3.0 PROJECT BACKGROUND

3.1 PROJECT LOCATION

The proposed Deltaport Third Berth Project is located on Roberts Bank in Delta, approximately 35 km south of Vancouver, BC (**Figure 1.1**). The existing VPA facilities at Roberts Bank include Westshore Terminals, an 80 hectares (approximately 200 acres) bulk handling coal port facility; and Deltaport, a 65 hectares (160 acres) container port facility, operated by TSI.

Roberts Bank is located within the Corporation of Delta on the south side of the Fraser River estuary. It is an important area in terms of its environmental attributes. Roberts Bank supports numerous species of fishes, ecologically important eelgrass beds and contains mudflats that sustain significant communities of birds on the Pacific Flyway. Socially and economically, the Roberts Bank area maintains agriculture and fishing, First Nations use, and since the late 1950s has provided direct and indirect employment to local and regional residents due to local transportation developments. The Corporation of Delta supports a community of approximately 97, 200 residents.

Roberts Bank also hosts two key transportation facilities for the movement of goods and people: the Roberts Bank Port, operated by the VPA; and the Tsawwassen Ferry Terminal, operated by the BC Ferries Corporation. The marine transportation facilities are connected to road and rail infrastructure, which continue the movement of goods and people across the region. The Roberts Bank Port facility is located at the end of an approximately 4.1 km long causeway and consists of Westshore Terminals, a major coal exporting terminal, and Deltaport, a two-berth container terminal operated by TSI.

3.2 PROJECT BACKGROUND AND RATIONALE

The purpose of this section is to provide an overview of the developments that have occurred at Roberts Bank over the past fifty years. This will provide a context for understanding the past and proposed developments at Roberts Bank. A summary of this history is shown on **Figure 3.1**. A more detailed history of the development at Roberts Bank is located in **Appendix A**.

3.2.1 History of Developments at Roberts Bank

In 1958, the provincial government announced that it would establish a ferry service between Lower Mainland and the Saanich Peninsula on Vancouver Island, BC. Following the announcement, construction of the Tsawwassen ferry terminal at Roberts Bank began and on June 9, 1960 the terminal opened with ferry service to Sidney, on Vancouver Island.

In the late 1960's, the Roberts Bank location was selected by the National Habours Board for the development of a coal terminal to facilitate coal shipments to the Japanese metallurgical coal markets. Land reclamation of Roberts Bank and causeway construction started on July 2, 1968. After a two year construction period, the Roberts Bank Coal Port facility, located just northwest of the Tsawwassen ferry terminal, was officially opened in 1970 as a coal terminal (now known as Westshore Terminals). The coal terminal was constructed as a 20-hectare artificial island connected to the mainland by a 5 km causeway.

In 1975, the National Harbours Board was again looking to expand their west coast marine port facilities. An environmental assessment of the proposed expansion was submitted in 1977 in accordance with the Federal Environmental Assessment and Review Process (EARP). In 1979, after a panel review process, the panel recommended a reduced expansion of the proposed terminal facilities. The revised port expansion proposal was approved by the Department of Environment in 1981 and expansion construction commenced with dredging in late 1981.

Westshore Terminal's new handling and loading facilities were completed in 1984 on Pods 1 and 2, resulting in an increase of Westshore's original 20 ha terminal to an approximately 50 ha terminal (see **Figure 3.2**). In addition to the coal terminal, additional land (Pods 3 and 4, total area approximately 65 ha), was constructed as part of the 1981-84 construction activities. This land was left undeveloped (vacant) at the end of the 1984 construction activities and would remain vacant until the 1990 development of the Deltaport Container Terminal (operated by TSI).

Meanwhile, B.C. Ferries Corporation had grown significantly since its creation in 1958. Due to increasing transportation demands, a second route from the Tsawwassen Ferry Terminal to Vancouver Island was required. This demand resulted in the 1991 – 1995 terminal expansion, which included the creation of 8 hectares of land on the north side of the existing ferry terminal facility to expand parking and loading lane areas.

In the early 1990's, the VPA (at this time known as the Vancouver Port Corporation), was looking to increase its container terminal capacity and proposed development of a container terminal on a portion of the vacant land (Pod 4) at Roberts Bank. After considerable discussion with the public and deliberations by an independent review panel, the panel concluded that a container terminal development at Roberts Bank was acceptable subject to implementation of the mitigation recommendations. Construction of the Deltaport facility on Pod 4 occurred between 1994 and 1996 (with marine works from 1994 to 1995). Deltaport was officially opened in June 1997.

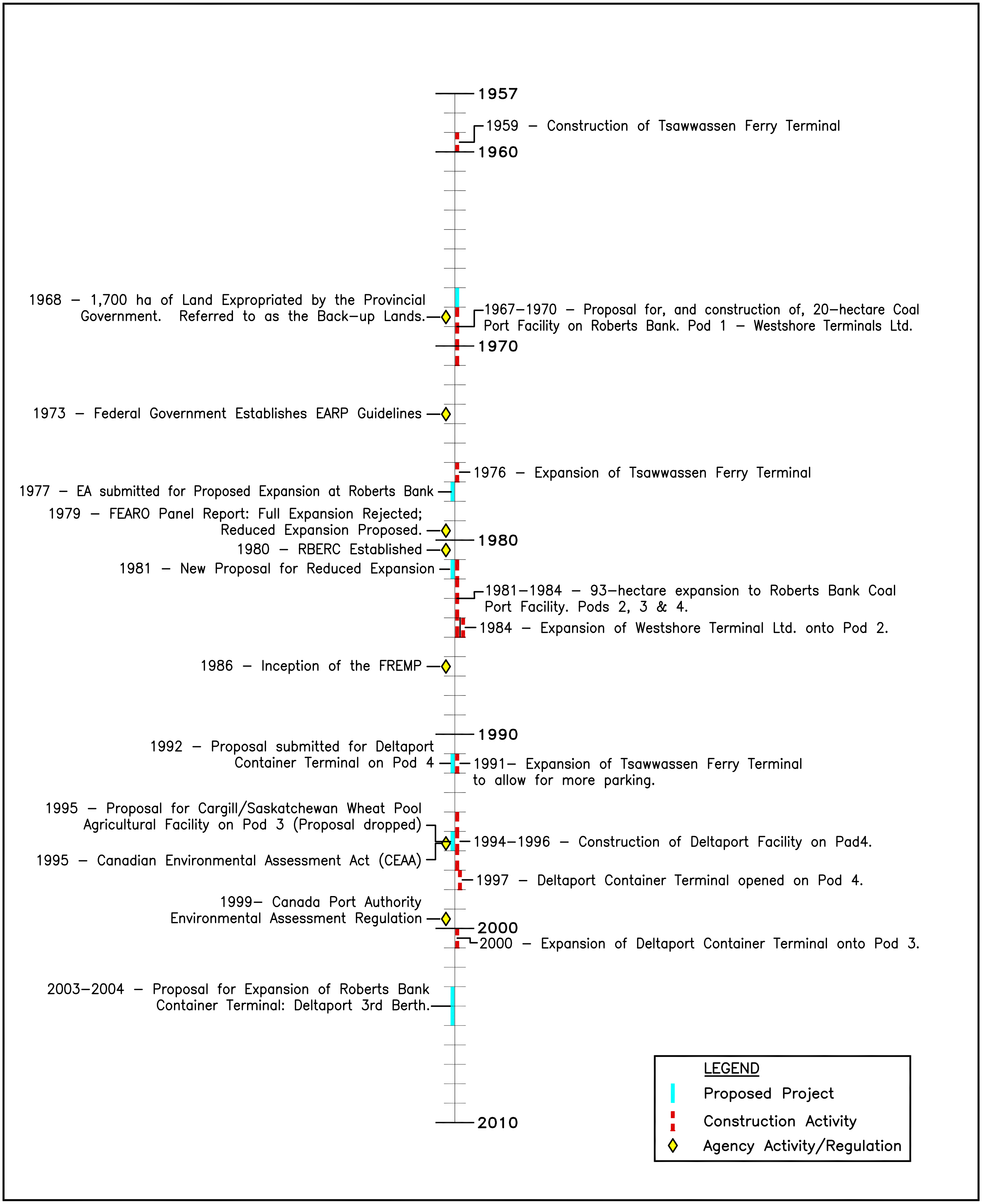

Figure 3.1 - History of Development at Roberts Bank

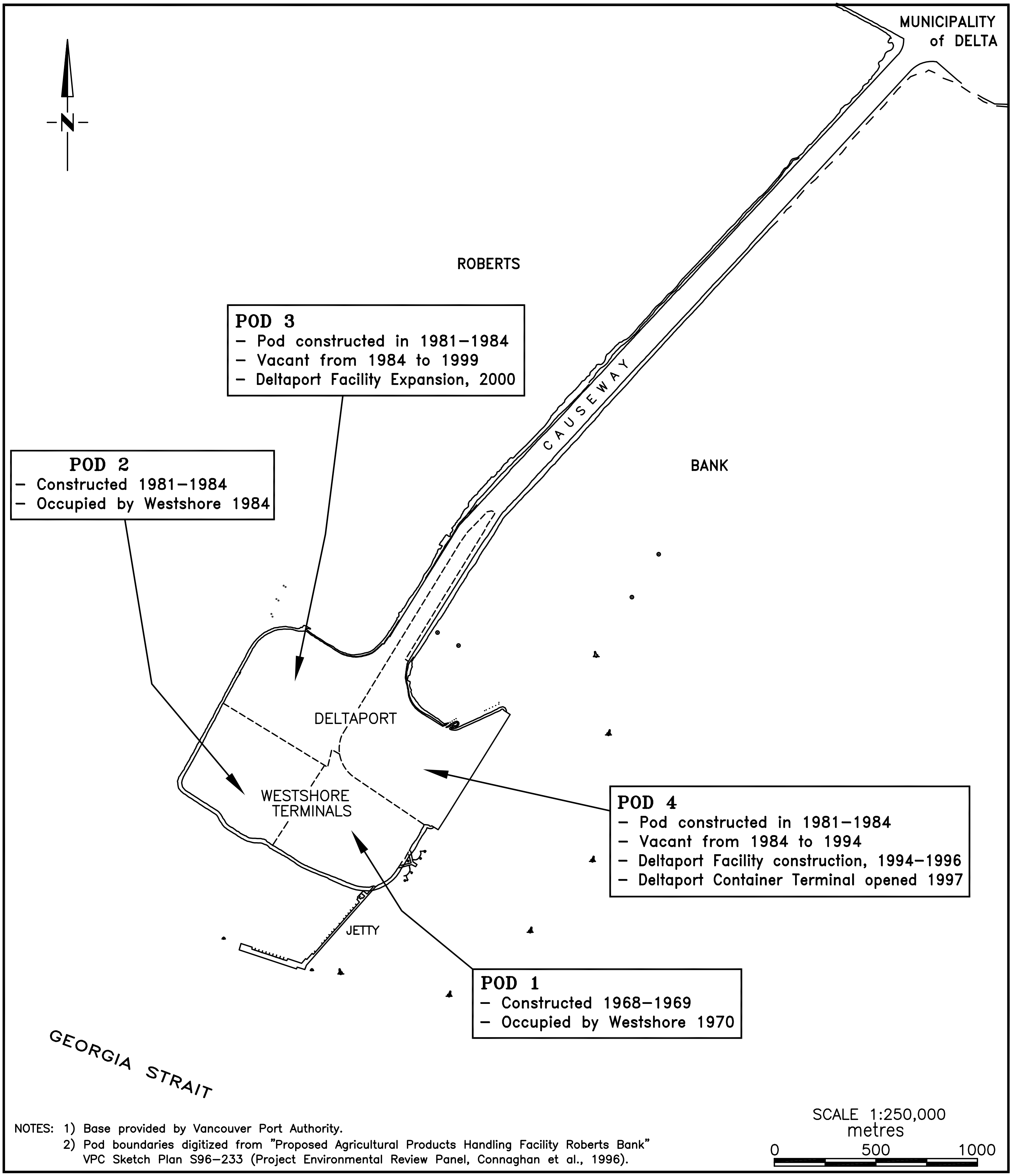

Figure 3.2 - Roberts Bank Port Facilities (1969-2000)

In 1999, the VPA looked at expanding the Deltaport container facility onto the remaining vacant land at Roberts Bank (Pod 3). The Fraser River Estuary Management Program (FREMP) Environmental Review Committee reviewed the Pod 3 Deltaport EA document (CEAA screening) and recommended that the project proceed. Construction of the Deltaport expansion on Pod 3 commenced in 2000 and the expanded terminal area opened in late 2000. By the end of 2000, Deltaport at Roberts Bank totalled 65 ha (located on both Pod 3 and Pod 4).

A summary of the physical developments at Roberts Bank is provided below:

1958 – 1960	Construction of the Tsawwassen Ferry Terminal
1968-1970	Construction of the 20 ha Roberts Bank coal terminal and causeway
1981 – 1984	Expansion of the 20 ha Roberts Bank coal terminal to a 50 ha coal terminal and the creation of 65 ha of undeveloped land (Pods 3 and 4)
1991 – 1995	8 ha expansion of the Tsawwassen Ferry Terminal
1994 – 1996	Development of Deltaport on Pod 4 (approximately 35 ha)
2000	Expansion of Deltaport onto Pod 3 (total area 65 ha)

The following sections provide additional background information, rationale and justification for the proposed Project.

3.2.2 Port of Vancouver and the Container Industry

The VPA administers Canada's largest port, the Port of Vancouver, located on the southwestern coast of British Columbia. The Port of Vancouver is made up of four key business sectors: containerized cargo, cruise lines, bulk cargo (*e.g.,* grain, coal, potash, etc.) and general cargo (*i.e.,* forest products). The Port of Vancouver is an important transportation link to British Columbia and the rest of Canada and this relationship is reflected in the VPA's mission statement, "To facilitate and expand the movement of cargo and passengers through Port Vancouver in the best interest of Canadians."

With a total container throughput of 1.54 million TEUs in 2003, the Port of Vancouver is Canada's largest container port and is nearing capacity (Port of Montreal is second, having handled approximately 1.1 million TEUs in 2003). The Port of Vancouver is also the fifth largest container port on the West Coast of North America after Los Angeles, Long Beach, Oakland and Tacoma. The container business at the Port of Vancouver enables Canadian consumers to buy a variety of manufactured goods including furniture, clothing, electronics, appliances and auto parts. Containerized exports include refrigerated cargo and value added goods such as pork, beef, forest products and specialty grains. In 2003, 93% of the containers that the Port of Vancouver handled were for the Canadian domestic market (*i.e.*, import and export traffic to and from BC and the rest of Canada). The domestic Canadian market is almost evenly split between shipments for BC and shipments for the rest of Canada. The remaining 7% of the containers consisted of US trade with Asia through the Port of Vancouver[5].

3.2.3 Project Justification

A review of the historical global, North American and Vancouver Port Area[6] container traffic growth from 1980 to 2003 provides context for today's container industry. Following an overview of historical market information, this section provides information on the drivers for container traffic growth. It further presents a breakdown of North American market shares of container port throughput, and forecasts North American, West Coast North American and Vancouver Port Area container traffic to 2020. A summary of the demand and capacity analysis for the Vancouver Port Area and the West Coast of North America is also provided. The Vancouver Port Area includes three terminals in the Port of Vancouver (Centerm, Vanterm and Deltaport) as well as one terminal in the Fraser Port (Fraser Surrey Docks).

This documentation illustrates the "need for" and the "purpose of" the Project.

Historical Container Market Records

Global Container Market

World seaborne general cargo trade increased from 527 million tonnes in 1980 to 1,082 million tonnes in 2001, a growth rate of 3.5 percent per year. In the same period, world container trade increased from 115 million tonnes to 639 million tonnes, a growth rate of 8.5 percent per year.

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5 InterVISTAS Consulting Inc., 2003. Potential Economic Impact of Container Terminal Development at Port Vancouver.

6 The Vancouver Port Area includes three terminals in the Port of Vancouver (Centerm, Vanterm and Deltaport) as well as, one terminal in the Fraser Port (Fraser Surrey Docks).

The container trade share of the cargo market increased from 22 percent of general cargo in 1980 to 59 percent in 2001, (see **Figure 3.3**)[7].

The general driver of this growth is the overall growth of the world economy. As the economy grows, so does the demand for overseas trade and therefore an increase in cargo and container shipments. In addition, the container market share of general cargo is increasing. The increased containerization of marine cargo can be explained by the following factors[8]:

- Containers provide smaller shipment size for "just-in-time" transportation logistics.
- Containers offer greater security and faster shipping times than break bulk (*i.e.*, pallets).
- Pricing for container shipments is not based on the value of the cargo; therefore, containerization has become more competitive for high value goods.
- Containers are also intermodal, meaning that they can be easily transferred to truck or rail for distribution. Cargoes that used to be shipped through the Panama Canal to the east coast of North America are now being shipped overland using double stack trains, saving five to six days in transit.

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7 Seaport Consultants Canada Inc., Container Traffic Projections for Vancouver Port Area – Draft Report, May 2004

8 Ibid.

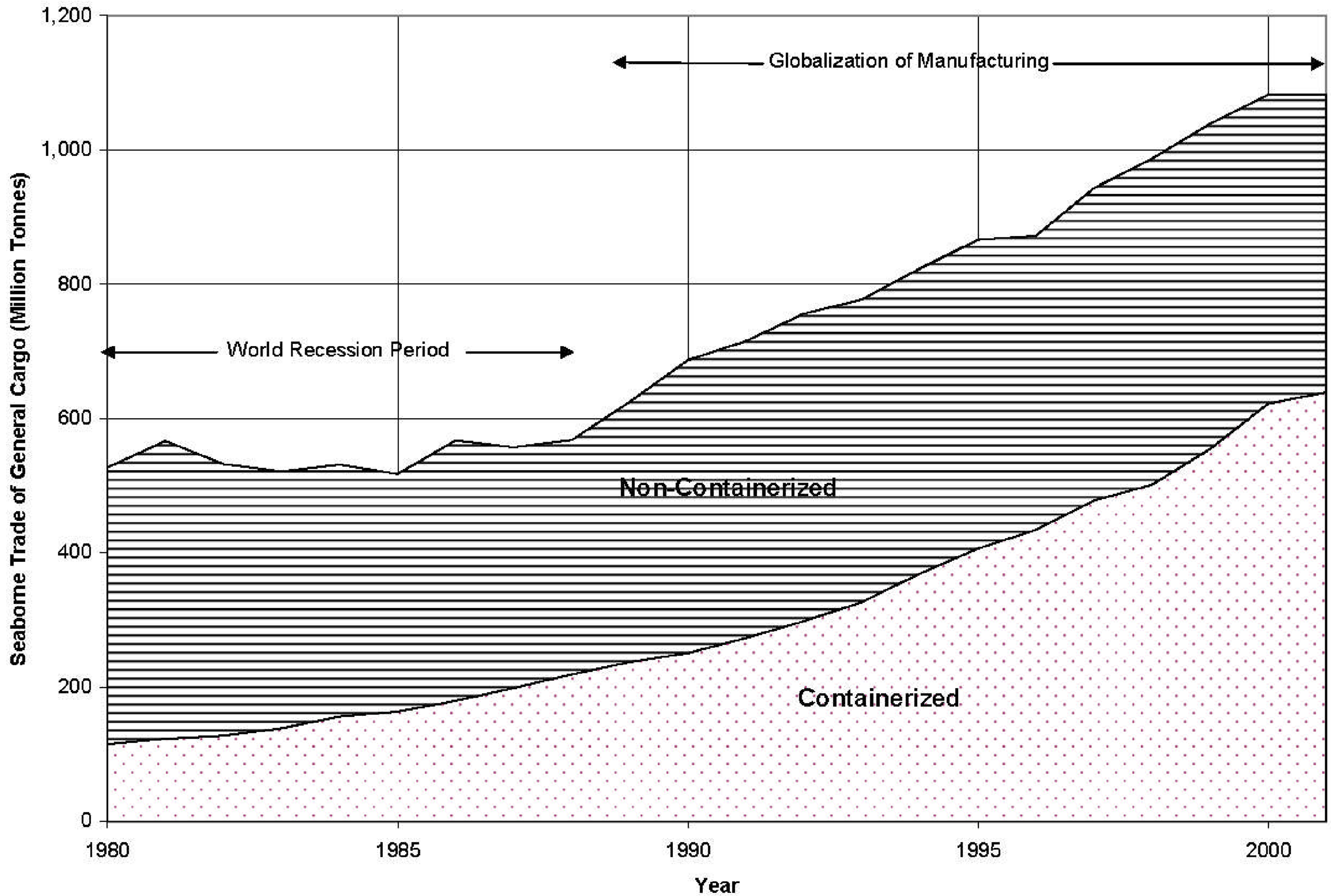

Figure 3.3 - Containerized and Non-Containerized World General Cargo Trade 1980 to 2001

North American and West Coast North American Container Market

North American container port throughput increased from 11.6 million TEUs in 1985 to 35.6 million TEUs in 2003, a growth rate of 6.4 percent a year. Between 1985 and 2003, year-to-year increases ranged between 0.4% and 11%. In 2003, the annual increase was approximately 9.6%[9].

West Coast North American container port throughput increased from 4.9 million TEUs in 1985 to 19.2 million TEUs in 2003, a growth rate of 8.0 percent a year. Between 1985 and 2003, year-to-year increases ranged between -2% and +20%. In 2003, the annual increase was approximately 12%[10].

The North American throughput from 1985 to 2003 is shown on **Figure 3.4** and is broken down by port regions. Westcoast throughput as a percentage of North American throughput has increased from 40% in 1984 to 54% in 2003[11], as shown on **Figure 3.5**.

The 2003 throughput of major west coast container ports is shown below in Table 3.1.

Table 3.1 2003 Westcoast Container Ports Throughput

Major Westcoast Port	2003 Throughput (TEU)	Percentage
Los Angeles	7,179,000	38%
Long Beach	4,658,000	24%
Oakland	1,923,000	10%
Tacoma	1,738,000	9%
Vancouver	1,539,000	8%
Seattle	1,486,000	8%
Portland	340,000	2%
Fraser River	253,000	1%
Total	**19,116,000**	

9 Seaport 2004 Op. Cit.
10 Ibid.
11 Ibid.

In addition to the global container market growth drivers outlined above, North American drivers include:

- globalization of manufacturing and particularly expansion of manufacturing in China, which adds to container trade growth in general and in particular to the eastbound transpacific trade to North America; and
- the high level of North American import demand.

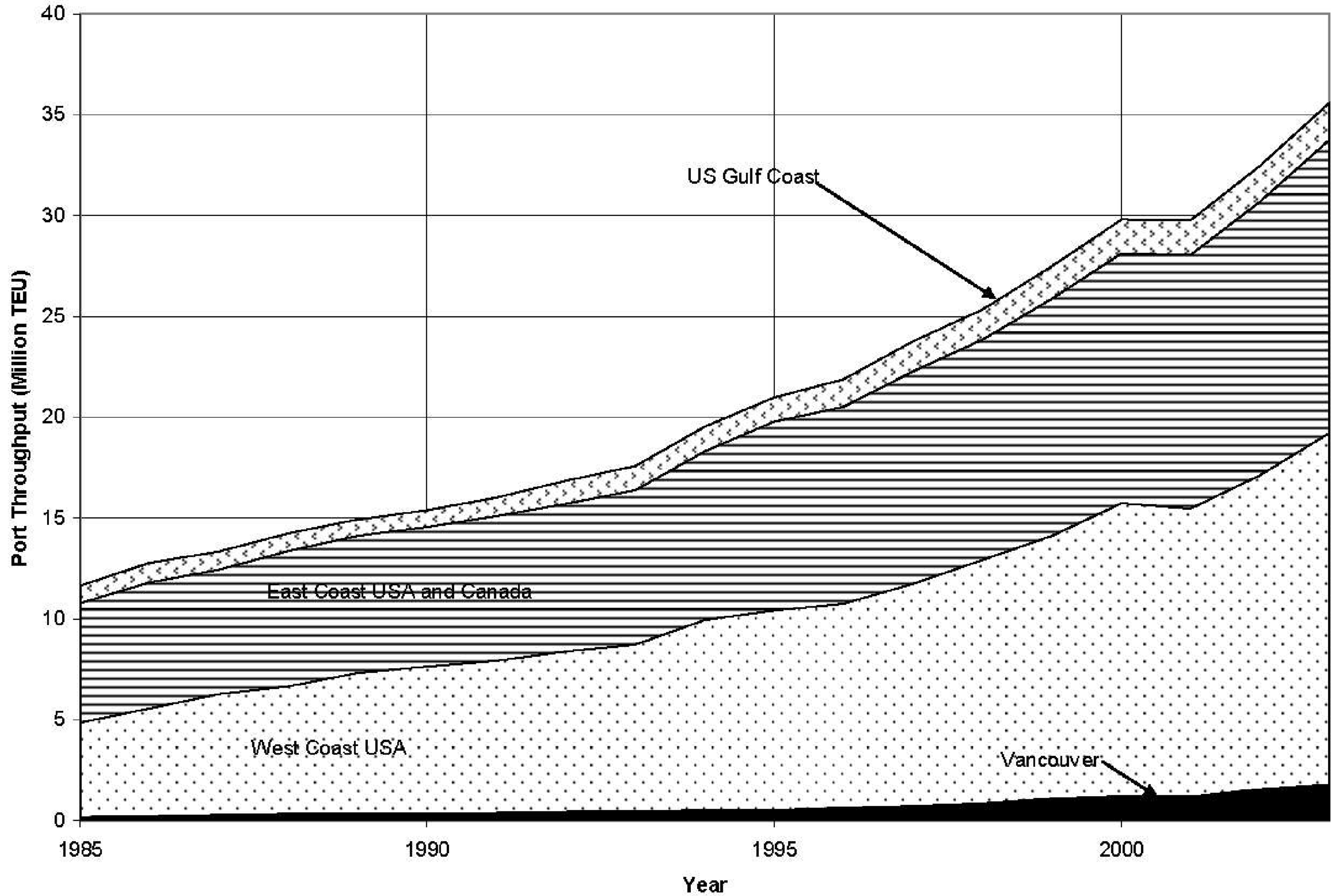

Figure 3.4 - North American Container Port Throughput 1985 to 2003

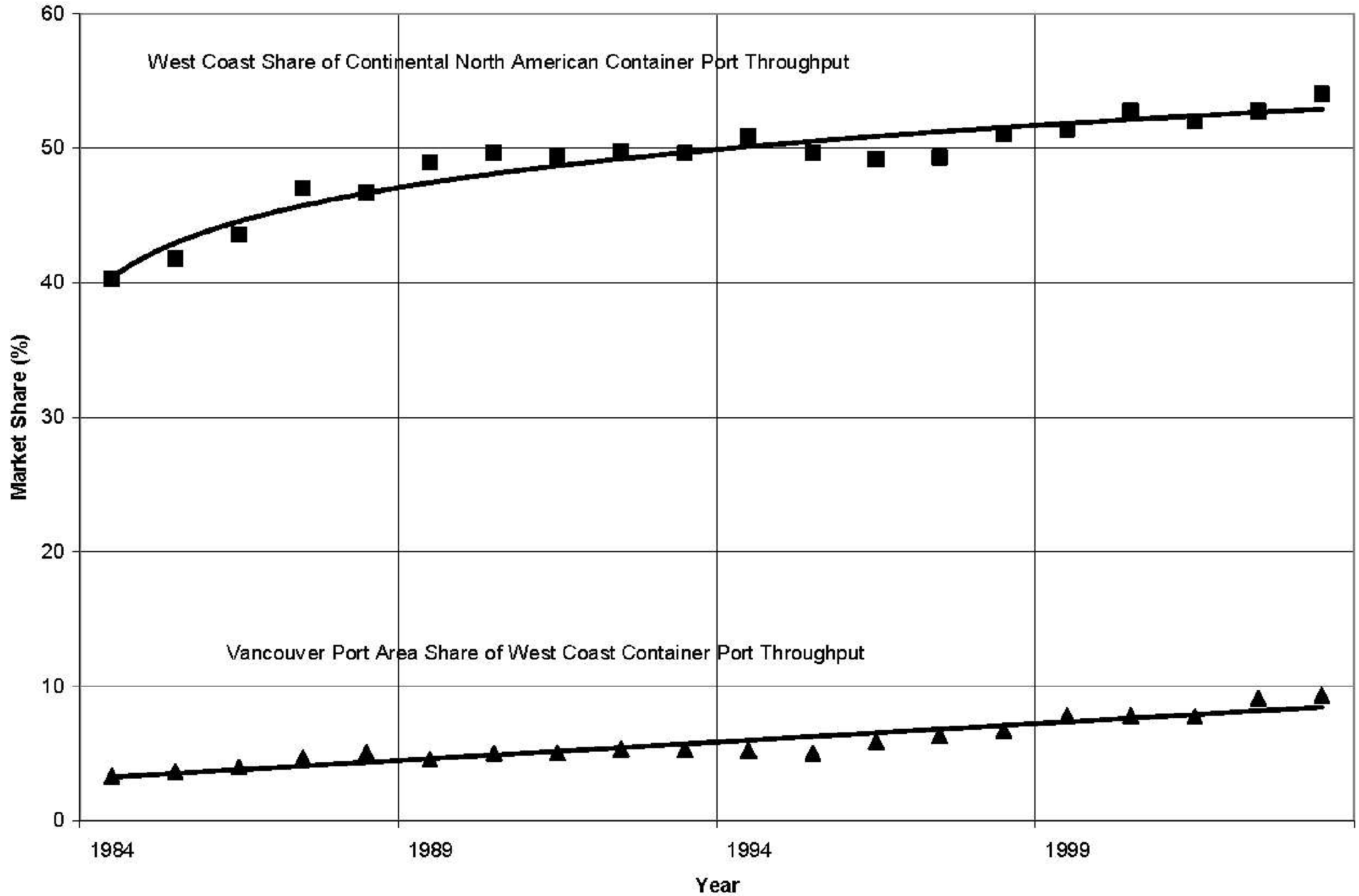

Figure 3.5 - Market Share of West Coast and Vancouver Port Area 1984 to 2003

Vancouver Port Area Container Market

The Vancouver Port Area includes three terminals in the Port of Vancouver (Centerm, Vanterm and Deltaport), as well as one terminal in the Fraser Port (Fraser Surrey Docks). Container traffic in the Vancouver Port Area increased from 0.18 million TEUs in 1985 to 1.79 million TEUs in 2003. Between 1985 and 2003, year-to-year increases ranged between -3% and +32%. In 2003, the annual increase was approximately 15%[12].

The following figure, **Figure 3.6**, shows the Vancouver Port Area container throughput 1980 to 2003. Some highlights include:

- the overall growth rate from 1980 to 2003 was 13%;
- year-to-year growth rates have been quite volatile, especially in the early 1980's when a severe recession was followed by a sharp rebound; and
- a steady increase in Vancouver Port Area's share of the West Coast North American market (from approximately 3% in 1984 to approximately 9% in 2003), as shown on both **Figures 3.5 and 3.6**.

The following table shows container through the Port of Vancouver and Fraser River Port.

Table 3.2 The Port of Vancouver and Fraser Port Container Traffic 2000 – 2003

Year	Port of Vancouver	Fraser Port	Vancouver Port Area
2000	1,163,000	67,000	1,230,000
2001	1,146,000	51,000	1,197,000
2002	1,458,000	101,000	1,559,000
2003	1,589,000	253,000	1,792,000

Sources: Fraser River Port Authority Website http://www.fraserportauthority.com/cargo/first.html, November 2004) and Vancouver Port Authority Website: http://www.portvancouver.com/trade_shipping/terminals/, November 2004

12 Seaport 2004, Op.Cit.

Drivers of growth in the Vancouver Port Area include the same North American and global drivers, plus some that are particular to Vancouver[13]:

- The availability of outbound containerizable cargoes, which has attracted shipping lines to the area. The Port of Vancouver is unique among West Coast ports with imports and exports being approximately equal. All other ports have a greater share of imports.
- The rapid growth of inbound containerizable cargoes from Asia, which grew consistently at some 20% a year between 1998 and 2002.
- The expansion of the containerized trade with China, with inbound cargoes from China increasing by 40% a year between 1998 and 2002, and outbound cargoes by 30% to 40% a year between 1998 and 2002.
- The advent of Deltaport and the related rail improvements in the 1990's that allowed container traffic growth and increased the attractiveness of the Port of Vancouver as an intermodal port compared to other West Coast ports.

In addition, due to the value of the Canadian dollar and differences in port tax structures, container throughput charges for the Vancouver Gateway are low by West Coast of North America standards[14].

Of note, Vancouver Port Area share of Canadian container traffic shipped through westcoast ports has increased from 80% in 1997 to 94% in 2003. During the same period, Vancouver Port Area's traffic, as a share of the total Canadian port traffic increased from 37% in 1997 to almost 50% in 2003.

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13 Seaport 2004 Op.Cit.
14 Ibid

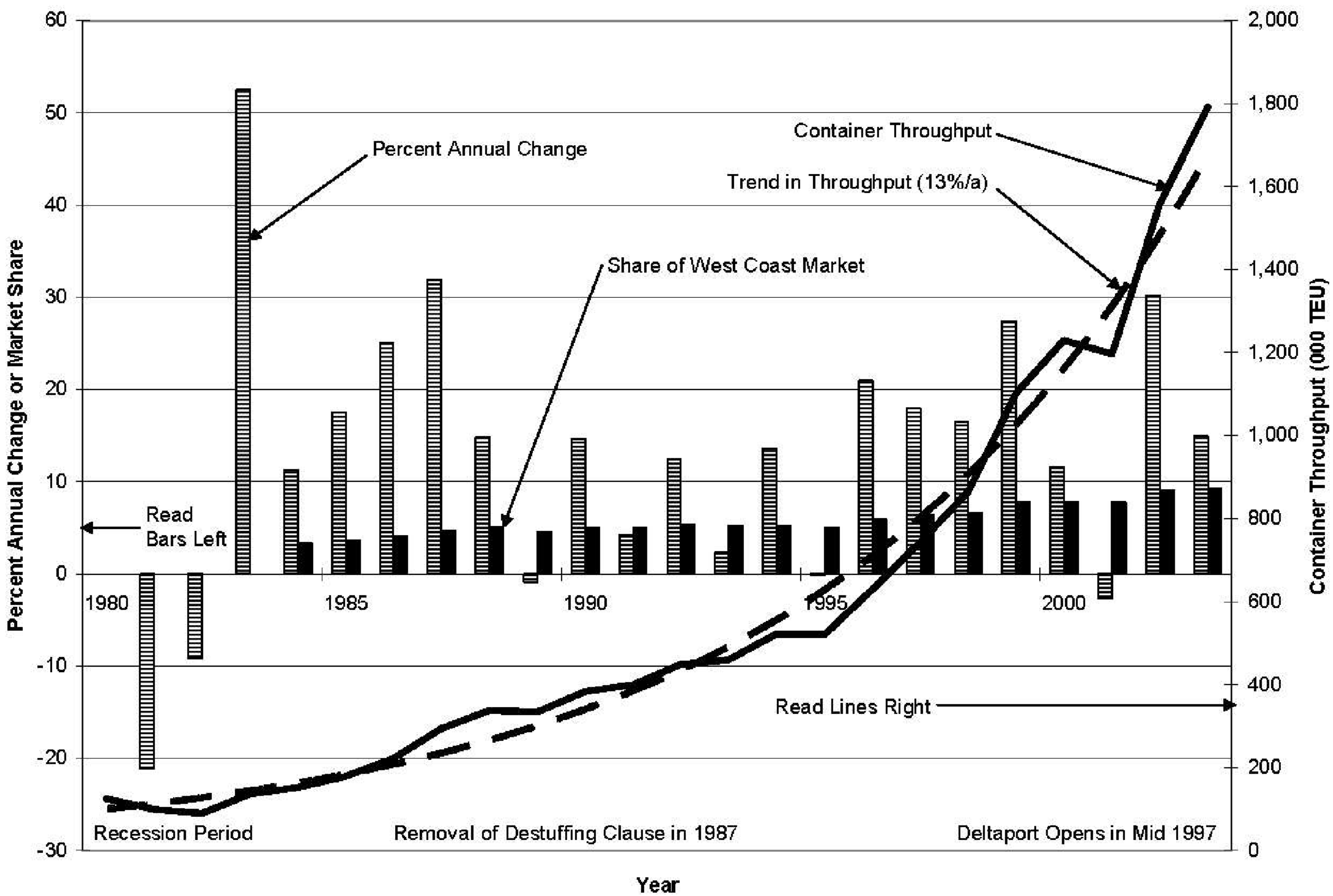

Figure 3.6 - Vancouver Port Area Container Throughput 1980 to 2003

Vancouver Port Area Container Traffic Forecast

Increasing global trade and containerization is forecasted to sustain long-term growth in trans-Pacific container traffic. All of the major container ports on the West Coast of North America expect their container traffic to double in the next ten years and triple in twenty years.

The most recent market study for the Port of Vancouver's container forecast to 2020 started with an analysis of North American and West Coast growth. This was followed by an assessment of the Vancouver Port Area's market share and competitive strengths to arrive at a container forecast for both the Vancouver Port Area and the Port of Vancouver.

Two projections were developed for North American and West Coast port container traffic to 2020. Scenario 1 is the best estimate of future traffic. Scenario 2 was developed to provide a reasonable upper bound for the traffic projection. The growth rates for these scenarios were based on the following factors:

- forecasted US and Canada GDP growth rates;
- general cargo growth versus GDP growth:
- container penetration of general cargo trades: and,
- Asian trade growth, particularly with China, as a direct result of the globalization of manufacturing.

Growth rates for North America and West Coast port container traffic are forecast to gradually decline over the study period to reflect maturing conditions in some of the above factors. They were also marginally higher for the West Coast than for North American based on the assumption that West Coast container traffic will continue to grow as a percentage of North American traffic. West Coast container traffic accounted for 54% of North American traffic in 2003 and is expected to reach 56% by 2020.

The projected growth of North American and West Coast container traffic is summarised in the following table.

Table 3.3 Projected North American and West Coast Container Traffic Growth

Year or Period	Basis	U.S. & Canada		West Coast		Vancouver Port Area		
		Scenario 1	Scenario 2	Scenario 1	Scenario 2	Low Case	Base Case	High Case
Port Throughout (Million TEU)								
2003	Actual	35.6	35.6	19.2	19.2	1.8	1.8	1.8
2005	Projected	40.4	42.3	21.5	22.6	2.0	2.1	2.2
2010	"	51.5	57.9	28.0	31.5	2.8	3.1	3.5
2015	"	62.7	73.9	34.6	40.8	3.6	4.3	5.1
2020	"	76.2	94.3	42.7	52.8	4.7	5.3	6.6
Growth Rates (%/a)								
2003-05		6.5%	9.0%	5.8%	8.3%	7%	8.9%	11.5%
2005-10		5.0%	6.5%	5.4%	6.9%	6.5%	8.2%	9.7%
2010-20		4.0%	5.0%	4.3%	5.3%	5.3%	5.4%	6.4%
2003-20		4.6%	5.9%	4.8%	6.1%	5.8%	6.6%	8.0%

The market study then projected container traffic for the Vancouver Port Area based on the North American and West Coast traffic forecasts. The forecast assumed that the Vancouver Port and Fraser Port will provide sufficient terminal capacity with efficient road and rail connections. It also assumed that terminals in the Vancouver Port Area will continue to offer competitive advantages such as terminal service and cost, berth depth for larger vessels, balanced imports and exports, and a strategic alternative to US ports.

Three traffic projections were prepared for the Vancouver Port Area including the best estimate or base case as well as a low and high case. The three cases assume that Vancouver Port Area's west coast market share will continue to increase but at different rates and to different levels. For example, the base case assumes that market share will increase from 9.3% in 2003 to 12.5% in 2015 and remain constant thereafter.

Projected growth for the Vancouver Port Area is summarised in the above table and **Figure 3.7**

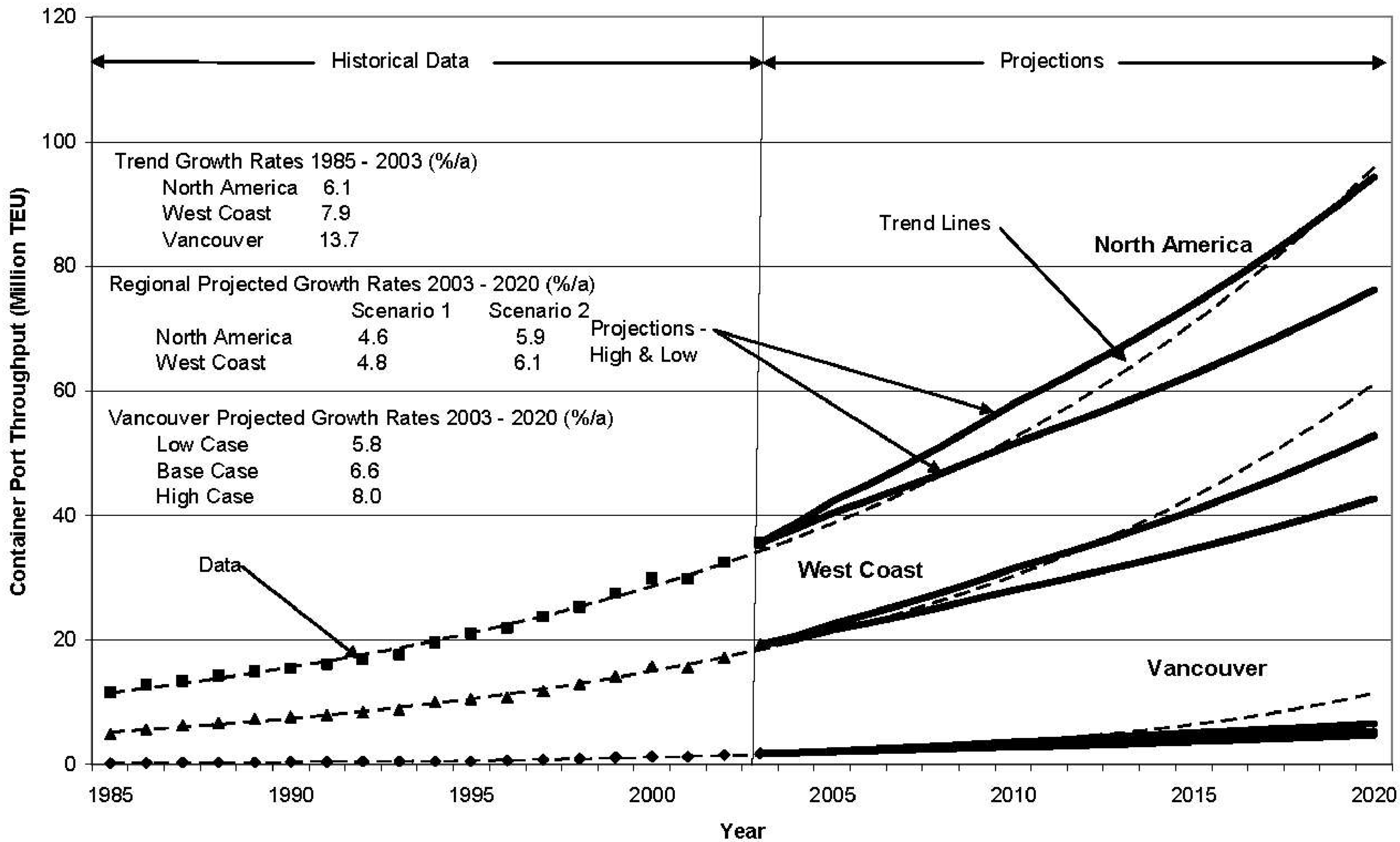

Figure 3.7 - Historical and Projected Container Port Throughput

The final step of the market study was to allocate Vancouver Port Area traffic between Vancouver Port and Fraser Port. This was done on the basis that both Ports would maintain their respective market shares from 2003 through to 2020. Port of Vancouver's market share in 2003 was 86%. This results in a base case forecast for Port of Vancouver container traffic to increase from 1.5 million TEU in 2003 to 4.6 million TEU in 2020.

The projected growth for the Port of Vancouver is summarised in the following table[15], **Table 3.4**.

Table 3.4 Port of Vancouver Projected Container Traffic Growth 2003 – 2020

Year	Basis	Low Case	Base Case	High Case
Port Throughput (million TEU)				
2003	Actual	1.5	1.5	1.5
2005	Projected	1.8	1.8	1.9
2010	Projected	2.4	2.7	3.0
2015	Projected	3.1	3.7	4.4
2020	Projected	4.0	4.6	5.7
Growth Rates (annual percentage %)				
2003-05		7.0%	8.9%	11.5%
2005-10		6.5%	8.2%	9.7%
2005-10		5.3%	5.4%	6.4%
2003-20		5.8%	6.6%	8.0%

15 Seaport 2004, Op.Cit.

Port of Vancouver Terminal Capacity

Current Capacity

The Port of Vancouver's existing container terminals include Deltaport, located at Roberts Bank, and Centerm and Vanterm, located in Vancouver's Inner Harbour along the south shore of Burrard Inlet, shown earlier on **Figure 1.2**. **Table 3.5** provides a summary of the existing capacity at Port of Vancouver container terminals.

Table 3.5 Capacity of Existing Port of Vancouver Container Terminals

Terminal	Location	Size	Berth Depth (m)	2003 Capacity (TEUs)
Centerm	South Shore Burrard Inlet, Vancouver, BC	29 ha, two berths	15.2 m, 15.5 m	340,000
Vanterm	South Shore Burrard Inlet, Vancouver, BC	30 ha, two berths	12.2 m, 15.5 m	435,000
Deltaport	Roberts Bank, Delta, BC	65 ha, two berths	15.8 m	900,000
Total Port of Vancouver		**124 ha, six berths**		**1,675,000**

Capacity Expansion

In 2002, the VPA prepared a container terminal expansion strategy to facilitate the forecasted traffic growth of 4.6 million TEU's. The strategy was established after a extensive analysis of project options on the North and South Shore of Burrard Inlet as well as Roberts Bank.

The following framework was established for the selection of potential projects based on the objective of maximizing utilization of existing terminals before building new facilities.

- increase production of existing terminals;
- convert existing terminal that may be under utilized for other cargo;
- expand existing terminals; and
- build new terminals

Five projects were selected for the VPA's expansion strategy based on the above criteria including:

- The Vanterm project will redevelop a portion of the existing container terminal on the South Shore of Burrard Inlet in order to increase capacity from 435,000 TEU per annum to 600,000 TEU by 2005. This will be achieved by adding new intermodal yard tracks, removing some existing buildings to make room for additional container yard storage and adding new equipment. This project is underway.
- The Centerm project is also a redevelopment program for an existing container terminal on the South Shore of Burrard Inlet. The project is under construction and is expected to increase terminal capacity from 340,000 TEU per annum to 700,000 TEU by 2006. The capacity increase will be achieved by adding new intermodal yard tracks, reconfiguring the container storage yard and replacing most of the equipment. As a result, Centerm will operate at a much higher density on the same site area.
- The proposed Lynnterm project will convert an underutilized forest products terminal on the North Shore of Burrard Inlet. The project may be developed in two phases beginning with partial conversion to 420,000 TEU per annum in 2010 followed by full conversion to 800,000 TEU by 2014.
- The proposed Deltaport Third Berth project at Roberts Bank will expand an existing terminal by adding a third berth, additional container storage yard and new equipment. The capacity of Deltaport will increase from 900,000 TEUs per annum to 1.3 million TEU by 2008.
- The proposed Terminal 2 project at Roberts Bank involves development of a new three berth terminal. Terminal 2 is planned to be built in phases starting with an initial capacity of 600,000 TEU per annum in 2012 and increasing to an ultimate capacity of 1,900,000 TEU by 2020.

Together, these five projects will increase the Port of Vancouver's terminal capacity by 3.6 million TEUs to a total of 5.3 million TEUs by 2020. Not only are all five projects required to serve forecasted growth but also each project includes significant terminal production improvements that must be achieved to reach the stated capacities.

Terminal production improvements will contribute approximately 25% or 900,000 TEU of the proposed 3.6 million TEU capacity increase. As a result, container terminals in the Port of Vancouver will continue to be among the most productive terminals in North America. More importantly, VPA has minimized expansion requirements for Deltaport and Terminal 2 by maximizing production at all of the terminals.

Table 3.6 summarises the proposed capacity increases at Port of Vancouver terminals and compares these with the forecasted container traffic projects to 2020.

Table 3.6 Port of Vancouver Forecasted Capacities and Traffic 2003 to 2020[16]

Year	Capacity (Million TEU)						Forecasted Traffic		
	Vanterm	Centerm	Deltaport	Terminal 2	Lynnterm	Total Forecasted Capacity	Low	Base	High
2003	0.43	0.34	0.90	0.00	0.00	**1.67**	1.5	1.5	1.5
2005	0.60	0.34	0.90	0.00	0.00	**1.84**	1.8	1.8	1.9
2010	0.60	0.70	1.30	0.00	0.42	**3.02**	2.4	2.7	3.0
2015	0.60	0.70	1.30	0.60	0.80	**4.00**	3.1	3.7	4.4
2020	0.60	0.70	1.30	1.90	0.80	**5.30**	4.0	4.6	5.7

The terminal capacities along with the forecasted traffic projections are also shown on the following figure, **Figure 3.8**

16 Seaport 2004, Op.Cit.

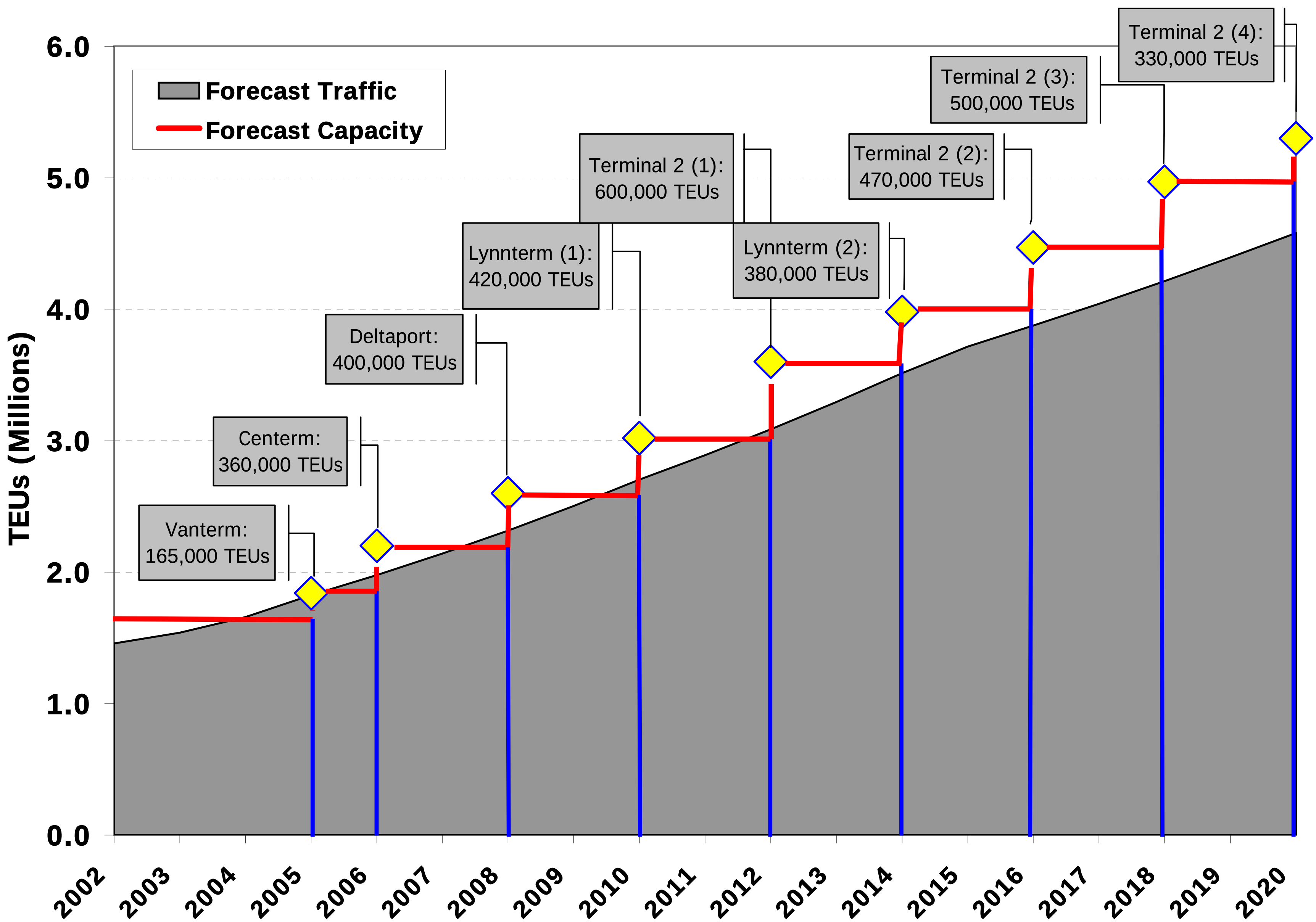

Figure 3.8 - Port of Vancouver Container Traffic and Capacity

3.2.4 Summary of The Need For and Purpose of Project

The primary objective and purpose of the Project is to provide competitive container terminal facilities to meet the needs of Canadian distribution companies. In achieving this objective, the Project will also increase BC/Canada competitiveness as a trading partner in the Pacific Northwest container market and contribute to BC/Canada employment and economic growth.

North American container volumes are expected to grow at a rate greater that the economy through 2020 and Pacific Northwest ports including the Port of Vancouver are expected to capture an increasing share of West Coast traffic. On November 28, 2003, Captain Gordon Houston, President and CEO of VPA, presented a speech about his recent trip to China with BC Premier Gordon Campbell. He discussed how the shipping companies *"…in the Asian-Pacific region…are clearly focused on the Pacific Northwest of North America. They believe that the Pacific Southwest is becoming choked and are looking to the Pacific Northwest to conduct their business*[17]*."*

The Port of Vancouver container business is well established and the Port is positioned to realize growth through 2020. In 2003, the Vancouver Port Area container traffic exceeded Tacoma and Seattle container traffic for the first time to become the fourth largest container port area on the West Coast of North America.

The VPA prepared a container expansion strategy in response to potential container growth that includes five projects to be undertaken between 2004 and 2020. Two of these projects are under construction. The proposed Deltaport Third Berth Project is the next container terminal expansion project available to build in the Port of Vancouver.

Finally, container vessels are increasing in size and Deltaport is the only terminal in the Port of Vancouver capable of handling "post-Panamax" ships up to 10,000 TEU. Deltaport has the berth depth and rail connections to serve larger vessels but the terminal is operating near capacity and needs to be expanded immediately to serve its shipping customers.

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[17] November 28, 2003 speech, VPA website, www.portvancouver.com/media/speech.html

3.2.5 Port of Vancouver's Economic Contributions

North American, and world container volumes are expected to keep growing at a rate greater than the economies projected growth through 2020, as shown by the forecasts presented in the previous sections. To meet the forecasted growth outlined in the previous sections, there is a physical need for additional container terminal facilities on the west coast of Canada.

In addition to the physical need for additional container terminals, there is a need to keep the Canadian share of the Asian-Pacific container market in order for British Columbians and Canadians to benefit from the increase in container volumes forecasted for the Pacific Northwest. The shift to the Pacific Northwest is also supported by large volume shippers, such as Walmart and Target, who are setting up distribution centres in the Pacific Northwest instead of California, because land is less expensive and more available and intermodal and road links experience less congestion[18]. In 2002, the Port of Vancouver was the leader in foreign tonnage in the Pacific Northwest market bypassing Ports of Seattle and Tacoma (the traditional leaders in the region). Port Vancouver container business is already well established and is positioned well to realise growth through 2020.

The Port of Vancouver is one of the most visible contributors to the economy of the Greater Vancouver region, but is also a major economic generator for Canada. The Port is a critical component of Canada's trade and commerce with other trading economies, especially those in the Asia Pacific region. The Port of Vancouver is the gateway through which $29 billion dollars of goods are exchanged with 90 trading economies each year generating 62,000 jobs across Canada. Many businesses in BC and across Canada rely on the Port of Vancouver and growth of the container market. Each container that passes through the Port generates $450 in wages and $550 in GDP and $1200 in economic output.

Further details on the expected economic impacts of the Project are contained in the **Chapter 17** *Socio-Community and Economics*.

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18 Containerisation International, October 24, 2003, *California Leavin': Congestion Sees Shippers Shift Cargo to PNW*"

3.2.6 Federal and Provincial Government Participation

There will be no Federal or Provincial funding participation for the Project. The VPA through its own financial capabilities, along with private sector participation, will fund the project. Infrastructure, such as rail track improvements, will be funded through the rail companies.

3.3 PROJECT ALTERNATIVES AND SITE SELECTION

3.3.1 Alternatives to the Project

This section outlines the alternatives that were considered with respect to VPA's strategy for increasing container terminal capacity in the Port of Vancouver as described in the previous section. The alternatives that were considered include: do nothing (status quo), increase production of existing terminals without site expansion, and develop terminals on other sites in the Port of Vancouver.

3.3.2 Do Nothing (Status Quo)

The first alternative VPA considered was to "do nothing" beyond the current expansions at Vanterm and Centerm. This would limit container terminal capacity in the Port of Vancouver to 2.2 million TEU as shown below:

Vanterm	600,000
Centerm	700,000
Deltaport	900,000
Total	2,200,000 TEU

Under the "base case" forecast, Port of Vancouver terminals will reach full capacity by early 2008.

The Port of Vancouver's long-term success as a container port depends on its continued ability to provide terminal and inland transportation facilities that meet customer needs. In recent years, the Port's strong competitive position has allowed it to capture almost all of the Canadian market as well as a share of container traffic moving from Asia to the United States. This could change if VPA adopted a "do nothing" strategy.

If VPA fails to expand capacity in time to meet customer needs, customers will move to another port and with them will go the BC/Canada economic and employment benefits. Canadian traffic that was recaptured over the last five years will be diverted back to US ports with capacity, and any business that is lost will be very difficult to get back if Port of Vancouver capacity does expand in the future.

Finally, the “do nothing” alternative is inconsistent with VPA’s mandate to facilitate and expand the movement of cargo and passengers through the Port of Vancouver in the best interests of Canadians. The “do nothing” alternative is not a viable option as long as the container expansion program can be done without having a significant negative residual impact on the environment or community.

3.3.3 Increase Production of Existing Terminals without Site Expansion

The second alternative VPA considered was to increase the production of existing terminals without expanding the terminal areas. In fact, this was the first priority for VPA’s container expansion strategy.

Container terminals have four major components that determine capacity including the berth, container storage yard, rail yard and truck gate. The overall capacity of the terminal is governed by the component with the lowest capacity.

The first production enhancement option VPA considered was at Vanterm and Centerm. For Vanterm and Centerm, the container and rail yards were the limiting components for capacity. Projects for both terminals were designed to improve the capacity of these components to match the capacity of other components thereby increasing the overall terminal capacity without increasing the size of the terminal. Deltaport’s capacity is limited by the berth and container storage yard. Increasing the capacity of any other component will not affect the overall terminal capacity unless a third berth is also added with additional container storage yard area.

With the redevelopment of Vanterm and Centerm, all three terminals in the Port of Vancouver will operate at the highest level of production that can be achieved within the current terminal area. Each terminal will operate with RTG cranes in the container storage yard that can load/unload containers stacked in rows seven wide and four high. The rail yards will operate with RMG cranes that load/unload rail cars and store containers adjacent to the tracks with maximum efficiency.

The proposed Lynnterm project is the second production enhancement option VPA considered in order to achieve maximum utilization of existing facilities before expanding terminal areas. Lynnterm is currently operating as a forest products terminal but not achieving its full potential. VPA and the terminal operator have prepared a phased development plan to convert operations from forest products to containers. However, the project has been delayed to approximately 2010 while efforts are underway to find an alternative facility for the forest products.

Maximum utilization of existing terminal facilities without site expansion, including the proposed Lynnterm project, will limit container terminal capacity in the Port of Vancouver to 3 million TEU as shown below:

Vanterm	600,000
Centerm	700,000
Deltaport	900,000
Lynnterm	800,000
Total	3,000,000 TEU

Under the “base case” forecast, Port of Vancouver terminals will reach full capacity in early 2008 and be restricted to 2.2 million TEU until Lynnterm is converted to container operations in 2010. The four terminals will then have capacity to grow for another four years and will reach full capacity again in 2014. The Port of Vancouver will lose approximately 400,000 TEU of potential business between 2008 and 2010 and will be restricted to a maximum of 3 million TEU after 2014.

Production improvements alone will not provide enough capacity to serve the “base case” traffic forecast for the Port of Vancouver

Recognizing that both the Deltaport Third Berth and Terminal 2 projects are required in addition to production improvements at existing terminals, VPA also planned both of these projects with maximum production capability. For example, Terminal 2’s container storage yard is planned to operate using automated RMG's together with equipment automation instead of manual RTG's. This will enable the terminal operator to minimize the size of the terminal by stacking containers in rows up to ten wide and five high. Terminal 2 is the best candidate for this operation because of its rectangular configuration.

The terminal improvements discussed in this section will enable Port of Vancouver terminals to achieve production levels comparable to the most efficient terminals in North America. The following table provides a summary of terminal capacity and production (measured in TEU/terminal ha) for the Port of Vancouver. By comparison, most North American terminals operate at 7,400 – 9,900 TEU per ha (3,000 - 4,000 TEU per acre) with the top terminals operating at 13,600 – 16,000 TEU per ha (5,500 – 6,500 TEU per acre).

Table 3.7 Port of Vancouver Terminal Capacity and Productivity

Terminal	Current			Expansion		
	Size (ha)	Capacity (TEU)	Productivity (TEU/ha)	Size (ha)	Capacity (TEU)	Productivity (TEU/ha)
Centerm	27	340,000	12,600	27	700,000	25,900
Deltaport	65	900,000	13,900	85	1,300,000	15,300
Vanterm	31	435,000	14,000	31	600,000	19,400
Lynnterm				61	800,000	13,100
Terminal 2				89	1,900,000	21,300
Total	122	1,675,000	13,700	293	5,300,000	18,100

3.3.4 Develop Terminals at Other Sites in the Port of Vancouver

The third alternative VPA considered in preparing its container expansion strategy was development of terminals on other sites in the Port of Vancouver. VPA has authority to plan and develop terminal facilities within three geographic regions of the port including Burrard Inlet between the First and Second Narrows, east of the Second Narrows and Roberts Bank.

On the North Shore of Burrard Inlet, between the First and Second Narrows, there are no vacant sites on which to develop a container terminal. The only opportunity to develop container capacity on the North Shore is to redevelop the existing Lynnterm Forest Products Terminal that is currently underutilized. A Lynnterm redevelopment plan has been prepared and the project is included in VPA's container expansion strategy. There are no other underutilized terminals on the North Shore.

On the South Shore of Burrard Inlet there are no vacant sites or practical options to expand the Centerm or Vanterm terminals. Options to expand the terminal area of Centerm and Vanterm were considered. However, both terminals are constrained by other terminal facilities that cannot be relocated.

Terminal development east of the Second Narrows Bridge (Iron Workers Memorial Bridge) was also considered. However, there are no potential development sites on either the north or south shores east of the Second Narrows and significant tide currents through the Narrows restricts shipping movements to periods of slack tide each day.

3.3.5 Other Canadian West Coast Container Terminal Expansion Projects

Fraser River

The Fraser River Port Authority recently announced its plans to expand container facilities at Fraser Surrey Docks to meet the growing demand (Vancouver Sun March 12, 2004). The expansion plans include two new ship-to-shore gantry cranes, a new streamlined truck gate, a 7.5 ha intermodal yard, infrastructure improvements and a 2.8 km extension from rail holding yard. These improvements will increase the existing capacity of the 300,000 TEUs to approximately 400,000 TEUs by 2005 and up to 600,000 TEUs by 2010.

VPA containers growth forecast for the Vancouver Port Area indicated that there is an opportunity for Fraser Surrey Docks to grow to 700,000 TEU by 2020. Further growth is somewhat limited to due to the relatively shallow berth depth of the facility and the Fraser River shipping channel (11.5 metres). The depth limits the container vessels calling on the Fraser River Port to Panamax sized vessels, leaving a demand in the Vancouver area for container terminal facilities able to handle post-Panamax sized vessels.

Prince Rupert

The Port of Prince Rupert is planning the development of a new container terminal to be in operation in late 2005 (Vancouver Sun, July 27, 2004). The Prince Rupert terminal will be operated by Maher Terminals Inc. and will have an initial capacity of approximately 550,000 TEUs. The terminal could be expanded to a total capacity of 1.2 million TEUs that would involve filling the seabed to create a total site area of 60 hectares (150 acres).

VPAs container growth forecast for the Vancouver Port Area did not include the Port of Prince Rupert, however, on-going congestion in the ports of Los Angeles and Long Beach indicates that there is an opportunity for the Port of Prince Rupert to attract even more business to the Pacific North West than previously forecasted.

The Port of Prince Rupert has some potential advantages as a container terminal as the shortest sea route between Asia and North America. Rail access is supplied by CN Rail's North Line, which feeds into the international CN network reaching directly into the US Midwest. As a result, the Port of Prince Rupert is positioned to serve eastern Canada and US Midwest business.

Based on the projected container forecasts, the Canadian container industry will require all of the terminal initiatives proposed by the Vancouver, Fraser River, and Prince Rupert ports. This conclusion is also supported by recent information published by the province in the B.C. Ports Competitive Profile (September 2004) for development of the B.C. Ports Strategy to be issued in early 2005.

3.3.6 "Alternatives To" Conclusion and Site Selection

VPAs container expansion strategy proposes five projects to increase the Port of Vancouver's container capacity from 1.7 million TEU to 5.3 million TEU, an increase of 3.6 million TEU. Projects are proposed for the north and south shore of Burrard Inlet as well as Roberts Bank. All of the proposed projects are required to facilitate the forecasted container traffic of 4.6 million TEU by 2020.

Roberts Bank is the best location to expand an existing container terminal in the Port of Vancouver. The site has the required water depth to handle post-Panamax sized vessels as well as the road and rail network to handle additional inland transportation. There are no other practical alternatives in the Port of Vancouver that meet the requirements for the proposed Project.

As noted previously, expansion and construction of other container terminals on the west coast of BC, particularly the Port of Prince Rupert, will most likely increase BC Ports share of West Coast container traffic rather than taking traffic away from Vancouver Port or Fraser Port.

3.4 ALTERNATIVE MEANS OF CARRYING OUT THE PROJECT AT ROBERTS BANK

Alternative means for carrying out the Project at Roberts Bank were considered. The process for determining the preferred project location and footprint at Roberts Bank is presented in the following sections.

3.4.1 Planning Criteria

The location and footprint configuration of the Project at Roberts Bank started with the following planning criteria for the expansion.

It was determined that the vessel berth required access to a ship channel and turning basin with a minimum depth requirement of approximately 16 metres. This depth would allow for "post-Panamax" sized vessels.

The terminal wharf should meet the following criteria:

- Consist of 427 metres (1400 feet) long;
- connected to the existing wharf;
- allow for provision for a tug basin; and
- provide a minimum width of 55 metres (180 feet) for container handling adjacent to the wharf.

The container yard should be a minimum of 32 hectares (80 acres) to support container terminal operations, be adjacent to the wharf, and be integrated with the existing Deltaport container storage yard.

3.4.2 Site Options

Based on the above planning criteria, the VPA developed three conceptual plans showing potential Project site selection at Roberts Bank. All of these plans showed the main container yard area located north of the existing Deltaport terminal and on the east side of the causeway. However, the plans differed in the location of the wharf. The three concept plans are described as:

- Option 1: Wharf Adjacent;
- Option 2: Wharf at Westshore; and
- Option 3: Wharf Perpendicular

Each of the Deltaport Third Berth options was evaluated using criteria such as: marine habitat, coastal seabirds and waterfowl, socio-community and First Nations, terminal operations, coastal geomorphology and development cost in determining the preferred site footprint.

The goal was to select a design for an operationally efficient container expansion footprint that took into consideration the environment, community and First Nations concerns, and development issues, whether they were cost related or location related.

Option 1 (Wharf Adjacent)

Option 1 consists of construction of a wharf to accommodate the additional berth adjacent to approximately 32 hectares (80 acres) of land for the expanded container storage yard (**Figure 3.9**). Option 1 would require dredging to lengthen the existing ship channel, deepening the turning basin and the creation of a tug moorage area adjacent to the terminal.

Option 1 is preferred from a terminal operations perspective as it provides the greatest operational efficiency for container handling and storage at Deltaport. However, Option 1 has a relatively larger impact on the marine environment due to the location of the 32 hectares of fill and the additional impact of the tug basin to be located behind the berth. Some of the marine habitats that would be impacted or lost due to the construction of Option 1 are the native eel grass beds, a crab nursery area and shorebird/waterfowl habitat use.

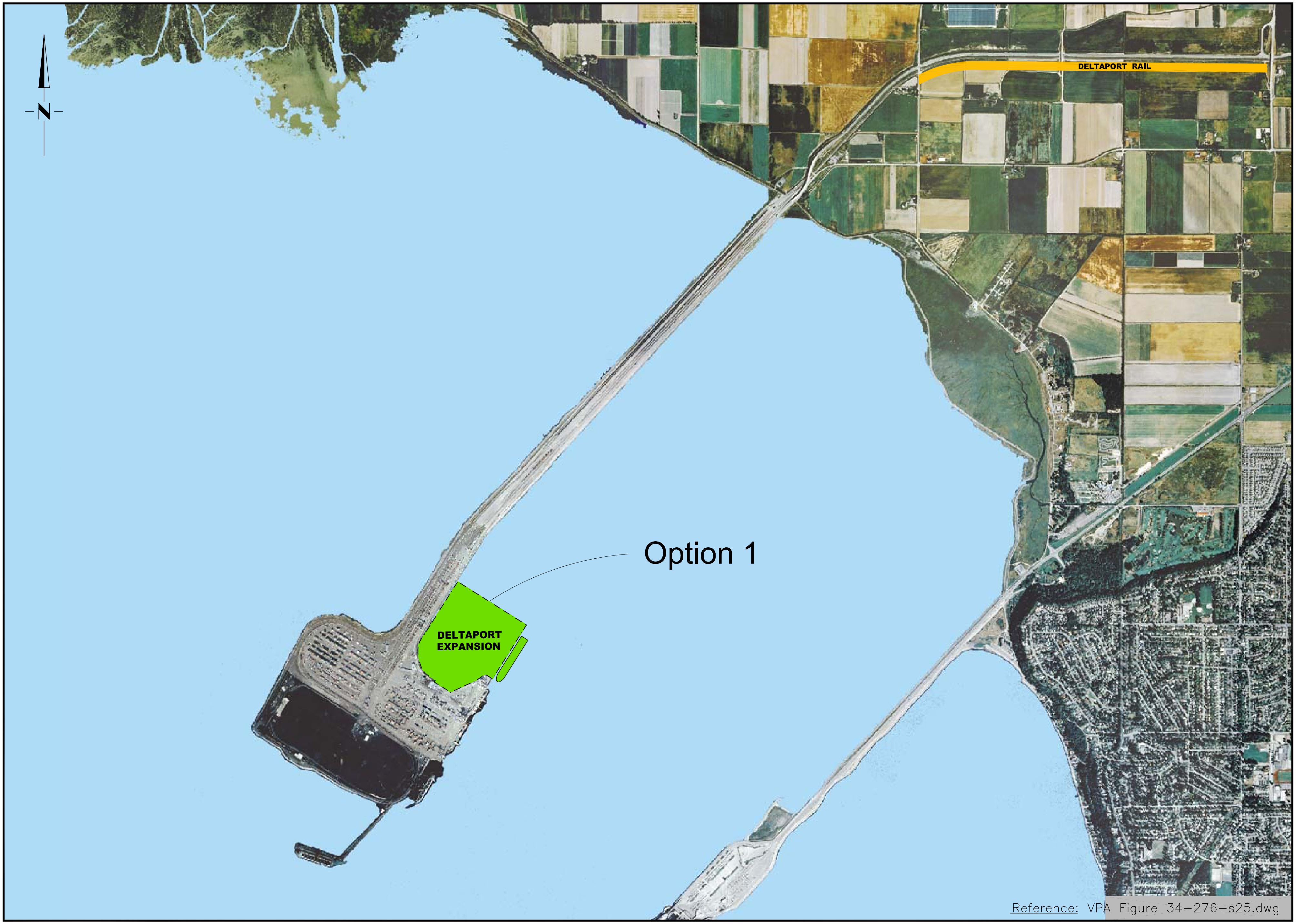

Figure 3.9 - Option 1 Wharf Adjacent

Option 2 (Wharf at Westshore)

Option 2 consists of construction of the new container wharf at the present location of Westshore's Berth 2 loading facilities (**Figure 3.10**). The Westshore Berth 2 coal loading facilities would then have to be relocated into deeper water in line with Westshore's existing Berth 1 loading facility. The land required for the expanded container yard would still be approximately 32 hectares (80 acres) of land but for this option the container storage yard would now be spatially removed from the new berth. Option 2 would not require the dredging to lengthen the existing ship channel but a tug moorage area would still be required adjacent to the container terminal.

Option 2 does not provide for efficient container terminal operations. The operation area behind the berth would be inadequate and the new berth would be removed from the container storage area adding time for shuttle carriers to transit containers to the dockside. In addition to increasing operating costs this would also result in an increase in vehicle emissions to the air from the terminal. There is also a significant disruption to Westshore's coal handling facilities with this option due to the requirement to relocate the coal loading facilities. Option 2 has similar impacts on the marine environment as Option 1 due to the location of the fill and the required tug basin, and there may be potential impacts to consider for the relocated coal berth. Option 2 would require more marine construction than Option 1. In addition, as a VPA business consideration, Westshore has a long-term lease with the VPA for its Roberts Bank coal handling facility.

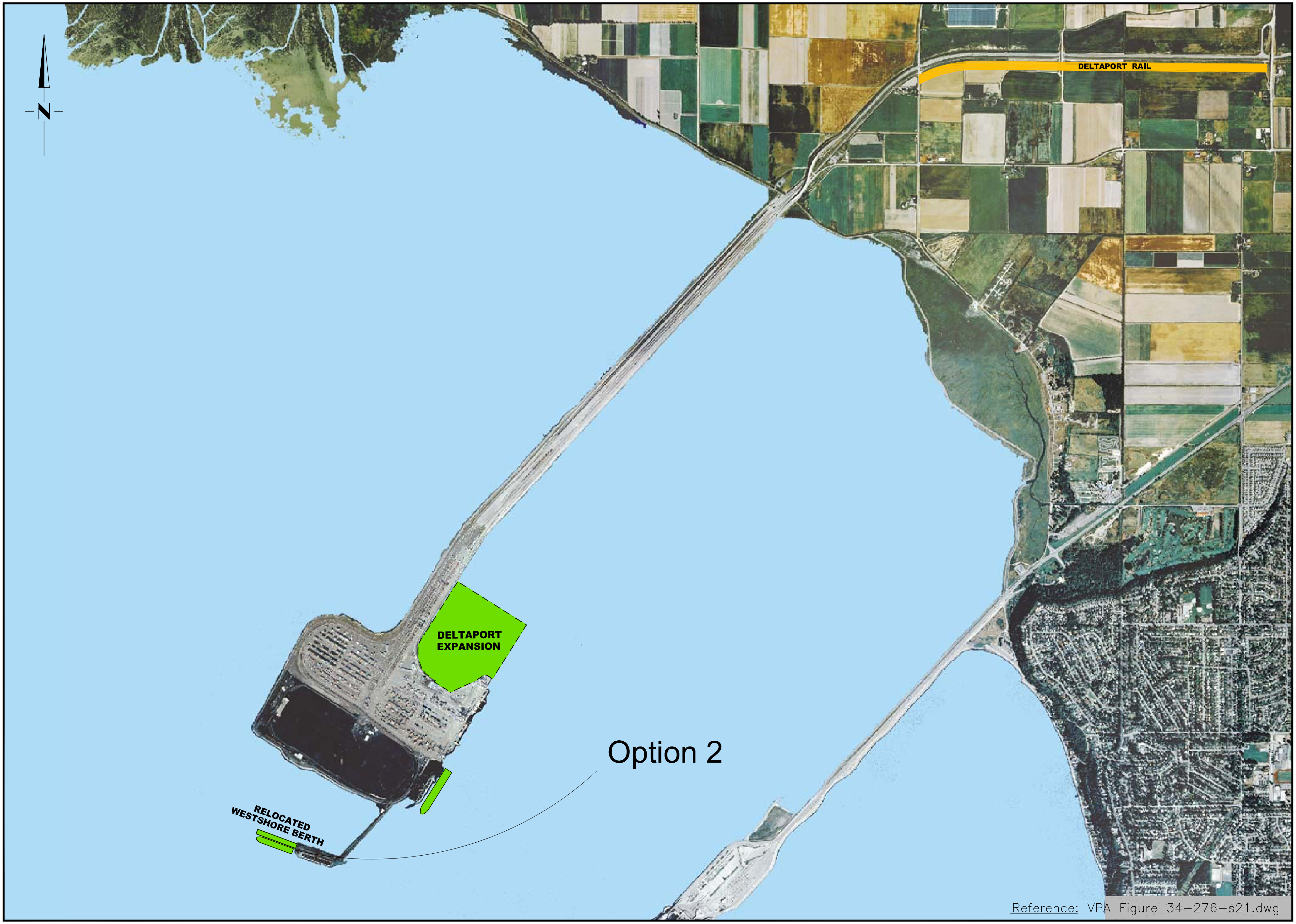

Figure 3.10 - Option 2 Wharf at Westshore

Option 3 (Wharf Perpendicular)

Option 3 consists of construction of a wharf perpendicular to the existing Deltaport (**Figure 3.11**). The land area required to support the expanded container handling facilities would still be approximately 32 hectares (80 acres) but some of the land area would be placed behind the proposed perpendicular berth. Option 3 would require dredging to expand the existing ship channel, the turning basin would have to be widened and the tug moorage area would still have to be adjacent to the terminal.

Option 3 reduces the terminal footprint impacts on sensitive marine habitats located along the causeway. However, the extension of the new berth towards the BC Ferries Causeway reduces tidal flushing and potentially creates geomorphologic impacts. The Option 3 berth location also has potentially greater visual and noise impacts to local communities. From an operational perspective the perpendicular berth is a challenging configuration to operate as an integrated container terminal. The location of the perpendicular berth also orientates ships into the prevailing winds with increased wave exposure resulting in increased downtime for the terminal.

Figure 3.11 - Option 3 Wharf Perpendicular

3.4.3 Preferred Site Option - Option 1 Revised

VPA's February 24, 2003 Letter of Intent to Initiate Pre-application Review for Deltaport Third Berth describes the project as the construction of an additional berth at Deltaport and the creation of approximately 32 hectares (80 acres) of land for an expanded container yard area in the preferred location, Option 1 (Wharf Adjacent). Option 1 was the preferred expansion option for container terminal operations as it provided the greatest operational efficiency for container handling and storage at Deltaport. However, Option 1 was determined to have relatively more impact on the marine habitat than the other options, notably on the presence of an existing crab nursery and on eelgrass. Based on preliminary results of the study program, a review of the evaluation criteria, and consultation with the regulatory agencies, including DFO and CWS, the public and First Nations, VPA prepared a revised plan for the Project.

The revised plan consists of a reduced terminal footprint of approximately 20 hectares (50 acres), as shown on **Figure 3.12.** The reduced terminal footprint was achieved through inmproved terminal operations and as a result, the impact to valuable marine and coastal waterfowl habitats is minimized. The coastal geomorphology assessment (see **Chapter 7** *Coastal Geomorphology*) further indicated that an "embayment" shoreline configuration enhanced the tidal action and water exchange. While terrestrial habitat did not influence the options it indicated that where possible there is benefit in retaining, replacing or creating riparian vegetation along the shoreline to serve as a transition zone to the marine environment. The revised 20 hectare footprint is also further away from the shore than the original proposed 32 hectare footprint thereby reducing the potential impact to the neighbouring communities and First Nations.

Once the preferred option was selected by the project team, outreach discussions on option selection findings were held with First Nations, environmental agencies, and the community. Open Houses were held in June 2004 during which time the VPA presented initial results of project studies to date, presented the preferred option, and invited public input.

Figure 3.12 - Option 1 Revised

3.4.4 Alternative Means for Construction

The Deltaport Third Berth project (the Project) will consist of a 430 m long wharf structure to berth container ships and support ship-to-shore gantry cranes for loading operations. The Project includes the construction of approximately 20 hectares (50 acres) of new land area for container operations and storage. Two methods of construction for the wharf were considered for the Project. They include an east facing caisson structure or an east facing pile and deck structure. The following section describes each proposed construction method and provides a description of the environmental and engineering benefits and impacts.

Caisson Wharf Structure

Caissons are a chamber, usually of concrete but sometimes of wood or steel, used in the construction of foundations or wharves in or near a body of water. In situations in which the depth from ground level to the final dredged bottom is not excessive and the bottom is of good self-supporting qualities before or after densification, the wharf can be constructed of precast concrete caissons floated into position and sunk onto a prepared bed. The existing Deltaport Container Terminal wharf is constructed of caissons as are the wharf structures of the Vanterm, Centerm and Lynnterm terminals located in the Port of Vancouver's Inner Harbour. All of the terminal caissons have been constructed locally and this would be the case for the Project as well. For the Project, 15.5 m wide reinforced concrete caisson structures would be employed. The soils underlying the proposed caisson structure would require densification as described in **Section 2.7.2** *Soil Densification*.

Pile and Deck Wharf Structure

During the preliminary engineering assessment, a pile and deck structure was considered as an alternative means of construction for the wharf. Conceptually the pile and deck structure would consist of a pile-supported cast in place concrete deck measuring 427 m long by 65 m wide. The container yard fill area would extend out under the deck with rip rap at a 2.5:1 slope for a total width of deck and berm of approximately 100 metres. Preliminary engineering indicated that 890-610 millimetre diameter concrete piles and 89-1727 mm diameter steel piles would be required to support the cast in place concrete deck. These piles are not available locally.

Consideration was also given to construct all or a portion of the container yard area using a pile and deck structure. However, as the load bearing capacity requirements for the container storage and equipment are so great the size and number of piles would be large, effectively infilling the area under the deck with piles, and making it cost prohibitive for such a structure. The soils underlying the proposed pile supported structure and the fill area would still require the same level of densification as the caisson construction method.

A proposed pile and deck construction schedule would take longer to construct than the caisson construction method primarily due to the pile driving requirements. The pile driving schedule was estimated to take approximately 14 months to complete based on driving five piles per day over a 10 hour construction day.

Preferred Construction Means: Caisson Structure

The pile and deck structure was considered as an alternative means of construction to the caisson structure as it provided some water column space under the deck thereby reducing the amount of total area of marine habitat lost due to the Project. Further, the piles and the rip rap slope provide hard substrate for sessile intertidal and subtidal fish habitat.

However, the impact of the pile driver hammer on the piles will result in substantial noise energy propagation within the water column and at surface. During pile driving, the size and maximum operating energy level of the hammer, the size and length of the piles, soil conditions, water depth, bathymetry, salinity, and temperature will all affect the level of sound produced in the water column from the impact hammering. Although there will be attenuation of the noise energy due to a number of factors, the attenuation level is impossible to accurately predict. The National Marine Fisheries Service in the US (NMFS) considers that underwater sound pressure levels above 190 dB could cause temporary hearing impairment in harbor seals and sea lions and levels above 180 dB could cause temporary hearing impairment in whales. The effects of elevated sound pressure levels on marine mammals may include avoidance of an area, tissue rupture, hearing loss, disruption of echolocation, masking, habitat abandonment, aggression, pup/calf abandonment, and annoyance. The NMFS has established a safety zone of 180 dB for gray whales. If marine mammals are found within the safety zone, pile driving of the segment will be delayed until they move out of the area.

The noise impacts on fish are even less understood than the effects on marine mammals. The VPA first identified dangers to fish as a result of pile driving at the Canada Place pier extension project in 2000. Overpressure shock waves were recorded that ruptured the swim bladders and organs of fish in the immediate area of pile driving operations. The VPA, as part of the Canada Place Environmental Monitoring Program, worked with the contractor and the Department of Fisheries and Oceans Canada to develop mitigation measures to address this impact. Successful construction mitigation, in the form of bubble curtains placed around the pile to attenuate the pressure waves from the pile driving, is now commonly used in British Columbia as mitigation methods. This mitigation method does slow down pile driving operations and may result in an even longer period of pile driving activity.

In addition to the impacts on the marine mammals and fish due to pile driving, the sound energy generated by pile driving also has the potential to impact the numerous migratory bird using the Roberts Bank area. Although the pile driving impacts are only related to construction, the duration of time required for placement of piles will require at least one full season thereby impacting on migratory populations stopping at Roberts Bank as they are headed to and from their nesting grounds. The impacts on these migratory populations are unknown although it is anticipated that resident bird populations would acclimate to the construction noise.

The pile driving noise also represents a potential acoustical impact on the residents in the adjacent communities of Tsawassen, Ladner and the Tsawassen First Nation.

From an engineering perspective, the pile and deck structure will cost slightly more that the caisson method, take longer to construct and use less locally available materials.

The environmental benefits of the caisson construction method are that there are less intrusive acoustic impacts on marine mammals, fish, migratory and coastal seabirds and on the surrounding communities during construction. The caisson construction method can also be completed in a shorter period of time than the pile and deck method reducing the temporal disturbance to the environment during construction. The caisson structure does result in slightly more loss of water column and fish habitat compared to the pile and deck option but the habitat impacts of the caisson structure can be fully mitigated and will comply with DFO's National

Policy of “no net loss” of productive fish habitat as described in more detail in **Chapter 10** *Marine Environment* and **Chapter 21** *Environmental Management Program*.

The engineering benefits of the caisson construction method include the shorter construction period necessary for project completion thus bringing the Project on sooner for market and for slightly less cost. Caissons are also preferred as a construction medium as they can be constructed in British Columbia with locally available materials. The caisson structure is also favoured to the pile and deck method for seismic resiliency. If a seismic event were to occur both structures would survive but the caisson structure could more easily repaired where as the pile and deck structure may require demolition and replacement.

Based on the environmental and engineering benefits and impacts the caisson construction method was selected as the preferred wharf structure.

3.5 PROJECT CONSTRAINTS

There are no significant development constraints faced by the project such as energy sources, major physical barriers, or distance constraints.