THE URBAN GROWTH AND TRANSPORTATION IMPLICATIONS
IN PORT DEVELOPMENT: A CASE STUDY,
VANCOUVER, BRITISH COLUMBIA

by

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We accept this thesis as conforming to the
required standard

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____________________________
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Preface

This study, unlike most, is the work of two authors. Their individual contribution has resulted in a comprehensive presentation of Port Development in an urban situation. Many of the ideas presented throughout the study are jointly derived, specifically the writing of the introductory and concluding chapters, (I and VII). Chapters III, IV and VI were primarily written by Peter Tassie and Chapters II and V and Appendix IX by Neil Griggs.
Abstract

While most research on Port Planning in the past has focused on the marine and rail aspects, this study examines the urban influence on port development. It is a case study of a portion of the waterfront of the Port of Vancouver, British Columbia, Canada, which lies adjacent to a metropolitan area of 1,000,000 persons.

A survey was carried out on all the waterfront users to determine origins, destinations and volumes of cargo handled, frequency of service calls, employment and space requirement, site and plant characteristics, and mode and frequency of transportation. A second survey on a major cargo terminal was completed to determine the origin and destination of truck trips, and the length of time spent at the waterfront. A third survey sampled 25% of the 350 marine service industries as part of an economic impact study of the port.

The conclusions reached are as follows:

1. The volume shipped through the Port of Vancouver will double during the next decade. As the 1968 capacity of the port was barely adequate to handle the existing flows a twofold expansion of facilities is necessary if the projected flows are to be accommodated.

2. Space to accommodate shipping operations of these proportions is not available without either land reclamation or major disruption of adjoining urban sites. Within the waterfront, 50% of the waterfront users indicate a need within five years to increase their sites for a total of 84 acres.
3. Congestion on the urban street system increased the cost of trucking from a general cargo terminal by 27%.

4. The unproductive time of trucks delayed at one general cargo terminal amounted to $750,000 annually.

5. The present switching methods and arrangements of the railway lines impose delivery delays and increase costs, amounting to about $400,000 annually.

6. Cargoes and waterfront products have few direct links with the city. Only 0.6% of the port's exports originate from the city and 10% of its imports are destined for the city.

7. An urban location for the port is no longer necessary due to the change in cargo flows and service links. Eighty-five per cent of the major port service sector indicate they would remain in the city should the entire port operations be moved south, 18 miles, to Roberts Bank.

8. The urban growth has resulted in one-third of the port waterfront being used for non-port functions. In addition, three-quarters of the port interface is being redeveloped with urban renewal and residential projects, which is effectively preventing port expansion in this direction.

9. Management of the port is impeded, in that no single agency exercises jurisdiction over port lands, to provide coordinated planning.

10. The variation in downtown land values are reflected in similar variations in waterfront assessments, irrespective of the waterfront function, or its trade and service links.

This study found that the conflict between the shipping activity and the adjoining urban area is a significant impediment to the present operation and future development of the Port of Vancouver.
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CHAPTER I

THE PROBLEM AND ITS SIGNIFICANCE

A. STATEMENT OF THE PROBLEM

The ship was cheered, the harbour cleared,
Merrily did we drop
Below the kirk, below the hill,
Below the lighthouse top.¹

The scene that Samuel Coleridge described one hundred years ago is a far cry from the harbour activity of today, with its unit trains, super tankers, mammoth elevators, container terminals and the never ending stream of vehicle traffic. Yesterday they cheered ships out of ports and today we cheer astronauts into space, and in the midst of this progress a trucking manager bitterly comments,

It takes longer to collect a shipment from the Vancouver waterfront, than it does to orbit a man around the earth.²

The unceasing demand for space has seldom been more succinctly illustrated than in the case of harbour lands adjoining metropolitan areas. Operating within this area are the traditional and accepted shipping activities involving the transshipment of goods between land


²Interview with Mr. M. Brink, President, Johnston Terminals Ltd., Vancouver, British Columbia, November 21, 1969.
and water transport, and requiring extensive facilities and space. Competing for the same land is a more aggressive opponent, the urban land user, whose needs stem from the expanding central city business districts and their demands for increased space. The conflict between these opposing forces has become apparent in the years following World War II, but has received greater emphasis in the past decade, as pressures from all sides have increased, and as the "squeeze play" has become tangible and formidable.

It would appear that most world ports are caught in the middle of two apparently conflicting developments. On one hand international trade is increasing rapidly, resulting in greater port activity, thus requiring additional port facilities, space and accessibility. On the other hand the greatest concentration of populations are in coastal cities, and in Canada for example, the three largest cities predicted to experience the greatest growth are port cities. These are Toronto, Montreal and Vancouver, the latter two being the nation's two major ports. Thus the process of urbanization, which often results in greater congestion, conflicts with the needs of developing port areas. One response to this is the building of new ports outside urban core areas. For example in Europe this has happened at EUROPORT, near Antwerp, MEDAPORT, near Marseilles, PORT TALBOT (South Wales) and TILBURY near London, and in Canada at CANPORT 6 miles southwest of Saint John, New Brunswick, and ROBERTS BANK 30 miles south of Vancouver, British Columbia.
From these observations it would appear that if indeed there is a problem, it would be an urban one, to be resolved by those in the immediate area. This conclusion however would be a misconception, due to the misunderstanding of the true function of a port. Port cargoes are generated at some distance from the port itself, thus any change in trade policies, cargo types, sizes, frequency, etc. could have significant effects at the port itself in terms of handling time, cost, scheduling, storage, etc. Therefore regional, national and international interests should be considered when discussing port planning. For this reason some mention is now made of the interdependency of a local port to all its regions. The purpose of this is to present an overview of a port's function at each of these regions and finally to focus at the urban region which it is believed is a critical one in the entire trade system.

(1) International

Complex physical, economic, political and human factors affect the origin and evolution of a port. Perhaps the two most influential at the international level have been, (i) the changes in the world patterns of trade, and (ii) the changes in the transportation industry itself.

(i) The Industrial Revolution in Europe brought about vast changes in human activity and from the viewpoint of port activity similar changes also occurred. The Industrial Revolution's greatest impact was in northwestern Europe, thus creating a vast new market for
raw materials. As a result the English Channel and North Sea ports became the chief terminals connecting Europe with other continents, and a port such as Bordeaux found itself in the backwater of ocean transport. Similarly the Mediterranean ports lost commerce in the 15th Century after the discovery of the route to Asia around the Cape of Good Hope. However they were rejuvenated later with the opening of the Suez Canal. Cargo carried on the St. Lawrence-Great Lakes system, which in effect opened new markets to world shipping, increased five-fold during the first decade of the Seaway's operation. These are a few examples of developments that have opened new markets and of changes in human activity patterns and densities that have affected port activity.

Vancouver faces a similar potential for changes in port activity simply from its geographic position in the Pacific rim, where population changes are occurring at the fastest rate on this earth. The emergence of the Pacific Rim trading area, corresponding to the immense industrial growth and food demands of the Asian countries, has stimulated additional trade in the Pacific, and particularly between North America and Japan, China and the U.S.S.R. (Union of Soviet Socialist

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4Ibid., p. 367.

Republics). With the projections for rapidly increasing world populations in the underdeveloped continents, and with the tremendous emphasis being placed upon improvement in educational and living standards, the prospects for increased international trade remain optimistic, if not ensured, barring a major calamity. Figure 1 shows the Far East as having a population of nearly two billion in 1970, which will have doubled within 30 years to comprise 60% of the world's population. When one considers that two-thirds of all the trade through the Port of Vancouver is within this area, one can appreciate the staggering future potential.

(ii) Paralleling these changes in human activity are revolutionary changes in international marine transportation. Many of these marine changes have come about as a result of the high cost of transshipment at the port. Transshipment costs are often 50% of the total costs of shipping between two ports. 6,7,8 Shippers are attempting to reduce these port costs by developing economies of scale through reducing total handling costs in the use of unit trains, pipelines for solids, containerization, pallet boards, roll-on/roll-off operations and the LASH system. 9 All these have essentially been introduced in


9 Each of these are discussed in detail in Chapter III.
Projected growth of Population
1960-2000, by regions

Source: FAO monthly bulletin of Agricultural Economics and Statistics, July/August 1965
the past decade. The most recent development appeared in the *Vancouver Sun*, January 14th, 1970, in which Cascade Pipe Line Limited\(^{10}\) are applying to build a pipeline from Fernie (a community in the southeast corner of British Columbia near the Alberta border) to Roberts Bank, for transporting coal.

Other economies of scale are currently being gained through increasing shipping cargo capacity. Only twenty years ago a 28,000 ton dead weight (d.w.t.) tanker was described as a "super tanker". To-day the largest ship, an oil tanker, is rated at 326,600 d.w.t., 79 foot draught and 1,135 feet in length. On the drawing boards there are, however, larger tankers of 750,000 d.w.t. To-day crude oil is the only product that is being shipped in large quantities in such a manner (1,000 million tons annually). However, other products such as iron ore, presently being carried in 95,000 ton-size vessels, grain, coal, bauxite, phosphates and even containerized cargoes, could well be handled in the larger vessels. The volume of goods now becomes the critical factor to sustain the use of super-vessels, and Vancouver could well qualify in supplying the needed volumes: (1) because of the area's vast mineral and grain resources, and (2) because it is the only sizeable west coast terminal serving the entire nation and (3) Canada could be a land bridge for goods moving from Asia to Europe and vice versa, with Vancouver being the western terminal. A simple example illustrates these economies in scale. If one takes an 18,000

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ton ship which requires about 10,000 h.p. and double its length, width and depth, the result is approximately a 200,000 ton vessel. This ship does not require double the engine capacity or double the cost. The larger vessels operate with approximately the same number of crew, a 32,000 h.p. engine and cost less per ton to build, i.e., $75.00 a ton compared to $300.00 a ton for the 18,000 ton vessel.\footnote{F. C. Leighton, \textit{Economic Forces Behind the Roberts Bank Super Port Development}, paper presented at the annual meeting of the Association of Professional Engineers of B.C., Vancouver, December 6, 1968.}

It would appear therefore, with the potential reduction in transportation costs coupled with the rapidly rising world populations and urban agglomerations, that international trade can well expect some unprecedented growth. World sea-borne trade which exists to meet the needs of the current population of 3,500 million, amounts to 1,800 million tons. If predictions for the year 2000 are accepted then the sea-borne trade should double in the next 30 years to meet the needs of a world population of 6,300 million.\footnote{Stanley Johnson, \textit{op. cit.}, p. 7.} This increase of sea-borne trade will not result in a paralleled increase in shipping traffic as demonstrated by Figure 2. Here it is seen that vessel arrivals are declining while total cargo tonnage is increasing. However, this increase in trade will result in increased rail and truck activity. As most port cargo is destined for points outside the urban area, and because of the expected increase in rail and truck traffic, improvements will undoubtedly be required to improve port congestion and port access.
Canadian Shipping Activity

INTERNATIONAL SEABORNE SHIPPING ONLY

As future countries emerge from their colonial status to political independence, their growth and economic development becomes increasingly dependent upon International trade. Many countries are in this state of development and all face the same problem of future port efficiency and flexibility. Port planning and redevelopment is expensive and requires knowledgeable techniques in engineering and planning. This has been recognized by a number of International Agencies who have taken steps to meet these critical needs. Organizations such as the United Nations, The Colombo Plan, The Canadian and American International Development Agencies, The International Bank for Reconstruction and Development, and The International Association of Ports and Harbours, have contributed both money and personnel to assist in this international problem.

(2) National

All of these indications for increased international trade are of relevance only to those participating countries. Individually a nation's involvement in international commerce is a matter of government policy, formulated at the national level, and with national considerations at stake. In this formulation are involved not only the import demands of the nation, as well as the surplus goods, but also the encouragement that should be given to internal producers. The resulting policy is expressed in tariff regulations, quota restrictions and other measures designed to influence the volume of commodities crossing the national boundaries, and in turn affect a port's activity. For example wheat exports from Russia were stopped after the Bolshevik revolution
and the port and city of Odessa lost its principle function. With
the loss of this activity the port city ceased to grow and in fact
stagnated. The historic growth of Marseilles can be linked to both
economic and political factors. French colonial policy of the 19th
and 20th century was directed at Algeria, and Marseilles was the
direct link through which all traffic passed. Similarly New York
benefited through the early years of American colonization, as did
San Francisco, and Victoria in Canada.

Policy decisions of governments to achieve self-sufficiency in
certain important products may curtail port activity in the country
as well as the supply countries. A further example of the United
States not recognizing Red China or Cuba, has had a direct effect on
the activity of the affected ports—whereas Canada's attitude, though
more vague, allows for trade and hence Vancouver has substantial trade
links with Red China.

Preferential freight rates can directly influence the local
economy of a port city. The United States Interstate Commerce Act,
Section 22, allows railways special rates for government shipments.
This allows the railways to discriminate against the Great Lake ports,
by shipping directly to the Atlantic ports. Naturally they continue

13 C.D. Harris, "The Cities of the Soviet Union," Geographical

14 Guido G. Weigend, op. cit., p. 368.

15 Neil J. Griggs, The History of Planning in Victoria, unpublished
paper, School of Community and Regional Planning, The University of
to do this as Great Lakes–overseas shipping operations are a direct competitor to the railway lines that carry traffic from the Great Lakes area to the Atlantic Coast ports. Thus coastal cities receive a heavier volume of traffic resulting from preferential rates.

Government decisions for defense cargo movements or international aid or emergency programs can similarly stimulate a port's activity. However, governmental decisions on international aid could well be thwarted or made less effective, if the ports concerned in either country were operating at capacity or extreme inefficiency.

A fundamental need in all international trade is an efficient transportation network, providing facilities for the distribution of goods within the country, and externally, as well as for the transshipment of goods from one mode to another at break-bulk points. These points, the ports, are key connections in the total transportation process, and account for a significant, but variable proportion of the total costs. While line haul costs are generally consistent for any mode, the port costs and port efficiency are highly variable, and are components of the total cost upon which volume of trade and economic growth are dependent.

3. Provincial

For the purposes of this paper the Provinces are used as the next level of influence below the National and yet larger than the Municipal

or Metropolitan area. This division is of course arbitrary and would be different for each port. For Vancouver this provincial hinterland would include the Prairie Provinces, the Northwest Territories and British Columbia. Although the provincial boundaries are frequently inconsistent in terms of the present-day city and hinterland concept, they are nevertheless established and afford a framework for administration and control.

A significant regional influence on the ports is in terms of its geographic location as well as its hinterland. One example of this is Montreal whose hinterland in winter is only the town itself, whereas in summer it is the entire Great Lakes area, and to a lesser degree the entire nation. Canport near Saint John, New Brunswick, will have the nation as its hinterland in winter which will result in heavy port activity. However, during the summer months it could lose much of this to the St. Lawrence and Great Lake ports.17

The development of a port's hinterland in terms of efficient and rapid transportation is of great importance. An example of several raw materials shipped to Japan in the 1960's through Vancouver and its hinterland, shows the extremely high transportation element. In the case of wheat and sulphur, roughly 25% of the end price of the produce is due to transportation, for potash, this is 30% and in the case of coal this is a phenomenal 60%.18 Thus even minor improvements

18 F. C. Leighton, op. cit.
in the region's transportation network could substantially reduce the delivered price of the commodity.

Finally, a developing and urbanizing region, such as the Lower Mainland of British Columbia, is in itself a market and creates some degree of activity simply to meet its own needs. The megalopolis sea ports of the eastern seaboard of the United States are a further example of a somewhat larger region's influence on port activity, in terms of local consumer demand.

While external trade policies are generally determined by the national government through the control of import and export licences, intra-provincial commerce comes under the control of individual provincial governments. In the aggregate, national policy is the cumulative expression of the constituent provinces, but provincial policy may conflict with or oppose that of the national government. At the port planning level the result is that provision must be made not only to accommodate commodities entering or leaving the country as a result of federal government policy, but also those flows staying within the province, such as coastal trade, which may be encouraged or rejected by provincial consideration.

4. Municipal

The final level to be examined is the local administrative area, usually a municipality. Here the administrative responsibility is primarily with matters of local concern, including provision of municipal services, planning, education, recreation, and public health.
The rationale for the incorporation of municipalities is their ability to deal with matters of local need at a local level and with locally elected representatives. The basic and major revenue source is the property tax, and the concern with land is at a more intimate level than with either of the two senior governments previously mentioned. Lately much concern has been directed toward the optimum allocation of lands and planning for future growth, and this feeling has resulted in the growth and influence of municipal planning departments. In the planning considerations of the municipalities much attention is directed toward the central business districts, whose origin is usually rooted in the location of the original transportation terminals.

Despite the growth of the suburban areas and the improvements in transportation, the attraction of the CBD, (Central Business District), and the need for a concentrated, intensively developed commercial core remains strong and vigorous, and is likely to continue.\(^{19}\) It is because of the persistence of this trend, and the need for concentration of a large business population within a small area, limited to the extent that personal contact within walking distance is prevalent, that many problems of cities have been emphasized. Of greater emphasis in North America, but not limited to this continent, the CBD is the stage where the problems of congestion, the inadequacies of dwindling public transportation, and the threats of

intolerable limits of pollutants all have become prominent. At the same time the attendant problems of the CBD have not served to curb the demand for expansion, and land prices have maintained and extended themselves in an insatiable manner.

The expansion has also caused the problems of pollution and congestion mentioned above, as well as originating the question of relocation of tenants displaced as residences have been razed. In the cases of waterfront cities, the CBD, usually located close to the water, has expanded in that direction. In this case the problems raised by commercial users encroaching or infringing upon waterfront lands are likely to restrict the efficiency of movement of goods through the waterfront area.

The threat of encroachment onto waterfront lands is a tangible one, inasmuch as the normal market conditions are operative, and the commercial bidder is able to offer a higher price than the waterfront user can match. Despite the existence of zoning by-laws, these have been shown countless times to be a mere facade, sensitive and susceptible to the market demands for a different use.

The critical influence that the local area has on the port is in terms of congestion. Inadequate planning along with uncoordinated efforts of harbour and city planning authorities could lead to ports being "choked to death". In addition to this are the changing site requirements of new terminals and berths which places higher demands for adjacent port lands to be used for port functions.
Engelmann \(^{20}\) indicates that 6 to 10 acres per berth is standard requirement today for general cargo berths. Statistics are as yet unavailable for average size of container terminals. However Long Beach, California, is building a 120 acre site container terminal committed to a single tenant. \(^{21}\) These figures indicate the need for larger site requirements for port operations. This problem is compounded if the port under study is adjacent to a highly developed and expanding central business district.

B. PURPOSE OF STUDY

In the introductory section of this chapter, the waterfront lands were introduced by describing the four levels of activity that had a bearing upon the use of these lands. Particular emphasis was placed upon the central business district, and the conflict introduced as CBD needs spilled over and encroached upon waterfront lands.

The separation of interest between the urban area, emphasized by the central business district, and the transportation and shipping interest on the waterfront, appears to be a natural division, inherent in the activities of the two interests. It would also appear to be a desirable division. The urban area is concerned with large volumes of people and high interaction and accessability amongst them. On the other hand the waterfront shipping area operates to move goods

\(^{20}\) Peter Engelmann, _op. cit._, pp. 1769-4.

\(^{21}\) _Vancouver Sun_, January 7, 1970, p. 32.
freely and quickly from one mode to another, with little interference.

The purpose of this study is to examine the port-urban inter-
face, particularly those sections where the urban influence is
sufficiently strong to appear to interfere with the port operation.
Prerequisite to the examination of the interface will be the tabulation
of data on site use and characteristics, and economic and transporta-
tion features. Analysis of the data includes a compilation of the
waterfront users, an estimate of the validity of their land use, and
the establishment of the presence of significant impediments to port
operations.

A summary of the purposes therefore is to examine:

(1) the existing port functions,
(2) the existing land requirements,
(3) the expected land requirements,
(4) the existing transportation facilities,
(5) future transportation facilities needed
   for the port operation,
(6) the existing urban development patterns,
(7) the expected future development
   patterns,
(8) the linkages between the port operation
   and other waterfront users with the
   urban area.
C. HYPOTHESIS

The port, essentially a junction between land and water transportation, is located where suitable land transport facilities may be combined with an adequate water site. As the essence of activity of the port is in transshipment of goods, equipment for conveyance from one mode to another must be provided, in addition to storage and service area.

Initial waterfront users were free to locate at sites along the harbour, unrestricted by a shortage of land, by high land prices, or by regulations governing site usage. The optimum sites were selected first, in which the location of the transportation routes, and resulting accessibility, was a prime consideration. The consequent emerging pattern of site use was a random distribution of waterfront users, which condition prevails today.

While the same open conditions applied to the remaining urban lands, the greater intensity of business, the higher land demands and the rapid turnover here operated to force some centralization of activities and separation of land use, which today are regulated by zoning by-laws.

In the development of both waterfront lands and the urban lands it would appear that the location of the first transportation routes and terminals was the prime determinant in the resulting growth pattern.

The purpose of this study, as previously stated, is to examine this waterfront area, in this case, part of the Vancouver harbour, to
evaluate the site characteristics and apparently unsystematic land uses. It would appear that this random growth has increased the cost of port activities and the shipping function. The following hypothesis is put forward:

The conflict between the shipping activity and the adjoining urban area in terms of interfering land uses, expanding shipping requirements, disarrangement of waterfront sites, congestion of transportation facilities, lack of available land, and administration is a significant impediment to the present operation and future development of the Port of Vancouver.

In order to test this hypothesis it is necessary to select an appropriate section of the Vancouver harbour, analyze its land use and value, and that of the urban counterpart, and derive information on transportation needs and interaction with adjoining business. The methods used to derive this information are explained in following parts of this chapter.

In the hypothesis six areas of conflict are specified, and these are dealt with in succeeding chapters. Expanding shipping requirements and congestion of transportation facilities are dealt with in Chapter IV, while interfering land uses, disarrangement of waterfront sites and lack of available land are covered in Chapter V. Lastly, administration forms the bulk of Chapter VI.
D. PLANNING APPLICATION

(1) International and Domestic

The focus of this thesis is at the local level, However as ports have local, national and international hinterlands, a comment will be made regarding the international applicability of planning. Such international organizations as the World Bank, and the F.A.O. (Food and Agricultural Organization) are vitally concerned with optimum returns of investments or international loans. Thus the success of a new cash crop or industrial program, say in India, will be influenced by efficient transportation, and if this is in terms of exports then these products will naturally pass through ports. As remarked earlier, generally 50% of the transportation costs occur in the port area in terms of transshipping costs. If these ports are unduly inefficient and congested then much of the benefit of these international aid programs is siphoned off at the ports. International aid aimed at increasing the efficiency of ports may well produce economies of scale throughout that nation in allowing competitive international prices for its goods and produce. F. C. Leighton, the vice-president of the engineering firm in charge of the Roberts Bank development suggests that the cost of shipping coal to Japan through the new port will be reduced from $10.50 to $7.00 per ton. He estimates that over the 15-year contract a total saving of $150,000,000 will be realized in transportation costs.22

In the same way that international agencies could be interested in port planning, National Governments too can have considerable influence through a systematic approach to port planning. Canport and Roberts Bank are examples of recent Canadian Government programs in port planning.

It is suggested that ports are sensitive to the two pressures of increasing trade and urbanization, and thus National Governments can direct programs at either aspect, hopefully to increase trade and decrease urban congestion. However, in a recent Canadian publication (Multiple Use of Transportation Corridors in Canada: Part II, 1969) it was suggested that the Federal Government, by contributing the finances for a second harbour crossing, are in fact contributing to increased congestion around the port's back land.\(^{23}\)

(2) **Provincial and Municipal**

The relevance of a study into the demands on waterfront lands may be justified on several counts. All of these reasons have an application in the planning process, to which this study is directed.

Firstly there has been no study made of the waterfront area that lists the various users, site requirements, employee characteristics, transportation needs, and other data. While some information is available in the City of Vancouver, or National Harbours Board, it is directed

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toward a more general use and does not include all of the above information.²⁴

Secondly, both under the City of Vancouver and the National Harbours Board there is no systematic allocation of waterfront land that considers the overall effect of the proposed tenant. Indeed, in an examination of a proposal to develop air rights over a railway right-of-way in downtown Vancouver, (Project 200), it was shown that the congestion and other resulting effects had received little consideration by municipal and provincial government officials.²⁵ Although most waterfront properties are smaller in area than the proposal in Project 200, the aggregate size and effect of all waterfront properties is much larger.

Lastly the proposal to study the waterfront lands and their urban counterparts is justified in national terms, in which it is in the national interest and need to maintain an efficient port operation. Such a need is particularly true along the Pacific Coast of Canada, where the number of suitable port sites is extremely limited. In addition the large investments in the present port warrants its continued use and efficient operation.


²⁵V. Setty Pendakur, et al., op. cit., p. 63.
E. STUDY AREA

In the Metropolitan Vancouver area, there are close to 330 miles of waterfront. The two Harbour Commissioners (Fraser River Harbour Commission and North Fraser Harbour Commissioners) control the 200 mile Fraser River section and the National Harbours Board control the remaining 130 miles from Point Atkinson in the north to Boundary Bay in the south, (see Figure 3). Time did not allow a complete survey, so an area was chosen that was both actively engaged in shipping and industry as well as being adjacent to the urban area.

The Inner Harbour of the Vancouver waterfront met these requirements and was selected as the study area, (see Figure 4). In addition this area was under one municipal authority and one harbour authority, which made data gathering an easier task. The western limit of this area, Cardero Street, was chosen because it marked the western extent of the railway trackage. Furthermore the area further west of Cardero was in a land use transition which would have resulted in data collection difficulties. The easterly extent was the Vancouver City limits at Boundary Road.

At the outset the study area was to be limited to waterfront users. However, as the area was investigated more comprehensively it was soon discernible that the right-of-way of the Canadian Pacific Railway formed a natural southern limit to the area, as this line effectively limited access to the waterfront, and constituted a barrier. In addition, assessment data of the City of Vancouver used this same limit in grouping records.
F. STUDY METHODOLOGY

The central issue postulated in this study hinges on the arrangement of waterfront land users and their transportation modes and commodity flows. The information required for the study was obtained from two major sources: published materials and questionnaires and interviews.

At the general level much introductory and background material was examined in textbooks and reports. This information dealt with transportation, with costs of congestion, estimates of level of service, and with generation of traffic by land use. Other texts on the economic approach considered business locations, the determination of rate of return as well as the whole aspect of location theory. At a more local level publications of the City of Vancouver Planning Department and of the National Harbours Board were also examined.

The second source was from a specially designed and tested questionnaire developed for waterfront operations. A list of waterfront businesses was compiled from various sources, the City Directory, The Ward Report on Waterfront land, and through personal observations in the area. Each business was sent a letter one week prior to the interview requesting their cooperation. A copy of this letter is in the Appendix. Each interview was conducted personally and usually lasted 35 to 45 minutes. In several instances the forms were left with the firms for a few days, if they requested this, in order to consult their records. The interviewing was completed in a two-week period,
and was conducted during general business hours. A copy of the questionnaire is in the Appendix.

The final source of information was obtained from personal interviews with waterfront users, planning and municipal officials, transportation company officials and Federal and Provincial Government agencies. Much of this information was obtained at the same time as the administration of the interviews while an additional amount was gathered through casual conversations with government, municipal and transportation officials. Lastly in some specific instances, interviews were arranged to inquire further into a question.

G. LIMITATIONS

The findings of this study are only applicable to the Port of Vancouver and specifically to the City of Vancouver portion of the port. As ports, however, have many common properties, the applicability of the findings to other ports merits serious consideration. In order to pursue this, however, this study must first be expanded to encompass the entire port, and thus support or reject the present findings.

H. DEFINITIONS OF TERMS USED

Port and Harbour are used interchangeably. A port is the place of contact between land and maritime space. Its primary function is the
transference of goods and people from ocean vessels to land or inland carriers and vice versa.

Back Land is the immediate area adjacent to the wharves and jetties. It contains for the most part storage sheds, aprons, transit storage space and transportation rights-of-way.

Hinterland is the land area connected with the port by means of transport lines, and which receives or ships goods through the port.

Port Interface is that area of land where port and marine activity is replaced by urban activity. In this study it is marked by the waterfront railway.

Port Linkages are all forms of interaction between the port and the land or marine area. Examples of the land linkages are vehicle and rail movements, individual trips, and communication by mail, telegram, telephone, etc., between the waterfront and the urban area.

Metropolitan Vancouver. Greater Vancouver Regional District.

Port of Vancouver. That foreshore and land covered by water under the jurisdiction of the National Harbours Board. It includes all tidal water of Burrard Inlet lying easterly of a line drawn between Port Atkinson and Point Grey, and Boundary Bay, Roberts Bank and Sturgeon Point, but does not include the Fraser River.

Inner Harbour. That part of Burrard Inlet lying between the First Narrows and Second Narrows.
Vancouver Inner Harbour. That part of the Inner Harbour within the City of Vancouver.

Study Area. That part of the upland of the City of Vancouver extending from Cardero Street to Boundary Road and lying between the right-of-way of the Canadian Pacific Railway Company and Burrard Inlet.

I. DATA SOURCES

Automotive Transport Association of B.C.
British Columbia Research Council
Canadian National Railways
Canadian Pacific Railway Company
 Dominion Bureau of Statistics
Empire Stevedoring Co. Ltd.
Fraser River Harbour Commission
Greater Vancouver Real Estate Board
Greater Vancouver Regional District
Johnston Terminals Limited
National Harbours Board, Ottawa, Ontario
National Harbours Board, Vancouver, B.C.
North Fraser Harbour Commissioners
Port of Vancouver Development Committee
Swan Wooster Engineering Co. Ltd.
Vancouver Board of Trade
Vancouver City Engineering Department
Vancouver City Planning Department
CHAPTER II

THE METROPOLITAN AREA AS A RESOURCE

A. PHYSICAL CHARACTERISTICS

A resource as defined by the Oxford Dictionary is "a stock that can be drawn on" or "the means of supplying a want". The 330 miles of waterfront lands in Metropolitan Vancouver is one such resource that can be seen both as a stock that can be drawn on, as well as satisfying a number of industrial, commercial, agricultural and recreational wants. It is in this content that the waterfront is regarded as a resource, and in fact a limited resource in the sense that the supply is inelastic and fixed at 330 miles.

The purpose of this chapter is, therefore, to take an inventory of the resource with special focus on the Inner Harbour, (see Figure 3, p. 25). The findings should give the decision makers, the National Harbours Board and the Municipalities, a basis upon which to build and formulate policy on the allocation of all waterfront lands. This approach is currently being followed in the San Francisco Bay area, where each existing and potential use is examined in terms of their present and future land requirements. The San Francisco resource area under study is 345 miles of shoreline, an area almost identical, both in size and its present use, to the Metropolitan Vancouver
situation. Once this study is completed it is intended that the various Californian authorities will jointly develop a waterfront land use policy.

(1) Metropolitan Vancouver

Vancouver Harbour is one of the few natural harbours in British Columbia's rugged fiord-type coastline. It enjoys year-round ice-free access from the Pacific Ocean through the Strait of Juan de Fuca and the Strait of Georgia, and is protected from the open waters of the Pacific Ocean by Vancouver Island. The strong topographic features of this province with the drainage patterns principally orientated in a north-south direction, so limits access to the Pacific by land routes, that aside from Vancouver, only Prince Rupert and Squamish have developed as Canadian coastal rail terminals. Vancouver is located in the southwest part of the Province on Burrard Inlet, twenty-five miles north of the United States border (see Figure 3, p. 25).

It becomes apparent from this picture of trade flows that Vancouver, because of its location and the local geography, has become Canada's western gateway to the world, (see Figure 5). This has resulted in a vast array of land transportation and communication linkages that feed into this shipping network. Vancouver is the western

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2 Metropolitan Vancouver, as defined in the Census of Canada, 1961, consists of the Cities of Vancouver, North Vancouver, Port Moody, Port Coquitlam, New Westminster, and White Rock, and the Districts of West Vancouver, North Vancouver, Coquitlam, Fraser Mills, Burnaby, Surrey, Delta and Richmond, and some unorganized territory including the University Endowment Lands.
terminus of the Canadian National Railways and Canadian Pacific Railway Company, and the southern terminus of the Pacific Great Eastern Railway. In addition it has a direct rail route to the Puget Sound region in Washington, connecting with the major United States railway lines. The city is at the westerly end of the Trans-Canada Highway system, and has a freeway connecting to the Interstate system in the United States.

The Fraser lowland, a part of the Georgia Depression, is home to one million people who live in Metropolitan Vancouver, containing about 50% of the province's total population. This area is surrounded on the north by the Coast Mountains which rise steeply to elevations well over 5,000 feet immediately north of Burrard Inlet and east of Indian Arm. The broad flat-bottomed valley and delta of the Fraser River lie to the south of the City of Vancouver and for the most part requires dyking. The entire waterfront which borders this small but densely populated area totals 331.1 miles. The coastline runs from West Vancouver in the north, to Boundary Bay in the south and includes Burrard Inlet to Port Moody, both arms of the Fraser River and east to Pitt Meadows (see Figure 3, p. 25). This length of waterfront is the upland limit of the Port of Vancouver. Of the harbour's 331.1 miles, 135.6 miles is administered by the National Harbours Board. This is a recent development and was made possible in August, 1967,

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when the National Harbours Board extended its jurisdiction from
Burrard Inlet to include all tidal water to the south, but excluding
the water already under the jurisdiction of the North Fraser Harbour
Commissioners and Fraser River Harbour Commission (195.5 miles).

The physical characteristics of the shoreline vary consider­
ably between the extremes of the rocky coast bordering Indian Arm to
the flat peaty shores of the Fraser River.

(2) **City of Vancouver**

In the Port of Vancouver, the waterfront land has been histor­
ically connected to land and rail transportation routes. At first the
access was largely through rail facilities, but currently there is an
increasing use of trucks and highways. The port and its relation to
the city are shown again in Figure 3, p. 25.

The lines of the Canadian Pacific Railway Company skirt the
southern side of Burrard Inlet with an extension from the west part
of the line through a tunnel to the False Creek yards. The Canadian
National Railways and Great Northern Railway Company make joint use
of a line that runs inland from New Westminster through Burnaby to
the east end of False Creek. On the north side of the inlet are the
lines of the Pacific Great Eastern Railway Company and the Canadian
National Railways. A recently completed connection of the Canadian
National Railways through a tunnel and bridge at the Second Narrows,
has eliminated a slow and circuitous route along Burrard Inlet.

Highway access to the waterfront is along several of the water­
front distributories leading off the major north-south routes feeding
the City of Vancouver. In the downtown section the major waterfront route is the Powell Street, Water Street and Cordova Street route running parallel to the waterfront.

Water depth and the restricted access at the First Narrows is still a controlling factor for navigation in Burrard Inlet, or Inner Harbour as it is more commonly known. The First Narrows limiting entry depth is 39 feet, though contracts have been let to increase this to 50 feet. However, navigation of large vessels through the narrows will always remain a serious limiting factor. The main channel depth in this 5½ mile Inner Harbour area is well over 39 feet, and most wharves list depths of 30 to 40 feet.

The surficial geology at the Vancouver Waterfront is tertiary sandstone, siltstone, shale and minor volcanic rocks. The steepness of slope within five hundred feet of shoreline varies between 0 to 15 per cent, see Figure 6. The western two-thirds averages no more than 5 per cent, and the remainder is above 6 per cent.

The physical characteristics of this area, it would appear, are attractive to a wide variety of activities. The firm ground, the varied transportation access, the sheltered and relatively deep marine facilities and the varying land steepness, could be utilized by the large adjacent urban population in a variety of ways. The following sections describe the present uses of the waterfront, all of which are summarized in Table 1 below.

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4 All depths quoted refer to depths at lowest normal tides.

5 Charles N. Forward, *op. cit.*, p. 5.
TABLE 1
WATERFRONT LAND USES, CITY AND METROPOLITAN VANCOUVER, 1969

<table>
<thead>
<tr>
<th>Metropolitan Vancouver</th>
<th>Miles</th>
<th>%</th>
<th>City of Vancouver Study Area (Estimated mileage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture &amp; unused</td>
<td>201.7</td>
<td>60.8</td>
<td>.2</td>
</tr>
<tr>
<td>Recreational</td>
<td>35.2</td>
<td>10.6</td>
<td>.4</td>
</tr>
<tr>
<td>Residential</td>
<td>27.2</td>
<td>8.2</td>
<td>.0</td>
</tr>
<tr>
<td>Land Transport</td>
<td>20.1</td>
<td>6.1</td>
<td>.5</td>
</tr>
<tr>
<td>Fishboat Mooring &amp; Net Lofts</td>
<td>4.5</td>
<td>1.4</td>
<td>.2</td>
</tr>
<tr>
<td>Marinas</td>
<td>2.9</td>
<td>.9</td>
<td>.2</td>
</tr>
<tr>
<td>Towing &amp; Dredging</td>
<td>2.6</td>
<td>.8</td>
<td>.2</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>25.4</td>
<td>7.7</td>
<td>1.3</td>
</tr>
<tr>
<td>Wholesale &amp; Storage</td>
<td>1.8</td>
<td>.5</td>
<td>.2</td>
</tr>
<tr>
<td>Commercial &amp; Retail</td>
<td>1.5</td>
<td>.5</td>
<td>.2</td>
</tr>
<tr>
<td>Shipping Terminals</td>
<td>8.2</td>
<td>2.5</td>
<td>2.1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>331.1</strong></td>
<td><strong>100.0</strong></td>
<td><strong>5.5</strong></td>
</tr>
</tbody>
</table>

B. MANUFACTURING, COMMERCIAL AND STORAGE

Much of what follows in this and subsequent sections in this Chapter has been condensed from two sources, the study by Forward, quoted earlier, and the British Columbia Research Council Study, *Vancouver Harbour Traffic Trends and Facility Analysis*, 1967. All of the data for the Vancouver City Waterfront are estimates based primarily on the survey conducted for this study in November, 1969.

In Metropolitan Vancouver 28.7 miles of waterfront is taken up for manufacturing, commercial activity and storage, which is about 8.7 per cent of the total waterfront lands. The sites are scattered throughout the region, with some concentration along the North Arm of the Fraser River and the balance along Burrard Inlet and False Creek.

Along the Vancouver Inner Harbour approximately 1.7 miles of the 5½ mile waterfront is for manufacturing, commercial and storage purposes. These properties which represent 33 per cent of the area are scattered fairly evenly along the waterfront. In all they would cover about 200 acres out of a total of 3,920 gross acres of industrial-zoned land in Vancouver.\(^6\) Further details on the significance of this portion of the industrial land, along with the recent zoning changes for Project 200 and Harbour Park development are discussed in detail in Chapter V.

C. SHIPPING, TERMINALS AND LAND TRANSPORT FACILITIES

Shipping, terminals and land transport facilities also include governmental uses and utilities, and in all total 28.3 miles of metropolitan waterfront area, equivalent to 8.5 per cent of the total waterfront. These are scattered throughout the region with no particular concentration. In the Vancouver Inner Harbour, 47 per cent, or 2.6 miles, is devoted presently to this land use. Almost the entire western half of this area is presently under this use, though there are several proposals planned that will alter the situation. In the Vancouver Inner Harbour there is accommodation for 39 deep sea berths having a total of 22,195 feet. This represents approximately 50 per cent of the total berths in the metropolitan area, which has 78 deep sea berths for a total of 41,802 feet. The cargo handled in the Port of Vancouver as well as the Fraser River in 1968 amounted to 37,168,720 tons of which 24,493,320 tons were shipped through the Port of Vancouver. Official figures are unavailable for shipments through all the berths in the City of Vancouver, although this study's survey completed in October 1969 estimated that 30 per cent of the total Port of Vancouver tonnage (24,493,320 tons) passed through the City of Vancouver. Figure 7 indicates the summary of cargo tonnage:

7 North Fraser Harbour Commissioners, 1968 Annual Report, total tonnage 7,871,042.

8 See Chapter III for the survey analysis and Appendix A for estimated tonnage.
Port of Vancouver Cargo Tonnage

SOURCE: N.H.B. AND C.N. FORWARD. WATERFRONT LAND USE VANCOUVER
handled in 1955, 1961 and 1968. The figure demonstrates that Outward Foreign cargo is equal to half the region's total trade. There appears to have been relatively little change between each of the categories of trade in the past four years. The total volume has however in this period increased by 28 per cent. This suggests that the trade flows have reached a relatively stable state, however as the volume is still increasing, additional transportation and space requirements will continue to be in demand, the details of which are discussed in Chapters IV and V respectively.

D. AGRICULTURE AND UNUSED LAND

In Metropolitan Vancouver agricultural use of waterfront land is by far the greatest and totals 201.7 miles or 60.8 per cent of the entire waterfront. These areas dominate the upper reaches of the Fraser River, Lulu Island, Sea Island, Boundary Bay and Indian Arm, (see Figure 3, p. 25). In Vancouver Inner Harbour there is .2 miles of vacant land, equivalent to 3.6 per cent of the waterfront. Half of this is in the process of development and the remainder is in the eastern portion of the waterfront. The eastern portion has no back lands due to the steep ground slope and hence is of marginal use unless substantial sums of money are spent in reclamation, which is unlikely due to very deep waters. In total this amounts to about 10 acres of vacant land.
E. RESIDENTIAL LAND

A total of 27.2 miles or 8.2 per cent of the metropolitan waterfront is devoted to residential land use. There are several distinct types of residential occupancy. Single family detached homes of good quality are found along Burrard Inlet with summer cottages along the upper part of Indian Arm. A few highrise apartments have been built on the waterfront in West Vancouver. In addition there are scatterings of poor quality housing along the Fraser River, usually owned by fishermen. In the Inner Harbour along the Vancouver waterfront there is no residential property. There is, however, a hotel at the westerly end and there are additional hotels and apartment buildings in various stages of development and approval for this same area.

F. RECREATION, FISHBOAT MOORING, MARINAS AND TOWING

Ten per cent or 35.2 miles of the metropolitan waterfront is set aside for recreation. Most of this is in the Stanley Park, Point Grey and North Arm of the Fraser River areas. Within the Inner Harbour 7 per cent of the area is set aside for recreation in the form of a park at the easterly end. There is, however, an equivalent amount of area at the westerly end in the form of a marina for private moorings and a yacht club. Forward suggests that in the suburban areas only there appears to be a need for additional space for recreation and
public open space. Stanley Park and English Bay provide adequate facilities for the city population. He concludes that Boundary Bay be acquired as a park area and the Roberts Bank area be protected as a wildlife and waterfowl conservation. Additional comments are elaborated on this point in Chapter V in the section on Recreation Requirements.

In the metropolitan area fishboat mooring, marinas and towing facilities occupy only a small portion of the waterfront, i.e., 10 miles, or equivalent to 3.1 per cent of the area. In the Vancouver waterfront area each of these facilities occupy .2 miles or 3.6 per cent of the waterfront, and are scattered throughout the waterfront with no particular concentration.

G. SUMMARY

Any attempt to forecast future demands for all waterfront land would require a detailed social and economic survey of the entire region. However the conclusion reached by Forward was that during the next 15 to 20 years present commercial, industrial, institutional and recreational facilities in the metropolitan area will have to be doubled. The demand for waterfront land will increase greatly, but if properly managed these demands can be met. For example the Fraser-Pitt river system can provide the principle stock of waterfront land.

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for most of the future metropolitan industrial requirements. Boundary Bay, if developed as a marine park could meet much of the entire area's recreation demands. Finally the study suggested that there was considerable evidence to indicate that Burrard Inlet could accommodate most of the required shipping terminals for the foreseeable future. Thus from a Metropolitan or Macro viewpoint there is an adequate supply of this waterfront resource, if properly managed, for Greater Vancouver's future requirements.

The remainder of this study is devoted to a micro examination of just one portion of this waterfront resource in the Inner Harbour to see how this resource is being utilized and what demands are being made on it.
CHAPTER III

WATERFRONT CHARACTERISTICS

The setting of the Port of Vancouver was described in Chapter II. The unique location of an ice-free, sheltered harbour, at the entrance to a land transportation route leading to the eastern part of the country are important determinants to its development. The position of the first railway line and its terminus had a significant influence upon the location of the first mercantile and shipping facilities from which further development ensued.¹

The Port of Vancouver operates under the influence of local conditions, which include the existing topographical features, and the spatial and land use patterns. As discussed in Chapter I, the main thrust of this thesis is directed at the conflict between, on the one hand, the demands of increased port functions, and on the other hand, the demands emanating from the central city in response to burgeoning urban activities, which are non-port functions.

In order to derive quantitative data regarding the land use and transportation characteristics within the study area, a questionnaire was developed. This chapter deals with the study area, the questionnaire, and the results obtained. It is not intended to be exhaustive,

¹V. Setty Pendakur, Peter Tassie, Neil Griggs, Multiple Use of Transportation Corridors in Canada, Part II: Socio-Economic Impact and Transport Consequences, Vancouver: School of Community and Regional Planning, The University of British Columbia, October, 1969, p. 8.
but forms the basis from which further analyses are developed in succeeding chapters.

A. THE STUDY AREA

The formulation of the hypothesis and the choice of the study area were discussed in the initial chapter. In brief, the study area was governed by the hypothesis, and an area was selected that would give the highest contrast in activity between port and non-port functions. As a result that part of the City of Vancouver between the Canadian Pacific Railway Company right-of-way in Burrard Inlet, extending from Cardero Street to Boundary Road, was chosen. This area is shown in Figure 4, p. 26.

While the questionnaire results disclose information on present land uses and other characteristics, which are discussed in succeeding parts of this chapter, it does not reveal information on the trends in land use that have led to the present sites. Records of previous ownerships are on deposit in the Land Registry Office, and recollections and descriptions of past conditions are recorded in historical journals, libraries and archives, from which it would be possible to prepare a comprehensive documentation of the change that the study area has undergone. However, without going into this detail it is possible to describe in more general terms the changes in the area that have occurred from changes in passenger travel modes. Most of this information is derived from the memory of the author over the past two decades.
The section that has undergone the greatest change in use is that part of the study area between Burrard Street and Main Street, shown in Figure 8. In this section, which is the oldest part, there has been a significant decrease or complete suspension of the activities of the marine passenger terminals, which occupied a large part of the waterfrontage. Amongst these are the Canadian Pacific Steamships Pier B-C, once the terminus for regular trans-Pacific runs, as well as thrice daily Vancouver Island and coastal runs. These piers are now largely used as berths for occasional ocean-going cruise ships and visiting naval vessels, and otherwise for general cargo ships. Similarly, Pier D, on the east of Pier B-C, was destroyed by fire in the mid 1930's and has never been replaced. More recently a shed adjoining a marginal wharf at the foot of Abbott Street, was severely damaged by fire in 1969, and has not been restored.

Further east, at the foot of Columbia Street, Municipal ferry systems to North Vancouver and West Vancouver were suspended because of insufficient patronage. In the same area, at the foot of Carrall Street, the Union Steamships Limited once offered a coastal service in competition with the Canadian Pacific Steamships. This operation has now ceased and the successor to the company has shifted its operation to the eastern part of the study area, about two miles east of the Central Business District.

Generally the passenger traffic that once used the facilities mentioned above has been shifted elsewhere in the study area, or outside the urban area. Trans-oceanic and coastal steamer runs have
Changes in Land Use - Burrard St. to Main St.
largely been replaced by aeroplane flights, served from the airport adjoining the southern edge of the city, although cruise ships still use the downtown piers. Vancouver Island transportation, has, to a large extent, been taken over by the British Columbia Ferries using two terminals located out of the urban area, (see Figure 3, p. 25). One of these is at Tsawwassen at the southern end of Delta Municipality adjoining the Roberts Bank Super-Port, approximately 15 miles south of Vancouver. The other is at Horseshoe Bay, in Howe Sound, at the west end of West Vancouver Municipality. Locally, ferry traffic across Burrard Inlet has been replaced by vehicular transportation using the Lions Gate and Second Narrows Bridges.

Within this part of the study area between Burrard and Main Streets, the former land uses have not been replaced, or have been replaced by a use of a less intensive nature. Two minor passenger facilities, a hovercraft service and a water taxi, have located in this area, but they do not generate substantial passenger volumes.

Elsewhere in the study area the changes in land use have not been so striking.

B. QUESTIONNAIRE ADMINISTRATION

The questionnaire\(^2\) was developed to obtain information on occupants and land use within the study area, employment and parking

\(^2\)See Appendix I for the questionnaire.
characteristics, quantity of commodity flows, modes of transportation employed, and dependency upon urban services. It was designed for response by personal interview. Prior to the interview a list of businesses from the study area was compiled and a letter\textsuperscript{3} was sent to each of these businesses, outlining the purpose of the questionnaire, and giving the date of the survey and the interview. The justification for sending a letter in advance was demonstrated as the personal interviews were conducted, in which the advance notice provided a more favourable reception and higher returns.

The list of businesses mentioned above was compiled from a local directory,\textsuperscript{4} and showed 164 businesses within the study area. Upon administration of the questionnaire, which took place in the latter part of November, 1969, it was found that some of these businesses no longer were situated at the address shown, or that one office served several different companies separated in name only, and in effect constituting one business. The decrease in number uncovered by this field check was significant, and reduced the original 164 businesses to 100, each of whom was approached and asked to complete the information on the questionnaire.

From the interviews of the 100 businesses mentioned above, 79 were partially or fully completed, and 21 were not executed. The 21 unexecuted returns resulted either from outright refusal of the

\textsuperscript{3}See Appendix II for a copy of this letter.

business to supply any information to inconvenience or lack of time of the proprietors of small offices. Where time permitted call-backs were made, but were not always successful.

In the 79 partially or fully completed returns, the incomplete sections resulted either because the respondent did not have the information, or because he was not prepared to divulge it. Where possible the missing information was obtained from other sources, such as City of Vancouver and National Harbours Board records, but otherwise was left blank.

Upon completion of the questionnaire the values were coded, and punched onto standard computer cards, enabling the data to be analyzed by computer. Initially, however, only a simple correlation analysis, including means and standard deviations, was conducted.

One of the locations in the study area on Commissioner Street, contained six similar industries engaged in frozen fish processing and storage. Because the assessment data in this location was tabulated for the one parcel of land on which all these industries were located, and not separately for each of the individual industries, it was considered appropriate to combine the six returns into one. The result of this combination reduced the returns by five, and the total returns, originally numbering 79, was decreased to 74.

To assist in the evaluation and analysis of the questionnaire, the assessment and taxation records of the City of Vancouver were obtained. This information, called the Assessment Roll, is open to

City of Vancouver Assessment Roll 1969, Vancouver: Assessment Department, City of Vancouver, 1969.
public inspection, and gives the abbreviated legal description of the property, and the assessed values for school and general purposes, of land, buildings and machinery.

The principal use of this record was to check the questionnaire returns with the City of Vancouver data to determine if all lands had been included, and to obtain assessed values of land and improvements for all parcels within the study area.

The values shown in the Assessment Roll are supposed to represent market values, although it is recognized that because of increasing values and slow turnover of property in some sections of the city, there is a lag between the values shown on the roll, and the selling price. Nevertheless, the assessed values are consistent within the study area, and therefore constitute a suitable indicator of values.

The Assessment Roll of the City of Vancouver did not contain any information on the area of parcels, the nature of buildings and improvements on the property, or the unit assessment for land and improvements used to compute the total assessment. Had this information, which is tabulated separately, been divulged, it would have been of great value. Unfortunately it was not, and this deficiency in data had to be supplanted by approximations from other sources.

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6 Interview with Mr. H. Urquhart, Assessment Department, City of Vancouver, June 3, 1969.

7 It would be possible to obtain the area of most of the parcels from a search of Land Registry Office records. However the time and expense involved in such a search excluded this approach. In addition
C. QUESTIONNAIRE RESULTS

(1) Site Characteristics

The site characteristics of the study area, shown in Table I, p. 38, were derived from the questionnaire. In Table 2 the characteristics are listed under eight land use classifications. In the determination of the classifications of sites in which more than one land use was involved, the major or predominant land use was adopted, and the minor use was not mentioned. The one entry in the table in the "other" column, a publishing service for an ethnic group, did not fit into the other classifications and was thus listed separately.

The third column, "Average footage from CBD", lists the results assuming that the CBD extends from Burrard Street to Main Street adjoining the south side of the Canadian Pacific Railway Company right-of-way but not extending across to the north side. As a result the distance from the CBD of those businesses within the study area varies from 500 feet to a maximum of 15,400 feet.

The fourth and fifth columns, "Year of Origin" and "Year of Major Investment", were evaluated from questionnaire data. The year of origin is the year in which the present occupant began operations at the site, while the year of major investment is the year in which the major capital investments were constructed.

some of the leases are not deposited in the Land Registry Office. However, additional information on sizes of parcels was obtained from the National Harbours Board, and from composite maps showing the lots within the study area.
## TABLE 2

LAND USE CHARACTERISTICS IN STUDY AREA, 1969

<table>
<thead>
<tr>
<th>Land Use</th>
<th>No. of users</th>
<th>Average footage from CBD</th>
<th>Average year of Origin</th>
<th>Average year of major investment</th>
<th>Average floor area</th>
<th>Average site area (acres)</th>
<th>Average waterfront area (feet)</th>
<th>Average employees</th>
<th>Average parking spaces</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goods Terminals</td>
<td>14</td>
<td>5,844</td>
<td>1934</td>
<td>1935</td>
<td>73,700</td>
<td>14.9</td>
<td>591</td>
<td>49</td>
<td>7</td>
</tr>
<tr>
<td>Passenger Terminals</td>
<td>6</td>
<td>5,600</td>
<td>1960</td>
<td>1964</td>
<td>1,300</td>
<td>0.7</td>
<td>84</td>
<td>3</td>
<td>35</td>
</tr>
<tr>
<td>Marine Sales Service and Repair</td>
<td>14</td>
<td>5,700</td>
<td>1948</td>
<td>1952</td>
<td>10,400</td>
<td>6.5</td>
<td>134</td>
<td>18</td>
<td>27</td>
</tr>
<tr>
<td>Fish Processing</td>
<td>21</td>
<td>6,500</td>
<td>1949</td>
<td>1949</td>
<td>60,000</td>
<td>6.4</td>
<td>427</td>
<td>98</td>
<td>17</td>
</tr>
<tr>
<td>Other Processing</td>
<td>10</td>
<td>6,100</td>
<td>1943</td>
<td>1953</td>
<td>99,500</td>
<td>4.3</td>
<td>222</td>
<td>75</td>
<td>5</td>
</tr>
<tr>
<td>Public Administration</td>
<td>6</td>
<td>4,700</td>
<td>1940</td>
<td>1935</td>
<td>9,500</td>
<td>0.3</td>
<td>38</td>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td>Construction</td>
<td>2</td>
<td>7,600</td>
<td>1960</td>
<td>1958</td>
<td>10,500</td>
<td>1.2</td>
<td>69</td>
<td>12</td>
<td>18</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>7,900</td>
<td>1967</td>
<td>1967</td>
<td>3,800</td>
<td>0.1</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Average of Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>74</td>
<td>5,844</td>
<td>1945</td>
<td>1945</td>
<td>44,400</td>
<td>5.7</td>
<td>268</td>
<td>41</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Average of Total: 2,622,000 337.2 15,806 2,415 1,559 686
In the columns listing floor area, and site area, the land uses involving goods terminals, fish processing and other processing occupy the largest areas. This result conforms to what might be expected. On the other hand, sites used for passenger terminals occupy a relatively small area. The sites used for the latter purpose consist of float plane, hovercraft, water taxi and cruise-line facilities.

The oldest occupants on the waterfront are the goods terminals. Their tenancy averages 36 years and their average age of facilities are 35 years; and exceeds those of all other users, except public administration.

The large number of off-site employees is attributed to those marine services such as towing and fishing companies, and cruise lines, in which the bulk of the employees are afloat and away from the land site.

(2) Cargo Flows and Volumes

A large part of the questionnaire sought information on the commodities handled by the businesses, their tonnage, origin and destination. This information included annual import and export tonnage, the mode of transportation used, and the number of trips made by each mode. The origin and destination of zones were tabulated in zones which started at the waterfront and worked outward in increasingly larger increments, ending with the zone consisting of all of the world except Canada.
No information was returned concerning the type of goods handled, although an estimate could be made of this by considering the individual questionnaire returns.

In considering whether goods were imported or exported, the direction of movement of these goods was the determining factor. Goods moving into the business or operation, irrespective of the mode of transport, and whether it was by land or water, were considered imports. In the same manner, goods moving outward or away were considered exports. Thus for any business the total import tonnage would equal the total export tonnage, plus any allowance for inventory depletion or build-up.

The outcome of the questionnaire results were tabulated to give total cargo flows in and out of the study area and are listed in Tables 3 and 4. The strong external patterns of the commodity flows of the waterfront users are well illustrated in these tables, in which commodities entering the study area from the metropolitan region account for only slightly over 1 per cent of the total imports. In considering goods moving out of the study area, the metropolitan region is the destination of slightly over 12 per cent of the total movement of goods. The CBD, waterfront, and one-half mile zones account for an even lower origin or destination of goods than the metropolitan region.

3. **Transportation Services**

In addition to the tonnage of commodities and their sources, the questionnaire sought information on the modes of transportation
### Table 3
**Imports into Study Area by Zone of Origin in 1969**

<table>
<thead>
<tr>
<th>Zone of Origin</th>
<th>Waterfront</th>
<th>CBD</th>
<th>Within ½ mile</th>
<th>Remainder of Vancouver</th>
<th>Remainder of Metro Vancouver</th>
<th>Remainder of B. C.</th>
<th>Remainder of Canada</th>
<th>Foreign</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Tonnage</td>
<td>1,392</td>
<td>1,452</td>
<td>5,244</td>
<td>12,444</td>
<td>21,324</td>
<td>481,608</td>
<td>2,663,448</td>
<td>384,684</td>
<td>3,571,596</td>
</tr>
<tr>
<td>Percent</td>
<td>.04</td>
<td>.04</td>
<td>.15</td>
<td>.35</td>
<td>.60</td>
<td>13.48</td>
<td>74.57</td>
<td>10.77</td>
<td>100.00</td>
</tr>
</tbody>
</table>

### Table 4
**Exports from Study Area by Zone of Destination in 1969**

<table>
<thead>
<tr>
<th>Zone of Destination</th>
<th>Waterfront</th>
<th>CBD</th>
<th>Within ½ mile</th>
<th>Remainder of Vancouver</th>
<th>Remainder of Metro Vancouver</th>
<th>Remainder of B. C.</th>
<th>Remainder of Canada</th>
<th>Foreign</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Tonnage</td>
<td>107,532</td>
<td>6,132</td>
<td>8,016</td>
<td>113,796</td>
<td>205,116</td>
<td>361,728</td>
<td>669,888</td>
<td>2,150,660</td>
<td>3,622,788</td>
</tr>
<tr>
<td>Percent</td>
<td>2.97</td>
<td>0.17</td>
<td>0.22</td>
<td>3.14</td>
<td>5.66</td>
<td>9.98</td>
<td>18.49</td>
<td>59.37</td>
<td>100.00</td>
</tr>
</tbody>
</table>
available, their adequacy, the tonnage handled and the number of movements by each mode. These results are listed in Tables 5, 6 and 7.

The sample should not be construed as a total sample of the study area as 21 responses were not obtained out of the 100 businesses. While information on freight movements along the waterfront is scanty, a report prepared in 1963 showed freight movements in the Greater Vancouver region for 1961. In that year the number of loaded rail cars was estimated at 123,500 for the entire Vancouver waterfront.

4. Urban Dependency

This section relates to the dependency of the waterfront users upon adjoining urban services. To evaluate the importance of the urban link, one section of the questionnaire asked information on the frequency of contact with a broad range of services, including transportation agents, marine and financial services, labour market, the urban consumer market, and business with all levels of government.

To the question asking which three services requiring personal contact were considered the most important for the efficient operation of the business, the results are given in Table 8. While this table represents the returns from the sample of 74, not all returns listed three services, and as a result, the total is less than 222 (3 x 74).

---

### TABLE 5
TRANSPORTATION ACCESS TO STUDY AREA

<table>
<thead>
<tr>
<th>Mode</th>
<th>On-Site Access</th>
<th></th>
<th>Suitability of Access</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes</td>
<td>No</td>
<td>No Reply</td>
<td>Adequate</td>
</tr>
<tr>
<td>Rail</td>
<td>28</td>
<td>46</td>
<td>0</td>
<td>23</td>
</tr>
<tr>
<td>Highway</td>
<td>73</td>
<td>1</td>
<td>0</td>
<td>52</td>
</tr>
<tr>
<td>Deep Sea</td>
<td>31</td>
<td>36</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>Barge</td>
<td>52</td>
<td>22</td>
<td>0</td>
<td>40</td>
</tr>
</tbody>
</table>

### TABLE 6
ANNUAL TONNAGE HANDLED BY MODE IN STUDY AREA, 1969

<table>
<thead>
<tr>
<th>Mode</th>
<th>Inward</th>
<th>Outward</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail</td>
<td>2,412,930</td>
<td>480,445</td>
<td>2,893,375</td>
</tr>
<tr>
<td>Highway</td>
<td>220,506</td>
<td>749,356</td>
<td>969,862</td>
</tr>
<tr>
<td>Deep Sea</td>
<td>769,560</td>
<td>2,304,540</td>
<td>3,074,100</td>
</tr>
<tr>
<td>Barge</td>
<td>189,750</td>
<td>87,792</td>
<td>277,542</td>
</tr>
<tr>
<td>Air</td>
<td>301</td>
<td>1,176</td>
<td>1,477</td>
</tr>
<tr>
<td>Total</td>
<td>3,593,047</td>
<td>3,623,309</td>
<td>7,216,356</td>
</tr>
</tbody>
</table>

### TABLE 7
ANNUAL NUMBER OF MOVEMENTS BY MODE, 1969

<table>
<thead>
<tr>
<th>Mode</th>
<th>Number of Movements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail Cars</td>
<td>72,144</td>
</tr>
<tr>
<td>Trucks</td>
<td>311,262</td>
</tr>
<tr>
<td>Deep-sea Ships</td>
<td>6,252</td>
</tr>
<tr>
<td>Barges</td>
<td>3,228</td>
</tr>
<tr>
<td>Aeroplanes</td>
<td>7,200</td>
</tr>
</tbody>
</table>
TABLE 8
MOST IMPORTANT SERVICES REQUIRING PERSONAL CONTACT

<table>
<thead>
<tr>
<th>Service</th>
<th>Replies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marine Services (personnel, stevedoring, shipyards)</td>
<td>39</td>
</tr>
<tr>
<td>Transportation Agents</td>
<td>39</td>
</tr>
<tr>
<td>Financial Services</td>
<td>13</td>
</tr>
<tr>
<td>Labour Market</td>
<td>15</td>
</tr>
<tr>
<td>Urban Consumer Market</td>
<td>19</td>
</tr>
<tr>
<td>Business with all Levels of Government</td>
<td>12</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>137</strong></td>
</tr>
</tbody>
</table>

The dependency upon marine services and transportation agents is seen in Table 8, in which over half the users are dependent upon these services. The third most important service, the urban consumer market, showed a distinct spatial variation, in which 12 of the 19 replies were concentrated in that portion of the study area between Cardero Street and Granville Street. The remaining 7 replies were from businesses scattered throughout the eastern part of the study area.

A further question on urban dependency concerned frequency and origin of visitors to the businesses, such as customers and salesman, but not including employees. These results are given in Table 9.
TABLE 9  
DAILY VISITORS TO STUDY AREAS BY ZONE OF ORIGIN

<table>
<thead>
<tr>
<th></th>
<th>Waterfront</th>
<th>CBD</th>
<th>Within ½ mile but not CBD or waterfront</th>
<th>Remainder of Metro Vancouver</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of visitors</td>
<td>877</td>
<td>579</td>
<td>174</td>
<td>1,188</td>
<td>2,929</td>
</tr>
<tr>
<td>Per cent</td>
<td>33.7</td>
<td>19.8</td>
<td>5.9</td>
<td>40.6</td>
<td>100.0</td>
</tr>
</tbody>
</table>

5. Future Plans

The last section of the questionnaire dealt with future expected trends in volume of business and employment, and future plans concerning building area, site area, and alternative location.

Tabulation of the expected changes in volume of business and employment are given in Tables 10 and 11. It is evident that the large majority of the users expect an increase in business, while a smaller majority expect an increase in employment. The difference between the number expecting an increase in business, and those expecting an increase in employment can be explained by the increased use of labour-saving machines as a device to reduce the labour inputs.

In regard to the future plans of the study area respondents, the tabulation of these results are shown in Table 12. The numbers with definite plans for expansion numbered about 30 per cent, while those requiring increased site area numbered about one third of the total, with a significant number of "No Reply" returns.
### TABLE 10
VOLUME OF BUSINESS IN NEXT 5 YEARS

<table>
<thead>
<tr>
<th>No. of replies</th>
<th>Expect a Decrease</th>
<th>Expect an Increase</th>
<th>No Reply</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range of decrease or increase</td>
<td>7</td>
<td>61</td>
<td>6</td>
<td>74</td>
</tr>
</tbody>
</table>

- None stated
- 5% to 600%

### TABLE 11
EMPLOYMENT IN NEXT 5 YEARS

<table>
<thead>
<tr>
<th>No. of replies</th>
<th>Expect a Decrease</th>
<th>Expect an Increase</th>
<th>No Reply</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Range of decrease or increase</td>
<td>11</td>
<td>32</td>
<td>11</td>
<td>74</td>
</tr>
</tbody>
</table>

- 5% to 20%
- 5% to 600%

### TABLE 12
FUTURE PLANS OF BUSINESSES IN STUDY AREA

<table>
<thead>
<tr>
<th></th>
<th>Definite Plans for Increased Floor Area</th>
<th>Require Increased Site Area</th>
<th>Considered Moving to Another Site</th>
<th>Considered Moving to Roberts Bank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>22</td>
<td>25</td>
<td>18</td>
<td>6</td>
</tr>
<tr>
<td>No</td>
<td>45</td>
<td>30</td>
<td>54</td>
<td>55</td>
</tr>
<tr>
<td>No Reply</td>
<td>7</td>
<td>19</td>
<td>2</td>
<td>13</td>
</tr>
</tbody>
</table>
Businesses that had considered moving to another site numbered 18, while those who had specifically mentioned Roberts Bank totalled 6. While there is no comparison upon which to gauge the significance of this number of respondents that are considering moving, when almost one-quarter of the total are involved, it seems a high figure.

D. SUMMARY

The purpose of this chapter was to examine the study area in closer detail and reveal characteristics of land use, transportation and commodity flows.

That part of the study area adjoining the central business district was shown to have undergone a significant change in land use, resulting in a lower intensity of activity, as many passenger terminals have been suspended or replaced in another location. Whether such a change in land use is a result of the proximity of the CBD and difficulty of access was not answered in the chapter, but this question will be discussed in a later section of the study.

In a tabulation of the land use characteristics it was seen that the space and working force requirements showed large variations between the land users, as might be considered from an examination of the particular uses. At the same time the age of the various facilities showed wide variations with the oldest installations being those for transshipment of goods and for public administration.
Of the commodity flows through the study area, the adjoining lands were relatively insignificant as either origins or destinations of exports. As might be expected these flows reflected upon the large area which is tributary to the port.

Transportation modes used for commodity movement varied between land and sea transport. On the land side rail cars handled the bulk of tonnage, with trucks accounting for only about one-third of rail tonnage. However, in total movements, the relatively small loads carried by trucks were reflected in the high number of movements by that mode as compared to rail.

The greatest urban dependency of the businesses within the study area was upon marine services and transportation agents. The third ranking dependency, the urban consumer market, was concentrated among those businesses at the western end of the study area. The number of persons visiting the area was not high when compared with visitors to the CBD. The origin of these visitors was divided between the CBD, waterfront, and remainder of the metropolitan area in increasing order.

In the future plans of the waterfront study area, it was evident that the majority of the firms expected an increase in both volume of business and employment. Similarly, about one-third of the businesses expected an increase in building area or site area. Of the 74 replies, almost one-quarter (18) had considered moving to another site, although only 6 had specifically considered Roberts Bank as an alternative.

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9V. Setty Pendakur, et al., op. cit., p. 53.
PORT LAND NEEDS AND TRANSPORTATION REQUIREMENTS

The scene described in the opening lines of the first chapter, in which the departing ship sailed out of the harbour, is as much out of date as the Model T Ford is a conveyance for today's transportation needs. Yet both examples serve as a contrast to illustrate and emphasize the major advances that have been made in developing new methods of transportation.

Although the sailing ship has long departed from the high seas as a serious contender for commercial transportation of goods, its successor, the cargo liner with engine propulsion has, until recently, remained as the standard and accepted carrier with few innovations. Other than increases in vessel sizes, more efficient means of propulsion, and the use of new structural materials, the cargo vessel has shown little change. Similarly the methods of stowing and transferring cargo, had not undergone any radical change until the termination of World War II in 1945.

The year 1945, or the period following the Second World War, is often taken as the turning point in the movement toward more efficient methods of shipping.¹ ² This period initiated the departure


from isolationism, high-tariff and protectionist policies, built up and maintained during the decade of depression in the 1930's, and the ensuing war. Taking the place of these conditions was freer and more open trade as was evidenced in the formation of the European Common Market, the General Agreement on Tariffs and Trade (GATT), the expansion of United States and Russia as trading nations, and the remarkable resurgence of Japan.

In the decade between 1950 and 1960, the total world ocean-borne trade more than doubled from 500 to 1,100 million long tons, while in the following five-year period, from 1960 to 1965, the growth was even more dramatic, rising from 1,100 to over 1,700 million long tons. Locally, trade agreements with Communist Bloc countries and other Asian nations have resulted in huge shipments of bulk materials from Vancouver across the Pacific. At the Port of Vancouver foreign trade has increased from 3,100,000 tons in 1945 to 14,532,670 tons in 1968.

A. CHANGES IN TRANSPORTATION TECHNOLOGY

In the light of this developing and competitive overseas trade, attention was focused upon the cost of transportation. Here, one of

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3 Alfred H. Keil and Philip Mandel, "Transportation by Sea—Today and Tomorrow," *Proceedings of the IEEE*, (Proceedings of the Institute of Electrical and Electronics Engineers), Vol. 56, No. 4, (April 1968), p. 516, (Fig. 5 and 6).

the major components was that paid to labour as wages for manning vessels; the other was the increased capital cost of ships. If shipping costs were to be restrained, then ship utilization would have to increase, and port time decrease.

The incentive to lower costs has led to analysis of variation of costs with vessels of differing size and speed, and use of innovative loading and unloading equipment. In this latter aspect the type of dock movements and handling, and the performance of equipment came under scrutiny.

Vessel characteristics have undergone major changes, principally in size and draught; and have resulted in marked reductions in shipping costs. For example, a 50,000 dead-weight ton tanker can transport fuel at 0.18¢ per ton-mile, a 100,000 dwt. vessel at 0.11¢ a ton-mile, and a 200,000 dwt. vessel at 0.08¢.\(^5\)

The lower transportation costs obtained from the larger vessel result from the characteristics of vessel size, and crew and power requirements. Thus while one vessel may be double the capacity of another, the vessel dimensions and capital cost are less than double, the power requirements are only slightly increased, and the crew size remains the same. The economic benefits accruing from the use of such increased capacity vessels is immediately apparent.

On the dock side the increased competition has also served as an incentive in producing more effective handling movements at the

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\(^5\)E. G. Frankel, *op. cit.*, p. 517 (Table III).
port interface. Here the inefficiency of the traditional methods of handling cargo were revealed when it was shown that cargo arrived at the pierhead in various shapes and sizes that prevented complete automation either in handling or storing. For example, in Figure 9 the typical sequence for shipments of general cargo is shown, involving 28 operations and 19 waits. Each of the sections of the transportation process has a proper cost/time input and output affected by internal physical set-up as well as external factors including political and environmental influence. The possibility that various operations will not be carried out at their optimum conditions increases in probability as the number of operations increase, and this in turn reduces efficiency and results in increasing cost and time.

The new developments in shipping have given large reductions to the cost of shipping, both in better performance at sea, and in loading and unloading operations at the port. In both bulk movements and general cargo handling there have been changes which will be described hereunder.

(1) **General Cargo**

The inefficiency of traditional break-bulk port handling methods has led to the development of more effective techniques. Initially pallets were introduced as a base for supporting goods, which could be conveniently handled with fork-lift equipment. With the greater mobility available using such methods it was more efficient to handle goods of the same type, and this marked the first step toward unit handling of cargoes.
9 Sequence for Shipment of General Cargo

Source: Frankel; Proceedings of the IEEE Vol. 58. No. 4 (April 1968)
The pallet-fork lift method of handling goods is still prevalent in many ports, including the general cargo piers of the National Harbours Board in the Port of Vancouver. To a certain extent it has been replaced by unitized cargo in containers, which differs from the previous operation in that the shipper may stow cargoes at the point of origin in standard sized containers which are then sealed until delivered to the consignee. The advantage of such a method over pallet operations is that container cargoes, which are larger than pallet loads, may be handled in one loading or unloading operation from ship to shore; from there the container may be transported by land to the point of consignment. The single loading operation of a container reduces the number of movements and increases the rate of unloading, both of which contribute to reduced shipping costs.

The container is essentially a thin metal box which derives its strength from four vertical posts connected transversely and longitudinally by rails at the top and bottom. It varies in dimensions, although the 8 ft. by 8 ft. cross section in lengths of multiples of 10 ft. up to 40 ft. has generally been accepted. These dimensions allow a high degree of flexibility for loading on railway cars and highway truck trailers, as well as ships.

The maximum size container, 40 feet long, has a gross loaded weight of 67,200 lbs. (30 long tons), while the smaller sizes are proportionately lighter. The normal container is closed and sealed in

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shipment, to reduce pilferage, but special containers have been
designed with open tops for carrying machinery and some bulk goods.
Other containers include mechanical refrigeration, or are insulated
and contain a refrigerant to keep the cargo chilled while in shipment.

The wide application of containers and their adaptability to
a variety of general cargoes suggests that they may eventually be
used for handling the majority of general cargoes. Estimates on the
degree of containerization possible differ, but vary from 60 per cent
to 85 per cent.\(^7\),\(^8\),\(^9\)

Containers are designed to be stocked up to four high in the
hold of a ship, supported by the corner posts of the lower containers.
The vessels for carrying these containers are of special design,
essentially consisting of cells 8 feet wide and 40 feet long, with
vertical guides at the corners. Because of the need for vertical
access to all cells, and for unobstructed top decks for loading, the
container ship differs from the general cargo ship with its more
limited hatches, and proliferation of equipment on the top deck. On
this account the structure of the ships differ, the container ship
usually requiring bulkheads at forty-foot intervals.

\(^7\) E. G. Frankel, op. cit., p. 712
\(^9\) John T. McCullough, "The Impact of Containerization on the
World's Ports," The International Association of Ports and Harbours,
The full range of container vessels, shown in Figure 10, is large, but the majority of containers in transit today are partial container carriers. These carriers usually consist of a general cargo ship converted for carriage of containers in some holds, or on deck. The vessel designed for exclusive container use is expensive, costing from $6 to $10 million, and more than double the cost of conventional freighters of the same tonnage.

The handling of containers has either been by shipboard gantries or by dock-based cranes, although current usage tends to favour land-based unloading devices. The crane tackle is often equipped with self-levelling devices to ensure that the container remains level while being transferred from ship to shore.

The advantages and disadvantages of containers are tabulated in Table 13. The principal advantage, the high loading and unloading rate, results in greater vessel time at sea, claimed to be 85 per cent as against 40 per cent for a conventional cargo vessel. With such utilization it is claimed that less than 60 container berths could be used to handle 82 per cent of the general cargo of the United States overseas trade, as compared to several thousand general cargo piers now in use in that country. It is further claimed that with

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10 E. G. Frankel, op. cit., p. 721.
12 E. G. Frankel, op. cit., p. 724.
13 John C. Kostier, Norman H. Tilsley, op. cit., p. 712
14 E. G. Frankel, op. cit., p. 712.
Classification of Container Ships

CONVENTIONAL DISPLACEMENT HULLS

CONTAINER CARRYING SHIPS

TRAILER CARRIERS

BARGE CARRYING SHIPS

SEGMENTED SHIPS

NOVEL SHIP FORMS

CATAMARAN TYPE SHIPS

COMBINATION LIFT ON-RO-RO

RO-RO SHIP

BARGE CARRYING

BARGE FLOAT ON

MIX TUG COMBINATION

DISPLACEMENT CATAMARAN

SEGMENTED

FULL CONTAINER SHIPS

PARTIAL CONTAINER SHIPS

CONVERTIBLE CONTAINER SHIPS

SHIPS WITH SPECIAL DECK FITTINGS

GENERAL CARGO SHIPS

HINGED SHIPS

RODDILY COUPLED SEGMENTED SHIPS

PUSH TOW

TOW

RIGIDLY COUPLED

HINGE COUPLED

Source: Frankel; Proceedings of the IEEE Vol. 56, No. 4 (April 1968)
### TABLE 13
CONTAINERIZATION

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed-up of loading and unloading.</td>
<td>Cost of containers.</td>
</tr>
<tr>
<td>Protection against pilferage.</td>
<td>Tare weight of containers.</td>
</tr>
<tr>
<td>Protection against damage.</td>
<td>Loss of cubage of containers.</td>
</tr>
<tr>
<td>Lower Insurance rates.</td>
<td>Cost of returning empties.</td>
</tr>
<tr>
<td>Cheaper packaging of cargo.</td>
<td>Heavy gear requirement.</td>
</tr>
<tr>
<td>Reduced documentation required.</td>
<td>Labour practices.</td>
</tr>
<tr>
<td>Reduced number of package handling.</td>
<td>Fixed volume not always optimum usable size.</td>
</tr>
<tr>
<td>Provides temporary protected storage.</td>
<td>Part load problem.</td>
</tr>
<tr>
<td>Modification of external characteristics of cargo for easier handling.</td>
<td>Container routing and handling.</td>
</tr>
<tr>
<td>Cargo handling in all weather.</td>
<td>Container loss and damage.</td>
</tr>
<tr>
<td>Easier stowage.</td>
<td></td>
</tr>
<tr>
<td>Effective stow planning.</td>
<td></td>
</tr>
<tr>
<td>Cargo handling while ship on feeder, not in port.</td>
<td></td>
</tr>
</tbody>
</table>

such improvement in vessel use, one container ship may replace four conventional cargo ships. 16

Utilizing traditional cargo ships, 60 to 75 per cent of the cost of transporting cargo by sea is accounted for at the dock side. By making use of containers the pier to pier costs, as well as packaging costs are reduced markedly. In an example involving ship and truck transportation of containers, the total costs were reduced from $50 to $30 per measurement ton. 17

The widespread advantages claimed in container usage have not met with such extensive acceptance in the Port of Vancouver. 18 One of the unfavourable aspects in this port is the large imbalance of imports over exports of general cargo, and the consequent problem of returning large numbers of empty containers. Another point is that while pilferage of small lots of cargoes have been curtailed, pilferage of whole containers has been known to occur. A further point is the high cost of rail equipment for handling containers, and the limited use of this equipment.

However, the decision of the National Harbours Board to construct a container terminal scheduled to commence operation in May, 1970, indicates that the use of containers has been recognized in the

17 Alfred H. Kiel and Philip Mandel, op. cit., p. 519 (Fig. 11).
Port of Vancouver. The cost of this facility is approximately $5 million and is estimated to have a through-put of between 40,000 and 50,000 containers per annum by 1973.  

(2) Bulk Loading

The same economies that were evident in the shipping of goods by container are also effective in movement of goods in bulk quantities. Moreover, the movement towards larger vessel sizes and increased cargoes has been spearheaded by the bulk cargo vessel.

While the movement of goods in bulk quantities is usually identified with grain and petroleum products, other goods may also be handled in this fashion. Included are many minerals and ores, food-stuffs (sugar, molasses), as well as fuels that are liquified and transported at very low temperatures, such as methane, ethylene, and ammonia. Bulk cargo can then include many commodities, and is defined in one source as a "homogeneous cargo carried without any form of packaging, and not capable of being handled by slings." 

Of the total world ocean-borne shipping, the majority is carried in bulk cargoes, although the values of these cargoes are proportionately smaller. In the United States in 1966, 88 per cent of the tonnage of the foreign trade, but only 32 per cent of the value was carried by bulk movers. One of the large bulk commodities, petroleum,

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19 National Harbours Board: Vancouver Harbour, circular issued by National Harbours Board, Vancouver, no date.

20 R. B. Oram, op. cit., p. 118.

is moving in vessels of especially large size and deep draughts. In the ships of most recent design, 300,000 dwt., the lengths have reached 1,200 feet and the draughts have increased to 65 feet, while projected designs for 500,000 dwt. require a length of 1,300 feet and a draught of 85 feet.\(^{22}\)

Bulk cargoes, because of their homogeneous quality, are adaptable to movement on or off the vessel by special equipment such as conveyors, pipelines, or air-pressure devices that will transfer the cargo from the vessel to a collecting point. With such methods replacing break-bulk loading, it is not always necessary to have the collection point near the vessel. Often a more optimum loading point is located some distance inland where land access is more suitable, and where land does not command the same premium that it does at the waterfront.

A disadvantage of bulk cargo movement is the high cost of specialized equipment, the lack of flexibility of a single purpose vessel, contrasting with the tramp steamer and its wide variation in cargoes, and the back-haul problem. While on occasion bulk vessels have been adapted for return movements,\(^{23}\) such cases are limited by the possibility of finding a route adaptable for haulage in both directions.

\(^{22}\) Alfred H. Keil, Philip Mandel, *op. cit.*, p. 521 (Fig. 13).

(3) **Other Shipping Innovations**

In addition to movements of bulk commodities and general cargoes by special vessels, new methods have been designed for special conditions. One of these, LASH (lighter aboard ship), involves the ocean carriage of a preloaded lighter, lifted out of or discharged into the waters of the harbour. The use of LASH is effective where dock congestion is high, and where the lighter may be loaded in shallow water away from the dock. It is also effective in harbours having limited draught for deepsea vessels, often located at river estuaries. The probability of employing such a system in the Port of Vancouver is not considered high.\(^{24}\)

Other techniques such as commercial submarines and air cushion vehicles have been proposed but have not yet proved feasible for the conveyance of large tonnages. Future research and development will decide if these carriers will take their place alongside the conventional displacement hull.

(4) **Passenger Traffic**

The characteristics of passenger travel have changed considerably over the past decade, as scheduled trans-oceanic voyages have lost ground to the airlines. As a result passenger vessel runs have changed from competitive trans-oceanic passages to cruise trips, catering to a more affluent clientele and requiring a higher level of service.\(^{24}\)

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\(^{24}\) Interview with Mr. J.S. Wood, Swan Wooster Engineering Co., Ltd., February 11, 1970.
This emphasis on service is in fact a major point that will require consideration when new passenger terminals are built or renovated. The new terminals will not only be generally smaller, but more compact and designed for more sophisticated standards. Airports have responded to their passenger needs by providing lounges, dining-rooms, cocktail lounges, specialty shops and restaurants; and ports could follow this example. However, as cruise travel is largely seasonal, the terminal facilities require a measure of flexibility to meet these seasonal fluctuations, especially in terms of the visitors, cars, buses, and taxis that require access to the terminal.

(5) The Vessel Size Race

A leading question arising out of the trend toward increasing ship sizes concerns itself with the outcome of this movement and the eventual size of vessels. This question may be approached from the viewpoint of the ship owner, as well as that of the dock authority concerned with land facilities. A further point of view is that of the public which comes into play if matters of public concern are raised.

From the point of view of the ship owner the objective is to provide the most efficient movement. If the demand exists, then the inherent economies resulting from larger vessel sizes will come into play. On the other hand, the harbour authority must provide channels, wharfage, and loading facilities to accommodate these vessels and their cargoes, at considerable cost.
A rational solution to the vessel size race would be based upon minimum total transportation costs, in which the economies of transporting goods in large size vessels would be countervailed by the high cost of facilities, as well as a consideration of the quantity of cargoes demanded.

A further matter mitigating against large vessels and cargoes is the threat of pollutants escaping from shipwrecked vessels, likely to result in increased insurance rates for these carriers. Contributing to the risk of shipwreck is the relatively low maneuverability of a large vessel. For example, if a 1,000 ft. 200,000 ton tanker is scaled down to a model 40 ft. long, the corresponding power is reduced to one-half horsepower.25

At present the world's largest ship is an oil tanker of 326,000 tons in the service of the Gulf Oil Corporation26 and future plans call for even larger ships of 500,000 tons. One source estimates that vessel capacities will not exceed 1,000,000 tons, requiring a ship 1,640 feet long, 274 feet in breadth, with a draught of 100 feet.27 For general cargo vessels the capacities are very much smaller, and seem to be stabilizing at about 30,000 tons28,29 due to higher value
and more limited market of the commodities carried.

B. PORT SITE REQUIREMENTS

The preceding sections have outlined the trends in sea-borne carriers in response to increased shipping flows and competition. As a result "super" dimension vessels have emerged, first on the drawing board, then on the seas. At the general cargo level the volumes do not approach those of bulk cargoes, and vessel sizes have not increased in the same proportion. Nevertheless, substantial innovations have been devised in the form of unitized cargoes, including pallets and containers.

This section will proceed from the above discussion to that of the land facilities required to accommodate these vessels and their cargoes, as well as the land transport required in transshipment. In this accommodation the purpose of the site will govern the design, and thus an initial distinction must be made between facilities for bulk movement and those for general cargo.

The starting point for consideration of the land requirements is the berth, which must be planned in accordance with vessel characteristics. Various types of ship berthing facilities are in use,

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which may be classified as piers, wharves, offshore berths, ship
wharves, and ferry slips. For the purpose of this chapter the
following definitions have been adopted:  

Pier - a structure extending outward at an angle from the
shore into navigable waters normally permitting
the berthing of vessels on both sides along its
entire length.

Wharf - a structure extending parallel with the shore line,
connected to the shore at more than one point (usually
with continuous connection) and providing in most
cases, berthing at the outshore face of the structure
only.

Offshore berths consist of breasting and mooring dolphins and
are heavily constructed to withstand greater wave forces than exist
in the harbour. Ship wharves and ferry slips are used for bow and
stern loading but their use is not widespread, because of limitation
to vessels within a specific size.

Piers and wharves are both commonly used in harbours. The
piers permit bow, stern, and side loading, while wharves are ordinarily
only suitable for side loading. Despite such limitations, the wharf,

31 The American Association of Port Authorities, Incorporated,
Port Design and Construction, Washington: The American Institute of
or marginal wharf as it is often called, is currently receiving greater use because of greater flexibility and greater operational advantages for general cargo requirements.  

According to one source, the following minimum requirements are necessary to provide adequate space for berthing and mooring vessels:

- **Length** - length of vessel plus beam,
- **Width** - width of vessel plus 100 feet (for tug maneuvering),
- **Depth** - loaded draught of vessel plus 4 feet.

(1) **Bulk Cargo**

The bulk movement facility is now required to receive such large ships that many of the world's harbours have insufficient draught for the supercarriers. As a result, off-shore berths have been constructed which allow the vessel to tie up at moorage some distance from shore and discharge its cargo. The method of discharge

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is often by conveyor belt for dry bulk cargoes, and pipelines in the case of petroleum and other liquid products. In a recent article an example is cited in Australia of a conveyor belt used to discharge coal to an off-shore point some 2,000 feet out from the shoreline.\textsuperscript{35}

The design of areas for conveyance and storage of cargoes for off-shore moorage is dictated by the type of cargo, as well as local conditions, and no general standards have been formulated, although it may be said that the area required is less than that for general cargoes and requires less wharfage.\textsuperscript{36} The storage facilities need not be at the waterfront, and are often more suitably located near transportation routes inland.

In the case of shipside loading operations, a large area is usually required for storage in close proximity to the ship. If the bulk commodity is transported by unit train, the use of an unloading loop reduces cost considerably by allowing the train to remain intact, without the necessity of uncoupling and shunting. The minimum radius of such a loop is 350 feet, and with trains of 100 cars, each car being 50 feet long, the required area is 5,000 feet by 700 feet, or approximately 80 acres.\textsuperscript{37} An alternative arrangement without the rail loop would require less area. In this case the economies of loading and unloading would be foregone in favour of lower land costs.

\textsuperscript{35}Leonard S. Oberman, \textit{op. cit.}, p. 20.

\textsuperscript{36}Walter P. Heddon, \textit{op. cit.}, p. 13.

\textsuperscript{37}Leonard S. Oberman, \textit{op. cit.}, p. 25.
Modes of land transport of cargoes are still largely by railways for long hauls, although they have been superseded by truck transportation for shorter trips. On a ton-mile basis the cost of rail movement has been given as two cents, as opposed to four cents for truck transport, although factors such as length of haul will modify these figures.

The development of the unit train has enabled many economies to be affected in rail operation through greater utilization and lower loading and unloading costs. As an example it has been estimated that present freight costs on bulk commodities between Prairie points and the West Coast could be reduced from 25 per cent to 40 per cent with the inauguration of a unit train service.

(2) General Cargo

For a general cargo facility the vessel characteristics are again a determinant governing the design of marine terminals. Because general cargo vessels have not expanded to the same dimensions of bulk vessels, nearly all general cargo berths provide for the ship tying up at a wharf or pier adjoining the handling and storage area. Various lengths have been suggested for berths of vessels handling

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containers and general cargo ranging from 604 feet to 850 feet.  

Aside from the vessel berth, the general cargo terminal must accommodate the following operations:

1. Transit area including transit handling and transit storage of cargo.
3. Long term storage of cargo.
4. Auxiliary services, such as administration, parking fields, maintenance shops and personnel facilities.

Of these four components, the most difficult area to specify quantitatively is that for transit handling and transit storage operation. The latter area is that space required for storage in the interval between unloading from the ship and pick-up by land transport, while the transit handling area is that part required for aisles, aprons, loading platforms, roadway and railway tracks. Studies have shown that the transit area, comprised of both the transit handling and transit storage area, requires from 2 to 9 acres.

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42 J. M. Rienstra, op. cit.
43 Peter Engelmann, op. cit., pp. 1769-3.
The area required is dependent upon the design capacity, in the range of 56 to 300 tons per foot of berth per year. The depth of the back-up land has been given in one source as from 300 to 500 feet, while in another a depth of 480 feet is given.

The second operation, access for land transportation, must provide space for railway cars and trucks to take goods from the transit storage area to railway and highway routes. The provision of rail facilities is sometimes unnecessary in the case of ports handling cargoes largely of local origin and destination. Railway facilities require heavier supporting structures, and the rail handling operation is likely to interfere with other traffic.

The necessity of providing space for long term storage of cargo at the marine terminal is questioned in some reports, in which it is recommended that this space could be provided inland, and allow more turnover of goods at the terminal. In the same manner certain administrative facilities, not requiring personal contact with the wharf, could be located some distance away.

The total area required for such berths has again been specified in several sources. Engelmann, in 1958, recommended six to eight

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44 Walter P. Heddon, op. cit., p. 20.
45 Walter P. Heddon, loc. cit.
46 Walter Engelmann, op. cit., p. 1769-5.
acres per berth for all operations except long term storage. More recent publications have exceeded this standard and the general figure recommended today is 20 acres.

The remaining consideration for marine terminals is that of equipment, of which the most important single item is the crane for unloading containers. To unload the largest containers (8 feet by 8 feet by 40 feet) a crane having a lifting capacity of 67,200 pounds (30 long tons) is needed. While the controversy over ship-based or pier-based unloading facilities is long standing, the prevalence of recommendations in favour of pier-based cranes indicates the trend. From another aspect, the competition between ports has required the installation of land-based cranes if that port is to remain competitive.

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48 Peter Engelmann, *loc. cit.*


50 *loc. cit.*


52 *op. cit.* p. 178.
C. FUTURE TRENDS

The section on future trends is included at this point to supply a background to the study, and to impart to the reader the conception that as expansion takes place, an analysis of transportation characteristics will serve as a guide from which the impact of future development may be gauged.

The significant increases in world ocean borne trade were mentioned in the preceding parts of this chapter. In Canada the volume of maritime shipping has shown a corresponding growth, and the Pacific Coast and the Port of Vancouver have shared in this growth. Contributing to the increase are the exports of agricultural and mineral products, as a result of which Vancouver is now the principal outlet for Canada's grain, handling 40 per cent of the exports in the 1964-1965 crop year. In addition, an increasing demand for fuel and minerals, including coal, sulphur, potash and propane has accentuated the volume of shipping. Most of the established export flows have been maintained, and pulp and paper have shown larger increases.

Metropolitan Vancouver, now approaching a population of a million, is expected to reach 1.3 million in another decade, as shown in Table 14. This increase in population, and the increased purchasing power, will augment the demand for consumer goods, much of which is

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imported as general cargo from overseas points. In contrast to the marked imbalance of exports of natural resources over imports, the imports of general cargo exceed the exports. Such conditions might be expected to hold in a country with large reserves of minerals, forest and agricultural products, and with a scanty population.

The increases in trade occurring as a result of these growing export demands, and the growing consumer market are shown in Figure 11 and in Table 15, from information prepared in 1966.54 The predictions are for a doubling of shipping volumes in the next decade, corresponding to an approximate annual increase of 7 per cent per year. This figure closely conforms with predictions for world ocean borne trade, which predict a 7.7 per cent annual rise in the decade of the 1970's and a 5½ per cent annual increase in the following decade.55

Estimates of capacity at the waterfront are included in the projections, and are shown in Table 16. While the total 1968 capacity was adequate for the total flows of that year, it is seen that some of the individual facilities were beyond capacity for that year.

It is evident that more port terminal facilities will be needed in the next decade if the projected shipments are to be handled. In addition to waterfrontage, the major component of expanded terminals is adequate "back-up" land. Container sites are now being specified


55 Alfred H. Kell and Philip Mandel, op. cit., p. 516 (Figure 6).
Port of Vancouver Deepsea Cargo Tonnage - 1955-85

Source: 1955-65 NHB data 1965-85 BCRC estimate
TABLE 14

POPULATION PROJECTIONS, 1966-1986. CITY AND METROPOLITAN VANCOUVER

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>City of Vancouver</td>
<td>384,522</td>
<td>410,375</td>
<td>435,000</td>
<td>458,000</td>
<td>480,000</td>
<td>500,000</td>
</tr>
<tr>
<td>Metro Vancouver</td>
<td>892,384</td>
<td>972,467</td>
<td>1,026,000</td>
<td>1,169,000</td>
<td>1,335,000</td>
<td>1,524,000</td>
</tr>
</tbody>
</table>

Source: Department of Municipal Affairs, Victoria, Lower Mainland Regional Planning Board.

TABLE 15

PREDICTED CARGO TONNAGE, PORT OF VANCOUVER 1965-1985
(MILLION OF SHIPPING TONS)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain</td>
<td>4.9</td>
<td>6.1</td>
<td>7.0</td>
<td>9.4</td>
<td>11.4</td>
<td>13.0</td>
</tr>
<tr>
<td>Bulk out (non-grain)</td>
<td>2.8</td>
<td>5.2</td>
<td>7.4</td>
<td>14.0</td>
<td>19.0</td>
<td>23.0</td>
</tr>
<tr>
<td>Bulk in</td>
<td>0.7</td>
<td>1.0</td>
<td>1.2</td>
<td>1.6</td>
<td>1.9</td>
<td>2.4</td>
</tr>
<tr>
<td>Lumber</td>
<td>1.3</td>
<td>1.6</td>
<td>1.8</td>
<td>2.1</td>
<td>2.3</td>
<td>2.6</td>
</tr>
<tr>
<td>Pulp, Paper</td>
<td>0.1</td>
<td>0.2</td>
<td>0.4</td>
<td>1.0</td>
<td>1.2</td>
<td>1.5</td>
</tr>
<tr>
<td>General Cargo</td>
<td>1.3</td>
<td>1.8</td>
<td>1.9</td>
<td>2.3</td>
<td>2.8</td>
<td>3.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>11.3</td>
<td>15.9</td>
<td>19.7</td>
<td>30.7</td>
<td>38.6</td>
<td>46.0</td>
</tr>
</tbody>
</table>

Source: National Harbours Board Data
British Columbia Research Council estimate.

TABLE 16

PORT OF VANCOUVER TONNAGE AND CAPACITY
(MILLION OF SHIPPING TONS)

<table>
<thead>
<tr>
<th></th>
<th>Tonnage 1968</th>
<th>Capacity 1968</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain</td>
<td>6.1</td>
<td>7.0</td>
</tr>
<tr>
<td>Bulk out (non-grain)</td>
<td>5.2</td>
<td>12.0</td>
</tr>
<tr>
<td>Bulk in</td>
<td>1.0</td>
<td>ample</td>
</tr>
<tr>
<td>Lumber</td>
<td>1.6</td>
<td>1.4</td>
</tr>
<tr>
<td>Other General</td>
<td>2.0</td>
<td>1.9</td>
</tr>
</tbody>
</table>

Source: National Harbours Board Data
British Columbia Research Council estimates.
as 20 acres per berth, and recent terminals have been constructed on 120 acre sites. Similarly bulk loading facilities utilizing unit trains require about 80 acres.

Port capacities have become a concern of the Asian countries anxious to maintain an adequate flow of raw materials. In a recent meeting a prominent Japanese industrialist, Tadayoshi Yamada, referred to the Port of Vancouver when he said "Port capacities may become a deciding factor in the economic growth of Western Canada." \(^{56}\)

D. TRANSPORTATION NETWORK

(1) Railways

Initially the waterfront users were served by the main line of the Canadian Pacific Railway Company, which lies close to the whole southern edge of Burrard Inlet. Because this railway had precedence in location, subsequent lines were at a disadvantage in not being able to serve the waterfront directly, but had to rely on the Canadian Pacific Railway Company for switching their cars to waterfront customers. The Canadian National Railways and the Great Northern Railway have limited access to the waterfront using a Great Northern Railway line extending northerly from the railway yards at the east end of False Creek, and crossing the Canadian Pacific Railway at Campbell Avenue. Using this line, the Canadian National Railways has access

\(^{56}\) *Vancouver Express*, April 14, 1970.
to the National Harbours Board piers, and has joint access with the Canadian Pacific Railway to most of the National Harbours Board elevators.

The Canadian National Railways has extensive trackage at North Vancouver on the north shore of Burrard Inlet, where it joins with the Pacific Great Eastern Railway, serving the central and northern sections of the province. Until 1967 this trackage was only accessible by using the Canadian Pacific Railway line between Campbell Avenue and the Second Narrows, from there switching onto the Second Narrows Railway Bridge. However, in 1967 the Canadian National Railways completed a new line providing a link between the Great Northern line in Burnaby and the north shore, by means of a new tunnel and bridge, shown in Figure 12. This bridge replaced the earlier Second Narrows Railway Bridge, mentioned above. At the intersection of the Canadian National Railways line with the existing Canadian Pacific Railway tracks, the two lines are grade separated, and no direct rail connection is possible. As a result the Canadian Pacific Railway link with the north shore is severed, save by a circuitous route by way of Port Coquitlam and New Westminster.57

The Canadian Pacific Railway is still the dominant carrier in metropolitan Vancouver, handling about 55 per cent of the cars. The Canadian National Railways is the second largest with about 30 per cent, while the Great Northern and Pacific Great Eastern account for...

the remaining movements.  

(2) **Highways**

The highways serving the study area and CBD are shown in Figure 12. The CBD lies generally along Burrard and Granville Streets, to the north of False Creek, with the more intensive development in the northerly part. It is the major single generator of traffic flows from other parts of the city and from the north shore. Of the origins of CBD traffic, approximately 55 per cent enters from the east, 30 per cent from the south, 5 per cent from the West End (between Burrard Street and Stanley Park), and 10 per cent comes from the north shore over the Lions Gate Bridge at the First Narrows of Burrard Inlet.  

As a result of the unique location of the CBD of Vancouver on a peninsula lying between False Creek and Burrard Inlet, the flow of traffic entering or leaving the CBD from the east is concentrated into the narrow neck of land between False Creek and Burrard Inlet. In this section the main traffic streets east of Main Street are Powell, Hastings and Prior Streets, and west of Main Street are Cordova or Powell Streets (one way streets in opposite directions), Hastings, Pender and Georgia Streets. Traffic flows along these streets are all

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59 Interview with Mr. Jack Hutchinson, Traffic Division, City of Vancouver Engineering Department, June 3, 1969.
high, approximately 10,000 to 12,000 vehicles per 24-hour period, and about 5,000 to 6,000 vehicles in the 9 a.m. to 5 p.m. interval.  

Due to the constricted entrance to the CBD, congestion along the entering streets is high, and average vehicle speeds in the peak hour seldom exceed 23 mph. in the peak periods, as shown in Figure 13. In the non-peak hours, the conditions are improved only slightly, and average about 18 mph. along the main routes. If travel along the intersecting streets is included then the overall figure drops to about 15 mph. Thus the streets adjoining the major part of the study area suffer from congestion and over capacity.

E. EMPLOYMENT AND TRANSPORTATION REQUIREMENTS

In Chapter III, the waterfront businesses were grouped into land uses for purposes of tabulation into the general characteristics of sites, transportation flows, and future plans. Using these same categories of land use, further investigation may be made of employment and spatial characteristics, and of transportation requirements.

(1) Employment Requirements and Spatial Characteristics

Using the previously established categories of land use it was

60 Vehicle counts were obtained from the Traffic Division, City of Vancouver Engineering Department, March 11, 1970.

61 V. Setty Pendakur, Peter Tassie and Neil J. Griggs, Multiple Use of Transportation Corridors in Canada; Part II: Socio-Economic and Transport Consequences, Vancouver: School of Community and Regional Planning, The University of British Columbia, October 1969, p. 50.
possible to compute the area requirements per employee both in terms of floor area and site area, shown in Table 17. A definite trend is shown in which the space per employee is very much higher at the terminals than they are at the public administration facilities. In this latter category the floor space per employee is 469 square feet, not far above the same characteristic for the Vancouver CBD of 325 square feet. Generally the working force employed within the study area is much less intensive than in the CBD.

### TABLE 17

**EMPLOYEE SPACE REQUIREMENTS, STUDY AREA, 1969**

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Floor Space per employee (sq.ft.)</th>
<th>Site Area per employee (sq.ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goods Terminals</td>
<td>1,680</td>
<td>14,400</td>
</tr>
<tr>
<td>Passenger Terminals</td>
<td>512</td>
<td>30,000</td>
</tr>
<tr>
<td>Marine Sales, Service &amp; Repair</td>
<td>600</td>
<td>7,000</td>
</tr>
<tr>
<td>Fish Processing</td>
<td>613</td>
<td>2,800</td>
</tr>
<tr>
<td>Other Processing</td>
<td>1,280</td>
<td>2,400</td>
</tr>
<tr>
<td>Public Administration</td>
<td>469</td>
<td>570</td>
</tr>
</tbody>
</table>


While most of the land uses appear to be randomly distributed within the study area, shown in Figure 4, page 26, some patterns of concentration show up. The most apparent of these is in the marine

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sales, service and repair category, in which the businesses are largely found in the western part. Half of the 14 users are situated between Burrard Street and Cardero Street, while the remainder are scattered throughout the study area.

A similar trend is noticeable in the public administration facilities in which five of the six agencies are located in the section between Burrard Street and Campbell Avenue. The passenger terminals are also largely concentrated in the western part, with five of the six services situated west of Main Street.

As a result, the three land uses of marine sales service and repair; public administration; and passenger terminals are predominantly located in the western part of the study area. The remaining three land uses, goods terminals, fish processing, and other processing do not show any clustering characteristics, but are mainly located east of Main Street.

(2) Transportation

With the data available from the questionnaire the correlations of truck trips and total tonnage handled (by rail or truck) with area and waterfrontage were obtained using the TRIP computer control program. The resulting coefficients of correlation are shown in Table 18, and generally show a strong relationship between land tonnage and either site area or waterfrontage.

The correlations obtained would indicate that regression equations may be developed from this data to indicate and predict the
relationships between the independent and dependent variables. However because the standard errors of estimate were so large the independent variables were found to be non-significant. Accordingly this aspect of analysis was discontinued and further use was made of modes, number of trips and tonnages by land use, not intended to be used as predictors, but to illustrate the differences between land uses.

**TABLE 18**

**COEFFICIENTS OF CORRELATION**

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Total Land Tonn.-Floor Area</th>
<th>Total Land Tonn.-Site Area</th>
<th>Total Land Tonn.-Water-front</th>
<th>Truck Trips-Floor Area</th>
<th>Truck Trips-Site Area</th>
<th>Truck Trips-Waterfrontage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goods Terminals</td>
<td>.097</td>
<td>.798</td>
<td>.921</td>
<td>-.052</td>
<td>.095</td>
<td>-.186</td>
</tr>
<tr>
<td>Fish Processing</td>
<td>.001</td>
<td>.218</td>
<td>.424</td>
<td>-.038</td>
<td>.660</td>
<td>.470</td>
</tr>
<tr>
<td>Other Processing</td>
<td>.470</td>
<td>.882</td>
<td>.908</td>
<td>.930</td>
<td>.660</td>
<td>.540</td>
</tr>
</tbody>
</table>


(a) Modes

Separation of the businesses into land use, illustrated in Table 19, showed that several of the land uses had no need for rail access, and that others had minimal transportation requirements. As might be expected goods terminals and processing plants made the maximum use of transportation facilities.
### TABLE 19
**AVERAGE MONTHLY TONNAGE PER USER BY MODE**
**STUDY AREA 1969**

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Rail (tons)</th>
<th>Total Monthly Rail Tons</th>
<th>Truck (tons)</th>
<th>Total Monthly Truck Tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goods Terminals</td>
<td>20,220</td>
<td>222,400</td>
<td>4,283</td>
<td>47,100</td>
</tr>
<tr>
<td>Passenger Terminals</td>
<td>0</td>
<td>0</td>
<td>33</td>
<td>200</td>
</tr>
<tr>
<td>Marine Sales, Service and Repair</td>
<td>0</td>
<td>0</td>
<td>77</td>
<td>1,100</td>
</tr>
<tr>
<td>Fish Processing</td>
<td>202</td>
<td>3,200</td>
<td>349</td>
<td>2,100</td>
</tr>
<tr>
<td>Other Processing</td>
<td>1,612</td>
<td>12,900</td>
<td>2,714</td>
<td>21,700</td>
</tr>
<tr>
<td>Public Administration</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>238,500</td>
<td></td>
<td>72,200</td>
</tr>
</tbody>
</table>


(b) **Number of Trips**

Further analysis of the questionnaire data was used to compute the average number of cargo trips by land use, as an indication of rail and highway requirements. While the results, shown in Table 20, correspond to the trends shown in Table 19, they do not exhibit the wide ranges previously shown.

(c) **Tonnage**

The ratios of tonnage handled to area for each of the land uses within the study area were computed from the questionnaire data. The resulting ratios, the quotient of tonnage handled by either rail or truck, divided by the area, are shown in Table 21. The ratio for Goods Terminals is about 30 per cent greater than for Other Processing,
TABLE 20
AVERAGE MONTHLY TONNAGE TRIPS, STUDY AREA, 1969

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Rail Trips</th>
<th>Truck Trips</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>per acre</td>
<td>per user</td>
</tr>
<tr>
<td>Goods Terminals</td>
<td>23.9</td>
<td>428</td>
</tr>
<tr>
<td>Passenger Terminals</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Marine Sales Service &amp; Repairs</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fish Processing</td>
<td>2.5</td>
<td>16</td>
</tr>
<tr>
<td>Other Processing</td>
<td>12.5</td>
<td>53</td>
</tr>
<tr>
<td>Public Administr.</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


and about 16 times greater than Fish Processing, where large tonnages are handled by water. For Public Administration the ratio is so low that it would appear there is little to distinguish this land use from a normal office building in the CBD.

When the figures of Table 21 are applied against the waterfrontage occupied by each land use, shown in Table 2 (page 55), three major shippers account for over 99 per cent of the cargo tonnage shipped in and out of the study area. These three categories are Goods Terminals, Fish Processing, and Other Processing, and together they occupy
about 5/6 of the waterfrontage.

Of these three major land uses the Goods Terminals predominate the study area, in both waterfrontage occupied and throughput of goods. In waterfrontage they occupy 8,274 feet, or slightly over half of the total. In goods handled they account for about 87 per cent of the tonnage (Table 19), 90 per cent of the rail trips and 66 per cent of the truck trips (Table 20). They are thus the major land use in the study area insofar as transportation is concerned.

TABLE 21

TONNAGE - AREA RATIOS, STUDY AREA, 1969

<table>
<thead>
<tr>
<th>Land Use</th>
<th>Average Monthly Tonnage Per Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rail</td>
</tr>
<tr>
<td>Goods Terminals</td>
<td>1,028</td>
</tr>
<tr>
<td>Passenger Terminals</td>
<td>0</td>
</tr>
<tr>
<td>Marine Sales, Service and Repair</td>
<td>0</td>
</tr>
<tr>
<td>Fish Processing</td>
<td>32</td>
</tr>
<tr>
<td>Other Processing</td>
<td>380</td>
</tr>
<tr>
<td>Public Administration</td>
<td>0</td>
</tr>
</tbody>
</table>


(3) Destinations of Transportation

The preceding section showed that the Goods Terminals were the pre-eminent land use and transportation user, and that they accounted for the majority of tonnage handled and cargo trips by highway and
rail. It was therefore considered that information on trip destinations from the goods terminals would be representative of the study area.

The introductory section of this chapter segregated the goods terminals into bulk facilities and general cargo terminals. Analysis of the questionnaire results for the bulk terminals in the study area showed that their land shipments were almost exclusively by rail from sources outside the province to destinations outside the country. Aside from the working force, the urban dependency and interaction of these sites is minimal and their need for a location close to the urban centre is not acute.

The other segregation of the goods terminals, the general cargo piers, deal with diversified commodities of a different nature than the homogeneous cargoes handled at the bulk terminals. Analysis of the questionnaire returns revealed that movement of goods at these facilities involved both highway and rail transportation, and that the sources and destinations were not as concentrated as with bulk cargoes.

While the questionnaire revealed general information on the derivation and termination of products entering the study area, it did not yield specific data to determine the origins and destinations of land based traffic. To uncover this information would have required a tabulation of the large number of items on the ship's manifests. It was considered, however, that the majority, if not all of the rail based traffic, would be shipped out of the metropolitan area, while most of the truck trips would be within metropolitan Vancouver, in line
with the general economies of movement under these two modes.

To obtain information on truck trips to and from the study area a second questionnaire was devised, to be administered at a general cargo pier, as this facility was indicative of total trips in the area. This questionnaire, a copy of which is enclosed as Appendix III, requested information on the origins and destinations of trucks, the type and weight of truck and cargo, and the times of entry and exit from the pier.

This questionnaire was administered to truckers entering Centennial Pier, shown in Figure 4 (page 26), on February 18, 1970. The entrance and exit procedures at this pier, in which all traffic reports to a Gate House, lent themselves to the administration of the questionnaire from this building.

During the day the sample was taken 320 trucks entered the pier, and out of these 179 returns were received, although some were not completely answered. Consequently the sample represented 56 per cent of the truck population of that day, considered by the attendants to be typical of most working days. In addition about 210 cars entered the pier, from which no information was collected.

The analysis of the questionnaire returns showed that the dominant direction of movement of goods is away from the pier, contrasting with the characteristics of bulk cargo terminals, in which the prevailing direction of land based cargoes is toward the terminals. It was found that 35 trucks delivered a total of 256 tons to the pier,
while 116 vehicles hauled 1,045 tons away from the pier. This conclusion is verified in other studies,\textsuperscript{63,64} in which the rate of imports to exports was about four to one.

On the questionnaire the respondent was asked to supply information on the origin and destination of loads by census tracts. Of the 151 loads brought into, or taken out of the pier, 68 were within a \(1\frac{1}{2}\) mile radius, and 83 were within that part of the City lying to the north of 16th Avenue. If the whole of the City is considered, 99 out of the 151 were within the City limits, and the majority of the remainder were to the western part of Burnaby, with a few to New Westminster, Richmond, and North and West Vancouver. Only 6 trips out of the 151 went directly outside of metropolitan Vancouver, although some loads may have gone to a central collection point, to be exported out of the region as part of a larger shipment.

F. TRANSPORTATION DELAYS

Delay is used here in an overall sense, and refers to the delays that are caused to railway and highway traffic moving in and out of the study area. It includes delays caused by congestion and blockage, and from inefficiencies of movement.


\textsuperscript{64}Ross Robinson, \textit{Spatial Patterns of Port-Linked Flows: General Cargo Imports Through the Port of Vancouver, 1965}, Vancouver, Fall 1967.
Because of the precedence of rail traffic over highway traffic, allowing them for example, to block crossings for up to five minutes, they are not restricted within the same limits as vehicular traffic. Nevertheless, in the waterfront area, the railway operation is constrained by limits of capacity.

In spite of recent changes in railway switching procedure, whereby almost all Canadian Pacific Railway trains are broken up at Port Coquitlam, 17 miles east of Vancouver, the present line and yards in the study area are operating close to capacity. The chief point of congestion is the downtown yard of the Canadian Pacific Railway at the foot of Granville Street, which acts as a sub-depot for distribution to the nearby waterfront area.

Any increase in car loadings will require additional trackage and expansion. If, for example, the grain elevators are operating at their maximum capacity of 599 cars per day, the railways would have difficulty in finding enough trackage to carry out switching operations. In the downtown area expansion is not possible because of the restrictions imposed by Project 200. Elsewhere the right-of-way,

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65 V. Setty Pendakur et al., op. cit., p. 41, 54.
66 J. Kates, West Coast Commodity Transportation Study; Part I: The Transportation and Handling of Grains; Short Term Recommendations, Toronto: Kates, Peat, Marwick and Company, 1967, p. 35.
67 Interview with Mr. R. Hughes, Yardmaster, Canadian Pacific Railway Company, Vancouver, March 13, 1970.
68 V. Setty Pendakur et al., op. cit., p. 55.
generally 99 feet wide, would allow installation of additional trackage at most points east of the CBD, at the expense of increased blockage of grade crossings, and the extension or rebuilding of overpasses, underpasses and other structures.

Under the present arrangements between the railways operating in the study area, each company has its own trackage, under which there are definite restrictions on the switching of cars. Cars originating on Canadian National Railways sidings destined for Canadian Pacific Railway lines are not usually permitted to be switched by the Canadian Pacific Railway, but must be taken by the Canadian National Railways to the interchange point, where they are picked up by the Canadian Pacific Railway. For example, freight cars from the Canadian National Railways served Ballantyne Pier which are required to be handled out of Vancouver by the Canadian Pacific Railway must first be moved east by the Canadian National Railways to the interchange with the Canadian Pacific Railway at Campbell Avenue, and there picked up by the Canadian Pacific Railway for assembly into a train.

This arrangement increases the cost of handling a car routed to a siding controlled by another railway. The average cost of terminal handling in 1963 was estimated at 8 dollars per loaded car. When an interchange is required the cost is doubled to 16 dollars as a result of the duplication in handling by the two railways. In 1961 the waterfront area generated approximately 124,000 loaded rail cars. Of this number 38,000 required interchange at an estimated additional
cost of $300,000. 69

In addition to the additional cost incurred from interchanges between railways, a further charge results from delay at interchange points, estimated to be about a day. 70 The resulting cost of this delay, taking interest on capital, and insurance, as 10 per cent per year, is estimated at $125,000 annually for the waterfront study area.

(2) Highways

Delays resulting to highway vehicles operating on the waterfront occur at the terminals, between the terminals and the city streets, and on the city street system. Delays at the terminal apply only to that particular terminal or pier. Delays between the terminal and the city street system, and within the study area, are separated from those of the street system as responsibility for this phase is generally undertaken by the National Harbours Board, and involves railway crossings. Lastly delays on the city street system are within municipal jurisdiction.

(a) Terminal Delays

It was not within the scope of this study to tabulate delay time at all piers, and to evaluate their efficiency. The only data available is that from the Trucking Questionnaire at Centennial Pier in which the time spent at the pier for all trucks sampled was obtained


and is shown in Table 22. The data here probably represents an extreme case on account of the large number of trucks entering the pier and the small average load per truck. Much of this delay would be lessened by instituting a scheduling system.

If the data from Table 22 (below) is used to derive the accumulated non-productive time spent at the piers by trucks, and a thirty minute interval for loading or unloading a truck is a reasonable period, then the total delay time of the 132 trucks stopping for more than 29 minutes is approximately 135 hours. As the sample was approximately 56 per cent of all trucks, the total delay for one day was about 240 hours. If equipment and labour is valued at 12 dollars per hour, the average charge in a local freight tariff, then the additional expense imposed on shippers is $2,900 per day, and about $700,000 per year.

### TABLE 22

**TRUCK TIME AT CENTENNIAL PIER, 1969**

<table>
<thead>
<tr>
<th></th>
<th>0-29 min.</th>
<th>30-59 min.</th>
<th>60-89 min.</th>
<th>90-119 min.</th>
<th>120-149 min.</th>
<th>150-179 min.</th>
<th>180 min. and over</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Trucks</td>
<td>46</td>
<td>42</td>
<td>43</td>
<td>19</td>
<td>9</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>Percentage</td>
<td>26.0</td>
<td>23.6</td>
<td>24.0</td>
<td>10.7</td>
<td>5.1</td>
<td>6.7</td>
<td>3.9</td>
</tr>
</tbody>
</table>


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(b) Delays within the Study Area

In this section delays occur principally from blockages at the railway crossings. These crossings, along with underpasses and overpasses, are shown in Figure 12, page 96.

The two general cargo piers, Centennial and Ballantyne, shown in Figure 4 (page 26), are accessible by an overpass connecting with Heatley Avenue. A second overhead crossing constructed by the National Harbours Board at the foot of Renfrew Street allows traffic onto Commissioner Street. The last two overhead crossings, at Burrard and Granville Streets, are privately owned by the Canadian Pacific Railway. One of these, at Granville Street, is to be demolished as work on Project 200 commences in 1970, forcing traffic from the western part of the study area out into Burrard Street, or further west along a private road of the Canadian Pacific Railway to Cardero Street.

With grade separation structures, delay from the marine terminals to the city streets is negligible. However for those businesses within the study area using grade crossings, some delay is encountered from blockage of the crossing by railway cars.

Some field measurements of delay were taken at Rogers Street and Salsbury Drive, indicating that the total delay per day for all vehicles for one crossing is about one hour. The accumulated value for the 11 grade crossings would then be about 11 hours per day, a much smaller figure than that encountered at the general cargo pier.

The lack of a waterfront service road on the north side of the Canadian Pacific Railway right-of-way contributes to the difficulty...
of access in the study area. Although portions of a service road are in existence as Commissioner Street, this road does not extend westerly to the more congested parts of the city. Extension of this road would relieve traffic congestion in two ways. Firstly it would allow traffic to get directly from one waterfront site to the other without compelling it to make two crossings of the railway and travel along the city streets. Secondly, it would provide an alternative outlet for traffic from the waterfront area going to the city streets, in the event that one crossing was obstructed. As some parts of the study area at present are only accessible by one crossing, they are in effect "locked in" when the crossing is blocked.

While the construction of this service road would alleviate the difficulties described above, it would again be done at the sacrifice of land within the study area.

(c) Delays in City Streets

As mentioned previously, the only land access to the waterfront study area is across the railway. Because of the lack of a service road, traffic from the study area is forced onto the city street system at a crossing situated near the business location. In so doing it enters a street system where peak hour average speeds west of Main Street are between 0 and 13 mph., and in non-peak hours increase about 5 mph. Between Main Street and Victoria Drive average peak hour is about 10 mph. higher. Only in that part of the study area east of Victoria Drive does travel speed increase beyond 23 mph.
Not only is the congestion high on the east-west streets, but is also high on the north-south streets close to the waterfront. Throughout the CBD, and in that part of the city adjoining the study area as far east as Clark Drive, the average speed on these north-south routes is from 0--13 mph. at the peak.

To tabulate the delay resulting to traffic servicing the waterfront area, the origin and destination data of trucks entering Centennial Pier were tabulated by census tract. From data of the Traffic Division of the City of Vancouver Engineering Department showing distance and average 24 hour speed on the collector and arterial streets in metropolitan Vancouver, the distance and average travel time to each census tract was computed. The resulting total travel time of all trucks was compared with the result obtained from the same vehicles travelling on uncongested streets. The additional time resulting from congestion was 27 per cent above the base condition.

The 27 per cent surcharge resulting from congestion is supported by the findings of a local trucking company, in which a special tariff is imposed upon traffic originating in deepsea docks or terminals. The extra rate is about 15 per cent above the basic rate. According to a company official this extra rate is not high enough to cover costs of servicing the waterfront docks, but should be increased to about 30 per cent.\footnote{Interview with T. Barrie Lindsay, Manager, Export-Import Services, Johnston Terminals Limited, February 16, 1970.} The method used in determining
the increased costs was by random sampling of trucking costs of all vehicle trips, out of which emerged the increased cost of operating in the waterfront.

Elsewhere, an eastern trucking company executive estimates the cost of operating on inter-city hauls is about one quarter the cost of urban movements. In downtown Toronto the running costs in the downtown area were $2.06 per mile, as compared with $1.05 per mile in the fringe areas.

G. SUMMARY

This chapter has dealt with port land needs and transportation requirements as measured in the study area. It started with developments that have been initiated in maritime technology in the past decade, in which the resulting economies that may be effected in total transportation costs were shown to apply to both bulk loading and general cargo terminals. The facilities to contain these newer developments have one common requirement: land, which is required in large quantities, in the order of 100 acres.

The future shipping flows that may be expected in the Port of Vancouver were then introduced to indicate the magnitude of cargo tonnages that may be expected in the next decade. The total projected

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tonnage of 1980 is approximately double that of 1970.

In dealing with the study area it was shown that some land uses tended to concentrate in the western part. Employment space requirements varied considerably and employment at the goods terminals was much less space intensive than in normal CBD uses.

In considering all businesses in the study area different access and transportation requirements were exhibited. Some land uses had no need for rail access and minimal need for highway transportation, while others had much higher requirements. The goods terminals showed the maximum need for transportation accessibility both by highway and rail and accounted for 87 per cent of the tonnage, 90 per cent of the rail trips and 66 per cent of the truck trips.

The origin and destination of truck loads at a general cargo pier were concentrated close to the pier, although further research is needed to determine the ultimate destination of these loads.

In the concluding section on delays it was shown that inefficiencies and duplication of railway switching procedures imposed an additional $425,000 annual expense on the waterfront area. Delays at the terminal for the one case studied were excessive and resulted in an additional annual charge of $700,000 through unproductive time, that would be relieved in a scheduling system.

Lastly, transportation costs of vehicles operating in the study area are estimated to be 27 per cent higher than in uncongested areas, not because origins and destinations are in the CBD, but because traffic serving the area is routed onto the congested street system.
serving the CBD. The construction of a waterfront service road would alleviate this condition at the expense of a limited supply of land adjoining deep water moorage.
CHAPTER V

THE URBAN INFLUENCE ON WATERFRONT LANDS

It was suggested in the earlier chapters and hypothesis, that there are two developments occurring simultaneously at the port interface, the result of which impedes the future port development. The first of these is the changing shipping activity and port requirements for space and transportation in the context of recent technological developments. The details and consequences of these were discussed in Chapter IV. The conclusions reached were that future space needs for all existing users can not be met unless some industries relocate or additional land is available. Similarly the future transportation demand calls for large scale improvements simply to maintain the present levels of service. Thus technological changes in the shipping and related industries are causing significant pressures at the urban/port interface that require large scale transportation investments.

There is also a second development that is occurring at the port interface that adds to the already critical situation. This is the expanding urban population and its own space and transportation needs. The trend toward metropolitan living is strong and observers are unanimous in projecting this trend into the future.¹ In Canada

¹Benjamin Chinitz, City and Suburb, the Economics of Metropolitan Growth, Englewood, New Jersey: Prentice-Hall, Inc., 1964, p. 3.
for example 70 per cent of Canadians now live in urban areas and by 1980 this will have reached 80 per cent, most of them living in 29 major urban centers across the country.2

This chapter attempts to document these urban pressures and the relationship between the City of Vancouver and the Port. This relationship will be examined in terms of activities, zoning, land uses, land values, the flow of goods and people, industrial, commercial, residential and recreational needs, major developments, and blight and its social and economic consequences. By examining each of these, an overall impression of the city's influence on the port will be gained. This will be of value in understanding what the conflict is between shipping activity and the adjoining urban development.

This information alone would not be sufficient on which to base investment decisions for urban expansion into the port area or vice versa. As a result an understanding of the benefits, both economic and social, that the city receives from the port operation has to be undertaken. Intensive investigation into this area is not included in this study, however some basic measurements have been made in terms of port growth forecasts, land needs and the resultant economic impact.

A. URBAN GROWTH AND DEVELOPMENT

(1) Commodity Flows and Transport Linkages.

The growth of Vancouver has always been associated with the waterfront because of the import and export trade, which has been a part of the city since its earliest days. However the role of the downtown waterfront has changed markedly over the last century, as has its relationship to the city. Originally it served the most important means of transportation, making it the center of commerce for the early settlement. This settlement around 1859 was primarily engaged in sawmilling, and logging. Here at the waterfront timber was exported, goods were received, passengers landed and departed, mail was received and news and gossip spread. This was the first of what we believe to be the City's three stages of development.

The port and the town were one, through which all goods and people passed and to which all communication, roadways and paths were linked. Similarly 100 per cent of all incoming goods were destined for this community. This was the first of three stages of development which is graphically shown in Figure 14A, Port and Region Commodity Flows. The volumes of trade flows for the first two stages are estimates, but the third stage reflects the present situation and was extrapolated from the 1969 Waterfront Questionnaire.

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3 A similar development occurred in the state of Wisconsin. Wisconsin, Department of Housing and Urban Renewal, Waterfront Renewal, Madison, 1966.

The second stage of Vancouver's development, Figure 14B, occurred some twenty years later in the mid 1880's, and was primarily the result of poor navigation channels along the Fraser river. The town became the fur trade center for this area. The communication, trade and transportation links were now extended from the local community to a much larger hinterland, that could be penetrated by small river craft. Thus the port hinterland, in addition to the original settlement also became dependant upon the harbour, and in turn the harbour services. As the hinterland trade and population grew, so its demand on port facilities grew, both in terms of exports as well as imports. A result of this was a change in the overall flow of goods; the local community was no longer the generator of all port activity as the port began to service these other settlements inland. The linkages in this second stage were primarily short haul for both land and marine, as compared to the short haul land linkages of the first stage.

The third stage occurred as a result of a technological change that enabled land linkages to become long haul and transcontinental. With the arrival of the railway in 1883 to Vancouver, it lessened the dependence of the city and the local area on waterborne commerce for all its livelihood. The port was now linked with all parts of the continent, for its resources, and shipment of food, goods, mail and gossip. This process of linkage diffusion

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has continued with the addition of each new railway, road and freeway, and today the city/port relationship in terms of commodity flows has changed substantially as seen in Figure 14C-1 and 14C-2 (page 122). Of all goods flowing from the waterfront, the city now absorbs 10.3 per cent, and of all goods flowing to the waterfront the city's contribution is .6 per cent. This is a considerable change from the situation 100 years ago when the city received 100 per cent of the imports and was accountable for 100 per cent of the port's exports. Thus the waterfront area is no longer the city's transportation hub as it used to be. In some instances it would appear that the city has virtually "turned its back" on this area to which it now has few direct trade links. The discussion of road access in Chapter IV confirms this, where it was seen, in some instances, that access to the waterfront was only via tortuous and indirect back lanes.

(2) Service Links

As goods flow through the city, they have to be transferred from one transportation mode to another, from marine to land and vice versa. At this point, where change of ownership usually occurs, there develops a vast array of service industries to handle this transference. These include customs service, steamship agencies, shippers, brokers, marine insurance, banking, ship supplies and chandlery, tug hire, stevedoring, repair service, warehousing, and a port authority, to name a few. Each of these have direct links
with the port in various forms, either by telephone, telex, correspondence or by truck, automobile or personal contact.

These are important port/urban links, any one of which may be significant enough to influence locational decisions. The Lower Mainland Regional Planning Board suggested in 1961 that it would be quite impossible, at least for some decades to equip any new port facility with the supporting facilities which downtown Vancouver now provides for its harbour. For example, one basic pattern of links are the daily personal visits that are made to each site. Although all sites at one time or another receive service calls, each over time develops a basic pattern. Figure 15 shows the point from which most daily visits are made to each site. It would appear that the city (which includes the CBD and waterfront) and the metropolitan area have an equal share of linkages. This indicates the wide range of influence the waterfront has over the entire area.

An explanation of this scattering can be based on the location of businesses in the port service sector. Figures 16, 17, and 18 show the office distribution of these businesses. Each group appears to have differing and yet definite location patterns. Steamship Companies, Customs Brokers and Shipping Agents are highly concentrated and appear to require a Central Business District location over a waterfront location. The opposite appears to be the case for Ship Chandlers and Marine Equipment Suppliers, who have located

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MAJOR ORIGINS OF PERSON
TRIPS TO WATERFRONT SITES


15 Person Trips
close to the waterfront and adjacent to shipping terminals. Finally Importers and Exporters are both concentrated and dispersed, the latter is in part explained by their warehouses which are located to optimize distribution.

It would appear from these maps that waterfront proximity is not a foregone conclusion for these port service industries, in fact the analysis in Chapter III showed the average distance of Goods and Passenger Terminals to the Central Business District to be over one mile. An attempt was made to substantiate this conclusion. A 25 per cent sample was taken of the above businesses, primarily in respect to an economic analysis which appears in Section F. However one question was directed at this aspect of location. 6

Each of the sampled Marine Services were asked if they could continue to operate from their present location should the entire port function be relocated to the new Roberts Bank Super Port. Their response and the employment implications are seen in Table 23. It is interesting to note that most companies gave this question serious thought and indicated that if they did not move to the new location they most likely would open a small one- or two-staff branch office. The planning implications of this for both Delta and Vancouver are significant. Not only would there be a redistribution of business taxes, residential populations, and traffic, but also significant office space requirements. For example, of the 54

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6 This survey is referred to as The Service Sector Survey 1970. See Appendix IV for sample of the letter and questions asked.
businesses that indicated a definite move, they would require an additional 237,500 square feet of office space, based on 250 square feet per employee.  

### TABLE 23

**PORT RELOCATION: IMPACT ON SERVICE INDUSTRIES,**  
**VANCOUVER 1969**

<table>
<thead>
<tr>
<th>Service Industries</th>
<th>Companies that Indicated Relocation necessary</th>
<th>Employees Involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customs Brokers</td>
<td>10</td>
<td>50</td>
</tr>
<tr>
<td>Steamship Companies</td>
<td>8</td>
<td>880</td>
</tr>
<tr>
<td>Ship Chandlers and Agents</td>
<td>5</td>
<td>160</td>
</tr>
<tr>
<td>Marine Equipment and Supplies</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Importers and Exporters</td>
<td>31</td>
<td>124</td>
</tr>
<tr>
<td></td>
<td><strong>54</strong></td>
<td><strong>1,214</strong></td>
</tr>
</tbody>
</table>

Source: Service Sector Survey 1970.

It would appear from the responses that the largest waterfront employment category (Marine Services) would be affected by

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8 Service Sector Telephone Survey, conducted January 1970, using a 25 per cent sample of the 352 businesses.
less than 15 per cent shift in business operations if the entire port function was relocated, and that Vancouver would still retain the lion's share of this service business.

In summary the historic growth and development of Vancouver in terms of commodity flows and service links have been found to be a useful method of describing the changing relationship between city and port. This approach is basically a Systems Approach which attempts to view the port/city relationship in terms of a total transportation system. It is concerned with the flow of commodities as well as the servicing of this flow. Historically the city's relationship dominated the entire flow of commodities, and the port functioned to meet the community needs, therefore proximity of port and community was important. As transportation improvements were made and resource areas opened up in the country's interior, the city depended less and less upon the port for its goods and communication but rather became a service center for it. For example of all goods today flowing from the waterfront, the city absorbs 10.3 per cent and of all goods flowing to the waterfront, the city's contribution is .6 per cent. Conversely 89.7 per cent of imports and 99.4 per cent of the exports must pass through the urban area in order to reach their respective points of origin and destination. It is expected that this pattern will continue into the future, unless a significant change occurs within the city, for example changes in industrial growth that will alter this pattern. The following section expands upon this.
(3) Population Forecast

The City of Vancouver is forecast to receive a 25 per cent population increase over the 18-year period 1968 to 1986, or a total increase of some 90,000 persons. Table 24 below shows these trends for the city and metropolitan region.

TABLE 24

POPULATION PROJECTIONS, 1966-1986. CITY AND METROPOLITAN VANCOUVER

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>City of Vancouver</td>
<td>384,522</td>
<td>410,375</td>
<td>435,000</td>
<td>458,000</td>
<td>480,000</td>
<td>500,000</td>
</tr>
<tr>
<td>Metro Vancouver</td>
<td>894,384</td>
<td>972,467</td>
<td>1,026,000</td>
<td>1,169,000</td>
<td>1,335,000</td>
<td>1,524,000</td>
</tr>
</tbody>
</table>

Source: Department of Municipal Affairs, Victoria, Lower Mainland Regional Planning Board.

The reasons for this increase are complex, but according to a 1960 study, for the Metropolitan Joint Committee, two major factors are attributing to this increase.\(^\text{10}\) The first major force is the "amenity" factor. Edward Ullman suggests there is growing evidence today that pleasant living conditions and amenities such as climate, scenery, mountains, beaches and the sea are becoming more significant.

factors in the population growth of urban communities. Vancouver apparently has these amenities and planners believe this is a factor that is contributing to its rapid growth.

The second force is the growth of secondary manufacturing industries, these are tending to locate in Metropolitan Vancouver.

Being at the point of transportation break, where break-of-bulk occurs, Vancouver is therefore the place where manufacturing processes yielding reduced bulk and enhanced values, can take place profitably. Thus the early head start which Vancouver obtained as a result of its being located at the point of transportation break gave it an initial location advantage over other cities and towns. Since then her economic development and population growth have continued and there is no evidence that this trend will not continue into the future.

From these brief comments it appears that Vancouver can expect a steady growth so long as these two "resources"—amenity and break-of-bulk remain. The growth of the latter will result in increased resource demands as well as increased external trade. This could substantially influence the present pattern of commodity flows, and Vancouver may once again contribute substantially to port trade. However the critical issue here is the location of these industries, be they at the waterfront, other city industrially zoned lands or in industrial parks outside the city. For each of these locations the commodity flow patterns would differ and the degree of accessibility would also differ.

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12 G. Hodge, and I. M. Robinson, loc. cit.
The availability of land, as well as the projected requirements of industry, commerce, recreation and residences, are discussed next.

B. AVAILABILITY OF LAND

The arrival of the railway in 1883 along the Vancouver waterfront had a two-fold effect. The first has already been discussed, in that all parts of Canada were now directly linked to the Far East in terms of trade. It was also seen that the "dominant" role which Vancouver once influenced over the port was changed at this time. The second effect of the railway being located in 1883 at the waterfront, resulted in an immediate shortage of land for shipping facilities. Figure 19 shows the location of the railway in relation to land fill areas. From this it is seen that the entire port has been built on land-fill and that any future expansion will undoubtedly require further land reclamation.

It could be argued therefore that the port has historically been short of development space. This study found the situation to be no different to one made in 1961 which concluded that there was practically no readily available waterfront land on Vancouver Harbour. 13

13 Lower Mainland Regional Planning Board, loc. cit.
(1) Waterfront Land Needs

As cautioned in Chapter I, the findings that follow on waterfront land needs is based on only 74 responses of the 100 occupants and is not a complete survey of the entire waterfront. In attempting to obtain an overall land needs picture the results have been proportionately increased to account for this sampling bias.

Within this study area, 56 per cent of the industries indicated an expected increase of business over the next five years, 19 per cent gave no reply and 15 per cent expected a decrease. The overall increase reflects a growing area, whose spatial demands are now summarized.

Twenty-nine per cent indicated a definite need for increased floor area and 34 per cent additional outside space requirements. Table 25 summarizes these figures in terms of general land use categories. It is acknowledged that these figures are not exact measurements of future requirements, but rather an estimated, generally "off the cuff" projection of land needs that each manager foresaw for his own establishment.

Within the next five years it is expected that the present users of the city waterfront will require an additional 84 acres for their normal expansion needs. This may not appear too serious a problem, however, when 60 per cent of the establishments indicated that additional adjacent space was not immediately available, it becomes critical. The most obvious solution will be to develop more land fill and water lots. This is based on present National Harbour
TABLE 25
PORT LAND REQUIREMENTS, VANCOUVER WATERFRONT STUDY AREA, 1970-1974

<table>
<thead>
<tr>
<th>Land Use</th>
<th>No. of Firms</th>
<th>% that required additional outside space in 5 years</th>
<th>Average Plant Size (acres)</th>
<th>Respective Plants and Space requirements</th>
<th>Total Future Land Needs (acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fish Processing &amp; Storage</td>
<td>21</td>
<td>52%</td>
<td>1.47</td>
<td>1 @ 10%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4 @ 40%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 @ 60%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 @ 90%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3 @ 100%</td>
<td>9.0</td>
</tr>
<tr>
<td>Goods Terminal</td>
<td>14</td>
<td>43%</td>
<td>14.9</td>
<td>2 @ 5%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 @ 15%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 @ 20%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 @ 100%</td>
<td>38.5</td>
</tr>
<tr>
<td>Passenger Terminals</td>
<td>6</td>
<td>33%</td>
<td>0.7</td>
<td>1 @ 35%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 @ 100%</td>
<td>1.0</td>
</tr>
<tr>
<td>Marine Sales Service &amp; Repair</td>
<td>14</td>
<td>28%</td>
<td>6.5</td>
<td>2 @ 25%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 @ 30%</td>
<td></td>
</tr>
<tr>
<td>Manufacturing &amp; Other Processing</td>
<td>10</td>
<td>40%</td>
<td>4.3</td>
<td>1 @ 5%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 @ 15%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 @ 40%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 @ 100%</td>
<td>6.8</td>
</tr>
<tr>
<td>Public Administration</td>
<td>6</td>
<td>0%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Construction</td>
<td>2</td>
<td>50%</td>
<td>1.2</td>
<td>1 @ 30%</td>
<td></td>
</tr>
</tbody>
</table>

This total of 67.4 acres has been rounded up 25% to 84 acres to account for the differences between the sample taken and the total occupants.

Board policy that allows for this form of development so long as it does not interfere with shipping channels. The development of the new Centennial Pier container terminal exemplifies the policy.

In conclusion it appears that for some years now the availability of land at the waterfront has been at a premium. The situation for the next five years sees even greater space demands, which may account for the 13 industries that indicated they have been considering other waterfront and industrial sites. This space shortage has resulted from increased demands from existing waterfront industries. No account has been made of alternative sites or the additional urban demands on this area. Therefore a city perspective is added, which considers the main land uses and their potential demands on this waterfront.

(2) City Land Needs

As the city grows it is a foregone conclusion that land is developed and zoned areas become filled. The purpose here is to summarize the most recent publications on the city's future land requirements as they relate to the waterfront. The four land uses discussed, Industrial, High Density Residential, Commercial and Recreational, are selected on the criteria of their present developing trends on the waterfront. For the purpose of this study it is presumed that market forces will allow these developments to continue, despite the zoning.
(a) Industrial Requirements

The most recent industrial survey was completed in 1969 by the City Planning Department, and will be used, along with C. N. Forward's Waterfront Land Use, as the basis for this section. The study completed by the city also looks at the industrial land requirements for the metropolitan area and in doing so has relied upon work done some years earlier, by the Lower Mainland Regional Planning Board of British Columbia.

Figure 20, on General Land Uses, shows approximately 2,000 of the 2,834.81 acres of industrially zoned land in the city. Within these districts primary manufacturing firms dominate the Vancouver manufacturing activity of which Wood and Wood Products, Primary Metals and Non-Metallic Minerals account for 70 per cent of the manufacturing acreage. The major land uses in the industrial districts are as follows:

TABLE 26
MAJOR LAND USES IN INDUSTRIAL DISTRICTS - VANCOUVER 1969

<table>
<thead>
<tr>
<th></th>
<th>Acres</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Manufacturing</td>
<td>765.12</td>
</tr>
<tr>
<td>2.</td>
<td>Wholesale &amp; Retail Trade</td>
<td>421.39</td>
</tr>
<tr>
<td>3.</td>
<td>Storage &amp; Transport</td>
<td>313.55</td>
</tr>
<tr>
<td>4.</td>
<td>Vacant</td>
<td>210.87</td>
</tr>
<tr>
<td>5.</td>
<td>Residential</td>
<td>126.56</td>
</tr>
<tr>
<td>6.</td>
<td>Parking, Signs, Garages</td>
<td>55.98</td>
</tr>
<tr>
<td>7.</td>
<td>Other Uses</td>
<td>144.34</td>
</tr>
</tbody>
</table>

Source: Vancouver City Planning Department, 1970.

16 Vancouver City Planning Department, op. cit.
This survey indicated that approximately 75 per cent of the industrially zoned land (excluding the waterfront) is being used for industrial purposes and that 25 per cent is either vacant or in some other temporary use. This 25 per cent represents 502.52 net acres. According to the Technical Report Number 4, if the demands continue at their present level, 12.7 years' supply of potential industrial land remains in the city. This figure could be reduced to 10 years if the North and South sides of False Creek, and the Fairview slopes are rezoned and taken out of the industrial land market, which appears to be a most likely proposition. The details of each parcel and its annual take up rate is expanded in Appendix V.

Vancouver, over the past five years has received (176) new industries and follows Burnaby as the second most active in industrial development. Thus central location, within the Metropolitan Area, is still a strong determining force in the location of new industry. There is also a tendency for the new industries to be small wholesalers and with distributorships and servicing facilities. As these require small amounts of space, the high land values of $50,000-$175,000 per acre becomes less significant. Thus the waterfront area could be most attractive for these new industries that import or sell their products overseas and thus could claim a waterfront location. At present there is no detailed Harbours Board policy for the

18 Ibid., p. 17.
priority of waterfront tenants, other than by demonstrating a need for a waterfront site.  

Within 10 years it is expected that all city zoned industrial land will be occupied, when that occurs, there will be extreme competitiveness for such property.

The situation becomes less critical once a Metropolitan perspective is taken. Industrial Land--Metropolitan Vancouver, Appendix VI gives comparable figures for acreages and values in the Metropolitan region, here the 10,400 acres of vacant land is an obvious outlet for this near capacity situation in Vancouver. In addition C. N. Forward suggests that the Fraser-Pitt River-system offers the principle supply of potential waterfront land for industry in the future. The major disadvantage here is the restricted deep sea channel depth which is limited to 28 feet 6 inches.

In conclusion it appears that industrial pressures for waterfront land are indeed apparent. The city's available land supply is expected to last another ten years. This demand is not only measurable in land scarcity and rising values, but also in changing industrial demands, from primary to secondary and service. The latter two require different transportation requirements, smaller sites and

19 Interview with the National Harbours Board Port Engineer Mr. L. Carlyle, Vancouver, B. C., July 17, 1969.

20 C. N. Forward, op. cit., pp. 42, 43.

21 Ibid.
generally are more labour intensive, which result in their urban location preference. In addition to these future industries seeking industrial sites in the city, there are the existing waterfront users who themselves require additional space in an area where land is already at a premium. It would appear that the landlords of this property, the National Harbours Board, are about to experience some unprecedented demands for industrial space. This will require some policy decisions regarding their long-term land use objectives for the waterfront.

(b) Residential Requirements

The residential requirements for the city are examined only in terms of high density dwelling units as this is the only residential land use that appears to compete effectively with industrial or commercial uses for downtown waterfront property.

Indications are that soon there will be a shortage of zoned land for apartment development in Vancouver. Table 27 below projects when a 95 per cent development will occur in the five major apartment areas.\textsuperscript{22} The study by the city concluded that the areas presently zoned for high density residential could reach capacity development by 1977 (high estimate) or by 1981 (low estimate).

This would indicate that most areas in the city within ten years could be subject to rezoning. There are some indications that

TABLE 27
MAJOR APARTMENT ZONES, AND 95% DEVELOPMENT DATES
VANCOUVER 1969

<table>
<thead>
<tr>
<th>Zone</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kerrisdale</td>
<td>1968</td>
</tr>
<tr>
<td>South Granville</td>
<td>1970</td>
</tr>
<tr>
<td>Marpole</td>
<td>1971</td>
</tr>
<tr>
<td>Kitsilano</td>
<td>1972</td>
</tr>
<tr>
<td>West End</td>
<td>1973</td>
</tr>
</tbody>
</table>

Source: Vancouver City Planning Department, 1969.

certain commercial zones and industrial zones are today being rezoned to Comprehensive Development (CD-1) so as to allow a residential mix. Certain False Creek proposals have applied for this zoning, Denman Place in the West End is a residential/commercial complex, and two waterfront areas are preparing such development. These are Harbour Park in Coal Harbour, which will be hotel, convention center and apartments, and the second is Project 200, see Figure 22 page 160 to cover an area of 28.6 acres and will consist of three basic elements.

(i) An office/hotel/trade center.

(ii) A residential area containing six apartment buildings and some townhouses.

(iii) A department store-retail area.

The residential area alone will amount to 1,417,865 square feet of floor space. 23

23 V. Setty Pendakur et al., op. cit., p. 19.
In addition to these developments, both of which contain large hotels, there is an existing waterfront hotel presently being expanded at the foot of Cardero Street at the westerly end of the study area.

Thus there appears to be residential and hotel accommodation planned for the waterfront, before the existing zoned areas are themselves filled. This once again indicates the presence of the urban influence on the port and the attractiveness of this setting for high density residential units. In ten years, when the present apartment zones are filled, one can expect areas within the city to be rezoned, however as the shoreline has already proven to be an attractive location it is expected that developers will continue to buy or lease property and air rights in the area for high density residential units.

(c) Recreation Requirements

Recreation is assuming an increasingly important role in modern society and the community is being expected to provide recreational facilities to satisfy the growing demand. Many recreational activities are focused on water and waterfront areas, and Vancouver is fortunate in having public access to more than ten miles of shoreline from Stanley Park to Point Grey. The Vancouver beaches have been developed for swimming and are used extensively each summer week-end, catering to as many as 50,000 to 100,000 persons on a fine afternoon. The New Brighton beach at the east end of the study area,
sandwiched between a grain elevator and a gypsum plant, is evidence that limited recreational zones can exist in conjunction with industrial uses.\textsuperscript{24}

It is most difficult to measure the demand and future requirement of recreational shoreline space. The Parks Board have figures for park space requirements per 1,000 population, but at present have no official policy on marine park requirements. Several studies have been done in the United States which indicate the growing demands of a boating population.\textsuperscript{25,26} Two recent studies have been done on the Gulf Islands\textsuperscript{27} and Georgia Strait\textsuperscript{28} areas and although neither focus directly on the specific demands of Vancouver, the latter can be related in general terms. Both studies indicate the rapid growth of boat ownership and both project accelerated increases.

The N. D. Lea Study of 1966 surveyed the entire metropolitan area, and projected future requirements to 1976 and 1986. The City

\textsuperscript{24}C. M. Forward, op. cit., p. 45.


\textsuperscript{28}N. D. Lea and Associates, Recreation Boating Study in Georgia Strait Area of B.C., Government of Canada, Department of Public Works, 1966 (in the files of the department).
of Vancouver projections are as follows:

**TABLE 28**

**BURRARD PENINSULAR WET BERTHAGE REQUIREMENTS**

<table>
<thead>
<tr>
<th>1966 Total Existing Berths</th>
<th>1976</th>
<th>1986</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,323</td>
<td>low 4,800</td>
<td>low 6,580</td>
</tr>
<tr>
<td></td>
<td>high 7,350</td>
<td>high 10,050</td>
</tr>
</tbody>
</table>


Within this area in 1966 over 50 per cent of the existing berths were in the Vancouver Harbour. The following table (Table 29) lists these berths and their parking capacity, the latter is included as it is a significant acreage of land not usually associated with boating.

**TABLE 29**

**VANCOUVER HARBOUR, BERTH AND PARKING FACILITIES 1966**

<table>
<thead>
<tr>
<th></th>
<th>Berths</th>
<th>Parking Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boatland Marina</td>
<td>165</td>
<td>133</td>
</tr>
<tr>
<td>Cardero Wharf Co.</td>
<td>23</td>
<td>30</td>
</tr>
<tr>
<td>Bayshore Yacht Service</td>
<td>16</td>
<td>-</td>
</tr>
<tr>
<td>Wharfage Harbour Tours</td>
<td>55</td>
<td>15</td>
</tr>
<tr>
<td>Marker Marine Brokers</td>
<td>40</td>
<td>-</td>
</tr>
<tr>
<td>John Sangster Ltd.</td>
<td>15</td>
<td>-</td>
</tr>
<tr>
<td>Burrard Yacht Club</td>
<td>124</td>
<td>30</td>
</tr>
<tr>
<td>Royal Vancouver Yacht Club</td>
<td>240</td>
<td>46</td>
</tr>
<tr>
<td>Blackmore Marine Service</td>
<td>80</td>
<td>50</td>
</tr>
</tbody>
</table>


---

30 *Ibid.*, Appendix H.
If the future facilities are to be patterned after the present locations, then the harbour area can expect between 2,400 and 3,700 additional berths by 1976 and a similar increase in parking spaces from 300 to approximately 1,400 spaces. For the purposes of this study the ratio between berths and parking capacity is assumed to be linear, and is to be used only as a "ball-park" figure. The requirements for 1986 indicate a further 50 per cent increase for both berths and parking spaces. There is of course no indication when facilities will be expanded or what proportion will in fact develop in the harbour. The pressure however for waterfront marinas continues to exist and is reflected in a two-year waiting list at Vancouver's largest 300 boat downtown marina, the Burrard Civic Marina at the entrance to False Creek.31

It would appear that this marine aspect of recreation is yet to "take off" as it has in other European and American coastal cities. Marine parks, salt water picnicking facilities, salt water camping facilities, overnight and vacation boating boatels and public boat rentals are entire recreational areas that have yet to be developed in Vancouver. The Inner Harbour could be an ideal amphitheatre for international yacht and speed boat racing. According to Mr. Minock its sheltered location would also make it a unique location for yacht moorage. However there are existing conflicting uses,  

pollution and a lack of long-range harbour goals that make planning for this rapidly developing activity most difficult.

In conclusion it would appear that recreation demands for marine facilities are growing at an extraordinary rate. However these facilities are not compatible with the existing harbour traffic of hovercraft, seaplanes and marine shipping. The site requirements for marine pleasure craft are a major limiting factor as to where its development takes place, for instance, the areas have to be well sheltered. In the case of port facilities, natural shelter is not so critical, as witnessed by the Roberts Bank development. Therefore it remains a matter of policy to determine what form the future marine facilities will be at Roberts Bank and Vancouver. The present competitive influence of marinas and marine facilities on the port's development are minimal, however within ten years these demands are expected to increase by 130 per cent, for an additional 4,000 berths and 1,500 parking spaces.

(d) Commercial Requirements

Estimates for commercial requirements are perhaps the most difficult to project. The projections made in 1960 never foresaw the large scale super blocks of Project 200 and the Pacific Center which together produce a total floor area of approximately 4 million square feet. Thus city projections made in 1968 for the Arbutus Regional Shopping Center have since been revised, and this indicates
the rapid change taking place. 32

Unlike the industrial and residential zones in the city, which are made up of large tracts of land, the commercial zones are relatively small and are scattered throughout the city, principally along major thoroughfares. The density and permitted uses in these areas are many and fall into one of any of the eight classes, C1, C2, C3, C4, C5, CM1, CM2, CD1. A detailed account of each area and each class was found unnecessary as take up of commercial land along major thoroughfares, and local districts has remained relatively stable in spite of the large proportion of undeveloped commercial zones that still exist in the suburban community. For example there still exists 4,000 dwelling units within these districts. 33

The only significant block of land in commercial use is in the downtown area and this takes up 24.8 million square feet or 50 per cent of metropolitan Vancouver's 50 million square feet. The suburban commercial area in Vancouver amounts to 8.5 million square feet, and is made up of 75 local areas, 14 district centers and a regional center. 34 As the downtown area accounts for 90 per cent of all new commercial developments this section will focus on this


33 Ibid.

34 Vancouver City Planning Department, Proposed Arbutus Park Regional Shopping Center, p. 14.
area, which is outlined as the CBD on Figure 20 (page 141).

Forecasts of retail sales volumes for 1981 have been updated and Table 30 below summarizes these projections. 35

### TABLE 30

**PRESENT AND FUTURE COMMERCIAL SALES VOLUMES AND FLOOR AREAS**

(MILLIONS OF SQUARE FEET), 1962, AND 1981

**CITY AND METROPOLITAN VANCOUVER**

<table>
<thead>
<tr>
<th></th>
<th>1962</th>
<th>1981</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Department</td>
<td>Non-Department</td>
</tr>
<tr>
<td>Metro Vancouver</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sales Volume</td>
<td>174.7</td>
<td>532.9</td>
</tr>
<tr>
<td>Percent</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Floor Area</td>
<td>3.00</td>
<td>8.00</td>
</tr>
<tr>
<td>City of Vancouver</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sales Volume</td>
<td>125.7</td>
<td>263.1</td>
</tr>
<tr>
<td>Percent</td>
<td>72</td>
<td>49</td>
</tr>
<tr>
<td>Floor Area</td>
<td>2.22</td>
<td>3.99</td>
</tr>
<tr>
<td>CBD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sales Volume</td>
<td>108.3</td>
<td>67.3</td>
</tr>
<tr>
<td>Percent</td>
<td>62</td>
<td>12.6</td>
</tr>
<tr>
<td>Floor Area</td>
<td>2.2</td>
<td>1.03</td>
</tr>
</tbody>
</table>

Source: Vancouver City Planning Department, 1969.

In terms of department store business the CBD is seen in the 1981 projection, to continue as the dominant center, accounting for almost half the metropolitan sales. It is also expected to contain half the metropolitan floor area. The floor area of non-department

---

store business in the CBD is also expected to increase and in this case by 20 per cent in 1981. The CBD's market share of retail sales and floor space in this sector is expected, however, to decline substantially. Thus from these projections a considerable future growth in total commercial floor space is expected.

Substantial redevelopment has occurred in the Central Business District since 1963. In general this has involved the building of commercial and office space on residential and vacant land. Between January 1963 and July 1969 a total of 27 major redevelopments were initiated in the CBD, each over $500,000 in improvement value. These developments amounted to 13.51 net acres of improvements of which 11.5 acres occurred in the city's traffic zones, 3 and 7, see Figure 21 for the location of Downtown Traffic Zones. Indications, according to the city officials, are that increased redevelopment activity in the near future will occur in Traffic Districts 9 and 13. Thus two of the four districts which have and will experience the greatest commercial and office redevelopment, border the waterfront. This again indicates the attractiveness of Urban Development close to the waterfront.

As suggested earlier, the projections of future demands for suitable commercial space is difficult to estimate. The following table (Table 31) compiled by the city is an attempt to account for the supply of undeveloped commercially zoned land in the eight traffic zones in the urban core area.36

36Ibid.
TABLE 31

SUPPLY IN ACRES OF UNDEVELOPED LAND BY TRAFFIC DISTRICTS
CBD VANCOUVER, 1969

<table>
<thead>
<tr>
<th>Traffic Zone</th>
<th>Vacant Areas</th>
<th>Older Residential Acres</th>
<th>Unimproved Parking Acres</th>
<th>Total Acres</th>
<th>Under Used Commercial and Industrial Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>.6</td>
<td>10.0</td>
<td>12.8</td>
<td>23.4</td>
<td>25.9</td>
</tr>
<tr>
<td>6</td>
<td>.1</td>
<td>-</td>
<td>.9</td>
<td>1.0</td>
<td>10.4</td>
</tr>
<tr>
<td>7</td>
<td>-</td>
<td>.4</td>
<td>3.9</td>
<td>4.3</td>
<td>20.7</td>
</tr>
<tr>
<td>8</td>
<td>.2</td>
<td>.9</td>
<td>10.1</td>
<td>11.2</td>
<td>12.8</td>
</tr>
<tr>
<td>9</td>
<td>2.4</td>
<td>9.7</td>
<td>11.3</td>
<td>23.4</td>
<td>27.3</td>
</tr>
<tr>
<td>10</td>
<td>.2</td>
<td>2.0</td>
<td>4.8</td>
<td>7.0</td>
<td>12.2</td>
</tr>
<tr>
<td>11</td>
<td>.5</td>
<td>.1</td>
<td>7.6</td>
<td>8.2</td>
<td>9.5</td>
</tr>
<tr>
<td>13</td>
<td>.5</td>
<td>6.7</td>
<td>6.8</td>
<td>14.0</td>
<td>31.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4.5</strong></td>
<td><strong>29.8</strong></td>
<td><strong>58.2</strong></td>
<td><strong>92.5</strong></td>
<td><strong>150.3</strong></td>
</tr>
</tbody>
</table>

Source: Vancouver City Planning Department, 1969.

In total 92.5 net acres are available. At the average rate of
development which prevailed from 1963 to 1969 (2.08 net acres per
year), this supply would take 44.5 years to fill up. Even if the
highest rate recorded (4.44 net acres in 1967) were used, complete
redevelopment of the CBD would require 25 years.

This figure of 92.5 acres is not a true figure as underdeveloped
land must be included. Thus all properties with improvements to
land ratios below 2.00 are totaled in the last columns of the above
table. The new total of available land is now 242.8 net acres and
this is equal to 69 per cent of the CBD. At historical development
Future developments are not limited to surface space alone. The possibility of future developments utilizing street air rights or sub-surface rights, parking lot airspace, railway air rights would suggest that perhaps the entire CBD could be classed as having development potential.

In conclusion it would appear that there is adequate supply of commercial and office space within the city and the Central Business District to take care of the future requirements for many years, perhaps indefinitely, especially by applying the space and air rights concept. Theoretically there should be no commercial urban influence on the waterfront. In actuality the waterfront is an attraction for commercial and office activity, as witnessed by recent developments in traffic zone 3 and proposals for zone 13.

A discussion of recent developments as well as development proposals follows, which demonstrates how non-industrial businesses are locating in, as well as adjacent to, the waterfront.

C. INTERFERING LAND USES

(1) Zoning and General Land Use

A traditional method of examining the urban influence is to examine the zoning regulations and see if changes have occurred in
both zoning and land use. These are relatively simple to measure. Changes in zoning come about from a variety of reasons, political, speculative, social or economic, however without over generalizing this situation, there has to be a significant market demand to rezone land. New York City is often quoted as an example of a density populated city, and in 1964 recorded a total of 4,977 persons per square mile. The City of Vancouver density is double that of New York and one can therefore speculate that land in this city is indeed susceptible to development pressures.

Most city maps indicate the study area to be an industrial waterfront. Figure 20 (page 141) shows the general land uses surrounding the waterfront, which for the most part conform with the zoning.

A recent city publication in 1968 indicated two zoning changes on the waterfront, one from industrial to residential and the other from industrial to commercial. These properties cover the westerly 1,000 feet of shoreline bordering Stanley Park. A year later these same properties along with an additional 1,000 feet were all rezoned to Comprehensive Development (CD1). Comprehensive Development allows for a mix of residential and commercial land uses.

38 Benjamin Chinitz, loc. cit.


40 Vancouver City Planning Department, Downtown Vancouver, Part 1, The Issues, Vancouver, 1968.
This zoning category is a direct result of developers demanding greater flexibility for developments, however the City argue that this form of zoning also allows for greater civic control.\textsuperscript{41}

In 1968 the developers of Project 200 applied for rezoning for Stage 1 of the project which covers 500 feet of shoreline (see Figure 22, page 160, for location of Project 200). This they received from the city, and it appears that eventually the entire project will receive this zoning condition. The total rezoned shoreline area, including all of Project 200 which is 2,000 feet, amounts to approximately 4,000 feet, that has, and will have changed from industrial to comprehensive development. The entire waterfront shoreline adjacent to the downtown peninsula, from Stanley Park to Main Street is about 10,000 feet. Therefore approximately 40 per cent of this shoreline is no longer port orientated. It is assumed that it is technically possible to maintain the entire waterfront for maritime facilities, by dredging. At present the Coal Harbour portion is only dredged to a low water depth of 18 feet, which is ample however for ferry, barge and coastal traffic, but presently inadequate for deep sea shipping. It is not surprising in light of the earlier discussion on the city's density, that these changes in waterfront zoning have all taken place adjacent to the Urban Core and the High Density West End.

From this brief survey, it appears that industrial land is indeed at a premium in the City of Vancouver, and yet it appears to be.

\textsuperscript{41}Interview with Mr. W. E. Graham, Director of Planning, City of Vancouver Planning Department, July 17, 1969.
most susceptible to rezoning especially along the Inner Harbour as witnessed by, Harbour Park Development, the Bayshore Hotel, and Project 200.

These developments confirm the thesis that alternative use of the waterfront is being sought.

(2) Recent Developments and Development Proposals

The purpose of examining recent and proposed developments is to show where they are occurring and what proportion are on or adjacent to the waterfront. By seeing the concentration of developments, which are shown in Figure 22 an overall impression is gained, which indicates that most development is occurring within five blocks of the waterfront. New office developments in the Commercial and Central Business District, not shown on the map, tend to concentrate at the northerly edge of these districts. A list of these is seen in Table 32.

Between 1966 and 1969 the following thirteen office towers were built, all within the Central Business District and within a few blocks of the Port Interface. Their total office space amounts to 1,839,600 square feet. The remaining developments and development proposals that border the waterfront are briefly discussed, from west to east. Only the larger developments are seen in Figure 22.

---

TABLE 32
RECENT OFFICE DEVELOPMENTS IN DOWNTOWN VANCOUVER, 1966-1969

<table>
<thead>
<tr>
<th>Year</th>
<th>Building</th>
<th>Sq. Ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1966</td>
<td>Nesbitt Thompson Building</td>
<td>65,500</td>
</tr>
<tr>
<td>1966</td>
<td>Prescott Building</td>
<td>50,700</td>
</tr>
<tr>
<td>1967</td>
<td>Bentall Centre 1st Tower</td>
<td>245,000</td>
</tr>
<tr>
<td>1967</td>
<td>Royal General Insurance</td>
<td>97,000</td>
</tr>
<tr>
<td>1967</td>
<td>Phillips Building</td>
<td>67,000</td>
</tr>
<tr>
<td>1968</td>
<td>Montreal Trust Building</td>
<td>83,400</td>
</tr>
<tr>
<td>1968</td>
<td>Pacific Palisades</td>
<td>20,000</td>
</tr>
<tr>
<td>1969</td>
<td>MacMillan Bloedel</td>
<td>340,000</td>
</tr>
<tr>
<td>1969</td>
<td>Board of Trade</td>
<td>286,000</td>
</tr>
<tr>
<td>1969</td>
<td>Guiness Tower</td>
<td>260,000</td>
</tr>
<tr>
<td>1969</td>
<td>Bentall Centre 2nd Tower</td>
<td>170,000</td>
</tr>
<tr>
<td>1969</td>
<td>West Coast Transmission</td>
<td>150,000</td>
</tr>
<tr>
<td>1969</td>
<td>885 Dunsmuir Building</td>
<td>65,000</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>1,839,600</strong></td>
</tr>
</tbody>
</table>

Source: Greater Vancouver Real Estate Board, 1968.

The Harbour Park Area. Recently re-assigned to Mar-West Developments from the National Harbours Board, for the purpose of developing a hotel, apartment, trade center. This development will occupy waterfront property to the exclusion of any shipping or commerce.

Bayshore Inn Hotel Complex. Extensions there will accommodate some 500 rooms. Future developments anticipate a third hotel tower of 700 rooms as well as other facilities. This development occupies waterfront property and these extensions have been made possible through the
use of extensive land fills. The low water depth of Coal Harbour in the vicinity is 20 feet. This project occupies over 500 feet of waterfront and is not designed to accommodate shipping or maritime commerce.

Canadian Pacific Railway Ferry Slip. This land fill wharf and parking area of 10,000 square feet replaces the old Canadian Pacific Railway Pier A, and is used almost exclusively for trucks that are ferried to Vancouver Island and the Gulf Islands.

New First Narrows Crossing. The exact location and dimension of the causway will be determined once the city selects its route. This structure which protrudes into the harbour will undoubtedly restrict shipping activity to its west as the navigation channel will be narrower. If the waterfront freeway route is adopted, it will effectively cut off all parts of the waterfront from Burrard to Main Street from the urban area in terms of efficient truck access. The existing designs have not accommodated a waterfront truck route.

North Vancouver Commuter Ferry Terminal. A small temporary loading facility to accommodate commuters to the CBD located at the foot of Granville Street.

Pacific Hovercraft Limited. A small temporary loading and storage facility of 7,440 square feet that will accommodate the vehicle which connects Vancouver with Nanaimo.
Project 200. The total project covers some 28 acres and will extend 2,000 feet along the waterfront. The waterfront section is not designed to accommodate shipping or marine facilities. The existing Piers B and C, at its westerly boundary, will remain. Because of the large volumes of traffic that this project will generate the future accessibility of Piers B and C, for truck traffic to service this major general cargo and passenger terminal, is questionable. The Project is designed to accommodate 900,000 square feet of office space, 2,000,000 square feet of retail space, 1,000 hotel rooms, 1,000 apartments and parking space for 7,000 vehicles, and will generate 4,000 peak hour automobile trips.43

Townsite Renewal Program. A renewal program started in 1969 to "save Gastown", the historic center of Vancouver. The area covers several blocks and this program has encouraged reinvestment in an area of once declining land values. These increasing land values, have acted as a formidable barrier against industrial expansion into this area, a land use that appears to be needed along this waterfront.

Project 100. National Harbours Board. The first stage of this 100 acre project has been completed and consists of a new container terminal with one berth of 687 feet and approximately 5 acres of backland. The remaining 90 acres of fill has been temporarily halted, as discussions continue as to the future role of the inner

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43 V. Setty Pendakur et al., op. cit., p. 50.
harbour. The major conflict here is the esthetic impact of such a facility which would be viewed by thousands of office workers from the new and proposed developments. Mr. D. Mooney, the General Manager of Marathon Realty, who are the partners in Project 200, indicated that should Project 100 be completed he seriously doubted if his own Project 200 would be built to its intended capacity. He indicated that much of the attractiveness of the Project would be lost if the National Harbours Board persisted with their development. Whether the discontinuation of Project 100 has been influenced in any way by the developers of the $300 million Project 200, will be difficult to confirm, however it must surely be recognized as an urban pressure that is effecting port development.

Urban Renewal Projects 1 and 2; Urban Renewal Schemes 3, 4A, 5 and 6. The Urban Renewal Projects and Schemes, the first three of which are completed, are attempts to redevelop areas that are declining, both in the physical and economic sense. None of these schemes spill into waterfront property, but they face a substantial area of waterfront both in False Creek and along the harbour waterfront from Main Street east to Semlin Drive. Thus the city has attempted to inject new life into these old areas in the hopes that they will once again become attractive areas and regain some of their lost land values. This policy in effect will hinder the future port orientated industrial

44 Interview with Mr. D. J. Mooney, General Manager, Marathon Realty Company Limited, Vancouver, June 12, 1969.
lands spreading from the waterfront into the city in places where land values were once decreasing. Thus the urban renewal policy can be described as a definite pressure that will impede the development of port back-up lands into the city.

In conclusion it would appear that there are indeed urban developments that will effectively hinder waterfront development, especially in terms of obtaining relatively inexpensive port back-up lands. Adjacent to the Central Business District and west to Stanley Park it appears that developments have generally utilized waterfront lands. This westerly portion once considered excellent for deep-sea facilities, accounts for approximately one-third of the city's waterfront space in the Burrard Inlet. In the remaining two-thirds, where it is expected that maritime commerce will continue, 50 per cent of this area has and will experience major developments at the urban interface which will effectively hinder development of this area for storage and cargo handling. In the remaining 25 per cent which is the easterly 10,000 feet, 1,500 feet is park land and the rest has both limited and steep back-up lands. Within 500 feet of this shoreline steepness of the slope is between 11-15 per cent, see Figure 6 (page 37). Thus the entire waterfront has been influenced in terms of future development by either geographic conditions or man made urban developments.
D. THE DISARRANGEMENT OF SITES

The hypothesis stated among other things, that there was a disarrangement of sites within the port area. Figures 23 and 24 trace the major (75 per cent or over) trade flows to and from the waterfront sites. The tenants have been evenly spaced along the waterfront for cartographic purposes, and thus the figures are not the true patterning.

It appears that there is a random spatial relationship between the businesses and their markets. No one section of the waterfront has specialized in any one of the four markets, for example industries trading primarily with the metropolitan area are not necessarily located closest to it, i.e., at the easterly end of the study area. Similarly businesses receiving and sending goods to the "rest of Canada" are scattered throughout the waterfront.

The economies that result from centralizing activities or systematically arranging land uses, thereby reducing service costs, transportation and handling costs, are not being realized. For example in this area fishing industries are concentrated, but at three separate locations and the same is true for grain elevators. Cargo wharves and service industries are intermingled with all other users. Each business could be more efficiently served, in terms of marine and land transportation if the waterfront was planned around common transportation needs. Joint access roads, joint parking and bay areas are obvious economies that could be realized. Causes of such disarrangements are complex and costly to remedy, however as the harbour continues to be
MAJOR SOURCE OF INCOMING GOODS TO WATERFRONT SITES

MAJOR DESTINATION OF OUTGOING GOODS FROM WATERFRONT SITES

developed, and older areas become condemned, i.e., Fisherman's Wharf at Campbell Avenue, the overall situation can be improved, by adopting a systematic allocation of land uses.

A further aspect of this problem is the mixed variety of users within the waterfront lands. The Waterfront Survey (1969) found that 28 out of 74 occupants had no deep-sea access, in an area classified by the National Harbours Board as prime deep-sea waterfront. Therefore 38 per cent of the occupants along the deep-sea terminal are not engaged in deep-sea shipping, and therefore presumably have differing transportation and service requirements from the rest. Thus not only do the industries appear to be randomly scattered along the waterfront but the industries themselves are not all port orientated. It is in this context that the sites along the waterfront are found to be in a state of disarrangement.

E. OTHER URBAN PORT RELATIONSHIPS

(1) Comparative Land Values

Changes in land values is one method of observing the major development patterns of the city. In terms of the Central Business District, where most research by the city has been done; Figures 25 and 26 show the relative change in values from 1950 to 1965. The Central Business District, the West End and most parts of downtown west of Granville street have experienced continuous increases in land values, in several areas over 100 per cent increases in each
ten year period. In 1961 these values along the downtown waterfront ranged from $2.00 to $25.00 (see Figure 27).

The influence of this change of both rising values in the downtown, and decreasing values in the east is difficult to measure in exact terms along the waterfront, however at a macro level this has been done.

The study by Forward clearly demonstrated the pre-eminence of the Inner Harbour in terms of market values of waterfront land. In 1965 the per acre value of waterfront, from Stanley Park to Clarke Drive, 50 per cent of the city waterfront, was priced at over $50,000 per acre. From Clarke Drive to Boundary Road the value was placed at $15,000 to $50,000 per acre, the second highest category. From his study there appears to be a relationship between the price of waterfront property and the intensity of development in the adjoining urban area.

Waterfront lots have complex assessment procedures, each are assessed in terms of land lots, fill lots and water lots, in addition their boundaries are difficult to locate in the assessment rolls. An attempt was made to establish land values along the waterfront, and compare these with the urban interface lands to determine what influence one may have on the other. This was abandoned due to difficulties in data collection, and an alternative procedure of assessment comparison was used. There have been no sales of Vancouver harbour-front

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Average $ sq. ft. Value by Blocks, Downtown, 1961.
property for many years to establish current market values and in
turn assessments, and therefore the method of comparing assessments
has limitations. For the purposes of this study they have been used
for comparative purposes only. The city assessor who is aware of
rents charged by the National Harbours Board, has capitalized these
rental values in determining his assessment value. The National
Harbours Board had their harbour property appraised by J. B. Ward
and Associates in 1966 and from this have set their annual rental
rates, these being 7.75 per cent of this appraised value. Most of
the land area in the Harbour is filled and therefore the rate for
filled land is generally the same as for upland. Filled land ranges
in value from $1.00 per square foot and up. The assessed values for
Harbours Board properties within the study area is as follows. 46

TABLE 33

NATIONAL HARBOURS BOARD PROPERTY ASSESSMENTS
VANCOUVER 1970

<table>
<thead>
<tr>
<th>Per Square Foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardero Street to Boundary Road</td>
</tr>
<tr>
<td>Cardero Street to Heatley Avenue</td>
</tr>
<tr>
<td>Heatley Avenue to Clark Drive</td>
</tr>
<tr>
<td>Clark Drive to Boundary Road</td>
</tr>
</tbody>
</table>

Source: Vancouver City Assessment Department, 1970.

46 Interview with Mr. Peter George, City of Vancouver Planning
Department, March 12, 1970.
Though these are general figures they indicate an obvious decrease in values the further one moves from the downtown area.

This pattern of decreasing land values, occurring with distance from the Central Business District has been a common phenomena in most cities and in the case of Vancouver, Table 34 shows the changing downtown land values. As in the case of the waterfront, with increased distance from the center, land values decrease.

In conclusion it appears that the highest urban land values are adjacent to the highest waterfront assessments and similarly the lowest waterfront assessments are adjacent to lower city land values. The causal relationship between these is a complex subject however for the purpose of this study it is concluded, as a result of the previous findings, and discussions with the Assessment Department, that the urban influence is primarily responsible for the variation in waterfront assessments. This influence is not only seen in assessments but also rentals, which in turn partly determine the tenants.

(2) Social Considerations

The significant urban influences on port development have already been mentioned and are generally quantifiable. These are, for example, existing traffic flows with which port traffic must contend, changing land values, non-port orientated developments, and the availability of land. There are, however, other relationships that are often visible but difficult to isolate and measure. For example the influence of two large ethnic groups, Chinese and Japanese, being
TABLE 34

MARKET VALUES OF LAND: CITY OF VANCOUVER, 1961, 1967

<table>
<thead>
<tr>
<th>Downtown</th>
<th>1961</th>
<th>1967</th>
<th>% of change</th>
</tr>
</thead>
<tbody>
<tr>
<td>West End &amp; Bulge</td>
<td>$51,030,000</td>
<td>$95,151,000</td>
<td>+86.5</td>
</tr>
<tr>
<td>CBD &amp; East Hastings</td>
<td>103,200,000</td>
<td>101,536,000</td>
<td>-1.6</td>
</tr>
<tr>
<td>Main-Georgia</td>
<td>5,357,000</td>
<td>4,404,000</td>
<td>-17.8</td>
</tr>
<tr>
<td>Total</td>
<td>$159,587,000</td>
<td>$201,091,000</td>
<td>+26.0</td>
</tr>
<tr>
<td>City Total</td>
<td>$780,000</td>
<td>$1,180,877,000</td>
<td>+51.4</td>
</tr>
</tbody>
</table>

Source: Land Values 1961-1967, Vancouver: City of Vancouver Planning Department, March 1968, p. 3.

adjacent to the waterfront, and the influence of the "skid-road" community are difficult to gauge. Similarly the benefits of living close to this centre of employment for the fish processing industry and the casual waterfront gangs required for longshoring, are again apparent but difficult to quantify. It was reported by fishing company managers and the longshoreman's union staff that both rely on this downtown area for much of their seasonal help.

On clear days most vantage points along the waterfront, especially the Ballantyne Pier parking lot, are lined with persons viewing the harbour activity. For the local resident it may be a fleeting look, for the visitors who have never seen a port, it could be a fascinating half-hour, and for the unemployed and retired it could be his major pastime. Employees at the Centennial pier noted that there are a
large number of "regulars" that come, rain or shine, and even respect each other's spaces along the railing.  

(3) Pollution and Blight

Finally the cause and effect of blight, though easily observable, is again difficult to establish. Whether blight at the waterfront causes blight in the adjacent city, or vice versa is not known, and would require considerable research.

It was established at the beginning of this chapter that the role of the downtown waterfront has changed markedly over the last century. The waterfront area is no longer the city's transportation hub as it once used to be, in fact the city appears to have virtually "turned its back" on this area. This disinterest is reflected in many ways, both social and economic, all of which gives this area its characteristics.

On the urban side of the port interface, downtown land values have generally declined, except in the previously mentioned Central Business District and the west end. Declining land values and older buildings often witness changes in tenants, from retailing to wholesaling. This general change is witnessed in the Central Business District which has been moving in a westerly direction from its old center on Hastings Street. Like most coastal cities, Vancouver also finds its oldest section located at the waterfront, in a state of

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47 Interview with the two attendants, Gate House, Centennial Pier, January 19, 1970.
decline, and making no positive use of the water.

Civic improvements in areas like these, have been minimal. For example while most of the city is sewered, the waterfront is not. Plans are however under way to remedy this and the Harbour West Interceptor, from Cardero Street to Main Street will be completed in 1971, and the Harbour East Interceptor from Main Street to Boundary Road by 1978.\textsuperscript{48} Presently not only do most of the harbourfront industries dump their waste materials directly into the harbour,\textsuperscript{49} but there are also four city outfalls that drain into this area. As pollution of waters is a major contributor to waterfront blight, it would appear that the city is contributing and influencing this process of blight in terms of untreated sewage and industrial wastes that drain from the north-easterly section of the city into the harbour area.

Underlying all problems of development in the harbour area is the basic need for pollution abatement and control. Use of urban waterfronts for either, industrial, commercial, residential or recreational use, is and will continue to be severely inhibited by the present polluted conditions of the harbour. The causes of existing pollution are several, originating from both the City and the Port. The major causes being as follows:

\textsuperscript{48} Interview with Mr. D. Purdon, Chief Engineer, Greater Vancouver Sewerage and Drainage District, March 13, 1970.

\textsuperscript{49} National Harbours Board Officials were not prepared to give details on this information as "the situation is soon to be rectified".
Discharge of untreated sewerage from upland areas.
Discharge of untreated industrial waste, including chemicals.
Discharge of organic refuse from food processing plants.
Seepage from petro-chemicals in storage tanks.
Discharge of oil and untreated sewerage from vessels.

Water pollution may not only be discouraging new industries from locating at the harbour, but also may be discouraging new land uses.

At the marine side of the port interface, technological changes in shipping and goods handling are placing severe constraints on the existing facilities, and unless these are flexible enough to meet the changing demands they will, in turn, become obsolete. The deterioration of old bulkheading and other retention structures, as well as the general age and condition of the existing facilities are an indication of potential causes of blight. Thus deterioration of harbour facilities or upland areas can result from a number of factors—although there appears to be some patterning. If poor conditions exist on one side of the interface they are likely to exist on the other. The West End and Downtown will soon be mirrored with similar high investment waterfront projects. Similarly the poor wharf conditions from Main Street to Commercial Drive are mirrored by poor housing and commercial districts at the urban interface.

There are a host of other social forces that operate between City and Port. The nostalgic and historic significance of the port's development, is for many, the history of Vancouver. Secondly
the port for seamen is their only contact with other persons and for them it has yet a different roll. Thirdly port cities are often notorious centers of underworld activity, especially in drug trafficking. Examples such as these are many and serve to show that there are complex inter-relationships. The waterfront is like any other section of the city, it is an active functioning organ linked by numerous and complex ties to that greater organism, the city.

(4) The Control of the Port

The Harbour of Vancouver is owned, controlled and administered by a multiplicity of organizations, government bodies and corporations. The following is a list of those organizations which have control over some part of the study area, and in this sense have an influence over it. A more detailed discussion on this aspect is presented in Chapter VI.

Federal Government; Provincial Government; National Harbours Board; Canadian Pacific Railway Company; City of Vancouver; Vancouver Parks Board; Department of National Defence; Department of Public Works; Department of Transport; Department of Transport- Marine; Department of Fisheries; Customs and Immigration Department; Pollution Control Board; The Greater Vancouver Sewerage and Drainage District; The Greater Vancouver Water District; Other Provincial Departments - Fisheries, Highways, Forests, Water, Public Works, Recreation and Conservation, etc.
F. ECONOMIC IMPACT OF THE PORT FUNCTION ON THE CITY OF VANCOUVER

Thus far it has been shown that the land in the port area is being caught in a squeeze. The urban area's growth is resulting in an urban overflow into the port, and at the same time the congestion of urban traffic is making the port facilities less accessible. The second force in this pressure squeeze was described in Chapter IV in which the technological change taking place in both the shipping industry and marine handling technology has resulted in the need for an increased port area. Some of these space demands can be met through land fill, but others may have to involve redevelopment of adjacent urban areas, especially for improved transportation access and distribution routes. These conclusions are based on the assumption that the present port function and occupants are to continue. Equally possible is the proposal that certain users relocate their operations to other industrial sites or certain shipping functions be relocated to the new Roberts Bank Superport.

It is not the purpose of this study to complete such an investigation but rather to present an overview of the economic benefits received by the city as a result of port activity. In this way there is a better understanding of the urban impact should the present conditions be allowed to continue to the point of choking the port operations. This choking process can occur very rapidly as shippers change shipping routes and import or export through Seattle or other Pacific North West Ports. The recurring longshoremen's strikes have
demonstrated the ability with which shippers and trucking companies can switch their operations to the American networks. Finally, any decisions to relocate shipping activity to Roberts Bank will have to be preceded by a more detailed examination of this following economic survey to determine the overall costs and benefits to the city and region. For example the tax benefits received from a new land use in the Inner Harbour, would have to be considered.

The economic impact of maritime commerce is here defined as that portion of the city's jobs that would not exist were the port not present. Although this is a hypothetical statement, it allows for an overview. At a more precise level several sectors of the port service industry were asked if they would have to relocate to Roberts Bank should the shipping function be moved to that location. Comment on this was made earlier in the section on Service Links, page 124.

Two basic methods have been used in the past to measure the impact from ports. The first measures the direct income generated by each ton of goods handled at the waterfront, and the second is an employment measure which simply relates the total "port population" to the city population.

(1) Cargo-Generated Income

The port income approach was pioneered in 1953 by the Delaware River Port Authority, and later improved upon in 1959. For the

purposes of this study the Economic Review by Eric Schenker entitled, *The Port of Milwaukee*, will be used as a base as there are no figures available for Vancouver. At best these figures in Table 35, on income generated from port activity, must only be taken as "ball-park" comparisons.

**TABLE 35**

INCOME GENERATED BY PORT ACTIVITY, PORT OF VANCOUVER
STUDY AREA - 1968

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Income per Ton Milwaukee (a) 1963</th>
<th>Income Per Ton Vancouver (b) 1968</th>
<th>Tonnage Vancouver (c)</th>
<th>Total Income From Commodity</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Cargo</td>
<td>$17.00</td>
<td>$20.00</td>
<td>3,225,000</td>
<td>$64,500,000</td>
</tr>
<tr>
<td>Grains</td>
<td>5.45</td>
<td>6.50</td>
<td>2,737,500</td>
<td>17,783,750</td>
</tr>
<tr>
<td>Petroleum</td>
<td>2.67</td>
<td>3.20</td>
<td>500,000</td>
<td>1,600,000</td>
</tr>
<tr>
<td>Coal</td>
<td>2.21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soybeans</td>
<td>5.45 Dry</td>
<td>Bulk 2.50</td>
<td>415,000</td>
<td>1,037,500</td>
</tr>
<tr>
<td>Salt</td>
<td>2.21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ores</td>
<td>1.60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td>6,877,500</td>
<td>84,921,250</td>
</tr>
</tbody>
</table>

(b) Based on a 4 per cent annual increase since 1963, less United States Discount, 10 per cent.
(c) Vancouver City tonnage calculated from Total Port Tonnage, see Appendix VII.

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(2) Secondary Income

These figures do not take into account secondary income generated by the expenditure of the original $84.9 million. This economic concept of the "multiplier" as used in regional analysis, specifically with regional input-output techniques, is used to calculate this additional income. Examples in the application this theory have been documented by Isard, Leontief, Miernyk, and many others. The Milwaukee study used two marine multipliers, based on previous studies, these were 2.905 and 2.33.  For the sake of simplicity this study will use the mean figure of 2.62.

Other secondary income would arise out of spendings from the 260,872 passengers that landed or embarked in Vancouver in 1968. If each spent $10.00 per head this would amount to $2,608,720. This is a conservative estimate as many passengers are from out of town which would necessitate overnight accommodation and meals. Crew expenditures have not been included, but would be substantial as almost 2,000 vessels entered Vancouver harbour last year.


56 Eric Schenker, op. cit., p. 136 and 137.

Additional income would be generated from the mooring facilities, the local passenger service, and the car and truck ferries. No attempt has been made to calculate these, but a figure of $1,000,000 is estimated. Table 36 below summarizes all direct and secondary income generated by industries in that portion of the Port of Vancouver which is within the City of Vancouver and along the Burrard Inlet.

**TABLE 36**

TOTAL DIRECT AND INDIRECT INCOME GENERATED BY PORT ACTIVITY
VANCOUVER STUDY AREA, 1968

<table>
<thead>
<tr>
<th></th>
<th>Estimated</th>
<th>Income Multiplier (2.62)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreign &amp; Domestic</td>
<td>$84,921,250</td>
<td>$222,493,675</td>
</tr>
<tr>
<td>Passenger Service</td>
<td>2,608,720</td>
<td>6,834,846</td>
</tr>
<tr>
<td>Other</td>
<td>1,000,000</td>
<td>2,620,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$88,529,970</strong></td>
<td><strong>$231,948,521</strong></td>
</tr>
</tbody>
</table>


The total revenue, direct and indirect, that is generated by the Inner Harbour section of the Port amounts to an estimated $231,948,521. This figure is not complete for the entire waterfront business. To obtain complete information, measurements should not be restricted to cargo wharves as numerous industries and services in this area handle low volumes of goods but generate high cash flows, such as marine repair industries. By using this approach the total revenue would be considerably increased. One indication of the total impact is seen in the employment measurements discussed below.
The Gross Provincial Product (the market value of all Provincial goods and services produced) of British Columbia in 1968 was $7.5 billion,\(^{58}\) with a population of just over 2,000,000. As no Gross City Product has been calculated for Vancouver, a relative population percentage has been used to arrive at this figure. The city's population in 1968 was approximately 420,000 or 21 per cent of the Province, therefore an estimate of the City's Gross Product for 1968 would be 21 per cent of the Provincial Product or $1,575,000,000. From these extremely rough but conservative calculations, the shipping industry's $232,000,000 contributes to 15 per cent of the city's Gross Product, or about one dollar out of every seven that circulates in Vancouver is derived from port activity. This has not included the non-shipping waterfront users.

(3) Employment

In order to obtain an alternative perspective of this impact from the maritime industry, a second method is used, that of employment. This has been measured in terms of male and female workers, employed both on the waterfront as well as in the service industries. These figures are calculated from the questionnaire returns in this study, and summarized in Chapter III.

A separate telephone survey was conducted in January of 1970 to determine the size, payroll and characteristics of the major

service industries. These included Customs Brokers, Steamship Companies, Ship Chandlers, Ship Agents, Marine Equipment and Supplies, and Importers and Exporters. A 25 per cent random sample was taken from the City of Vancouver Telephone Directory and each was sent an introductory letter, asking five questions. The following week each manager was telephoned the results of which are tabulated in Table 37. A total of 352 such businesses were listed, 88 letters were sent out (25 per cent) of which 13 were returned, as "no such address". Of the remaining 75 businesses, 50 were willing to cooperate and offered information (66 per cent response). The figures in Table 37 have taken this into account, and the responses have been weighted accordingly.

TABLE 37
MARINE SERVICE INDUSTRIES EMPLOYMENT AND PAYROLL,
CITY OF VANCOUVER AND PORT STUDY AREA, 1969

<table>
<thead>
<tr>
<th>Service Industry</th>
<th>Total Number of Companies</th>
<th>Average Marine Employees</th>
<th>Total Marine Employees</th>
<th>Average Marine Salary (a)</th>
<th>Total Marine Salary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customs Brokers</td>
<td>24</td>
<td>5</td>
<td>120</td>
<td>$6,700</td>
<td>$ 804,000</td>
</tr>
<tr>
<td>Steamship Companies</td>
<td>56</td>
<td>110</td>
<td>6,160</td>
<td>8,400</td>
<td>51,744,000</td>
</tr>
<tr>
<td>Ship Chandlers and Agents</td>
<td>44</td>
<td>32</td>
<td>1,408</td>
<td>7,320</td>
<td>10,306,560</td>
</tr>
<tr>
<td>Marine Equipment and Supplies</td>
<td>56</td>
<td>5</td>
<td>280</td>
<td>8,300</td>
<td>1,324,000</td>
</tr>
<tr>
<td>Importers and Exporters</td>
<td>172</td>
<td>4</td>
<td>688</td>
<td>8,200</td>
<td>5,641,600</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>352</strong></td>
<td><strong>8,656</strong></td>
<td></td>
<td><strong>$69,820,160</strong></td>
<td></td>
</tr>
</tbody>
</table>

(a) Calculated from total annual payroll.

When the service employment and income are multiplied by the 2.62 marine multiplier established earlier, then the total employment, direct and indirect, of the service industries and their payroll amount to 2,267,872 persons and $187,928,819. Table 38 below shows the figures for the total employment related to all the port operations in the City of Vancouver along the Study Area of the Inner Harbour.

**TABLE 38**

**TOTAL EMPLOYMENT RELATED TO PORT OPERATIONS, CITY OF VANCOUVER AND STUDY AREA, 1969**

<table>
<thead>
<tr>
<th>Total Employment</th>
<th>Full Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterfront On Site</td>
<td>2,415</td>
</tr>
<tr>
<td>Off Site</td>
<td>914</td>
</tr>
<tr>
<td>Vancouver Longshoremen</td>
<td>1,800</td>
</tr>
<tr>
<td>Marine Service, Agents, etc.</td>
<td>8,656</td>
</tr>
<tr>
<td>Waterfront Trucking (a)</td>
<td>1,340</td>
</tr>
<tr>
<td>Railway, Off Site (b)</td>
<td>200</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>15,325</td>
</tr>
</tbody>
</table>

(a) See Appendix VIII for calculations.

(b) Estimate.


The actual employment that the Port is directly accountable for, amounts to 15,325 persons. By applying the regional marine

59 See Appendix E for a copy of this letter.
multiplier of 2.62, it becomes apparent that when direct and indirect employment of the port related operations are viewed as a whole, they are seen to be a significant factor in the city's total employment. The new total employment figure that the port activity generates now amounts to 40,177 persons, or approximately 10 per cent of the city's 1968 population, or 25 per cent of the total labour force.

In conclusion one can clearly state that Port operations in Vancouver is a major asset to the city, contributing to a quarter of its employment and approximately 15 per cent of the Gross City Product. Therefore any decisions to improve the port operations that involve the relocating of activities will have to consider the economic effects in terms of the Gross City Product and employment.

G. SUMMARY

This chapter has shown that there are measurable pressures created by the city, that are and will continue to influence port development, as long as the existing situation is left to continue. These pressures are seen in terms of:

1. A rapidly diminishing supply of land, 84 acres alone are required in the next five years by the present waterfront industries.

2. High urban land values reflected in high waterfront assessments.

3. Commercial developments of no relation to port activity
occupying port lands; and

4. Urban sewerage polluting the whole area.

Operating apart from these changing land uses has been the overall changing role of the port, which is perhaps the major source of the current port/urban conflict. At its inception one hundred years ago the port's function was entirely one of supplying and receiving goods from the city. Now only .6 per cent of its exports originate from the city and 10 per cent of its imports are destined for the city. Thus in terms of commodity flows the port appears not to be dependent upon the city for its survival. In terms of service links and economic impact, however, they city is critically tied to the port function. Though the service industries do not require proximity to the port they do account for 57 per cent of the port's labour force, the latter being 25 per cent of the city's total labour force. Thus the service link is now the critical relationship between port and city, and in an era of improving communication systems the physical aspects of the spatial relation of these two functions could become less significant. Finally in terms of future urban pressures most indications are that industrial, recreational and high density residential pressures will create a critical demand on this area within 10 years as land in the existing zones becomes fully developed.
CHAPTER VI

PORT ADMINISTRATION

The jurisdiction and authority granted to an individual or corporation serves as a guide to future planning by establishing the limits within which that individual or body may act. While conceptions are abstract, they develop into concrete plans in response to a need, and depend upon the administrative and legal framework for their inauguration. A knowledge of this framework is then a prerequisite to an effective planning program.

Ports are no different from any other corporation, in that they are governed and administered by management, that they are responsible to a senior body, and that they operate within the limits of a sovereign authority. However a distinction may be made between a port and another corporation, in which the ports are a link in the national transportation network, and an instrument of national policy. In this respect they command greater attention than a comparison by the usual economic criteria would indicate.

In the previous chapters the emphasis has been placed upon the study area, its internal and external characteristics, and its interaction with the adjoining urban area. Nevertheless, the second chapter introduced the concept of the metropolitan area as a resource, considered as a single unit. This penultimate chapter will similarly discuss the metropolitan area, but from a planning and administrative
viewpoint, in which the whole is considered as the amalgamation and integration of the constituent parts.

The chapter will commence with an outline of the legal framework covering ports in British Columbia, and then will go on to describe the method of operation of ports and planning agencies in the metropolitan area. The conclusion will examine some of the limitations imposed under the present arrangement.

A. CONSTITUTIONAL AND STATUTORY BACKGROUND

The fundamental legal document defining national and provincial jurisdiction is the British North America Act,1 from which stems the division between federal and provincial authority. Generally the intent was to assign responsibility for matters of national importance to Canada, and those of provincial interest to the province, with residuary power going to the senior government. As a result, navigation and shipping, inter alia, were federal responsibilities, while the management and sale of public lands became one of the provincial responsibilities.

Although the British North America Act was a British statute, and came into force in 1867, before the admittance of British Columbia into the Dominion of Canada, the Act contemplated the possibility of such a step, as set out in Section 146.

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British Columbia became a part of the Dominion of Canada on July 20, 1871 under the Terms of Union, in which it was specified that public harbours became the property of Canada at the date of entry. While some doubt existed regarding the definition of public harbours it was recognized that a natural harbour not actually used for harbour purposes at the date of Union did not go to the federal government.

Some of the doubt mentioned above was resolved in 1924 by an Order-in-Council of the Dominion Government, in which the "right, title, and interest" of the Dominion to foreshore lands and lands covered with water, was restricted to six harbours. These six harbours were Victoria, Esquimalt, Nanaimo, Alberni, Burrard Inlet and New Westminster.

This Order-in-Council cleared up much of the doubt regarding ownership of lands seaward from the high water mark, although subsequently the jurisdiction of ownership of sea land at Roberts Bank became an issue which was referred to the Supreme Court of Canada. The findings of this court was that all lands below ordinary low water mark are the property of Canada, and under the jurisdiction of the nation.

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2 Great Britain, Order of Her Majesty in Council Admitting British Columbia into the Union, Court of Windsor, May 16, 1871.

3 Governor General in Council, Ottawa, P.C. 741, June 7, 1924.

Turning now from the question of jurisdiction of lands covered by water to the question of rights of ownership, the title to land is established under the provincial land registration statutes. Under these statutes ownership in fee-simple is the strongest interest that may be acquired in land, although it does not give to the owner an unrestricted right to carry out any action or erect any structure upon that land. The owner is still considered a tenant in fee-simple subject to control of the sovereign power.

This concept of ownership as a "high-class tenant" subject to regulations imposed under legislative action, has been accepted as zoning regulations and expropriation acts have become more prevalent commensurate with the increasing competition for land. Although lands covered by water are seldom the subject of certificates of indefeasible title, the same sort of over-riding conditions apply, in which navigable waters are analogous to public highways, and for the benefit and use of all. For this purpose navigation, and structures built in navigable water are subject to the control of the federal government.

Leading out of the above paragraphs it is appropriate to consider all lands, whether they are covered by water or not, and whether they are privately or publicly owned, as subject to regulations on the use of that land, imposed by governments, granted under the authority of the federal parliament or provincial legislatures. While some of these regulations stem from municipal legislation, the municipalities in turn are entirely under the jurisdiction of the legislature.
Within the metropolitan area, described in Chapter II, the interest in land, and lands covered by water, are shown in Figures 28 and 29. Figure 28 shows ownership of water lands, and Figure 29 shows administrations. These interests are summarized below:

1. **Federal Government**

   Owner of the bulk of the "inner harbour" from the First Narrows easterly to Port Moody, and including Indian Arm; and owner of the six harbours mentioned in P.C. 741, of which New Westminster is the only other site in metropolitan Vancouver.

   These are a few private ownerships of water land in the inner harbour, of which the Canadian Pacific Railway Company is the predominant owner.

   In addition, the federal government is the owner of all lands seaward from the ordinary low water mark, outside of the bays, harbours and estuaries, to the outer limit of the territorial sea of Canada.

   Landward the federal government has less participation, and ownership is limited to holdings of Indian reserves, defence establishments, and some other waterfront lands in Burrard Inlet and False Creek.

   In addition to ownership the Federal Government has responsibility and control over navigation and shipping under the Navigable Waters Protection Act. Within established harbours it regulates navigation, harbour facilities, services and policing, and some leases of water lands, under the National Harbours Board Act, The
North Fraser Harbour Commissioners Act, and the Fraser River Harbour Commissioners Act.

On land the federal responsibility is somewhat less. It has ownership of some upland acquired under either the National Harbours Board Act, or the appropriate Harbour Commissioners Act. These statutes empower the acquisition of land, including the right to expropriate.

In general the federal government has limited responsibility for land transportation, exercised through the National Transportation Act, and more specifically through such statutes as the Railway Act.

The following are the principal relevant federal statutes, being part of the Revised Statutes of Canada, 1952:

<table>
<thead>
<tr>
<th>Statute</th>
<th>Ministry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada Shipping Act, (Chap. 29)</td>
<td>Transport</td>
</tr>
<tr>
<td>Department of Transport Act (Chap. 79)</td>
<td>Transport</td>
</tr>
<tr>
<td>Fisheries Act (Chap. 119)</td>
<td>Fisheries</td>
</tr>
<tr>
<td>Government Harbours and Piers Act (Chap. 135)</td>
<td>Transport</td>
</tr>
<tr>
<td>Harbour Commissioners Act (Chap. 32, Statutes of 1964-65)</td>
<td>Transport</td>
</tr>
<tr>
<td>National Harbours Board Act (Chap. 187)</td>
<td>Transport</td>
</tr>
<tr>
<td>National Transportation Act (Chap. 69, Statutes of 1966-67)</td>
<td>Transport</td>
</tr>
<tr>
<td>Navigable Waters Protection Act (Chap. 193)</td>
<td>Public Works</td>
</tr>
<tr>
<td>New Westminster Harbour Commission Act (Chap. 158, Statutes of 1913)</td>
<td>Transport</td>
</tr>
<tr>
<td>North Fraser Harbour Commissioners Act (Chap. 162, Statutes of 1913)</td>
<td>Transport</td>
</tr>
</tbody>
</table>
(2) **Provincial Government**

Owner of most of the lands seaward from high water mark from the First Narrows to the Port of Vancouver limits, and of most of the remaining lands below high water mark in the metropolitan Vancouver area, including the Fraser River and False Creek.

As was the case in the inner harbour, there are some lands under separate ownership, in which the three main owners are the Canadian Pacific Railway Company, the City of Vancouver, and the Federal Government. Their holdings are in False Creek, and in the Fraser River at New Westminster.

On land the province is the owner of all land that has not been alienated, of all streets and roads in unorganized territory and municipalities except Vancouver.

With the exception of the upland and foreshore adjoining Roberts Bank, the province has not acted as a port developer, and its main role has been that of leasing land and in administering secondary roads and arterial highways. However it occupies a pre-eminent role in that it is the sole authority for municipalities, and has the power to amend or innovate all municipal legislation.

The following are the principal relevant provincial statutes related to port administration, all being part of the Revised Statutes of British Columbia, 1960.
Within the metropolitan area are 14 municipalities, consisting of the Cities of Vancouver, North Vancouver, New Westminster, Port Moody, Port Coquitlam, and White Rock, and the Districts of West Vancouver, North Vancouver, Coquitlam, Fraser Mills, Burnaby, Surrey, Delta and Richmond; and shown in Figures 28 and 29.

These municipalities are, with the exception of Vancouver, governed by the Municipal Act. Vancouver comes under the Vancouver Charter. In either case the municipalities are empowered to regulate land use through official community plans and zoning by-laws. In addition to these regulatory powers the municipalities have the important responsibility of providing for local roads and for public access to all lands. They may, and commonly do, undertake to provide services of water and sewerage.

At a stage above the municipal level, but below the provincial level, a further level of government was recently created, called the regional government. Its jurisdiction is the regional district, in the case of the Greater Vancouver Regional District corresponding to...
the municipalities of metropolitan Vancouver, plus the inclusion of some unorganized territory, mostly in the northern part of the district.

At present the Greater Vancouver Regional District functions are limited to hospital services and planning. The latter function is centered around the official Regional Plan adopted by the Lower Mainland Regional Planning Board, the predecessor of the regional district, in 1966. This plan was not retroactive and allowed existing municipal zoning to stand. However, in the event of change, it required that the proposed change must be toward that use specified in the Official Regional Plan.

(4) Railways

The last single agency to be considered, the railways, operate as links in the national transportation network. They were an essential instrument in developing the nation, and were given large financial and land grants to encourage construction. Under their acts of incorporation they were given broad powers, including the right to acquire land, and the right of expropriation. In addition to their incorporating legislation, they operate under both federal and provincial legislation.  

Many of the lands that were acquired, either through purchase, or as a subsidy, are in the urban centres, and have great value in today's market. In particular the Canadian Pacific Railway Company has

large holdings along Burrard Inlet adjoining the CBD, and in False Creek. This railway, along with the Canadian National Railways, are the owners of the bulk of the 500 acres taken up for railway yards, exclusive of main line track, in the City of Vancouver.  

(5) Others

The remaining land in the metropolitan area is in private ownership, in parcels of various dimensions and areas, and held under literally thousands of certificates of title in the Land Registry Offices of the Province. Much of this land borders on water and as such has the right of riparian ownership. This right cannot be abrogated without the consent of the upland owner, often requiring an expensive consideration.

B. PLANNING ADMINISTRATION IN THE REGION

(1) Federal and Provincial

The trends in the past regarding port administration have been to separate it from the urban area, and manage it either as a branch of the government, a private corporation under contract or lease, a joint stock company in which the government retains majority control, or as a separate public entity. In Canada the senior port agency has

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always been under the federal government. Initially the Harbour Commission form of management prevailed, although this trend was altered as the National Harbours Board assumed control of the major Canadian outlets in 1936.

In the Vancouver metropolitan area, the Board has jurisdiction of the Port of Vancouver, originally defined in 1936 as all tidal waters lying east of the line between Point Atkinson and Point Grey. This area was extended in 1967 to include Roberts Bank, Sturgeon Bank and Boundary Bay. 8

The area under the Harbour Commissioners includes the Fraser River easterly and upstream from the mouth to beyond New Westminster. It is served under two federal agencies, The North Fraser Harbour Commissioners, and the Fraser River Harbour Commission.

The control exercised by these three federal agencies varies with the nature of ownership of the sea bottom, listed in the first section of this chapter. In the inner harbour National Harbours Board control is strongest, as possession of the sea bottom, as well as control of navigation and shipping, gives this senior government agency a free hand to lease these lands for a specified use. Elsewhere in the Port, the National Harbours Board exercises joint authority of applications made under the Navigable Waters Protection Act, through provision contained in the National Harbours Board Act. 9 As the name implies, the Navigable Waters Protection Act is limited to navigable

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9 National Harbours Board Act (R.S.C. 195, Chap. 187), Sec. 38.
water, and does not include upland.

In the case of those parts of Vancouver Harbour and the Fraser River in which the sea, river bottom or foreshore is owned by the Provincial Government, or is privately held, the control of the senior government is lessened. Although the relevant statutes state that jurisdiction of these areas is with the federal authority, the explicit nature of this jurisdiction has not been clearly established. Notwithstanding that the federal government has absolute authority over navigation and shipping, it would appear that any extension of control beyond this stage would be limited, and would require the approval and cooperation of the owner of the sea bottom as well as the riparian owner. Lacking such an arrangement, each government would then be able to exercise a veto over proposed development.

(a) National Harbours Board Management

The report which led to the enabling legislation of the National Harbours Board in 1936, recognized the shortcomings of the Harbour Commission form of port administration that was prevalent in Canada at that time. To a large extent political patronage was used in the choice of appointments in the various Harbour Commissioners, and resulted in inefficiencies in engineering work and in management.

Sir Alexander Gibb further recognized the necessity of the ports as a part of the national transportation system, in which he

succinctly stated: "The main lines of communication in Canada traverse the country from Atlantic to Pacific. The 'East and West' route is the national policy, dictated not only to assisting the interior provinces to compete in the markets of the world, but directed even more into linking the whole Dominion into a single unit. And the natural corollary is the demand by the seaboard provinces that Canadian traffic should flow by Canadian channels."\(^{11}\)

The recommended form of administration resulting from the conditions mentioned above was specified in the National Harbours Board Act, in which central control was vested in the head office of the Board at Ottawa, and some measure of local control remained at the port. The intention was to establish a system of administration that "will give the ports full opportunity to develop on individual lines in accordance with local requirements, and at the same time to play their part in the national transportation system."\(^{12}\)

While this concept of port administration into central and local areas of control may be valid in theory, and was certainly necessary at the time of the Gibb report, local control is minimal and has been dominated by the central function. Today the main task of the local port office is in making operating decisions, while the planning of port facilities is undertaken at the head office of the National Harbours Board.\(^{13}\)

\(^{11}\)Ibid., p. 9.

\(^{12}\)Ibid., p. 12.

\(^{13}\)Wallace Edward McMullen, *Port Administration Structures*, 
The remoteness of the central office from the port has worked against development in response to local needs. On the contrary National Harbours Board policy is to remain inert until the need for further facilities has been well established.14

(b) **Harbour Commission Management**

Contrasting with the National Harbours Board administration is that offered by the two Harbour Commissions in the metropolitan area. Although the commissioners are appointed by the Governor-General in Council, there is little interference with the administration beyond this step, as long as the Commission is operating at a profit. The threat of interference from the head office appears to be effective in inducing both these Commissions to operate profitably, and both have consistently stayed "in the black". Furthermore, it was stated that the Harbour Commissions are able to handle goods at lower cost than those in the Port of Vancouver by virtue of higher ship unloading rates and superior unloading equipment.

The vitality of these Harbour Commissions stems from two sources. Firstly, the profit motive has been effective in creating an


14 Interview with Mr. J. E. Chadwick, Port of Vancouver Development Committee, March 9, 1970.

15 Information in this section was obtained from interviews with Mr. N. D. Eastman, Port Manager, The North Fraser Harbour Commissioners, Vancouver, March 26, 1970; and Captain J. W. Kavanagh, Port Manager, Fraser River Harbour Commission, New Westminster, March 30, 1970.
efficient operation. Secondly, the composition of the commissioners with locally based members has made the operation sensitive and responsive to local pressures. Cooperation with the Province has been undertaken, in which both Commissions have had delegated to them by the Province, the responsibility of administration of water lands under provincial control, in return for a share of the revenue. This undertaking has been successful.

(2) Municipal Control

The planning function is a comparatively recent addition to municipal services but has become recognized for its important role, in most municipalities forming a separate department of the administration. As an aid to implementation of planning and land use, all metropolitan municipalities have adopted zoning by-laws. With few exceptions the legality of these by-laws has been upheld in the courts.

All of the municipalities in the area border on, or extend into navigable water, be it part of the Fraser River or an inlet of the sea. It would appear that in the case of those municipalities whose limits extend into navigable areas, that the land use in these areas could be determined municipally, even though federal legislation states that jurisdiction is under the senior government. While within the study area, the City of Vancouver zoning is consistent with the National Harbours Board use, it is not inconceivable that differences could arise between municipal and senior governments. This potential dispute has never been tested in the courts, an indication that the
municipal governments concede this right to the senior governments. 16

Municipalities, to a greater extent than the provincial or federal government, are dependent upon the local tax dollar and are sensitive to pressure to effect a change in land use which will result in greater assessments and increased tax returns. In such situations the zoning regulations are virtually ineffective against the market demands for a change in land use or an increased intensity of development.

In determining land use and transportation routes there has been little comprehensive planning between municipalities and the senior governments despite the success of the Lower Mainland Regional Planning Board in enacting a general plan. To a certain extent municipalities have been frustrated by the two senior governments who are not bound by zoning by-laws and have instituted land use changes without the cooperation of the municipalities. Notable offenders in this respect are the Department of Highways 17 and the British Columbia Hydro and Power Authority—a provincial government corporation. 18

Above the municipal level, the influence of the regional form of government has yet to be felt. However it appears that its

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16 Interview, Mr. W. T. Lane, Solicitor, Township of Richmond, April 4, 1970.


effectiveness lies in a coordinating role, assuming functions that individual municipalities cannot undertake, either because they extend across several municipalities, or because they need a stronger financial base. Recently passed amendments to the Municipal Act have given the Minister a stronger hand in imposing a function upon a regional district.

C. SUMMARY

This chapter has outlined the planning and administrative framework in the metropolitan port area. It commenced with an introduction of the statutory rights of the various interests connected with land and water use. Following this a more detailed study was made of the various agencies having planning authority. These agencies were:

1. National Harbours Board
2. The North Fraser Harbour Commissioners
3. Fraser River Harbour Commission
4. Province of British Columbia
5. Fourteen Municipalities in Metropolitan Vancouver
6. Greater Vancouver Regional District
7. Canadian Pacific Railway Company and other railways.

Three specific conclusions are reached in this chapter. Firstly, there is no overall port authority. Although the National Harbours Board comes closest to this function, it is imbalanced
in favour of maritime facilities, and its primary interest has been on the marine side of the waterfront.

Secondly, the above agencies are generally uncoordinated. The best efforts at coordination are between the regional district and the fourteen municipalities. The remainder of the agencies are controlled either at the capital of British Columbia or Canada, or at the head office of the railways outside the region.

Lastly, the jurisdiction of land use in parts of the port have not been resolved. At present both municipal and senior governments claim jurisdiction over navigable water, although the senior government decisions have generally prevailed in case of conflict. Under this condition the line of division between municipal and federal jurisdiction is the high water mark, a line along which port activity is concentrated.
CHAPTER VII

CONCLUSIONS

A. SUMMARY

This research has focused primarily upon the study area, that narrow strip of land within the City of Vancouver, shown in Figure 4 (page 26), between the railway and the sea, about four and a half miles long, and varying in width from a few feet up to a quarter of a mile. When compared with the city or metropolitan area, it represents only a small fraction of the aggregate area.

If other indications, such as employment and land values are used in place of area, then different characteristics are evidenced, which are not revealed in a comparison on the basis of area. Total employment, land values and economic impact are significant indicating a greater intensity of activity in this area than in other parts of the city. These characteristics are important to the local level of government concerned with the provision of local services and collecting revenues through taxation.

The hinterland of the port, an area simple in concept but different to define rigorously, has an interest differing from the local viewpoint and is directly concerned with the maintenance of export and import flows. As a result this hinterland region has an important stake in the study area, as the majority of trade flows pass through this section of the waterfront.
Going beyond the two levels of concern mentioned above, the study area may be viewed from a national point of view, in which its significance is equally apparent. While in some respects it resembles the natural transportation corridors found in British Columbia containing the two transcontinental railways, a national highway, and a communication network, it differs from these corridors in that it is not a point of movement along, but an area for transshipment and change of mode for goods. In this sense it takes on importance not only as a center of employment requiring services, generating income, and commanding high land values, not only as point of shipment of goods from various parts of the hinterland, but in addition as a particularly vital link of the total transportation network in the fabric of external trade of the nation, upon which Canada relies heavily. From the latter point of view it deserves careful attention and consideration from the whole country, elucidated in the National Transportation Policy as the declaration "that an economic, efficient, and adequate transportation system making the best use of all available modes of transportation at the lowest total cost is essential to protect the interests of the users of transportation and to maintain the economic well-being and growth of Canada . . . ."¹

¹ National Transportation Act (S.C. 1967, Chap. 69), Sec. 1 (part).
government. Rather it is an amalgam of all these positions, each of which has its own sphere of interest and responsibility. In this context the role of planning becomes significant not only for the manifold interests that are represented, but also because of the potential conflict that exists. It was in this connection that the hypothesis was formulated, mentioning seven points that may impede the port in the present and future, and which is repeated below:

The conflict between the shipping activity and the adjoining urban area (1), in terms of disarrangement of waterfront sites (2), lack of available land (3), interfering land uses (4), congestion of transportation facilities (5), expanding shipping requirements (6), and port administration (7), is a significant impediment to the present operation and future development of the Port of Vancouver.

The parts of the study that followed the hypothesis are related to the testing of each of the seven terms mentioned above. The remaining parts of this chapter consider each term and conclude as to their effect upon the present operation and future development.

(1) The Conflict Between Shipping Activity and the Adjoining Urban Area

The transshipment process that occurs in ports is a major item in the total transportation costs, estimates, discussed in Chapter IV, place this between 45 - 60 per cent of the total shipping costs. Because of these large transshipment costs, it would appear that any minor improvement in this area could produce major returns to total shipping costs. Until now, all efforts of improving investment returns in shipping have been focused on the vessels.
Attention has yet to be paid to this former problem, that of transshipment, in Vancouver and it appears that the expanding trade situation and the rapid urbanization are two forces that will further aggravate the existing situation. The Far East, with which the Vancouver port presently does two-thirds of its trade, is expected to double its population within the next thirty years to 4 billion persons, or 60 per cent of the world's population. According to the 1967 British Columbia Research Council's report discussed in Chapters I and IV, this is bound to produce a substantial increase in trade through Vancouver.

For the same thirty year period the Economic Council of Canada predicts a large population growth for a number of cities, Vancouver being one. If both trends are correct larger volumes of cargo will be passing through this rapidly urbanizing area, given that the present port terminal will remain where it is. One can only conclude that with rising urban land and congestion costs, the transshipment costs are destined to increase and represent an even greater proportion of the total transportation cost. This has come about as a result of the conflict between shipping activity and the adjoining urban development.

The role of the port and its changing relationship to its city gives rise to an additional source of urban/port conflict. At its inception one hundred years ago the port's function was entirely one of servicing the city of Vancouver. Now only 0.6 per cent of its exports originates from the city and only 10 per cent of its imports
is destined for the city. Thus in terms of commodity flows the port appears not to be dependent upon the city of Vancouver for its survival.

This separation of port and urban function can also be seen in the location patterns of the Port Service Sector. For example Steamship Companies, Customs Brokers and Shipping Agents are located in that part of the Central Business District which is adjacent to the least active shipping area of the waterfront. Similarly Importers and Exporters are not concentrated around the major shipping terminals, in fact, many are dispersed through the city in what appears to be an attempt to optimize distribution locations for their warehouses. Ship Chandlers, Marine Equipment and Supplies have located along the waterfront and adjacent to shipping terminals, however, when asked if they would relocate their businesses to Roberts Bank should the entire port function be relocated there, they felt the move would be unnecessary and that they could continue their operations from their present locations. In all only 18 per cent (50 companies) in the total Port Service Sector indicated that they would move with the shipping function.

It would appear that the conflicting marine and urban developments, as well as the lack of dependency between city and port in terms of commodity flows and service flows, is such that proximity to each other is not essential.
(2) **Disarrangement of Waterfront Sites**

Waterfront users located adjacent to the Central Business District do not necessarily transact business with that area, neither are businesses located at the edge of the city's waterfront, trading primarily with the metropolitan area. It appears that the locational advantages of proximity have not been made use of. Neither has advantage been taken of from concentrating industries of a similar type. Some concentration has occurred with the fishing industry at Fisherman's Wharf, however, there are still three separate fishing areas existing along this waterfront. Other uses such as shipping terminals, passenger terminals, marine repair yards, marinas and shallow draft users could each benefit through greater consolidation of activities. For example, economies in servicing, transportation, storage and parking are some of the direct benefits attainable through consolidation. In this aspect waterfront sites and land uses are seen to be in a state of disarrangement.

(3) **Lack of Available Land**

The entire Vancouver metropolitan waterfront measures 330 miles and according to C. N. Forward's Report, discussed in Chapter II, the supply will meet the demands if properly managed, despite the growing pressures placed on it. Along Vancouver's Inner Harbour there remain a few small parcels of vacant land, totalling no more than 10 acres. Apart from this there are other small parcels with steep back-up lands facing deep waterlots that presently have marginal potential use for
shipping facilities. In the remaining area which is designated as the major deep-sea terminal, there is a severe shortage of available land.

Of the 74 businesses interviewed, 34 per cent required an increased site area within the next five years, the total requirements amounted to 84 acres. In addition 60 per cent of the businesses also indicated that adjacent space for expansion was not available. As a result of this and other reasons thirteen firms are considering a move to another site.

It would appear that to accommodate the future land requirements, the present policy of "land-fill" on which the entire harbor has been built since 1867, will be continued. This is a direct reflection of a shrinking land supply brought about by the adjacent urban development.

(4) Interfering Land Uses

Approximately 25 per cent of the users of the Vancouver waterfront area can be classed as non-harbour orientated, i.e., construction, public administration, and other manufacturing and processing industries. A further indication of this non-waterfront orientation is that 28 out of 74 firms indicated having no deep-sea access and 28 indicated no rail access. Thus throughout the study area approximately one quarter of the present businesses are non-compatible and are labelled as "interfering land uses", in terms of future port development.
In addition to these existing mixed uses are a number of proposals that will utilize waterfront lands to the exclusion of marine functions. These are Harbour Park development, the proposed First Narrows Crossing approaches, and Project 200. These projects effectively use one-third of the Inner Harbour waterfront and are seen as a major interfering land use.

The existing situation is expected to worsen over the next ten years as marina demands will increase five fold, as industrial and high density apartment zones become filled and as commercial developments continue to be built at this interface capitalizing on an attractive location.

In an abstract and yet very real sense, pollution is interfering with all existing land uses. Most waterfront users dump untreated waste and sewage into the inlet in addition to the four outfalls that the city has that empty into this area. Thus all existing and future developments compatible or incompatible with the existing area will have to contend with the blight effects influenced by pollution.

Finally, the urban area itself is seen as an interfering land use. Major developments and renewal projects have taken place along three-quarters of the port interface, and these large investments have effectively prevented any expansion of port functions into the back-up land area. This is seen as a definite barrier influencing the direction of port development. In addition the relative value of these developments appears also to have influenced tax assessments
on the waterfront lands. The highest assessments are found in the western portion, similarly the highest city taxes are also found in the Central Business District and the West End.

Thus in many aspects there have been interferences or influences on the waterfront lands, with reference to the port function.

(5) Congestion of Transportation Facilities

The major difficulty faced in transportation to and from the study area results from its proximity to the Central Business District, in which the traffic flows are inordinately larger than those generated at the waterfront. The present system of arterial streets serving this district is over capacity and results in an average speed within the CBD of about 15 mph. in non-peak hours, and somewhat less than 13 mph. in peak periods.

This congested condition is applicable not only in that part of the study area adjoining the CBD, but has a "back-up" effect which extends east to Victoria Drive, and thus applies to about 60 per cent of the length of the study area, and a higher proportion of users.

Traffic entering or leaving the waterfront is required to use the same streets that CBD traffic uses, as there is no alternative access. Not only is external traffic affected, but also internal traffic faces the same conditions because there is no continuous service road within the study area. The additional cost resulting to a general cargo terminal from the congested street system amounted
to a 27 per cent surcharge from the condition existing with uncongested traffic.

While railway traffic has not reached the condition of highway traffic, nevertheless it is faced with the same problems, not resulting from an upsurge in downtown traffic, but from a general increase in shipping along and beyond the waterfront area. The present lines are inadequate if the maximum elevator input of 600 cars per day is required.

The present switching methods and the arrangement of railway lines as discussed in Chapter IV, impose additional costs on the waterfront users. Interchanges between the two main railways contribute to delays of delivery and double the cost of handling. The combined effect of these restrictions results in additional costs of about $400,000 per year. Direct shipments of rail cars between the north and south shores of Burrard Inlet are now impossible, and a 30 mile detour is required to make this one-half mile trip.

Because of the unique position of the Vancouver CBD, alleviation of congestion is both difficult and expensive. To maintain the present level of service alone, let alone improve it, for the increase in traffic accruing from a current downtown undertaking, Project 200, would require six grade streets leading to the eastern part of the city, costing approximately $15 million.

(6) Expanding Shipping Requirements

Forecasts for port shipping show an annual increase of about 7 per cent, which will double the volume shipped in the next decade.
Of the various commodities, the bulk users will show a marked rise, and in demands above those of other commodities.

The 1968 capacity of the port was barely adequate to handle flows of that year. In the next decade an expansion of almost two-fold will have to be provided if the projected flows are to be accommodated, and will require more berths, and faster turn around time.

The major component for higher unloading rates and expanded facilities, is the need for more land. Elsewhere container terminals are being constructed on site of 120 acres each, and bulk loading facilities utilizing unit trains require about 80 acres. The land required to accommodate operation of these proportions is simply not available in the Inner Harbour without major disruption of adjoining urban, commercial and residential sites.

(7) Port Administration

Management of the port is impeded, in that no single agency exercises jurisdiction over port lands to provide coordinated planning. In the study area both municipal and federal governments are involved, while outside of Burrard Inlet all three levels of government exert some authority. While the National Harbours Board comes closest to overall management, much of its authority, and the authority of federal statutes, is limited to lands covered by water and foreshore. The very important aspect of jurisdiction over the upland remains a provincial or municipal responsibility.

The lack of a suitable overall agency has been mentioned and emphasized in other studies, and ample evidence of disharmonious
relations have been recounted in the press regarding port facilities at Roberts Bank. At best such an arrangement can result in a sympathetic collaboration of regulatory agencies, at worst in a complete divergence of actions, and the breakdown of the overall port function.

(b) Further Study

This study has demonstrated the complexity of issues involved in Vancouver's future port development. The data and analysis has also indicated that this location is detrimental to the overall port operation. However, the study has also demonstrated the need to extend this pilot project to ascertain if similar conditions exist throughout the port system. Therefore, the following areas are of relevance for further study:

(1) The development of a systematic approach to allocating shipping and waterfront functions within port areas. The basis of such an approach would be founded in the total transportation costs of goods moving from their origin to their destination, using alternative shipping or port terminals. Such a model is developed in Appendix IX, entitled the Commodity Flow Model.

(2) A benefit cost study of a waterfront access road.

(3) The transportation requirements of prospective Roberts Bank tenants, measured in terms of the added congestion this will have on the existing transportation network.
(4) The effects on the national economy of reducing transshipment costs by 10 per cent.

(5) Establishment of a coordinating body at the regional level for all port management.

(6) Amendments to the National Harbours Board Act to allow for zoning powers for the use of land constituting the immediate port service area to protect the national interest, similar to the airport zoning legislation.

(7) The ultimate destinations of cargo initially destined for Vancouver City warehouses, in order to arrive at more precise origin and destination figures.

This list is by no means endless, however, its purpose is to demonstrate the need for additional study in this area by all levels of government, City, Provincial and National.
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APPENDIX I

WATERFRONT QUESTIONNAIRE, NOVEMBER, 1969
### VANCOUVER HARBOUR QUESTIONNAIRE

Conducted by the School of Community and Regional Planning
University of British Columbia in conjunction with
the Policy and Research Branch, Canada Department of Transport

1. PLEASE INDICATE THE PRODUCT CATEGORIES WHICH DOMINATE THE SITE BASED ON VALUE OF BUSINESS (MAXIMUM OF 3) TYPE OF BUSINESS

<table>
<thead>
<tr>
<th>Industries</th>
<th>Services</th>
<th>Column 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foods and beverages</td>
<td>Transportation</td>
<td></td>
</tr>
<tr>
<td>- fish</td>
<td>- marine</td>
<td>11 [ ]</td>
</tr>
<tr>
<td>- other foods</td>
<td>- land</td>
<td>12 [ ]</td>
</tr>
<tr>
<td>Primary metals</td>
<td>Storage</td>
<td></td>
</tr>
<tr>
<td>Machinery industries manufacture and repair</td>
<td>- fish &amp; fish products</td>
<td>13 [ ]</td>
</tr>
<tr>
<td>- marine</td>
<td>- cereal and grain</td>
<td>14 [ ]</td>
</tr>
<tr>
<td>- land</td>
<td>- meat fruit &amp; vegetables</td>
<td>15 [ ]</td>
</tr>
<tr>
<td>Transportation equipment</td>
<td>cargo</td>
<td>16 [ ]</td>
</tr>
<tr>
<td>- marine</td>
<td>- moorage</td>
<td>17 [ ]</td>
</tr>
<tr>
<td>- land</td>
<td>- auto and other</td>
<td>18 [ ]</td>
</tr>
<tr>
<td>Non metallic minerals</td>
<td>Communication</td>
<td>19 [ ]</td>
</tr>
<tr>
<td>Chemical products</td>
<td>Wholesale trade</td>
<td>20 [ ]</td>
</tr>
<tr>
<td>Construction</td>
<td>Retail trade</td>
<td>21 [ ]</td>
</tr>
<tr>
<td></td>
<td>Public administration</td>
<td>22 [ ]</td>
</tr>
<tr>
<td></td>
<td>Recreation</td>
<td>23 [ ]</td>
</tr>
<tr>
<td></td>
<td>Business to management</td>
<td>24 [ ]</td>
</tr>
<tr>
<td></td>
<td>Hotels and restaurants</td>
<td>25 [ ]</td>
</tr>
<tr>
<td></td>
<td>Other - (Please specify)</td>
<td>26 [ ]</td>
</tr>
</tbody>
</table>

2. WHEN DID YOU BEGIN OPERATIONS AT THIS SITE?  
   _______ year

3. WHEN WAS THE MAIN PLANT AND/OR BUILDING CONSTRUCTED?  
   _______ year

4. WHEN WERE THE MAJOR CAPITAL INVESTMENTS CONSTRUCTION?  
   _______ year

5. IS THIS SITE THE ORIGINAL LOCATION FOR YOUR FIRM IN THE METROPOLITAN VANCOUVER AREA?  
   Yes 1 [ ]  No 2 [ ]

6. IF NOT, WHERE WAS THE PREVIOUS LOCATION?  
   Also on Burrard Inlet Water front 1 [ ]
   Elsewhere City of Vancouver 2 [ ]
   Elsewhere Metropolitan Vancouver 3 [ ]

7. PLEASE INDICATE WHICH OF THE FOLLOWING CATEGORIES ACCURATELY DESCRIBES THE SITUATION OF YOUR BUSINESS: (SEE ALSO QUESTION #34)  
   Own Land and Buildings 1 [ ] Lease Portion of Building 3 [ ]
   Lease Land and Buildings 2 [ ] Lease Land, Own Building 4 [ ]

8. HOW MUCH FLOOR AREA DO YOU OCCUPY?  
   _______ square feet; _______ no. of floors

9. WHAT IS THE TOTAL AREA OF THE SITE? (PLEASE GIVE TO NEAREST TENTH OF AN ACRE)  
   _______ acres

10. HOW MANY FEET OF SHORELINE DO YOU OCCUPY, EXCLUDING FILL, BUILDING EXTENSIONS, ETC.?  
    _______ feet
11. **HOW MANY FEET OF THIS SHORELINE IS DOCK FRONTAGE?**

   [Number of feet]

   38-41

12. **HOW MANY PARKING SPACES DO YOU MAKE AVAILABLE ON SITE FOR THE FOLLOWING PURPOSES?**

   - **Employee Parking** [Number of spaces]
   - **Company Vehicles** [Number of spaces]
   - **Visitor Parking** [Number of spaces]

   42-43
   44-45
   46-47

13. **PLEASE INDICATE THE PRESENT NUMBER OF YOUR EMPLOYEES AT THIS SITE ENGAGED IN THE FOLLOWING CATEGORIES:**

   - **Management and professional** [Number of employees]
   - **Clerical, Sales and Service** [Number of employees]
   - **Craftsmen, production, processing and related workers** [Number of employees]
   - **Transport operators and communication** [Number of employees]
   - **Other** [Number of employees]

   48-49
   50-51
   52-53
   54-55
   56-57

   **Total employment (Not including casual or temporary employees)** [Number of employees]

   58-60

14. **HOW MANY OF YOUR EMPLOYEES SPEND THE GREATER PART OF THE WORK DAY OFF THE SITE?**

   [Number of employees]

   61-62

15. **DO YOU HAVE ON-SITE ACCESS TO THE FOLLOWING TRANSPORTATION MODES?**

<table>
<thead>
<tr>
<th>Mode</th>
<th>Yes</th>
<th>Adequate</th>
<th>Inadequate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Truck</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sea - Deepsea Draught</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Barges or Shallow Draught</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

   63
   64
   65
   66

16. **PLEASE LIST THE TOTAL ANNUAL IMPORT TONNAGE HANDLED BY THE FOLLOWING METHODS: (USE SHORT TONS)**

<table>
<thead>
<tr>
<th>Method</th>
<th>Tons</th>
<th>Sea-Deepsea Vessels</th>
<th>Tons</th>
<th>Barges</th>
<th>Tons</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Truck-GVW under 10,000 lbs.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-GVW over 10,000 lbs.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   226-232
   233-236
   237-240

17. **PLEASE LIST THE TOTAL ANNUAL EXPORT TONNAGE HANDLED BY THE FOLLOWING METHODS:**

<table>
<thead>
<tr>
<th>Method</th>
<th>Tons</th>
<th>Sea-Deepsea Vessels</th>
<th>Tons</th>
<th>Barges</th>
<th>Tons</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piggyback</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

   260-266
   267-270
   271-274

18. **THE FOLLOWING TWO QUESTIONS ASK FOR INFORMATION ON INCOMING AND OUTGOING TRIPS TO OR FROM YOUR BUSINESS. PLEASE LIST ALL TRIPS TO YOUR SITE BY VEHICLE, SHIP OR BARGE, IRRESPECTIVE OF WHETHER THE VEHICLE, SHIP OR BARGE IS EMPTY, PARTIALLY LOADED, OR FULL, AS INCOMING TRIPS. IN THE SAME MANNER PLEASE LIST ALL TRIPS FROM YOUR SITE, WHETHER EMPTY, PARTIALLY LOADED, OR FULL, AS OUTGOING TRIPS.**

19. **IN AN AVERAGE MONTH OF 1969 WHAT WOULD BE THE NUMBER OF INCOMING TRIPS BY?**

<table>
<thead>
<tr>
<th>Mode</th>
<th>Number</th>
<th>Mode</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rail Car</td>
<td></td>
<td>Truck-GVW under 10,000 lbs.</td>
<td></td>
</tr>
</tbody>
</table>

   316-318
   319-321
   322-323
20. OF ALL YOUR INCOMING GOODS AND MATERIALS, INDICATE BY PERCENTAGE, WHERE ARE THE MAJOR ORIGINS?

<table>
<thead>
<tr>
<th>Zone Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterfront</td>
<td>341</td>
</tr>
<tr>
<td>City of Vancouver</td>
<td>346</td>
</tr>
<tr>
<td>Metropolitan Vancouver</td>
<td>349-350</td>
</tr>
<tr>
<td>Remainder of B.C.</td>
<td>351-352</td>
</tr>
<tr>
<td>Yukon, N.W.T., Alberta, Sask., Man.</td>
<td>353-354</td>
</tr>
<tr>
<td>Remainder of Canada</td>
<td>355-356</td>
</tr>
<tr>
<td>United States</td>
<td>357-358</td>
</tr>
<tr>
<td>Outside Canada</td>
<td>359-360</td>
</tr>
</tbody>
</table>

21. OF ALL YOUR OUTGOING GOODS AND MATERIALS, INDICATE BY PERCENTAGE, WHERE ARE THE MAJOR DESTINATIONS?

<table>
<thead>
<tr>
<th>Zone Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterfront</td>
<td>361</td>
</tr>
<tr>
<td>City of Vancouver</td>
<td>366</td>
</tr>
<tr>
<td>Metropolitan Vancouver</td>
<td>369-370</td>
</tr>
<tr>
<td>Remainder of B.C.</td>
<td>371-372</td>
</tr>
<tr>
<td>Yukon, N.W.T., Alberta, Sask., Man.</td>
<td>373-374</td>
</tr>
<tr>
<td>Remainder of Canada</td>
<td>375-376</td>
</tr>
<tr>
<td>United States</td>
<td>377-378</td>
</tr>
<tr>
<td>Outside Canada</td>
<td>379-380</td>
</tr>
</tbody>
</table>

22. FOR AN AVERAGE DAY, PLEASE LIST THE APPROXIMATE NUMBER OF INCOMING DAILY TRIPS (OTHER THAN EMPLOYEES) TO YOUR BUSINESS:

<table>
<thead>
<tr>
<th>Trip Origin</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterfront</td>
<td>407-408</td>
</tr>
<tr>
<td>Downtown business district (other than water front)</td>
<td>409-410</td>
</tr>
<tr>
<td>Metropolitan Vancouver</td>
<td>413-414</td>
</tr>
</tbody>
</table>

23. FOR AN AVERAGE DAY, PLEASE LIST THE APPROXIMATE NUMBER OF OUTGOING DAILY TRIPS (OTHER THAN EMPLOYEES) FROM YOUR BUSINESS:

<table>
<thead>
<tr>
<th>Trip Destination</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waterfront</td>
<td>415-416</td>
</tr>
<tr>
<td>Metropolitan Vancouver</td>
<td>421-422</td>
</tr>
</tbody>
</table>
24. LOOKING TO THE FUTURE, IN YOUR OPINION WILL EMPLOYMENT AT THIS SITE INCREASE OR DECREASE?

1 [ ] increase  2 [ ] decrease

Please estimate the approximate percentage of increase or decrease by 1975, and 1980:

1975 increase _____ %; decrease _____ %
1980 increase _____ %; decrease _____ %

25. DOES YOUR BUSINESS HAVE DEFINITE PLANS TO INCREASE ITS FLOOR AREA?

Yes 1 [ ] No 2 [ ]

26. IF YES, ARE THESE EXPANSION FACILITIES AVAILABLE AT THIS SITE?

Yes 1 [ ] No 2 [ ]

27. IS THE PRESENT STRUCTURE SUITABLE TO ACCOMMODATE THESE ADDITIONS?

Yes 1 [ ] No 2 [ ]

28. DOES YOUR BUSINESS REQUIRE TO INCREASE ITS OUTSIDE AREA, e.g. STORAGE, TRANSPORTATION BAYS, SIDINGS, ETC.?

Yes 1 [ ] No 2 [ ]

29. IS THERE ADJACENT SPACE FOR THESE NON-BUILDING EXPANSIONS?

Yes 1 [ ] No 2 [ ]

30. APPROXIMATELY WHAT % OF INCREASE IN TOTAL SITE AREA WILL YOU REQUIRE OVER THE NEXT 5 YEARS?

No increase 1 [ ] 51% - .75% 5 [ ]
0 - 10% 2 [ ] 76% - .100% 6 [ ]
11% - 25% 3 [ ] over 100% 7 [ ]
26% - 50% 4 [ ]

31. DOES YOUR BUSINESS EXPECT TO INCREASE ITS VOLUME OF BUSINESS?

Yes 1 [ ] No 2 [ ]

Anticipated increase _____ % by 1975
_____ % by 1980

32. PLEASE RATE THE FREQUENCY OF PERSONAL CONTACT OF YOUR BUSINESS WITH THE FOLLOWING SERVICES:

<table>
<thead>
<tr>
<th></th>
<th>(1) Daily</th>
<th>(2) Weekly</th>
<th>(3) Monthly</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Personal</td>
<td>Personal</td>
<td>Personal</td>
</tr>
<tr>
<td></td>
<td>Contact</td>
<td>Contact</td>
<td>Contact</td>
</tr>
</tbody>
</table>

Marine Services
Personnel - deep sea
- coastal
- pilots
- tugs
Stevedoring
Shipyards
Agents - railway
- trucking
- shipping
- public transportation authorities
Finance Services - custom brokers
- marine insurance
- financial institutions, banks, etc.
Labour Market - semi-skilled
- highly skilled
- labour organizations
- wholesale trade salesmen
Urban Consumer Market (Vancouver)
<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily Personal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weekly Personal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monthly Personal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contact</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Business with all levels of Government 19 [ ] [ ] [ ] 459

OF THE ABOVE SERVICES, WHICH DO YOU CONSIDER THE 3 MOST IMPORTANT FOR
THE EFFICIENT OPERATION OF YOUR BUSINESS?

[ ] number, [ ] number, [ ] number 460-465

33. HAVE YOU CONSIDERED MOVING TO EITHER:

Another Industrial Site? Yes ___ No ___ 466
or
Roberts Bank? Yes ___ No ___ 467

Why? _____________________________ (code in $,000) 468-470

34. VALUE - LAND $ _____
BUILDING $ _____
MACHINERY $ _____
APPENDIX II

CONTACT LETTER TO BUSINESSES IN STUDY AREA

NOVEMBER, 1969
Gentlemen:

The School of Community and Regional Planning, in cooperation with the Policy and Research Branch of the Canada Department of Transport, is studying urban development pressures and land use patterns in the Port of Vancouver environment. The research is concerned with present adequacies of transportation and other services, and port user requirements. This concern stems from the fact that the Port of Vancouver will continue to grow in its importance as an outlet for external trade between Canada and other countries. The quantity and quality of this trade and the ease and economics of transshipment of goods and the availability of land and services for the expansion of the port function is essential for the efficient operation of the Port. The Port of Vancouver and its economic efficiency is of national concern and significance and the purpose of the study is to assess current port user requirements to form the basis for an understanding of the elements of the Port of Vancouver in the '70's and the '80's.

As a part of this research two of our research assistants, Mr. Neil J. Griggs, and Mr. Peter Tassie would be coming to your office to interview one of your officials on related questions. We expect to start on the interviews during the week of November 17, 1969. The interview should take approximately 20 to 30 minutes and is an essential pre-requisite to the success of our research.

We would appreciate it very much if you would be good enough to cooperate with Mr. Griggs and/or Mr. Tassie when they visit you to obtain relevant data. The results of the study will be made available to you when the study is completed. Thank you very much for your cooperation.

Sincerely yours,

V. Setty Pendakur  
Acting Director

VSP/nm
Good day

The School of Community & Regional Planning at The University of British Columbia, with the co-operation of the Automotive Transport Association of B.C., is studying the origin and destination of trucks entering this pier. We would like you to help us by answering the following five questions:

1. No. of axles of vehicle
2. GVW Registration of vehicle (lbs)
3. If you are delivering a load to this pier
   - What is the type of load
   - What is the weight of load (lbs)
4. If you are picking up a load at this pier
   - What is the type of load
   - What is the weight of load (lbs)
5. On the map below please mark the origin of this trip with an "O", and your next stop (either to load or unload goods) with an "X".

Please hand this form back to the attendant at the Gate House on the way out. Your co-operation is appreciated.
APPENDIX IV

QUESTIONNAIRE SAMPLE: SERVICE SECTOR SURVEY, 1970
Dear Sir:

The School of Community and Regional Planning in cooperation with the Policy and Research Branch of the Canada Department of Transport, is studying urban development pressures and land use patterns in the port of Vancouver environment. The research is also concerned with the port linkages and its economic influence in Vancouver and in this regard I will be telephoning you next week to obtain information on the following questions. I would appreciate it very much if you would be good enough to cooperate with me in giving me the relevant data which is an essential prerequisite to the success of my research. The results of the study will be made available to you when it is completed. If exact figures are not immediately available an estimate will be sufficient.

Sincerely yours,

Neil Griggs

2. What is the annual payroll, 1969?
3. What percent of your business is exclusively marine?
   20% 40% 60% 80% 100% Don't know
4. If the entire port operation was moved to Roberts Bank, could you continue serving the new port from your present location?
5. What percent of your business is connected with general cargo, as compared with bulk cargo?
APPENDIX V

INDUSTRIAL LAND AVAILABILITY AND RATE OF TAKE-UP

CITY OF VANCOUVER, 1969
### INDUSTRIAL LAND AVAILABILITY AND RATE OF TAKE-UP, VANCOUVER CITY, 1969

<table>
<thead>
<tr>
<th>District</th>
<th>Vacant Residential</th>
<th>Open Storage</th>
<th>Total Available</th>
<th>Annual Take-up 1964-1968</th>
<th>Year's Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Granville Island</td>
<td>-</td>
<td>1.34</td>
<td>1.34</td>
<td>.10</td>
<td>13.4</td>
</tr>
<tr>
<td>2 Granville to Burrard</td>
<td>12.72</td>
<td>.07</td>
<td>12.79</td>
<td>1.08</td>
<td>11.8</td>
</tr>
<tr>
<td>3 Fairview</td>
<td>25.99</td>
<td>.69</td>
<td>26.68</td>
<td>1.18</td>
<td>22.5</td>
</tr>
<tr>
<td>4 Cambie - 2nd Avenue</td>
<td>42.39</td>
<td>4.50</td>
<td>46.89</td>
<td>4.17</td>
<td>11.2</td>
</tr>
<tr>
<td>5 False Creek Flats</td>
<td>14.48</td>
<td>12.06</td>
<td>26.54</td>
<td>3.60</td>
<td>7.7 1</td>
</tr>
<tr>
<td>6 False Creek North Side</td>
<td>2.84</td>
<td>27.92</td>
<td>30.76</td>
<td>-</td>
<td>* 2</td>
</tr>
<tr>
<td>7 False Creek East End</td>
<td>10.71</td>
<td>31.57</td>
<td>42.28</td>
<td>.41</td>
<td>* 2</td>
</tr>
<tr>
<td>8 False Creek South Side</td>
<td>4.68</td>
<td>12.66</td>
<td>17.34</td>
<td>-</td>
<td>* 2</td>
</tr>
<tr>
<td>9 Arbutus &amp; 12th Avenue</td>
<td>3.88</td>
<td>.57</td>
<td>4.45</td>
<td>.38</td>
<td>12.1</td>
</tr>
<tr>
<td>10 Powell Street</td>
<td>45.92</td>
<td>3.24</td>
<td>49.16</td>
<td>1.25</td>
<td>39.3</td>
</tr>
<tr>
<td>11 Clark Drive</td>
<td>32.63</td>
<td>4.66</td>
<td>37.29</td>
<td>3.96</td>
<td>9.4</td>
</tr>
<tr>
<td>12 Lougheed &amp; Boundary</td>
<td>47.56</td>
<td>-</td>
<td>47.56</td>
<td>3.47</td>
<td>13.7</td>
</tr>
<tr>
<td>13 Cedar Cottage</td>
<td>2.13</td>
<td>-</td>
<td>2.13</td>
<td>.30</td>
<td>7.1</td>
</tr>
<tr>
<td>14 Joyce Road</td>
<td>8.13</td>
<td>-</td>
<td>8.13</td>
<td>2.11</td>
<td>3.9</td>
</tr>
<tr>
<td>15 Hudson Street</td>
<td>6.38</td>
<td>.40</td>
<td>6.78</td>
<td>.26</td>
<td>26.1</td>
</tr>
<tr>
<td>16 Marine Drive - West</td>
<td>46.91</td>
<td>9.58</td>
<td>56.49</td>
<td>6.92</td>
<td>8.2 3</td>
</tr>
<tr>
<td>17 Marine Drive - Centre</td>
<td>36.26</td>
<td>.62</td>
<td>36.88</td>
<td>5.28</td>
<td>7.0</td>
</tr>
<tr>
<td>18 Marine Drive - East</td>
<td>48.43</td>
<td>.60</td>
<td>49.03</td>
<td>5.23</td>
<td>9.4</td>
</tr>
</tbody>
</table>

**TOTAL**                     | 392.04             | 110.48       | 502.52          | 39.7                      | 12.7          |

* No estimate made.

1. The supply of suitable and available acreage which may become available in the future tends to be understated because of the large amount of railway land excluded. This railway land may become available in the future.

2. The industrial take-up 1964-1968 in those districts was nil or extremely small thereby making projection by this method impossible.

3. The 28 acre site of the Manitoba Works Yard was excluded in assessing annual industrial take-up.

APPENDIX VI.

INDUSTRIAL LAND, METROPOLITAN VANCOUVER, 1969
### INDUSTRIAL LAND -- METROPOLITAN VANCOUVER, 1969

<table>
<thead>
<tr>
<th>District</th>
<th>Total Acreage</th>
<th>Developed Acreage</th>
<th>Vacant Acreage</th>
<th>% Occupied</th>
<th>Approximate Price/Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vancouver</td>
<td>2,834.81</td>
<td>2,332.29</td>
<td>502.52</td>
<td>82.3</td>
<td>50,000 - 175,000</td>
</tr>
<tr>
<td>Burnaby</td>
<td>3,028.70</td>
<td>1,989.66</td>
<td>1,039.04</td>
<td>65.7</td>
<td>20,000 - 70,000</td>
</tr>
<tr>
<td>New Westminster</td>
<td>581.94</td>
<td>445.43</td>
<td>236.51</td>
<td>76.5</td>
<td>N.A.</td>
</tr>
<tr>
<td>Fraser Mills</td>
<td>212.36</td>
<td>212.36</td>
<td>-</td>
<td>100.0</td>
<td>N.A.</td>
</tr>
<tr>
<td>Coquitlam</td>
<td>719.28</td>
<td>460.66</td>
<td>258.62</td>
<td>64.0</td>
<td>N.A.</td>
</tr>
<tr>
<td>Port Moody</td>
<td>772.25</td>
<td>675.54</td>
<td>96.71</td>
<td>87.5</td>
<td>N.A.</td>
</tr>
<tr>
<td>Buntzen</td>
<td>364.59</td>
<td>364.59</td>
<td>-</td>
<td>100.0</td>
<td>N.A.</td>
</tr>
<tr>
<td>Port Coquitlam</td>
<td>1,631.42</td>
<td>845.30</td>
<td>786.12</td>
<td>51.8</td>
<td>2,500 - 3,500</td>
</tr>
<tr>
<td>Richmond</td>
<td>4,743.71</td>
<td>1,172.99</td>
<td>3,570.72</td>
<td>24.7</td>
<td>7,500 - 15,000</td>
</tr>
<tr>
<td>North Vancouver-City</td>
<td>456.43</td>
<td>240.25</td>
<td>216.18</td>
<td>52.6</td>
<td>25,000 - 40,000</td>
</tr>
<tr>
<td>North Vancouver District</td>
<td>617.95</td>
<td>503.29</td>
<td>114.66</td>
<td>81.4</td>
<td>20,000 - 50,000</td>
</tr>
<tr>
<td>Delta</td>
<td>2,412.39</td>
<td>356.29</td>
<td>2,056.10</td>
<td>14.8</td>
<td>N.A.</td>
</tr>
<tr>
<td>Surrey</td>
<td>3,611.63</td>
<td>1,931.95</td>
<td>1,679.68</td>
<td>53.5</td>
<td>N.A.</td>
</tr>
<tr>
<td>TOTAL</td>
<td>21,987.46</td>
<td>11,530.60</td>
<td>10,456.86</td>
<td>53.5</td>
<td>N.A.</td>
</tr>
</tbody>
</table>

N.A. Not Available

APPENDIX VII

CARGO TONNAGE, PORT OF VANCOUVER AND CITY OF VANCOUVER

STUDY AREA, 1968
# Cargo Tonnage, Port of Vancouver and City of Vancouver

## Study Area, 1968

### BULK CARGO

<table>
<thead>
<tr>
<th></th>
<th>Port of Vancouver</th>
<th>Vancouver Study Area (estimates)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>4,943,500</td>
<td>2,034,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugar &amp; Molasses</td>
<td>125,000</td>
<td>125,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fodder</td>
<td>118,500</td>
<td>100,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seeds</td>
<td>503,500</td>
<td>503,500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fertilizer</td>
<td>124,000</td>
<td>100,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scrap Metal</td>
<td>12,000</td>
<td>10,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coal</td>
<td>1,247,000</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asbestos</td>
<td>207,000</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand &amp; Gravel</td>
<td>2,274,000</td>
<td>50,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stone</td>
<td>319,000</td>
<td>50,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phosphate Rock</td>
<td>402,000</td>
<td>80,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salt</td>
<td>410,000</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulphur</td>
<td>1,178,000</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ores</td>
<td>266,500</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potash</td>
<td>1,656,000</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas &amp; Fuel Oil</td>
<td>2,117,000</td>
<td>500,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cement</td>
<td>160,000</td>
<td>100,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Logs</td>
<td>826,000</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulp Chips</td>
<td>1,158,000</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>17,847,000</strong></td>
<td><strong>3,652,500</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### GENERAL CARGO

<table>
<thead>
<tr>
<th></th>
<th>Port of Vancouver</th>
<th>Vancouver Study Area (estimates)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>46,000</td>
<td>46,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugar &amp; Meats &amp; Molasses</td>
<td>40,000</td>
<td>20,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fodder</td>
<td>37,500</td>
<td>30,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seeds</td>
<td>10,000</td>
<td>8,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fertilizer</td>
<td>21,000</td>
<td>12,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scrap Metal</td>
<td>48,000</td>
<td>30,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coal</td>
<td>497,000</td>
<td>350,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asbestos</td>
<td>12,000</td>
<td>10,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sand &amp; Gravel</td>
<td>36,000</td>
<td>36,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stone</td>
<td>150,000</td>
<td>50,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phosphate Rock</td>
<td>51,000</td>
<td>30,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salt</td>
<td>369,000</td>
<td>260,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sulphur</td>
<td>97,000</td>
<td>80,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ores</td>
<td>43,000</td>
<td>43,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potash</td>
<td>143,000</td>
<td>100,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas &amp; Fuel Oil</td>
<td>272,000</td>
<td>70,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cement</td>
<td>2,148,000</td>
<td>1,000,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Logs</td>
<td>852,000</td>
<td>200,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulp Chips</td>
<td>96,000</td>
<td>50,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>6,326,000</strong></td>
<td><strong>3,225,000</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total Port of Vancouver**: 24,173,000
**Total Study Area**: 6,877,500

APPENDIX VIII

ESTIMATE OF WATERFRONT DAILY TRUCK TRAFFIC
(STUDY AREA)
ESTIMATE OF WATERFRONT DAILY TRUCK TRAFFIC
(STUDY AREA)

|每月去水边的交通 | 40,000 | * |
|  | 2,000 | 每天的交通，5天工作周 |
| 平均每次行程时间 | 3.5小时 | (2小时在港口) |
| 另外每行程额外人力 | 1.5小时 | 用于卸货、服务、办公室时间等(估计) |
| 水边每行程人力 | 5小时 |

5 x 2,000 每天的行程 = 10,000 小时。

1,340 估计全职员工以8小时工作日。

* 26,000 从调查和额外14,000
估计从不完整的调查中，例如，码头B和C，Ballentyne码头，
和Terminal码头。
APPENDIX IX

COMMODITY FLOW MODEL
COMMODOITY FLOW MODEL

This study has attempted to demonstrate what the existing conditions are along one portion of the Vancouver waterfront. It has not attempted to produce any solutions or recommendations. To do this would require considerably more information as well as study on the implications of any such recommendations. What follows is a proposal that could provide the first step or foundation for a waterfront allocation policy for port lands. It is simply a theoretical concept and as yet is untested, but is based on the information gained from this study. As no comprehensive policy exists that systematically allocates port lands to its optimum use in terms of a total transportation system, the following provides such a base upon which other social, economic and political conditions can be added.

The model is based on a simple Route Theory principle that selects a route with the least cost for the distribution and collection of goods. Presently Freight Forwarders and Shippers apply various models as to optimum routes, load factors and warehouse locations.\(^1\) Similarly Shipowners operate their own models of cost/productivity,

cost/revenue and ship size and speed.\textsuperscript{2} Industries likewise have optimum location models.\textsuperscript{3} In its basic form this theory considers the location of a single route. August Lösch (1954, p. 184), applied the "Laws of Refraction" to the route selection of a port site. The problem was to find the least cost route to ship goods from site A to site B.\textsuperscript{4} Figure 30-A shows the influence of transportation costs in the selection of a site, assuming that port construction is equally favourable at any point. As land transport costs increase $C_1$ over ocean costs $C_2$ the length of the land haul decreases. Lösch showed that the least-cost location of the port, using one route would be where $C_1 \sin x - C_2 \sin y = 0$, where $x$ and $y$ are the angles that the two transport routes make with the coastline. Figure 30-B shows examples of least-cost port sites. For example, Site No. 1 reflects proportionately higher land transportation costs, and Site No. 2 reflects proportionately higher marine transportation costs.

This theoretical application would only be possible where there is one point of origin, one point of destination and one commodity. Situations such as this could exist in mining communities close to the coast engaged in the export of the raw materials.


LAWS OF REFRACTION APPLIED TO ROUTE LOCATION

Source: Lösch, 1954.
Although the situation in Vancouver is more complex, this principle can still be applied, and instead of considering the selection of a single route and a single commodity, a route network is developed accommodating a variety of commodities. The Model now becomes a dynamic stochastic linear programming model based on network analysis. The result is a Commodity Flow Model which selects routes that allow for the maximum flow of goods with the minimum costs.

The Model is a modified version of "Maximum Flow Paths," one of several network models used in Geography. The problem of defining maximum flow was solved in 1955 by Dantzig and Fulkerson through their "Maxflow-mincut" theorem, which showed that the maximum flow through a network was equal to the sum of the capacity of the branches of the minimum cut. A "cut" is any collection of branches which completely separates two terminals in the network. In Figure 31, there are four possible cuts which separate A from D. The capacity of these cuts are 7, 8, 15, and 6 respectively, see Figure 31-B. The maximum cut is the line ACBD with a total capacity of 6 units, which is also the maximum flow.

Once accepting this basic principle of maximizing flows and minimizing costs, the next step is to look at a local area and apply this concept.

---


THE MIN-CUT MAX-FLOW PATH FOR A SIMPLE NETWORK

In Greater Vancouver we now have three alternative port sites, Burrard Inlet, the Fraser River and Roberts Bank. Feeding each of these sites is a transportation network of roads and railways. Figure 32 is a hypothetical example of the road transportation network of Southern British Columbia and is presented in the form of a Decision Tree Network faced by a shipper.\(^7\) The example in this case is the export flows of Okanagan canned fruit. The origin is known, a canning plant or warehouse in Penticton, and the destination is known, for example, the United Kingdom.

In the reverse situation, that of Import Flows, the origin of a good is known, for example, transistor radios from Japan, and the destination is also known from the bills of lading. However, in most cases when importing goods, the immediate receiver is usually an agent with the goods being warehoused, so in this case the warehouses would be used as destination points.

The next step is to take each import and export commodity, for example, canned fruit from the Okanagan, and trace the existing flow pattern through the Burrard Inlet Terminal and calculate its transportation costs. Figure 33 is a hypothetical network of the existing flow capacities and costs.\(^8\) A similar process would be completed for each of the three Port sites, and as the Model is a dynamic program, both

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\(^7\)E. G. Frankel, "Containerized Shipping and Integrated Transportation," *Proceedings of the Institute of the Electrical and Electronic Engineers*, Vol. 56, No. 4 (April 1968), p. 716. (Figure 32 is a modified version of that presented by Frankel).

\(^8\)Richard J. Charley and Peter Haggett, eds., *op. cit.*, p. 618.
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EXPORT FLOW IN TRANSPORTATION DECISION TREE NETWORK—TRUCKING
MINIMAL-COST FLOW THROUGH A COMPLEX NETWORK

A. MAXIMUM FLOW CAPACITY OF EACH LINK

B. UNIT SHIPPING COSTS ALONG EACH LINK

C. INITIAL FLOW PATTERN

D. MAXIMUM FLOW PATTERN. LINKS NOT FULLY SATURATED WITH FLOW SHOWN BY BROKEN LINES

the existing street use and capacity as well as any added usage would be a continuous input. An output from this program would be a suggested least cost and maximum flow route to one of the three ports for each commodity. Figure 33-C would be the initial flow pattern of the suggested canned fruit, and the terminal could be, for example, a Fraser River site.

Two assumptions are made that would enable this Commodity Flow Model to work.

1. There is to be one port authority to manage all port operations on the West Coast.
2. That money be made available to develop the required facilities and improvements in access to any or all three port sites.

It is assumed that any allocation of resources to improve one port site over another would be subjected to an economic analysis based on the premise that the goal is to provide the least cost maximum flowing transportation system.

The single port authority would receive all bills of lading prior to any shipment. These could be fed into computer terminals throughout British Columbia and on the entry points along the provincial border. Each trucking company would be given a route, a port site and delivery time for the load. Similarly the shipping companies would be required to forward their bills of lading so as to determine the "optimum discharge port", in terms of the cargo destination, again based on
least cost maximum flow routes. In cases of mixed cargoes the "optimum port" would be chosen, based on the "critical" cargo or cargoes carried. This decision could be simply handled by the computer.

In the same way that terminals would be allocated for use, so too could this model be applied to water-orientated industries. Each industry would be measured in terms of its commodity flows and a basic site selected in terms of access that allows for maximum commodity flows with minimum costs. It is cautioned that this model is not to replace the existing Industrial Location Models but rather to supplement them in terms of providing a basic and efficient transportation input which is critical to any location model.

The most obvious application of this model is with road transport. However, it could also be applied to the railway systems, especially when there are now three sites to choose from, each of which could have differing rail service. It could provide shippers, using road, rail and sea with more effective techniques for planning, scheduling, routing, cost accounting and document control. For the consumer or the nation as a whole, it would provide a more efficient transportation system and in turn a better allocation and utilization of resources.