or police department, state the following:

1. Location of emergency (street, number, district).
2. Nature of emergency (what persons or things are involved, extent, causes).
3. Your name and address.

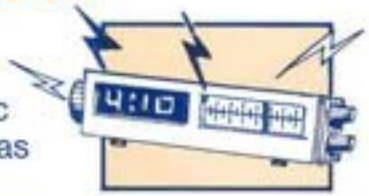
EMERGENCY NUMBERS

	FIRE	POLICE
NORTH VANCOUVER CITY	985-5323	988-4111
NORTH VANCOUVER DISTRICT	985-2525	988-4111
[illegible]	922-2345	922-0111

DO NOT TIE UP TELEPHONES

Fire department, police, and involved businesses need every available telephone line to initiate help and rescue procedures. Therefore: use the telephone only when absolutely necessary. If all you need is information call non-emergency numbers, available in the telephone book.

TURN YOUR RADIO ON



Announcements concerning the emergency, instructions and specific evacuation procedures as well as all-clear signals may also be broadcast by regional radio stations and Cable 10 North Shore television.

PAY ATTENTION TO LOUDSPEAKER ANNOUNCEMENTS

Fire department and police will tell you what to do via loudspeaker vehicles.

DO NOT BLOCK TRAFFIC

Police, fire department, and emergency teams depend on free roadways. **STAY AWAY FROM THE EMERGENCY SCENE.**

STAY AT HOME...

or at your place of work and listen fo
loudspeaker evacuation announcer
fire or police departments.

DO NOT PICK UP YOUR CHILDREN FROM SC

School regu
ensure a swi
response to
evacuation.
ence of pare
ing for their
only cause
and delays. Evacuation reception c
been organized throughout the Nor
and media broadcasts will inform p
as to which centre school children
been taken.

CALL CHILDREN IN IMME

Where they can
supervised and
react in the
out of igno

HELP elderly or handicapped and give temporary shelter to pedestrians.

Evacuation reception centres will contain some facilities for pets.

CXY Chemicals

CXY Chemicals
North Vancouver Plant

RISK MANAGEMENT PROGRAM

a report to the community

venue
Columbia V7H 1S4
ax: (604) 929-7610

EMICALS

YOU

NT PROGRAM

o the Risks

ram began several years ago with programs
ess hazard reviews and specific engineering
tions have already been made as a result of

rations

ng building, storage tanks, and piping
zardous liquid storage tanks
inspection program including

ved at the plant site
vent for shipping routes.

ommunity Awareness

itors
afety and Emergency Response
onse professionals in the community
nts and community emergency
asures for the community
N) system which permits the community
dent occur
de these results available to the

le Community Awareness visits to

ve

gram
eviews of the plant operations
y Awareness and Emergency Response
een industry and the community by

EMERGENCY PREPAREDNESS

What you can do

Emergencies, like fires, floods, earthquakes or chemical releases present risks to you, your family and your home. You can control those risks - plan a course of action - your personal Risk Management Program.

At home

1. Learn what the risks are.
   Your community emergency response officials, the public library, the bookstore are good resources for emergency planning and earthquake information.
   Learn more about us - we welcome your questions - phone us, read our brochures, take a tour of the plant.
2. Develop a personal plan - your emergency preparedness plan.
   Decide what you will do when an emergency occurs. Learn what measures you should take to control and reduce the risks.
3. Take steps to protect your home and family. Review the plan with each family member and practice through drills.

In your community

1. Find out what resources your community has to offer.
2. Participate in the emergency planning process in your community; through work, school and in your neighbourhood.

The Community Alert Network

The Community Alert Network is an emergency warning system: a computer based system which phones all homes and businesses in an affected area.

The system can only be activated by the police, fire department or north shore emergency program.

Responsible Care®

CXY Chemicals through its membership in the Canadian Chemical Producers' Association (C.C.P.A.) has made a formal commitment to Responsible Care®.

Responsible Care® is a set of initiatives each company carries out by implementing six Codes of Practice which apply to every part of the chemical life cycle:

- Community Awareness and Emergency Response
- Research and Development
- Manufacturing
- Transportation
- Distribution
- Hazardous Waste Management

Responsible Care® is value based and not a passing program - it is a commitment we make to safeguard our employees, the community and the environment.

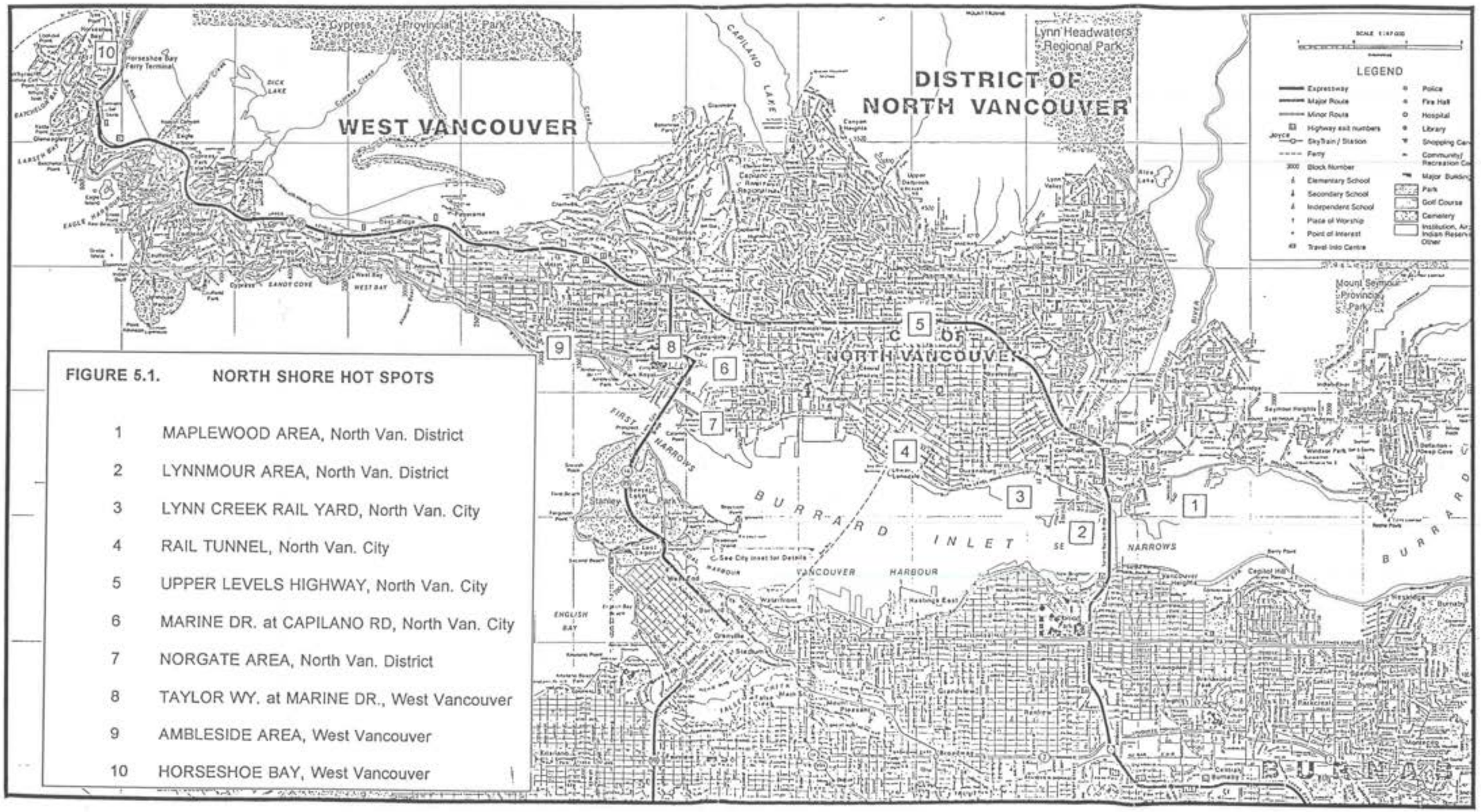


FIGURE 5.1. NORTH SHORE HOT SPOTS

1 MAPLEWOOD AREA, North Van. District

2 LYNNMOUR AREA, North Van. District

3 LYNN CREEK RAIL YARD, North Van. City

4 RAIL TUNNEL, North Van. City

5 UPPER LEVELS HIGHWAY, North Van. City

6 MARINE DR. at CAPILANO RD, North Van. City

7 NORGATE AREA, North Van. District

8 TAYLOR WY. at MARINE DR., West Vancouver

9 AMBLESIDE AREA, West Vancouver

10 HORSESHOE BAY, West Vancouver

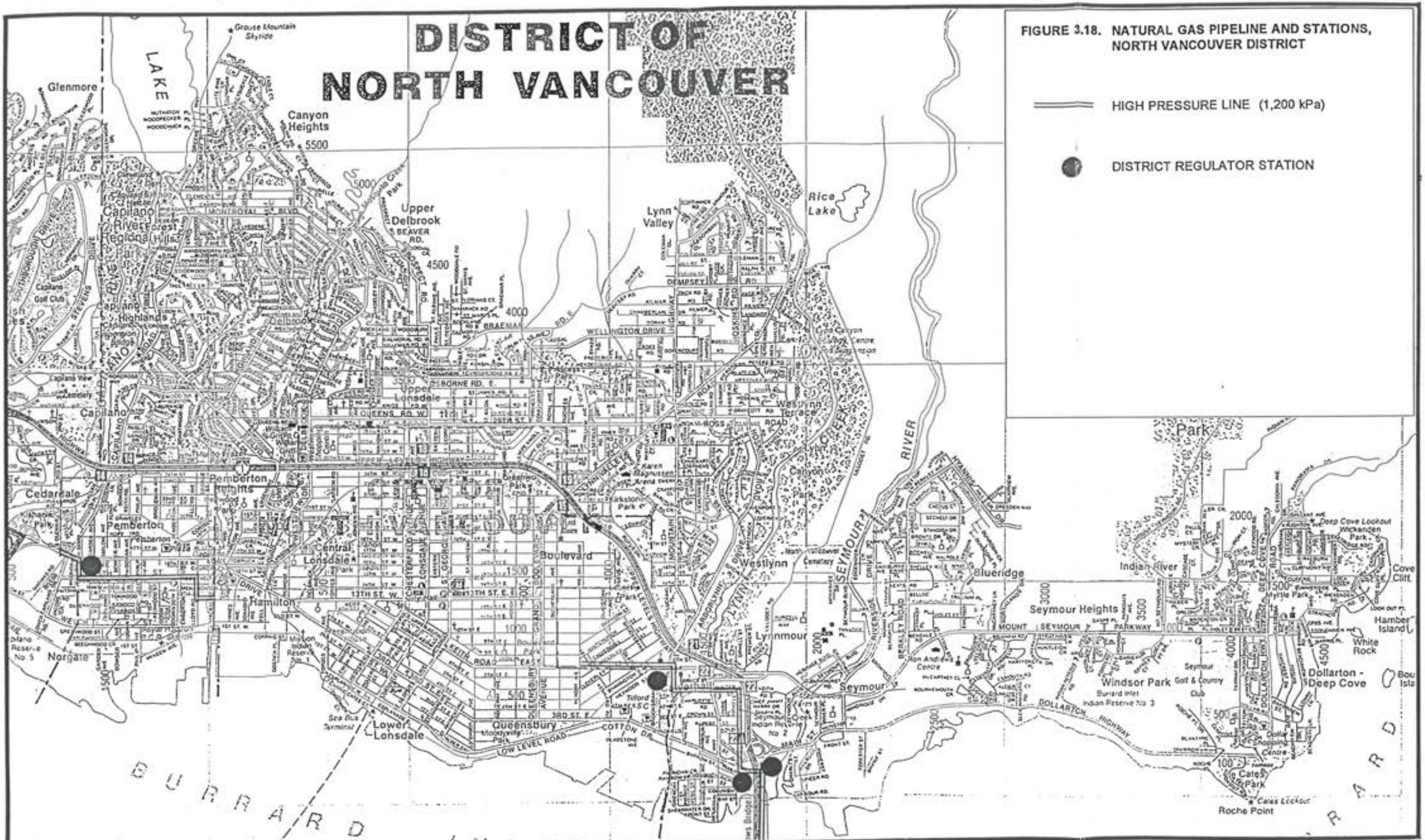


FIGURE 3.18. NATURAL GAS PIPELINE AND STATIONS, NORTH VANCOUVER DISTRICT

HIGH PRESSURE LINE (1,200 kPa)

DISTRICT REGULATOR STATION

DISTRICT OF NORTH VANCOUVER

FIGURE 3.11. RAIL LINES USED FOR DANGEROUS GOODS TRANSPORT, NORTH VANCOUVER DISTRICT

Rail Line

At-Grade Road Crossing

TERMINAL RAIL YARD (B.C. RAIL)

LYNN CREEK RAIL YARD (C.N. RAIL)

DISTRICT OF NORTH VANCOUVER

FIGURE 3.8. TRUCKED VOLUMES OF DANGEROUS GOODS, NORTH VANCOUVER DISTRICT

KEY TO LINE WIDTHS

1mm = 10,000 DG Vehicles/Yr

40,000 DG vehicles/yr

0.8 acc/million-veh-kms

41,500 DG vehicles/yr

0.8 acc/million-veh-kms

75,000 DG vehicles/yr

0.8 acc/million-veh-kms

19,000 DG vehicles/yr

1.5 acc/million-veh-kms

DISTRICT OF NORTH VANCOUVER

FIGURE 3.4. ROADS USED FOR DANGEROUS GOODS TRANSPORT, NORTH VANCOUVER DISTRICT

Dangerous Goods Routes

DISTRICT OF NORTH VANCOUVER

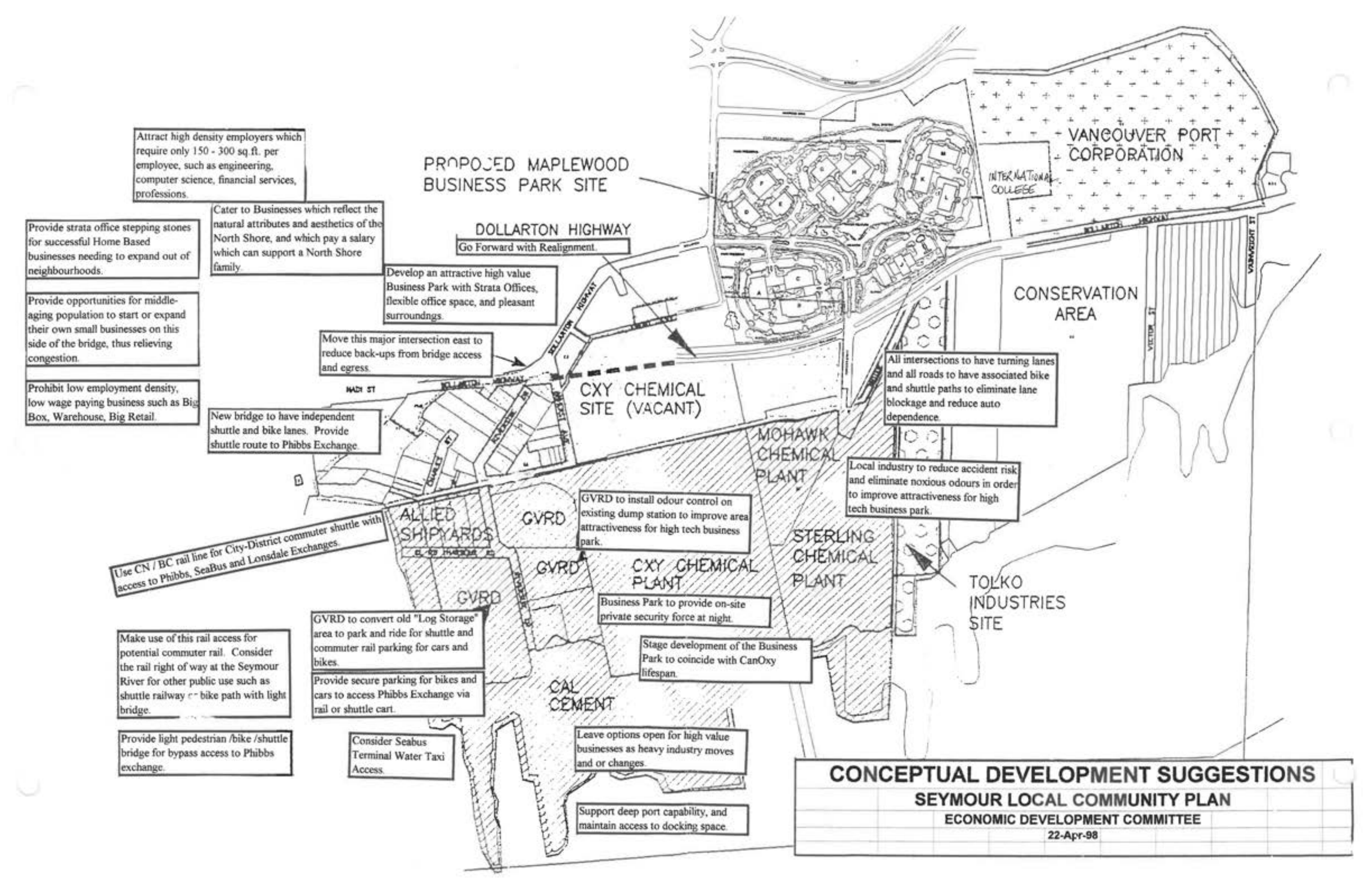
FIGURE 3.2. FACILITIES WITH DANGEROUS GOODS, NORTH VANCOUVER DISTRICT

- ● Sufficient Information Available
- ●/ Additional Research Needed

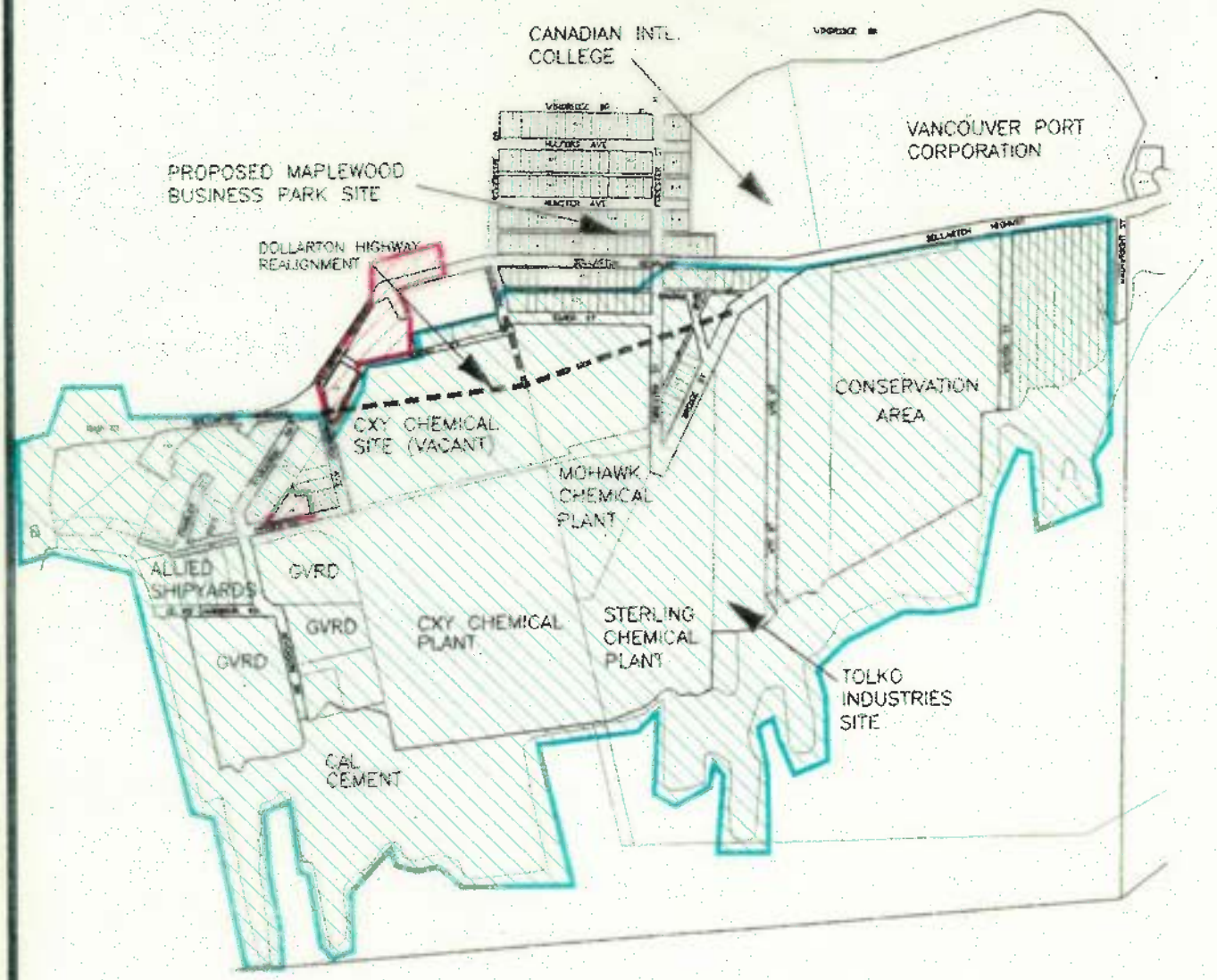
DISTRICT OF NORTH VANCOUVER

FIGURE 3.1. SENSITIVE POPULATIONS AND ENVIRONMENTS, NORTH VANCOUVER DISTRICT

(1) School
(2) Shopping Centre
(3) Highrise Apartment
(4) Theatre
(5) Hospital
(6) Senior's Home
(E) Environmentally Sensitive Area


Attract high density employers which require only 150 - 300 sq.ft. per employee, such as engineering, computer science, financial services, professions.
Cater to Businesses which reflect the natural attributes and aesthetics of the North Shore, and which pay a salary which can support a North Shore family.
Provide strata office stepping stones for successful Home Based businesses needing to expand out of neighbourhoods.
Provide opportunities for middle-aging population to start or expand their own small businesses on this side of the bridge, thus relieving congestion.
Prohibit low employment density, low wage paying business such as Big Box, Warehouse, Big Retail.
PROPOSED MAPLEWOOD BUSINESS PARK SITE
DOLLARTON HIGHWAY
Go Forward with Realignment.
Develop an attractive high value Business Park with Strata Offices, flexible office space, and pleasant surroundngs.
Move this major intersection east to reduce back-ups from bridge access and egress.
VANCOUVER PORT CORPORATION
INTERNATIONAL COLLEGE
CONSERVATION AREA
CXY CHEMICAL SITE (VACANT)
All intersections to have turning lanes and all roads to have associated bike and shuttle paths to eliminate lane blockage and reduce auto dependence.
New bridge to have independent shuttle and bike lanes. Provide shuttle route to Phibbs Exchange.
MOHAWK CHEMICAL PLANT
Local industry to reduce accident risk and eliminate noxious odours in order to improve attractiveness for high tech business park.
Use CN / BC rail line for City-District commuter shuttle with access to Phibbs, SeaBus and Lonsdale Exchanges.
ALLIED SHIPYARDS
GVRD
GVRD to install odour control on existing dump station to improve area attractiveness for high tech business park.
GVRD
CXY CHEMICAL PLANT
STERLING CHEMICAL PLANT
TOLKO INDUSTRIES SITE
Business Park to provide on-site private security force at night.
Stage development of the Business Park to coincide with CanOxy lifespan.
GVRD
GVRD to convert old "Log Storage" area to park and ride for shuttle and commuter rail parking for cars and bikes.
Make use of this rail access for potential commuter rail. Consider the rail right of way at the Seymour River for other public use such as shuttle railway or bike path with light bridge.
Provide secure parking for bikes and cars to access Phibbs Exchange via rail or shuttle cart.
CAL CEMENT
Consider Seabus Terminal Water Taxi Access.
Leave options open for high value businesses as heavy industry moves and or changes.
Provide light pedestrian /bike /shuttle bridge for bypass access to Phibbs exchange.
Support deep port capability, and maintain access to docking space.
CONCEPTUAL DEVELOPMENT SUGGESTIONS
SEYMOUR LOCAL COMMUNITY PLAN
ECONOMIC DEVELOPMENT COMMITTEE
22-Apr-98

Maplewood Industrial Area



LEGEND

INDUSTRIAL ZONED AREAS

COMMERCIAL ZONED AREAS

FIGURE: 1.5

DISTRICT OF NORTH VANCOUVER
ECONOMIC DEVELOPMENT
STRATEGY STUDY

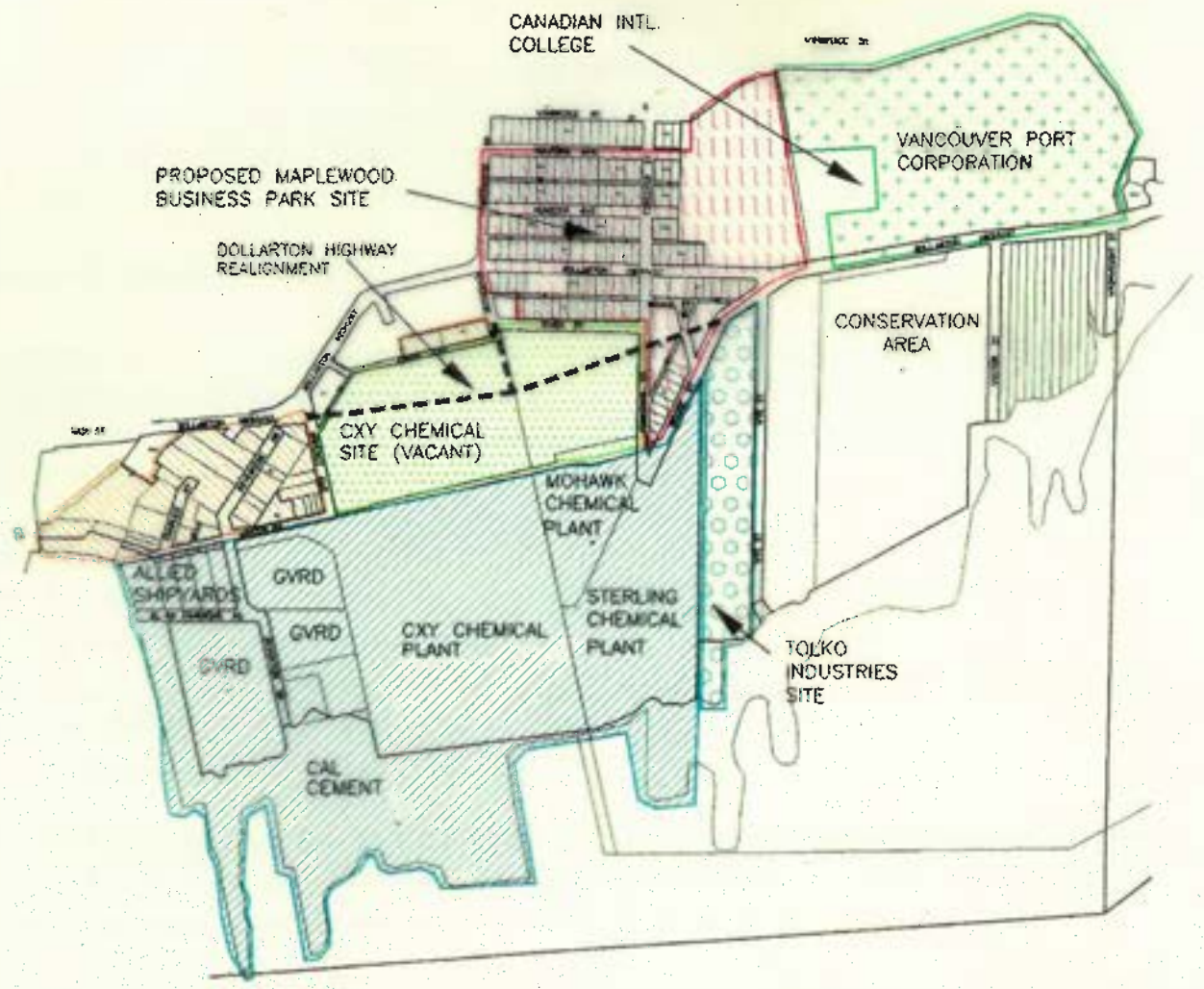
FEBRUARY 1997
SCALE: N.T.S.

BASE SOURCE: DISTRICT OF NORTH VANCOUVER

URBAN SYSTEMS

Maplewood

Industrial Area & Sub--Areas



LEGEND

- WATERFRONT AND PORT RELATED SOUTH OF CNR
- NON-WATERFRONT: NORTH OF CNR/ WEST OF AMHERST AVE.
- CXY CHEMICAL VACANT LANDS
- PROPOSED MAPLEWOOD BUSINESS PARK
- VPC VACANT LANDS NORTH OF DOLLARTON HWY
- TOLKO INDUSTRIES SITE

FIGURE: 6.4

DISTRICT OF NORTH VANCOUVER
ECONOMIC DEVELOPMENT
STRATEGY STUDY

FEBRUARY 1997
SCALE: N.T.S.

BASE SOURCE: DISTRICT OF NORTH VANCOUVER

URBAN SYSTEMS

DISTRICT OF NORTH VANCOUVER

355 West Queens Road
North Vancouver, BC V7N 4N5
604-990-2311
DNV.org

Full Pamphlet is not available online

To view the original, please see the Public Hearing Binder at District Hall

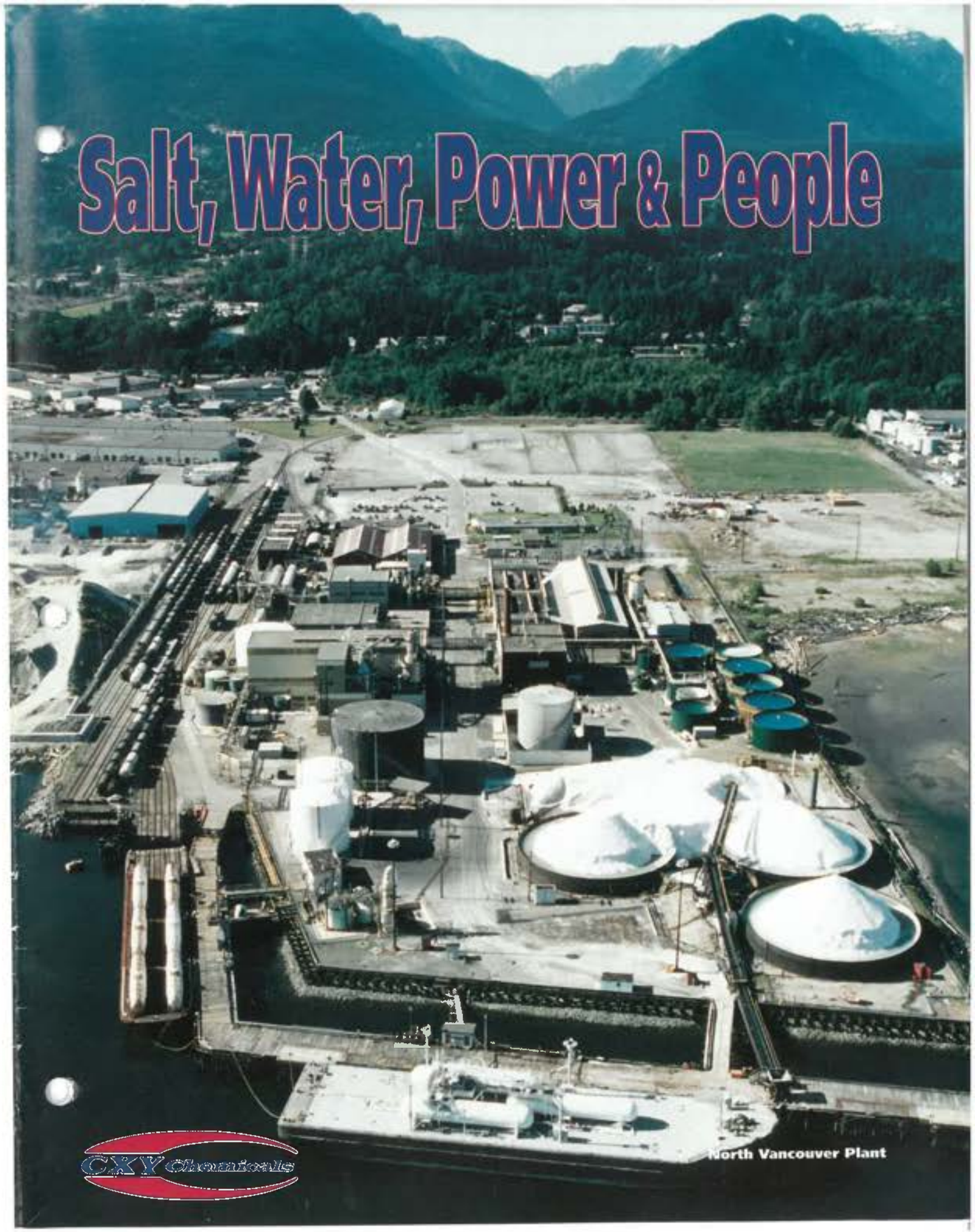
CXY CHEMICALS LTD.

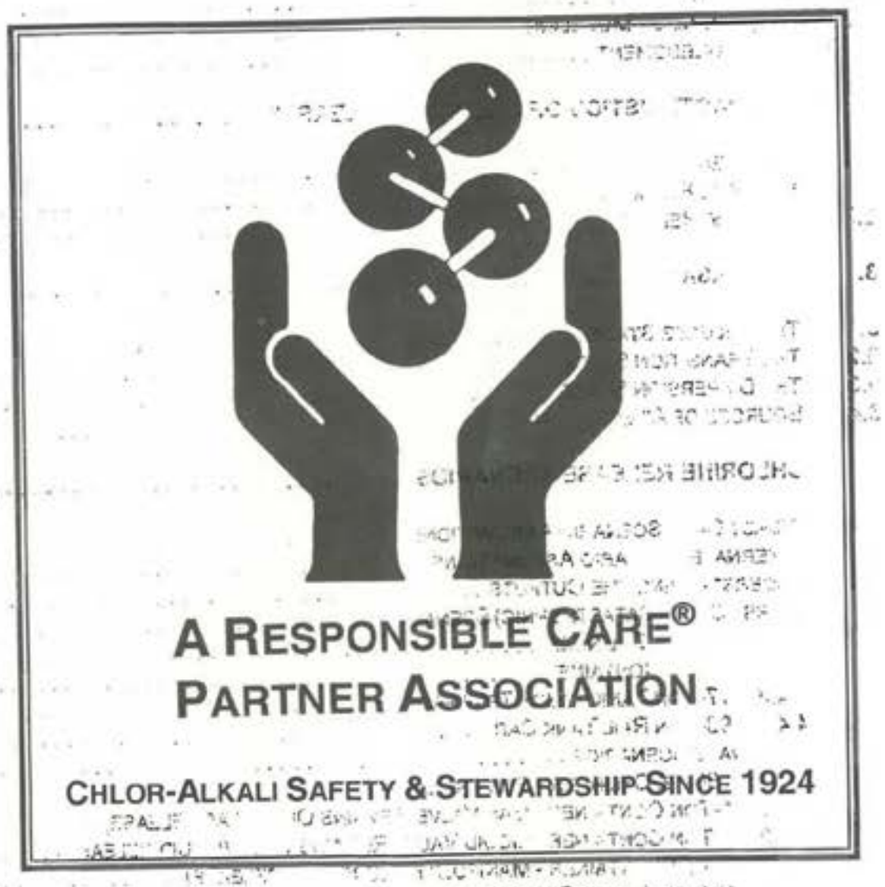
Industrial Chemicals Division
100 Amherst Avenue
North Vancouver, BC V7H 1S4

Telephone 604.929.3441

Additional copies of this brochure may be obtained from the Plant Manager of the Norht Vancouver plant.

Salt, Water, Power & People





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1. INTRODUCTION

1.1 Scope

The intent of this pamphlet is to provide a simplified document to be used by small chlorine producers/users, local emergency planning committees, fire departments, and municipalities to estimate the area affected by a chlorine release for emergency planning and hazard assessment purposes.

1.2 Responsible Care

The Institute is a Chemical Manufacturers Association (CMA) Responsible Care® Partnership Association. In this capacity, the Institute is committed to: Fostering the adoption by its members of the Codes of Management Practices; facilitating their implementation; and encouraging members to join the Responsible Care® initiative directly.

Chlorine Institute members who are not CMA members are encouraged to follow the elements of similar responsible care programs through other associations such as the National Association of Chemical Distributors' (NACD) Responsible Distribution Program or the Canadian Chemical Manufacturers Association's Responsible Care® program.

1.3 Definitions

ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
Accidental Release	An unanticipated emission of a regulated substance or other extremely hazardous substance into the environment.
Crosswind Distance(s)	A point or points that are in the 90° direction from the path of the wind. If the wind is blowing from the west, points in the north and south directions constitute crosswind distances. The concentration at a specific crosswind distance will vary as the downwind distance is changed. In this pamphlet concentrations at crosswind distances are reported at ground level elevation. At different elevations, the concentration at a specific crosswind point will vary.

Downwind Distance(s)	A point or points that are directly in the path of the wind direction. If the wind is blowing from the west, points directly east of the release source constitute downwind distances. In this pamphlet concentrations at downwind distances are reported at ground level elevation. For any release, the maximum concentration of the material being released will occur at some downwind distance. At different elevations, the concentration at a specific downwind point will vary.
ERPG	Emergency Response Planning Guidelines
ERPG-2	The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action. For chlorine, this value is 3 ppm (as established by AIHA).
ERPG-3	The maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects. For chlorine, this value is 20 ppm (as established by AIHA).
Footprint	As used in this pamphlet, a graphical depiction of the maximum downstream area affected by a chlorine release at specified concentrations without regard to time. In this pamphlet, footprints are shown at ground level elevation. At different elevations, the footprint will be different.
LEPC	Local Emergency Planning Committee
Maximum Crosswind Distance	The maximum distance in the crosswind direction that a specific concentration reaches. The maximum crosswind distance will occur at some point both downwind and crosswind from the release point. The maximum width of the release cloud is twice the crosswind maximum distance.
m/s	Meters per second 1 m/s = miles/hour = feet/second
TWA	Time-weighted average

Worst-Case Scenario	As used in this pamphlet, the instantaneous release of the entire contents of chlorine from a container and the complete evaporation at a constant rate in a ten-minute period with no mitigating devices allowed. Under specific circumstances, passive mitigation devices, such as diking, may be utilized to mitigate the consequences of a release. However, the worst case scenarios described in this pamphlet assume no mitigating devices are available.

1.4 DISCLAIMER

The information in this pamphlet is drawn from sources believed to be reliable. The Institute and its members, jointly or severally, make no guarantee and assume no liability in connection with any of this information. Moreover, it should not be assumed that every acceptable safety procedure is included or that special circumstances may not warrant modified or additional procedures. The user should be aware that changing technology or regulations may require a change in the recommendations herein. Appropriate steps should be taken to assure that the information is current when used. These suggestions should not be confused with federal, state, provincial, municipal, or insurance requirements or with national safety codes.

1.5 APPROVAL

The Chlorine Institute Plant Operations and Safety Committee approved Edition 3 of the pamphlet on September 30, 1997.

1.6 REVISIONS

Suggestions for revisions should be directed to the Secretary of the Chlorine Institute.

1.7 REPRODUCTION

The contents of this pamphlet are not to be copied for publication, in whole or part, without prior Chlorine Institute permission.

1.8 ABSTRACT

Because of the toxicity of chlorine, the chlor-alkali industry has established strict safety measures for the handling of chlorine. The chlorine industry continues to improve methods of handling chlorine in order to improve safety, but the possibility of human error, mechanical failure or an external event which could result in a chlorine release still exists.

In planning for emergency response to a chlorine release, it is necessary to estimate the area affected by the release. This pamphlet provides examples of scenarios that a facility may find useful. These scenarios are based in part on typical chlorine industry containers, other equipment and their configuration.

Results are provided as graphic presentations (footprints) of the estimated downwind distances for specific chlorine concentrations.

Additionally, other outputs are depicted. These include the following:

- Graphs showing centerline concentrations as a function of distance
- Concentrations as a function of time at 25%, 50%, 75% and 100% of the maximum distance that a 3 ppm cloud travels
- The time for the release to stop, or at least slow to less than 1% of its initial discharge rate, recognizing that evaporation cooling (auto-refrigeration) will reduce the release rate in many instances
- Where applicable, the time for the pool mass to evaporate

These results have been prepared using the Safer System, Inc. Trace Version 8 dispersion model. Where more precision or different scenarios are required, a person skilled in the modeling of heavy gases should be consulted.

1.9 LIMITATIONS OF MODELING

The real world dispersion of a chemical release into the atmosphere is a very complex phenomenom. The chemical released, the size of the release, the wind velocity, the surface roughness near the release, and a host of other components affect the dispersion of a chemical. With this inherent complexity, all models must make simplifying assumptions. It follows that all attempts to exactly model a chemical release via a mathematical algorithm must, by the limitations of the technology, be only an approximation. The accuracy of the model's estimation of cloud dispersion is determined by both the assumptions contained within the model and by the assumptions made by the user as the data sets are prepared for modeling.

Since small chemical releases do not correspond well to most model assumptions, there are no small quantity scenarios in this pamphlet. There is no distinct threshold for "small". As a rule of thumb, model calculations for a release under one pound per minute should be interpreted with caution.

Complete sets of real world data for the dispersion of chemical releases are very limited. The generation of data sets using a controlled release facility is highly complex. Using available data, many mathematical models have been compared to real world releases.

It is generally accepted that a model that predicts the atmospheric concentration of a chemical release within a factor of 2 (model prediction falls between one half and twice the actual concentration) is operating within the limits of current modeling technology. Such results are particularly true when looking at the low concentrations that are discussed in this pamphlet.

Even with the limits of the technology, dispersion modeling still provides the best working estimate of the potential impact of a chemical release. Such modeling contributes to the continuous improvement process for chemical operations. As a screening tool, dispersion of modeling can help establish priorities for detailed analysis, and the detailed analysis modeling can help evaluate mitigation opportunities. Additionally, it is through the understanding of the potential impact of an incident that appropriate emergency response plans and procedures are developed to minimize the impact on the community and the environment should a chemical release occur.

Several chlorine release scenarios are described within this pamphlet. Each scenario has been modeled under specified meteorological conditions. The information developed as a result of this modeling exercise is intended to allow the reader to appreciate the magnitude of a potential chlorine release. However it is impossible to represent here every possible combination of chlorine release scenario and meteorology. The reader should consider additional detailed modeling studies, beyond the scope of this pamphlet, as required to understand and mitigate the risk associated with the storage and/or use of chlorine.

For a variety of reasons there may be a need to evaluate scenarios beyond those presented in this pamphlet. Because of model variability, it is highly desirable that outputs from the same computer model be compared whenever possible. This pamphlet provides all the release and meteorological conditions used to model each scenario. If a model other than TRACE is used, the worst case and alternate scenarios from this pamphlet should be recalculated using the same computer model used for any new scenarios. Side by side comparisons of the relative impact from various release scenarios will be more meaningful using this approach.

To convert the model setup conditions in this pamphlet to setup conditions appropriate to another model, see that model's technical documentation. The services of an experienced modeling professional should be sought if needed.

1.10 ACKNOWLEDGMENT

This pamphlet was developed by a volunteer task group comprised of producers and users of chlorine as well as professional modelers. Drafts were reviewed with representatives of several Local Emergency Planning Committees (LEPCs).

The task group, the Plant Operations and Safety Committee, and the Chlorine Institute very much appreciate the volunteer contributions of Safer Systems, Inc. in developing the

scenario outputs used in this pamphlet. By using the TRACE model, the Institute is not endorsing it. The TRACE model is one of several commercially available models suitable for estimating the area affected by a chlorine release.

2. CHARACTERISTICS OF CHLORINE RELEASES

2.1 SOURCES

Under abnormal circumstances, chlorine could be released from a number of sources. Common sources may include:

a. Storage facilities (tanks or spheres)
b. Pipelines
c. Process vessels
d. Vents
e. Relief valves
f. Railroad tank cars
g. Highway truck trailers
h. Portable containers or cylinders

2.2 PHYSICAL FORM

Chlorine occurs as a greenish-yellow gas or an amber liquid depending on the pressure and temperature. Typically, chlorine is stored and transported as a liquid under pressure. Liquid chlorine expands in volume by nearly 460 times when it evaporates. As a result, for a given hole size, the area affected by a liquid release will be significantly greater than for a gas release.

During a release, chlorine can escape from a containment vessel as a gas, a liquid, or both. Chlorine gas is two and one-half times heavier than air. As a result, escaping chlorine will tend to accumulate in low areas. When chlorine is released from a container, the temperature and pressure inside the container will decrease as material escapes. At some point, the pressure inside the tank will fall to near atmospheric pressure and the release rate will be reduced. A large portion of the chlorine can remain contained at this point.

Escaping liquid may collect in a pool at the lowest level or may actually form a running stream. Liquid chlorine will quickly cool to its boiling point (-29 °F) as it vaporizes. Upon contact with any heat source–the air, the ground, or water–the heat will cause the chlorine to boil readily. Typically, the boil-off rate will be relatively high initially and then decline as the heat source surrounding the chlorine pool is cooled.

Since water in bulk provides a vast heat source for evaporation, any liquid chlorine falling into water should be assumed to vaporize. For this reason, water should be prevented from coming in contact with a liquid chlorine pool, and chlorine should be prevented from flowing into water drains.

Humidity in the air may serve to reduce the evaporation rate from a pool or the release rate from a container by forming an ice layer [consisting primarily of chlorine hydrate (freezing point of 49.3°F)]. Because such effects may reduce the evaporation or release rate, the area affected by such an incident may be lessened. One should note that the reduced evaporation/release rate would increase the time involved for the consequences of such an incident to be eliminated. None of the scenarios depicted in this pamphlet assume the formation of any such ice layer, and this possible effect is not further discussed.

2.3 MODE OF RELEASE

For modeling purposes, chlorine releases can be classified into two categories-instantaneous and continuous.

An instantaneous release is characterized by the release of chlorine to the atmosphere in a relatively short period of time (usually less than 5-10 minutes), resulting in a cloud which moves across the downwind range while growing in size and decreasing in concentration (see Figure 2-1). Thus, the concentration of chlorine monitored at any given point downwind will vary over time depending on the position of the chlorine cloud. The rupture of a chlorine container is an example of an instantaneous release.

A continuous release is characterized by the release of chlorine to the atmosphere over a longer period to time (usually more than 5-10 minutes), resulting in a continuous plume which reaches an equilibrium size and concentration gradient (see Figure 2-2). Thus, the concentration of chlorine monitored at any given point downwind from the source will be constant over time for the duration of the release. The failure of a valve or fitting on a large container is an example of a continuous release.

3. DISPERSION

When chlorine is released to the atmosphere, its behavior and subsequent dispersion in the atmosphere can be considered in three stages:

- Release stage
- Transition stage
- Dispersion stage

3.1 THE RELEASE STAGE

As chlorine is released, it enters the atmosphere and begins to disperse. Initially, the release is influenced by the source conditions and by the physical properties of chlorine itself. Therefore, the factors characterizing this stage of the release include the following:

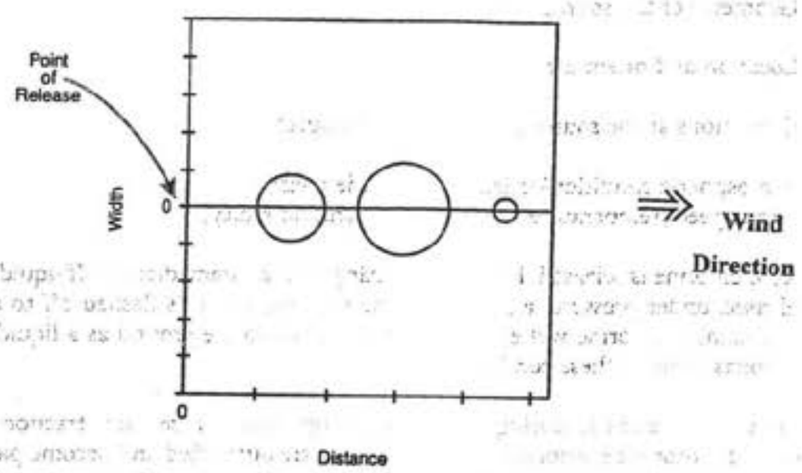


Figure 2.1
Instantaneous Release Footprint
The three circles represent the same concentration at different times

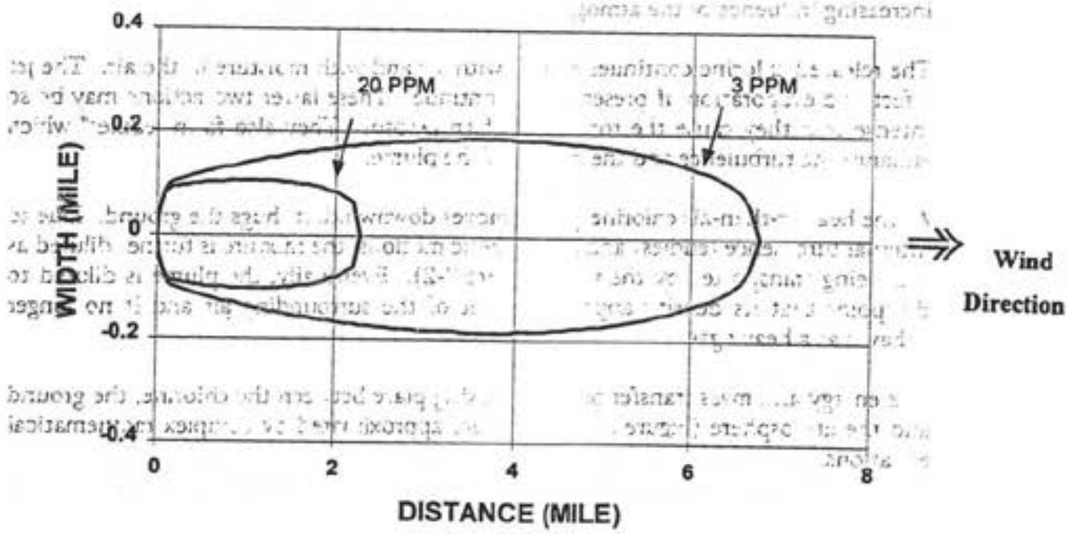


Figure 2.2
Continuous Release Footprint

1. The type of release (vapor, liquid, or both)
2. Geometry of the source
3. Location and orientation of the source
4. Conditions at the source (temperature, pressure)
5. Atmospheric conditions existing during the release (wind speed, temperature, solar radiation and humidity)

If vapor chlorine is released, it will start mixing with air immediately. If liquid chlorine is released under pressure, a portion of the escaping liquid is flashed off to a vapor. The remaining chlorine will either aerosolize or fall to the ground as a liquid. Figure 3.1 depicts some of these conditions.

In simulating releases, during the release stage, the release rate, fraction initially evaporated, drop size, velocity, and temperature are quantified and become parameters for subsequent dispersion calculations. In addition to the above, there are many complex phenomena associated with the release of chlorine. Similarly, there are many theories, equations and models simulating this initial release stage.

3.2 THE TRANSITION STAGE

In this stage, the released chlorine changes from the influence of the source to the increasing influence of the atmosphere.

The released chlorine continues to mix with air and with moisture in the air. The jet effect and evaporation, if present, also continue. These latter two actions may be so intense that they cause the formation of an aerosol. They also form "eddies" which enhance the turbulence and the mixing of the plume.

As the heavier-than-air chlorine plume moves downwind, it hugs the ground. Due to internal turbulence (eddies) and atmospheric motions, the mixture is further diluted as it is being transported by the wind (Figure 3-2). Eventually, the plume is diluted to the point that its density approaches that of the surrounding air and it no longer behaves as a heavy gas.

The energy and mass transfer processes taking place between the chlorine, the ground and the atmosphere (Figure 3-3), again, are approximated by complex mathematical equations.

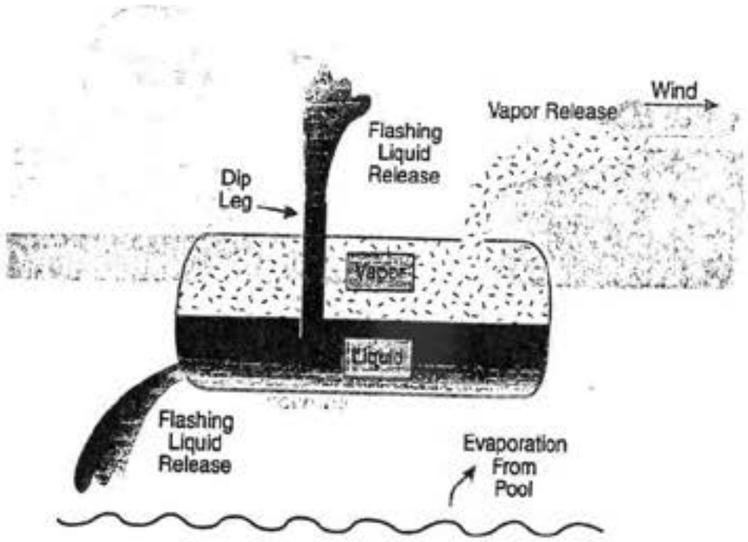


Figure 3.1
Chlorine Vessel Leak Scenarios

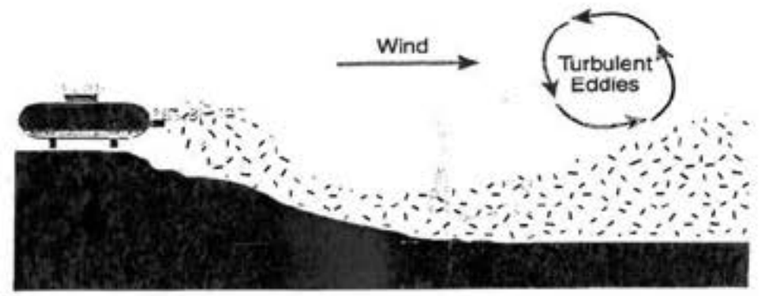


Figure 3.2
Dense Gas Behavior

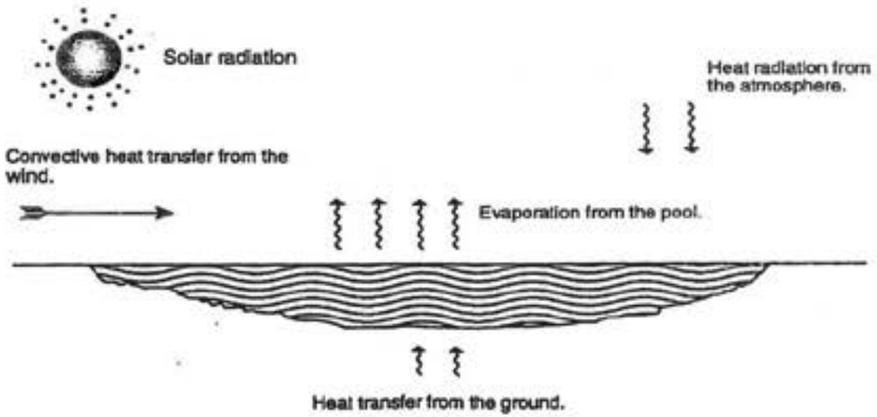


Figure 3.3
Heat Sources Affecting Evaporation Rate

3.3 THE DISPERSION STAGE

In the final stage, the plume is almost completely dominated by the dynamics of the atmosphere. The dynamics of the atmosphere, on the other hand, are controlled by the level of incoming solar radiation. This radiation (Figure 3-4) causes the heating of the earth surface, which then generates the vertical and horizontal movement of the atmosphere (wind).

Normally, the earth's surface absorbs the incoming heat and in turn heats the air layer directly above it. As a result, the ambient air temperature decreases as the altitude increases. During daytime, since the warmer air on the earth's surface has lower density, it tends to rise inducing a vertical atmospheric movement and consequently, vertical instability of the atmosphere. In this situation the atmosphere is referred to as being unstable. In the pre-dawn hours, after the earth's surface has cooled down during the evening, the reverse is true. In that case, the atmosphere is called stable. To characterize the vertical and horizontal movements (turbulence or stability) of the atmosphere, stability classes are used. Most commonly, the atmosphere is classified from Stability Class A (very unstable) to Stability Class F (very stable) (Table 3-1).

The horizontal and vertical movements of the atmosphere (stability) have great influence on the dispersion of the chlorine plume. In fact, in mathematical equations describing the dispersion of the plume, its spread is directly related to the stability classes. If the release lasts for an extended period of time, the change in wind direction also needs to be considered due to the possible new direction the plume might travel (Figure 3-5). Wind direction generally becomes less predictable at low wind speeds. A wind speed of zero cannot be calculated in most models.

3.4 SOURCES OF ATMOSPHERIC DATA

For modeling purposes, historic weather data can be taken from an on-site weather station or from the closest station of the National Weather Service. Prior to preparing an agency mandated study using data from an on-site station, it would be prudent to verify whether the reviewing regulatory agency has adopted any instrument and testing standards. These data can be entered into a model manually or imported as an electronic file. Electronic weather data are available from the EPA Office of Air Quality Planning and Standards (OAQPS) and from the National Weather Service. Electronic data often require reprocessing before they are in a form usable by a given model. Weather data may also be available from commercial sources.

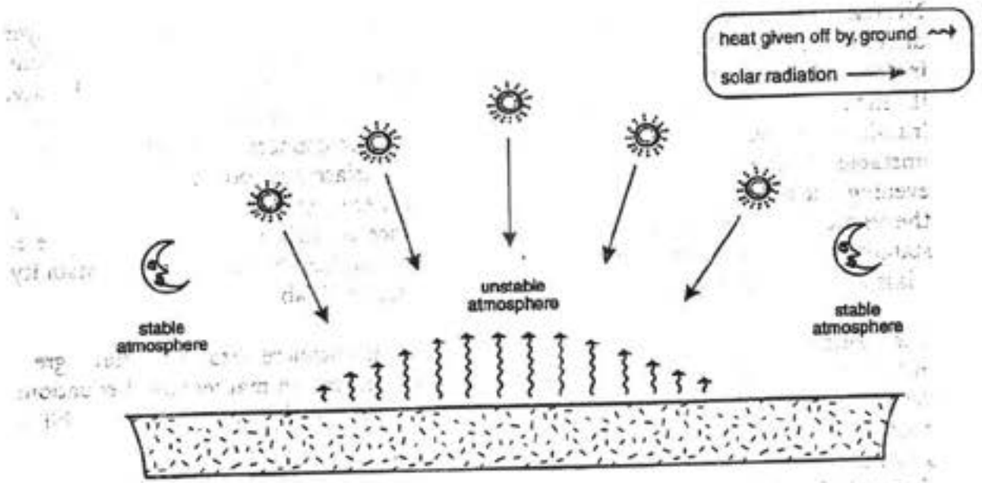
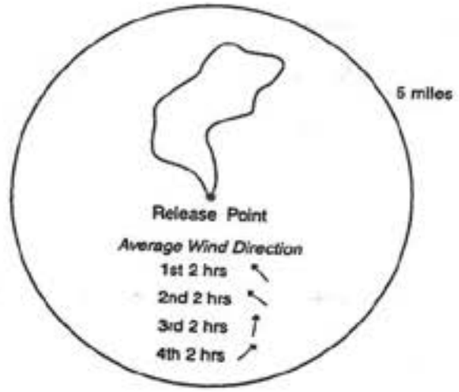
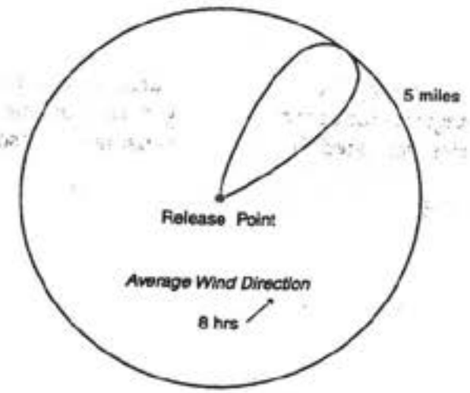


Figure 3.4
Effect of Changing Solar Radiation and Temperatures at Different Times of the Day



(a) Vapor Cloud Movement During an 8-Hour Period with a Wind Persistence Time of 2 Hours



(b) Vapor Cloud Movement During an 8-Hour Period with a Wind Persistence Time of 8 Hours

Figure 3.5
Examples of Atmospheric Dispersion of Vapor Clouds with Different Wind Persistence Times

Table 3.1. Pasquill-Turner Approach for Determining Atmospheric Stability in Rural Terrain.

Atmospheric Stability Categories*					
Surface Wind Speed (elevation of 10 meters) (meters/sec)	Day			Night	
	Incoming Solar Radiation			Thinly Overcast or ≥ ½ Cloud Cover	< ½ Cloud Cover
	Strong	Moderate	Slight		
<2	A	A - B	B		
2 - 3	A - B	B	C	E	F
3 - 5	B	B - C	C	D	E
5 - 6	C	C - D	D	D	D
>6	C	D	D	D	D

Note:

"Strong" incoming solar radiation corresponds to a solar altitude of > 60° with clear skies. "Slight" incoming solar radiation corresponds to a solar altitude of 15° to 35° with clear skies. The degree of cloudiness strongly influences the incoming solar radiation.

Neutral category D can be assumed for overseas conditions day or night, regardless of wind speed. "Night" refers to a period from 1 hour before sunset to 1 hour after sunrise.

*This categorization scheme applies only to rural areas (i.e., areas consisting of flat, vegetated terrain.) Stability categories for urban areas are generally one or two categories more unstable than stability categories estimated for a rural area using the Pasquill-Turner approach.

Source: Reference 5.6

4. CHLORINE RELEASE SCENARIOS

Each of the following examples gives an estimate for the area affected by a chlorine release under a given scenario. The scenarios were selected to give a wide range of potential release quantities and conditions. Also included are four examples developed to demonstrate Worst Case conditions as defined by the Environmental Protection Agency (5.9 and 5.10). Appendix I gives additional information explaining the computer model utilized to make the estimates. The footprints depict downstream distances at which chlorine concentration exceeds 20 parts per million (ppm) and 3 ppm. These values represent the American Industrial Hygiene Association (AIHA) Emergency Response Planning Guidelines ERPG-3 value (20 ppm) and ERPG-2 value (3 ppm) (Reference 5.8). These values were chosen because of their applicability to emergency response planning within LEPCs and industry and have been accepted by EPA.

In addition to the footprint type of outputs, two additional outputs have been added in this edition. The second output shows the maximum (or peak) chlorine concentration at approximately 25, 50, 75, and 95% of the 3 ppm cloud distance versus time. This output provides information on the time required for the cloud to reach specific downwind distances.

The third output shows the maximum or peak concentration of chlorine at a specific distance down wind from the source. While the footprint output is both common and useful, it does not allow for a determination of how high the concentration of chlorine might be within the overall cloud. This new output will allow the reader to determine the maximum distance that a cloud will travel at chlorine concentrations other than 3 or 20 ppm.

4.1 WORST CASE SCENARIO ASSUMPTIONS

These are release scenarios involving standard chlorine containers and utilizing the methods prescribed by EPA in its RMP Offsite Consequence Analysis Guidance (Reference 5.9). All of the worst case scenarios depicted in this pamphlet involve transportation containers. These have been selected because they represent various size containers in common use. Facilities must individually determine whether the use of any of these scenarios satisfies the requirements of EPA's Risk Management Rule (5.10). Inputs common to these worst case scenarios are as follows:

a. The ambient relative humidity is 50%.

b. The ambient temperature is 77°F (25°C).

c. Liquid chlorine is at 77°F and 100 psig before the release.

d. Surface roughness is 3.94 inches (0.1 meters). Such a surface roughness corresponds to a relatively flat, grassy, rural setting. A release in hilly terrain, forested area, urban environment or over water may have significantly different dispersion results.

e. The wind speed is 3.36 miles/hour (1.5 m/s). The reference height for measuring the wind speed is 32.8 feet (10 meters).

f. The contents of the container are released instantaneously and evaporated at a constant rate over a ten-minute period.

g. The atmospheric stability is class F.

h. The release occurs at ground level.

I. Solar radiation is assumed at 0 Btu/hr/ft^2

j. Averaging time is 10 minutes.

k. Receptor height is 0 feet (ground level)

4.2 ALTERNATE SCENARIO ASSUMPTIONS

These are release scenarios involving equipment in use at chlorine production and/or use facilities. Facilities must individually determine whether the use of any of these scenarios satisfies the requirements of EPA's Risk Management Rule (5.10). Inputs common to these alternate scenario assumptions are as follows:

a. The ambient relative humidity is 50%.

b. The ambient temperature is 77°F.

c. Liquid or gaseous chlorine is at 77°F and 100 psig before the release.

d. Surface roughness is 3.94 inches (0.1 meters). Such surface roughness corresponds to a relatively flat, grassy, rural setting. A release in hilly terrain, forested area, urban environment or over water may have significantly different dispersion results.

e. The wind speed is either 7.72 miles/hour (3 m/s) or 3.36 miles/hour (1.5 m/s). The reference height for meteorological condition is 32.8 feet (10 meters).

f. The minimum pool depth is 0.394 inches (1 centimeter)

g. The maximum pool area is the model default (10,000 meter^2).

h. The pool temperature is allowed to drop.

I. The initial substrate temperature is 77°F.

j. Averaging time used is as follows: If the release duration is greater than 10 minutes, one hour averaging time is used. Otherwise, a 10 minute averaging time is used.

k. Receptor height is 0 feet (ground level)

l. The model determines whether there is aerosol formation.

m. If aerosol has formed, it is assumed to evaporate at the source.

Changes in the ambient temperature or relative humidity assumptions will have little effect of the dispersion. Changes in the assumptions about the temperature and pressure of the chlorine prior to the release could significantly affect the dispersion. As stated in Section 1.2, the user of this pamphlet should consult with a person skilled in the modeling of heavy gases if different assumptions are used.

4.3 Understanding the Outputs

Outputs for the worst case scenarios are depicted only for stability class F. Outputs for alternate scenarios are depicted for stability classes B, D, and F. This approach is thought to cover most of the atmospheric conditions (see Section 3.3).

Appendix II provides a detailed explanation of how to interpret each of the outputs.

- The graphs were derived by considering an approximately 5 degree average wind direction fluctuation. If during the release the wind direction shifts considerably, the area impacted by the plume will be accordingly wider.

- Care should be taken when interpolating results from a graph.

  Concentration is not linear with distance. The user is further cautioned that the second output for each scenario, maximum concentration of chlorine at a specific distance downwind from the source, is presented as a semi-log graph. As needed, refer to Appendix II for an explanation on how to use this type of graph.

4.4 Worst Case (Catastrophic) Scenarios

See Sections 4.4.1 to 4.4.4 below.

4.5 Alternate Scenarios

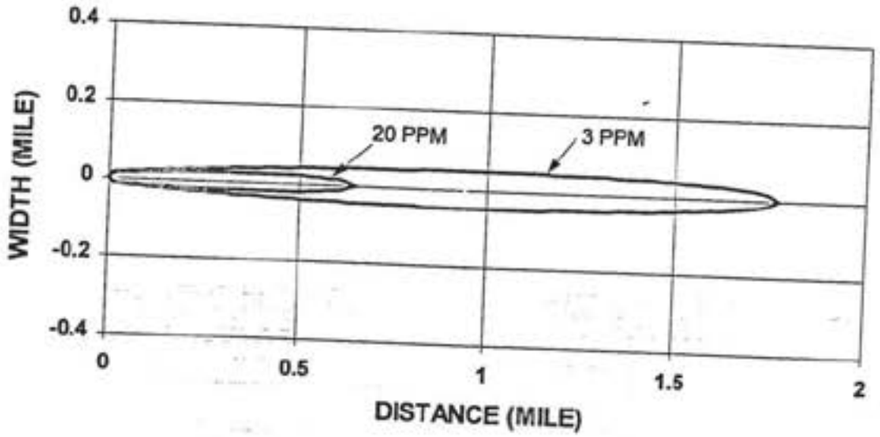
See Sections 4.5.1 to 4.5.13 below.

4.4.1 150-lb. Cylinder

- total mass release = 150 pounds
- 10 minute release
- 0.25 pounds/second steady state release
- release occurs on concrete

Note - The reader is cautioned to compare this scenario with scenario 4.5.1. Some events could lead to a release with greater consequences than this scenario which adheres to the EPA definition of a worst case scenario.

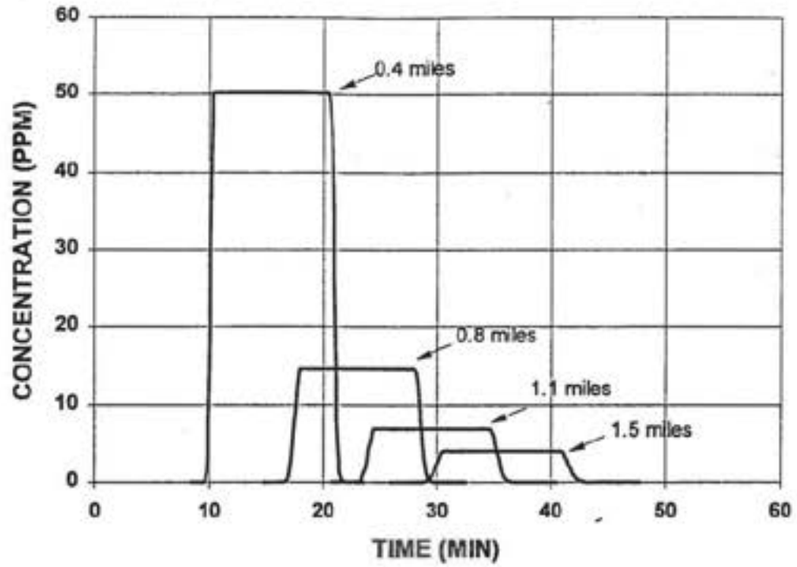
Maximum downwind distance to 3ppm = 1.7 miles
Maximum crosswind distance to 3ppm = 0.05 miles
Maximum downwind distance to 20ppm = 0.6 miles
Maximum crosswind distance to 20ppm = 0.02 miles



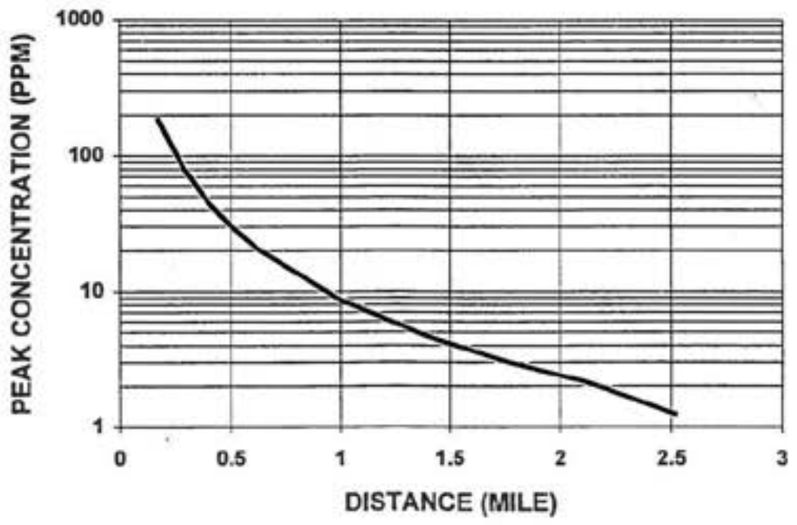
Note: The scale on the X and Y axes are different.

4.4.1 150 lb Cylinder - continued

Peak Concentration As A Function Of Time At Various Downwind Distances:



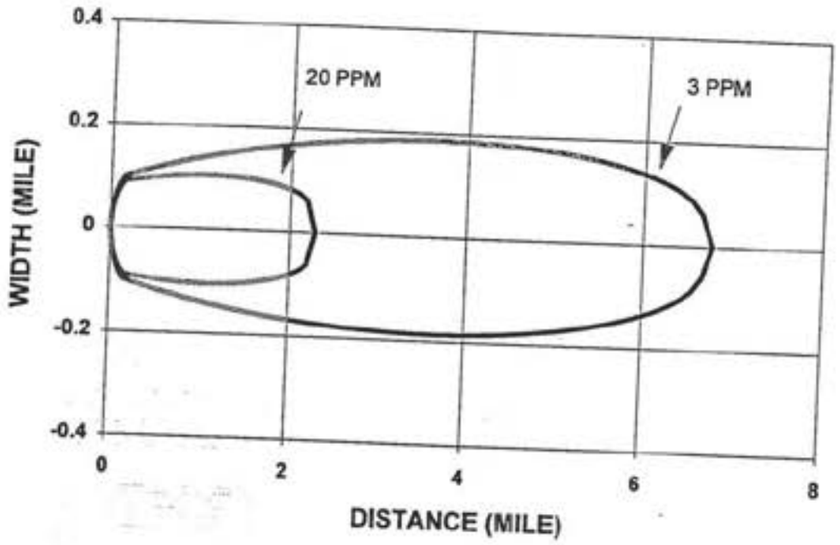
Peak Concentration As A Function Of Distance:



4.4.2 1-Ton Container

- total mass release = 2,000 pounds
- 10 minute release
- 3.33 pounds/second steady rate release
- release occurs on concrete surface

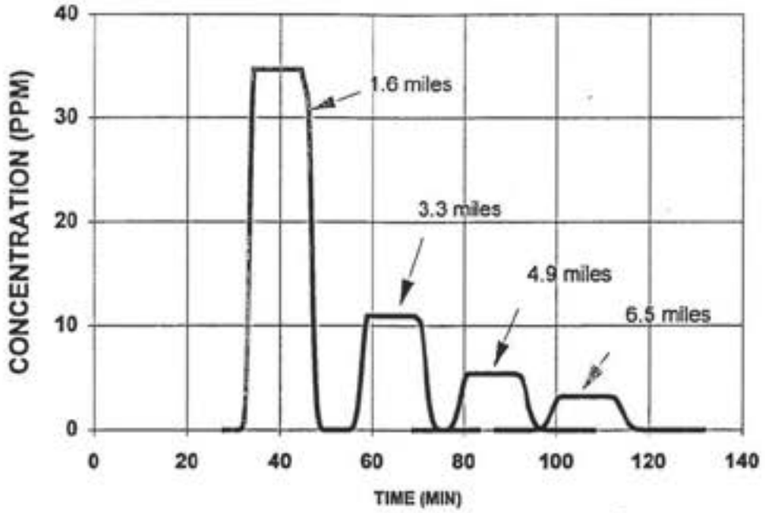
Maximum downwind distance to 3ppm = 6.7 miles
Maximum crosswind distance to 3ppm = 0.2 miles
Maximum downwind distance to 20ppm = 2.2 miles
Maximum crosswind distance to 20ppm = 0.1 miles



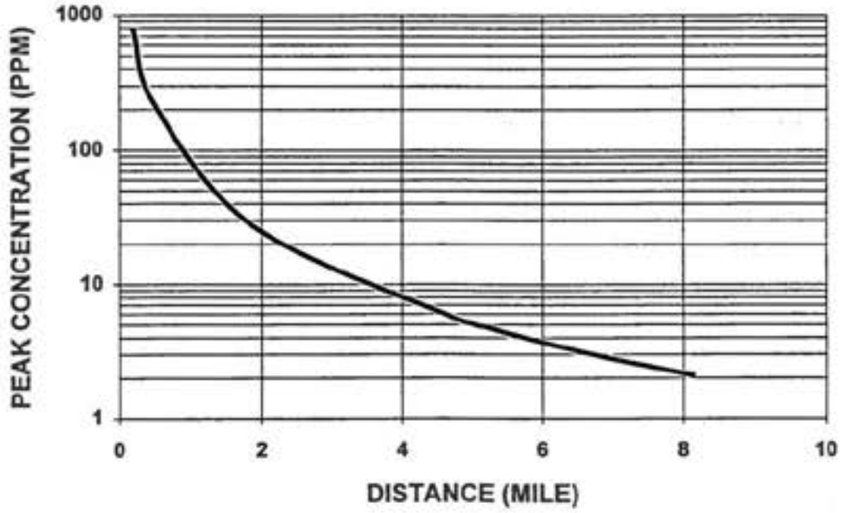
Note: The Scales on the X and Y axes are different.

4.4.2 1 Ton Container - Continued

Peak Concentrations As A Function Of Time At Various Downwind Distances:



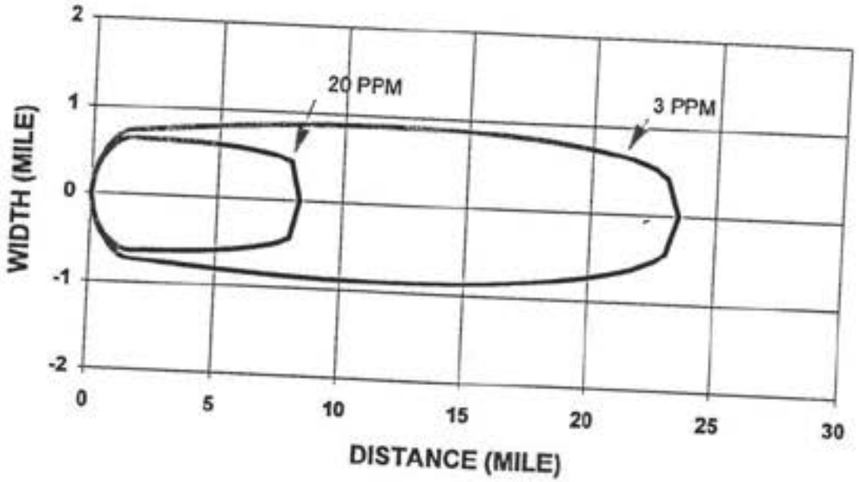
Peak Concentrations As A Function of Distance:



4.4.3 17-Ton Tank Truck Trailer

- total mass release = 34,000 pounds
- 10 minute release
- 56.67 pounds/second steady rate release
- release occurs on concrete surface

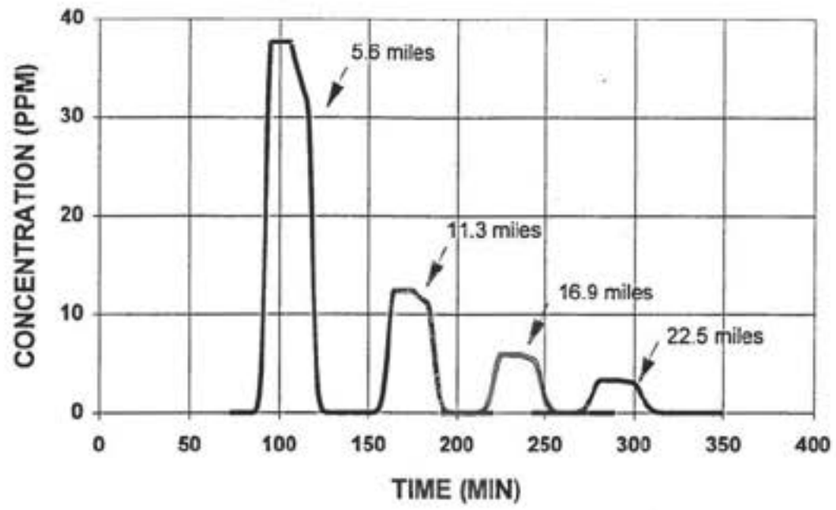
Maximum downwind distance to 3ppm = 23.0 miles
Maximum crosswind distance to 3ppm = 0.9 miles
Maximum downwind distance to 20ppm = 7.9 miles
Maximum crosswind distance to 20ppm = 0.6 miles



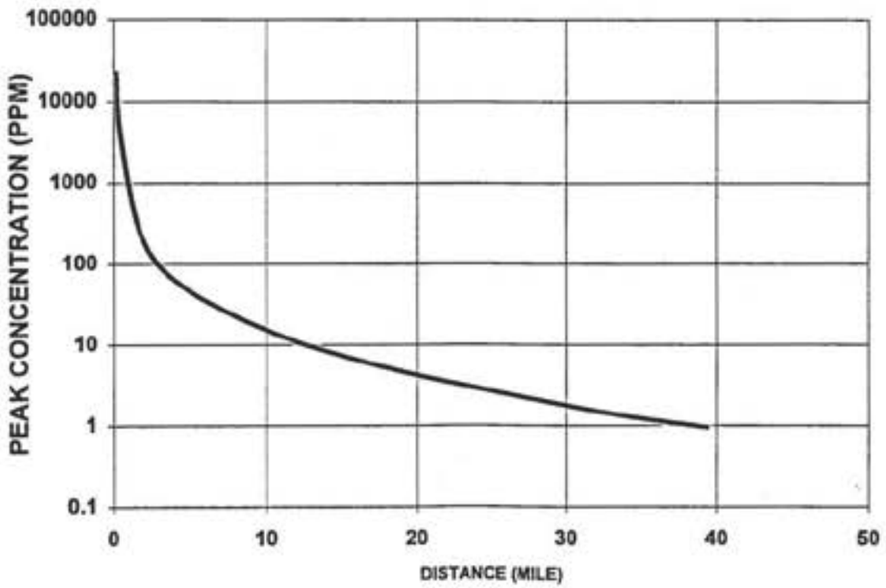
Note: The scale on the X and Y axes are different.

4.4.3 17 Ton Tank Truck Trailer - Continued

Peak Concentration As A Function of Time At Various Downwind Distances:



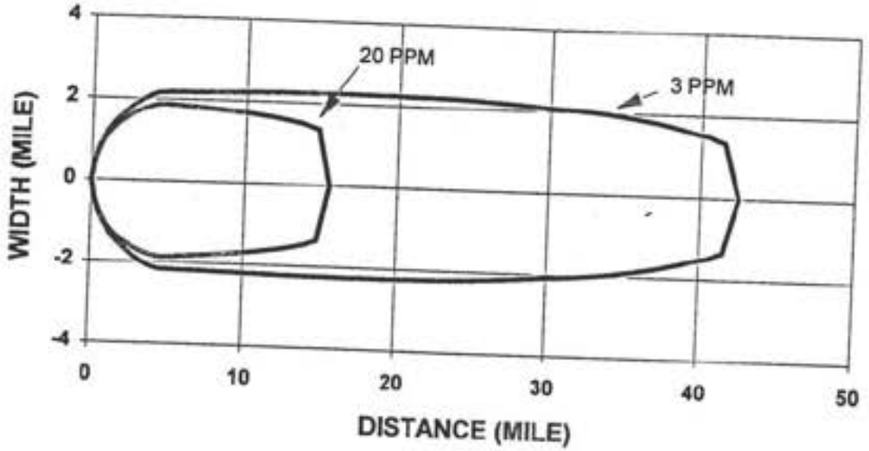
Peak Concentration As A Function of Distance:



4.4.4 90-Ton Rail Tank Car

- total mass release = 180,000 pounds
- 10 minute release
- 300 pounds/second steady rate release
- release occurs on concrete surface

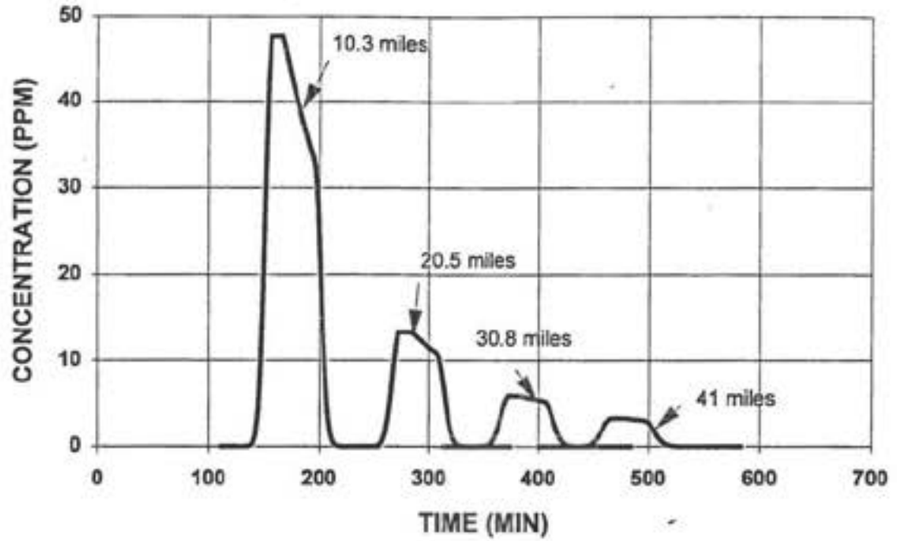
Maximum downwind distance to 3ppm = 41.5 miles
Maximum crosswind distance to 3ppm = 2.3 miles
Maximum downwind distance to 20ppm = 14.8 miles
Maximum crosswind distance to 20ppm = 1.9 miles



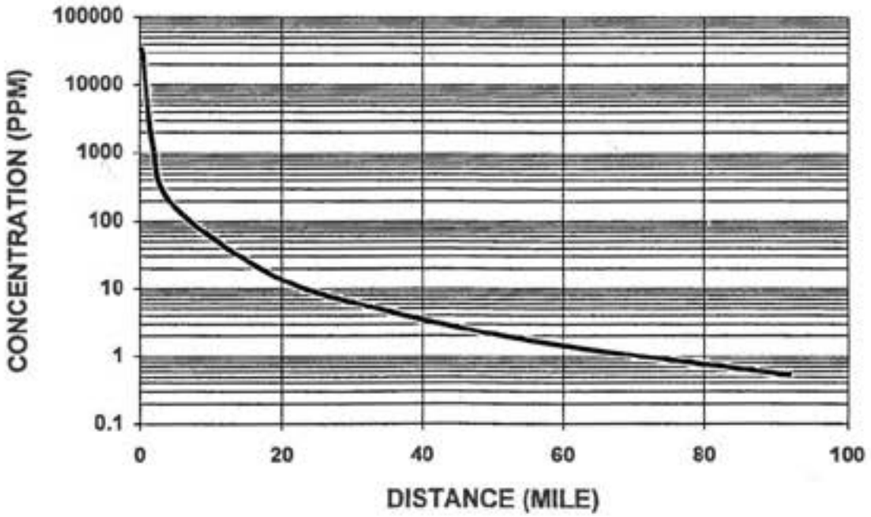
Note: The scales on the X and Y axes are different.

4.4.4 90 Ton Rail Car - Continued

Peak Concentration As A Function of Time at Various Downwind Distances:



Peak Concentration As A Function of Distance:



4.5.1 150-lb. Cylinder - Gas and Liquid

- a 150-lb. chlorine cylinder falls over and shears off the valve. Entire contents released.

Release Mechanism: Valve Failure
Release State: liquid and gas
Max. Release rate: 68.4 lb/minute

Time for pool to evaporate: 52-87 minutes
Duration of release: 52-87 minutes
Time to empty the container: 3.2 minutes
Hole elevation: 0 feet
Valve opening diameter: 3/16 In.
Contents mass: 150 lb.

Surface under pool: concrete
Initial air entertainment: Evaporate all aerosol at source

Stability Class B
Wind Speed = 3m/s
@ 3ppm
Maximum downwind distance = 0.5mi
Maximum crosswind distance = 0.2mi
@ 20 ppm
Maximum downwind distance = 0.2mi
Maximum crosswind distance = 0.1mi

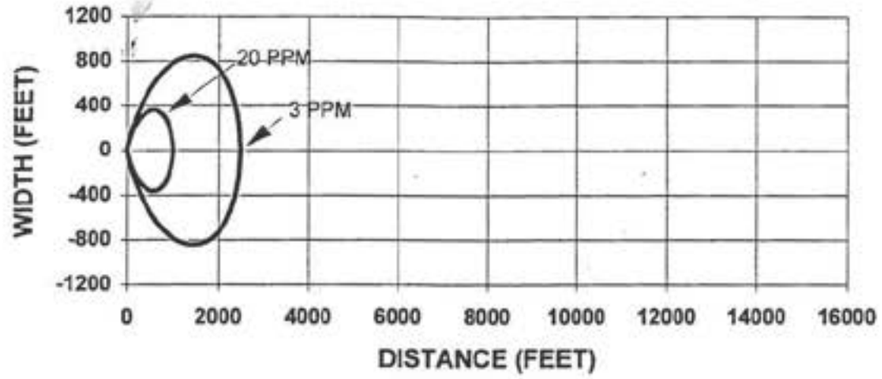
Stability Class D
Wind Speed = 3m/s
@ 3ppm
Maximum downwind distance = 1.1 mi
Maximum crosswind distance = 0.1 mi
@20 ppm
Maximum downwind distance = 0.4 mi
Maximum crosswind distance = 0.03 mi

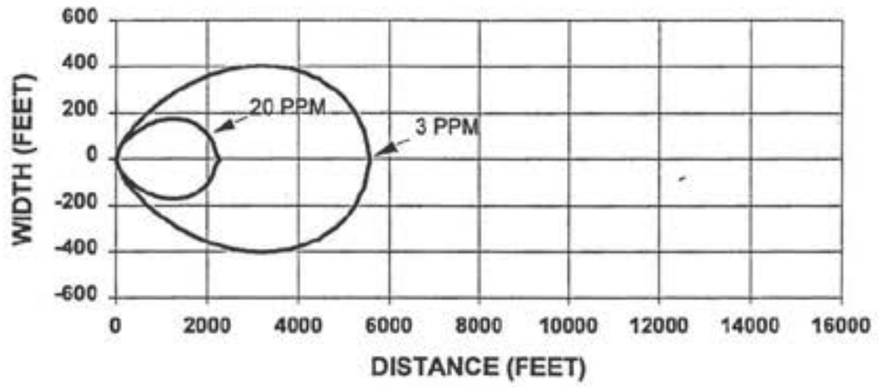
Stability Class F
Wind Speed = 1.5m/s
@3ppm
Maximum downwind distance = 2.6 mi
Maximum crosswind distance = 0.1 mi
@20 ppm
Maximum downwind distance = 1.2mi
Maximum crosswind distance = 0.1mi

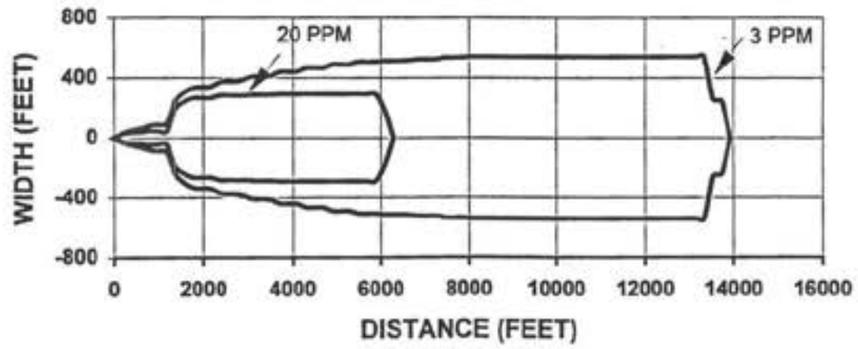
Note: The scales on the X and Y axes are different.

See section 4.2 for assumptions common to all alternate scenarios. See section 6 Appendix 1 for input assumptions used by the dispersion model.

4.5.1 150-lb. Cylinder - Gas and Liquid (Continued)

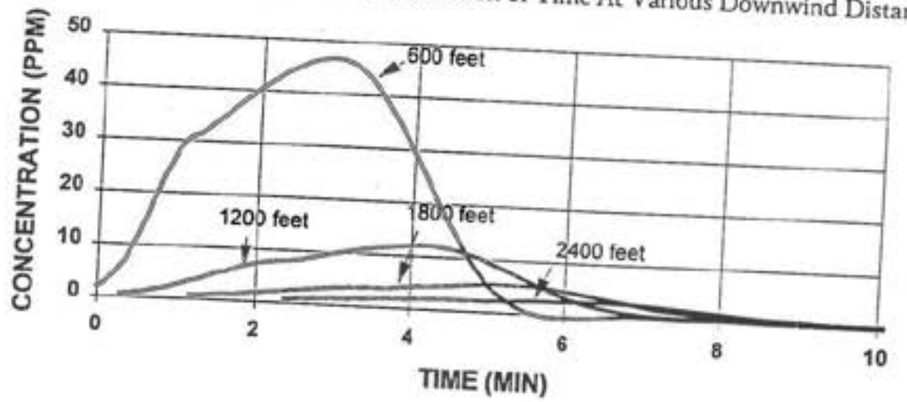


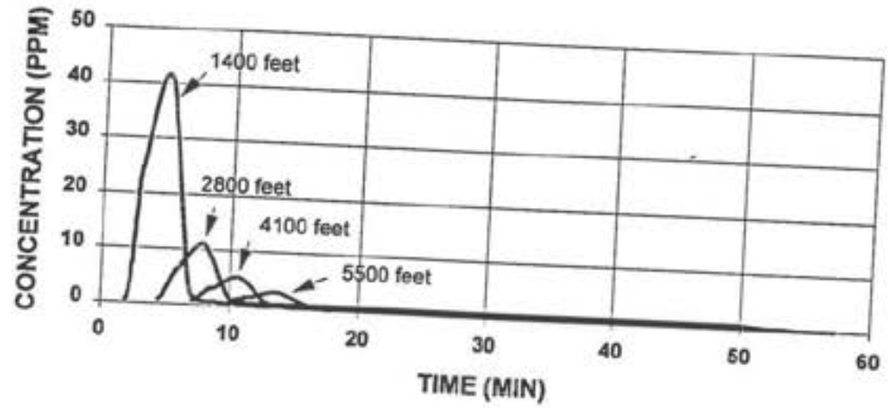


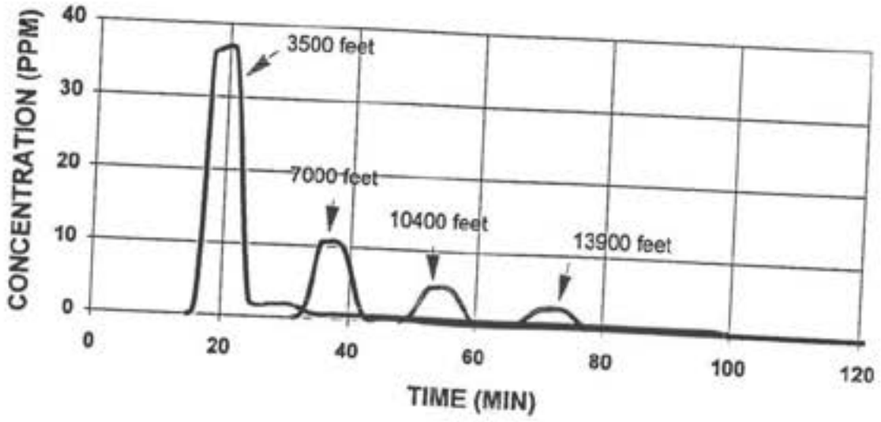


4.5.1 150 lb. Cylinder - Gas and Liquid (continued)

Peak Concentration As A Function of Time At Various Downwind Distances.

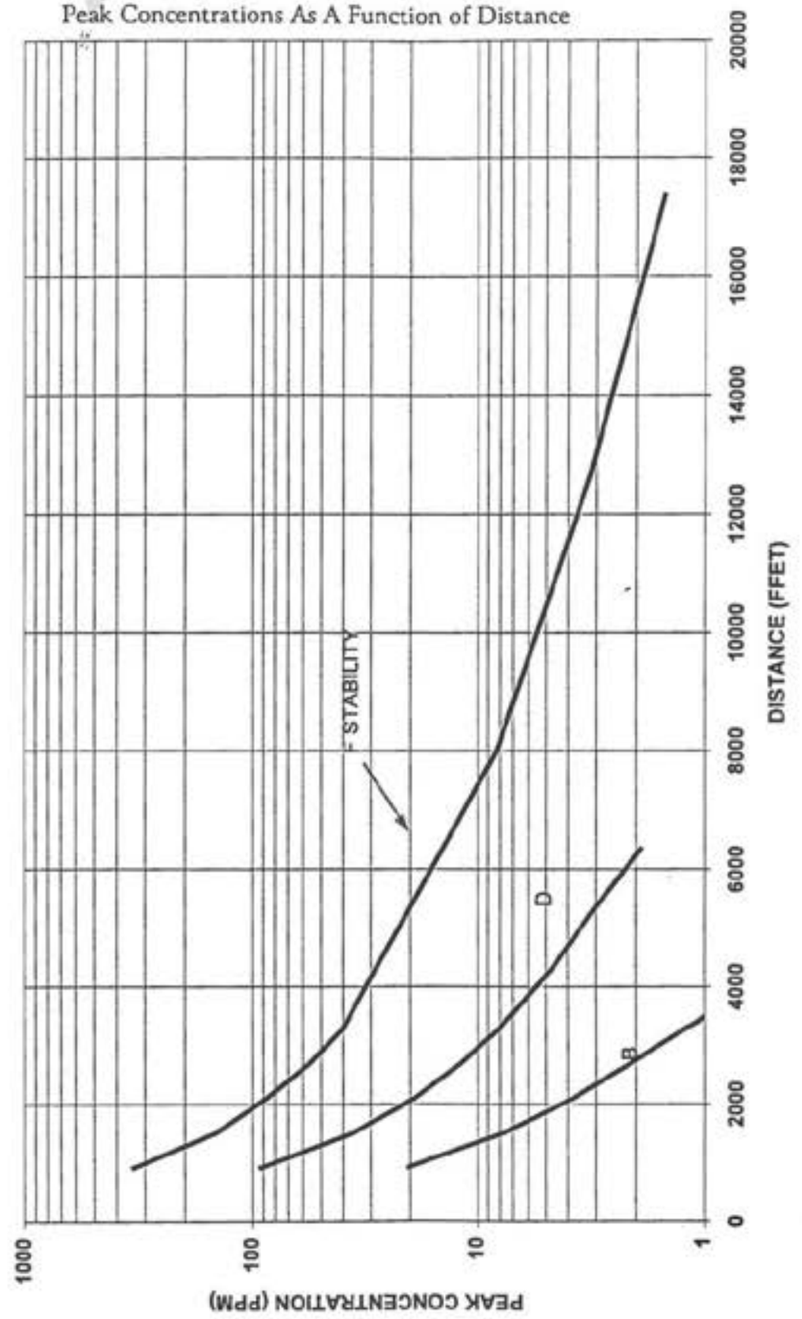






4.5.1 150 lb. Cylinder –Gas And Liquid (Continued)

Peak Concentrations As A Function of Distance



4.5.2 1-Ton Container - Gas Valve Remains Open (gas release)

- mitigation is assumed to occur in one hour

Release mechanism: Valve Failure
Release state: Gas
Maximum Release state: 12.7 lb/min
Contents Mass: 2,000 lb

Duration of Release: 60 minutes
Time to empty the container: 106 minutes
Hole elevation: 1 ½ feet
Valve Opening diameter: 5/16"

Stability Class B
Wind speed = 3m/s
@ 3ppm
Maximum downwind distance =0.3mi
Maximum crosswind distance = 0.1mi
@ 20 ppm
Maximum downwind distance = 0.1mi
Maximum crosswind distance = 0.1mi

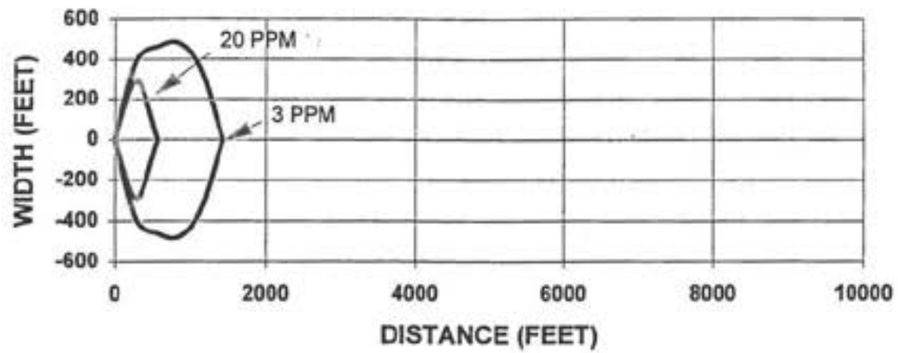
Stability Class D
Wind speed = 3m/s
@ 3 ppm
Maximum downwind distance = 0.5mi
Maximum crosswind distance = 0.1mi
@ 20 ppm
Maximum downwind distance = 0.2mi
Maximum crosswind distance = 0.02mi

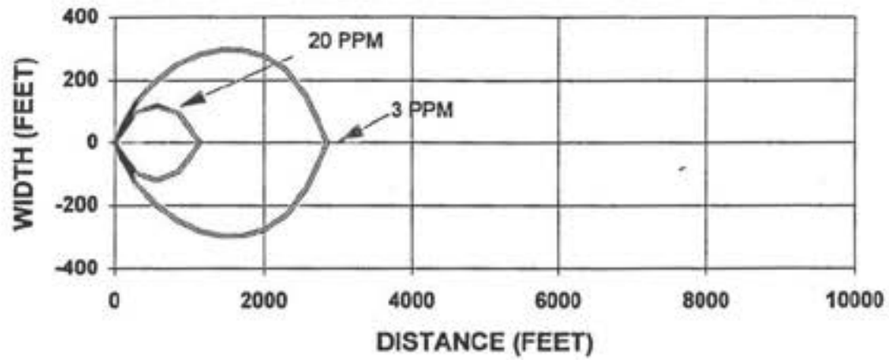
Stability Class F
Wind speed = 1.5m/s
@ 3ppm
Maximum downwind distance = 1.7mi
Maximum crosswind distance = 0.1mi
@ 20 ppm
Maximum downwind distance = 0.7ppm
Maximum crosswind distance = 0.02 mi

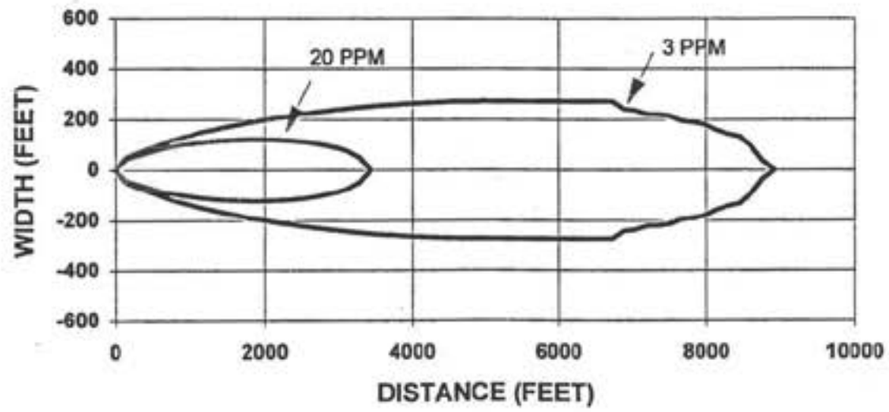
Note: The scales on the X and Y axes are different.

See Section 4.2 for assumptions common to all alternate scenarios. See Section 6 Appendix 1 for input assumptions used by the dispersion model.

4.5.2 1-Ton Container - Gas Valve Remains Open (gas release) (Continued)

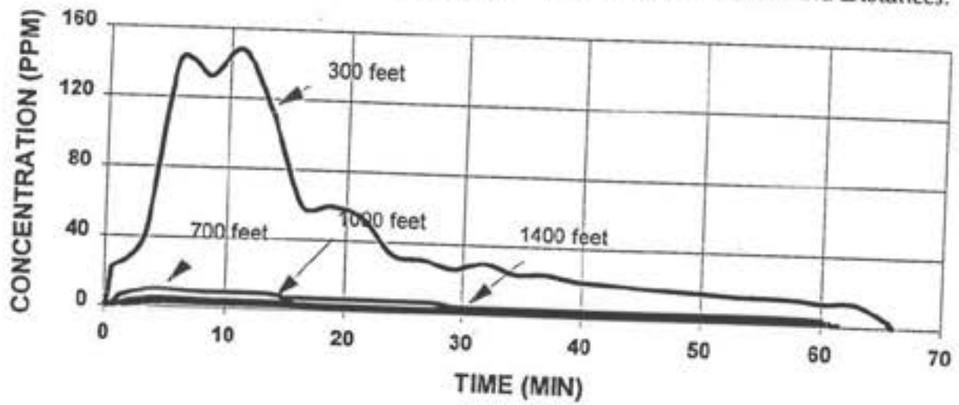


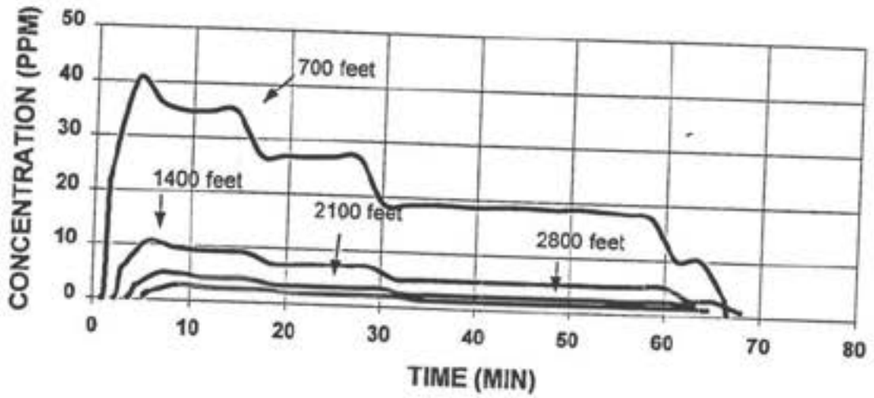


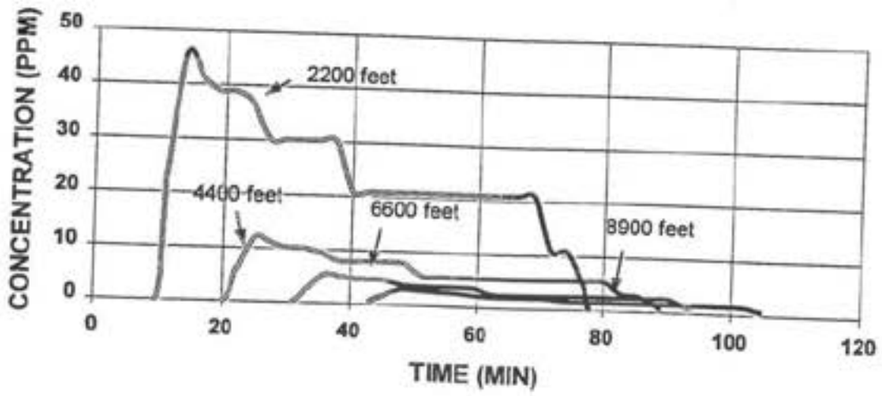


4.5.2 1 Ton Container - Gas Valve Remains Open (gas release) (Continued)

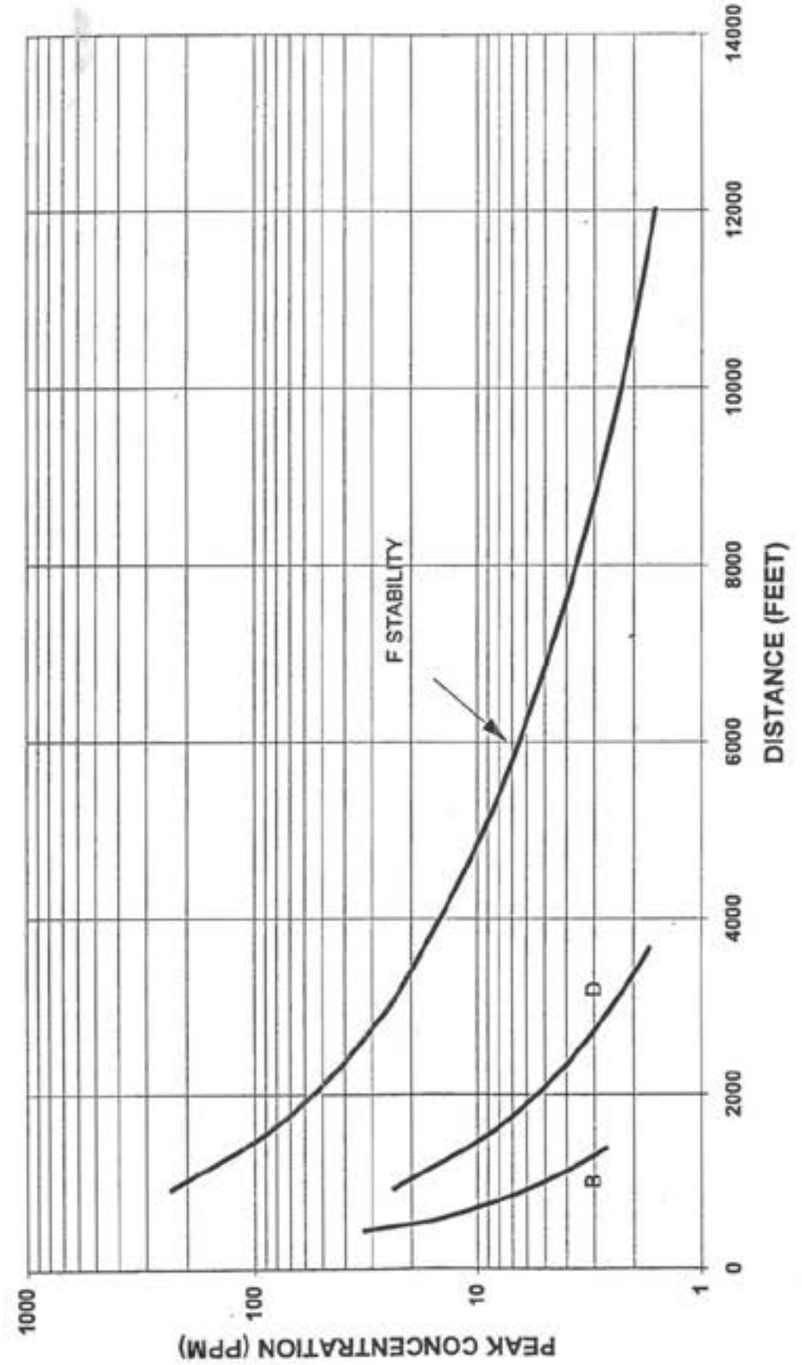
Peak Concentration As A Function of Time At Various Downwind Distances.







4.5.2 1 Ton Container - Gas Valve Remains Open (gas release) (continued)



4.5.3 1-Ton Container - Liquid Valve Remains Open (liquid release)

Release mechanism: Valve Failure
Release state: Liquid
Maximum Release Rate: 191 lb/min
Contents Mass: 2,000 lb

Time for pool to evaporate: 1-2 hours
Duration of release: 1-2 hours
Time to empty the container: 16 minutes
Hole elevation: 3 feet
Valve opening diameter: 5/16"

Stability Class B
Wind speed = 3m/s
@ 3 ppm
Maximum downwind distance = 0.9mi
Maximum crosswind distance = 0.3mi
@ 20 ppm
Maximum downwind distance = 0.3mi
Maximum crosswind distance = 0.1mi

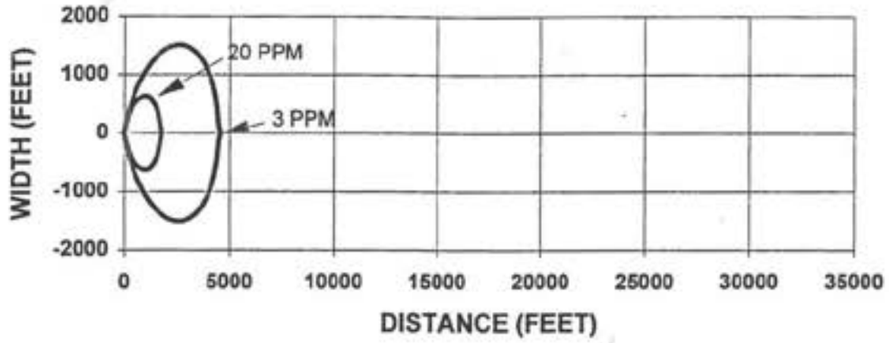
Stability Class D
Wind speed = 3m/s
@ 3 ppm
Maximum downwind distance = 2.0mi
Maximum crosswind distance = 0.1mi
@ 20 ppm
Maximum downwind distance = 0.8mi
Maximum crosswind distance = 0.1mi

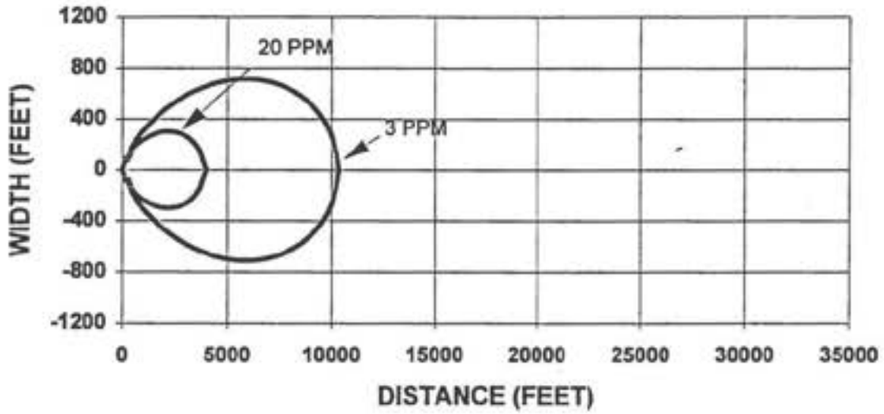
Stability Class F
Wind speed = 1.5m/s
@3 ppm
Maximum downwind distance = 5.8mi
Maximum crosswind distance = 0.2mi
@20 ppm
Maximum downwind distance = 2.3mi
Maximum crosswind distance = 0.1mi

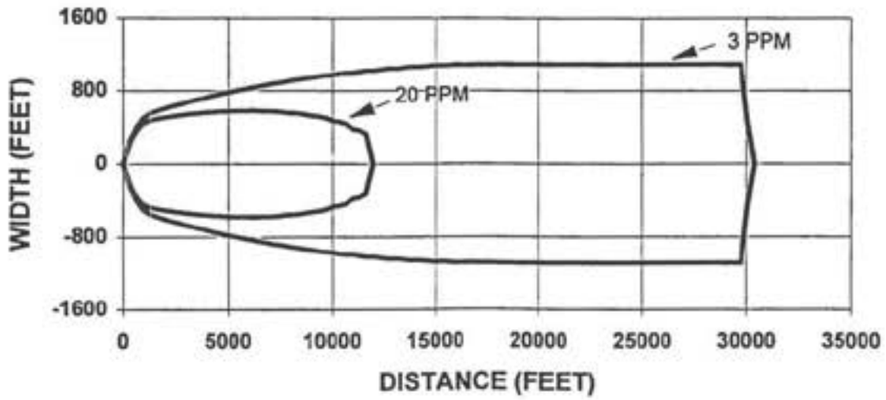
Note: The scales on the X and Y axes are different.

See Section 4.2 for assumptions common to all alternate scenarios. See Section 6 appendix 1 for input assumptions by the dispersion model.

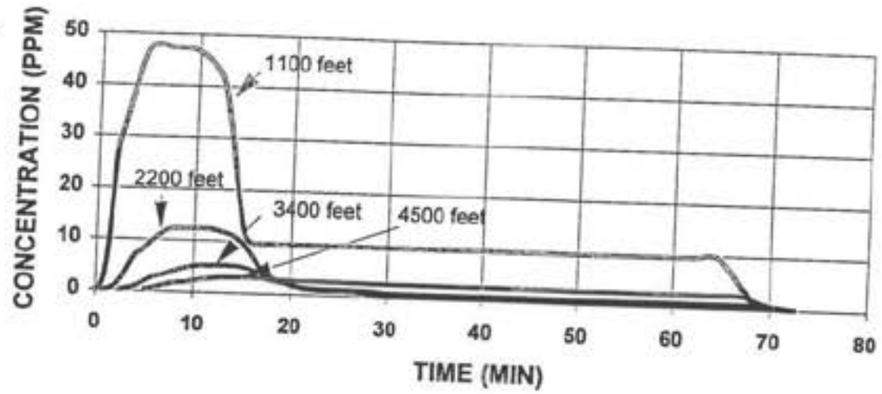
4.5.3 1-Ton Container - Liquid Valve Remains Open (liquid release) (Continued)

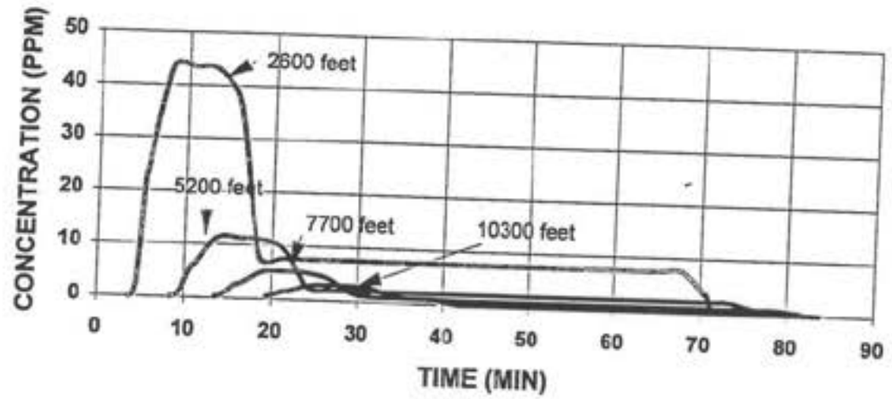


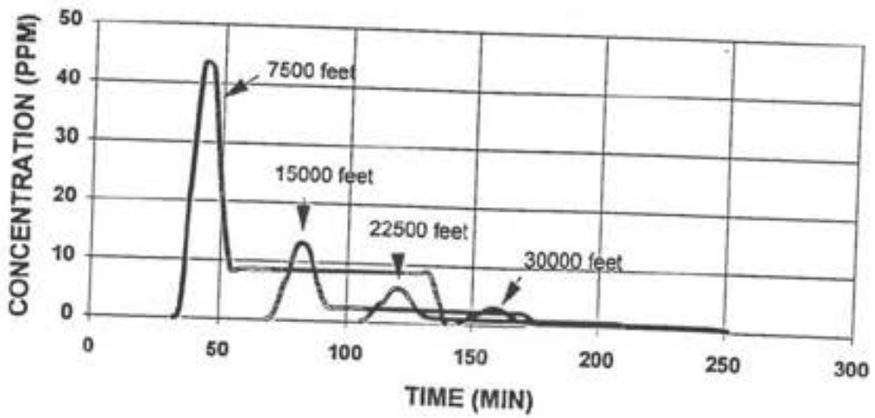




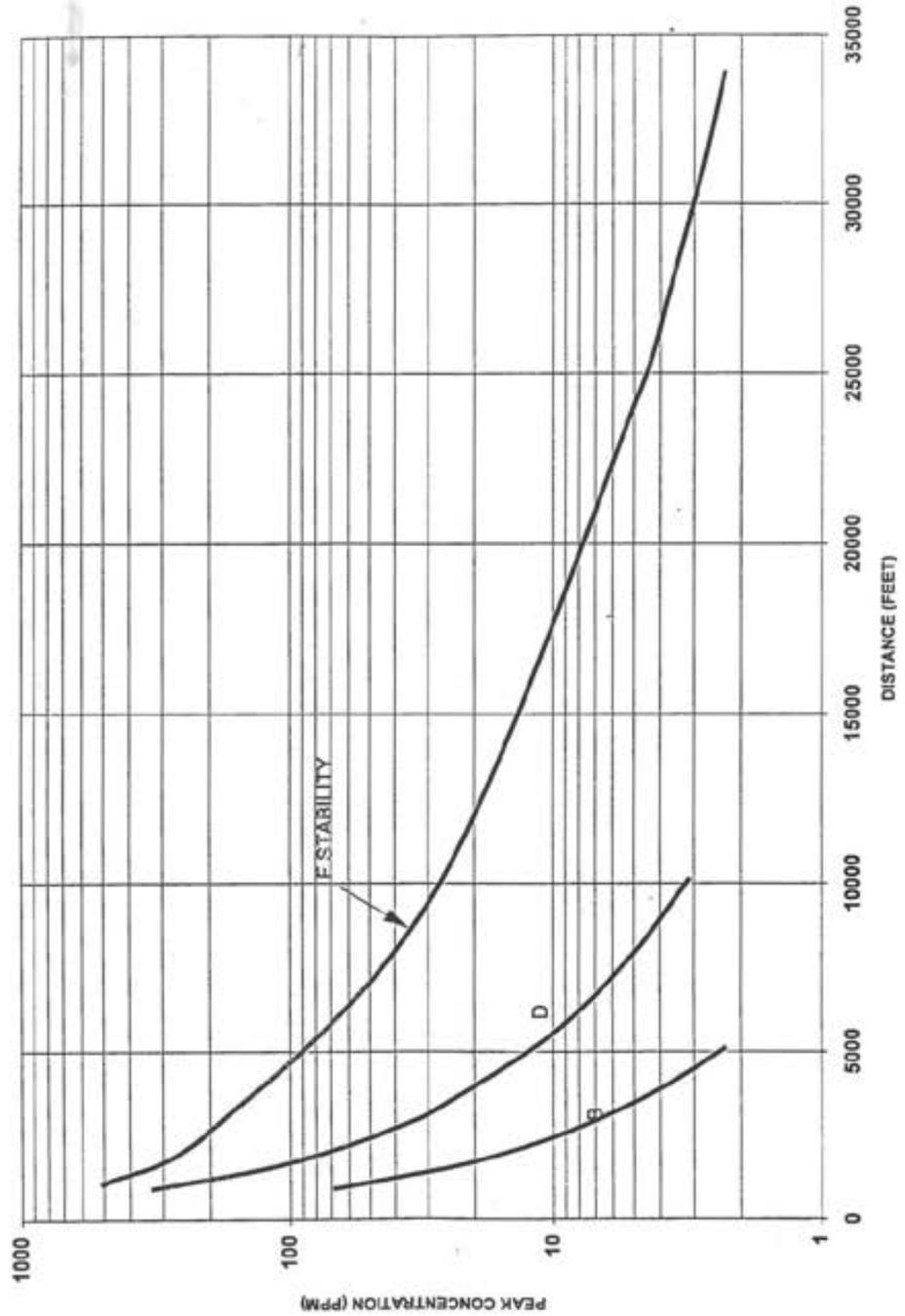
4.5.3 1-Ton Container - Liquid Valve Remains Open (liquid release) (Continued)







4.5.3 1 Ton Container – Liquid Valve Remains Open (Liquid Release) (Continued)



4.5.4 1-Ton Container - Manifold Failure (Gas Release)

- four 1-ton containers are connected to a 1-inch schedule 80 pipe manifold, and the manifold is sheared off

Release Mechanism: Line Failure
Release State: Gas
Maximum Release Rate: 120 lb/min
Contents mass: 8,000 lb.
Duration of Release: 40-50 minutes
Time to Empty the Containers: 40-50 minutes
Hole Elevation: 3 ft.
Opening diameter: The inside pipe diameter is 1 inch. However, the 5/16 inch diameter valve opening on each cylinder is the limiting condition.

Stability Class B
Wind speed = 3m/s
@ 3 ppm
Maximum downwind distance = 0.7mi
Maximum crosswind distance = 0.2mi
@ 20 ppm
Maximum downwind distance = 0.3mi
Maximum crosswind distance = 0.1mi

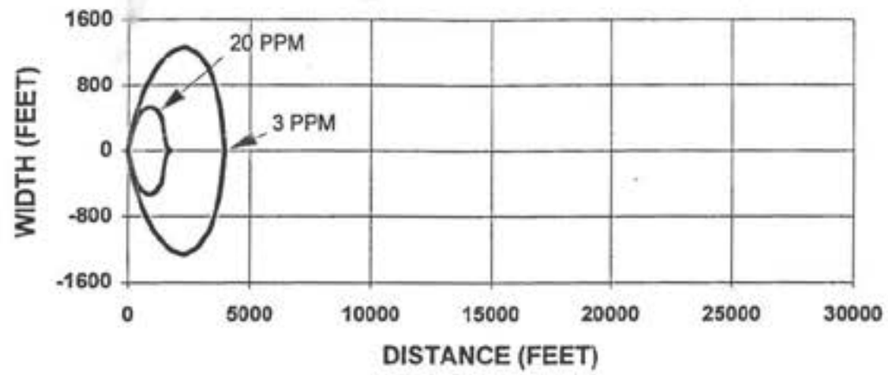
Stability Class D
Wind speed = 3m/s
@ 3ppm
Maximum downwind distance = 1.6mi
Maximum crosswind distance = 0.1mi
@ 20 ppm
Maximum downwind distance = 0.6mi
Maximum crosswind distance = 0.05mi

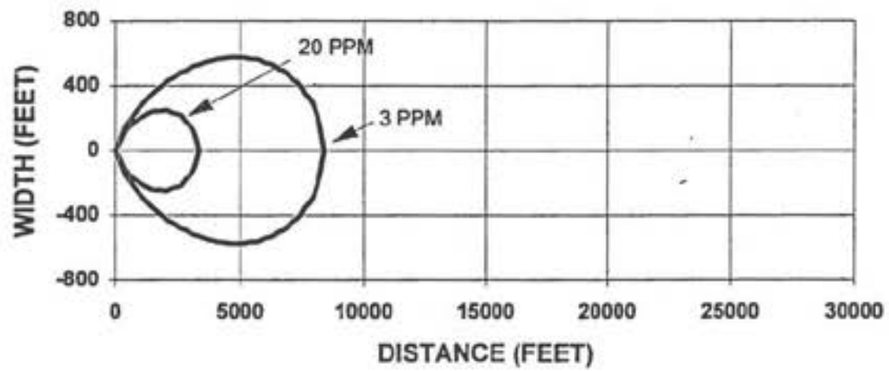
Stability Class F
Wind speed = 1.5m/s
@ 3 ppm
Maximum downwind distance = 4.8mi
Maximum crosswind distance = 0.1mi
@ 20 ppm
Maximum downwind distance = 1.9mi
Maximum crosswind distance = 0.1mi

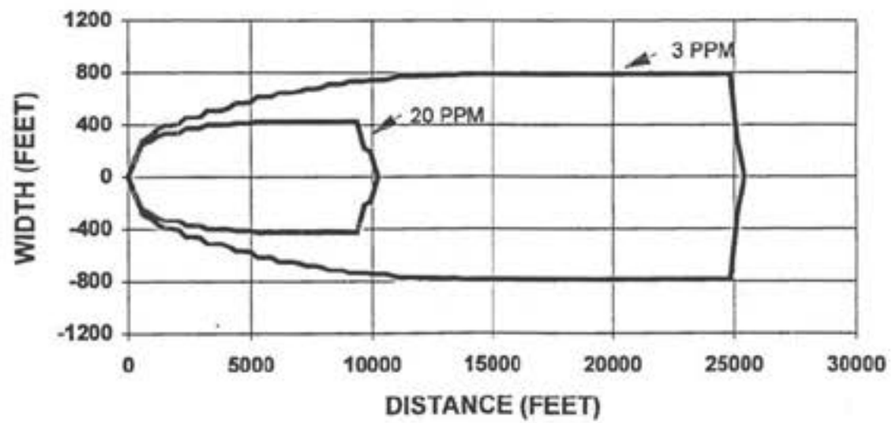
Note: The scales on the X and Y axes are different.

See section 4.2 for assumptions common to all alternate scenarios. See Section 6 Appendix 1 for input assumptions used by the dispersion model.

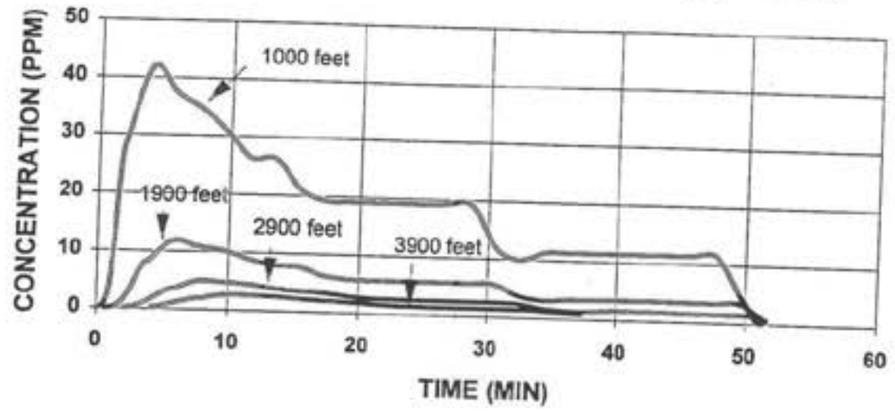
4.5.4 1-Ton Container - Manifold Failure (Gas Release) (Continued)

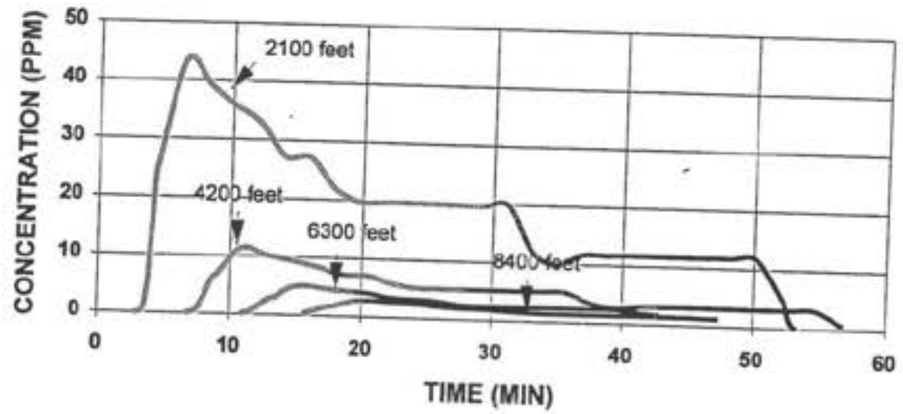


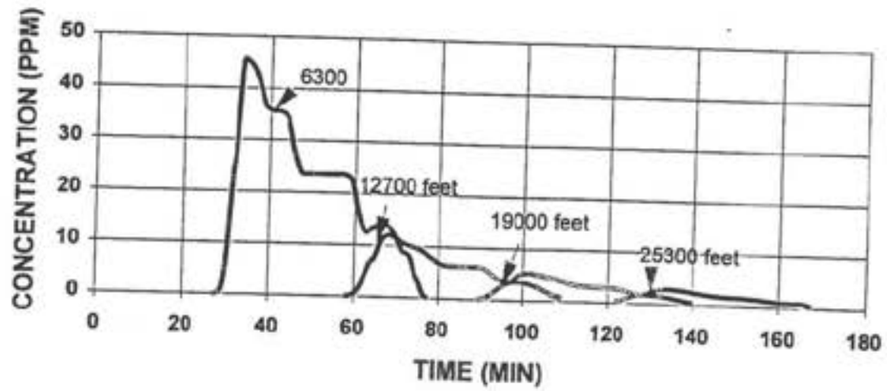




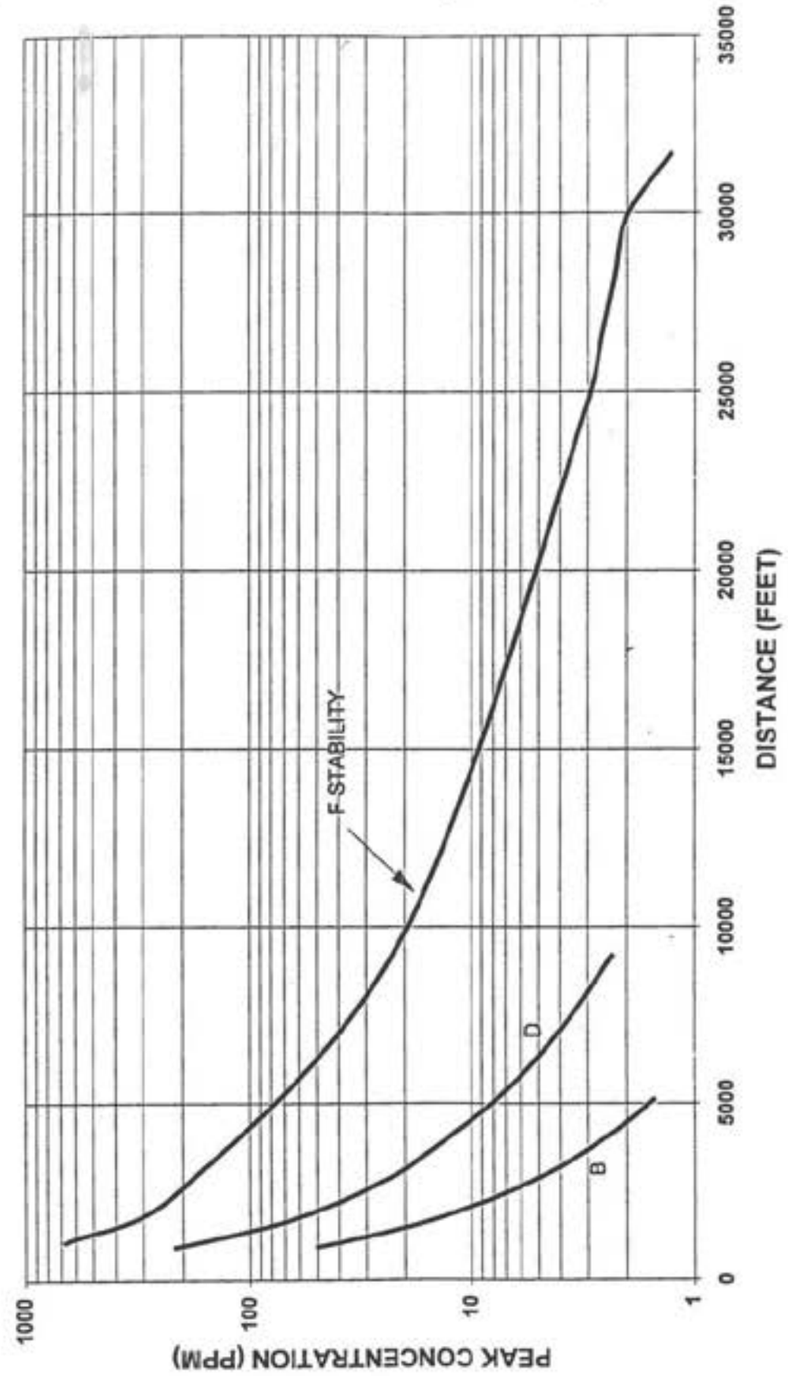
4.5.4 1-Ton Container - Manifold Failure (Gas Release) (Continued)







4.5.4 1 Ton Container – Manifold Failure (Gas Release)



4.5.5 ¼-Inch Tubing Failure - Gas

- a ¼-inch, type K copper tubing is sheared off. Infinite supply. Mitigation is assumed to occur in one hour.

Container type: tubing
Release mechanism: failure
Release state: gas
Release rate: 8.3 lb./min
Contents mass: 500 lb.

Duration of release: 60 minutes
Hole elevation: 3 ft.
Opening diameter: 1/4 inch

Stability Class B
Wind speed = 3m/s
@ 3ppm
Maximum downwind distance = 0.2mi
Maximum crosswind distance = 0.1mi
@ 20ppm
Maximum downwind distance = 0.1mi
Maximum crosswind distance = 0.03mi

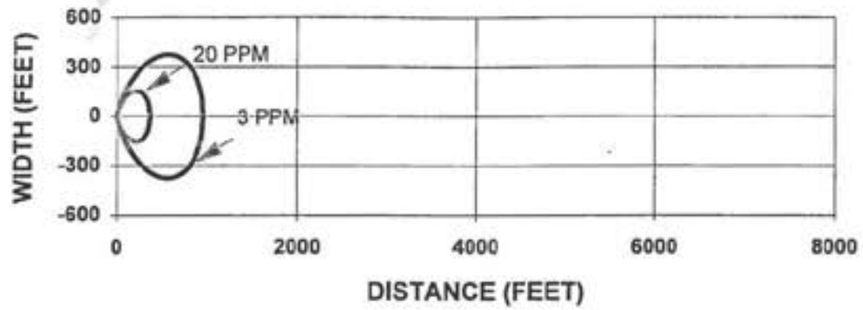
Stability Class D
Wind speed = 3m/s
@ 3ppm
Maximum downwind distance = 0.4mi
Maximum crosswind distance = 0.03mi
@ 20ppm
Maximum downwind distance = 0.1mi
Maximum crosswind distance = 0.01mi

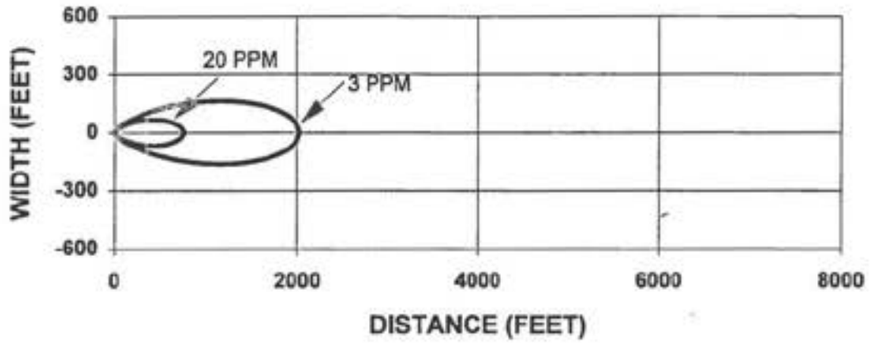
Stability Class F
Wind speed = 1.5m/s
@ 3ppm
Maximum downwind distance = 1.2mi
Maximum crosswind distance = 0.04mi
@ 20 ppm
Maximum downwind distance = 0.4mi
Maximum crosswind distance = 0.02mi

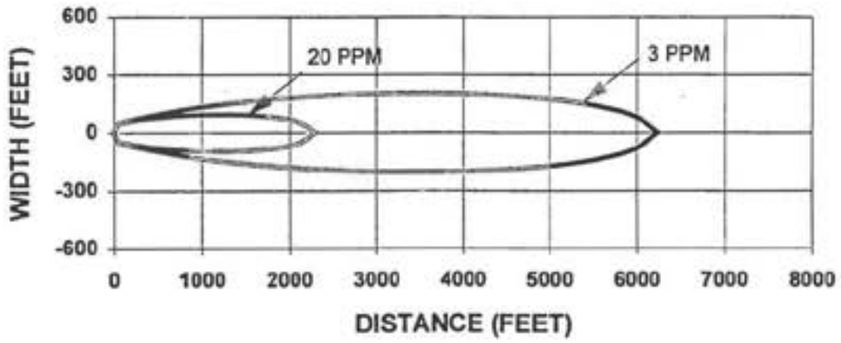
Note: The scales on the X and Y axes are different.

See Section 4.2 for assumptions common to all alternate scenarios. See Section 6 Appendix 1 for input assumptions used by the dispersion model.

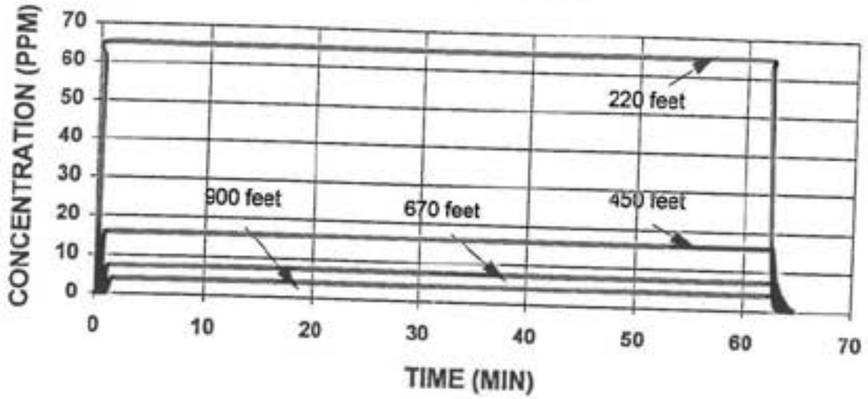
4.5.5 ¼-Inch Tubing Failure - Gas (Continued)

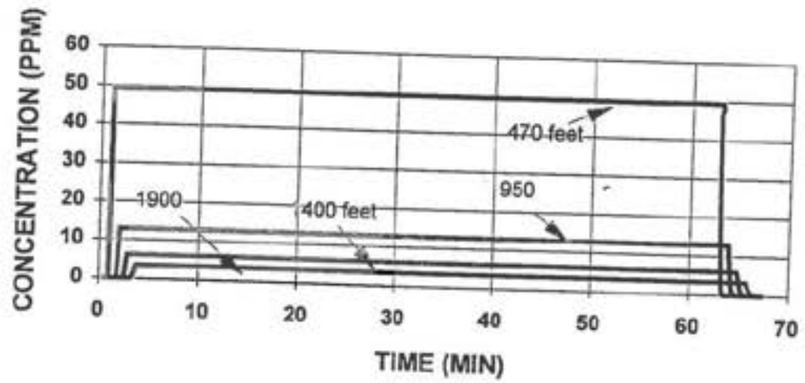


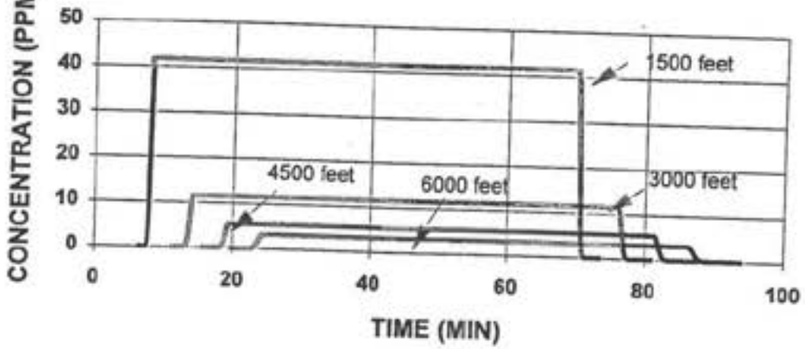




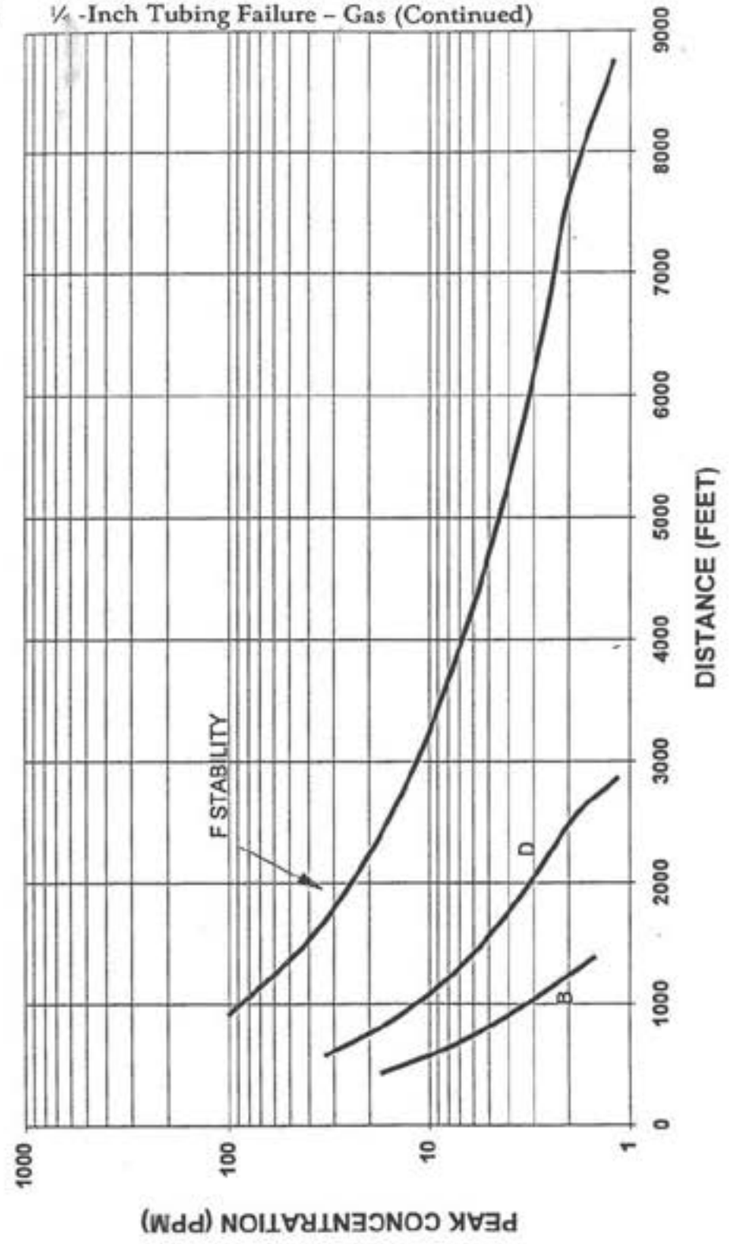
4.5.5 ¼-Inch Tubing Failure - Gas (Continued)







4.5.5 ¼-Inch Tubing Failure – Gas (Continued)



4.5.6 ½-Inch Tubing Failure - Gas

- a ½-inch, type K copper tubing is sheared off. Infinite supply. Mitigation is assumed to occur in one hour.

Container type: tubing
Release mechanism: failure
Release state: gas
Release rate: 36.0 lb/min
Contents mass: 2,160 lb.
Duration of release: 60 minutes
Hole elevation: 3 ft.
Vale opening diameter: ½ inch

Stability Class B
Wind speed = 3m/s
@ 3ppm
Maximum downwind distance = 0.4mi
Maximum crosswind distance = 0.1mi
@ 20 ppm
Maximum downwind distance = 0.1mi
Maximum crosswind distance = 0.1mi

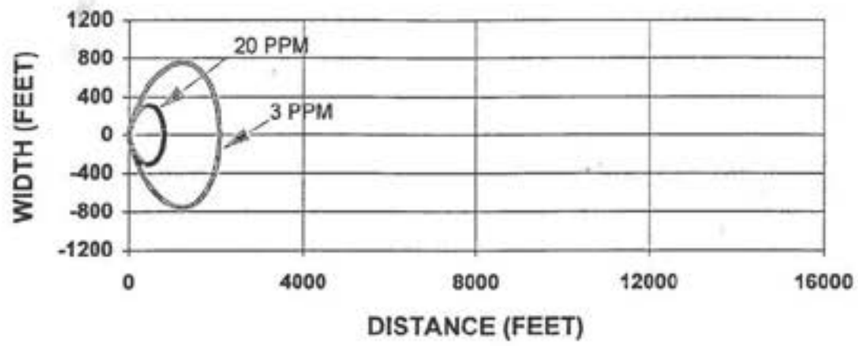
Stability Class D
Wind speed = 3m/s
@ 3 ppm
Maximum downwind distance = 0.8mi
Maximum crosswind distance = 0.1mi
@20 ppm
Maximum downwind distance = 0.3mi
Maximum crosswind distance = 0.03mi

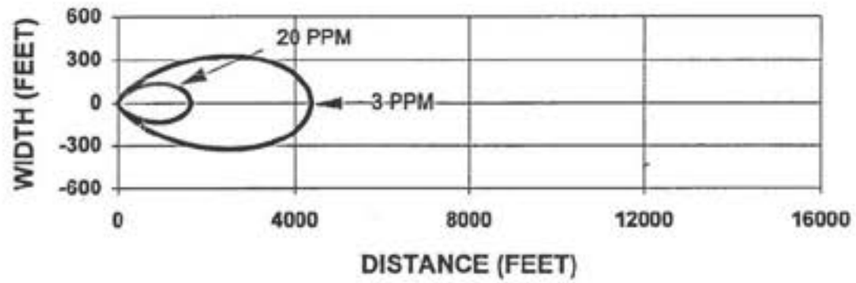
Stability Class F
Wind speed = 1.5m/s
@ 3 ppm
Maximum downwind distance = 2.5mi
Maximum crosswind distance = 0.1mi
@20 ppm
Maximum downwind distance = 0.9mi
Maximum crosswind distance = 0.04mi

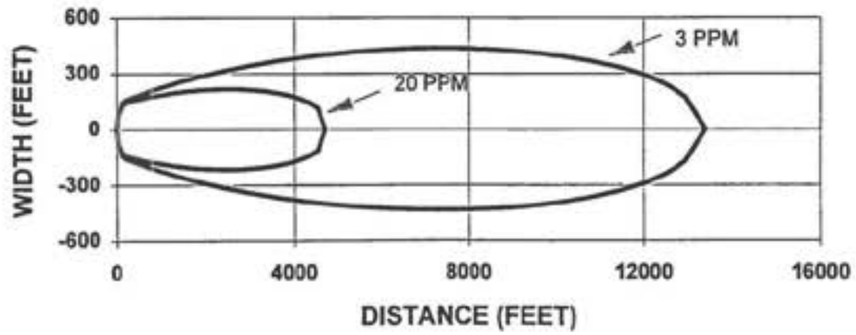
Note: The X and Y axes are different

See Section 4.3 for assumptions common to all alternate scenarios. See Section 6 Appendix 1 for input assumptions used by the dispersion model.

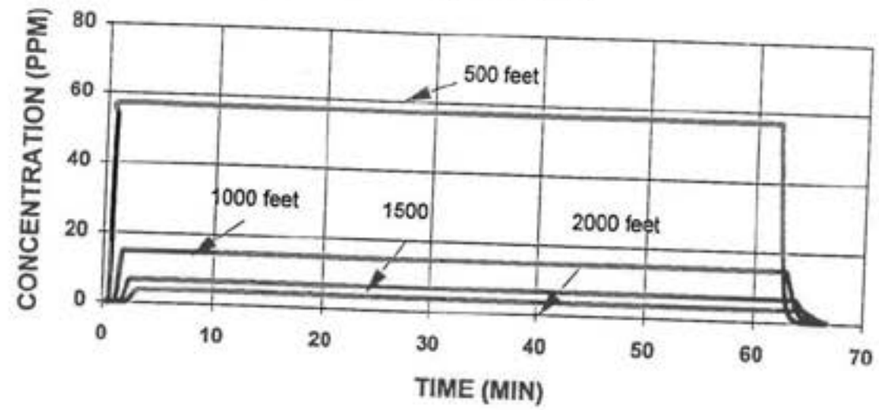
4.5.6 ½-Inch Tubing Failure - Gas (Continued)

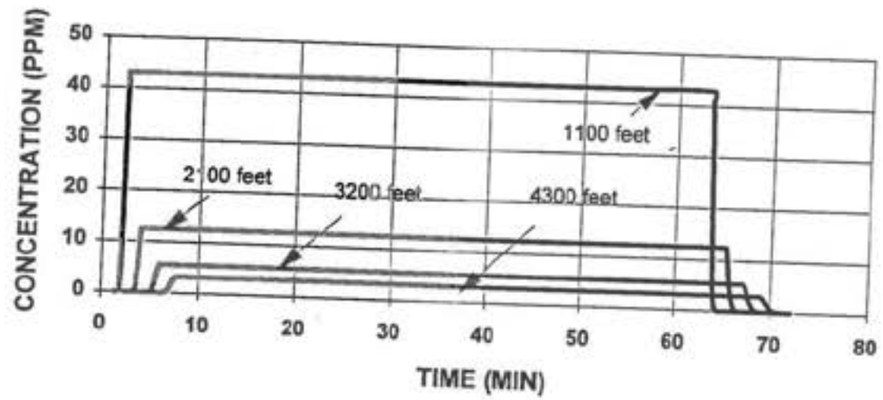


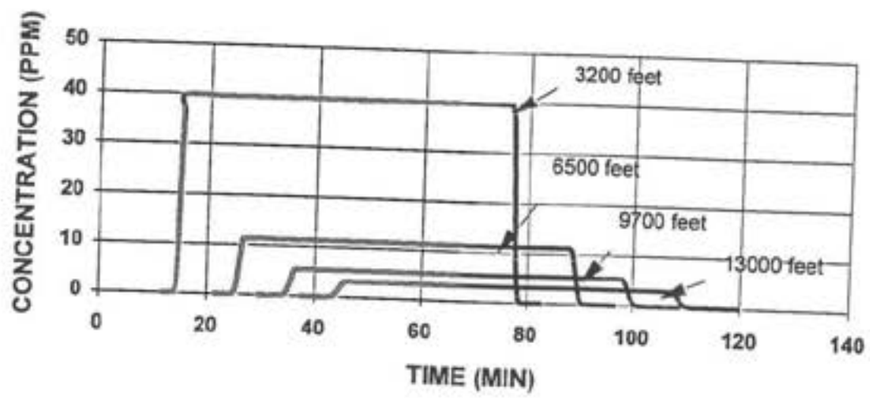




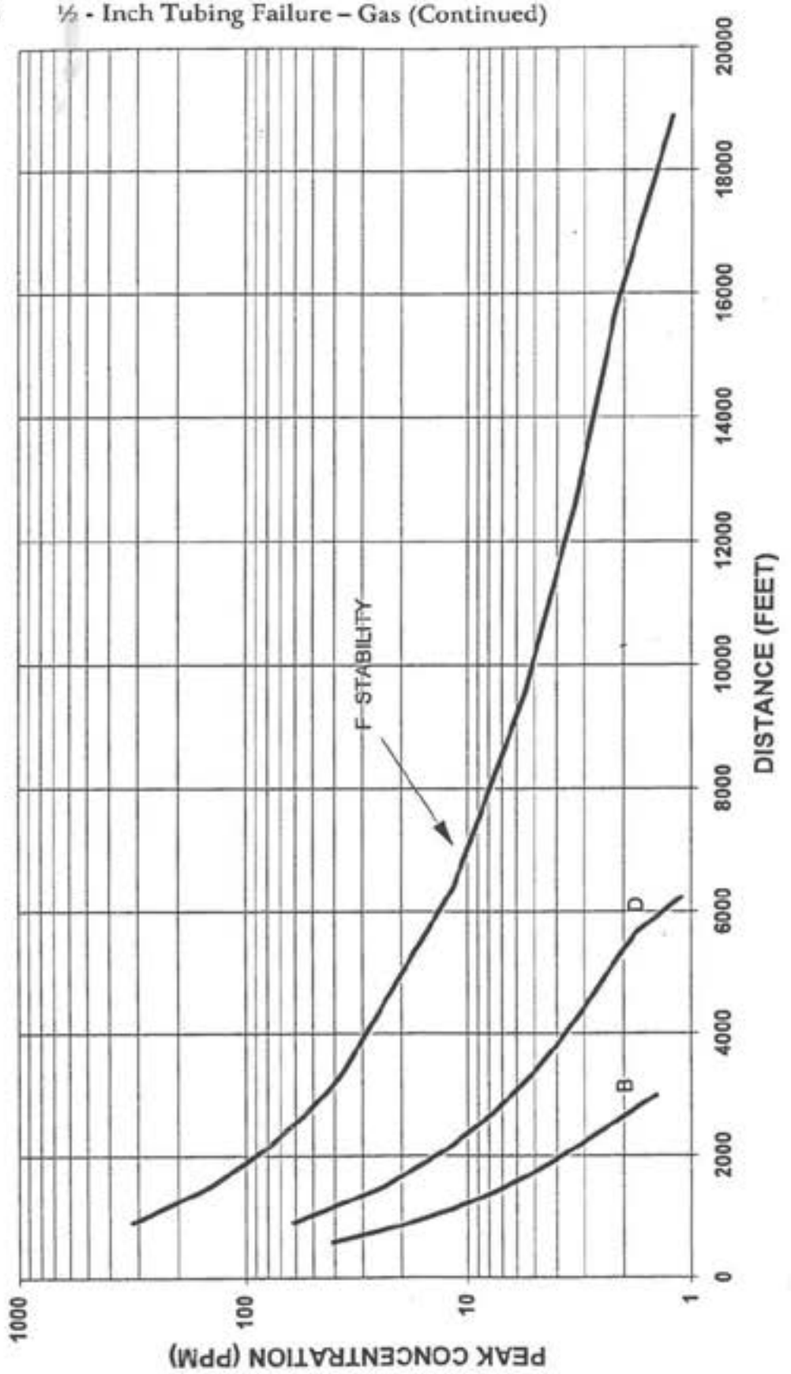
4.5.6 ½-Inch Tubing Failure - Gas (Continued)







4.5.6 ½ - Inch Tubing Failure – Gas (Continued)



4.5.7 1-Inch Pipe Failure - Gas

- a 1-inch schedule 80 pipe is sheared off. Infinite supply. Mitigation is assumed to occur in one hour.

Container type: pipe
Release mechanism: failure
Release state: gas
Release rate: 137 lb/minute
Contents mass: 8,208 lb.
Duration of release: 60 minutes
Hole elevation: 15 ft.
Opening diameter: 1 inch

Stability Class B
Wind speed = 3m/s
@ 3ppm
Maximum downwind distance = 0.9mi
Maximum crosswind distance = 0.3mi
@20 ppm
Maximum downwind distance = 0.3mi
Maximum crosswind distance = 0.1mi

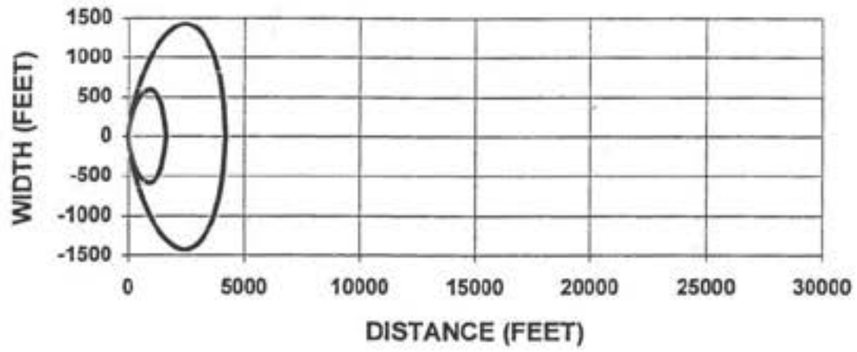
Stability Class D
Wind speed = 3m/s
@3 ppm
Maximum downwind distance = 1.7mi
Maximum crosswind distance = 0.1mi
@20 ppm
Maximum downwind distance = 0.6mi
Maximum crosswind distance = 0.05mi

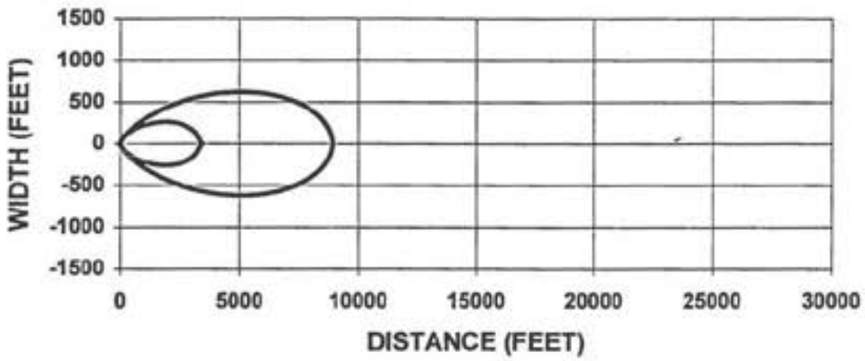
Stability Class F
Wind speed = 1.5m/s
@3ppm
Maximum downwind distance = 5.0mi
Maximum crosswind distance = 0.2mi
@20 ppm
Maximum downwind distance = 1.7mi
Maximum crosswind distance = 0.1mi

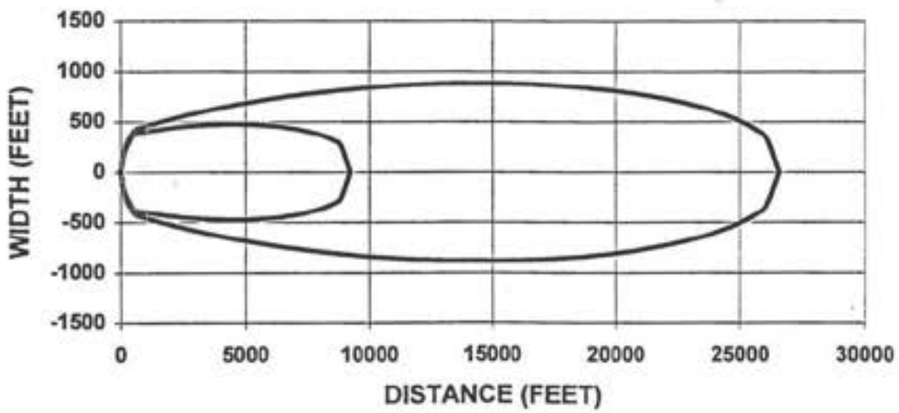
Note: The scales on the X and Y axes are different.

See Section 4.2 for assumptions common to all alternate scenarios. See Section 6 Appendix 1 for input assumptions used by the dispersion model.

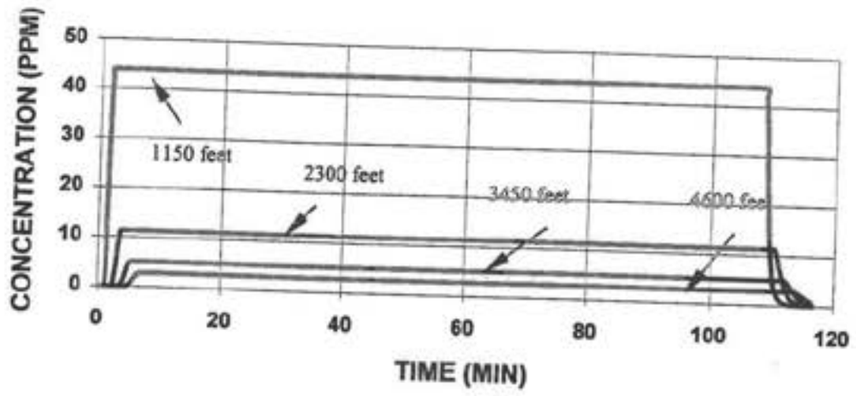
4.5.7 1-Inch Pipe Failure - Gas (Continued)

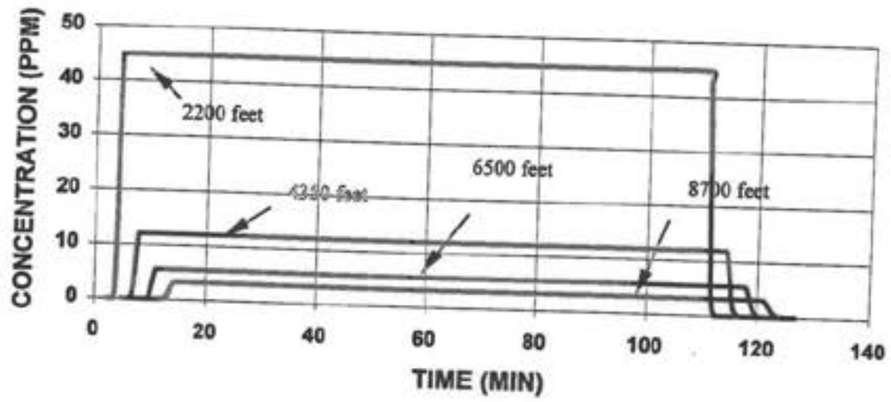


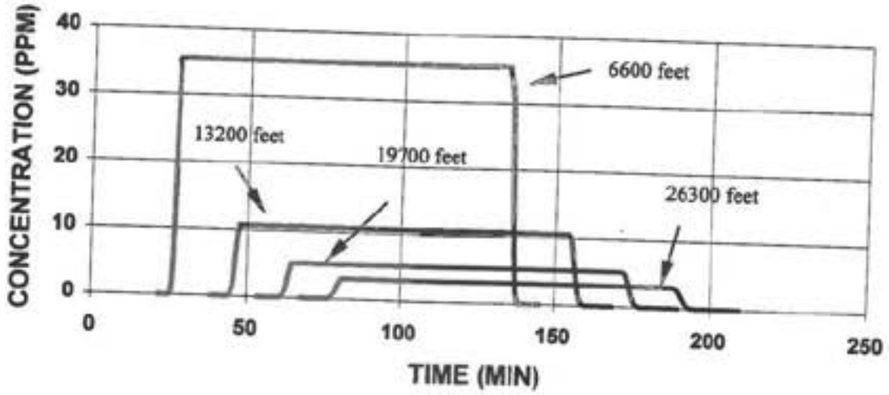




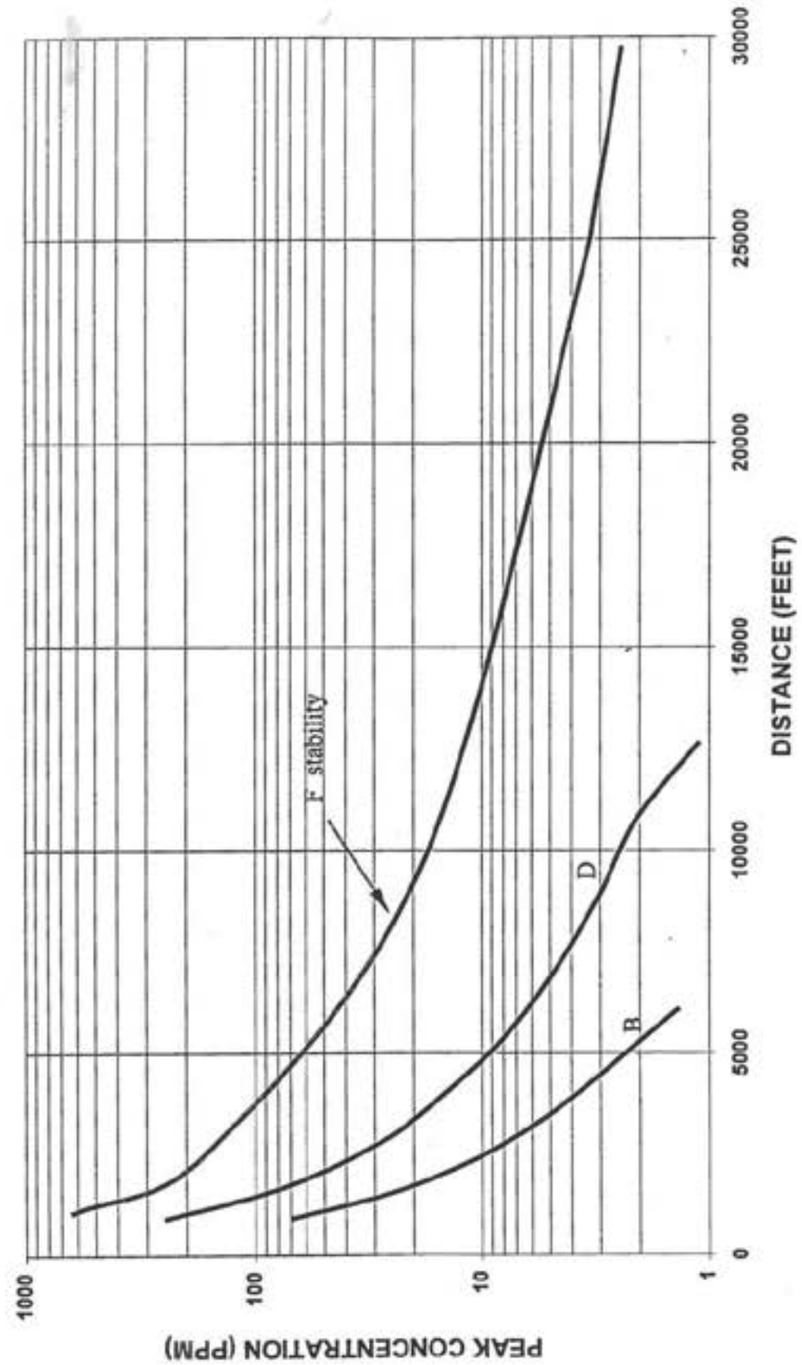
4.5.7 1-Inch Pipe Failure - Gas (Continued)







4.5.7 1-Inch Pipe Failure - Gas (Continued)



4.5.8 ¼-Inch Tubing Failure - Liquid

- a ¼-inch, type K copper tubing is sheared off. Infinite supply. Source is assumed to be stopped in one hour. Evaporation of pool is assumed to continue.

Container type: tubing
Release mechanism: failure
Release state: liquid
Release rate: 36.6 lb/min
Contents mass: 2,200 lb
Time for pool to evaporate: 110-150 minutes
Duration of release: 110-150 minutes
Hole elevation: 3 ft.
Opening diameter: 1/4 inch

Stability Class B
Wind speed = 3m/s
@3 ppm
Maximum downwind distance = 0.4mi
Maximum crosswind distance = 0.1mi
@20 ppm
Maximum downwind distance = 0.2mi
Maximum crosswind distance = 0.06mi

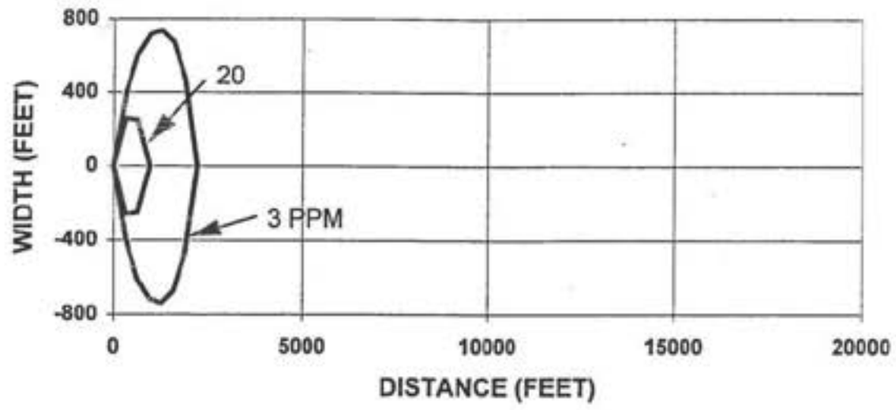
Stability Class D
Wind Speed = 3m/s
@3 ppm
Maximum downwind distance = 0.9mi
Maximum crosswind distance = 0.07mi
@20 ppm
Maximum downwind distance = 0.4mi
Maximum crosswind distance = 0.03mi

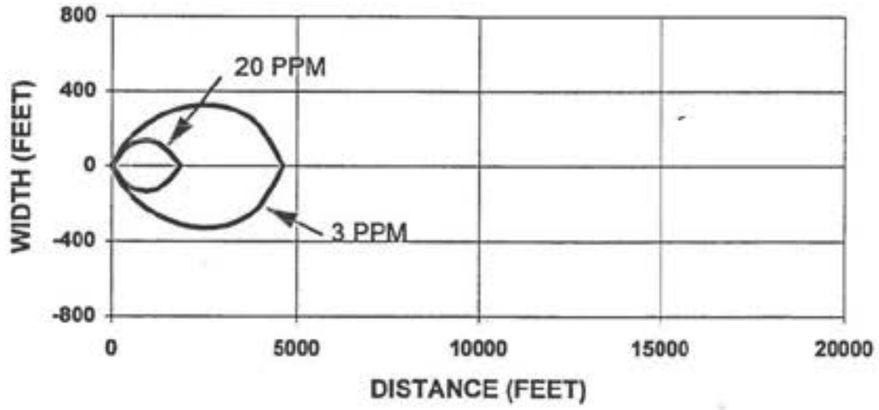
Stability Class F
Wind Speed = 1.5m/s
@3 ppm
Maximum downwind distance = 2.8mi
Maximum crosswind distance = 0.1mi
@20 ppm
Maximum downwind distance = 1.0mi
Maximum crosswind distance = 0.04mi

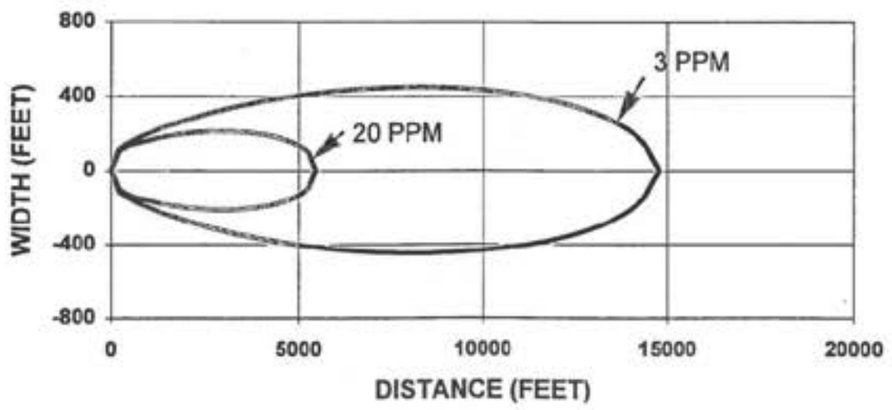
Note: The scales on the X and Y axes are different.

See section 4.2 for assumptions common to all alternate scenarios. See Section 6 Appendix 1 for input assumptions used by the dispersion model.

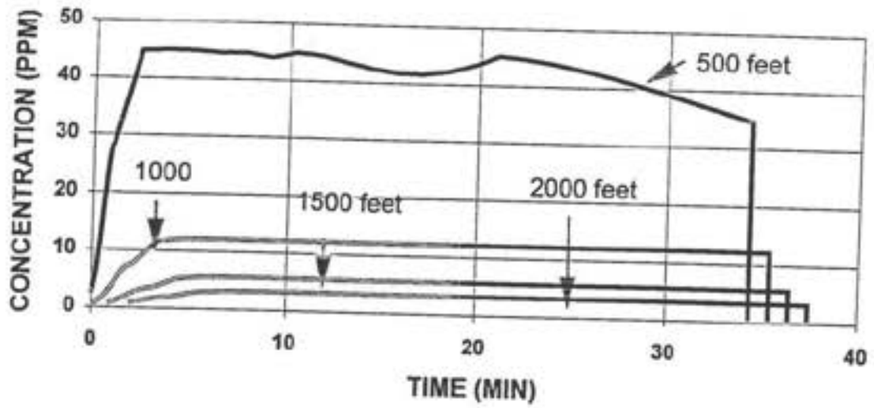
4.5.8 ¼-Inch Tubing Failure - Liquid (Continued)

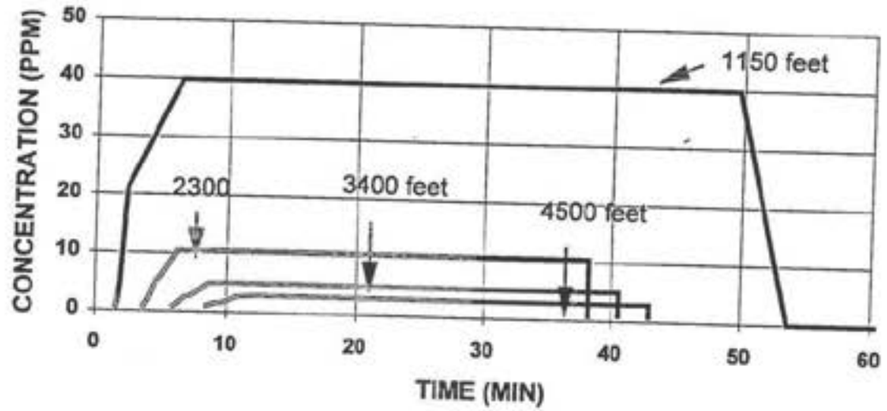


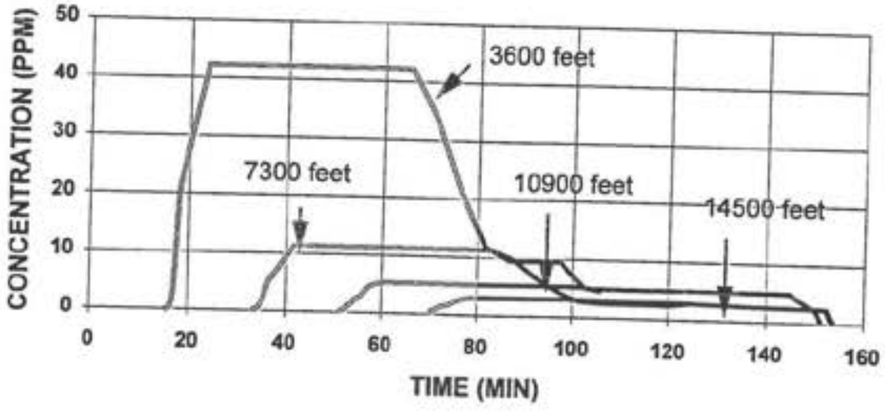




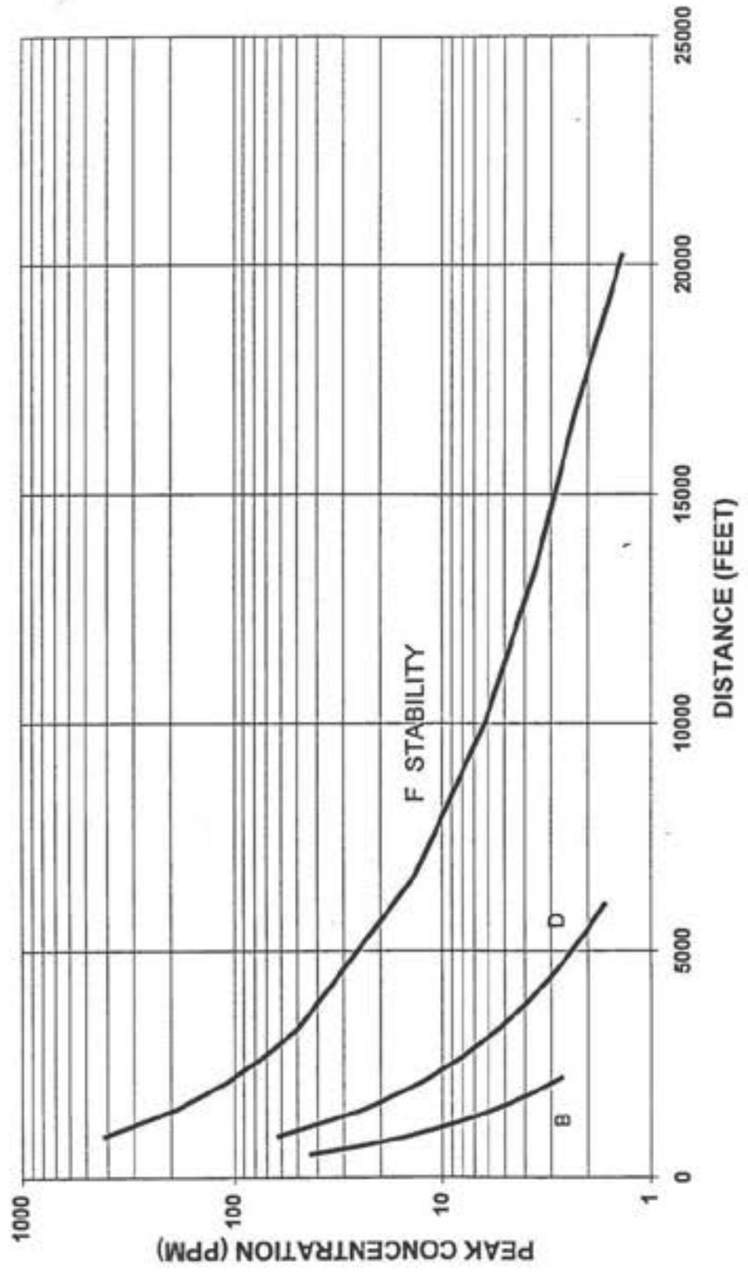
4.5.8 ¼-Inch Tubing Failure - Liquid (Continued)







4.5.8 ¼-Inch Tubing Failure - Liquid (Continued)



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4.5.9 ½-Inch Tubing Failure - Liquid

- a ½-inch, type K copper tubing is sheared off. Infinite supply. Source is assumed to be stopped in one hour. Evaporation of pool is assumed to continue.

Container type: tubing
Release mechanism: failure
Release state: gas
Release rate: 158 lb/min
Contents mass: 9,500 lb
Time for pool to evaporate: 110-170 minutes
Duration of release: 110-170 minutes
Hole elevation: 3 ft.
Opening diameter: ½ inch

Stability Class B
Wind speed = 3m/s
@3 ppm
Maximum downwind distance = 0.9mi
Maximum crosswind distance = 0.3mi
@20 ppm
Maximum downwind distance = 0.4mi
Maximum crosswind distance = 0.1mi

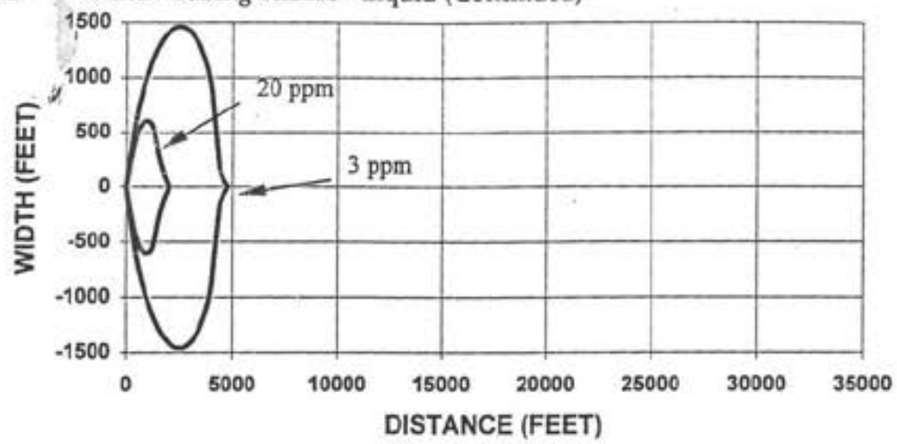
Stability Class D
Wind speed = 3m/s
@3 ppm
Maximum downwind distance = 1.9mi
Maximum crosswind distance = 0.1mi
@20 ppm
Maximum downwind distance = 0.8mi
Maximum crosswind distance = 0.05mi

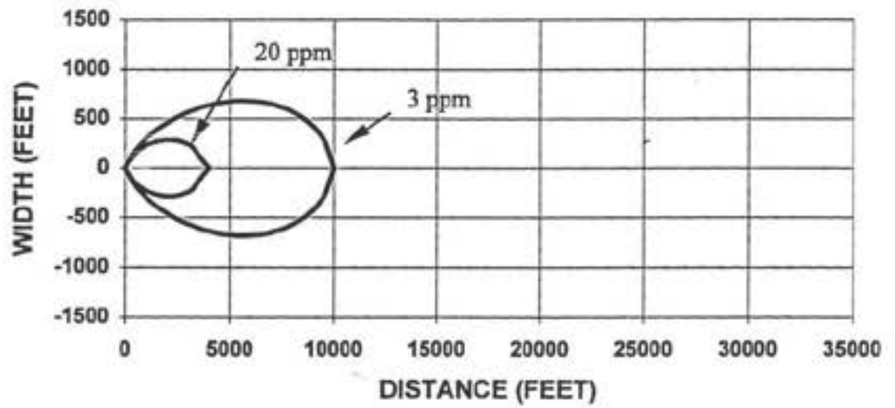
Stability Class F
Wind speed = 1.5m/s
@3 ppm
Maximum downwind distance = 5.6mi
Maximum crosswind distance = 0.2mi
@20 ppm
Maximum downwind distance = 2.1mi
Maximum crosswind distance = 0.1mi

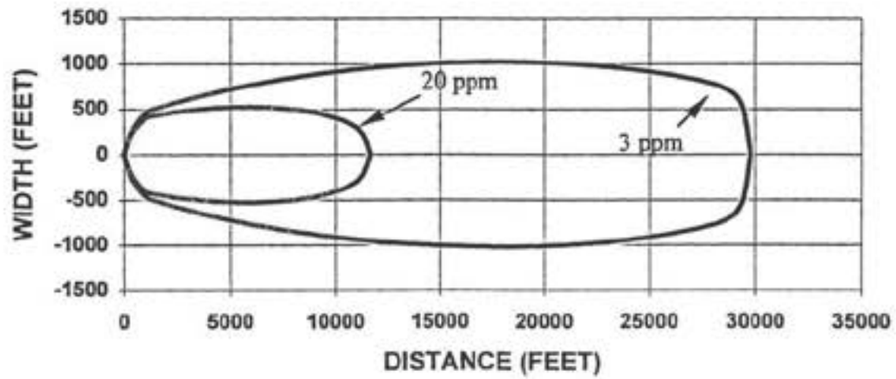
Note: The scales on the X and Y axes are different.

See Section 4.2 for assumptions common to all alternate scenarios. See Section 6 Appendix 1 for input assumptions used by the dispersion model.

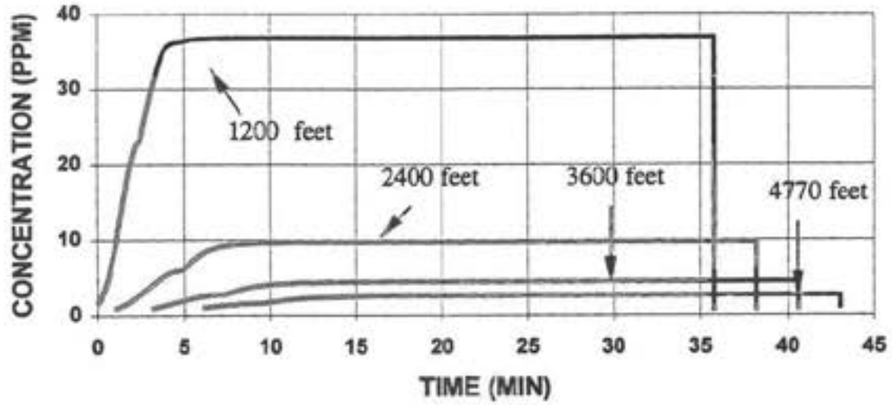
4.5.9 ½-Inch Tubing Failure - Liquid (Continued)

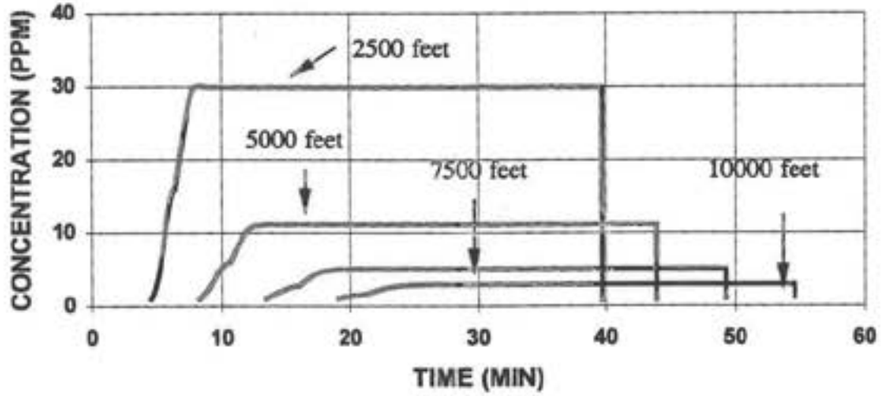


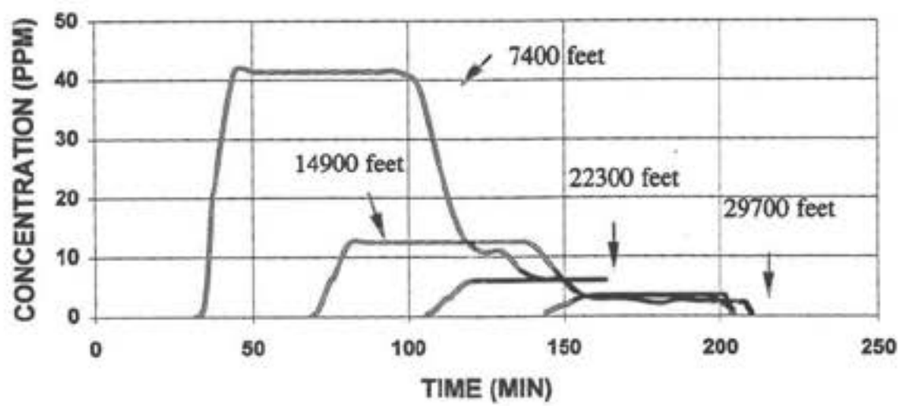




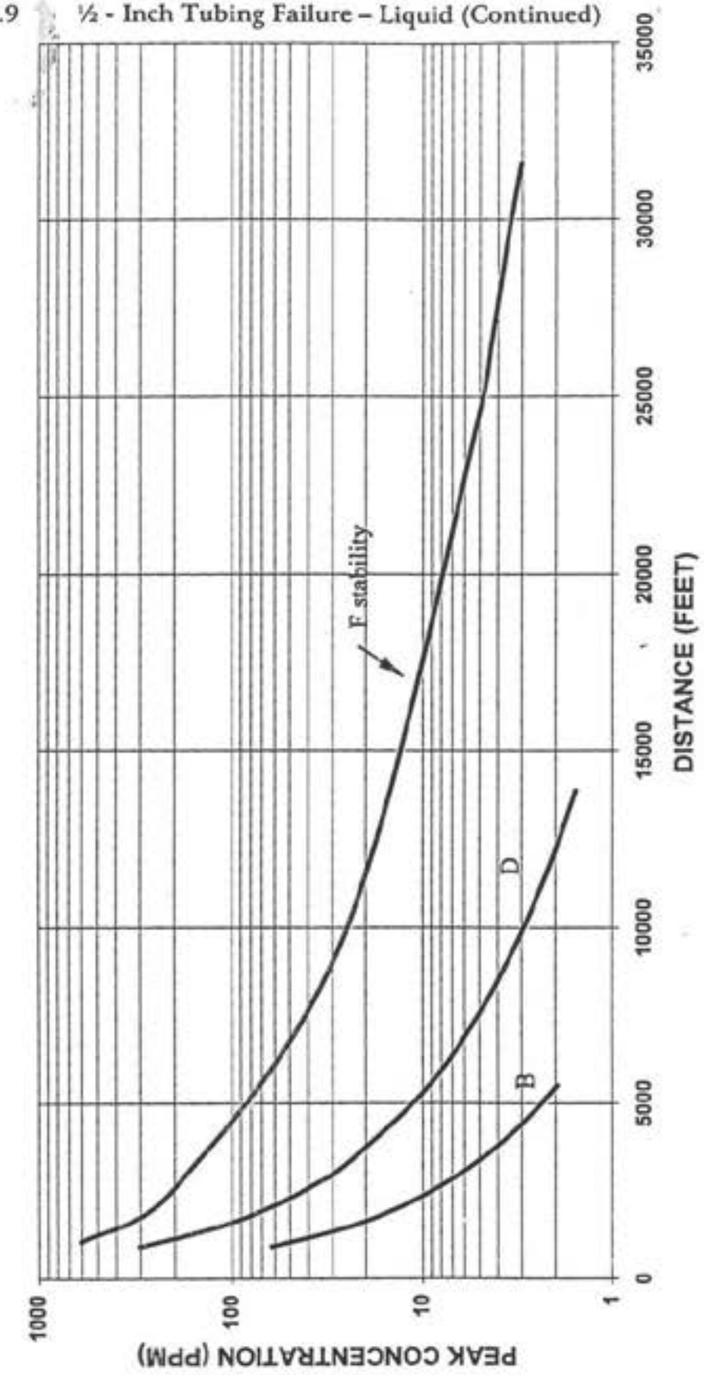
4.5.9 ½-Inch Tubing Failure - Liquid (Continued)







4.5.9 ½ - Inch Tubing Failure – Liquid (Continued)



4.5.10 1-Inch Pipe or Transfer Hose Failure - Liquid

- a 1-inch schedule 80 pipe is sheared off. Infinite supply. (approximately equivalent to failure of braided chlorine transfer hose). Source is assumed to be stopped in one hour. Evaporation of pool is assumed to continue.

Container type: pipe
Release mechanism: failure
Release state: liquid
Release rate: 240 lb/minute
Contents mass: 14,400 lb
Time for pool to evaporate: 110-160 minutes
Duration of release: 110-160 minutes
Hole elevation: 15 ft.
Valve opening diameter: 15 ft.

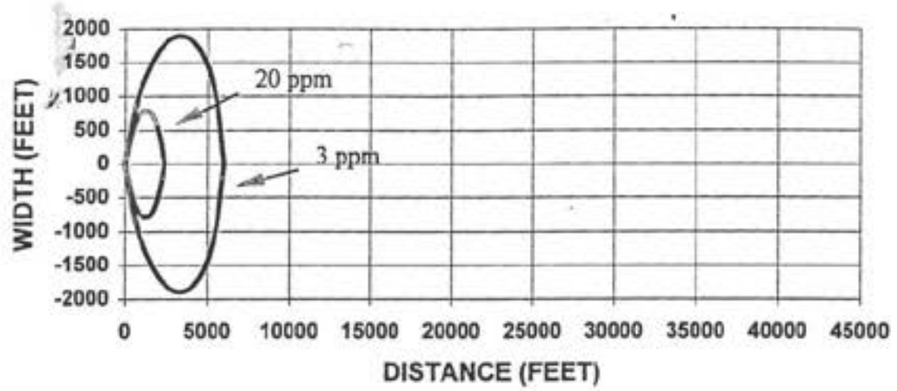
Stability Class B
Wind speed = 3m/s
@3 ppm
Maximum downwind distance = 1.1mi
Maximum crosswind distance = 0.4mi
@20 ppm
Maximum downwind distance = 0.5mi
Maximum crosswind distance = 0.1mi

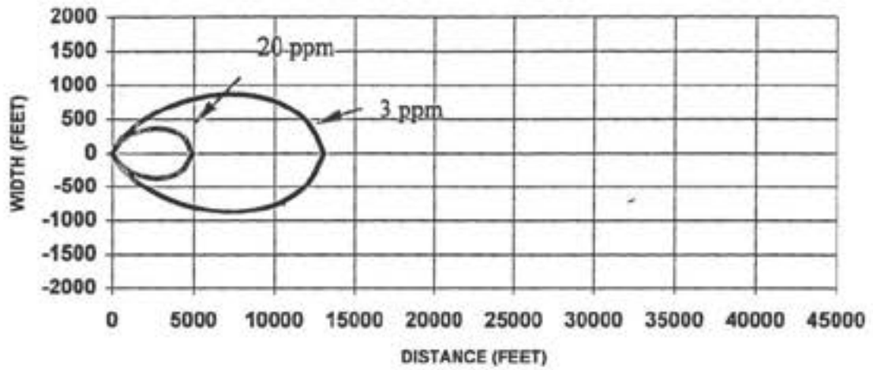
Stability Class D
Wind speed = 3m/s
@3 ppm
Maximum downwind distance = 2.4mi
Maximum crosswind distance = 0.2mi
@20 ppm
Maximum downwind distance = 0.9mi
Maximum crosswind distance = 0.1mi

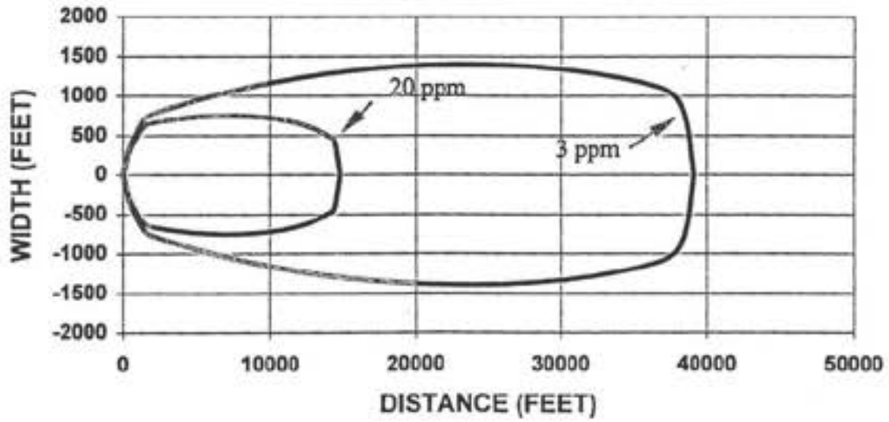
Stability Class F
Wind speed = 1.5m/s
@3 ppm
Maximum downwind distance = 7.1mi
Maximum crosswind distance = 0.3mi
@20 ppm
Maximum downwind distance = 2.7mi
Maximum crosswind distance = 0.1mi

Note: The scales on the X and Y axes are different.

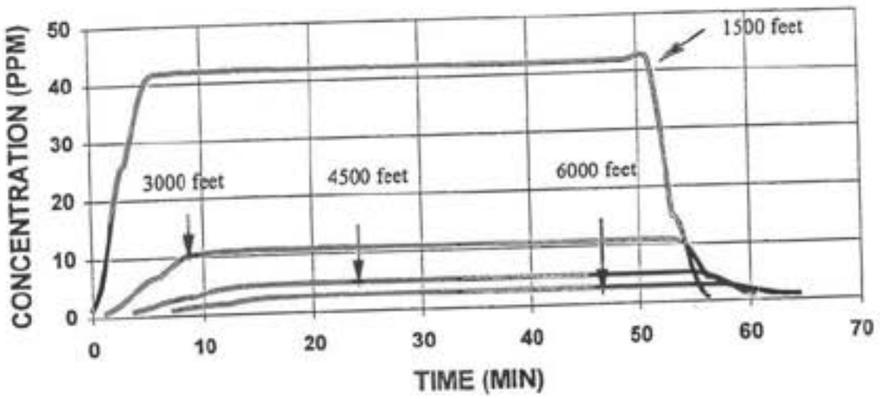
See Section 4.2 for assumptions common to all alternate scenarios. See Section 6 Appendix 1 for input assumptions used by the dispersion model.

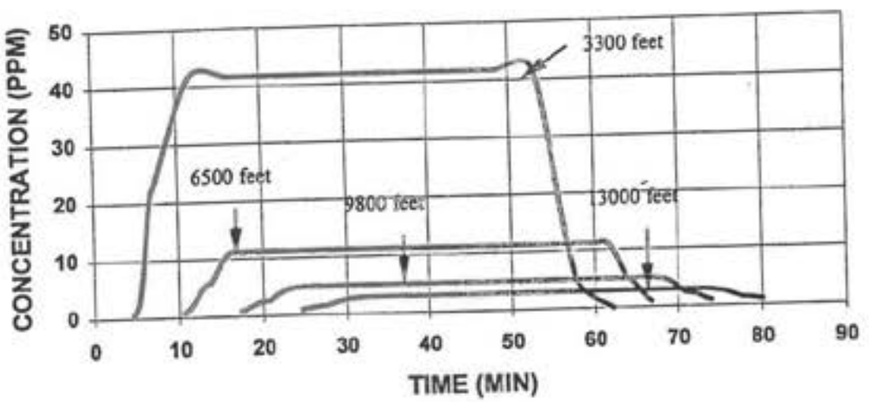


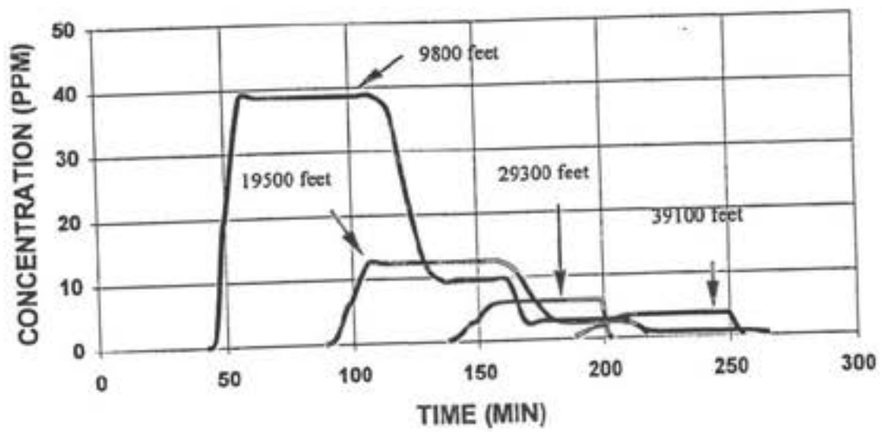




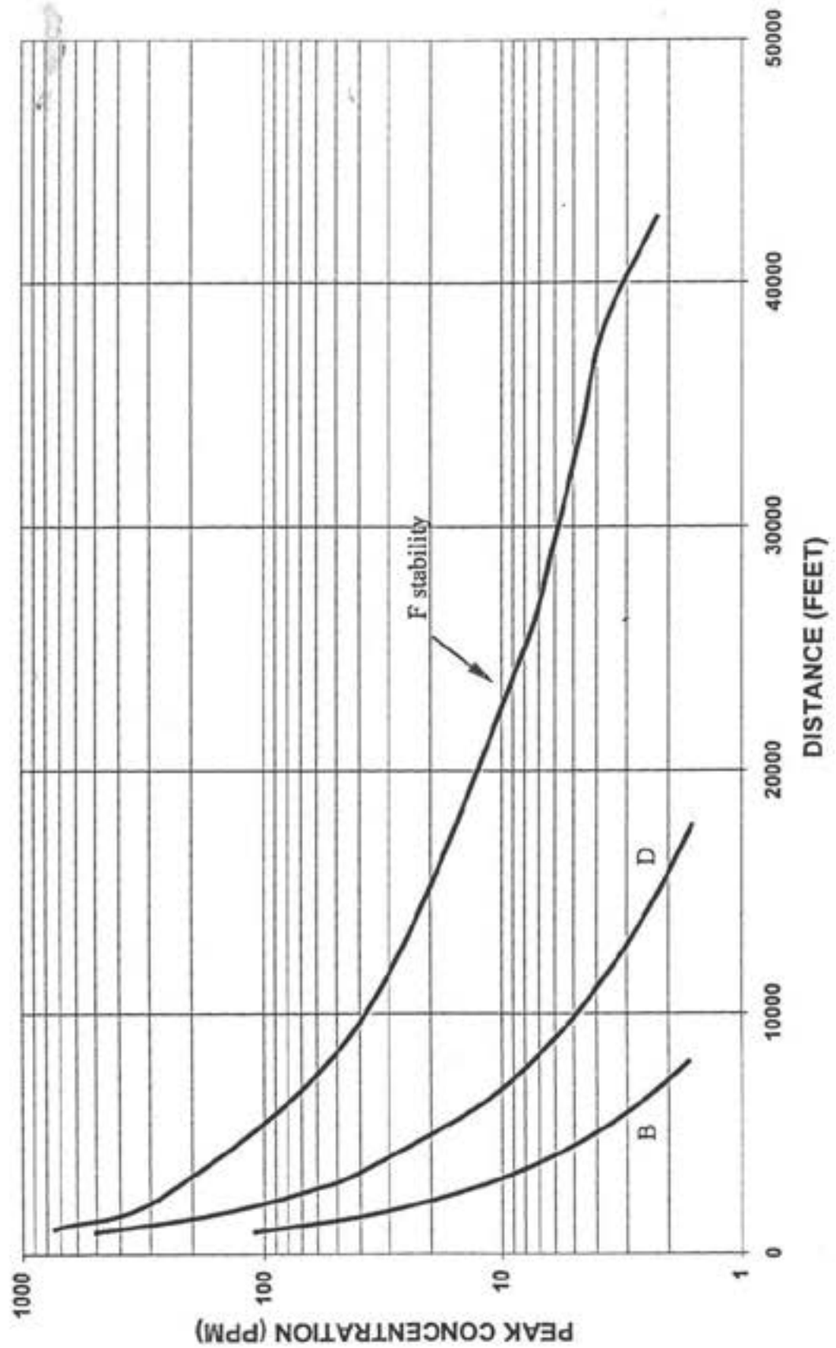
4.5.10 1-Inch Pipe or Transfer Hose Failure - Liquid (Continued)







4.5.10 1 Inch Pipe or Transfer Hose Failure – Liquid (Continued)



4.5.11 90 Ton Rail Tank Car - Relief Valve Opens

- a rail car is over filled with chlorine; the pressure rises and the relief valve opens; in reality, the relief valve will open, close, open, close, etc; the frequency of opening is dependent on heat transferred to the car from the environment; for modeling purposes, it is assumed the relief valve remains open for 30 minutes.

Container type: rail car
Release mechanism: over pressure
Release state: liquid/gas
Max. Release rate: 141 lb./min.
Contents (approximate) mass: 101 tons
Time for pool to evaporate: 60-75 minutes
Total amount of Cl_2 released
= approximately
4,000 lb
Duration of release: 30 minutes
Relief valve elevation: 13.5 feet
Valve opening diameter: 1.04 inches

Stability Class B
Wind speed = 3m/s
@3 ppm
Maximum downwind distance = 1.2mi
Maximum crosswind distance = 0.2mi
@20 ppm
Maximum downwind distance = 0.5mi
Maximum crosswind distance = 0.1mi

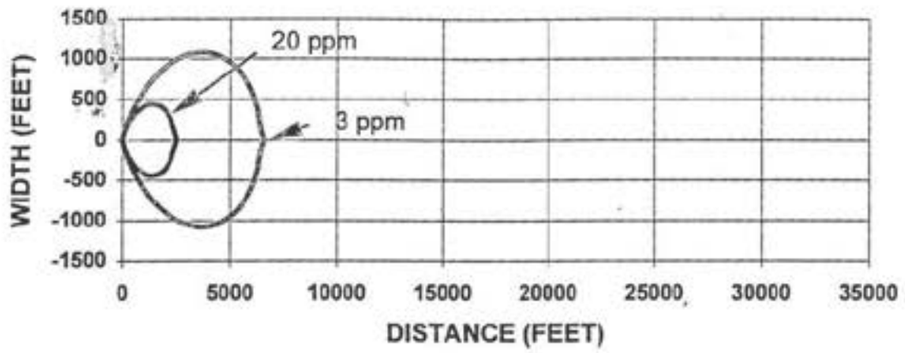
Stability Class D
Wind speed = 3m/s
@3 ppm
Maximum downwind distance = 1.9mi
Maximum crosswind distance = 0.1mi
@20 ppm
Maximum downwind distance = 0.7mi
Maximum crosswind distance = 0.06mi

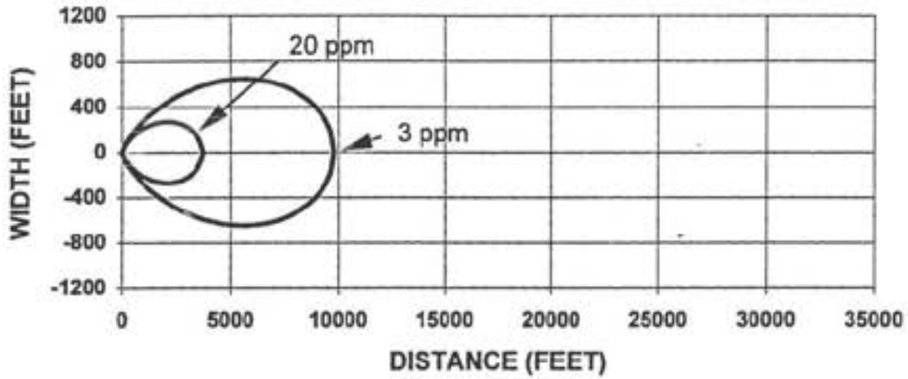
Stability Class F
Wind speed = 1.5m/s
@3 ppm
Maximum downwind distance = 5.7mi
Maximum crosswind distance = 0.2mi
@20 ppm
Maximum downwind distance = 2.2mi
Maximum crosswind distance = 0.09mi

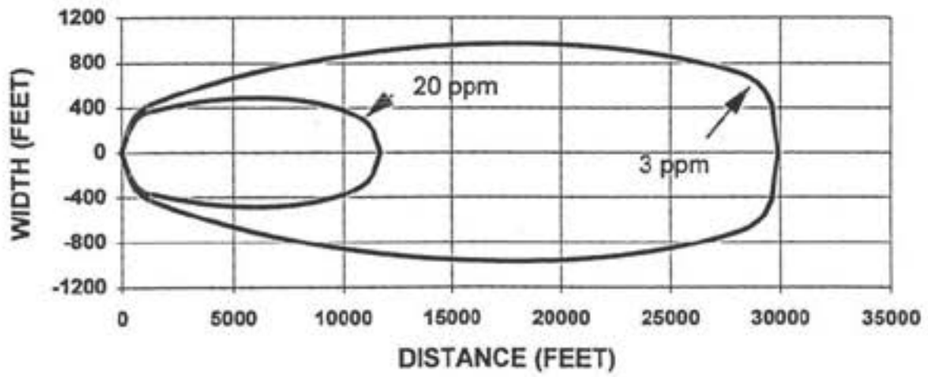
Note: The scales on the X and Y axes are different.

See Section 4.2 for assumptions common to all alternate scenarios. See Section 6 Appendix 1 for input assumptions used by the dispersion model.

4.5.11 90 Ton Rail Tank Car - Relief Valve Opens (continued)







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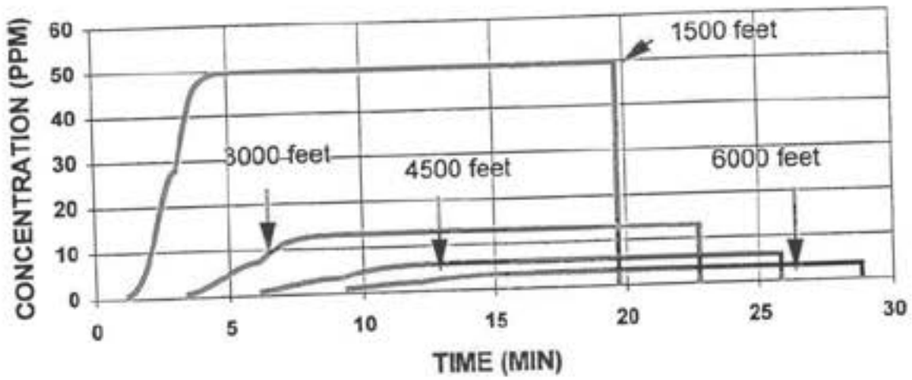

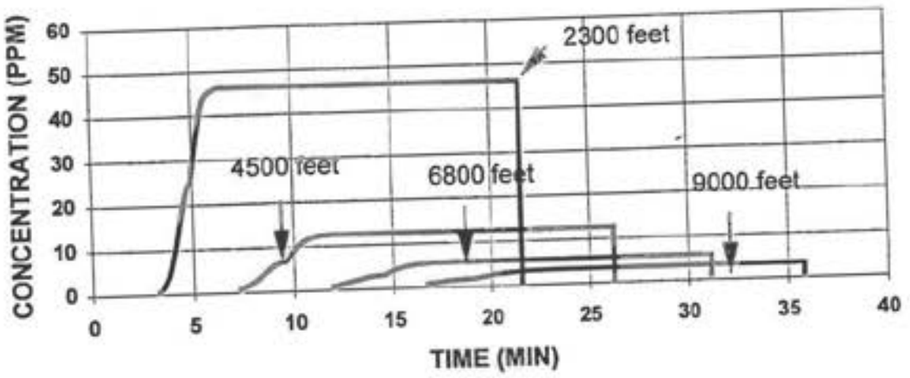

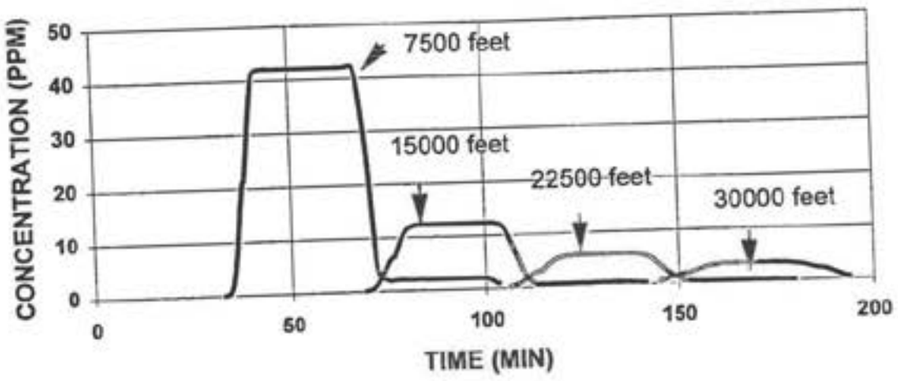

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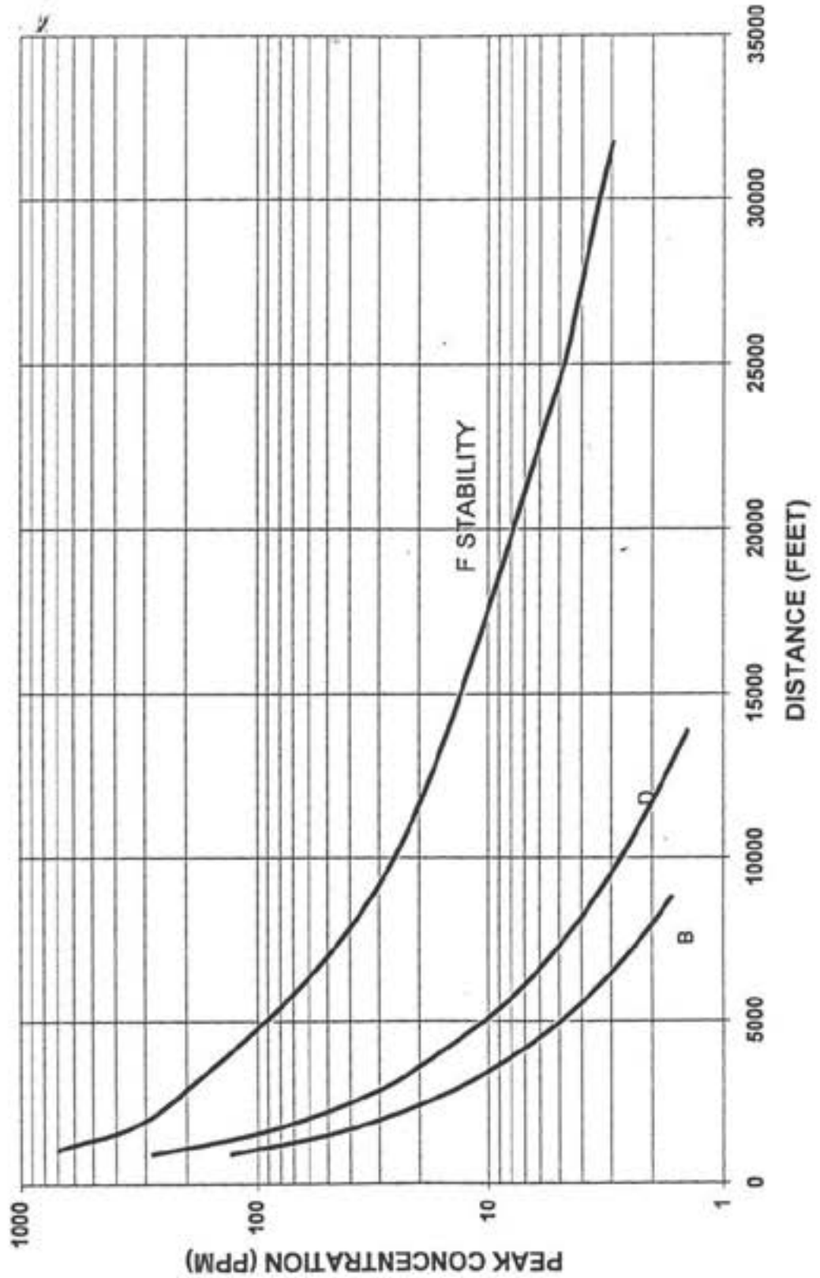


4.5.12 Sodium Hypochlorite - Acid Reaction

- 31.5% hydrochloric acid is introduced into a 5,000-gallon tank of 15% sodium hypochlorite. It is assumed that complete decomposition takes place and releases 6,250 lb. of chlorine at a constant rate over 5 minutes.

Container type: vessel
Release mechanism: Chemical reaction
Release state: gas
Release rate: 1,250 lb/min
Contents mass: 6,250 lb.
Duration of release: 5 minutes
Elevation of release: 0 feet

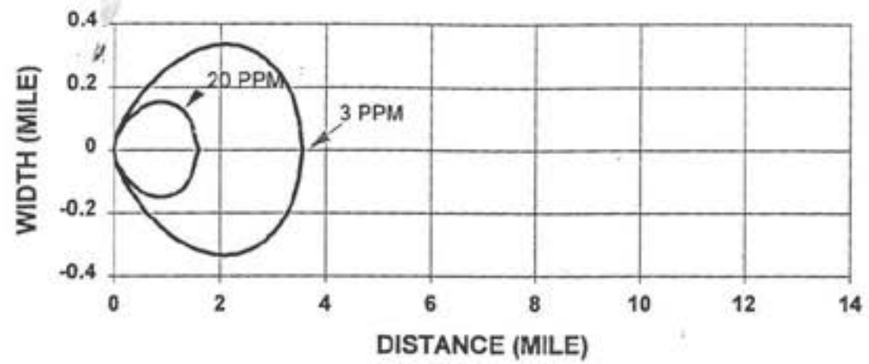
Stability Class B
Wind speed = 3m/s
@3 ppm
Maximum downwind distance = 3.5mi
Maximum crosswind distance = 0.3mi
@20 ppm
Maximum downwind distance = 1.6mi
Maximum crosswind distance = 0.2mi

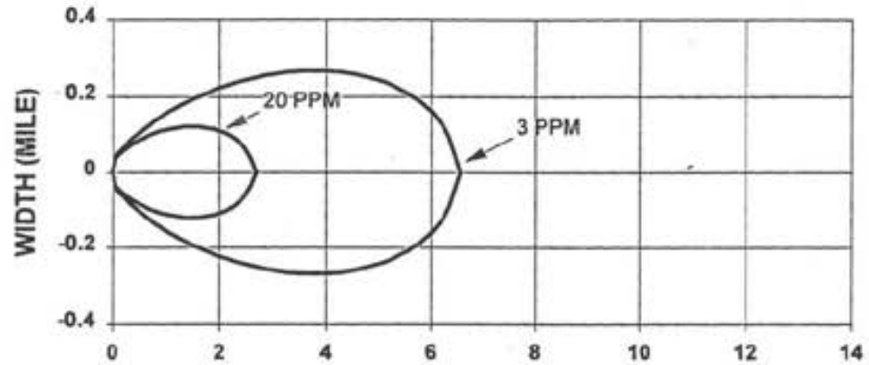
Stability Class D
Wind speed = 3m/s
@3 ppm
Maximum downwind distance = 6.4mi
Maximum crosswind distance = 0.3mi
@20 ppm
Maximum downwind distance = 2.6mi
Maximum crosswind distance = 0.1mi

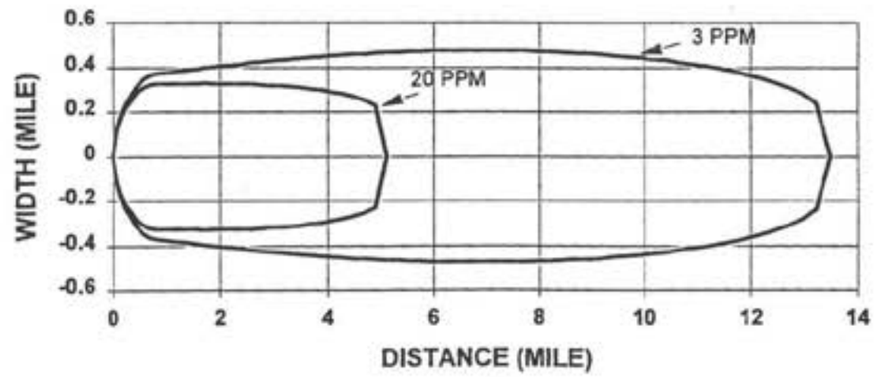
Stability Class F
Wind speed = 1.5m/s
@3 ppm
Maximum downwind distance = 13.2mi
Maximum crosswind distance = 0.5mi
@20 ppm
Maximum downwind distance = 5.2mi
Maximum crosswind distance = 0.3mi

Note: The scales on the X and Y axes are different.

See Section 4.2 for assumptions common to all alternate scenarios. See Section 6 Appendix 1 for input assumptions used by the dispersion model.







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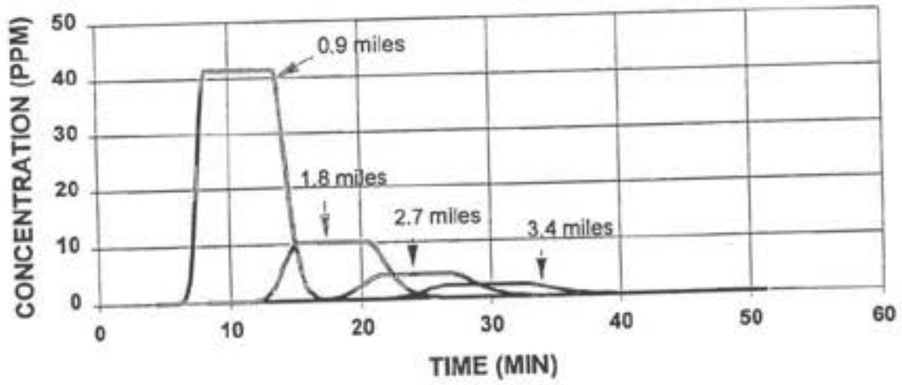
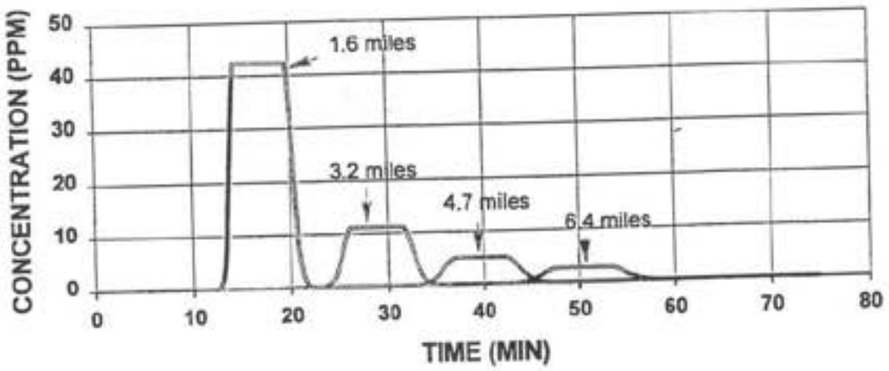
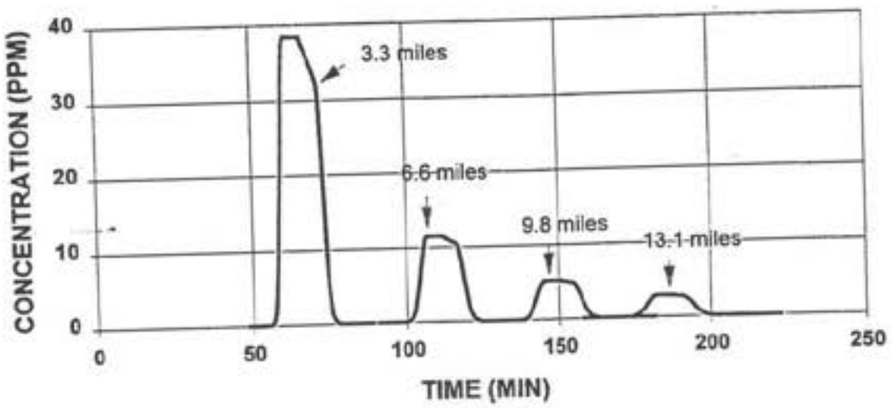
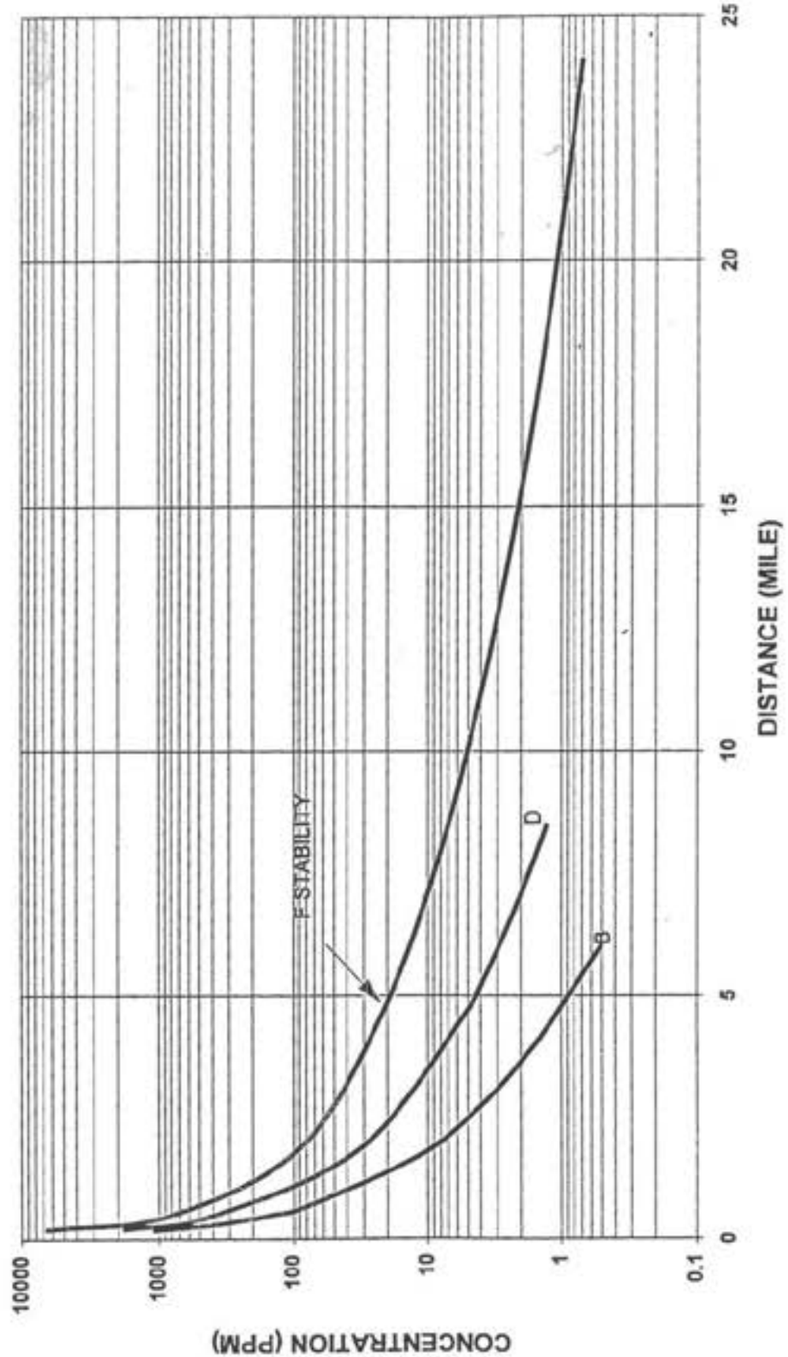






4.5.12 Sodium Hypochlorite – Acid Reaction (continued)



4.5.13 Calcium Hypochlorite - Decomposition

- A reaction of 100 lbs. of 65% calcium hypochlorite (65% available chlorine) occurs at a swimming pool. An assumption is made that 25% of the available chlorine or 16.25 lbs. are released at a constant rate in 1 minute.

Container type: vessel
Release mechanism: chemical reaction
Release state: gas
Release rate: 16.25 lb/min.
Duration of release: 1 minute
Elevation: 0 feet

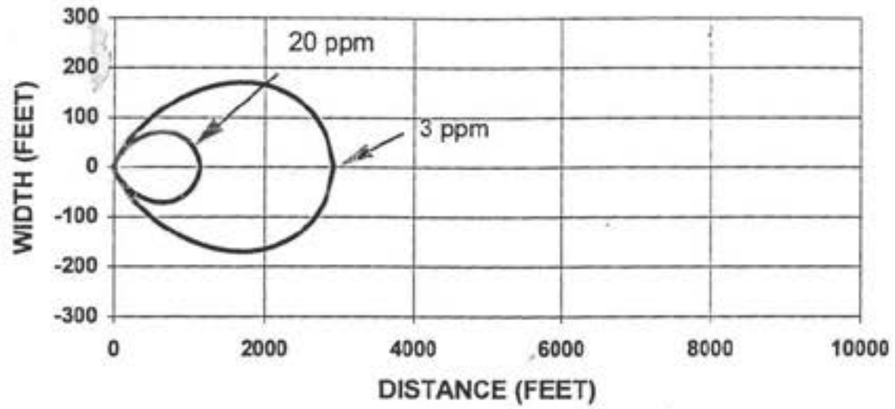
Stability Class B
Wind speed = 3m/s
@3 ppm
Maximum downwind distance = 0.5mi
Maximum crosswind distance = 0.03mi
@20 ppm
Maximum downwind distance = 0.2mi
Maximum crosswind distance = 0.02mi

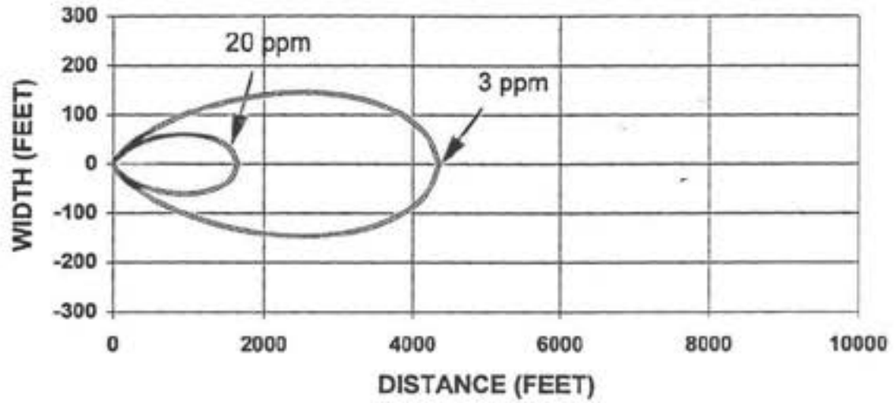
Stability Class D
Wind speed = 3m/s
@3 ppm
Maximum downwind distance = 0.8mi
Maximum crosswind distance = 0.03mi
@20 ppm
Maximum downwind distance = 0.3mi
Maximum crosswind distance = 0.02mi

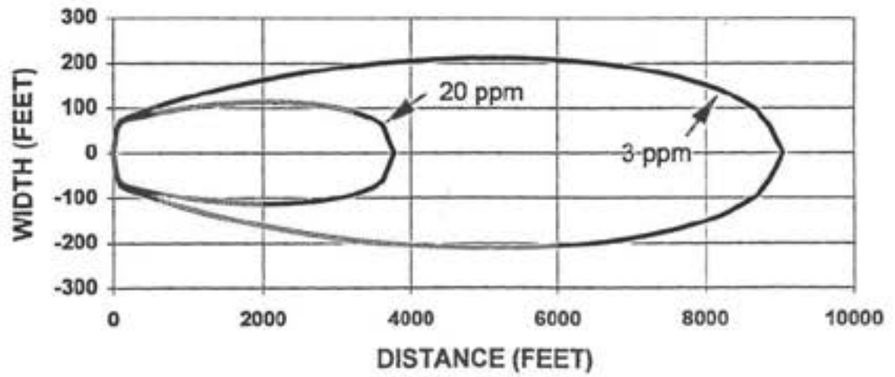
Stability Class F
Wind speed = 1.5m/s
@3 ppm
Maximum downwind distance = 1.7mi
Maximum crosswind distance = 0.04mi
@20 ppm
Maximum downwind distance = 0.7mi
Maximum crosswind distance = 0.02mi

Note: The scales on the X and Y axes are different.

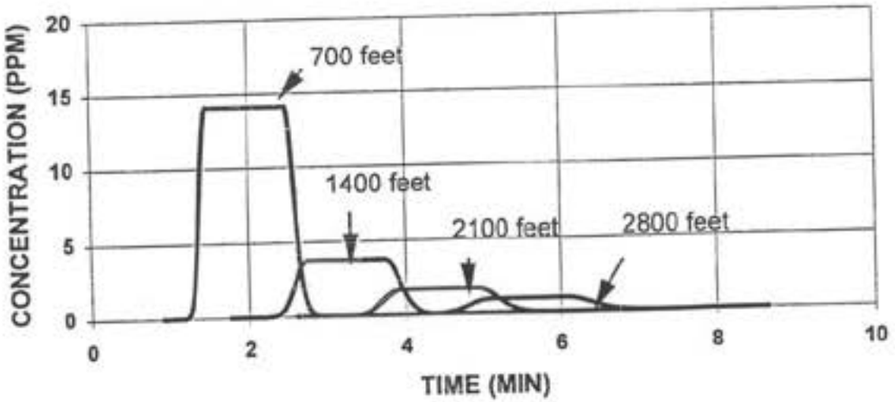
See Section 4.2 for assumptions common to all alternate scenarios. See Section 6 Appendix 1 for input assumptions used by the dispersion model.

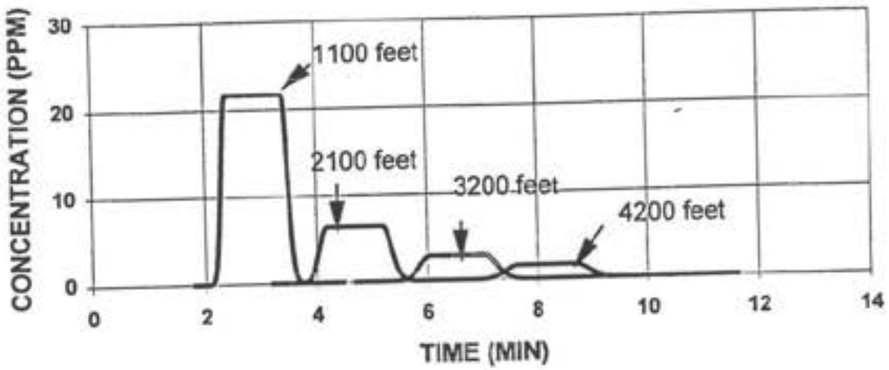


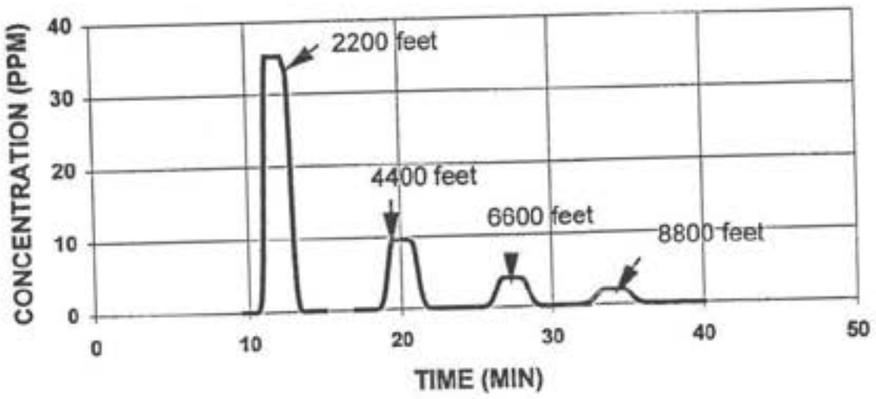




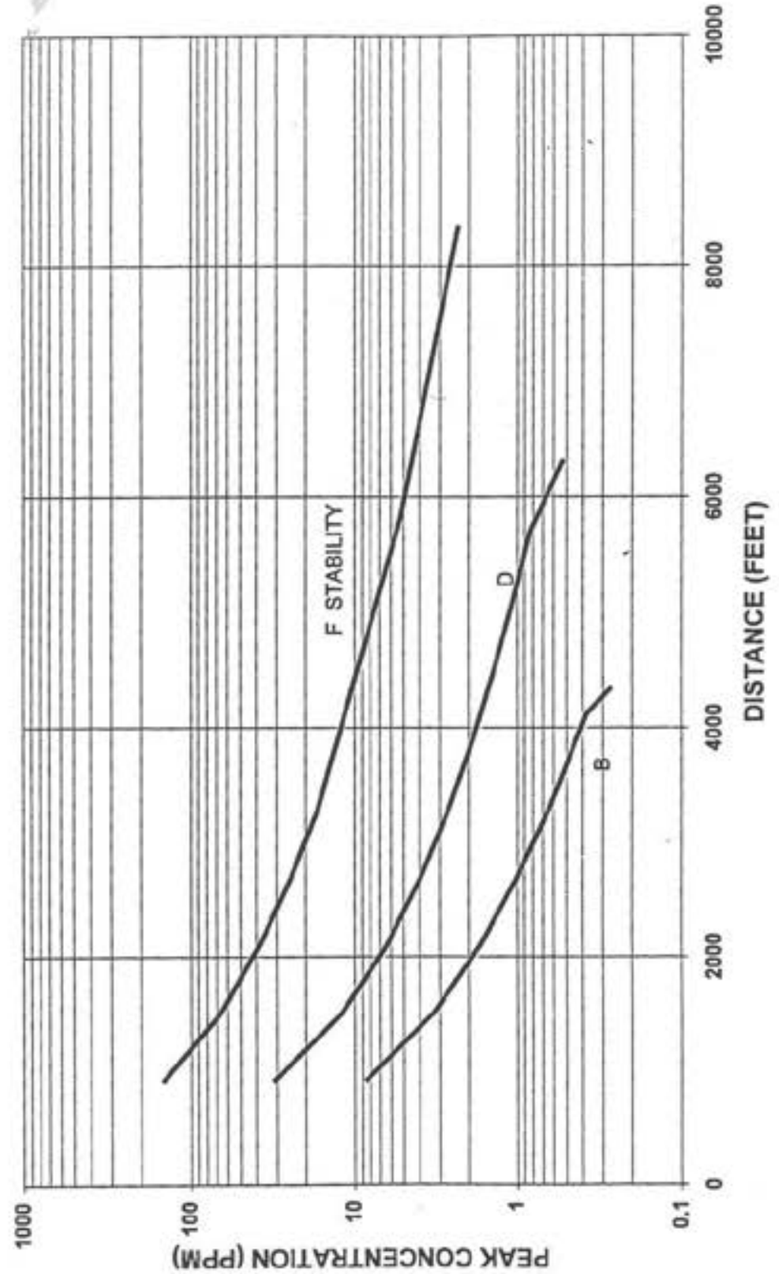
4.5.13 Calcium Hypochlorite - Decomposition (continued)







4.5.13 Calcium Hypochlorite – Decomposition (continued)



5. REFERENCES

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5.2 *Guidelines for Use of Vapor Cloud Dispersion Models*; 2nd ed.; Center for Chemical Process Safety, American Institute of Chemical Engineers: New York, 1996.

5.3 *Guidelines for Post-Release Mitigation Technology in the Chemical Process Industry*; Center for Chemical Process Safety, American Institute of Chemical Engineers: New York, 1996.

5.4 *Concentration Fluctuation and Averaging Time in Vapor Clouds*; Center for Chemical Process Safety, American Institute of Chemical Engineers: New York, 1995.

5.5 *Understanding Atmospheric Dispersion of Accidental Releases*; Center for Chemical Process Safety, American Institute of Chemical Engineers: New York, 1995.

5.6 Turner, D. B. *Workbook of Atmospheric Dispersion Estimates*, ed. 2; Lewis: Ann Arbor, 1994.

5.7 *Guidance on the Application of Refined Dispersion Models for Hazardous/Toxic Air Releases*: 1993; U.S. Environmental Protection Agency. U.S. Government Printing Office: Washington, DC, 1993; EPA-454/R-93-002.

5.8 *Emergency Response Planning Guidelines, Chlorine*; American Industrial Hygiene Association: Fairfax, VA, 1988.

5.9 *RMP Offsite Consequence Analysis Guidance*; U.S. Environmental Protection Agency: Washington, DC, May 24, 1996.

5.10 *Accidental Release Prevention Requirements: Risk Management Program Under the Clean Air Act*; Federal Register; Volume 61; No. 120; Section 112(r)(7); June 20, 1996.

5.11 *Chlorine Manual*, ed. 6; Pamphlet 1; The Chlorine Institute: Washington, DC, 1997.

5.12 *Emergency Shut Off Facilities for Tank Car & Tank Truck Transfer of Chlorine*; ed. 2; Pamphlet 57; The Chlorine Institute: Washington, DC, 1989.

6. APPENDIX I - MODEL EXPLANATION

The model used to develop the scenario graphs in this pamphlet is TRACE 8.0 developed by Safer Systems, Inc. This appendix summarizes some of the key concepts employed in this model.

6.1 ESTIMATION OF LEAK RATES

The first stage in the development of many chemical accidents, which lead to hazardous situations, is the generation of a vapor cloud (toxic or flammable in nature). This cloud may consist of vapor from a pool or liquid droplets suspended in the vapor. The crucial variables at this stage are the amount (or rate) of discharge and the thermodynamic properties (temperature, pressure, state, etc.) of the stream.

In the case of a tank rupture, SAFER/TRACE™ algorithms take into account the chemical properties, environmental variables (atmospheric pressure and ambient temperature), tank specifications (length, width, height, or diameter), rupture geometry (circular, rectangular, smooth, or jagged edges), pipe length, and the containment variables (pressure, temperature).

SAFER scenarios are categorized into four distinct groups:

a. Gas flow through a rupture

This module has capabilities to model sonic and subsonic flows. The critical pressure ratios are determined as a function of tank dimensions, rupture size, and chemical properties. If the critical pressure ratio exceeds P(atm)/P(tank), sonic flow occurs or otherwise exists. Depending upon each region (sonic or subsonic), the SAFER/TRACE calculates an appropriate release rate. For the subsonic region, isentropic flow is assumed to occur. The SAFER/TRACE algorithm carries out an iterative process by which a sonic flow is reduced to subsonic (as the pressure decreases) and subsequently is reduced to atmospheric pressure.

b. Two-phase flow-through rupture

In two-phase flows, the volumetric void fraction of vapor in the liquid is first calculated. Subsequently, the model estimates whether two-phase subsonic or two-phase sonic flow occurs. The critical pressure ratio in this case is determined as a function of the stagnation quality.

c. Liquid flow-through rupture

For chemicals whose boiling point is above ambient temperature, the flow is assumed to be incompressible. The flow rate is dependent upon the area of the

hole, discharge coefficients, and height of liquid above the hole. The program calculates the flow rate in increments until the liquid level reaches to top of the hole or until the hole pressure approaches atmospheric pressure and air is ingested.

d. Liquid flow through sheared pipe

The chemical mass in the tank is divided into several increments so that each increment is equal or greater than the pipe hold up. During the discharge of each element the tank thermodynamic variables are assumed constant. A two phase flow model uses a trial and error procedure to find the correct initial pressure into the pipe until the maximum discharge or choked flow is obtained.

If the pressure differential approaches zero, the SAFER/TRACE algorithm has an air ingestion formulation. The volumetric flow of ingested air is set to equal the equivalent volume of out-flowing chemical until the liquid level reaches the bottom of the hole, and subsequently, the flow stops.

When the pressure in the vapor space falls below the vapor pressure of the chemical at the tank temperature, evaporation of the liquid occurs. This process results in cooling the contents of the tank.

Heat transfer considerations account for the above-described evaporation process and by the heat exchange with the ambient atmosphere. The balance of these processes determines the temperature of the contained chemical and, consequently, the chemical/physical properties.

The above formulations are used to develop a time history for the release rate, temperature, pressure, void fraction and pressure of the tank. These functions are then used by other SAFER/TRACE algorithms (described subsequently) to set up the source term for dispersion.

6.2 Source Function for Dispersion

The SAFER/TRACE algorithms outlined in the previous section produce the state of the stream after release from containment due to a failure/rupture. This released chemical, in general, would consist of a two-phase stream (vapor and liquid chemical). Depending upon the initial containment variables, the stream could undergo a flashing phenomena. The mass fraction flashed can be calculated knowing the latent heat of vaporization and the enthalpy differential due to the release. The aerosol content of this stream (liquid droplet fraction entrained) is dependent upon the flashing fraction, the liquid/vapor density ratio, the rate of heat transfer between the liquid and vapor phases, velocity of the stream, and the surface tension. The above variable can be conveniently grouped as a "bubble" growth rate constant and a Weber number. Depending upon the condition during the release, it is possible to have a flash, an aerosol, and a liquid pool fraction. For

low flashing fraction, the inlet stream consists of flashed vapor and the liquid forming a pool on the ground. For high flashing fraction, the inlet stream consists of flashed vapor with the rest of the liquid being entrained as an aerosol. For intermittent flashing fractions, the stream consists of a flashed vapor, partially entrained liquid droplets, and partial pool formation on the ground.

The initial vapor cloud, in general, consists of flashed vapor and liquid droplets. An initial air entrainment formulation determines the quality of air in the cloud. Two possible scenarios exist:

a. Complete evaporation of all initial liquid aerosol

Just-sufficient air is entrained in the cloud to evaporate all liquid aerosol. This situation normally results in maximum density and minimum temperature of the cloud for initial conditions.

b. Evaporation of liquid aerosol during cloud dispersion
The air entrainment gradually evaporates the liquid aerosol as a function of time, resulting in a cloud with higher chemical concentration and with the aerosol's persisting for a substantial distance downwind.

The liquid stream that forms the pool is routed into the system's evaporation algorithm. In general, this model consists of a system of coupled ordinary differential equations for the pool volume, pool radius, and mass evaporated; with time being the independent variable.

The pool volume equation balances the initial volume instantaneous liquid spill, the volumetric liquid flow rate in the pool (steady, continuous, or varying transient), and the volume of evaporated liquid.

The pool radius equation allows for a spread dependent upon the pool height. In case the substrate is collapsible (e.g., water), the height of the pool is adjusted for density differences.

The amount of liquid evaporating from a pool is dependent upon the exposure area and the balance of heat streams into and out of the pool. The heat balance includes conduction from the ground, solar radiation, long-wave radiation, convection from wind, and latent heat losses.

The heat conduction term is modeled as a one-dimensional, semi-infinite heat-transfer problem. This situation results in a heat transfer rate that decreases with time. For pool growth formulations, however, the radius of the pool constantly increases (and may subsequently decrease also); "fresh" contact, therefore, is made constantly between the liquid and the ground. As a result, for the heat conduction term in growing pools, a radial

integration must be performed to account for uneven distribution in contact time for various sections of the pool. The substrate also plays a crucial role for heat conduction. The thermal diffusivity of different substrates (e.g., concrete, average soil, sandy soil, moist soil) is determined as a function of density, specific heat, and thermal conductivity of the substrate.

The heat convection term is dependent upon wind speed, ambient temperature, pool temperature, and pool dimension. The mass transfer rate across the boundary layer above the pool surface is determined, and by applying a heat/mass transfer analogy, the heat convection term can be determined.

The heat flux due to radiative transfer consists of the incident solar radiation, the emissivity of the pool surface, and the emissivity of the atmosphere. The incident solar radiation is modified, taking into account the reflection characteristic of the pool. Such characteristics are dependent on the incident angle of the oncoming radiation and the reflectority characteristics of the pool surface.

For cryogenic liquids, the heat conduction term dominates over the other transfer mechanisms. For other liquids (boiling point close to and greater than ambient temperature), the heat convection and radiation mechanisms may be the driving force. In the case of a multi-component liquid spill, the system's model treats the spill as an ideal liquid solution. The standard mass transfer rate equation for evaporation is applied to each component, and the total evaporation rate is obtained by summing all compounds. The mass transfer coefficient for each component is formulated as described in the section on heat convection.

The pool evaporation model can be run in an isothermal (pool temperature constant), or non-isothermal model. In the latter case the temperature is capped at fifteen degrees below chemical boiling point at atmospheric pressure.

6.3 TRANSPORT AND DISPERSION MODELING

The first state in the sequence of a chemical accident is the formation of a vapor cloud. This initial cloud formation is modeled by the physical processes outlined above. The cloud (instantaneous or continuous generation) is then transported and dispersed into the atmosphere, depending upon the ambient conditions and the physical characteristics of the cloud (temperature, density, etc.). The system's model encompasses a wide variety of scenarios--Gaussian formulation for passive dispersion, dense gas modeling for heavier-than-air releases, instantaneous puffs or continuous plumes, elevated or ground-level releases.

The transport and dispersion module utilizes local meteorological measurements of wind speed, direction, and temperature. The transport of puffs is carried out using a Lagrangian trajectory. A wall (two-dimensional surface) is emitted at different intervals. The spacing between the walls is controlled by the wind speed and amount emitted.

For dense gas modeling, the SAFER/TRACE programs have different modules for simulating behavior in the air and on the ground. The models involve solving equations for the conservation of mass, momentum, and energy. When the cloud is in the air, the SAFER/TRACE programs solve equations concerning the mass (chemical, air, and water), momentum (horizontal and vertical), and energy. On the ground, the equations additionally include the simulation of gravity slumping and frictional drag/mixing due to surface roughness effects. The motion of the cloud on the ground is determined by the height-averaged wind speed within the cloud. A power law wind profile is assumed where the exponent is determined by a weighted least-squares fit of a logarithmic profile, along with a Businger correction. Heating of the cloud is determined by natural and forced convection and by ambient air flow into the cloud. The dense gas model has a transition into a Gaussian phase when the zone of constant concentration decays to zero, or the Richardson number (R_i) drops below seven.

The above-described numerical model serves as the core for physical simulation of heavier-than-air gas releases. The model is enhanced to consider aerosol effects. A thermodynamic sub-module carries out an iterative vapor-liquid equilibrium calculation to estimate the new temperature and density of the system (liquid/vapor ratio).

The above formulation describes the gross or average characteristics of the cloud. The SAFER/TRACE system solves additional equations for a horizontal and vertical distribution parameter to introduce a similarity profile for the concentration within the cloud.

Instantaneous values of the concentration can be obtained at a point as a function of time. The SAFER/TRACE system uses these values to determine the dosage experienced at a specific location. A variable that averages time permits the user to see time-averaged values of the concentration and isopleths.

The release of a vapor cloud often occurs in an area where structures exist. The cloud often has to pass through a region where there may be pipe racks, columns, and process equipment. The presence of obstructions increases the rate of dilution. The SAFER/TRACE model accounts for obstructions in a gross manner by surface roughness.

The model does not carry out any buoyant lift-off calculations from the ground. Once the puff/plume is on the ground, it is likely to remain on the ground (criteria have been suggested for buoyant lift-off from the ground, but they are not precisely formulated). If a puff/plume is in the air, however, the trajectory is decided on the basis of density momentum; there can be cases of a buoyant lift-off under these circumstances.

The SAFER/TRACE system simulates variable release rates by considering a series of pseudo steady-state releases. The final concentration profile is obtained by combining the distributions from each steady-state release. The dispersion model is basically three-dimensional. The dilution of the cloud is carried out in a three-dimensional grid block with varying wind vectors assigned to each block. The direction and magnitude of these vectors depend on the terrain constraints and stability class. The dispersion characteristics also are three dimensional.

Similarity profiles are imposed in the vertical (Z) and crosswind (Y) directions. Downwind (X) dispersion is introduced subsequently, and the concentration profile is suitably modified.

6.4 OTHER MODELS

There are alternate models available for estimating dispersion modeling of heavier-than-air gases. The reference section of this pamphlet (Section 5) provides some sources in the selection of appropriate models.

7. APPENDIX II - UNDERSTANDING DISPERSION MODELING RESULTS

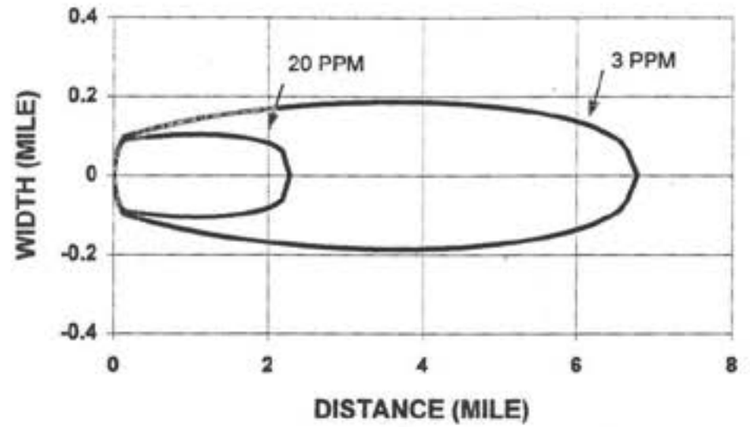
The ***results of dispersion modeling*** for release scenarios are often presented ***graphically*** (concentration vs. distance, concentration vs. time, etc.). When there is a chlorine release from a given ***"source"*** (e.g., chlorine cylinder, railroad car, etc.), emergency response personnel need to know the ***concentration*** (typically expressed ***in parts per million*** or ***ppm***) of chlorine in the atmosphere at various ***"receptor"*** sites (e.g., locations of homes, businesses, etc.).

The results of any given release scenario may be ***graphically presented*** in ***several different ways***. The particular graphical format(s) selected for use will depend on the questions that need to be answered.

In order to facilitate the user's selection and use of the appropriate information, ***sample graphical outputs*** of the types used in this pamphlet are presented below with some explanatory notes.

Note - all the examples described are actual outputs of Scenario 4.4.2.

7.1 FOOTPRINTS



This footprint shows the area downwind from the point of release where the chlorine concentration will reach or exceed the specified levels of concern (3 ppm and 20 ppm) at the time of maximum impact as determined by a model. The footprint thus represents the maximum area that a given concentration of chlorine will reach or exceed after a release. At a given time after a release the affected area may be less than that shown by the footprint, but at no time after a release is it expected that the release will exceed the area depicted by the footprint. However, each footprint is based on specific assumptions which, if changed, would change the dimensions of the footprint.

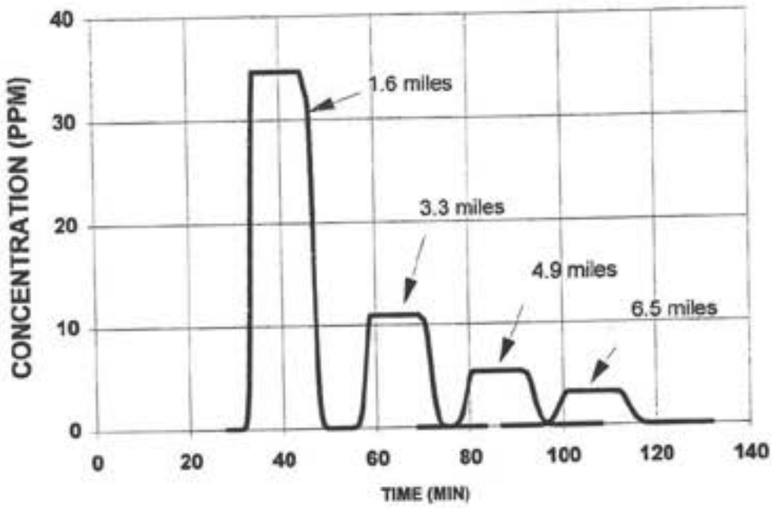
In this footprint, the outer area represents the maximum area where chlorine concentrations are expected to peak at between 3 and 20 ppm. The inner area represents the maximum area where the chlorine concentration exceeds or reaches 20 ppm. The inner area does not designate a maximum chlorine concentration. Theoretically, at the very point of the release the chlorine concentration would reach 100%.

This footprint shows the maximum downwind distance from the release that the concentration exceeds or equals 20 ppm is approximately 2.2 miles. Crosswind from the release, the maximum distance that the concentration exceeds or equals 20 ppm is about 0.1 miles on each crosswind side of the release.

This footprint shows the maximum downwind distance from the release that the concentration exceeds or equals 3ppm is approximately 6.7 miles. Crosswind from the release, the maximum distance that the concentration exceeds or equals 3ppm is about 0.2 miles on each crosswind side of the release.

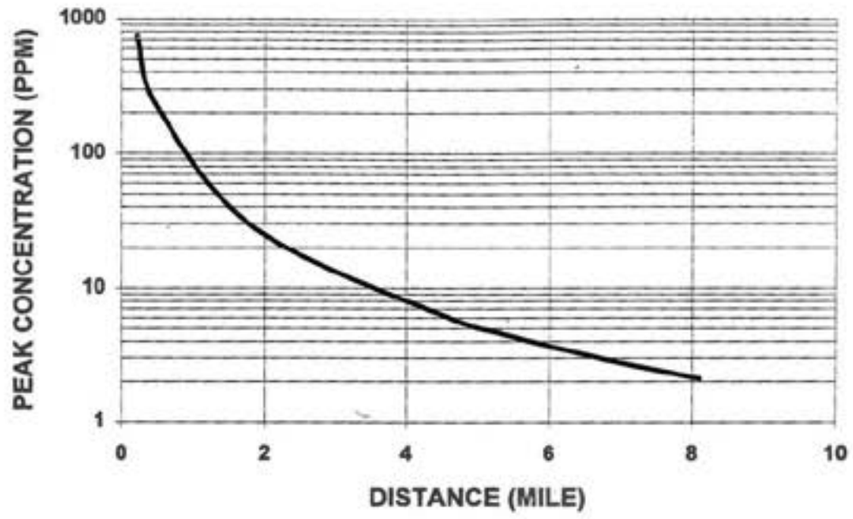
When viewing a footprint, one should think of being in the air looking down on the elease area. In most cases, the x- and y- axes are not drawn to the same scale.

7.2 Peak (Maximum) Concentrations As A Function Of Time At Various Downwind Distances



This graphical output shows the peak (maximum) concentration at approximately 25, 50, 75, and 95% of the maximum 3 ppm cloud distance as a function of time. In looking at the output depicted above, it can be seen that at 1.6 miles downwind from the source, the chlorine concentration will peak at about 34 ppm. At 3.3 miles downwind from the source, it will peak at about 11 ppm. This output also provides an estimate of the time after the release that a point downwind will be affected. If one is concerned about a point 1.6 miles downwind, the output indicates that the area will begin to be affected about 30-35 minutes after the release. About 20 minutes later, the 1.6 mile point will no longer be affected. At 3.3 miles downwind, the point will begin to see the affects of the release about 50-55 minutes after it occurs. It will also last for about 20 minutes.

7.3 Peak Concentration As A Function Of Distance



This graphical output shows the maximum or peak concentration at a specific distance downwind from the point of release. For example, if one wanted to know the maximum distance that the concentration would reach 100 ppm, the graph shows this distance is about 1 mile. If one wanted to know the maximum distance that the chlorine concentration would reach 20 ppm, the graph shows that this distance is about 2.2 miles. This distance should agree with the 20 ppm distance as shown by the foot print (it does).

Note: The y - axis is a log scale.

MISSION STATEMENT

The Chlorine Institute, Inc. exists to support the chlor-alkali industry and serve the public by fostering the continuous evaluation of and improvements to safety and the protection of human health and the environment connected with the production, distribution and use of chlorine, sodium and potassium hydroxides, and sodium hypochlorite; and the distribution and use of hydrogen chloride. The Institute meets this obligation by maintaining a scientific and technical organization that fully meets its members' and publics' needs and expectations. The Institute works with governmental agencies to encourage the use of credible science and technology in developing regulations impacting the industry.

THE CHLORINE INSTITUTE, INC.

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Please return to CORRIE KOST

ESTIMATING THE AREA AFFECTED BY A CHLORINE RELEASE

Edition 3

April 1998

PAMPHLET 74

THE CHLORINE INSTITUTE, INC.

CXY Chemicals

July 8, 1998

Corrie Kost
[redacted]

Dear Corrie,

Some time ago, you requested for a copy of The Chlorine Institute's Pamphlet 74 - "Estimating the Area Affected by a Chlorine Release." This pamphlet was not immediately available as it was in the process of being rewritten.

Our order finally arrived last week, and attached is a copy for your reference.

Yours truly,
CXY CHEMICALS

[redacted]

John Billham
Plant Manager

CXY Chemicals Canada Limited Partnership
North Vancouver Chlor-Alkali Plant
100 Amherst Avenue, North Vancouver, BC V7H 1S4
(604) 929-3441 Fax (604) 929-7610

CXY Chemicals Canada Ltd.
General Partner

Jan 9/98

Lori Mallen phoned

[redacted]

– Pamphlet 74 cases

– Will forward other reports

Rec Peterson [redacted]

September 26, 1997

Dear Corrie

Enclosed is a copy of the original Peer report by A.D.Little. This report (summary) came out in October 1996 and resulted in the District asking A.D.Little to get together with BOVAR-CONCORD and straighten out their differences so that another (independent) report could be submitted to the public in July 1997.

I had some difficulties getting the report from Irwin Torry, but I was finally handed to me last Wednesday. (the day of the public meeting).

[redacted]