AIR +

LAND +

WATER +

LIFE +

LOCATION

ENVIRONMENTAL RESOURCES OF THE TORONTO CENTRAL WATERFRONT

INVENTORY - INTERPRETATION - SYNTHESIS and
PERFORMANCE REQUIREMENTS for FUTURE ACTION

Prepared by WALLACE McHARG ROBERTS & TODD for
the CENTRAL WATERFRONT PLANNING COMMITTEE
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1976

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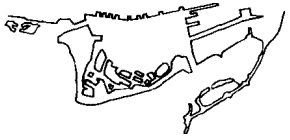
Icentral waterfront planning committee



R. V. DOTY JOINT CHAIRMEN JUANNE HEMSOL

AN INTER-AGENCY CO-ORDINATING COMMITTEE ESTABLISHED TO MAKE RECOMMENDATIONS ON PLANS AND POLICIES FOH THE CENTRAL WATERFRONT

235 QUEENS QUAY WEST TORONTO ONTARIO M5J IA6 PHONE (416) 367-7611

December 1, 1976

To: Co-chairmen and Members of the Central Waterfront Planning Committee, and Chairman and Members of the City of Toronto Planning Board

Your report of November, 1974, "Programme for Planning, The Central Waterfront," articulated the need for a new approach to planning which would ensure that environmental concerns would be given at least as much due as social, political, and economic concerns. There is a key paragraph in that report that deserves repeating as it provided the motive and spur which has led to this report by WMRT:

''In the past, planning in the Central Waterfront has tended to deal with the needs, goals, aspirations and activities of people influenced by the development of the Central Waterfront. However, the character and influence of land, water and air on which these activities are carried out constitutes at least as major a directive to planning. Sites have specific personalities of their own-some tolerate heavy use, others do not; different sites have different soil characteristics which influence their ability to take building loads; they host different plant and animal communities; they have different topographic and climatic conditions; and they have different aesthetic characteristics. The inventory of various natural phenomena, followed by evaluation of the capability and suitability of the various sectors of the Central Waterfront to take different uses (or to be retained as "no-build" areas) is regarded as a major priority."

The first step taken to achieve this occurred in January, 1975, with the formation of two Environment Study Groups-Land and Water-consisting of staff from agencies in all levels of government to prepare a comprehensive inventory of all environmental aspects of the Central Waterfront. The work is contained in an Information Base report consisting of seven sections: Climate, Vegetation, Wildlife, Physical Geography, Air Quality, Noise and Water, which has recently been transmitted to you.

The second step taken was the hiring by the City of Toronto Planning Board in October, 1975, of WMRT. Their mandate, simply put, was to develop the means whereby the C.w.P.C. could achieve its goal of a new approach to planning.

This report provides planning tools which should be used by members of the C.W.P.C. and its Area Task Groups to develop policy recommendations which will reflect intelligent response to the opportunities and constraints provided by the Central Waterfront environment. It is, accordingly, set out in a series of sections that by their sequence and internal organization ensure that the reader can understand every aspect of the process.

The five critical resource maps reproduced in the report are also available at a larger scale to facilitate their use. These are available, free of charge, from the Waterfront Site Office, City of Toronto Planning Board, 235 Queens Quay West, Toronto M5J 1A6.

I believe that WMRT has fulfilled their mandate admirably, by developing a method which should have great application and consequence to the Central Waterfront, and ultimately, to the Metro Toronto Region as a whole. I take great pleasure in forwarding their report for your use.

Yours sincerely,

Peter de Tolly

Technical Coordinator

PETER DE TOLLY, TECHNICAL CO-ORDINATOR REPRESENTATIVE OF THE COMMISSIONER OF PLANNING, CITV OF TORONTO PLANNING BOARD

This report presents the findings of the Environment Synthesis commissioned by the Central Waterfront Planning Committee and the City of Toronto Planning Board as a part of their Programme for Planning addressed towards preparation of an Official Plan for the Toronto Central Waterfront. Funding for this study was provided by the City of Toronto, the Ministry for Natural Resources [Ontario] and the Ministry of State for Urban Affairs [Canada] .

The Information Base reports prepared by the C.W.PC. Environment Study Groups provided the base data, while the members of the C.w.P.C. and its Area Task Groups reviewed the study in progress. Numerous staff members of the various agencies working with the C.w.P.C.'s Technical Committee provided additional technical information. Peter de Tolly, Doug Ferguson, Linda Cardini and other staff members of the C.T.P.B.'s Waterfront Planning Group enabled realization of the study through their indefatigable work of coordination and review of work in progress.

The study was conducted by Wallace, McHarg, Roberts and Todd, Architects, Landscape Architects, Urban and Ecological Planners, 1737 Chestnut Street, Philadelphia, Pennsylvania 19103, U.S.A. Narendra Juneja, Senior Associate Partner was in charge with Anne Whiston Spirn as the Project Director. Carol Reifsnyder reviewed and generated additional data for vegetation and wildlife. The wildlife interpretations were reviewed by *Clive* Goodwin, Executive Director, The Conservation Council of Ontario. Review, interpretation and identification of future data requirements for geology, hydrology and soils is the work of WMRT's consultant, Dr. Arthur Johnson, Assistant Professor of Geology and Regional Planning, University of Pennsylvania. Dr. Johnson received valuable help from Marta Griffiths of the Ministry of Environment [Ontario] . Climate data were provided by Roger Smith, Climatologist, under a contract funded by matching contributions provided for Central Waterfront planning by the Federal and Provincial Governments. Beth Kitchen of WMRT staff performed the *review* of noise studies. William Robinson and John Czarrlowski prepared the graphics. Jane Laughlin was responsible for report production; Margaret Dewey for composition. John Purkess and Rodney Robinson assisted in its production.

The graphics in the Data Review section of this report are reproduced from the original Information Base reports provided by the C.w.P.c. The photographs are from Toronto Harbour Commissioners, the Toronto Star, Rick Phillips, Peter de Tolly, Doug Ferguson and Neil Turnbull.

The report was printed by Winchell Press, 1315 Cherry Street, Philadelphia, Pennsylvania 19107, U.S.A. in December 1976.

ENVIRONMENTA RESOURCES OF THE TORONTO CENTRAL WATERFRONT

INTRODUCTION

PLANNING BACKGROUND

The Central Waterfront is a unique resource for the entire Toronto area. The waterfront has been manipulated by man for the past tury and a half, yet it still harbours plants and animals which are rare in the region It is also an environment that has attracted a wide range of human activities from recreation to industry. The natural processes and man's activities are intimately linked in such an environment; together they give it its unique character. Today the Central Waterfront is beleaguered by conflicting demands for the accommodation of future uses. industry, housing, and recreation on the one hand, protection of valuable natural and cultural resources on the other.

Since July 1973, the Central Waterfront Planning and Technical Committees have been working to reconcile these conflicting demands. The Central Waterfront Planning Committee (C.W.P.C.) was formed to coordinate planning activities for the Central Waterfront. The C.W.P.C. is composed of representatives from all government agencies with jurisdiction in the Central Waterfront-city, metropolitan, provincial, federal, and special purpose (such as the M.T.R.C.A. and the T.H.C.), and of representatives from citizen groups with special interest in the waterfront.

The mandate of the C.W.P.e. is to make recommendations to the participating agencies on all Central Waterfront planning matters, but most particularly to bring forward to the City of Toronto new Official Plan policies. The interagency e.W.T.C. advises the Planning Comm ittee, and is composed of staff representatives from the City of Toronto Planning Board and other participating government agencies. Technical work is coord inated by staff of the City of Toronto Planning Board.

To achieve its mandate, the C.W.P.C. adopted a two-phase work programme, with the first phase consisting of a study design and the second, the conduct of the main study as defined in Phase I. In November 1974, the C.W.P.e. published its first-phase report, Programme for Planning, the Central Waterfront. **Th** is report identified key issues needing resolution, made recommendations on those needing immediate action, and defined the nature, extent, and direction of the second-phase, main study. The main study comprises two steps, the preparation of a series of Information

Base reports, and the preparation of policy recommendations.

The Central Waterfront environment has been described in an Information Base Report consisting of seven sections: Climate, Physical Geography, Vegetation, Wildlife, Air Quality, Noise, and Water. These have been compiled by staff of the various agencies working with the Technical Committee. Information Base Reports on Housing, Industry, Recreation, Transportation, and Waterfront Precedents have also been published. The first step of the main study is, therefore, essentially complete.

In 1977, the C.W.P.C. and C.w.T.C. will prepare Official Plan Part I Amendments for the entire Central Waterfront and Part II Statements for various sub-areas. This environment synthesis was undertaken to aid that planning process by identifying important resources of the natural environment, by relating them to social values expressed by the CWP.C. agencies and citizen groups, and by recommending measures which will ensure that these social values are sustained.

METHOD

"Planning is not a 'one-shot' exercise in which a master design is carefully prepared to be implemented in every detail over a period of years Public objectives and local situations are changing constantly, and plans must be both action-oriented and broad, as well as strategic, capable of constant updating to accommodate such changes. The Work Programme is therefore geared to provide a base of information and a machinery for the regular updating of both information and plans. This will make planning for the Central Waterfront an ongoing concern for all the participating agencies and the public." (C.w.P.C., Programme for Planning, 1974).

The purpose of this environment synthesis study is to provide the City of Toronto with the tools to evaluate alternative courses of action in terms of their effect upon the natural environment of the Central Waterfront. In recognition of the need to respond in the future to new information, specific needs, and to changing public objectives, the study ;s organized in a way that facilitates regular updating.

The method employed consists of a description of the waterfront through a review of all available data concerning the natural environment, an identification of social objectives for the waterfront, an interpretation of the data in light of those social values, and the recommendation of future actions required to achieve the social objectives. Since each component of the study is explicit, the implications of all data inputs and their interpretations can be clearly perceived in every step.

The study consists of three major sections:
INVENTORY includes the review and analysis of all available data and the recommendation of future work required to refine these data.

INTERPRETATION includes the identification of current social objectives, the reorganization of data into resource categories-Air, Land, Water, Life, and Location-which relate to the social objectives, the identification of opportunities and constraints for accommodating future land uses, and the description of performance requirements necessary to achieve the stated social objectives.

SYNTHESIS includes the demonstration of a method by which the study can be put to work in formulating a plan of action for the future, a summary of important waterfront issues, and an outline of future planning action by CW.P.C.

First, the data collected over the past four years by the CW.P.C and cooperating city, metropolitan, and provincial agencies are reviewed. The purpose of this review is to identify inconsistencies or deficiencies in the information, to augment the available data where necessary through literature search and limited field work, and to identify areas where further research is needed.

Once the available data have been accumulated and reviewed, the relationships among elements of the natural environment and the processes which govern those interactions can be identified. Data are aggregated into broad resource categories. The categories Air, Land, Water, and Life describe the features of the natural environment, and Location identifies features of the cultural environment.

Social values ascribed to environmental resources of the Central

Waterfront are identified. Social values determine the relative importance of specific environmental features to society and are therefore the basis for the recommendation of future action. Concerns about the Central Waterfront have been expressed by public agencies and private groups in published documents. These concerns, identified as social objectives, are related to the environmental resource categories of Air, Land, Water, Life, and Location.

In Inventory: Data Interpretation, features within each of the five resource categories are mapped and assigned a social value based on the identified social objectives. Implicit in the resource value of each feature are opportunities for related human activities. At the same time, the conditions necessary to sustain a feature's value to society entail the regulation of all future activities by performance requirements. Meeting these performance requirements entails a certain amount of effort. This effort is expressed as varying degrees of constraint imposed by a particular performance requirement on a specific land use.

Resource features are reorganized into categories which require similar regulations in Interpretation: Resource Interpretation. These regulations are described in the form of performance requirements for future actions.

APPLICATION OF THE STUDY

Each step of this study provides a set of tools which may be used in planning the future of the Central Waterfront. The first step, review of the Information Base, establishes an understanding of the waterfront environment, and the second step documents the need for future research in specific areas. The third step, identification of social objectives, establishes a comprehensive list of social concerns which may now be discussed and evaluated in terms of their relative importance. In the next two steps, social values are attributed to environmental features. The implications of social values are established in terms of opportunities and constraints for specific activities. To the extent that a resource offers great opportunity and imposes little constraint for a particular land use, it is deemed to be "suitable" for that use. Thus, these steps provide the tools to assess the suitability of land for all prospective uses. The sixth step, performance requirements for future action, provides the means to ensure that public health, safety, and welfare are maintained, that valuable resources are preserved, that the waterfront environment is enhanced, and that development is accommodated with minimal cost. The performance requirements can be readily translated into by-laws and ordinances, or can be used to guide and evaluate future development plans in the Central Waterfront. Detailed design strategies and guidelines for specific projects within the waterfront are outside the scope of this study, but are readily derived from the performance requirements. Two examples which demonstrate the application of these tools to determine the most suitable locations for recreation and development conclude the study.

It is not the purpose of this study to identify the most appropriate use for each part of the Central Waterfront. Such decisions must await determination of the demand for specific land uses and the resolution of conflicts between competing uses. This study does enable citizens of Toronto to assess the environmental consequences of any proposed action, and thus to weigh the alternatives judiciously.

INVENTORY

DATA REVIEW

INTRODUCTION

From 1974 to 1976, members of the Central Waterfront Planning and Technical Committees studied the natural environment of the Toronto Waterfront and published the results of this effort in a series of Information Base publications which include: Climate, Air Quality, Physical Geography, Water, Vegetation, Wildlife, and Noise. These publications provide the data for the Natural Environment Synthesis Study. The data, as presented and synthesized in this study, will be used to assess the impact of planning on the waterfront environment. The first part of the study is a summary of the natural environment of the Central Waterfront. The Information Base publications should be referred to for a more detailed description At the conclusion of this section important relationships between elements of the natural environment are identified and recommendations are made for future studies to augment the data base.

Geology is the framework upon which the landscape of Toronto rests. Natural and man-induced processes operate within that framework to shape the landscape elements of climate, physiography, soils, ground and surface waters, plants, animals and current land use. In the Central Waterfront, the hydrologic system of Lake Ontario adjoins the landscape system and interacts with it. This system comprises hydrodynarnic elements (waves, currents), water quality, lakebed sediments, and aquatic plants and animals. The interactions between the landscape and hydrologic systems dominate the natural processes of the Central Waterfront and determine its special characteristics.

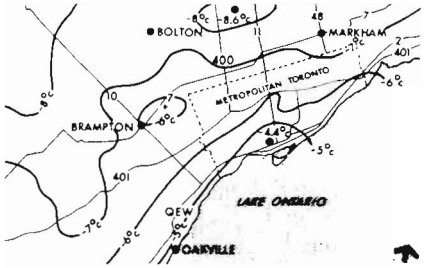
In this chapter elements of the landscape and hydrologic systems are examined separately climate, air quality, geology, physiography, hydrology, lakebed sediments, surficial sediments, vegetation, and wildlife. In addition, two primarily human elements of the environment are presented. noise and land use. This separation of elements is convenient, but artificial. All operate together in the environment to form a dynamic, interacting system To understand this system, one must both understand the parts and comprehend how they fit together to make the whole. One can then evaluate the impact of human activities on the natural environment. At the end of this chapter, therefore, important relationships between landscape elements are examined

CLIMATE

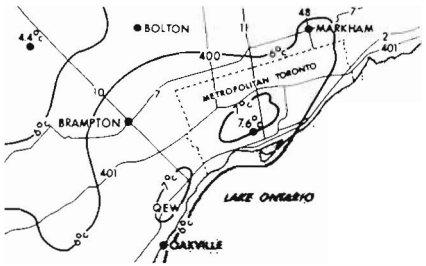
Southern Ontario has a climate with adequate precipitation and temperatures ranging from sub-freezing in winter to very warm in summer Approximately 200 high and low pressure systems move through the region annually, causing frequent variations in weather The climate of Southern Ontario is modified by the proximity of Lake Ontario. Summers are not as hot, winters not as cold, and spring storms not as intense as they would be without the presence of the Lake. Many of the effects which characterize the lakeshore climate are localized and seldom extend more than a few kilometers inland Thus the Impact of the Lake is felt to a great extent in the Central Waterfront and to a lesser extent in outlying Metropolitan Toronto This influence accounts not only for warming in winter and cooling in summer, but also for a diurnal lake breeze, fog, and increased wind speeds in the Central Waterfront.

Temperature moderation occurs in all seasons along the waterfront. Average wintel' temperatures on the Toronto Islands are about two degrees Celsius warmer than in the northern suburbs, and average spring and summer temperatures are one degree Celsius cooler. In spring and early summer, temperatures along the waterfront are reduced by the cooling effect of lake breezes. The lake breeze is a product of the temperature difference between land and water and is independent of the prevailing winds. It occurs when the speed of winds blowing off the land is under 20 kilometres per hour and when the prevailing air mass is warmer than the water. A weak lake breeze (16 kph) penetrates less than two kilometres inland and has a cooling effect of 3 to 5 degrees Celsius, whereas a moderate lake breeze (32 kph) penetrates 10 to 15 kilometres and has a cooling effect of 6 to 8 degrees. The diurnal cycle of the Toronto lake breeze can be divided into four stages. night, morning, day, and evening, as shown in the adjacent diagram. The lake breeze mitigates the effect of the urban heat island on the Central Waterfront. This is most apparent in May when the lake breeze reaches its greatest intensity

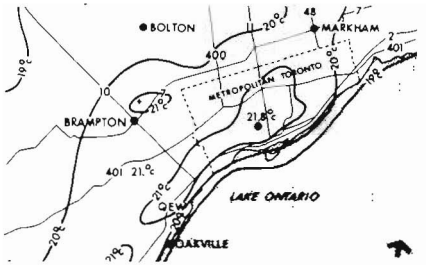
Temperature variations occur within the Central Waterfront as well as between the waterfront and downtown Toronto. Average temperatures are probably one degree Celsius higher along the mainland waterfront than on the Toronto Islands and in the Eastern Industrial and Outer Headland areas.



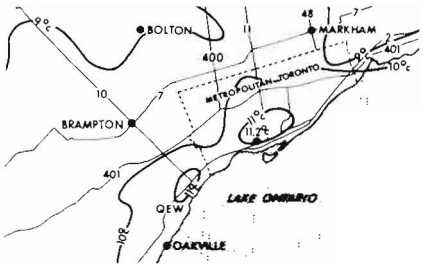
January (1941-19701



April (1941-19701



July (1941-1970)

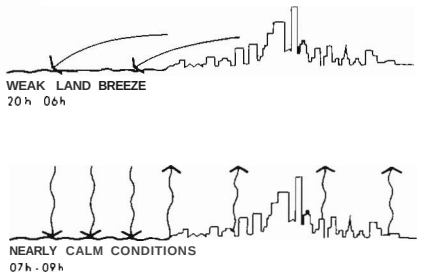


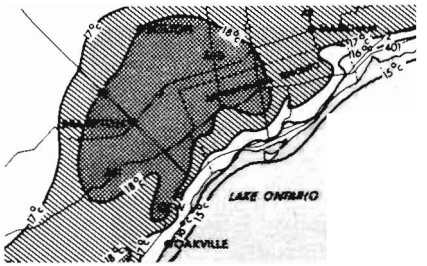
October (1941-1970)

Regional Variations in Mean Temperature

Source: C.W.P.C. Information Base, Climate, 1976

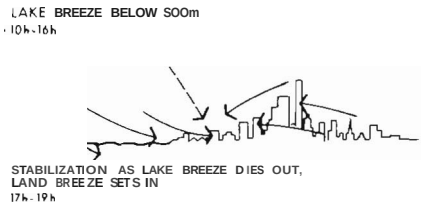
Generalized Minimum Temperature for Clear, Calm Conditions-Winter





Mean Maximum Temperature-May

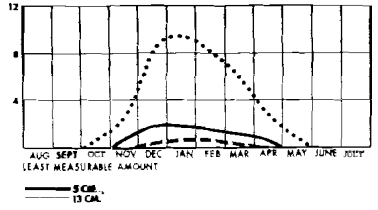
Source: C.W.P.c. Information Base, Climate, 1976.



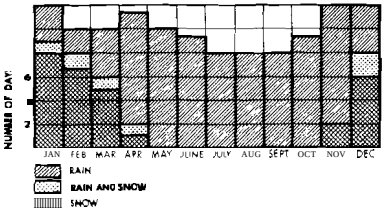
Diurnal Model of the Lake Breeze

Source: C.W.P.C. Information Base. Climate. 1976.

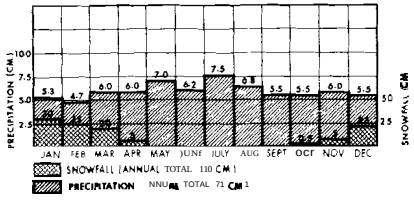
Average Annual Snowfall (1941-1970)
(Figures in em.!
Source: C.W.P.c. Information Base. Climate, 1976.



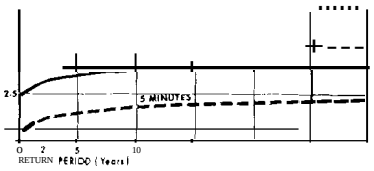
Average Number of Days with Snowfall
Source: C.w.P.c. Information Base, Climate, 1976.



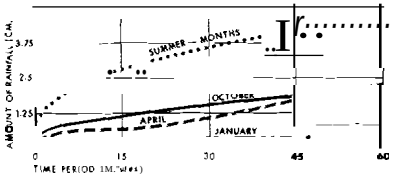
Average Number of Days Per Month with Precipitation
Source: C.W.P.C. Information Base. Climate. 1976.



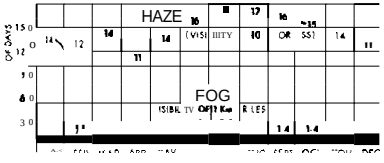
Average Precipitation Amounts
Source: C.W.P.C. Information Base, Climate. 1976.



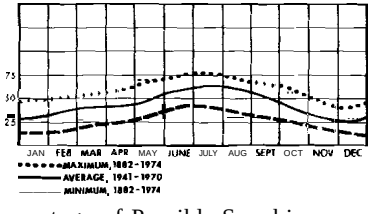
Return Periods of Heavy Rainfalls
Source: C.W.P.C. Information Base, Climate. 1976.



Maximum Recorded Rainfalls in Short Periods
Source: C.W.P.C. Information Base, Climate, 1976.



Average Monthly Frequency of Fog and Haze at Toronto Island Airport
Source: C.W.P.C. Information Base. Climate. 1976.

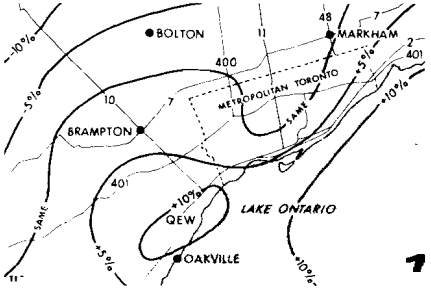


Percentage of Possible Sunshine
Source: C.W.P.C. Information Base. Climate. 1976.

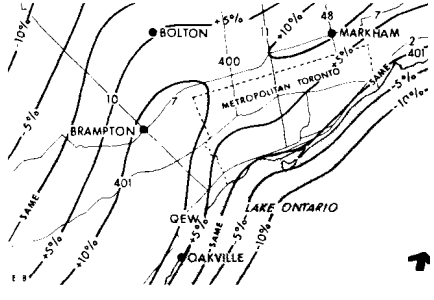
Regional variations in rainfall are due to the characteristics of particular storm systems rather than to an interaction between the Lake and land. Monthly summer rainfall in the Central Waterfront is almost identical to inland rainfall. Heavy rains may occur in any season but the most intense rainfalls occur in summer. The heaviest 24 hour rainfall exceeds 5 cm in most years. Snowfall is 30% less on the Toronto Islands than in the northern suburbs of Toronto due to the transformation of some snow to rain after winds have crossed the open waters of Lake Ontario.

Lake Ontario has a slight influence on humidity in the Central Waterfront. In spring and summer, average vapour pressure is slightly lower on the Toronto Islands than inland; in other seasons it is slightly higher. There is little variation in absolute humidity within the waterfront. However, relative humidity may vary considerably. Sites in constant shade may remain moist for extended periods after rain or snow.

Sunshine and visibility in the Central Waterfront are also affected by the Lake's proximity. Sunshine may be less frequent along the waterfront in winter but more frequent in summer. Fog occurs at the Toronto Island Airport an average of 22 days per year; twice as often as at Bloor Street, but half as frequently as at inland stations. The Outer Headland and south shore of the Toronto Islands have fog 50 days per year, m6re than twice the frequency for other areas in the waterfront.

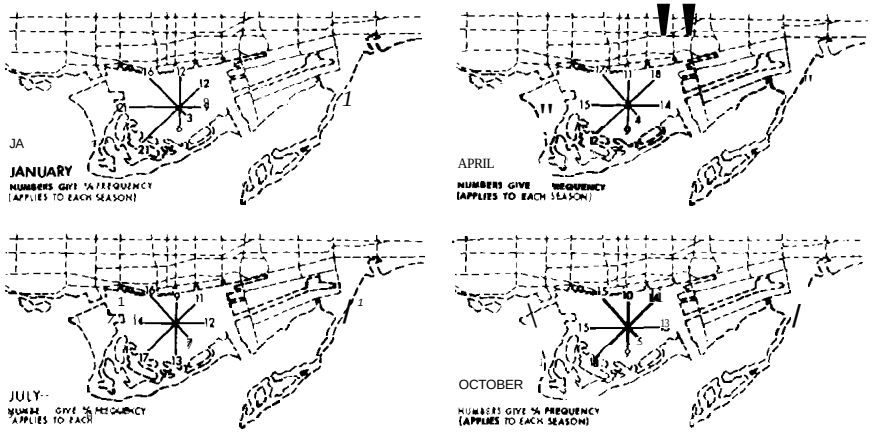


Summer



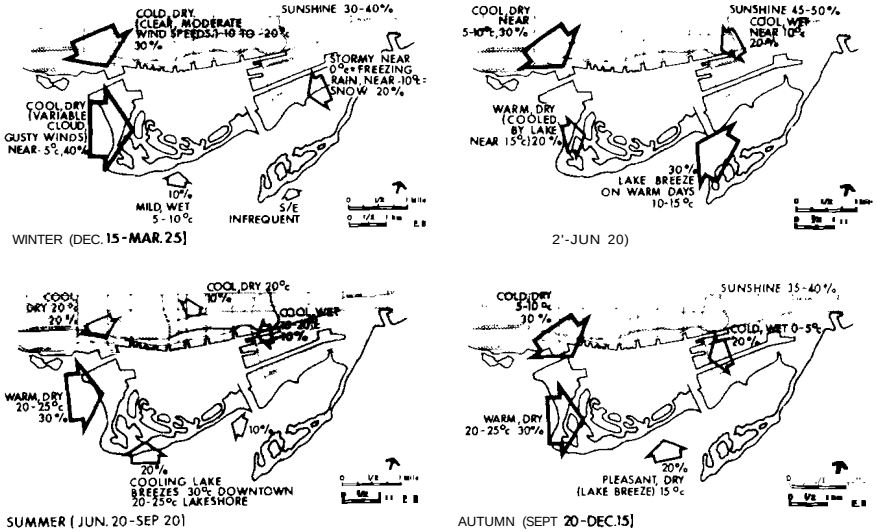
Winter

Sunshine Variation
Source: CW.P.C. Information Base. Climate. 1976.



Seasonal Wind Roses

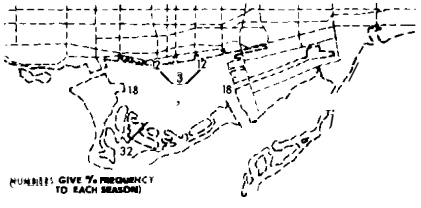
Source: C.W.P.C. Information Base, Climate, 1976.



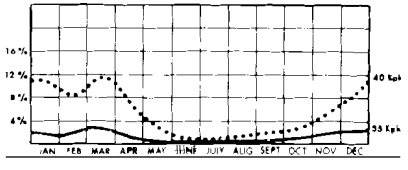
Seasonal Wind Maps

Source: C.W.P.C. Information Base, Climate, 1976.

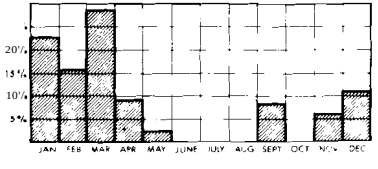
Toronto lies in the mid-latitude belt of westerly winds, and the east-west orientation of Lake Ontario increases the frequency of westerly winds. Winds from the southwest, west, and northwest blow 50-60% of the time throughout the year, usually at speeds of 15-30 kph, but occasionally much higher. Wind speeds are higher over the Lake. Therefore winds from the west, southwest, south, southeast, and east which have a long fetch over open water are especially strong In addition, the temperature gradient between lake and landmass may increase wind speed; a sharp gradient may double the wind speed near the shore. Wind speeds are greatest in winter and least in summer; the average wind speed at Toronto Island Airport is nearly 20 kph in winter and 13 kph in summer. Strong winds are also of longer duration in winter and may create severe discomfort. A wind speed of 40 kph causes difficult walking conditions; a gale force wind of 55 kph is almost impossible to walk against. The direction and speed of moderate (24-39 kph) and strong (40 kph) winds are similar in all parts of the waterfront except in localized sheltered areas.

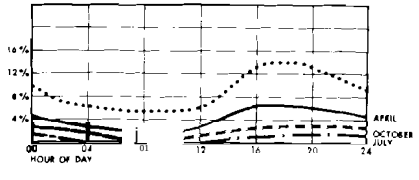


Wind Rose for Speeds of 40 kph or More



Monthly Frequency of Strong Winds





Relative Frequency of the Annual Extreme Characteristics of Strong Winds in the Central Waterfront

Frequency of 40 kph Winds

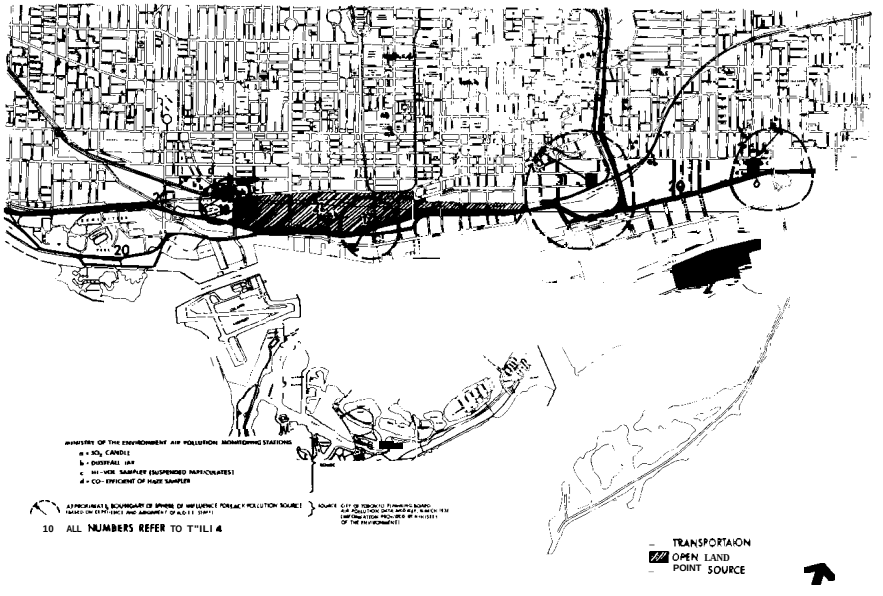
Source: C.W.P.C. Information Base. Climate, 1976.

AIR QUALITY

Air quality in Metropolitan Toronto usually meets public health standards. However, certain weather conditions may cause pollution levels to exceed these standards. A stationary high pressure system may create a temperature inversion, where cold air is trapped near the ground by warmer air above, gradually accumulating pollutants. The Toronto region is particularly susceptible to hazardous pollution levels due to temperature inversions in the late summer and fall. In other seasons, the lake breeze may alleviate this situation by increasing air movement, thereby dispersing pollutants.

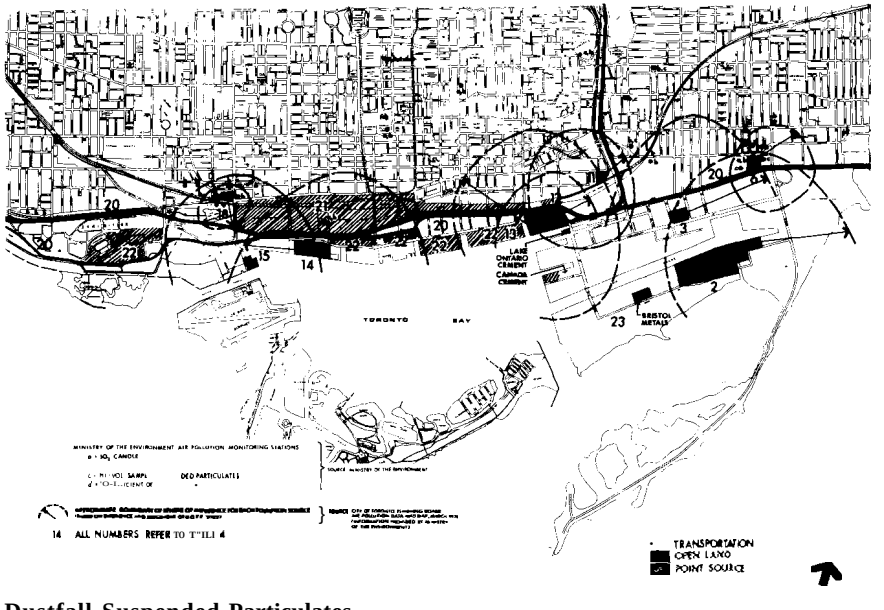
Air quality in the Central Waterfront is affected by both regional and local air quality There are three types of air pollution: gaseous, particulate, and odourous. Gaseous pollutants in the waterfront include carbon monoxide, sulphur dioxide, and nitrogen oxides. All may have serious effects on human health and on plant growth, and are covered by legislated standards (Environmental Protection Act of 1974, Statutes of Ontario). Overall, gaseous pollutants in the Central Waterfront do not exceed the required standards. The sources of gaseous pollutants are identified on the adjacent map. Industries are required to comply with the standards, but emissions from vehicular exhaust along transportation corridors are not now subject to control.

Particulate matter is defined by type and size. Airborne particle-size elements may be chemical, organic, or elemental. Larger particles are classified as dustfall, small particles as suspended particulates or haze. Chemical particulate pollutants include lead, cadmium, and copper. A/I are toxic substances which pose potential health problems to humans and wildlife. All may become concentrated in the soil and in plants, remaining in the local environment for many years. Organic dustfall in the waterfront is primarily a by-product of grain-associated industries. Elemental dustfall comprises wind-blown particles of soil and soot from diverse sources: unstabilized storage piles, vacant lots, railway yards, and chimneys. Sources of chemical, organic, and elemental dustfall in the Central Waterfront are shown on the adjacent map. Dustfall and suspended particulates in the waterfront regularly exceed M.O.E. (Ministry of the Environment, Ontario) criteria of 20 tons per square mile over 30 days.



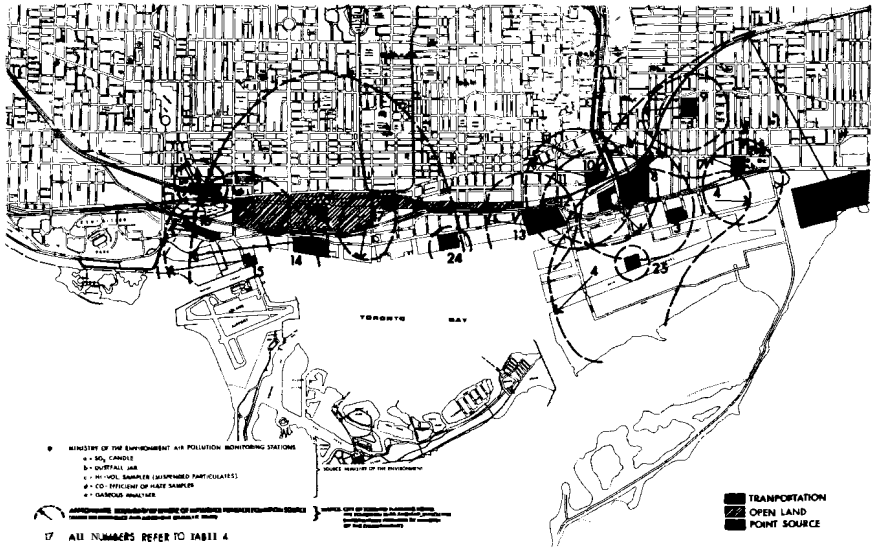
Gaseous Pollutants

Source: C.W.P.C. Information Base, Air Quality, 1976.



Dustfall-Suspended Particulates

Source: C.W.P.C. Information Base, Air Quality, 1976.



Odours

Source: C.W.P.C. Information Base, Air Quality, 1976

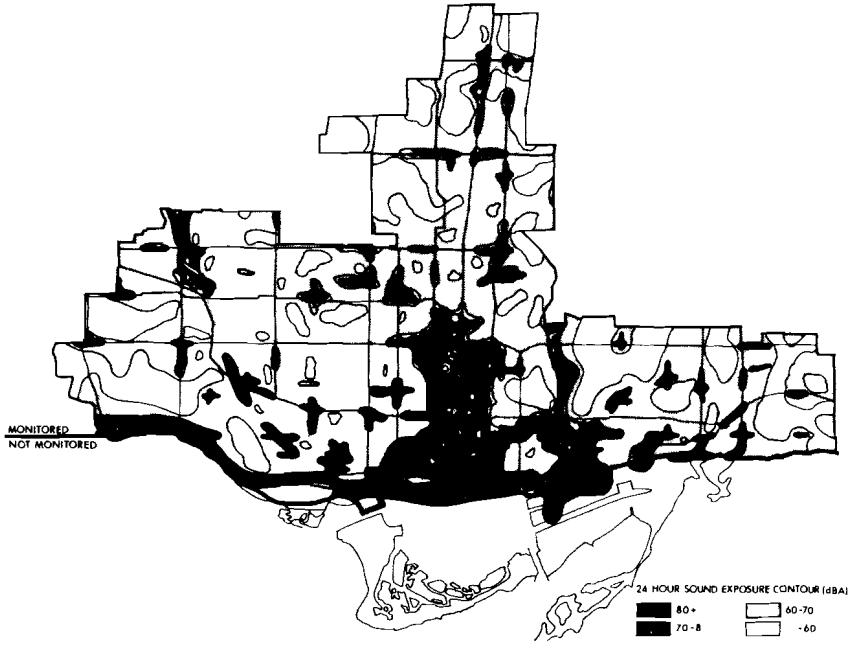
Offensive odours in the Central Waterfront are primarily associated with transportation, industry, and public utilities. These include odours from gasoline exhaust, incineration, sewage treatment, garbage, and meat by-products. Odours, if unassociated with toxic air pollutants, are difficult to control by legal standards. However, the effects of offensive odours should be considered in planning new land uses near the odour sources identified on the Odours map.

The air quality in the Central Waterfront is affected by the prevailing wind direction. Southerly winds produce significantly higher air quality in the waterfront than in that area of the city core immediately north of the Gardiner Expressway. Northwest winds bring pollutants from the north and produce degraded air quality where all gaseous pollutants except carbon monoxide may exceed M.O.E. standards. Conversely, air pollution originating in the waterfront may degrade air quality downwind, and reduction of ventilating lake breezes to the urban core may reduce air quality in that section. A concentration of high-rise buildings along the bayfront could adversely affect air quality north of the Gardiner Expressway.

NOISE

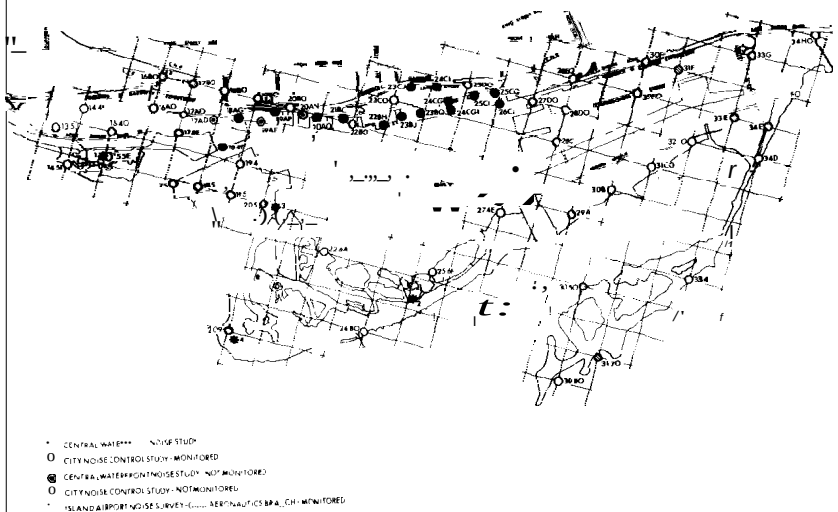
Noise is any undesired sound. Despite the tact that individuals differ in their reactions to sound levels and types, high noise levels may have a profound effect upon people's physical and psychological well-being. Portions of the Central Waterfront have sound levels comparable to the noisiest areas of downtown Toronto; other areas are unusually quiet given their proximity to the downtown.

Transportation, industry, and construction are typical sources of outdoor urban noise which are found in the Central Waterfront. Of these, transportation noise is generally the most annoying Surface transportation-cars, buses, trucks, and trains-produces the most pervasive outdoor urban noise. Along highway corridors like the Gardiner Expressway and Lakeshore Boulevard, this noise is continuous. Air transportation produces intense but intermittent noise, and is a severe problem in areas near airports. High frequency noise from jet aircraft is significantly louder to the human ear than

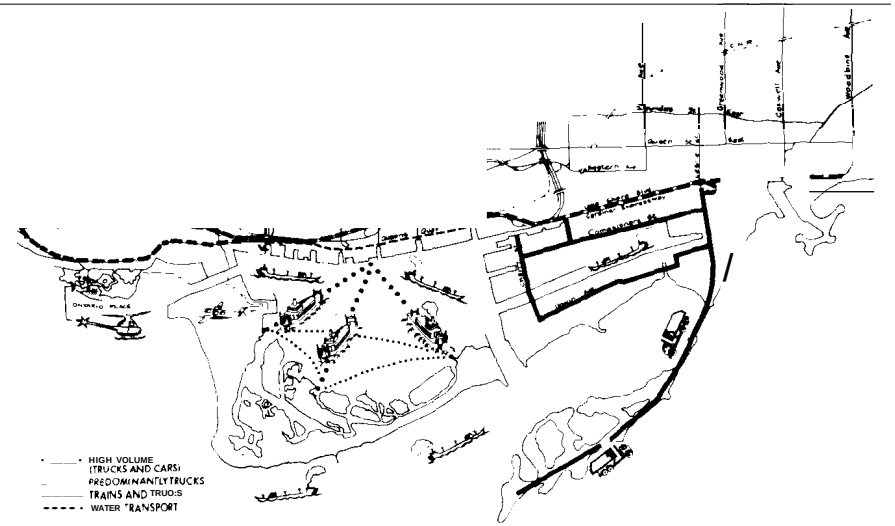


City Noise Contour Map

Source: City Noise Control Study Based on 1973-1976 Data



Noise Monitoring Stations
Source: C.W.P.C. Information Base, Noise, 1976.



Transportation Noise Corridors
Source: C.W.P.C. Information Base, Noise, 1976.

noise from propeller aircraft Thus, small jets using the Island Airport are potentially more annoying than small propeller planes. NOise from outdoor industrial operations, such as steam discharge or metal crushing, may carry a long distance, especially over open water. Thus, industrial noise in the Port area and Bayfront may affect other parts of the waterfront

The impact of other sounds in the waterfront is more difficult to assess. Sounds of people talking, radios, and boat engines are examples of miscellaneous derived from human activities. In addition, sounds of winds, waves, and birds are associated with the waterfront.

Since annoyance potential of noise depends on environmental context, it is useful to the noise characteristics of specific areas within the waterfront. For example, high sound levels in industrial and commercial areas may be acceptable, whereas they are not acceptable in quiet residential, institutional, or recreation areas

Sound levels have not been monitored extensively throughout the Central Waterfront, and noise monitoring stations are concentrated in the Bayfront. The Bayfront and Port areas are the noisiest parts of the waterfront. Transportation and industrial noise dominate the sound environment in these areas. Heavy truck and car traffic on the Gardiner Expressway and Lakeshore Boulevard, as well as industrial operations and rail service contribute to the high noise levels

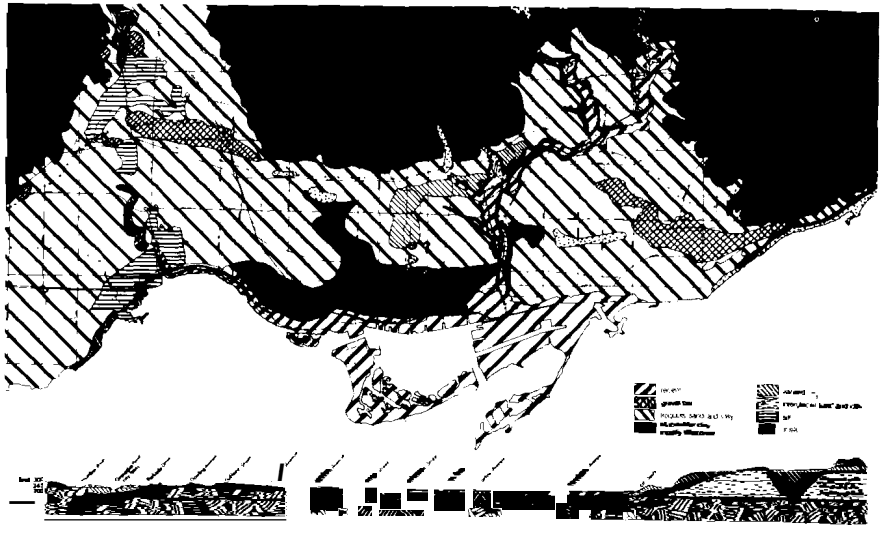
Planes and helicopters taking off and landing at the Island airport contribute noise to the entire Central Waterfront. Aviation noise is the only noise produced on the Toronto Islands which would affect other parts of the waterfront. The airport is exposed to noise from the mainland. The rest of the Islands are relatively quiet and are vulnerable to noise from industrial operations in the Port area. Cherry Beach and Aquatic Park (after landfill operations are completed) are also relatively quiet areas which are potentially affected by noise from industrial operations.

With the exception of the Toronto Islands few areas in the Central Waterfront sound levels below the M.O.E. recommended guideline for passive outdoor recreation (LEO 55 dBA, L50 52 dBA)

GEOLOGY

The bedrock underlying Toronto is the Georgian Bay Formation which is composed of shale with interbedded sandstone, siltstone, and argillaceous limestone. The bedrock is about 600 feet thick, and slopes toward the south; it is subject to severe weathering and breaks when tunnelled. Bituminous shales associated with oil seepage and pockets of natural gas as well as expanding clay minerals occur within the bedrock.

Glacial deposits overlie the bedrock throughout Toronto. Surficial deposits in the waterfront, however, are mostly landfills placed by man in the past century. Silt and clay glacial tills occur in Exhibition Park and recent littoral deposits make up the waterfront beaches. The thickness of surficial sediments ranges from 10 to 30 feet in the Bayfront to over 80 feet in the Toronto Islands and Outer Headland. Deep surficial deposits in the port area reflect a pre-glacial valley in the bedrock underlying the Don River valley.

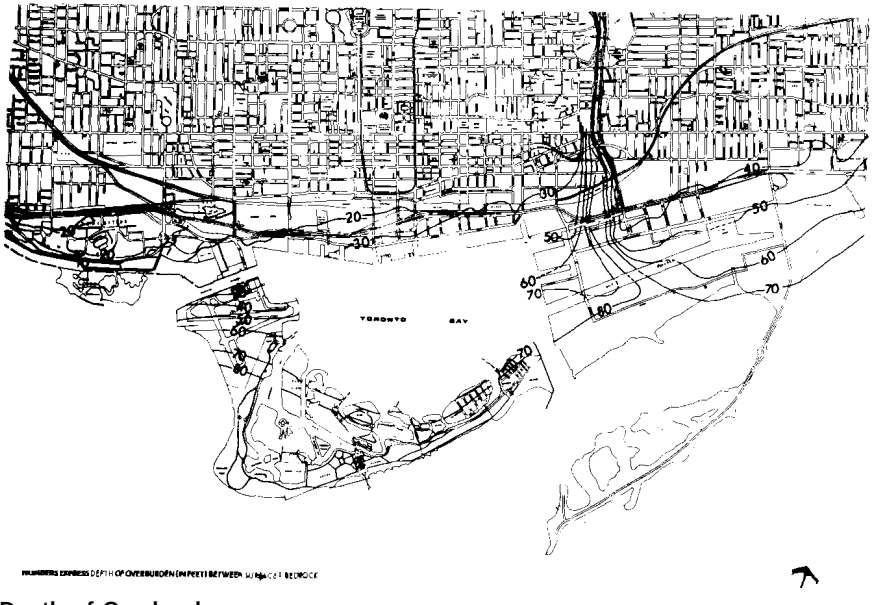


Surficial Geology

Source: Ministry of Natural Resources, Division of Mines.

Bedrock Contours

Source: Ministry of Natural Resources, Division of Mines.



Depth of Overburden

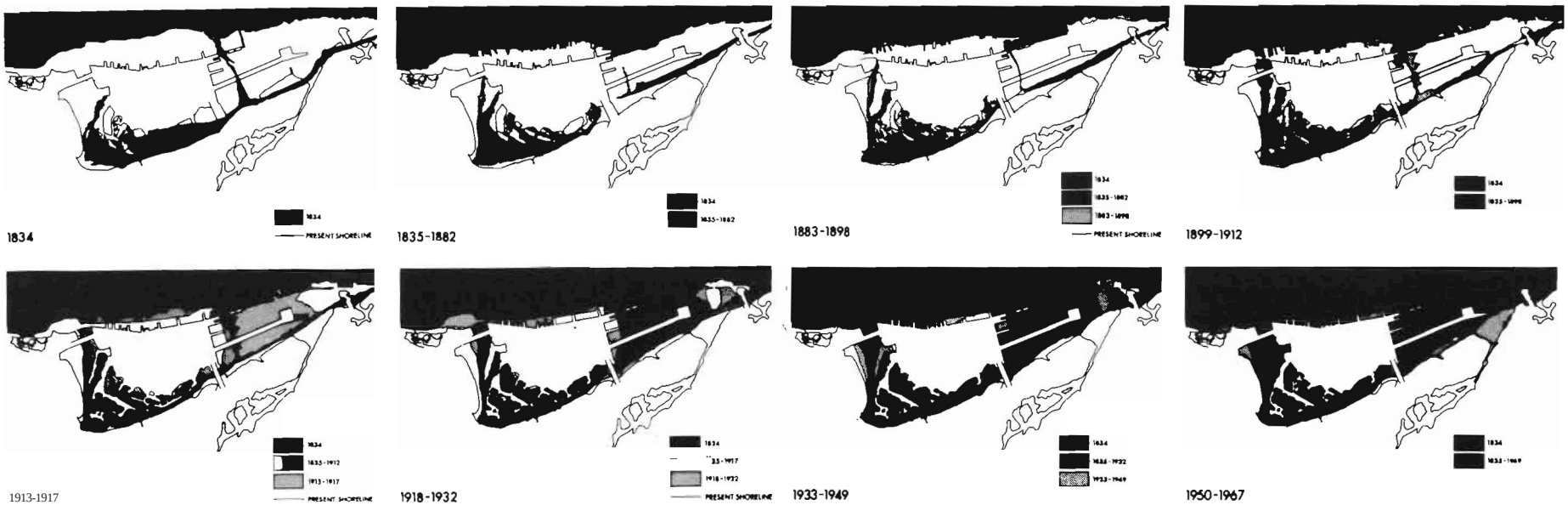
Source: Ministry of Natural Resources, Division of Mines.

Historic Landfill Operations

PHYSIOGRAPHY

More than 10,000 years ago, in the late Pleistocene, the present site of Toronto lay beneath Lake Iroquois, glacial ancestor of Lake Ontario. The bluff near St. Clair Avenue marks the ancient Iroquois shoreline. Almost 200 years ago, when Toronto was founded at the site of a natural harboul-, most of the present land area of the Central Waterfront lay beneath Lake Ontario The old shoreline is marked by Front Street to the east and by Lakeshore Boulevard to the west of Fort York. Since 1835, man has augmented and altered the water front. Initially, the mainland was expanded into the bay. Then fill was added to the littoral deposits of the Toronto Islands and to the marshland at the mouth of the Don River Fill operations continue today on the Outer Headland.

Topography in the waterfront reflects the land's origins The elevation along the original shoreline at Front Street is about 255 feet above sea level. Filled land is fairly flat and averages 250 to 252 feet in elevation.



Shoreline Alterations

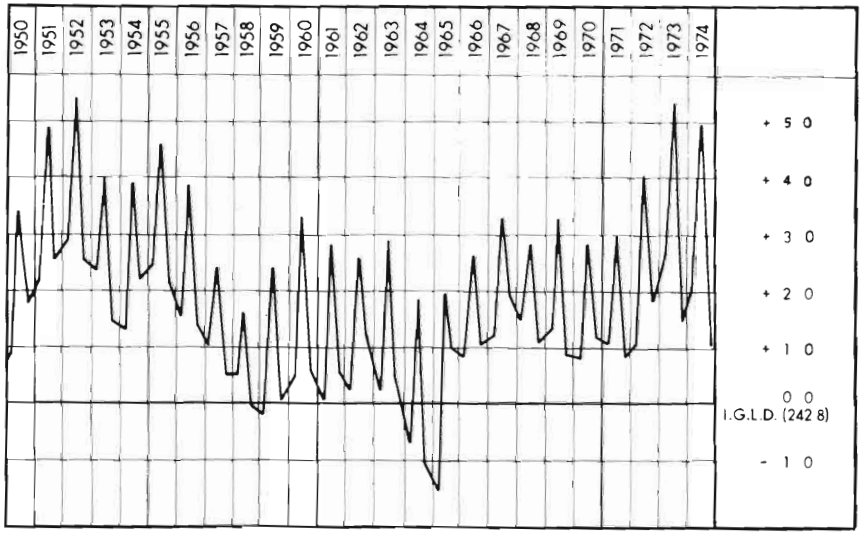
Source: C.w P.C. Information Base, Physical Geography, 1976.

Flooding on the Toronto Islands

HYDROLOGY

The hydrologic regimen of the Central Waterfront is dominated by Lake Ontario. Ground water levels, flooding, currents, shoreline erosion and accretion, and harbour water quality are all closely related to lake dynamics.

Ground water levels in the Central Waterfront respond to water levels in Lake Ontario and therefore fluctuate seasonally with changing lake levels. The ground water level is at an average elevation of 242.8 feet above sea level, the average lake level Thus the ground water table is normally at least 5 feet below the land surface. In most years, the highest lake level is 245 to 246 feet, infrequently it may reach 248 feet. During these periods of elevated lake levels the ground water table may be only 2 to 6 feet below grade throughout most of the waterfront After an intense storm, the ground water level may rise temporarily to a height of 12 inches above the lake level. If an extremely high lake level (248 feet) coincides with an intense rainstorm, the water table may be elevated to 249 feet, and areas less than 249 feet above sea level will be flooded.



Note: Water Levels are shown in feet from chart datum. Chart Datum is 248.8 International Great Lakes Datum (I.G.L.D.)

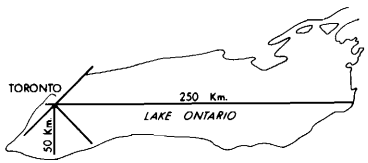
Lake Ontario Water Level Changes (1950-1974)

Source: C.W.P.C. Information Base, Water, 1976.

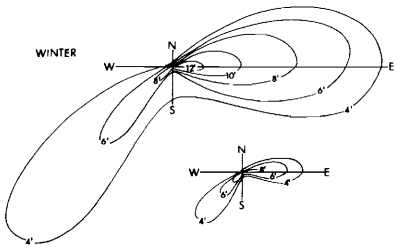
Floodprone Areas of the Toronto Islands

Source. City of Toronto Planning Board.

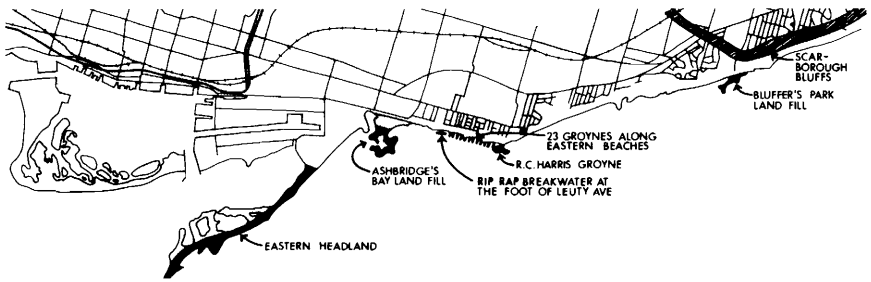
The primary hydrodynamic processes operating in the Central Waterfront are current movements, erosion, sediment transport and deposition, and water exchange between the Inner Harbour and Lake. Currents south of the islands are dominated by a westward flowing longshore current. This littoral current is a product of wind-generated waves. The force of a wave depends on wind strength and the extent of open water traversed (fetch). Although high speed winds blow more frequently from the southwest, waves from the east have more energy, since fetch is much longer. Thus westward waves strike the shoreline with the greatest force. The littoral drift transports eroded sediments westward along the shore, depositing them where barriers are encountered. The Toronto Islands were originally formed from material which was eroded from the Scarborough Bluffs and transported westward by littoral drift. The volume of sand that reaches the Toronto Islands is decreasing now that the Scarborough Bluffs have been stabilized, and since barriers to littoral drift have been constructed east of the Islands. Consequently, substantial additions of littoral deposits which occurred in the past can no longer be anticipated. Southwest storms produce winds and waves which are now eroding Centre Island east of Gibraltar Point at the rate of 1.5



Fetch Across Lake Ontario

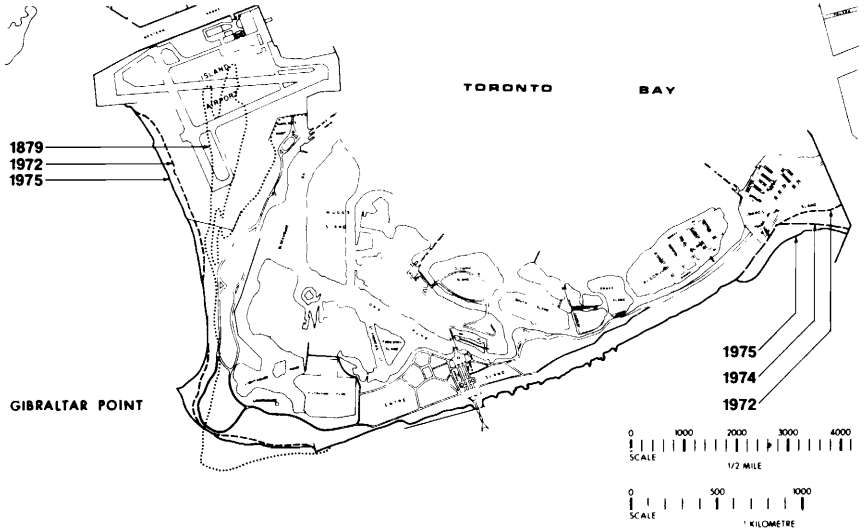


Wave Roses for the Central Waterfront



Barriers to Littoral Drift

Source: C.W.P.C. Information Base, Water, 1976.



YEARS	PERIOD YEARS	GAIN ACRES	LOSS ACRES	CUMULA-TIVE	RATE OF CHANGE ACRES/YR.
1879-1915	36	7.2		+7.2	+.20
1915-1924	9		4.2	+3.0	-.47
1924-1935	11	20.5		+23.5	+1.86
1935-1957	22		4.6	+18.9	-.21
1957-1971	15	4.6		+23.5	+.31

WEST SIDE

YEARS	PERIOD YEARS	GAIN ACRES	LOSS ACRES	CUMULA-TIVE	RATE OF CHANGE ACRES/YR.
1879-1915	36		9.1	-9.1	-.25
1915-1924	9	4.3		-4.8	+.47
1924-1935	11		4.6	-9.4	-.42
1935-1957	22		11.3	-20.7	-.51
1957-1972	15		0.7	-21.4	-.05

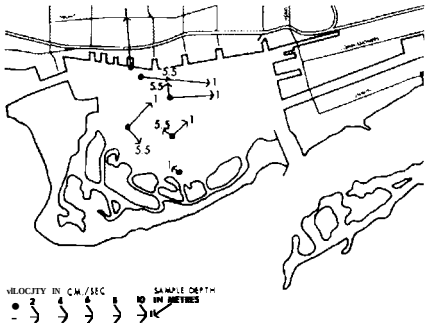
SOUTH SIDE

YEARS	PERIOD YEARS	RATE OF CHANGE ACRES/YR.	GAIN/LOSS ACRES		
1879-1915	36	-.05	-1.9		
1915-1924	9	+.01	+.1		
1924-1935	11	+1.45	+15.9		
1935-1957	22	-.73	-15.9		
1957-1972	15	+.26	+3.9		
	NET CHANGE -1879-1972		+2.1		

MASS BALANCE FOR GIBRALTAR POINT

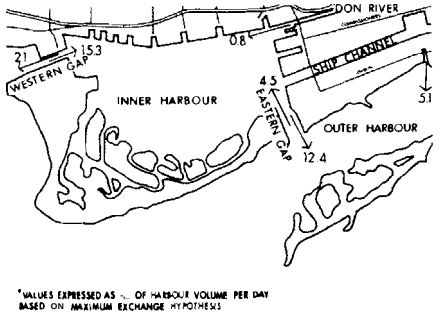
Changes in Gibraltar Point Since 1879

Source: C.W.P.C. Information Base, Water, 1976.



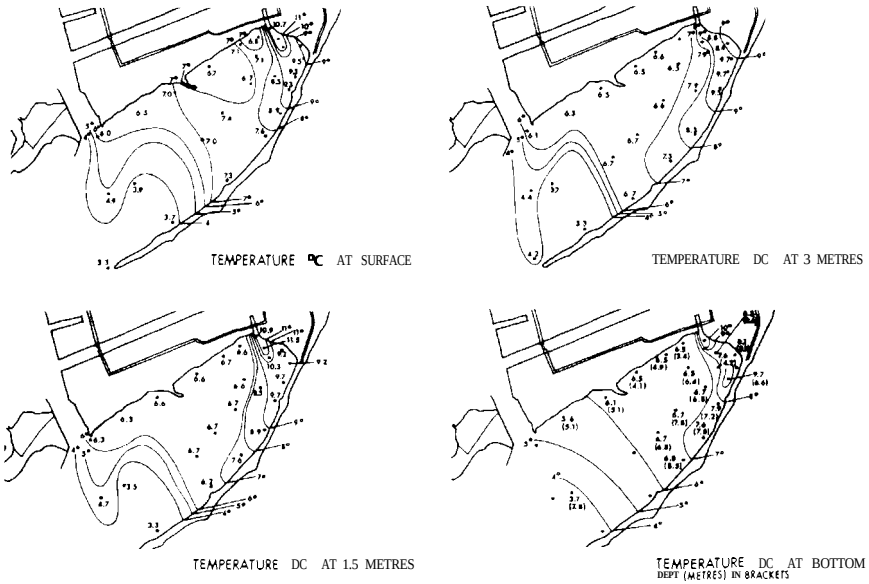
Current Velocity and Direction in the Inner Harbour

Source: Rogers, Great Lakes Institute, Unpublished Data



Water Mass Balance Based on Maximum Exchange Hypothesis

Source: M.O.E., Unpublished Data



Hearn Generating Station Thermal Plume (April 1971)

Source: Ontario Hydro (1971)

metres per year, and northwest littoral movement has shifted the beaches at Gibraltar Point to the northwest for the past several decades. The eroded material on the south side of Gibraltar Point has been balanced by accretion on the north side; the net change in the area between 1879 and 1972 has been a gain of 2.1 acres.

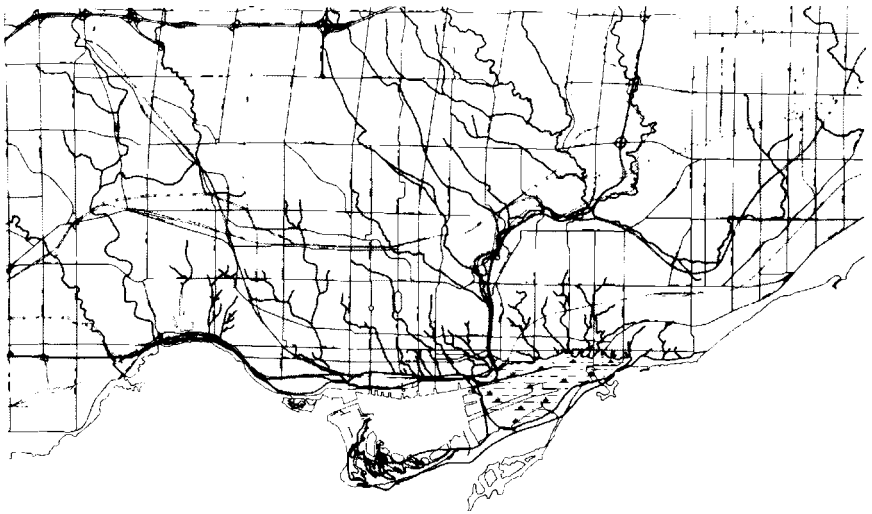
The exchange of water in the Inner Harbour with lake water is induced by winds, by seiche movement through the Western Channel and Eastern Gap, and by discharge from the Hearn Generating Plant. The mean retention time of water in the Inner Harbour is estimated to be between 5 and 20 days. Prolonged winds and changes in the cross-sectional area of the gaps induce secondary effects. The precise mechanism of water circulation in the Inner Harbour, however, has not been determined, and an understanding of this process is essential in determining residence times of pollutants. Water movement in the Island lagoons seems to be sufficient to prevent stagnation in most areas. Currents in the Outer Harbour are apparently induced by the Hearn Generating Plant which takes water from the Turning Basin, uses it for cooling purposes, and discharges it to the Outer Harbour.

Man has altered the pattern of surface drainage over the past century. At one time, many streams drained from the Toronto region into Lake Ontario. These streams have since been incorporated within the city's storm and sanitary sewer system or contained within concrete drainage channels. Although invisible, the ancient drainage courses serve as a basis for the city's sewer system, which delivers drainage from the hinterlands to the harbour.

The filled land in the Central Waterfront is relatively flat, and most storm runoff in the Bayfront and Port areas is directed toward storm sewers or over the dockwall into the bay. Since the soil of the Toronto Islands is porous sand, most runoff seeps directly into the ground.

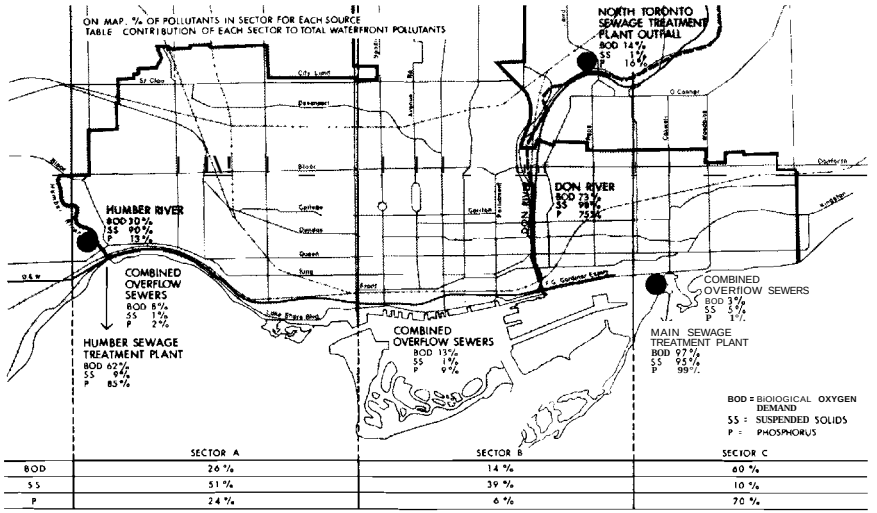
Many storm and sanitary sewers have discharge outlets along the waterfront. In wet weather, storm and combined storm-sanitary sewers discharge suspended solids and coliform bacteria into the nearshore waters of the Central Waterfront.

The water quality of the Central Waterfront is measured by bacterial levels, by the amount of suspended solids, and by nutrient



Historic Rivers

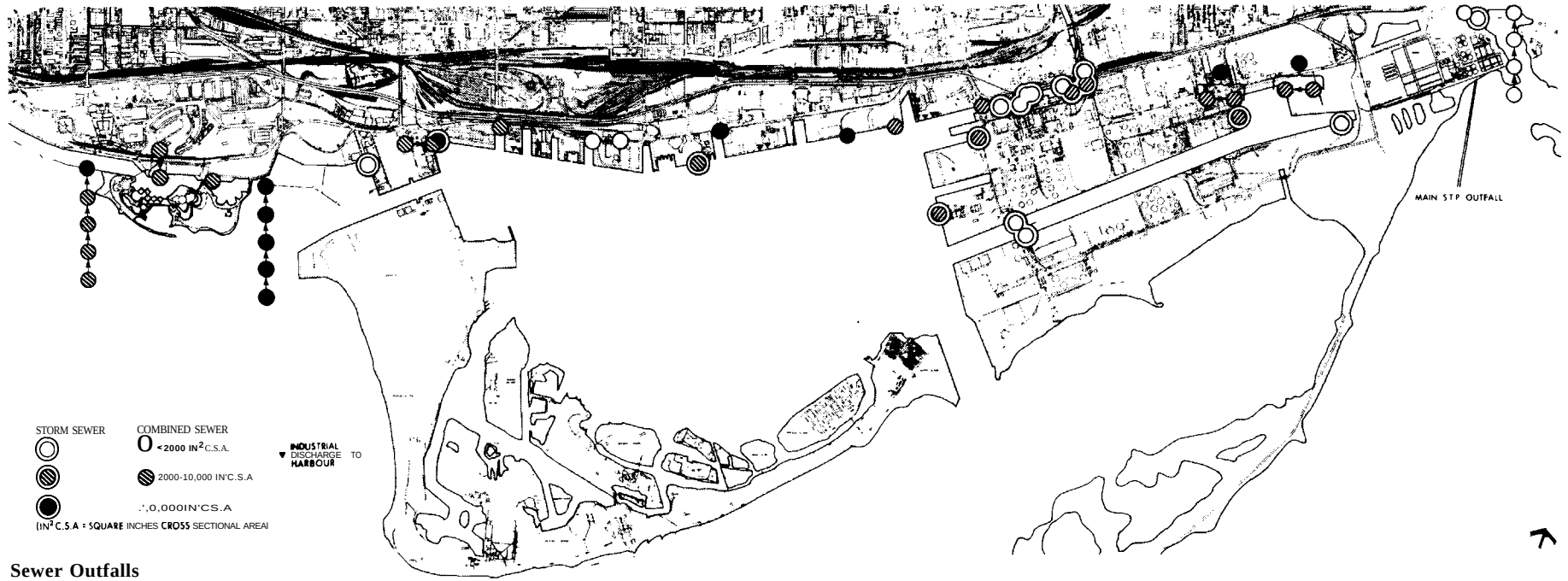
Source' C.W.P.C. Information Base, Water, 1976.



	SECTOR A	SECTOR B	SECTOR C
BOD	26 %	14 %	60 %
SS	51 %	39 %	10 %
P	24 %	6 %	70 %

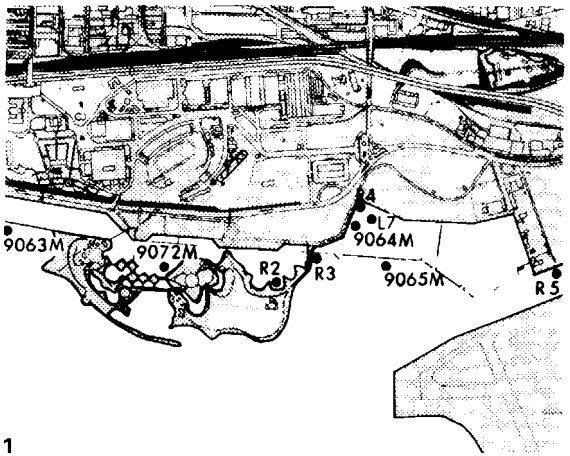
Sewage Treatment Plants and Percentage Loading by Source and Area

Source C.W,P.C. Information Base, Water, 1976.



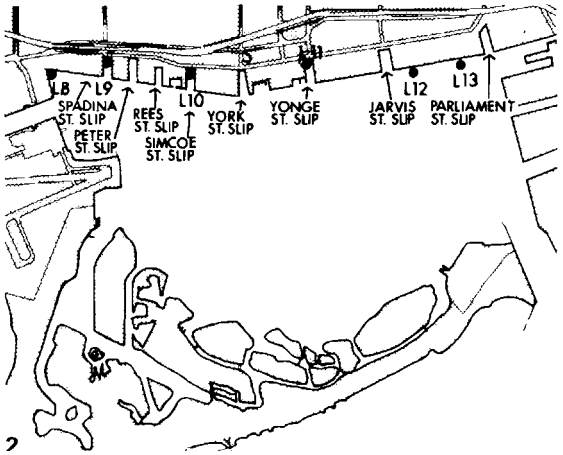
Sewer Outfalls

Source C.W.P.C. Information Base, Water, 1976.



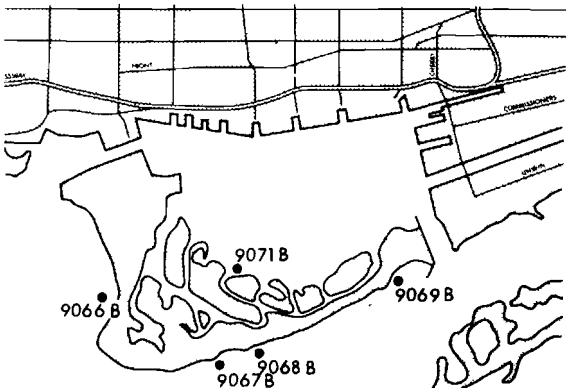
1

Exhibition Place and Ontario Place



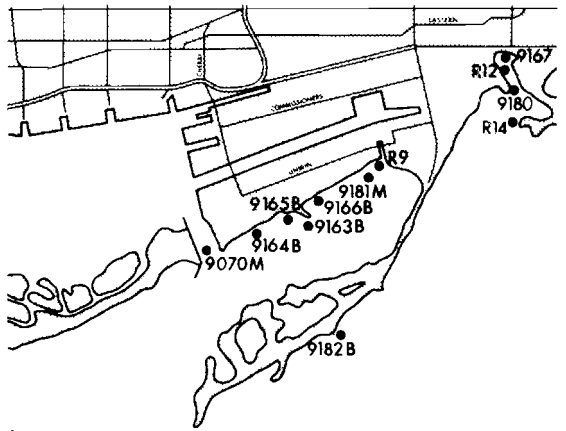
2

Bayfront



3

Toronto Islands



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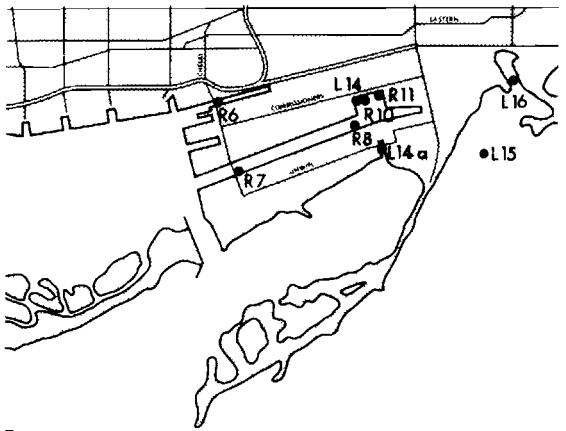
Outer Harbour and East Waterfront



5

Port Area

1

PARAMETER	YEAR	SAMPLE SITES											
					R2	9064	R4	9065	L7	R5			
TOTAL COLIFORMS /OG MEAN/100 ML	1974	907	300	432	4127	947	1051	380	106	3850			
	1975	415.0	459.4	1427.1	5696	2720	7190	77618	6294	4316			
FECAL COLIFORMS	1974	19	22	44	117	14	365	17	0	117			
LOG MEAN/100 ML	1975	354	171	175.1	393	42.67	671.9	59.7	3.7	162			
PERCENT OF FECAL COLIFORMS TO TOTAL COLIFORMS	1974	2.1	7.3	7	2.7	1.5	3.5	4.5	1	3			
	1975	8.5	3.7	12.3	6.9	7.4	6.6	0.5	1.6	3.6			
PERCENT OF SAMPLES CONTAINING FECAL COLIFORMS ABOVE 100/100 ML	1974	2.3	27.3	24.1	35.1	27.3	72.4	20	0	38.8			
	1975	40.0	21.4	61.5	70.0	37.5	76.9	53.8	30.0	37.5			
RATIO OF FECAL COLIFORMS TO FECAL STREPT	1974	4.7	2.8	1.0	2.8	3.02	2.7	3.7		2.5			
	1975	4.5	4.9	3.5	18.4	4.8	24	14.2		1.6			

2

PARAMETER	YEAR	SAMPLE SITES					
		L6	L9		L11	L2	L3
TOTAL COLIFORMS /OG MEAN/100 ML	1974	20800	460	235	4600	7400	18220
	1975	94810	3649	6857	9334	22834	106743
FECAL COLIFORMS /OG MEAN/100 ML	1974	619	28	9	30	52	503
	1975	3622	60	352	37	281	3586
PERCENT OF FECAL COLIFORMS TO TOTAL COLIFORMS	1974	3	6	3.5	0.6	0.7	3
	1975	5.9		4	1.4	1.2	5.4
PERCENT OF SAMPLES CONTAINING FECAL COLIFORMS ABOVE 100/100 ML	1974	66.7	42.9	57.1	42.9	60	80
	1975	80.0	40.0	80.0	60.0	80.0	80.0
RATIO OF FECAL COLIFORMS TO FECAL STREPT	1974						
	1975						

3

PARAMETER	YEAR	SAMPLE SITES				
		9066	9067	9068	9069	9071
TOTAL COLIFORMS /OG MEAN/100 ML	1974	59	983	199	193	314
	1975	80	1413	138	360	1090
FECAL COLIFORMS /OG MEAN/100 ML	1974	2	203	15	8	5
	1975	6.2	809	5.62	11.6	32.2
PERCENT OF FECAL COLIFORMS TO TOTAL COLIFORMS	1974	3.4	2.2	7.5	3	6
	1975	7.7	4.2	3.5	3.2	4.8
PERCENT OF SAMPLES CONTAINING FECAL COLIFORMS ABOVE 100/100 ML	1974	3.3	14.3	0	4.7	4.7
	1975	6.3	12.5	6.7	14.3	40
RATIO OF FECAL COLIFORMS TO FECAL STREPT	1974	2	3.67	1.14	2.7	4
	1975	3.4	4.2	2.3	5.3	20.5

4

PARAMETER	YEAR	SAMPLE SITES											
		9070	9164	9165	9163	9166	9181	R5	9182	9167	R12	9180	R14
TOTAL COLIFORMS /OG MEAN/100 ML	1974	1260	334	252	96	197	67	568	33	647	728	406	2082
	1975	2140	235	1447		1065	868	695	76	570	19220	374	5018
FECAL COLIFORMS /OG MEAN/100 ML	1974	18	7	5	4	2	6	78	1	39	197	10	54
	1975	282	82	73		12	54	324		28	981	5	302
PERCENT OF FECAL COLIFORMS TO TOTAL COLIFORMS	1974	1.4	2.1	2	4	1.5	3	12.7	3	6	24	2.5	2.5
	1975	13	3.1	5.0		8.8	6.4	46.2	3.6	4.9	5.2	5.2	6.0
PERCENT OF SAMPLES CONTAINING FECAL COLIFORMS ABOVE 100/100 ML	1974	9.5	11	11	0	0	0	42	0	31.8	57.1	19	33
	1975	30.8	9.3	40		6.3	15.4	45.0	6.3	33.3	92.5	20.0	67.5
RATIO OF FECAL COLIFORMS TO FECAL STREPT	1974	2.2	2.5	3.2	3.4	4	2.6	6.5	0.9	4	2.2	4.5	4
	1975	6.6	3.4	2.2		3.4	9	9.8	4.7	2.5	4.6	6.4	9.5

5

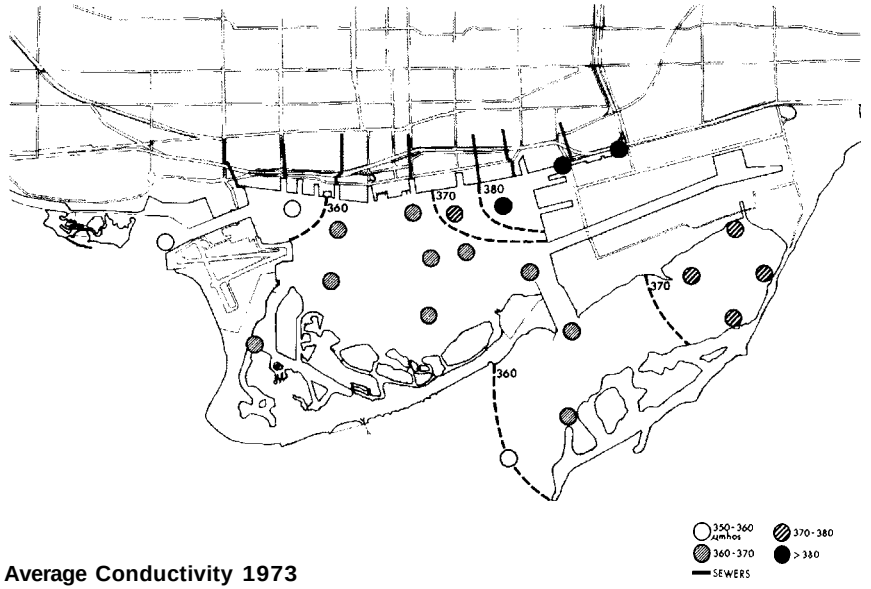
PARAMETER	YEAR	SAMPLE SITES							
		R6	R7	R9	R10	R11	L14	14a	L15
TOTAL COLIFORMS /OG MEAN/100 ML	1974	23369	8427				650	128	42
	1975	46239	3761	907	23147	26808	650	199	266
FECAL COLIFORMS /OG MEAN/100 ML	1974	841	92				170	23	10
	1975	2839	130	220	228	2869	24000	87	10
PERCENT OF FECAL COLIFORMS TO TOTAL COLIFORMS	1974	3.4	1.1				14.2	7	7.0
	1975	6.2	3.5	9.2	5.3	8.9	9.2	4	3.7
PERCENT OF SAMPLES CONTAINING FECAL COLIFORMS ABOVE 100/100 ML	1974	94	55.6				16.3	4.3	0.0
	1975	92.8	51.3	57.5	93.3	88.9	100	20.0	0.0
RATIO OF FECAL COLIFORMS TO FECAL STREPT	1974	2	1.5						
	1975	5.6	4.6	5.2	8.5	7.4			

Bacteriological Densities

Source C.W.P C. Information Base, Water, 1976, 9000-City Health, R-City Works, L-Metro Works

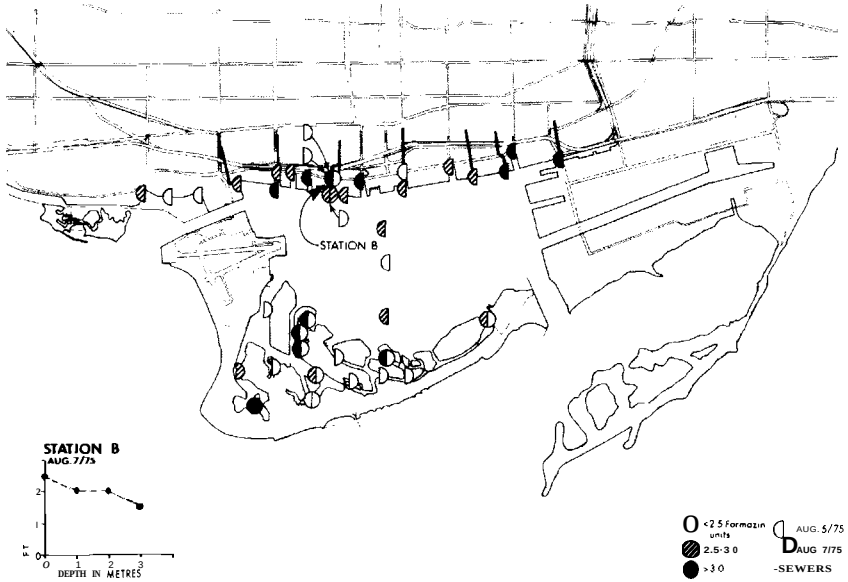
levels. Water quality in the waterfront can be expressed as a gradient from worst to best, from the Inner Harbour to the Outer Harbour to the Lake. This gradient is evident in conductivity contours shown on the adjacent map. This map clearly shows the Don River-Keating Channel as a major source of pollutants to the waters of the Harbour. Oxygen depletion in the Inner Harbour is not severe, since oxygen-rich lake water flows through the gaps and mixes with Harbour water. Suspended material in the waters discharged by the Don River and storm sewers and occasional oil spills contribute to the high turbidity levels in the Inner Harbour. Water along the Bayfront has a high incidence of fecal coliforms, due principally to sewer discharges. Levels of nutrients (nitrogen and phosphorus) are highest at the outlet of the Keating Channel and in the Island lagoons. High nutrient levels in the Island lagoons may result from large waterfowl populations, fertilization programs in the Island parks, and discharge from septic tanks.

Water quality of the Outer Harbour is much better than that of the Inner Harbour. Heavily polluted water from the Turning Basin is used by the Hearn Generating Plant for cooling purposes and discharged to



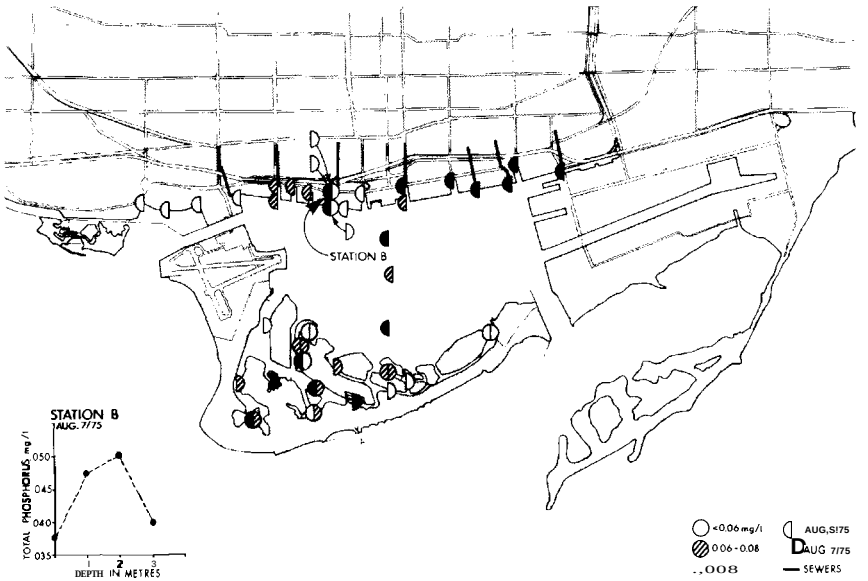
Average Conductivity 1973

Source: University of Toronto, 1974.



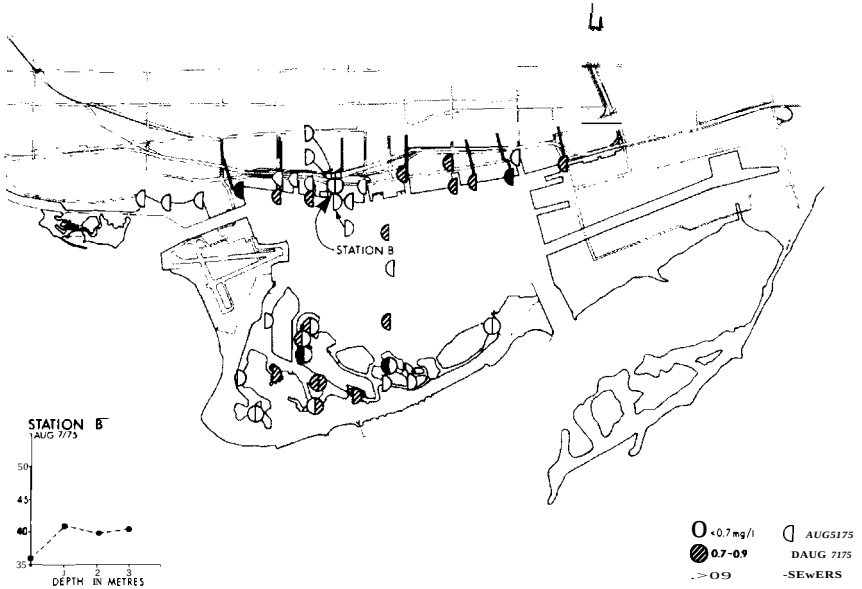
Turbidity

Source: M.O.E. Special Survey



Total Phosphorus

Source: M.O.E. Special Survey



Total Nitrogen

Source: M.O.E. Special Survey

the Outer Harbour. This discharge contains high levels of nutrients and coliform bacteria. Water quality along the western shore behind the breakwater near Ontario Place is considerably degraded by the many sewers which discharge there.

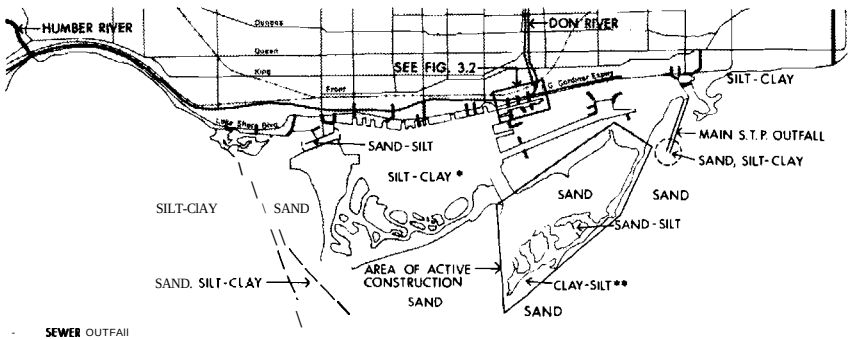
The quality of water in Lake Ontario does not exceed M.O.E. water quality standards for coliform bacteria, nutrients, or suspended solids. It is a source of high quality water to dilute polluted waters of the Inner Harbour.

SUBAQUEOUS SEDIMENTS

Subaqueous sediments lie beneath the water of the Central Waterfront. They are derived from sediments deposited by littoral currents, rivers, storm sewer outfalls, and landfill activities. Subaqueous sediments range in texture from sand to clay.

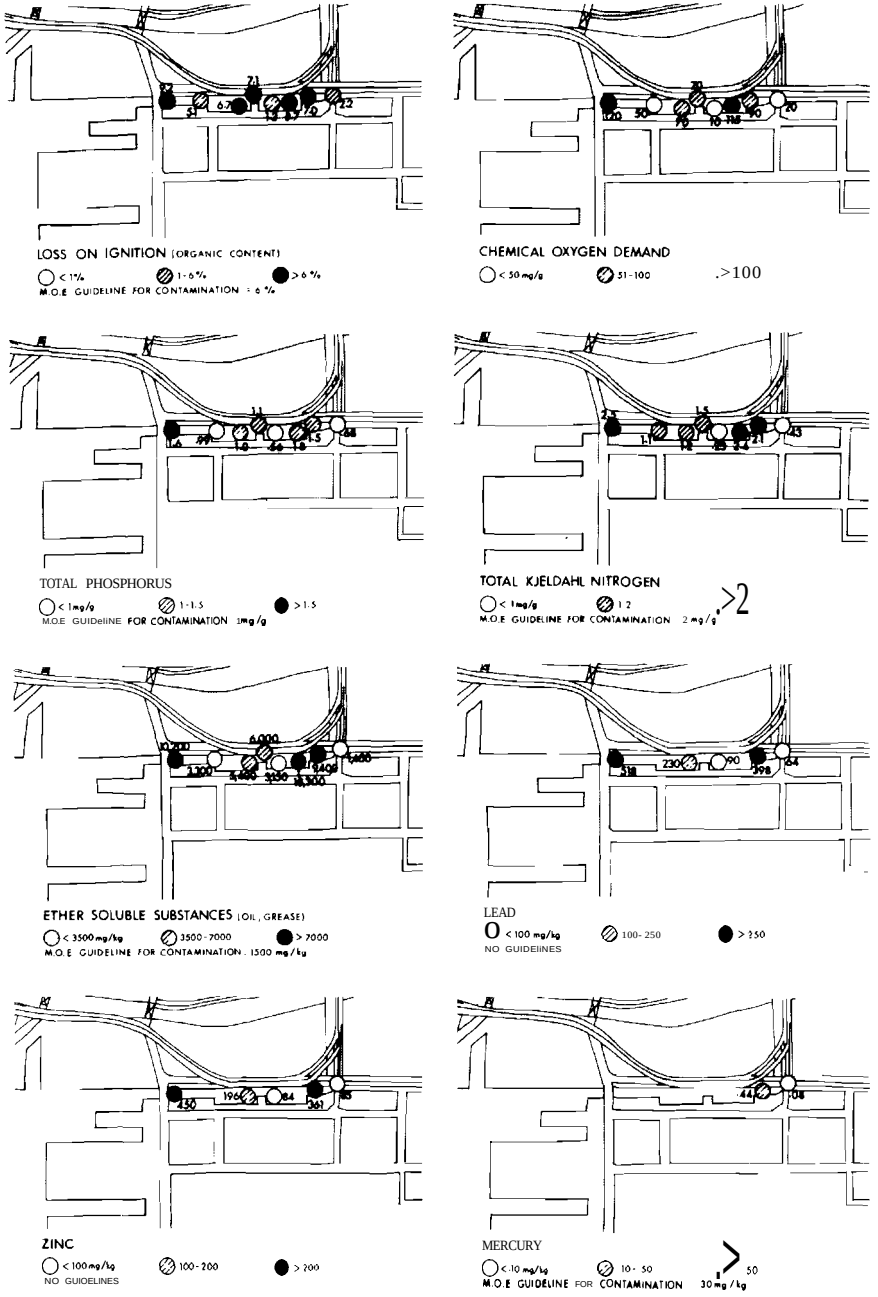
Lakebed sediments in the Outer Harbour and Lake Ontario are derived from littoral drift and consist primarily of sand. The lakebottom in offshore regions is characterized by a bedrock platform with a patchy sand veneer. The sediments in the Western Gap are composed of sand and silt. Sand in the Western Gap may have been deposited by eastward flowing currents. Offshore areas to the west of Toronto Islands contain silty muds with admixtures of sand. The silt-clay fraction is an accumulation of sediments discharged by the Humber River. The Inner Harbour sediments are silty-clay deposits derived from the discharge of storm sewers and the Don River.

Subaqueous sediments in some parts of the Central Waterfront are contaminated by toxic heavy metals (lead, zinc, mercury), by nutrients (phosphorus, nitrogen) and by oil and grease. Under certain conditions these sediments may contaminate the water. Colloidal material present in the sediments (clays and organic matter) may absorb phosphorus and heavy metals from the overlying



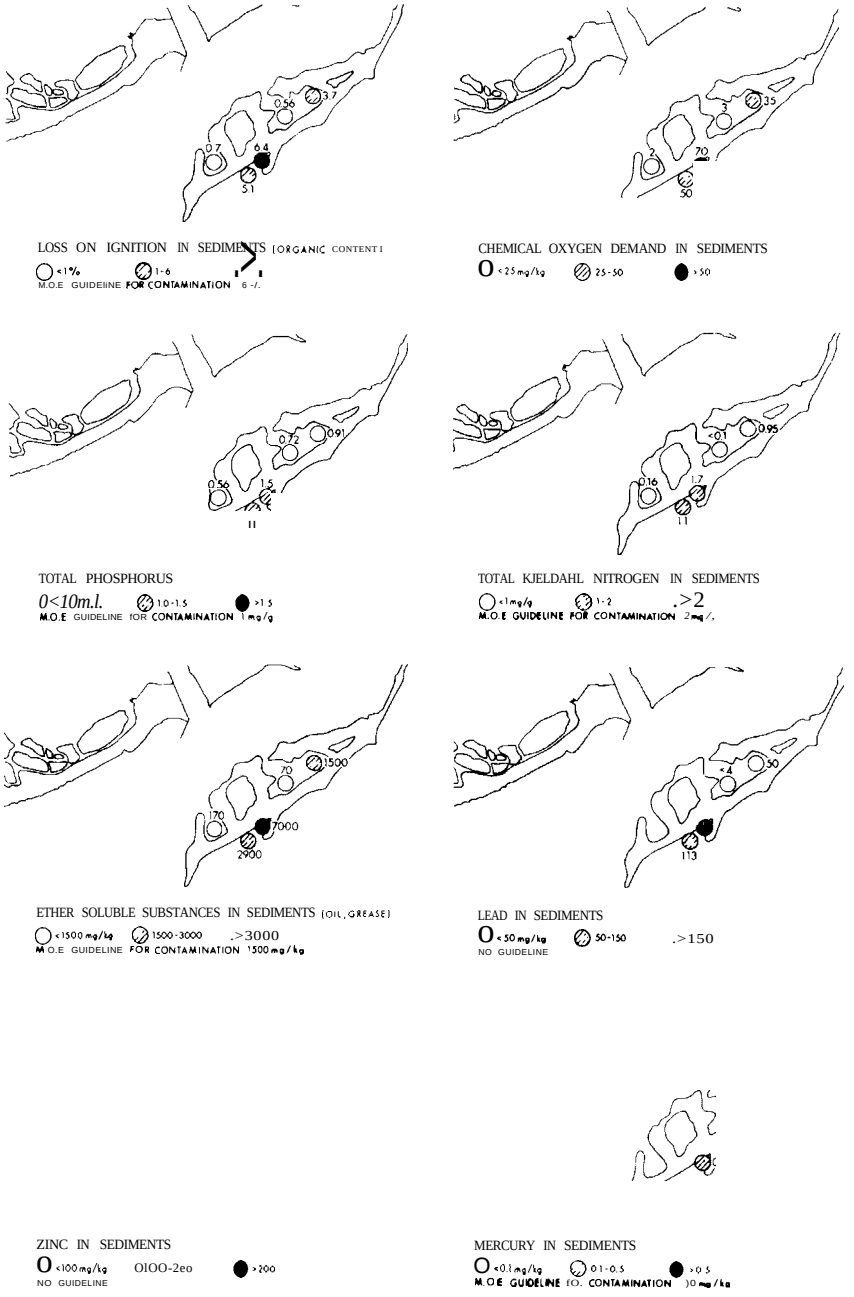
Subaqueous Sediment Types

Source: Lewis and Sly, 1971; *Hutchinson, 1975; **M.O.E., 1975.



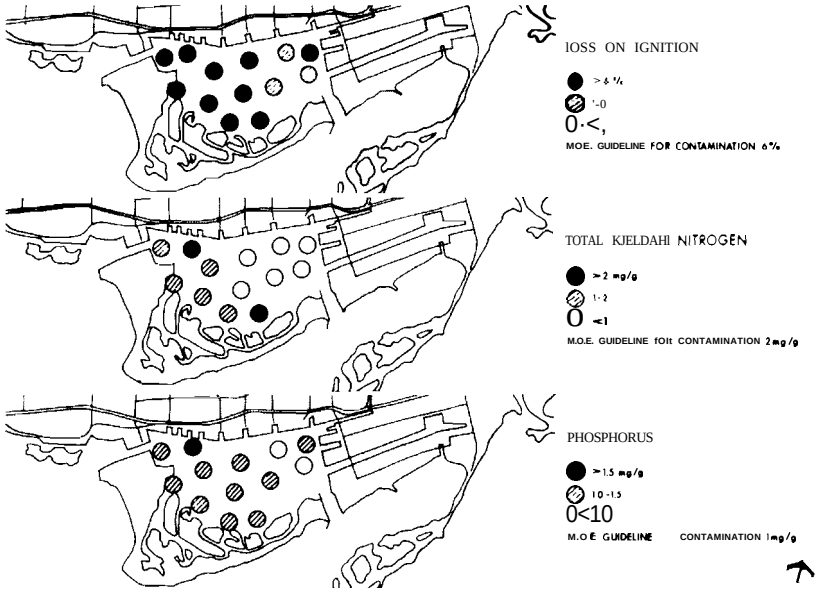
Keating Channel Sediments, June 1975

Source: M.O.E. Unpublished Data.



Eastern Headland Sediments, June 1975

Source: M.O.E. Unpublished Data.



Inner Harbour Sediments, May 1974
Source: University of Toronto

water. Sediments can also release phosphorus and heavy metals to solution.

Subaqueous sediments in the Keating Channel contain very high levels of organic materials, phosphorus, nitrogen, and the heavy metals lead and zinc. These are probably derived from industrial wastes and from sanitary and storm sewer outfalls upstream in the Don River. Since the Keating Channel requires periodic dredging, disposal of these highly contaminated sediments poses a problem. Contaminated sediments discharged into the Keating Channel by the Don River also affect the quality of sediments in the Inner Harbour. Many of the Inner Harbour sediments are contaminated by toxic heavy metals (lead, zinc, mercury), by nutrients (phosphorus, nitrogen), and by oil and grease. Under certain conditions these sediments may contaminate the water. High levels of the heavy metals zinc and lead have also been identified in subaqueous sediments near the Outer Headland. These are probably derived from dredge disposal from the Keating Channel and trucked fill. Other areas of subaqueous sediments containing high levels of organic carbon and nutrients are located along boat slips in the Bayfront and in northern areas of the Island lagoons.

SURFICIAL SEDIMENTS

Surficial sediments in the Central Waterfront consist primarily of landfill. The glacial till of Exhibition Park and the littoral deposits on the Island beaches are exceptions. A range of landfill types have been used in the Central Waterfront-dredged lake sediments, soil, street sweepings, and rubble. Historically few records were maintained of fill content, and today it is difficult to predict the precise composition of the surficial sediments in a particular place.

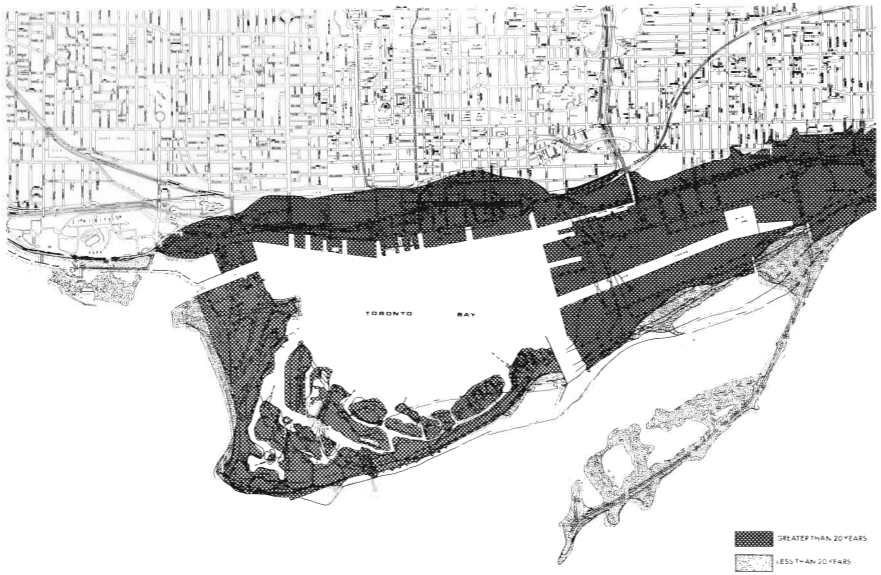
A generalized map of fill types has been drawn from old records and borehole logs. Hydraulic fill is primarily sand dredged from the lake bottom. The Toronto Islands and the northern portion of Aquatic Park are composed of hydraulic fill. Trucked fill comprises an unpredictable mixture of silt, clay, rubble, and street sweepings. This fill material is found extensively throughout the Bayfront and Port areas. Additional areas are composed of both hydraulic and trucked fill. As landfill operations proceeded, old wharves, buildings, and boats were buried. These buried structures and artifacts render the composition of fill in the Bayfront even more unpredictable.

The properties of the surficial sediments vary in accordance with the degree of compaction as well as composition. Hydraulic fill, with the exception of the most recent deposits, has been in place more than twenty years. It is assumed that these materials have reached a maximum natural compaction. Since trucked fill may be composed of materials such as wood pilings, artifacts, and rubble, the required settlement time cannot be predicted and further settlement may yet occur. Areas of buried structures are most susceptible to continued settlement as the old wharves and dockwalls rot.

The "soil" of the Central Waterfront, which extends only as deep as plant roots, is derived from these unconsolidated fill materials, except where topsoil has been added or where soil has developed on glacial deposits. The surface layer may comprise sand, clay, or fill. The surface horizons on the Toronto Islands have a sandy texture and a relatively low fertility. The texture of soils in other areas of the waterfront must be determined from soil borings. The tendency for soils to produce runoff has been estimated based

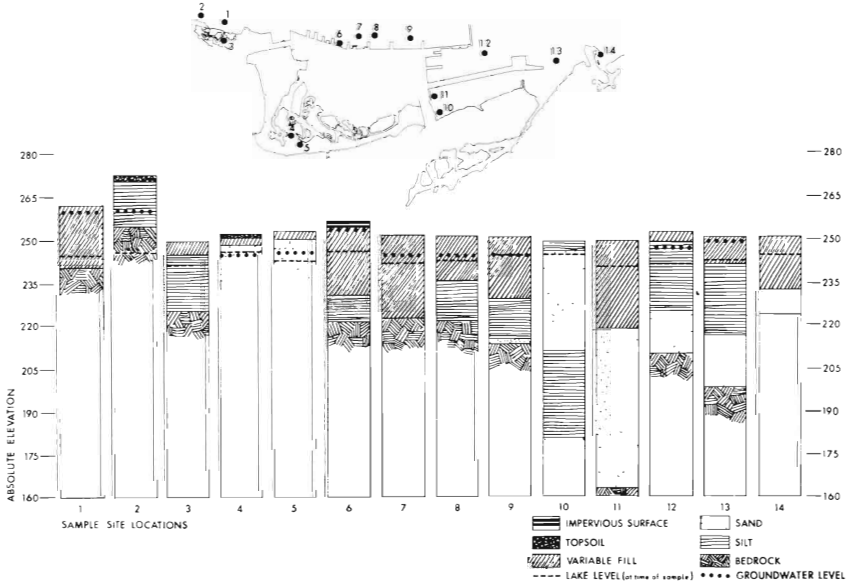
Landfill: Types

Source: City of Toronto Planning Board



Landfill: Length of Time in Place

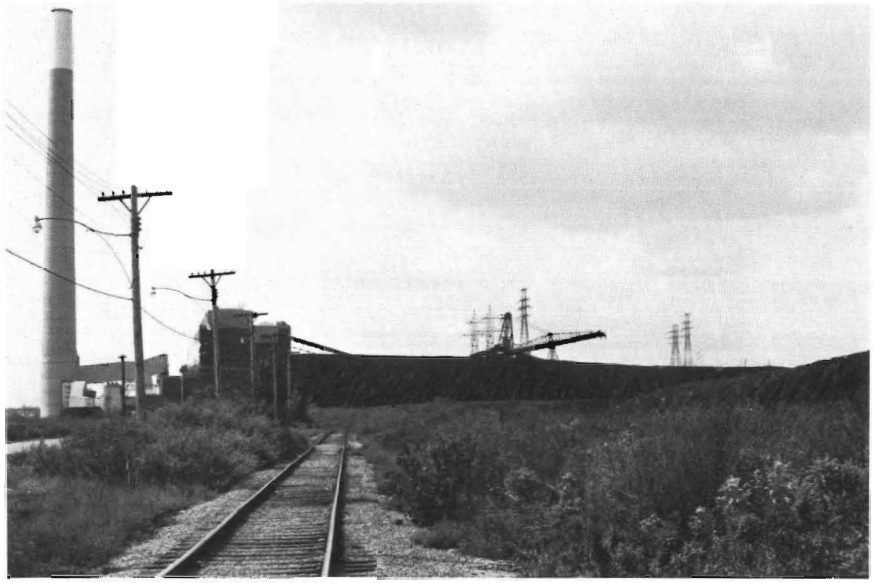
Source City of Toronto Planning Board, Toronto Harbour Commission



Sediment Types in Selected Boreholes

Source: City of Toronto Planning Board, W. Trow Associates

Landfill Operations on the Outer Headland



Coal Piles in the Port Area

on the characteristics of the ground cover Areas of impervious paving and bare soil produce much runoff while areas of vegetation or sand have relatively little runoff Thus the Bayfront and Port areas will produce large amounts of runoff, whereas the Toronto Islands and Aquatic Park tend to be quite permeable and will absorb most storm runoff

Areas of soil containing potentially phytotoxic substances, namely salt, coal, oil, lead, copper, cadmium and other chemicals are identified on the basis of past and present land uses Measurements of the lead, copper, and cadmium content in soil on selected sites within the waterfront have been tested Other known phytotoxic metals such as zinc, are not specifically identified but probably coincide with areas of lead, copper, and cadmium accumulation Areas exceeding M.O.E standards for toxic substances are located within the Island Airport, Bayfront, and Port The Islands appear to have no significant soil toxicity problems.

VEGETATION

The Central Waterfront has fourteen distinct vegetation associations, both cultivated and natural The natural associations include beaches, dunes, wet meadows, lagoon edges, early successional and old fields, shrub thickets and hedgerows, and open and dense woodlands. The natural areas are particularly notable since they contain several species which are unusual in the Toronto region They occur predominantly on the Toronto Islands "From a strictly biological point of view, these wild areas presently existing on the Islands are perhaps the most important anywhere in the city They are unique in harbouring certain rare plants and unusual plant communities, and also in being a major focal point of bird migration" (Catling McKay, "On the Flora of Toronto Islands, Part I," Ontario Field Biologist, Volume 28, 1974)

There are two types of beaches along the Island periphery moist strands which represent the newest land formations and are more similar to wet meadow and lagoon edges vegetationally, and the dry beaches and ridges where water is at premium and where sun and sand burn, dry out, and abrade the plants Both of these areas are prey to wind and water erosion

Beaches are the initial stage in a successional process which takes

Beach and Dune

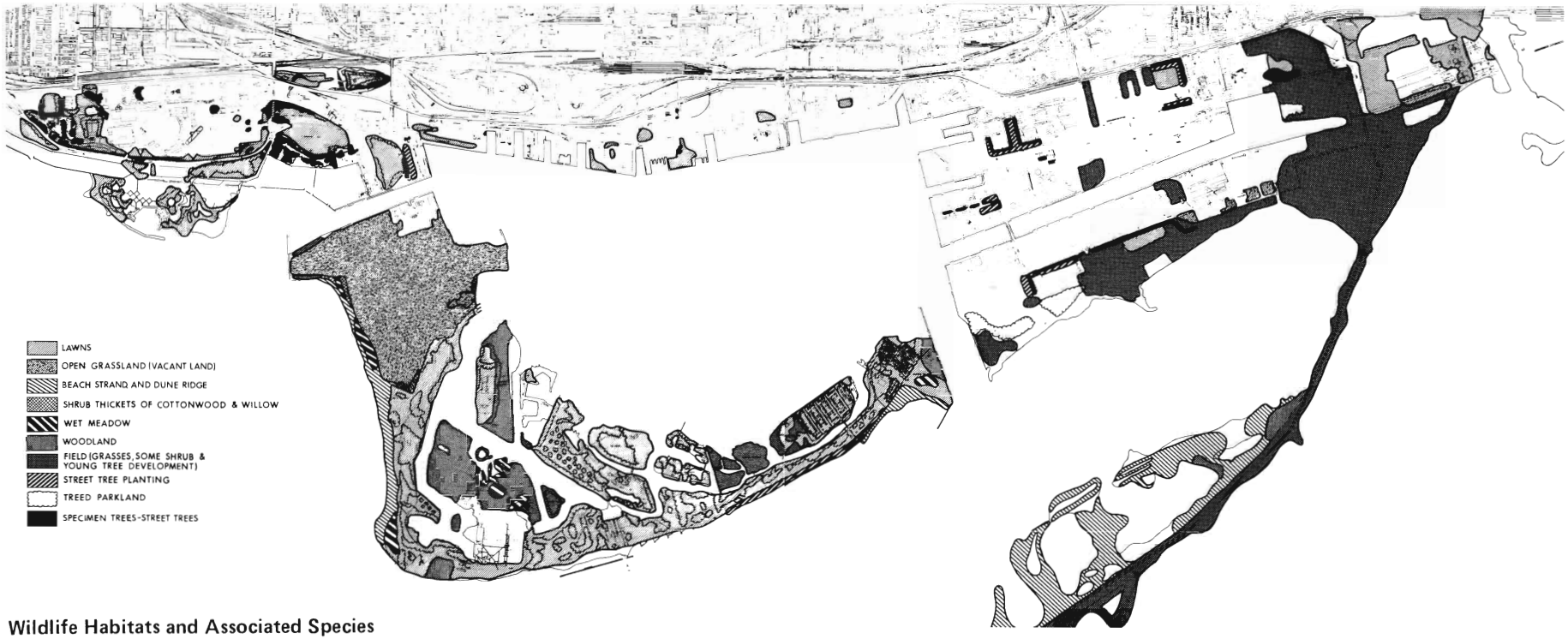
The second is a common one in areas which have been created or disturbed by man The two stages of this succession process which are present in the Central Waterfront are the early successional field and the old field These occur mainly in the Port area on vacant lots and on newly placed fill of the Outer Headland Although not especially significant for the species they contain, they do represent the steady progression of annuals, perennials, shrubs and trees on drier, somewhat more stabilized areas Annual grasses, clovers, mulleins, chicory, asters and wild carrots are herbaceous plants typical of the early successional field, while the old field contains several of these species plus a rich growth of goldenrods, thistle, milk weed, shrubby willow, cottonwood and mulberry with some barberry and honeysuckle Areas of shrub-height thickets are found near the lawn portion of the airport. These are dense, moist and contain shrubby cottonwoods, willows and grasses

The two lowland woodlands associations comprise many of the same species They are predominantly cottonwood-osier dogwood woodlands Dense woodlands have a well developed understory and occur on Snake and Muggs Islands Open woodlands occur near the Island Nature School

A large portion of the Island, Exhibition Place, and isolated areas along the Bayfront are given over to maintained grasses, shrubs and trees These are manifest as young parkland, residential, lawn, and mature parkland The native woody vegetation on the Islands consists of cottonwoods and willows, but in addition honey locusts, Norway maple, basswood and poplar have been introduced and thrive. Characteristic of the mature parkland are the eighty to ninety foot willows and cottonwoods which are imposing specimens yet have but a few years left Most of these were planted in the 1880's as part of a park development program Future work should include a study for the maintenance of mature parkland areas on the Toronto Islands

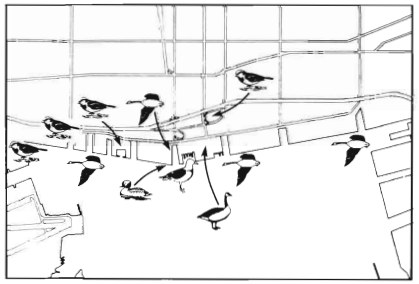
Early Successional and Old Fields

Mature Parkland



Wildlife Habitats and Associated Species

Source: C.W.P.C. Information Base, Wildlife, 1976.



9 Bayfront

SHOREBIRDS

MUSKRATS

SQUIRRELS

CANADA GEESE

DOMESTIC RODENTS

FIELD RODENTS

SONGBIRDS

URBAN BIRDS

OVERWINTERING DUCKS

GULLS AND HAWKS

RACCOONS

OWLS AND HAWKS

WADING BIRDS

AMPHIBIANS AND REPTILES

MONARCHS AND OTHER MIGRATING INSECTS

FISH SPAWNING AND NURSERY AREAS

GRAZING GEESE, FEEDING MALLARDS

LAND USE

The land meets the water at the Central Waterfront Transportation modes change from subway, buses, and cars to bicycles, ferries, and sailboats Views change from enclosed to expansive The Central Waterfront is an active port, an industrial center, and a focus for regional recreation

For the most part, similar land uses cluster in distinct waterfront areas Industrial and commercial structures hug the Inner Harbour and channels in the Bayfront and Port areas Extensive parkland fronts Lake Ontario at Exhibition Place and Ontario Place, the Toronto Islands, and Aquatic Park, affording views of the city skyline to the north and unencumbered views across Lake Ontario to the south Residential areas occur in the Harbour Square area and on the Toronto Islands

Within the waterfront are landmarks of historic and architectural significance and many recreation resources—beaches, yacht clubs, fishing areas, and wildlife preserves.

The diversity of the Central Waterfront is the key to its character The challenge of future planning is to accommodate all uses without disrupting the natural environment

Industry in the Bayfront

Toronto Island Park

Sailboats in Toronto Bay

The Island Ferries

Runoff Co-efficient as Determined by Surface Type
Source: City of Toronto Planning Board

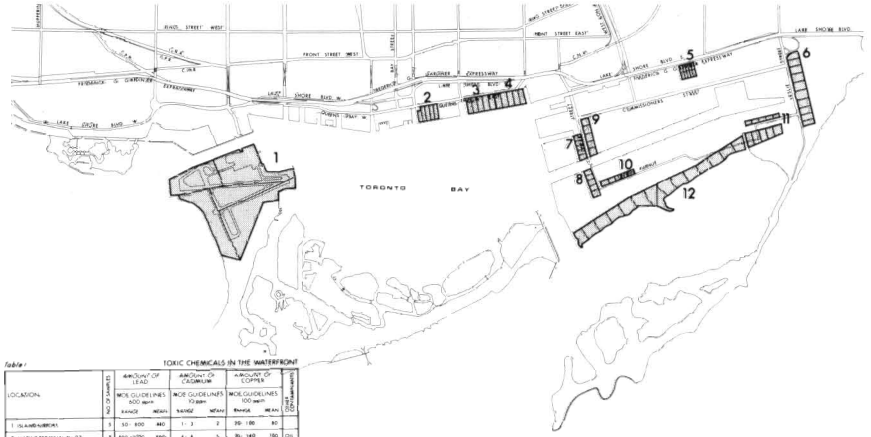
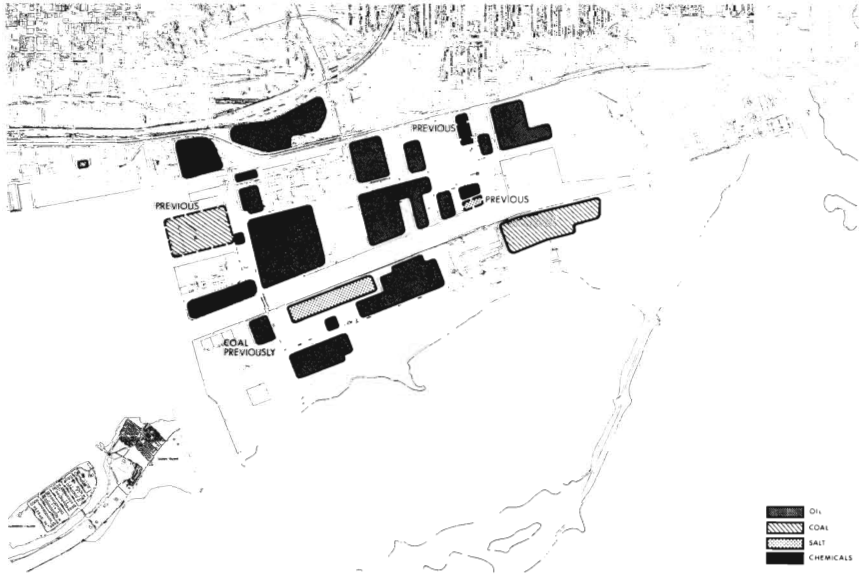


Table I TOXIC CHEMICALS IN THE WATERFRONT

LOCATION	NO. OF SAMPLES	AMOUNT OF LEAD MOE GUIDELINES 600 ppm		AMOUNT OF CHROMIUM MOE GUIDELINES 70 ppm		AMOUNT OF COPPER MOE GUIDELINES 100 ppm		OTHER CONTAMINANTS
		RANGE	MEAN	RANGE	MEAN	RANGE	MEAN	
1 ISLAND AIRPORT	5	50 - 800	440	1 - 3	2	20 - 100	80	
2 MARINE TERMINAL No 27	5	800 - 1400	1000	4 - 8	5	30 - 140	100	OIL
3 MARINE TERMINAL No 28	5	400 - 1800	1200	3 - 8	5	70 - 190	80	OIL
4 MARINE TERMINAL No 29	5	500 - 1300	1100	3 - 9	5	80 - 120	110	OIL
5 McCLEARY PARK	10	70 - 440	290	1 - 3	2	20 - 100	60	
6 ALLOTMENT GARDENS	10	90 - 340	210	1 - 2	2	20 - 50	30	
7 CHERRY STREET (NORTH OF LAKE SHORE BLVD. EAST)	5	120 - 4100	2240	30 - 80	55	80 - 1800	1000	
8 CHERRY STREET (LAKE SHORE BLVD. EAST TO GARDINER EXPRESSWAY)	5	300 - 1000	840	5 - 9	6	60 - 180		
9 CHERRY STREET (GARDINER EXPRESSWAY EAST TO DON RIVER)	5	400 - 2000	2600	9 - 20	14	90 - 340	120	OIL
10 LOWER JARVIS AVENUE (GARDINER EXPRESSWAY TO ESPLANADE EAST)	5	1200 - 9500	3700	5 - 9	7	120 - 320	290	OIL
11 JARVIS AVENUE (SOUTH OF LAKE SHORE BLVD. EAST)	5	80 - 400	210	1 - 3	2	20 - 36	30	
12 UNIVERSITY AVENUE (SOUTH OF LAKE SHORE BLVD. WEST)	15	100 - 1000	450	3 - 5	4	30 - 160	100	

Soil Analysis Sites
Source: R.F. Fisher



Potentially Toxic Soil Areas in the Port Area
Source: City of Toronto Planning Board

Woodland and Lagoon Edge

place in the waterfront Initially a spit is formed by littoral processes and colonized by early beach strand vegetation. As the spit grows larger and stabilizes, dune ridge vegetation becomes established, and finally the woodland community.

The successional beach species have adapted to the rigorous environment which consists of wind abrasion, alternating periods of scorching sun and overcast, wet weather and low nutrient availability The species on the wet and dry beaches are dissimilar. Marram grass, sea rocket and seaside spurge, typical Atlantic coastline species, are found on the drier beaches, while toad rush, stream umbrella sedge, goosefoot, smartweed and bur-marigold are representative of the moister sands of the strand Shrubby willows and poplars are associated with older areas

Beaches where well developed vegetation occurs are those near the airport, at Gibraltar Point and to a somewhat lesser extent on Centre Island near the school and on Ward's Island. A growth of annual grasses has accumulated along the sandy edges of Aquatic Park and on portions of Cherry Beach.

Beach vegetation is characteristically low, widely spaced herbaceous growth Only the most tenacious, intricately rooted species can survive sand movement and drift As a result a few hardy species thrive Although extremely tolerant to natural disruptions, they are extremely frail when subject to the human disturbances

Wet meadows which once occupied a large portion of the Islands have been largely erased by draining and filling What now remains are small strips landward from the beaches near the airport and on Gibraltar Point, and the small low areas on Centre and Ward's Island It is not always easy to differentiate between the wet strand and the wet meadow. The latter, however, is more stable, vegetated

Lagoon Edge

Woodland

by willow thickets which edge seasonal ponds, filled with water until summer These meadows contain most varied plants, among them Baltic rushes, Nelson's horsetails, spike rushes, sedges, bulrushes, wet grasses as well as several colorful forbs The Toronto Islands have an extensive lagoon system The diverse vegetation associated with lagoon edges includes Baltic rushes, Water horehound, and many other species

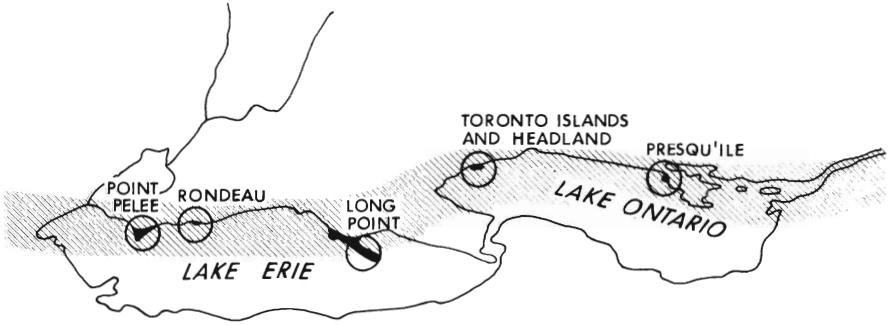
There are two dominant successional trends that are operative in the natural vegetation associations of the Central Waterfront The first, which is related to waterfront processes, is described above

WILDLIFE

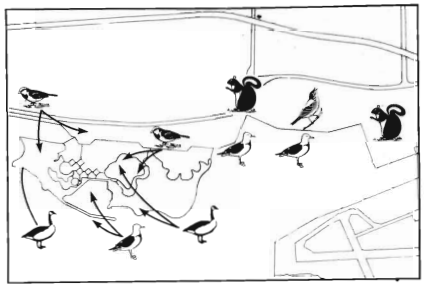
In addition to typical wildlife species associated with urban areas, the Central Waterfront provides habitats for a wide range of other wildlife usually associated with a more rural area In fact, there are greater concentrations of birds in the Central Waterfront than anywhere else on Lake Ontario with the exception of Presqu'ile. This remarkable diversity of wildlife is due to several factors—the richness and abundance of both natural and parkland plant communities and the location of the waterfront on the shore of Lake Ontario and along two major migration flyways. The most abundant and diverse wildlife populations occur on the Toronto Islands.

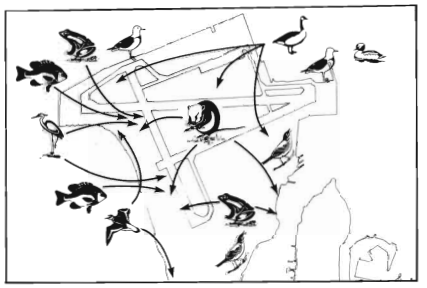
Migrating species of birds, butterflies, and bats use the Central Waterfront as a resting area on their long migrations. The Toronto Islands and the newly created Outer Headlands are part of a system of stop over areas which extend along the northern shore of Lake Ontario and Lake Erie. With the exception of the Toronto area, other maior stop-over areas are preserved as national or provincial parks or as wildlife preserves.

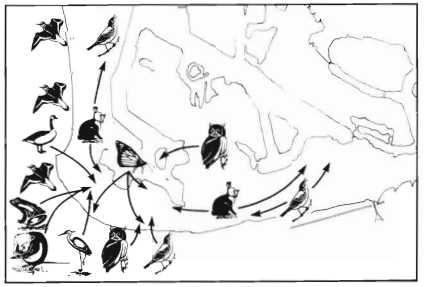
In addition to migrating wildlife which are present during part of the year, a large number of mammalian, avian, reptilian, amphibian, aquatic, and invertebrate species reside in the Central Waterfront year round. These resident species include wildlife typically associated with urban areas—racoons, squirrels, rats, and songbirds, as well as more sensitive wildlife which require protection from human dis-

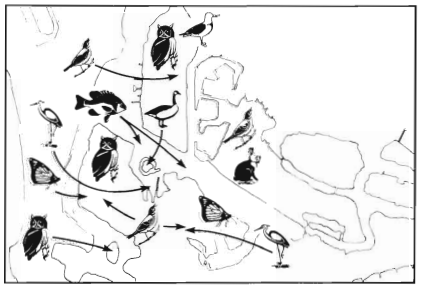


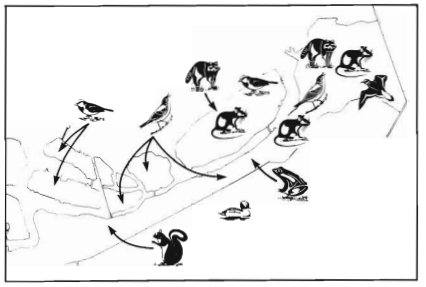
Migratory Stop-Over System
Source: C.W.P.C. Information Base, Wildlife, 1976.

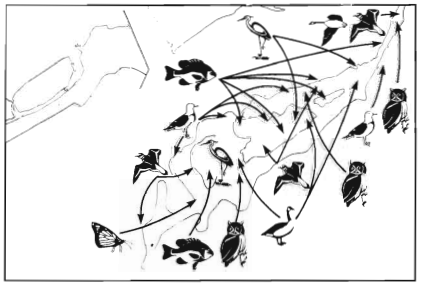

1. Ontario Place

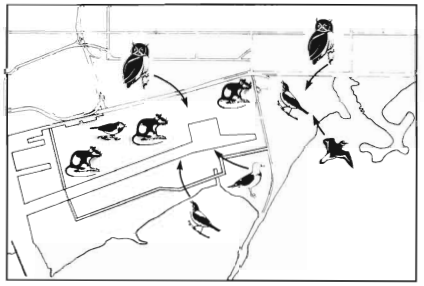

2. Island Airport

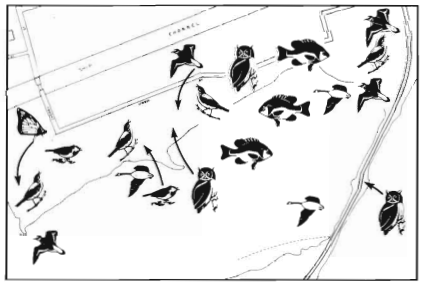

3. Hanlan's Point


4. Wildlife Sanctuary, Muggs Island


5. Centre Island to Ward's Island


6. Aquatic Park


7. Port Area: North of Unwin Avenue


8. Port Area: Cherry Beach

Protected Shore Habitat

turbance The urban wildlife are found throughout the waterfront; the more sensitive wildlife are found mainly in native plant communities on the Toronto Islands and Outer Headland

The vegetation communities of the Central Waterfront provide food and shelter for wildlife. Beach and dunes are feeding and nesting areas for shorebirds and gulls The large breeding colonies of Ring-billed and Herring Gulls and Common and Caspian Terns are especially notable. Snapping Turtles and Painted Turtles also lay their eggs in the dry, sandy areas of this habitat

Wet meadows are no longer extensive in the Central Waterfront and are limited to the Toronto Islands The remnants are important habitats for many wildlife species. Wet Meadows provide a breeding habitat for amphibians and the Great Blue Heron, and shelter for other birds, as well as reptiles, mammals, and invertebrates. Muskrats and migrating shorebirds feed in this wetland habitat

Lagoon edges are important to both aquatic and terrestrial wildlife. The Island lagoons support a diverse and productive aquatic community. Carp, catfish, bowfin, pike, bass, and other warm water fish species use the lagoons as a spawning and nursery area Approximately fifteen percent of the total shoreline is used for spawning and an additional fifty percent is judged to be potentially useable Lagoon edges represent nesting, sheltering, and feeding areas for many birds, including the Great Blue Heron Reptiles and amphibians, such as the Snapping Turtle and Midland Painted Turtle live and feed along the Lagoon edges.

The woodlands in the Central Waterfront are, with minor exceptions, limited to the Toronto Islands. These woodlands are the habitat of many songbirds, owls, reptiles, and invertebrates, and provide shelter for migratory bats, large concentrations of Monarch Butterflies and Saw-whet Owls.

Successional fields occur in many parts of the Central Waterfront in areas which have been recently created or disturbed by man. The rodent population of these fields is very high and attracts hawks and owls. Old Fields with dense shrubs provide shelter for songbirds and field birds.

Parkland occurs throughout the Central Waterfront, both on the Toronto Islands and to a limited extent on the mainland. Areas of trees and mown lawn are attractive primarily to urban wildlife species such as songbirds and squirrels. In recent years, a large population of Canada Geese has taken up year round residence in the waterfront parkland. Their large number constitutes a nuisance in these areas, and unsuccessful attempts have been made to induce them to migrate.

The open water of the Inner and Outer Harbours are wintering grounds for diving ducks. Oldsquaw, Common Goldeneye, Bufflehead, and Greater Scaup occur in large numbers in these areas Oldsquaws are particularly abundant in the Central Waterfront. Black and Mallard Ducks, whose estimated population exceeds 6000 are found throughout the waterfront. Unlike the other ducks, they are dependent on man for food.

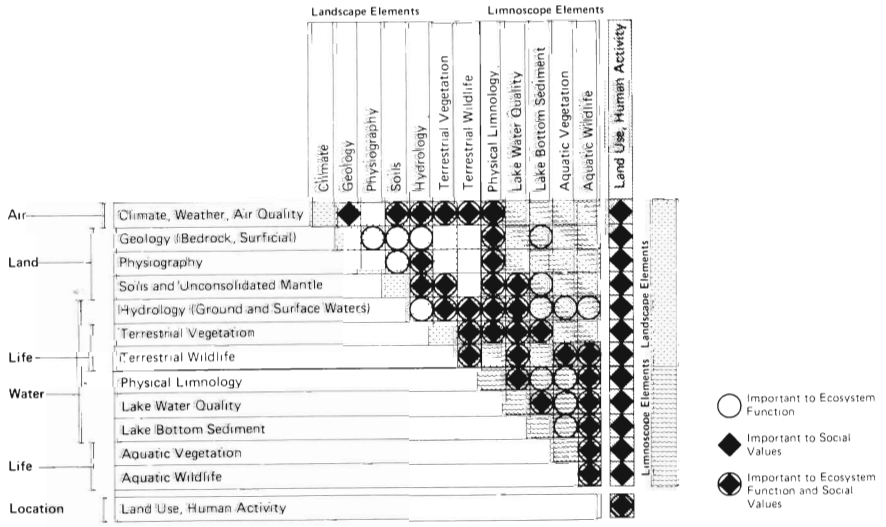
The greatest diversity of wildlife is found in the natural, as opposed to cultivated or urban habitats. The regional and national significance of wildlife populations in the Central Waterfront is due mainly to the existence of these natural habitats. These communities are presently limited almost entirely to the Toronto Islands and Other Headland

DATA ANALYSIS

The purpose of this study is to establish a framework within which wise planning decisions concerning the natural environment can be made. To achieve this goal it is as necessary to understand the relationships among elements of the environment as it is to understand the individual elements. Relationships among elements may be due to spatial concurrence or may result from the interaction of natural processes. A geologic formation, the soils overlaying it, and the plants growing in those soils are related by spatial concurrence. The erosion of shorelines by littoral currents and waves is a natural process which relates many elements: climate, water, physiography, lakebed sediments, surficial sediments, and vegetation.

The Natural Factors' Interaction Chart tabulates the important relationships among landscape and "limnoscape" elements and is a tool which can be used to identify those elements affected by particular activities. Chart symbols indicate whether the relationship is important primarily to ecosystem function or to human use (social value) Each block of the matrix containing a symbol represents a direct relationship between elements. The sum of all pairs of relationships defines all possible relationships. Indirect relationships can also be interpreted from the matrix. For example, geology may determine physiography, which is related to soil, which affects vegetation type, which affects wildlife. The impact of any proposed land-use or activity may be interpreted by locating those elements which are either directly or indirectly affected on the matrix. For example, paving a large area will change the nature of the soils, which will directly affect the hydrologic response and indirectly affect vegetation and lakewater quality. Vegetation changes will affect terrestrial wildlife; lakewater quality changes may affect lakebed sediments, aquatic vegetation and aquatic wildlife. Hydrologic changes may alter lake circulation patterns, which will in turn change the distribution of bottom sediments.

To identify the direct and indirect impacts:
- First, determine the land or limnoscape elements that will be affected.
- Second, analyze interactions with all other elements to determine how they will be affected.
- Third, check the interactions of elements identified in the foregoing step with all other elements to determine what further effects may be expected.
- Fourth, continue this process until all possible combinations have been identified.



Natural Factors' Interactions

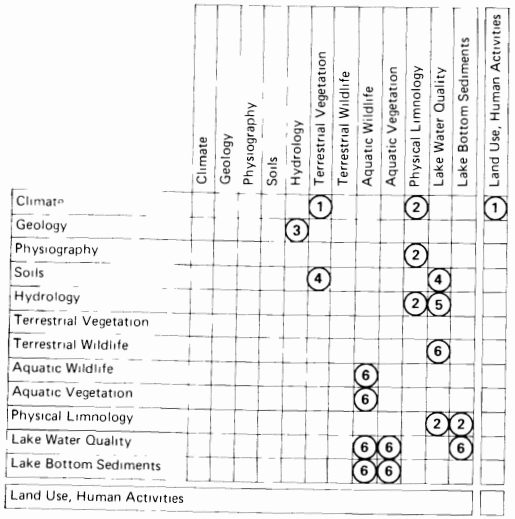
INVENTORY

FUTURE DATA REQUIREMENTS

The C.W.P.C. and cooperating city, metropolitan, and provincial agencies have compiled a remarkable information base for the natural environment of the Central Waterfront. The results of this work, published in seven reports—Climate, Air Quality, Noise, Physical Geography, Water, Vegetation, and Wildlife—provide a comprehensive documentation of the waterfront environment, which will be invaluable to the planning process. The C.W.P.C. and cooperating agencies are committed to the expansion and refinement of the environmental information base. The purpose of this step of the study is to identify deficiencies in the information and areas where further research is needed.

Future work necessary to complete the Central Waterfront Information Base is identified in this chapter. Some studies require an examination of the entire waterfront and should therefore be conducted under the aegis of a public agency. Other studies required for specific purposes may be conducted for smaller areas by public or private developers. For example, the investigation of lake and harbour current patterns, of ground water movement, and of coordinated water quality monitoring must be a comprehensive effort. A thorough understanding of the hydrologic regimen is needed to predict patterns of shoreline erosion and pollution distribution. Air quality studies must also be coordinated across the entire waterfront area if results are to be useful. A framework should be established for an inventory of terrestrial and aquatic vegetation and wildlife to give detailed studies a waterfront context. A survey of soil phytotoxicity problems to determine the relationships of contaminants to vegetation and water quality could be conducted for any specific site. Microclimate and topographic studies could similarly be compiled for local areas and used to augment the data base. These broad recommendations are summarized in a chart on the following page. The adequacy of currently available data and the future needs for additional data for each environmental factor are summarized below.

Climate: The overall climatic patterns are fairly well understood. Normal meteorological observations are adequate in predicting any large scale future changes. But at a microscale, closer examination of climatic factors is necessary to avoid the incidence of climatic stress by any proposed future action. Exposure to strong winds, disruption of lake breezes, generation of local turbulence and downdrafts are the major stressful factors which need to be minimized. Careful orientation and responsive building masses are advocated.



1 Investigate the levels of airborne heavy metals, which accumulate on terrestrial vegetation. Are the levels accumulating on home garden vegetables potentially toxic to the people who eat the vegetables?

2 A study of Lake and harbor current patterns to determine how they are affected by winds and storm events, how channel size and storm runoff from the Don River affects circulation, and how the current patterns affect the distribution of pollutants and sediments

3 Groundwater movements and quality

4 Survey of soils to determine phytotoxicity problems and select plantings which would be tolerant to the presence of these substances. Also determine relationships between runoff and contaminants derived from toxic soil areas

5 Studies of storm events will help define the loads of pollutants inputs to the Inner Harbour

6 A study of the interactions among contaminants (nutrients, heavy metals, nuisance organic compounds) water quality, sediments, and aquatic biota

Future Data Requirements

Wind tunnel analysis of large developments is recommended.

Air Quality: Several indices of air pollution and their presumed distribution and sources in the Toronto area are adequately described, but notably absent are data concerning photochemical oxidants, particularly ozone (O_3) and peroxyacle nitrates (PANs). Such pollutants have been found to adversely affect plant growth in large urban areas. Data concerning the levels and distribution of these pollutants would help determine performance standards for activities adversely affecting air quality.

The heavy metal content of the particulate fallout (particularly lead, cadmium and mercury) might prove to be a useful measurement, since fallout from some metal producing industries has been known to cause potentially toxic accumulations of heavy metals in garden vegetables on experimental plots. The effect of those industries producing heavy metals at the stack should be investigated, if garden plots are planned in the Central Waterfront.

Noise: The available measurements of the Toronto Waterfront are inconsistent with respect to year measured as well as time of year, number of monitoring days, and representative monitoring points. It is recommended that to obtain a sound data base the following measures be taken:

- Consistent monitoring at selected representative points on the waterfront should be undertaken. The basis for selecting points of measurement should be clearly documented. Measurements should be taken to establish existing sound levels for areas which may be sensitive to increase in those levels.
- Measurements should be taken during the same year and the same season since experience demonstrates that significant fluctuations occur from year to year and from season to season.
- Measurements at each monitoring area should be taken during two non-holiday weekdays. Saturdays and Sundays should be monitored separately to determine weekend noise levels, since these affect proposed and existing recreational uses.

Geology: There is insufficient information on bedrock characteristics which will affect tunneling or foundations supported on bedrock. Detailed geological investigations including lithology, stratigraphy and structure are required to establish whether there are any zones of weakness. A waterfront-wide study would be desirable.

Thorough investigation of surficial geology is also necessary, as the last comprehensive study was conducted in 1933. As the surficial characteristics affect all uses, requiring all future users to submit detailed site data will, over time, permit accumulation of this information for the whole Central Waterfront.

Physiography: Site level examinations are adequate to ensure site drainage and excess runoff retention. Hazards due to unstable banks and erosion need to be identified on each site.

Sub-surface Hydrology: No available information exists on the water table and its seasonal fluctuations. The inference that the ground water is generally the same as the lake level is valid, but better definition is needed at the site level to ensure minimization of pollution hazard, undisrupted interchange of ground and surface waters, and safeguarding of sub-surface structures.

Surface Hydrology: Despite the fact that water is the very reason for the existence of the waterfront, knowledge about it is deficient. The Information Base study is an impressive compendium of the recent short-term investigations, but a fuller understanding of the hydraulic regimen is important. The Ontario Ministry of the Environment has

several studies already under consideration*, which it is hoped will get underway next year These are:

- A study to establish specific water quality objectives in order to meet the requirements of existing and proposed activities.
- Studies of water quality to determine (a) loadings of the Don River and its effects on quality; (b) residence time of pollutants, the circulation of water and the exchange mechanism within the harbour; (c) the sources, extent and causes of bacterial contamination and variations with dry and wet weather; and (d) eutrophication, water clarity, changes in trophic state, distribution of algal and plant growth.
- Studies of heavy metal and organic contaminants to determine the sources of high levels in sediments and in fish.
- Studies of shoreline alterations to determine the effects of recently completed changes (e.g. the Eastern Headland) and the possible effects of potential future actions (e.g. the Western Headland, the filling of the Western Gap).

Although all the study objectives anticipated above are necessary, the importance of some concerns is overriding. Top priority should be accorded to the production of a model which simulates the circulation of water in the Inner Harbour. It is clear that the capability provided by a computer simulation is essential to confidently determine the effects of major shoreline changes, such as excavation of new access channels. Such information is extremely valuable for planning purposes. The determination and prediction of the direction and movement of currents and their seasonal changes will also be helpful in predicting the movement of pollutants from point source inputs and the movement of sediments from dredgeate disposal areas.

Dredgeate disposal is one of the most critical issues in the waterfront. The contamination associated with this activity needs to be fully understood to ensure avoidance of health hazard. It is important that exchangeable ions as well as the total concentrations of the observed polluting elements should be determined by monitoring. This exchangeability will determine whether toxicity, if there is any, will have an effect on plant growth or wildlife.

Soils: Available information on soils is extremely limited. Proper soil investigations should precede all site development proposals. Different factors need to be emphasized for various parts of the waterfront. The recommended general procedure is to collect five to ten samples from each acre. Each sample should be representative of the top 12 inches of soil. In order to assess the variability within a site, the samples should not be composites of several areas, but rather one pint of soil should be gathered at one point. The following should be determined using routine or standardized soil testing procedures:

- pH in water or in 0.01 M $CaCl_2$ solution
- Cation exchange capacity
- Exchangeable bases (Ca, Mg, K, Na)
- Soil organic matter content
- Soil textural class, permeability and drainage class.

Over areas of recent fill and dredgeate without established vegetation, chemical tests on sodium acetate-acetic acid extracts (other suitable extracting solutions may be used) should be conducted for the purpose of establishing concentrations of calcium, magnesium, potassium, phosphorus, ammonia and nitrate.

Areas with suspected problems such as salinity and heavy metals require special considerations. In areas where salinity is suspected of limiting plant growth, a simple and inexpensive electrical conductivity test will give adequate results. But for suspected heavy metal contaminated areas, especially dredgeate, careful analysis must precede their use as base for plant growth. Metals other than the commonly identified toxins (lead, zinc and mercury) may also be significant as potential problems. These include cadmium (Cd), cobalt (Co) and particularly copper (Cu) and nickel (Ni). Arsenic, molybdenum, and selenium are possible hazards but much less likely to be a problem since they are not often present in large quantities in urban sewage and runoff. The nature of the problem associated with heavy metals centers around their mobility in the soil and their plant mobility. If available for plant uptake, they may be accumulated by vegetation in toxic amounts, thus limiting or preventing suitable ground cover. Heavy metals may be accumulated by plants in amounts not toxic to the plant, but toxic to consumers further up the food chain (i.e. animals or man).

Some of the available findings on the effect of heavy metals on plants and animals applicable to plant growth on dredgeate are as follows:

*Written communication from B.A. Singh, Manager, Technical Support Section, Ontario Ministry of the Environment, Central Region to P. De Tolly, Technical Coordinator, Central Waterfront Planning Committee, September 1, 1976.

- There is no fixed amount of any particular metal that will have toxic effects. These metals in various combinations have antagonistic and synergistic effects; high levels of Cu may be tolerated in combination with Co in some animals, for instance.
- The availability of heavy metals in the soil to plants tends to decrease over time. There is no fixed rate, but a decade or more may be required for this to occur.
- The mobility of these metals will most likely be highest in acid, sandy soils.
- Total amounts of these metals in a soil or sediment cannot usually be interpreted into plant available amounts.

It is important that the levels of metals are measured in the vegetation, and extractable (by DTPA-TFA, .1NHCl, or .05NHCl + .025N H_2SO_4) metals in the dredgeate are measured. Perhaps the best guideline, which is still only a very crude estimate, is that if the total of the extractable (ppm zinc + 2[ppm copper] + 8[ppm nickel]) is greater than 5% of the cation exchange capacity (CEC) of the soil, phytotoxic effects may occur (particularly if the pH is less than 6.5). For instance at a CEC of 15 mg/100g, 250 ppm (Zn + 2 Cu + 8 Ni) would possibly curtail plant growth.

Vegetation: Available information has been enhanced by additional field work. The dynamics of succession in the most sensitive environments such as beach, strand and wet meadows are well understood. The relatively more stable vegetation associations, such as parkland, are so extensively managed that it is hard to establish successional patterns for these which will require less maintenance and provide richer and more diverse vegetational experiences. Most of these areas are approaching maturity, and replacement of existing vegetation is necessary. Rather than resorting to high cost nursery stock, an attempt should be made to diversify available choices by understanding the natural successional dynamics. Some site level experimental work is indicated, where limited areas can be fenced off and the growth dynamics observed.

There is insufficient information available on the success rate of establishing new vegetation on areas of recent fill and other areas which have been extensively modified by previous human action. The current option of replacing the top 12-18 inches of soils with imported topsoil is inordinately expensive and offers limited choice of species that will survive. Again, some experimental plots should be established to identify successional trends in these areas.

A notable precaution for allowing either natural successive or planted species to come up relates to the toxicity of resident soils and dustfall. Unless it is clearly established through additional studies (described above under Air Quality and Soils) that these do not present a problem, care needs to be exercised in allowing growth of specific vegetation types. Toxicants may accumulate in the wildlife dependent upon these vegetation types for a food source.

Wildlife: The available information on wildlife is quite remarkably detailed and rich, especially when it is realized that the waterfront is very much an "urban" environment. Studies of the avian component of resident and migratory wildlife have been emphasized. The mammalian and reptilian elements are much less understood, while the insect component is practically unknown. Future work should emphasize this segment of faunal population as the higher life forms are directly or indirectly dependent upon it. Insects perform a function in maintaining the ecological balance and are also important for their direct bearing on the human population. The disease vector and nuisance value of the insect population often initiates pest control practices, which produce disastrous effects on other wildlife populations. It is recommended that future work in this area needs to be done at the larger areawide scale, rather than relying upon site scale accumulation.

Land Use: No comments need to be made on this subject as future planning work will emphasize study of this environmental factor.

INTERPRETATION

SOCIAL OBJECTIVES

INTRODUCTION

The purpose of this portion of the study is to identify all those social objectives concerning the Central Waterfront which have been expressed in published documents and legislation. Since these objectives are derived from many sources, some are contradictory, whereas others are complementary. No attempt is made in this study to resolve contradictions or to establish relative importance. This must be done by the citizens of Toronto. Here the social objectives are merely set forth and identified with those environmental features to which they relate.

When these social objectives are related to specific features of the natural environment, their implications for human activities can be readily perceived. Conflicts between values can then be identified and resolved. This will permit the formulation of a consistent approach to the waterfront's natural environment and will provide a sound framework for future planning decisions.

IDENTIFICATION OF SOCIAL OBJECTIVES

A list of social objectives was compiled from reports approved by the City of Toronto, from Central Waterfront Planning Committee reports, and from publications of regional agencies and the provincial government. The social objectives were aggregated into the categories described below. This list was condensed, then reviewed and amended by staff of the Central Waterfront Technical Committee, and approved by the Central Waterfront Planning Committee. This final list of social objectives adopted by the C.W.P.C. is presented on the following pages. The objectives do not represent the official position of the C.W.P.C., but serve as a basis for the interpretation and synthesis of data in this study and thus as a means for understanding the implications of specific social values for planning decisions.

Social objectives are classified into three categories: safety and comfort, preservation and protection of valuable resources, and provision of amenity and development. Safety and comfort relate to the protection of humans from hazards and discomfort. Safety implies a need for the reduction of hazards to human life, health, and property, whereas comfort refers to the need to mitigate en-

vironmental stress which is not necessarily hazardous. Preservation and protection refer to valuable resources. Preservation implies the need to ensure the continued undiminished presence of the resource in its existing state. Protection implies that the resource may be utilized but that its use must be controlled to sustain its value. Amenity and development address human needs to use specific aspects of the environment. Amenity refers to the utilization of natural resources for general social well being ("enjoyment"), whereas development refers to the need for a specific organized land use ("industry"). The following are examples of social objectives for each category:

Safety—Ensure safe building foundations.
Comfort—Optimize climate conditions for year-round use.
Preservation—Preserve historic buildings.
Protection—Protect soil and groundwater from pollution.
Amenity—Provide environmental education programs.
Development—Develop commercial facilities which will complement adjacent uses.

The adjacent charts list all of the social objectives as defined by the Central Waterfront Technical Committee and approved by the Central Waterfront Planning Committee. Each is documented with supporting sources and relevant legislation.

APPLICATION OF SOCIAL OBJECTIVES

The next identified social values are related to features of the waterfront's natural and social environment which then can be mapped. Each social objective is matched to the most relevant of five broad resource categories: Air, Land, Water, Life, and Location. The following are examples of social objectives matched to a resource category.

Air—Ensure that development does not adversely affect air quality.
Land—Preserve areas of geologic significance.
Water—Maintain safe water quality.
Life—Preserve existing wildlife corridors.
Location—Preserve views to the water.

The important features of these five resource categories are illus-

IDENTIFICATION OF SOCIAL OBJECTIVES **CENTRAL WATERFRONT PLANNING COMMITTEE, JUNE 1976**

Social Value	Resource Factor		Social Objective	Supportive Source	Relevant Legislation
Safety and Comfort	Air	SA1	Optimize climate conditions in order to encourage day/evening year-round use	HS, PP, AqPS, Ex, TIPN, Hbft, IA, PPT (MPCO)	
		SA2	Ensure that development (housing, recreation, commercial, industry) does not adversely affect air quality (noise, odours, gas, particulates, dustfall)	ONT, PP, OP, WP, PITF, IA, Hbft, TC-Env, POHAT	Official Plan, Environmental Protection Act, Toronto Noise By-Law
	Land	ST1	Ensure that the water's edge is safe (noting that different uses will require different levels of safety)	Wp, AqP, (THC), (MTRCA), Hbft	
		ST2	Ensure safe public access to and along the water's edge, including for the handicapped	WP, PP, HT, Hbft, PITF, IA, HS, (MPCO)	
		ST3	Protect the soil and groundwater from pollution	(ONT), POHAT, PITF	Environmental Protection Act
		ST4.	Ensure safe building foundations for development		Building Code
	Water	SH1	Maintain safe water quality for various forms of life and for various uses	WP, ONT, CAN, CWPC, PITF, PITN, K I & II, Hbft, MTPB, POHAT	Environmental Protection Act, Ontario Water Resources Act, Ontario Lakes and Rivers Improvement Act
		SH2	Restrict the placing or dumping of fill so as to not affect flooding, pollution, land conservation	POHAT,MTRCA, ONT	Official Plan, Environmental Protection Act, THC By-Law 23
		SH3	Ensure flood control, water conservation agreements and waterfront protection	MPCO	THC By-Law 23
		SH4	Designate lands in Waterfront with low-lying beach and marsh areas and susceptibility to erosion as hazard lands and control as such	MPCO, MTRCA	
		SH5	Maintain safe navigable waters	WP, AQps, POHAT, TC-Env, Hbft	Navigable Waters Protection Act, THC By-Law 23
	Life	SE1	Ensure human protection against disease from animals	OP	Official Plan
		SE2.	Protect animals and persons from the disposal of injurious substances into water and soil in contact with water	ONT	Ontario Water Resources Act
	Location	SL1.	Ensure safe aircraft operations	CAN	Aeronautics Act
Preservation and Protection of Valuable Resources	Air	PA1	Optimize climate conditions in order to encourage day/evening year-round use	AqPS, Ex, HS, PP, IA, PPT, (MPCO), Hbft	
		PA2.	Ensure that development (housing, recreation, commercial, industry) does not adversely affect air quality (noise, odours, gas, particulates, dustfall)	ONT, PP, OP, WP, PITF, IA, Hbft, TC-Env, POHAT	Official Plan, Environmental Protection Act, Toronto Noise By-Law
	Land	PT1.	Limit landfilling to areas where compatible with the environment	OP, PITF, (THC), (MTRCA)	
		PT2.	Protect shorelines subject to erosion (mentioned were Ward's Island, Beach, Gibraltar Point, and south shore of Eastern Headland)	WP, PP, THC, MP, TC-Env, MTPB, IA, MPCO	
		PT3.	Protect the soil and groundwater from pollution	ONT, POHAT, PITF	Environmental Protection Act

Social Value	Resource Factor	Social Objective		Supportive Source	Relevant Legislation
		PT4	Ensure that all development protects, conserves and wisely manages the environment	ONT, CWPC, CWTC, PI	Environmental Assessment Act (regulations pending)
		PT5	Maintain an aviation use in the Central Waterfront	OP, MPCO, WP	
		PT6	Maintain Island integrity of the Toronto Islands	MP, MPCO	
		PT7	Preserve and conserve natural history areas of geological significance	CWTC, MTPB, IA, PP POHAT, AqPS, TC-Env	
	Water	PH1	Maintain safe water quality for various forms of life and various uses	ONT, POHAT, PITF, K I & II, TIPN, CWPC, PI, Hbft	Environmental Protection Act
		PH2	Protect existing fish spawning and feeding areas	(PITF), (CWPC), TC-Env, POHAT, PI	
		PH3	Preserve existing sheltered water areas for boating, sailing, mooring	AqPS, TC-Rec, Hbft, TC-Env, WP, (THC)	
		PH4	Maintain the Eastern Gap for water circulation, recreation, shipping	(THC), CWPC, MTPB	
		PH5	Maintain the Western Gap for water circulation, recreation, shipping	(THC), CWPC, MTPB	
		PH6	Maintain the ship channel for water circulation, recreation, shipping	(THC), CWPC, MTPB	
		PH7	Maintain present size of Outer Harbour and shoreline configuration	HS, CWPC, PITF	
		PH8	Maintain present size of Outer Harbour and shoreline configuration	POHAT	
	Life	PE1	Preserve and conserve natural history areas of biological significance	CWTC, MTPB, IA, PP, POHAT, AqPS, TC-Env	
		PE2	Protect healthy mature trees	CWPC	
		PE3	Encourage vegetation that supports wildlife (feeding, shelter, breeding, rearing of young)	PP, CWPC, CWTC, POHAT, PI, AqPS, IA	
		PE4	Regulate planting on beaches to maintain open value for wildlife	CWPC, AqPS, PI, IA	
		PE5.	Preserve existing wildlife corridors	PP, POHAT	
		PE6.	Prohibit the disposal of harmful substances in water frequented by fish	TC-Env, CAN	Fisheries Act
		PE7	Encourage support of wildlife and vegetation in a natural state within Metropolitan Parks	MPCO	
	Location	PL1	Preserve uniqueness and character of the Waterfront, view to and from water, focal points, historic places, and buildings	OP, PP, WP, IA, AqPS, Ex, MTPB, TIPN, TC-Rec, Hbft, HS	Official Plan
		PL2	Preserve public space as generalized in City Official Plan, including Regional, District, Local Parks and City-owned land	OP, CWPC	Official Plan
		PL3	Protect residential areas and eliminate incompatible uses in established neighbourhoods	OP, WP, TIPN, TC-Rec	Official Plan
		PL4.	Retain industry on the Waterfront	OP, WP, POHAT, PITF, Hbft, MPCO	Official Plan

Social Value	Resource Factor	Social Objective		Supportive Source	Relevant Legislation
Desirability of Providing Amenity and Development	Air	DA1	Optimize climate conditions in order to encourage day/evening year-round use	PP, IA, Ex, Hbft, HS, PPT, (MPCO)	
		DA2	Ensure that development does not overshadow public use areas	HS, Hbft	
		DA3	Ensure that development (housing, recreation, commercial, industry) does not adversely affect air quality (noise, odours, gas, particulates, dustfall) as defined in relevant legislation	ONT, PP, OP, WP, PITF, IA, Hbft, TC-Env, POHAT	Official Plan, Environmental Protection Act, Toronto Noise By-Law
	Land	DT1	Provide amenity for prominent and attractive features, waterfront character, historical points of interest, views to the water	OP, WP, PP, Ex, HS, IA, PI, Hbft	Official Plan
		DT2	Develop efficient convenient public transportation to and across the the Waterfront (considering those environmental factors that will affect transportation	OP, WP, PP, PITF, Hbft, HS, PPT (MPCO)	Official Plan
		DT3	Develop roads, parking facilities, walkways and bikeways, to accommodate the variety of proposed uses	OP, WP, PP, PITF, PPT, (MPCO)	Official Plan
		DT4	Provide for expansion of municipal services as need arises	OP, WP TINP, PITF	Official Plan
		DT5	Provide for expansion of utilities and institutions as need arises	OP, WP, PITF	Official Plan
		DT6.	Develop a varied integrated parks system to include passive and active recreation (considering those aspects of the environment affecting recreation suitability)	OP, WP, PP, Hbft, PITF, HS, AqP, MPOS, Ex, MPCO	Official Plan
		DT7	Provide recreation for adjacent neighborhoods	WP, IA, TC-Rec	St. Lawrence Official Plan
		DT8	Link the Waterfront development with the valley park system	MTRCA	
		DT9.	Create recreational opportunities having regard for proximity to other Metro or contiguous regional/municipal parks	MPCO	
		DT10.	Ensure safe public access to and along water's edge including for the handicapped (mentioned were a continuous public walkway and providing viewing opportunities of waterfront activities	WP, PP, Hbft, HT, PITF, IA, HS, MPCO, TC-Rec	
		DT11	Develop environmental education programs	MPCO, CWPC	
		DT12.	Develop the Port Area as an industrial complex oriented towards water transport and water processing industries	OP, WP, PITF, (MPCO)	Official Plan
		DT13.	Develop a variety of housing types and develop housing in areas of compatible land use	OP, WP, Hbft	Official Plan
		DT14.	Develop commercial facilities which will complement adjacent uses	OP, WP, Hbft, PITF, Ex, (MPCO)	Official Plan
		DT15	Allow landfilling to continue in order to provide disposal sites and to create land for all uses	OP, WP, AqP, PITF, (MTRCA), (MP)	Official Plan
	Water	DH1	Provide for the expansion of water-requiring utilities (Hearn Generating Station, Main Sewage Treatment Plant, Water Filtration Plant)	OP, WP	Official Plan

IDENTIFICATION OF SOCIAL OBJECTIVES **CENTRAL WATERFRONT PLANNING COMMITTEE, JUNE 1976**

Social Value	Resource Factor	Social Objective		Supportive Source	Relevant Legislation
		DH2	Encourage water-oriented recreation activities swimming, water-skiing, fishing, viewing waterfowl, boating, and touring	OP, WP, PP, PI, POHAT, Hbft, PITF, AqPS, MPCO, TC-Rec, TC-Env	Official Plan
		DH3	Encourage industry requiring water transport and water resources	PITF, OP, WP, POHAT	Official Plan
	Life	DE1	Provide landscaping for aesthetics (including visual buffers), noise control, air quality, and human comfort	OP, POHAT, PITF, PI, IA, TC-Rec	Official Plan
		DE2	Enhance the landscape for wildlife habitat	TC-Rec, TC-Env, IA	
		DE3.	Develop new and expand existing terrestrial and aquatic wildlife areas	TC-Rec, TC-Env, IA	
		DE4.	Provide natural history interpretation centres	TC-Rec, TC-Env, MPCO	
	Location	DL1.	Encourage development for all uses: housing, recreation, industry, commercial and institutional	OP, WP, PP, Hbft, TC-Rec, POHAT, PITF, TINP	Official Plan
		DL2.	Encourage cross-waterfront transit, direct access to and along water's edge, access to private, port and industrial areas where safety and security permits	OP, WP, PP, Hbft, TC-Rec, POHAT, PITF, TINP	
		DL3.	Encourage access to Central Waterfront from downtown. Tunnels are not conducive to pedestrian and bicycle use		

Supportive Sources

City of Toronto Approved Reports

OP City of Toronto Official Plan, October 1969
WP 1967 Waterfront Plan (Bold Concept), December 1967
HS Revised Objectives for Harbour Square, December 1973
TIPN Toronto Islands Park Neighbourhood, September 1973
Official Plan Part II Excerpts Metro Centre Area
PPT Proposed Plan for Toronto, June 1967
HT Mayor's Task Force on the Elderly and Handicapped, 1975

Central Waterfront Planning Committee Reports

PP Programme for Planning, November 1974
PI Planning Issues, April 1974
IA Immediate Action Report
Criteria, Constraints and Considerations for the Redevelopment Area (East Bayfront)
CWPC – Minutes of CWPC
– Future Transportation Requirements of the Bayfront Area, April 1973
– Proposed Bay Street Trolley-Bus Report, July 1975

CWPC Sub-Committee Reports

TC-Rec CWTC Recreation Sub-Group, 1973
TC-Envir CWTC Environmental and Shoreline Management Sub-Group, 1973
AqPS Aquatic Park Steering Committee Minutes
POHAT Port and Outer Harbour Area Task Group Minutes

Other Agency Reports

MP Metropolitan Toronto Parks. A Compendium, 1973
MPW Metropolitan Toronto Works—response to Keating Channel Dredge Spoil Disposal, 1976
K I Disposal Study of Keating Channel Dredging Material, T.H C., January 1974
K II Dredged Material Disposal Study Phase II, December 1975
ONT – Environmental Protection Act, Ontario, December 1975
– Water Resources Act
– Environmental Assessment Act, 1975
– Harbour City, Ontario, 1970
– Ontario Lakes and Rivers Improvement Act
MPCO Metroplan Concept and Objectives, 1976
CAN – Navigable Waters Protection Act
– Fisheries Act
– Aeronautics Act

Other Reports

AqP Aquatic Park Report, Johnson, Sustronk & Weinstein, 1976
Hrbt Harbourfront Corporation, January 1976
Ex Rehabilitation of Exhibition Park, April 1971
PITF Port Industry Task Force, 1975
IAN Toronto Island Airport Non-Aviation Uses Study, February 1976

trated on maps in the following chapter. All mapped features which relate to each social objective are identified, along with the actions required to sustain that feature's value to society. Each social objective related to a specific feature of the natural environment implies an action in order to ensure that objective is met. Each required action or "performance requirement" in turn implies opportunities and constraints for different land uses and activities. Examined together, opportunities and constraints for a specific use afford a means to evaluate the suitability of a particular place for that use. Thus the determination of land use suitability is derived directly from the expressed social values.

INTERPRETATION

DATA INTERPRETATION

INTRODUCTION

The preceding two steps, Data Review and Social Objectives, presented the natural features and social objectives which are the basis of this study. In the first step, elements of the natural environment were examined separately and relationships among the elements were documented. Since the key to understanding the environment of the Central Waterfront is to comprehend the interactions among elements, the data were reorganized into resource categories in which relationships could be better perceived and understood. In this chapter the important known relationships between natural features within five resource categories, Air, Land, Water, Life, and Location, are established. Each mapped feature is also related to relevant social objectives and the performance requirements needed to achieve each objective.

The maps illustrated here are summaries of known data, but the data are presented in a format that permits a new understanding of relationships between natural features in the waterfront. The Water map, for example, is based not only on water depth, water quality, and sewer outfall maps from the C.W.P.C. Information Base, Water, but also on toxic soil and runoff coefficient maps from the Physical Geography report. Those aspects of soils relating to toxicity and runoff characteristics are included on the Water map because they have great impact on the hydrologic regimen. By combining this information on one map, one can perceive relationships between water circulation, water depth, storm water runoff from land, and pollution levels.

The available data, reorganized into the five broad resource categories, are summarized on seven maps: Air, Land: Thickness of Sediments, Land: Types of Sediments, Water, Life: Vegetation, Life: Wildlife, and Location. Each map is accompanied by a legend which not only identifies the mapped features, but also illustrates the nature of their relationships. A series of data interpretation charts relates the mapped features to social objectives, performance requirements and a range of land uses. The key to the charts is shown on the following page. The key explains the significance of the headings, abbreviations, and symbols which appear on the chart.

Each data interpretation chart has six parts. The first, Region/ Feature, identifies a mapped feature to which the other five parts

Data Interpretation: Key to Charts

Region/Feature	is an identifiable element of homogeneous environmental characteristics. Features are mapped within the resource categories of Air, Land, Water, Life, and Location.
Social Value	is a generalized expression of concern related to the specific environmental feature, which is derived from the C.W.P.C. social objectives.
Social Objectives Reference	identifies by code the social objectives adopted by the C.W.P.C. which express some concern about a specific environmental feature. Social objectives are grouped under the headings of maintenance of safety and comfort, the preservation and protection of valuable resources, the provision of amenity, and the accommodation of development.
Performance Required	outlines the performance required of all future actions to sustain the social value of a specific feature.
Perf Ref.	identifies by code the performance requirements described in Performance Requirements for Future Action.
Implications for Land Use	identifies the "Opportunities and Constraints" represented by each resource feature for prospective uses.

DATA INTERPRETATION: WATER RESOURCE

Region/ Feature	Social Value	Social Objectives Reference	Performance Required	Perf. Ref.	Implications for Land Use RC	RP	RR	RM	RS	AL	AT	AH	AU	DP	DS	DH	WG	WL	WS
Water Shallow (0-10')	Safe for recreation	SH1, PH1, DH2 PT4	Ensure availability for recreation	W IIIB	■	·	·	▩	■	◇	·	▨	·	·	·	·	·	·	·
	Vulnerable to pollution build-up	SH1, SH2, PH1 PT4	Regulate use and discharges to maintain water quality	W IIB W IIC	·	·	·	·	◇	◇	·	·	·	·	·	·	·	·	·
	Easily developable	PT1, DT15, SH2 PT4	Ensure productive resource utilization		·	◇	·	▩	◇	◇	◇	■	·	·	◇	◇	·	■	▩
Water Moderately Deep (10-30')	Vulnerable to pollution	SH1, SH2, PH1 PT4	Regulate use and discharges to maintain water quality	W IIB W IIC	·	·	·	·	◇	·	·	·	·	·	·	·	·	·	·
	Valuable amenity for recreation	SH1, PH1, DH2 PT4	Ensure availability for recreation	W IIIB	■	·	·	■	◇	·	·	◐	·	·	·	·	·	·	·
	Potentially developable	PT1, DT15, SH2 PT4	Ensure productive resource utilization		·	·	·	◐	○	·	·	●	·	·	·	·	·	●	●
Water Deep (Over 30')	Vulnerable to pollution	SH1, SH2 PT4	Regulate use and discharges to maintain water quality	W IIB W-IIC	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
	Valuable for recreation	SH1, PH1, DH2 PT4	Ensure availability for recreation	W IIB	◇	·	·	■	◇	·	·	▨	·	·	·	·	·	·	·
					·	·	·	○	·	·	·	●	·	·	·	·	·	●	●
Water. Sewer Outfall Areas	Pollution hazard	SE1, SE2	Regulate human use to maintain health	W IB	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
		SH1,PH1,PT4	Monitor and regulate discharges to prevent degradation	W IIB	·	·	·	◇	·	·	·	·	·	·	·	·	·	·	·
					·	·	·	●	○	○	·	◐	●	·	·	·	·	◢	◢

Opportunity results when the social value of the resource feature is a

- ▩ Critical factor in determining the location of a particular land use
- ■ Highly desirable factor in determining the location of a particular land use
- ▨ Desirable factor in determining the location of a particular land use
- ◇ Desirable factor in satisfying the needs of a specific land use
- • Factor of no concern

Constraint results from the amount of effort involved in meeting the performance requirements necessary to sustain the social value of the resource feature. The resultant cost may imply:

- ■ Probable prohibition of a particular land use
- ◢ Permission of a particular land use only as a special variance due to exceptional social reasons, nevertheless severely restricted
- ● Severe restriction of a particular land use due to stringent development controls
- ◐ Moderate restriction of a particular land use due to development guidelines
- ○ Modification of a particular land use in response to recommended design or management strategies
- • Unrestricted use

Prospective uses are defined as discrete use categories. A future Land Use will be a combination of more than one of the following uses:

Recreation

- RC Conservation with limited recreation. Human use needs to be regulated and restricted to well-defined areas. Maintenance of the environment in its present state is implied.
- RP General low intensity recreation, including hiking, picnicking. Moderate modification of the environment to accommodate human activities is implied.
- RR Intensive recreation for specific organized activities on land, including playfields and exhibition plazas. Extensive modification of the environment is implied.
- RM Intensive recreation for specific water-related activities, including boating and swimming. Extensive modification of the environment may be necessary.
- RS Special recreation for specific reasons, including outlooks for scenic views and interpretation areas for educational recreation.

Amenity

- AL Landscaping, including the establishment of new planting and modification of existing vegetation.
- AT Minor roads and trails to accommodate limited traffic.
- AH Major roads and transit systems, including highways and ferries, to accommodate high intensity traffic.
- AU Utilities, including sewer, gas, electricity, telephone, and water lines.

Development

- DP Extensive paving, generally associated with parking.
- DS Small, low residential, commercial, or institutional structures.
- DH Heavy, mid- or high-rise residential, commercial, institutional, or industrial structures.

Waste Disposal

- WG Gaseous, particulate, odourous, or noise emissions to the air.
- WL Discharge of waste materials to water.
- WS Disposal of solid wastes, including dredge and fill.

pertain. The second part, Social Value, describes those impacts of the mapped feature which are relevant to social values. Given that social value, Social Objective Reference lists those objectives approved by the C.W.P.C. which are relevant. Performance Required outlines future actions necessary to achieve each objective. Detailed development guidelines and controls are referenced under Perf. Ref. Implications for Land Uses summarizes the opportunities offered and the constraints imposed upon land uses within that feature. The fifteen land uses represented here are very general categories and are used to give an indication of relative opportunities and constraints. They are useful in gaining an overview, but when specific uses are proposed for a particular area, reference should be made to the more detailed development guidelines in Performance Requirements for Future Actions.

For example, the water feature "sewer outfall areas" is related to human safety, since such areas represent a pollution hazard. "Ensure human protection against disease from animals" (SE1) and "Protect animals and persons from the disposal of injurious substances in contact with water" (SE2) are adopted social objectives which support policy recommendations addressing this aspect of the feature. The performance or action required to meet these social objectives is "Regulate human use to maintain health." This performance requirement implies constraints for certain land uses and offers no opportunities for others. Thus the chart indicates no entries under opportunities, while there are severe restrictions placed upon water related recreation.

Another social objective is related to pollution hazard in sewer outfall areas. Where the first objective would entail a restriction on human use of polluted water, the second would entail the regulation of activities which cause the pollution hazard. The second performance requirement relates to the following C.W.P.C. social objectives: "Maintain safe water quality for various forms of life and various uses" (SH 1, PH 1) and "Ensure that all development protects, conserves, and wisely manages the environment" (PT4). To meet these objectives it is necessary to "monitor and regulate discharges to prevent degradation." The actions necessary to meet this performance requirement are described in Performance Requirements for Future Actions.

Thus, the data interpretation charts summarize and link all other parts of this study. For each feature, relevant social values, social objectives, performance requirements, and implications for prospective land uses are summarized. "Region/Feature" is a key to the data maps, "Social Objectives Reference" is the list compiled by the C.W.P.C., and "Perf. Ref." is a reference to the required development and management guidelines described in Performance Requirements for Future Action.

This chapter examines the five resource categories-Air, Land, Water, Life, Location-in terms of important processes and features, and their relevance to social objectives and planning.

AIR

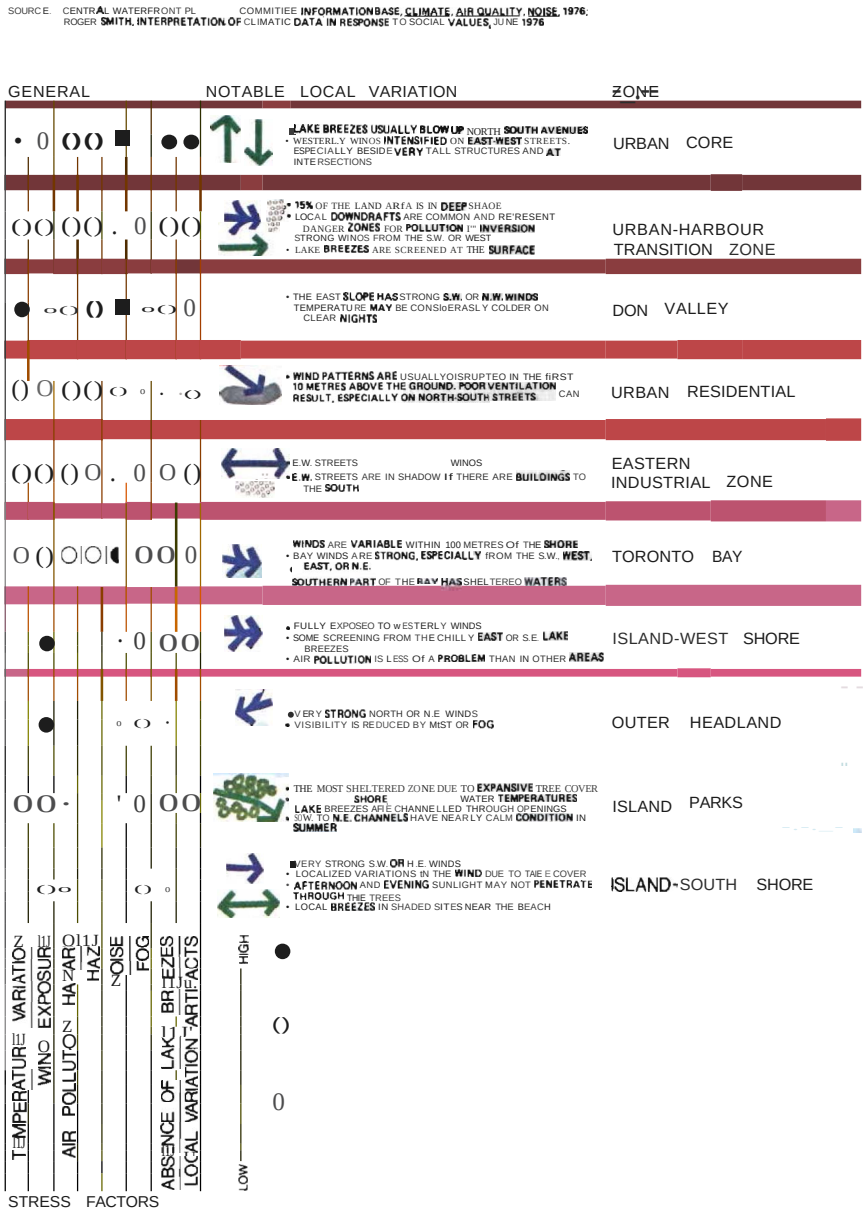
All important factors relating to the atmosphere- climate, air quality, and noise- are combined here on one map. Ten climatic zones can be distinguished in the city near the Central Waterfront. Seven are within the waterfront-Island-South Shore, Island Parks, Island-West Shore, Outer Headland, Eastern Industrial Zone, Toronto Bay, and Urban-Harbour Transition Zone. Three zones are identified on the map but lie outside the study area-Urban Core, Urban Residential Zone, and Don Valley. Each zone has characteristic climatic features of temperature variation, wind and lake breeze exposure, and fog. In addition, characteristic features of air pollution and noise are associated with specific zones. All these features are represented on the Air map

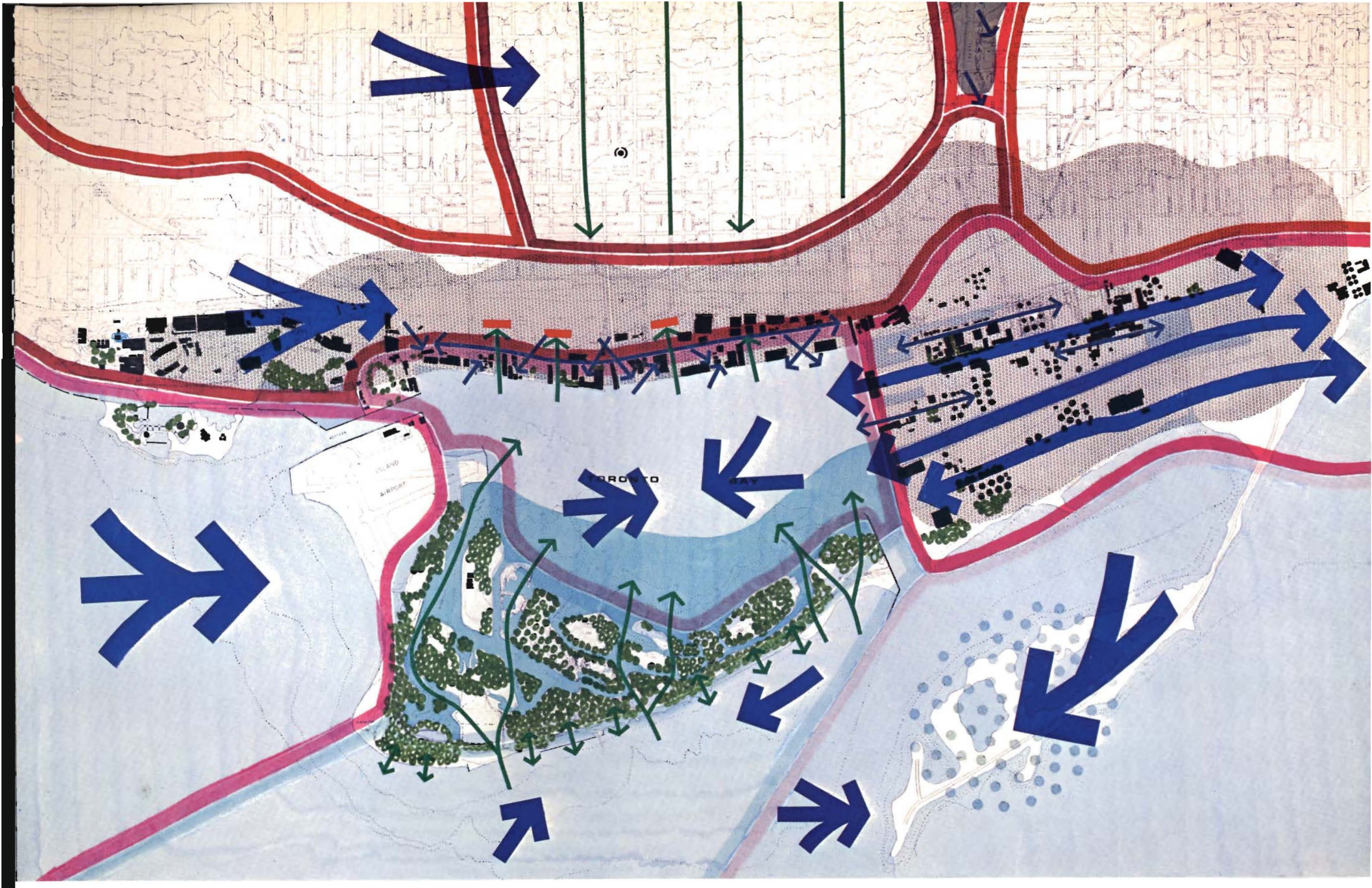
The climatic zones shown on the Air map are derived from the C.W.P.C. Information Base Report, Climate. The colour outlines on the map, ranging from dark red to light blue, reflect a gradient of stress from most to least. Stress factors may include exposure to strong winds, fog, or high levels of air pollution. Climatic features which may ameliorate stress include ventilating lake breezes. The accompanying legend identifies the stress factors present within each zone, as well as the notable local microclimatic and air quality characteristics.

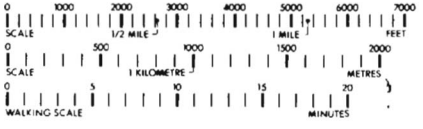
The most pronounced climatic stress is present in the Urban-Harbour Transition Zone. This zone is subject to strong westerly winds which are intensified and distorted by tall buildings. Downdraft areas are common on the northeast corners of tall buildings and may develop hazardous concentrations of air pollutants during temperature inversions. High levels of air pollution and noise exist throughout most of the zone. Lake breezes which might otherwise disperse air pollutants, are blocked at the ground level by tall buildings Fifteen percent of the land area is in deep shade all or most of the time. Shade in combination with strong winds makes this zone extremely uncomfortable in winter.

The Eastern Industrial Zone is subject to strong westerly winds which are channelled down east-west streets. These streets may also be in shadow throughout most of the winter if there are structures on the south side Air pollution and noise levels are high in the Eastern Industrial Zone.

AIR




TORONTO
BAY
ISLAND
AIRPORT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SCALE 1/2 MILE 1 MILE FEET
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SCALE 1 KILOMETRE METRES
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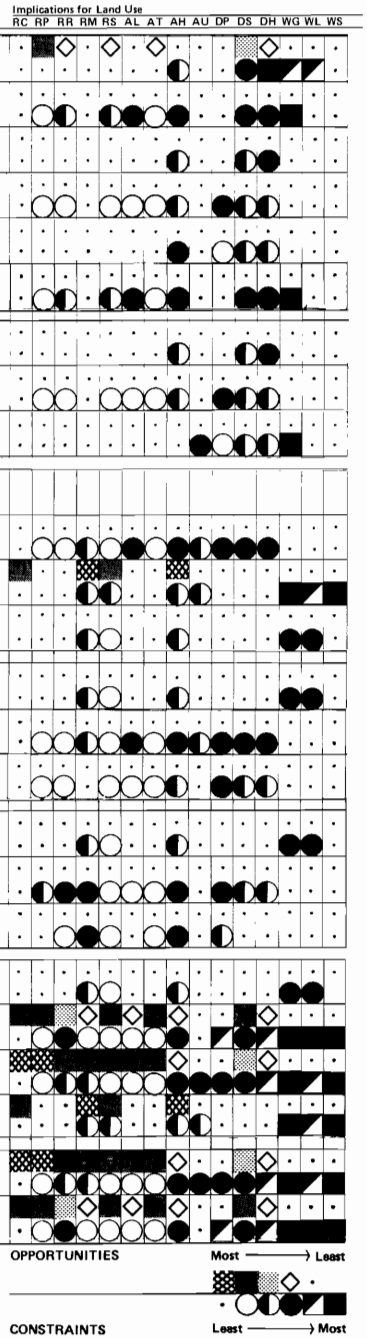
WALKING SCALE MINUTES

DATA INTERPRETATION: AIR RESOURCE

Region/ Feature	Social Value	Social Objectives Reference	Performance Required	Perf. Ref.
Urban-Harbor Transition Zone Openings between structures	Maintain comfort	SA1,SA2,PA1,PA2, DA1,DA2	Allow uninterrupted passage of lake breezes	W-IIIB
Local down-draft areas	Potential pollution hazard	SA2,PA2,DA2	Ensure free ventilation to dissipate pollution	A-IB
General Region	Maintain comfort	SA1,PA1,DA1,DA2	Minimize shading	A-IIIC
		SA1,PA1,DA1	Provide shelter from westerlies	A-IIB
	Potential pollution hazard	SA1,SA2,PA1,PA2, DA1,DA3,PT4	Regulate air emissions	A-IA
		SA2, PA2, DA2	Ensure free ventilation to dissipate pollution	A-IB
Eastern Industrial Zone General Region	Maintain comfort	SA1,PA1,DA1,DA2	Minimize shading	A-IIIC
		SA1,PA1,DA1	Provide shelter from westerlies	A-IIB
	Potential pollution hazard	SA1,SA2,PA1,PA2, DA1,DA3,PT4	Regulate air emissions	A-IA
Toronto Bay Bayfront	Potential safety hazard	See Urban Harbor Transition Zone	All six listed under Urban Harbor Transition Zone	
		SA1,PA1,DA1	Safeguard against icing resulting from spray	A-IIA
Southern Protected Waters	Valuable recreation resource	PH3	Maintain high recreational amenity value	A-IVA
Open Water	Maintain safety	SA1,PA1,DA1	Safeguard against strong shifting winds	A-IIC
Island-West Shore: Gibraltar Point and Open Water	Potential safety hazard	SA1,PA1,DA1	Safeguard against strong shifting winds	A-IIC
Western Beach	Potential safety hazard	SA1,PA1,DA1	Safeguard against icing resulting from spray	A-IIA
General Region	Maintain comfort	SA1,PA1,DA1	Provide shelter from westerlies	A-IIB
Outer Headland South Shore and Open Water	Potential safety hazard	SA1,PA1,DA1	Safeguard against strong shifting winds	A-IIC
General Region	Maintain comfort	SA1,PA1,DA1	Provide shelter from strong northeastern winds	A-IIB
	Potential safety hazard	SA1,PA1,DA1	Safeguard against fog	A-IID
Island South Shore: Gibraltar Point and Open Water	Potential safety hazard	SA1,PA1,DA1	Safeguard against strong shifting winds	A-IIC
South Beach	Maintain comfort	SA1,PA1,DA1	Maintain shade to enhance pleasant lake breezes	A-IIIB
General Region	Maintain comfort	SA1,PA1,DA1	Maintain vegetation pattern to sustain tempered climate	
Southern Protected Waters	Valuable recreation resource	PH3	Maintain high recreational amenity value	A-IVA
Island Parks: General Region	Maintain comfort	SA1, PA1 DA1	Maintain vegetation pattern to sustain tempered climate	A-IIB A-IIIA
		SA1, PA1, DA1	Maintain pleasant lake breezes	A-IIB



The Toronto Bay Zone includes the open water of the Inner Harbour and a strip along the Bayfront from the dockwall to Queens Quay West. The entire zone is subject to strong winds from the west, southwest, east, and northeast, although local areas may be protected from either east-northeast or west-southwest winds. Winds are variable within 100 metres of the shore and may quickly shift direction. In winter, icy spray may cover areas of the Bayfront which are within 200 metres of the water, rendering sidewalks and streets extremely hazardous. The Toronto Bay Zone is subject to high air and noise pollution levels, the effect of which is mitigated somewhat by the lake breeze and winds. The southern waters of Toronto Bay are the most protected in the waterfront, except during storms accompanying northeast and east winds, and have value as a recreational resource.

The Island-West Shore includes open water, the Island Airport, and Ontario Place. This zone is fully exposed to westerly winds, and in winter, icy spray may reach 200 metres inland along the western beach. Air pollution is not presently a problem due to the prevailing westerly winds off the Lake.

Weather conditions on the Outer Headland are similar to those over the open water of Lake Ontario. Northeast winds may reach speeds twenty percent higher than in other areas of the Waterfront. Visibility is reduced by mist or fog especially, between April and July. Fog occurs on an average of fifty days per year, more than twice the frequency for other areas of the Central Waterfront.

The Island-South Shore is mostly open water, but also includes a strip of beach along the southern shore of the Toronto Islands. Although fully exposed to Lake Ontario, the Island-South Shore is one of the least stressful zones. Very strong southwest and northeast winds whip along the south beach and over the water but most of the shoreline is protected from west and northwest winds by tree cover. In summer the Island-South Shore is cooled by lake breezes. Local breezes are also generated along shaded sites near the beach by the temperature contrast between shaded and exposed sandy ground. The Island-South Shore is presently one of the quietest areas in the Central Waterfront.

Due to the extensive tree cover, the Island Parks Zone has the most pleasant microclimate in the waterfront. This zone is sheltered

by trees from storm winds and summer sun, and the trees also channel cooling lake breezes. The Island Parks Zone is also one of the quietest areas in the Waterfront.

Each characteristic of every zone can be ascribed a social value relating to "safety" or "comfort". Performance requirements listed on the Air Data Interpretation Chart specify actions necessary to prevent, avoid, or mitigate hazards and to promote or maintain comfort. These are outlined in Resource Interpretation and are described in detail in Performance Requirements for Future Actions.

LAND

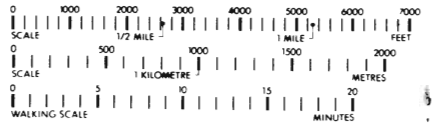
The shale bedrock of the Central Waterfront is overlain by glacial sediments deposited in the Pleistocene age and littoral and alluvia/ sediments deposited more recently. The natural landform configurations have been modified by landfill in the past century. Both the thickness of this overburden and the various types of overlying sediments are illustrated on the two Land Resource maps-Surficial Sediments: Thickness, and Surficial Sediments: Type. These maps are based on two C.W.P.C. Information Base reports -Physical Geography and Water.

The overburden thickness on the Surficial Sediments: Thickness map is computed from the superimposition of topographic elevation on bedrock contours. The diagrammatic section on the legend illustrates the relationship of overburden thickness to the colours of the mapped areas. The lighter the colour the more shallow are the sediments overlying the bedrock. The overburden ranges from very thin (0 to 20 feet) to moderately thick (20 to 60 feet) in the Bayfront and Exhibition Park, and from moderately to very thick (greater than 60 feet) in the Port area and the Toronto Islands. Deep surficial deposits in the Port area reflect a pre-glacial valley in the bedrock underlying the Don River Valley. Overburden thickness has implications for development costs. Costs for building foundations supported on bedrock will be relatively low where the overburden thickness is less than twenty feet, and will be very high where overburden thickness exceeds sixty feet.

The second map identifies the nature of the surficial sediments-their origins, composition, and degree of compaction. Glacial till is the only glacial sediment which occurs within the Central Waterfront. It consists of silt and clay and poses potential foundation and slope failure problems. The landfill sediments-trucked fill, trucked and hydraulic fill, and hydraulic fill-are all potentially unstable, and soil explorations are required to determine their suitability for building foundations.

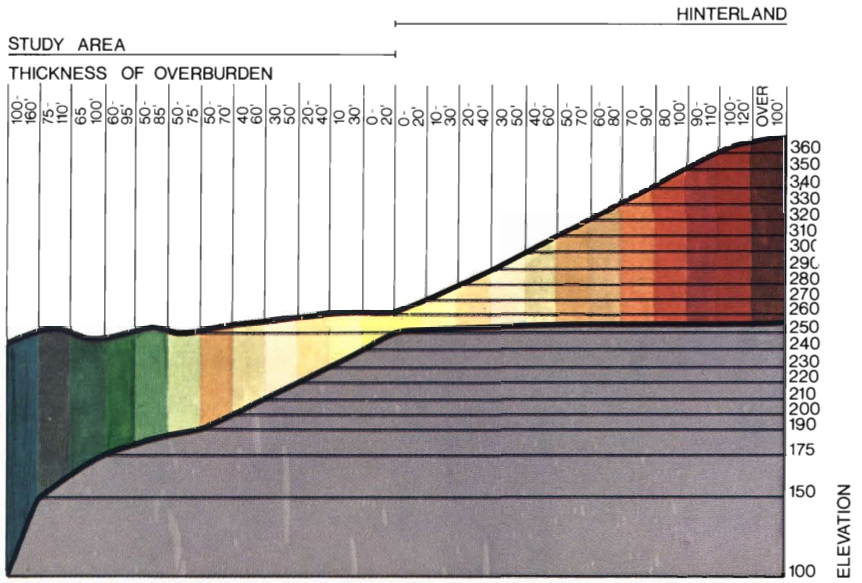
Some areas contain the buried remains of old buildings, dockwalls, and piers, which once stood along the historic shorelines. These structures are buried under landfill in the Bayfront. Landfill containing buried structures is a treacherous material on which to found a building, and soil explorations are required for development requiring foundations.

LAND
SURFICIAL MATERIAL: THICKNESS



LAND
SURFICIAL MATERIAL: THICKNESS

SOURCE: CENTRAL WATERFRONT PLANNING COMMITTEE INFORMATION BASE, PHYSICAL GEOGRAPHY, 1976.



Littoral deposits have accumulated from sediments carried and deposited by long-shore currents. The littoral deposits on the Toronto Islands are recent. These beaches are a recreation resource for the Toronto region. The deposits in the Port area are remnants of the spit which once formed at the mouth of the Don River, enclosing Toronto Bay. These ancient deposits have value as an educational resource.

Uncompacted sediments in the Central Waterfront consist of littoral deposits or landfill which have been in place for less than ten years. Since these sediments have not yet achieved their maximum natural compaction, they are prone to settlement. They will provide an unstable support for foundations until they become compacted.

Subaqueous sediments range in texture from sand to clay Silt and clay subaqueous sediments provide a poor foundation for structures and may also present a potential pollution hazard. Sand and sand-silt sediments are more easily developed. They are also a potential source of high quality fill material.

Most land features relate to social values in terms of safety and development cost or in terms of resource protection. Performance requirements listed on the Land Data Interpretation Chart specify actions necessary to prevent or avoid hazards, to minimize development costs, and to protect resources. These are outlined in Resource Interpretation and are described in detail in Performance Requirements for Future Actions.

DATA INTERPRETATION: LAND RESOURCE

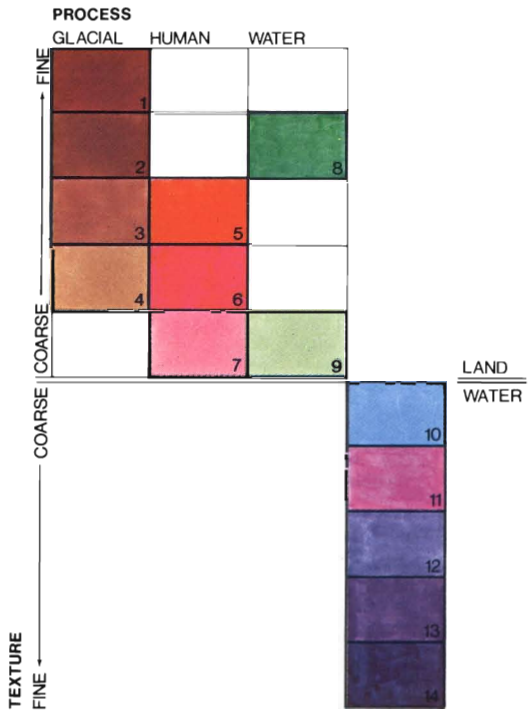
Region/ Feature	Social Value	Social Objectives Reference	Performance Required	Perf Ref.	Implications for Land Use RC	RP	TR	RM	RS	AL	AT	AH	AU	DP	DS	DH	WG	WL	WS
Little up to 20' Thickness of Overburden	Low foundation cost for all structures	ST4	None																
Moderate up to 60' Thickness of Overburden	Acceptable foundation cost (for mid-rise structures)	ST4	Account for additional cost	T IIA															
High more than 60' Thickness of Overburden	High foundation costs	ST4	Account for additional cost	T IIA															
Glacial Till Surficial Material	Potential hazard of 'slope failure' poor foundation	ST4,PT4	Protect deep cuts and stabilise embankments	T IIA															
Trucked Fill Surficial Material	Potentially unstable variable foundation conditions	ST4	Ensure suitable engineering standards	T IIA															
Hydraulic + Trucked Fill Surficial Material	Same as listed under Trucked Fill	ST4																	
Hydraulic Fill Surficial Material	Same as listed under Trucked Fill	ST4																	
Littoral Deposits Surficial Material	Unique, scarce resource of high educational value	DT11 DE4, PT7 PT4	Ensure availability for education/recreation	T IA															
	Variable foundation conditions	ST4	Same as listed under Trucked fill	T IIA															
Sand Sand Silt Sub Aqueous Material	Potentially good foundation material	ST4	None																
	Valuable for maintenance of water quality	SH1 SH2, PH, PT1, ST3, PT3 PT4	Regulate activities to avoid loss of resource	T IB															
Sand-Silt Clay Silt-Clay, Clay Silt Sub Aqueous Material	Poor foundation	ST4	Account for additional cost																
	Potential Pollution Hazard	SH1, SH2, PH1 PT1, ST3, PT3, PT4	Regulate activities to prevent degradation	T IB															
Uncompacted Sediments Surficial Material	Potentially unstable	ST4	Ensure suitable engineering standards	T IIA															
Buried Structures Surficial Material	Potentially hazardous highly variable foundation	ST4	Same as under Uncompacted Sediments	T IIA															

OPPORTUNITIES Most → Least

CONSTRAINTS Least → Most

LAND
SURFICIAL MATERIAL: TYPE

CENTRAL WATERFRONT PLANNING COMMITTEE INFORMATION BASE, PHYSICAL GEOGRAPHY, WATER, 1976

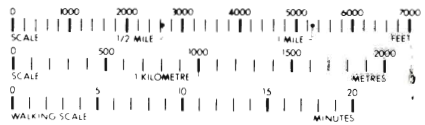


1. VARVED CLAY
2. GLACIAL TILL
3. INTERGLACIAL SAND AND CLAY
4. IROQUOIS SAND AND CLAY
5. TRUCKED FILL
6. HYDRAULIC FILL + TRUCKED FILL
7. HYDRAULIC FILL
8. ALLUVIAL DEPOSITS
9. LITTORAL DEPOSITS
10. SAND
11. SAND - SILT
12. SAND - SILT CLAY
13. SILT - CLAY
14. CLAY - SILT

COMPACTED LESS THAN 10 YEARS

BURIED STRUCTURES

LAND
SURFICIAL MATERIAL: TYPE



WATER

Lake Ontario dominates the natural environment of the Central Waterfront. Thus an understanding of processes related to water is the key to an understanding of how the waterfront environment functions. Relationships between the Lake and local climate, between lake currents and water-borne sediments, between moisture levels and vegetation, between water and wildlife habitats, and between water and human activities are explored in other parts of this study. In this section, the nature of the water itself—its depth and quality—and the land features which influence its quality are examined.

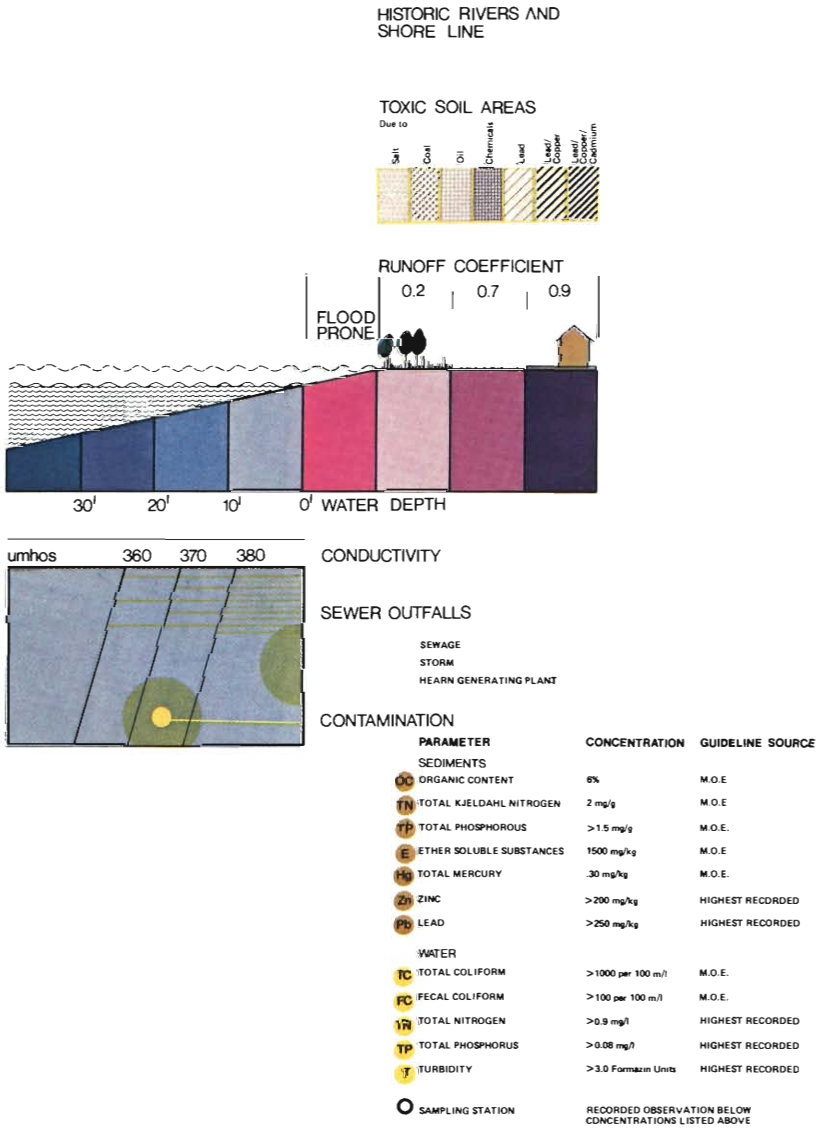
Features displayed on the Water map relate to water depth (blue), flooding and runoff characteristics of land (purple), and contamination of water, lakebottom sediments, and soil (yellow). Water depth is a result of past and present geologic, climatic, and hydrologic processes which are modified by human activities. The shape and depth of the lakebottom are determined by natural processes of wave action and currents, whereas depths in Toronto Harbour and the Island lagoons are determined by human actions. The dredged ship channel in Toronto Harbour is 27-30 feet deep and requires periodic maintenance. The shape of the Bay bottom has undoubtedly also been affected by dredging as man has mined it for fill material. The Island lagoons and other shallow waters are susceptible to silting, resulting from erosion due to man's activities near the shore. Present knowledge of hydrodynamics is insufficient to permit the prediction of possible changes in water depth.

Shallow water (0-10 feet deep) is most easily developed for man's needs, but being adjacent to the shore it is also most vulnerable to pollution. Moderately deep water (10-30 feet) also has value as a recreation and potential development resource. Deep water (over 30 feet) is not easily developed, but its abundance and depth give it recreation value. Moderately deep and deep water are slightly less vulnerable to pollution since contaminants may disperse more readily than in shallow water.

Since the quality of water in Toronto Harbour and Lake Ontario is also directly affected by man's activities on adjacent land, it is important to determine the relationships between land and water in the Central Waterfront. Water moves from land to the Lake as

WATER

SOURCE. CENTRAL WATERFRONT PLANNING COMMITTEE INFORMATION BASE, WATER, PHYSICAL GEOGRAPHY, 1976

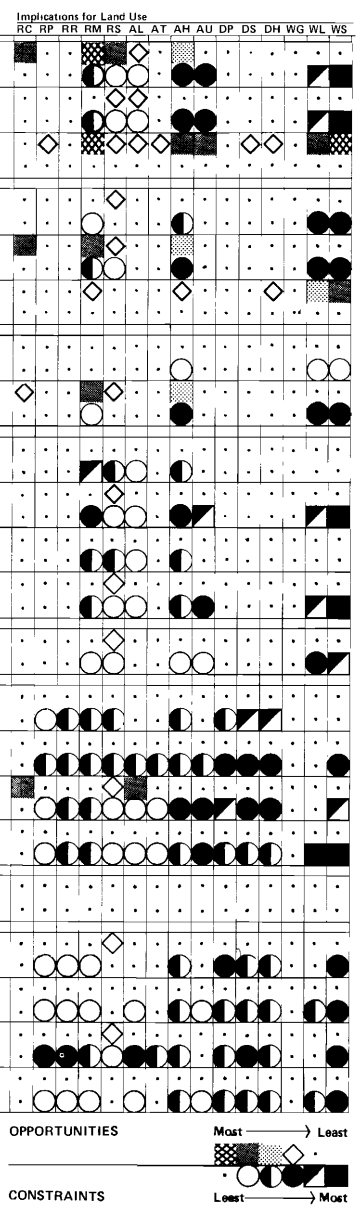


WATER

SCALE 0 1000 2000 3000 4000 5000 6000 7000 FEET
1/2 MILE 1 MILE
SCALE 0 500 1000 1500 2000 METRES
1 KILOMETRE
WALKING SCALE 0 5 10 15 20 MINUTES

DATA INTERPRETATION: WATER RESOURCE

Region/ Feature	Social Value	Social Objectives Reference	Performance Required	Perf. Ref.
Water Shallow (0-10')	Safe for recreation	SH1, PH1 DH2 PT4	Ensure availability for recreation	W-IIIB
	Vulnerable to pollution build-up	SH1, SH2, PH1 PT4	Regulate use and discharges to maintain water quality	W-IIB W-IIC
	Easily developable	PT1, DT15 SH2 PT4	Ensure productive resource utilization	
Water Moderately Deep (10-30')	Vulnerable to pollution	SH1 SH2, PH1 PT4	Regulate use and discharges to maintain water quality	W-IIB W-IIC
	Valuable amenity for recreation	SH1, PH1, DH2 PT4	Ensure availability for recreation	W-IIIB
	Potentially developable	PT1, DT15, SH2 PT4	Ensure productive resource utilization	
Water Deep (Over 30')	Vulnerable to pollution	SH1, SH2 PT4	Regulate use and discharges to maintain water quality	W-IIB W-IIC
	Valuable for recreation	SH1, PH1, DH2 PT4	Ensure availability for recreation	W-IIB
Water Sewer Outfall Areas	Pollution hazard	SE1, SE2	Regulate human use to maintain health	W IB
		SH1,PH1,PT4	Monitor and regulate discharges to prevent degradation	W-IIB
Water Other Contaminated Areas	Pollution hazard	SE1, SE2	Regulate human use to maintain health	W-IIC
		SH1, SH2, PH1 PT4	Regulate use and discharges to prevent degradation	W-IIB W-IIC
Water Contaminated Sediment Areas	Potential pollution hazard	ST2 ST3, PT3 PT4	Monitor and regulate activities to prevent degradation	W-IIC
Land Floodprone Areas	Hazard to life & property	SH3, SH4	Avoid permanent habitation	W-IA
		SH2, SH3, SH4,PT1 PT4	Ensure artifacts are flood protected and do not aggravate hazard	W-IA
	Land-water interaction valuable to hydrologic regimen	ST3, PT3 ,PT4	Maintain run-off/recharge balance	W-IIIA
	Potential pollution hazard	ST3, PT3,PT4	Regulate toxicant and nutrient application	W IIA
Land Low Runoff Areas	Land-water interaction valuable to hydrologic regimen	ST3, PT3,PT4	Same as listed under Flood prone Areas	
Land High Runoff Areas	Potential flooding and pollution hazard	SH1,PH1,ST3,PT3 PT4	Provide for retardation of excess run-off	W-IIIA
		SH1,PH1,ST3,PT3 PT4	Regulate toxicant and nutrient application	W-IIA
Land Toxic Soil Areas	Pollution hazard	SH1,PH1,ST3,PT3 PT4	Prevent run-off and recharge to avoid pollution	W-IIIA
		SH1,PH1,ST3,PT3 PT4	Restrict toxicant and nutrient application	W-IIA



overland and underground flow, and from the Lake to land as underground flow or occasional flood water.

In vegetated areas with sandy soil most storm runoff is absorbed directly into the ground. As ground water it may gradually move toward the Lake, and the soil may remove some contaminants as the water is filtered through it. Man generally increases overland flow at the expense of underground flow by introducing paving and storm sewers, two elements which hasten the coursé of storm runoff from land to Lake, often bypassing the filtering process of underground flow.

The amount of overland storm water runoff which can be expected for specific areas is shown on the Water map in a gradient of purple colours. Light purple areas produce a low amount of surface runoff, since most storm water is absorbed into the ground. The darkest purple identifies paved areas where almost nothing is absorbed; practically all storm water runs off into adjacent water or soil.

During intense storms, floodwaters from the Lake inundate the land. Areas below 249 feet in elevation are floodprone and have a seasonal high water table. Areas subject to flooding should be retained as low runoff areas to promote the absorption of storm water. These areas are highly vulnerable to pollution, since toxicants and nutrients may readily enter Lake Ontario either directly or through the groundwater.

Toxicants or nutrients discharged or applied on low runoff areas are absorbed into the soil with storm water. They may then either be filtered out of the water by soil or may be carried into the groundwater. If they are absorbed by the soil, toxicants may damage plants growing within the soil, or may become concentrated in the plants, thereby entering the food-chain. On the other hand, if toxicants and nutrients move into the groundwater, they may eventually contaminate both ground and surface waters. Thus a potential pollution hazard exists in low runoff areas.

Toxicants or nutrients discharged or applied on high runoff areas with runoff coefficients of .7 and .9 are carried overland by storm water to low runoff areas or directly to surface waters via storm sewers. High runoff areas within the Central Waterfront generally

contain more contaminants (oil, dust, eroded soil) and present a pronounced pollution hazard.

Toxic soil areas are indicated by a yellow outline on the Water map. Toxic soils occur mostly in the Bayfront and Port areas in association with industry, and coincide with both low and high runoff areas.

Limited sampling of subaqueous sediments has revealed some areas of contaminated sediments. High concentrations of heavy metals (lead, mercury), oil, and grease, or nutrients (phosphorus, nitrogen) have been recorded. These contaminated sediments are the direct result of human activities, such as contaminated dredgeate disposal or sewer discharge. These contaminated sediments represent a pollution hazard since toxicants and nutrients may gradually be taken up by the surrounding water. Disturbance of these sediments is likely to hasten the dispersal of contaminants.

Certain water areas are identified as being contaminated, due to high levels of coliform bacteria, nutrients (phosphorus, nitrogen), or suspended solids. The presence of total and fecal coliform bacteria indicates the pollution of water by animal or human wastes. Levels of coliform bacteria which exceed M.O.E. standards are found in many areas of the Central Waterfront which receive discharge from sewers. These areas are a health hazard and are not suitable for any human activity which might entail water contact. High levels of nitrogen and phosphorus are mostly related either to sewer outfall areas or to the north shore of the Toronto Islands. High nutrient levels in the Island lagoons may be caused by inadequately filtered septic tank effluent, by fertilization of Island parklands, or by bird droppings. Since the Island lagoons are shallow, with limited water circulation, they are particularly susceptible to the buildup of pollutants.

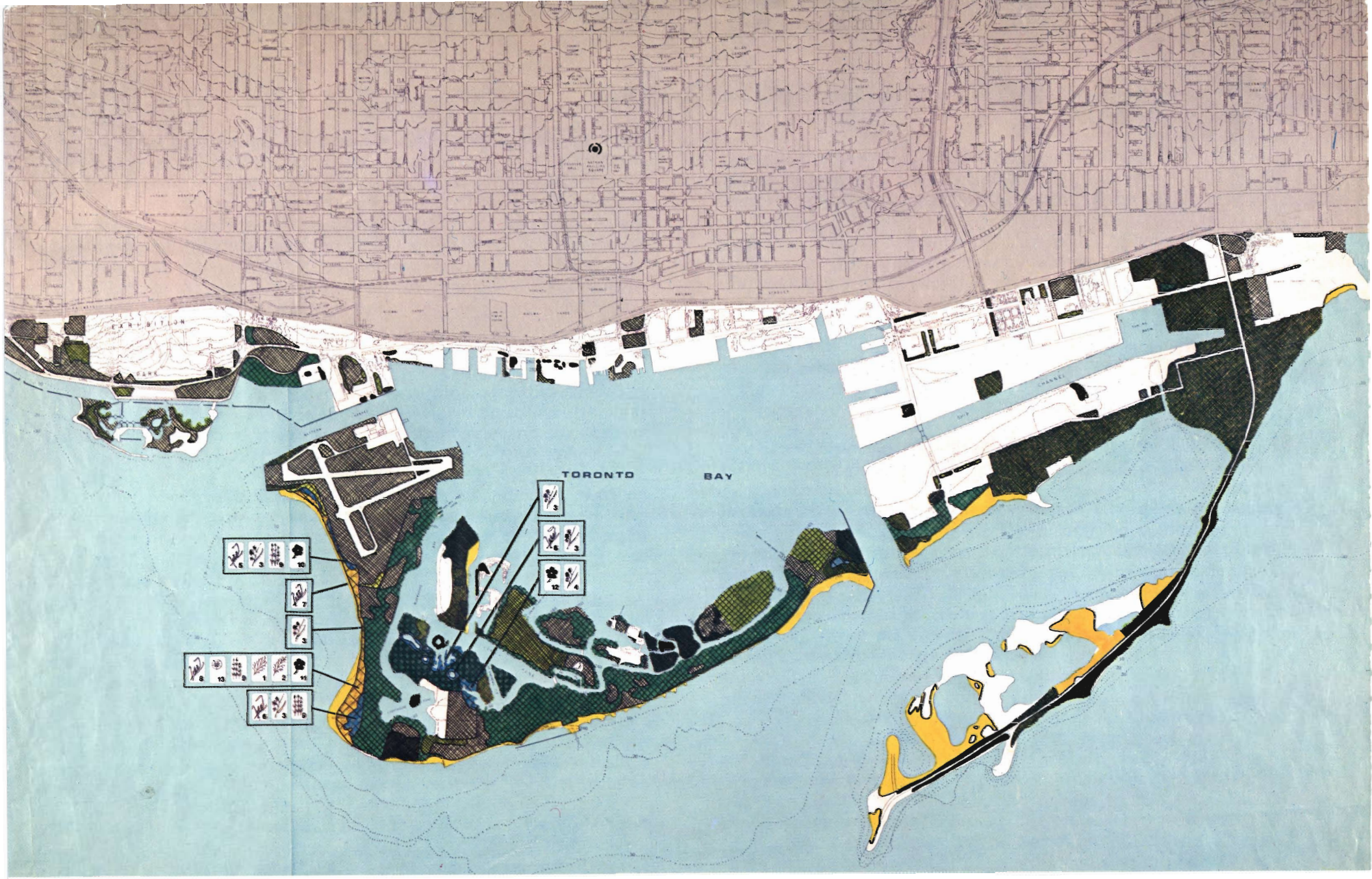
Water is the raison-d'etre of the Central Waterfront. Despite its abundance, its vulnerability needs to be underscored. Wise and judicious management of both the water and adjacent lands is necessary to ensure the avoidance of health hazard due to pollution, continued resource availability for recreation and water-related development activities, and protection of life and property in floodprone areas.

LIFE

The Central Waterfront harbours a remarkable diversity of plant and animal life, including some species which are rare to the whole Southern Ontario region. This diversity is enhanced by the presence of Lake Ontario and its ameliorating effect on climate, by the extensive shorelines of the Toronto Islands and Outer Headland, and by the location of the waterfront within major intercontinental migration routes. "The natural communities of the Toronto Waterfront would make it a significant natural area even if it were not located in Toronto, but these plant and animal communities become even more significant because they are located here, as their sheer availability gives them enormous recreational, aesthetic and educational significance." (Clive Goodwin, "A Commentary on the Natural Values of the Metropolitan Toronto Inner Waterfront," 1975). The extent of habitat diversity and the sites where rare or unusual plant and animal species exist on the Toronto Islands are clearly evident on the two Life resource maps-Life: Vegetation and Life: Wildlife.

Fourteen vegetation types are identified on the Life: Vegetation map, as well as their characteristic structure, moisture requirements, tolerance, and diversity. Structure is a function of the shape and height of the component species and their spacing in relation to each other. This is essentially a function of natural processes, although the current expression is a direct or indirect result of its management by man. Structure ranges from open and low, as in Beach, Dune, and Wet Meadow associations, to dense and tall as the Dense Woodland association. The low, open structure of Beach and Dune associations is a function of the recent colonization of an ever-shifting environment. The tall, layered structure of Dense Woodland is due to the adaption of different species to varying light levels in an environment which is relatively stable. The structure of cultivated vegetation types is the direct result of human activities. Lawn is kept open and low by repeated mowing; parkland is kept open and tall by mowing under the trees and pruning of lower limbs. The natural course of plant succession is arrested in these cultivated environments.

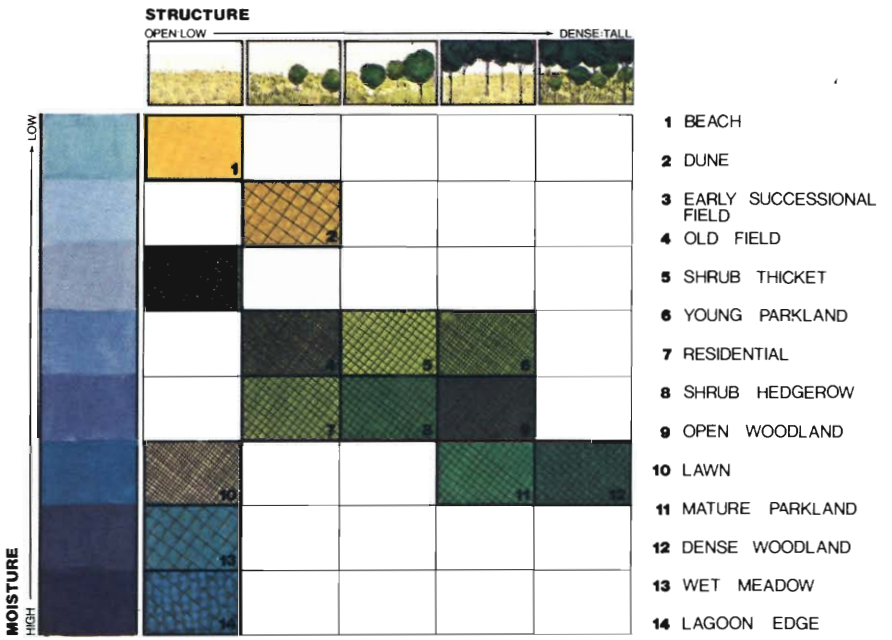
The different plant communities are adapted to different moisture levels. The amount of moisture available to plants ranges from very high in the standing water of wet meadows and lagoon edges to relatively low in the wind-exposed desiccated beach and dune environments. The plant species within each vegetation type are adapted to

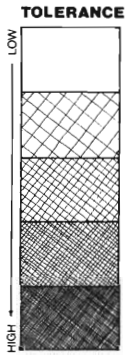


LIFE
VEGETATION

LIFE
VEGETATION

SOURCES: CENTRAL WATERFRONT PLANNING COMMITTEE, INFORMATION BASE, VEGETATION, 1976; POPOV, "A BOTANICAL DESCRIPTION OF TORONTO ISLANDS"; CATLING AND McKAY, "ON THE FLORA OF TORONTO ISLANDS," ONTARIO FIELD BIOLOGIST, 1974.





a particular range of available moisture. Thus, the successful introduction of plant species with a high moisture requirement into an environment which has a lower amount of available moisture requires additional watering. Human actions which change the amount of moisture available to a plant community may result in a gradual shift to a vegetation type better suited to the new conditions.

Vegetation types differ in their ability to tolerate human activities. Plant species of the Beach and Dune associations are highly sensitive to human intrusions, such as trampling, and Wet Meadow and Lagoon Edge species are sensitive to any activities which might cause a reduction of available moisture or degradation in water quality. Early Successional and Old Field associations, on the other hand, are highly tolerant of human activities. They are found on sites recently disturbed by man where other plant species might not survive. These pioneering species prepare the environment for higher, more stable and often less tolerant species to colonize in the future. The cultivated vegetation types—Parkland, Lawn, and Residential—are moderately tolerant of human activities, and require continual maintenance to ensure their survival under intensive use. If a vegetation type is intolerant of human activities, human uses must be restricted in area as well as intensity of use. A highly tolerant vegetation type, on the other hand, may require few restrictions on human use and little or no management.

In a highly diverse vegetation community many different plant species are present. A diverse vegetation type maintains a larger genetic pool for the future, provides greater opportunities for recreation and education, and is generally more adaptable to environmental change. Natural communities exhibit a greater diversity of species than cultivated plant communities, and are therefore more adaptable to change, such as aging or disease.

Plant species unusual to the Toronto region occur in certain areas of the Toronto Islands. These are herbaceous species which occur in the vegetation associations exhibiting the greatest diversity—Beach, Dune, Lagoon Edge and Wet Meadow. Coincidentally, these associations also have the least tolerance to human activities. These species and the places they occur are identified on the Life: Vegetation map.

Wildlife in the Central Waterfront is notable for its abundance and diversity, for the presence of breeding and nesting species, and for

the seasonal presence of migrating birds, bats, and butterflies. The diversity of species resident in the Central Waterfront is remarkable given its location in a large urban center Wildlife species normally associated with more remote areas are present, as well as those commonly associated with urban areas. This is due, to a great extent, to the diversity of natural plant communities on the Toronto Islands. Cultivated Parkland and Residential vegetation types do not offer the opportunities for food and shelter afforded by such natural communities as Woodlands, Old Fields, and Wetlands. Although an extensive and detailed list of fauna has been compiled in the Wildlife Information Base (C W P.C., 1976), a selected list of notable species is used as a reference for establishing the value of available waterfront habitats for wildlife.

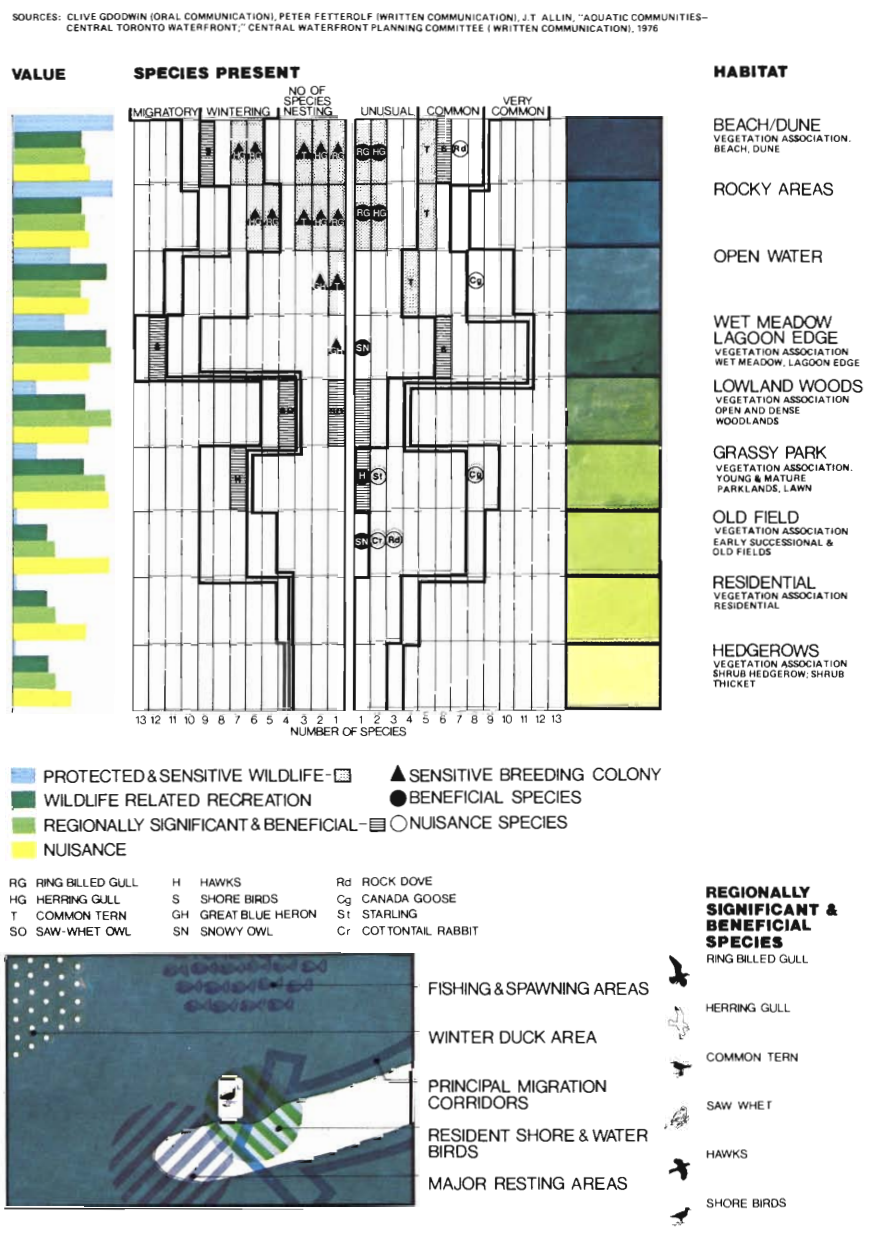
The presence of sensitive breeding colonies of such nesting species as Ring-billed and Herring Gulls and Common Terns is particularly notable. These species have been identified as requiring "protection" in the Toronto region to ensure their continued presence. Breeding colonies are sensitive to human disturbance especially during the nesting season. Sensitive breeding colonies occur in those vegetation types which are least tolerant to human use: Beach and Dune, Wet Meadow, and Lagoon Edge.

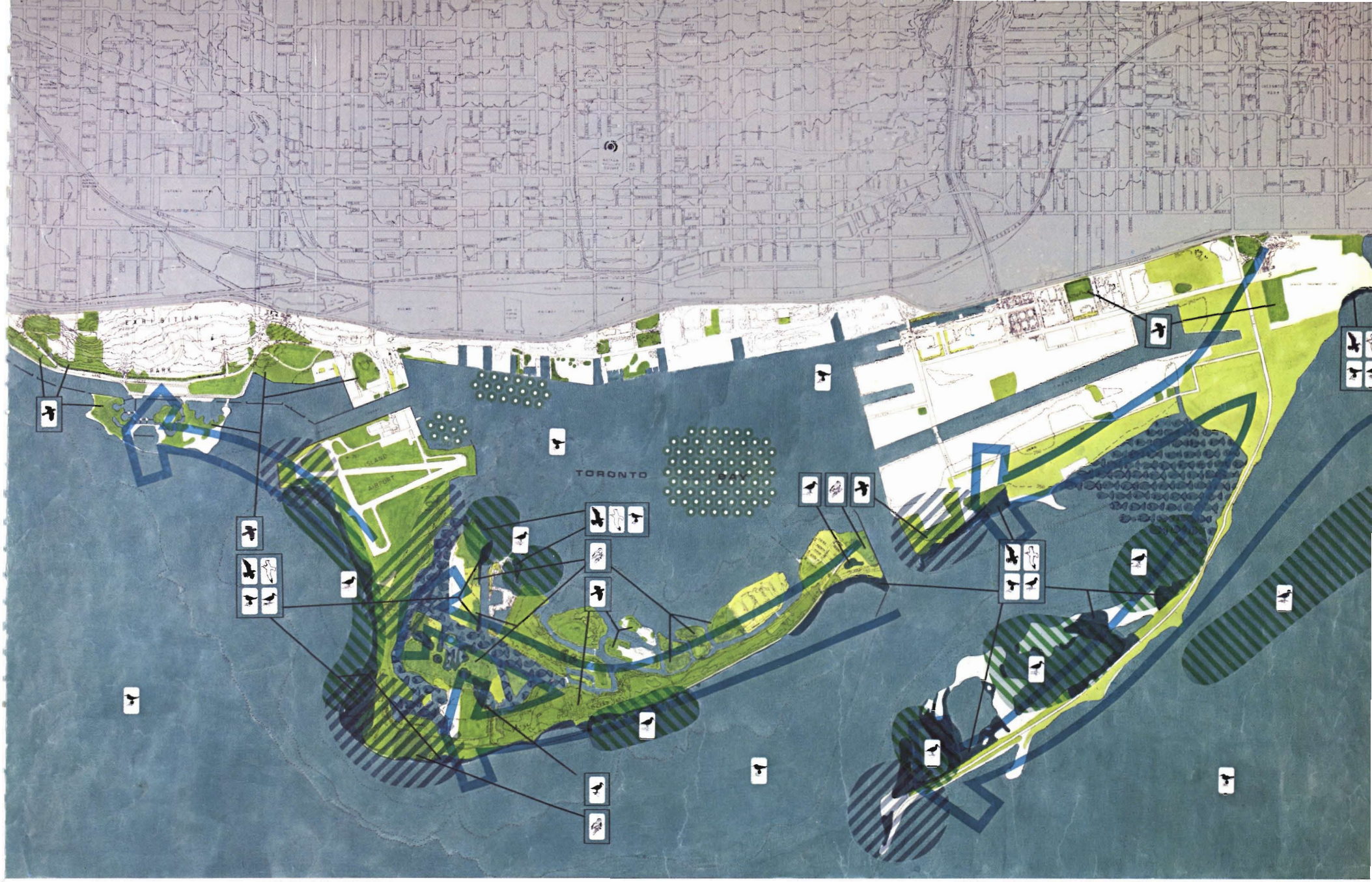
Certain species are present, either seasonally or year round, in unusually large numbers or regionally significant concentrations. These species include the Saw-whet Owl and a number of unusual hawk species, as well as Monarch Butterflies and common shorebirds The preferred habitats of these species include Lowland Woodland, Grassy Park, Beach/Dune, and Wet Meadow/Lagoon Edge.

Certain wildlife species ensure ecological balance through their role as scavengers and predators. Ring-billed and Herring Gulls, the Great Blue Heron, and Common Tern are among these "beneficial" species. The Saw-whet and Snowy Owls control rodent pest populations through predation. Certain other wildlife species, such as Canada Geese and Starlings, are perceived as a nuisance, due to their large numbers, due to the damage they cause to structures or garden crops, or due to the potential hazard which they represent for disease communication.

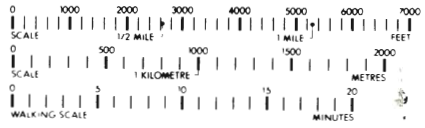
Nine wildlife habitats are identified on the Life: Wildlife map. Seven are associated with vegetation types: Beach/Dune, Wet Meadow/

LIFE
WILDLIFE





LIFE
WILDLIFE



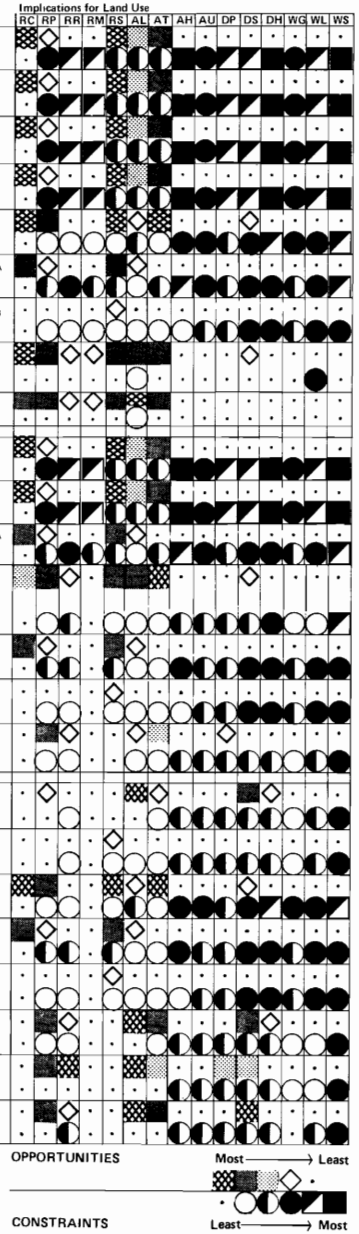
Selected List of Notable Wildlife Species

FREQUENCY OF OCCURRENCE			SPECIES	VALUE						HABITAT
Nesting	Wintering	Migrating		Requires Protection	Sensitive Breeding Colony	Regionally Significant Concentration	Ecologically Beneficial	Nuisance		
			UNUSUAL							
●	●		Ring Billed Gull	●	●		●			Rocky Areas, Beach, Dune
●	●		Herring Gull	●	●		●			Rocky Areas, Beach, Dune
●			Great Blue Heron		●					Open Water, Beach, Dune, Wet Meadow, Lagoon Edge
●		●	Black Crowned Night Heron							Wet Meadow, Lagoon Edge, Woodlands
●			Blue Winged Teal							Open Water
●			Least Bittern							Wet Meadow, Lagoon Edge
●			Gadwall Duck							Open Water, Wet Meadow, Lagoon Edge
●		●	Saw-whet Owl			●	●			Woodlands
	●		Snowy Owl				●			Wet Meadow, Lagoon Edge, Old Field
			COMMON							
●			Common Tern	●	●					Open Water, Rocky Areas, Beach, Dune
		●	Caspian Tern							Open Water, Rocky Areas, Beach, Dune
	●		Common Goldeneye							Rocky Areas, Beach, Dune
	●		Bufflehead							Open Water
●	●		Mallard							Open Water
		●	Shorebirds			●				Beach, Dune, Wet Meadow, Lagoon Edge
●			Swamp Sparrow							Wet Meadow, Lagoon Edge
●			Yellow Warbler							Wet Meadow, Lagoon Edge
●			Yellow Throat							Wet Meadow, Lagoon Edge
●			Redwinged Blackbird							Wet Meadow, Lagoon Edge
	●	●	Winter Finches							Woodlands, Old Field
		●	Snow Bunting							Old Field
		●	Blue Jays							Woodlands, Old Field, Residential
	●	●	Sparrows							Woodlands, Grassy Park
		●	Warblers							Woodlands, Grassy Park
		●	Hawks				●			Woodlands, Grassy Park
●			Grackle							Woodlands, Old Field, Grassy Park, Residential
●			Robin							Woodlands, Hedgerow
●			Downy Woodpecker							Hedgerow, Grassy Park
●			Rock Dove					●		Beach, Dune, Old Field
●			Starling					●		Grassy Park, Residential
●			Cotton Tail Rabbit					●		Old Field
●			Gray Squirrel							Woodlands, Grassy Park
●			Muskrat							Wet Meadow, Lagoon Edge
		●	Bats							Woodlands
		●	Monarch Butterfly							Woodlands
			VERY COMMON							
	●		Old Squaw							Open Water
	●		Greater Scaup							Open Water
●			Canada Geese					●		Open Water, Grassy Park
●			Ringnecked Pheasant							Hedgerow, Old Field
●			House Sparrow							Woodlands, Grassy Park, Residential
●			Melanistic Garter Snake							Rocky Areas

DATA INTERPRETATION: LIFE RESOURCE

Region/ Feature	Social Value	Social Objectives Reference	Performance Required	Perf. Ref.
Veg./Beach (Island West)	Presence of unusual plant species 3,7	PE1 PE7	Ensure survival	E-ID
Veg./Dune	Presence of unusual plant species 1,2,8,11,13	PE1, PE7	Ensure survival	E-ID
Wildlife/ Beach/	Presence of protected wildlife species RG, HG, T	SE2,PE1,PE3,PE4, PE7, DE2, DE3	Ensure protection of habitat	E-IA
	Presence of sensitive breeding colonies of wildlife species RG, HG, T, GH	SE2,PE1,PE3,PE4, PE7, DE2, DE3	Ensure survival	E-IB
	Significant regional concentration of wildlife species S	SE2,PE1,PE3,PE4, PE7,DE2,DE3,DE4	Ensure maintenance of wildlife/recreation value	E-IC
	Presence of ecological beneficial spp RG, HG	SE2,PE3,PE4,PE7, DE2,DE3	Regulate use and manage to protect habitat	E-IIIA
	Presence of nuisance spp Rd	SE1	Regulate human use and manage to curb nuisance	E-IIIB
Veg./Dune	Recreation value due to highly diverse, open/low tolerance vegetation	DT6,DT9	Regulate use and manage to ensure survival	E-IIA
Veg./Beach	Limited recreation value due open/low, low tolerance veg	DT6,DT9*	Regulate use and manage to ensure survival	E-IIA
Wildlife/ Rocky Areas	Presence of protected wildlife spp RG,HG,T	SE2,PE1,PE3,PE4, PE7,DE2,DE3	Ensure protection of habitat	E-IA
	Presence of sensitive breeding colonies of wildlife spp. RG, HG,T	SE2,PE1,PE3,PE4, PE7,DL2,DL3	Ensure survival	E-IB
	Presence of ecological beneficial spp. RG,HG	SE2,PE3,PE4,PE7, DE2,DE3	Regulate use and manage to protect habitat	E-IIIA
Veg./ Early Successional, Field, Old Field	Recreation value due to moderately diverse, open/low, highly tolerant vegetation	DT6,DT9*	Regulate use and manage to maintain value	E-IIB
Wildlife/ Old Field	Presence of ecologically beneficial spp. SN	SE2,PE3,PE7* DE2,DE3	Regulate use and manage to protect habitat	E-IIIA
	Presence of nuisance spp Rd, Cr	SE1	Regulate human use and manage to curb nuisance	E-IIIB
Veg./Wildlife/ Shrub Thicket, Shrub Hedgerow	Moderate recreation value due to partially closed, tolerant veg	DT6, DT9	Regulate use and manage to maintain value	E-IIB
Veg. & Wildlife/ Residential	Moderate recreation value due to canopied, tolerant veg	PE2, DT6	Manage to maintain value	E-IID
	Presence of nuisance spp St	SE1	Manage to curb nuisance	E-IIIB
Wildlife/ Grassy Park	Significant regional concentration of wildlife spp. H	SE2,PE1,PE3,PE7* DE2,DE3,DE4	Ensure maintenance of wildlife/recreation value	E-IC
	Presence of ecologically beneficial spp. H	SE2,PE3,PE7*,DE2, DE3	Regulate use and manage to protect habitat	E-IIIA
	Presence of nuisance spp St, Cg	SE1	Regulate human use and manage to curb nuisance	E-IIIB
Veg./Young Parkland	Moderate recreation value due to canopied, tolerant veg	PE2,DT6,DT9	Manage to maintain value	E-IID
Veg./Lawn	Moderate recreation value due to open, tolerant veg	DT6,DT9*	Regulate use to maintain value	E-IID
Veg./Mature Parkland	Moderate recreation value due to canopied, low tolerance veg	PE2,DT6,DT9	Manage to maintain value	E-IID

*Applies only to selected areas



DATA INTERPRETATION: LIFE RESOURCE (Continued)

Region/ Feature	Social Value	Social Objectives Reference	Performance Required	Perf. Ref.	Implications for Land Use RC	RP	RR	RM	RS	AL	AT	AH	AU	DP	DS	DH	WG	WL	WS
Wildlife/ Lowland Woods	Significant regional concentration of wildlife spp SO	SE2,PE1,PE3,PE7 DE2,DE3,DE4	Ensure maintenance of wildlife/recreation value	E-IC	◪	■	·	·	◪	◇	◪	·	·	·	◇	·	·	·	·
					·	○	○	·	○	◑	○	●	●	●	●	◢	●	●	◢
	Presence of ecologically beneficial spp. SO	SE2,PE3,PE7 DE2 DE3	Regulate use and manage to protect habitat	E-IIIA	■	◇	·	·	■	◇	·	·	·	·	·	·	·	·	·
					·	◑	◑	·	◑	○	○	●	●	◑	●	●	◑	●	●
Veg./Open Woodland	High recreation value due to canopied, highly tolerant veg	PE2,DT6,DT9	Manage to maintain value	E-IIC	◇	◪	▨	·	◇	■	◪	·	·	·	◪	▨	·	·	·
					·	◢	◑	·	·	·	·	●	●	●	●	◢	○	○	◢
Veg./Dense Woodland	High recreation value due to diverse dense/tall, tolerant veg	PE2,DT6,DT9	Regulate use and manage to maintain value	E-IIC	◪	◪	▨	·	◪	■	◪	·	·	·	▨	▨	·	·	·
					·	●	○	·	○	○	●	◢	●	◢	■	■	●	●	■
Veg. & Wildlife/ Wet Meadow Lagoon Edge	Presence of sensitive breeding colonies of wildlife spp GH	SE2,PE1,PE3,PE7, DE2,DE3	Ensure survival	E-IB	◪	◇	·	·	◪	▨	■	·	·	·	·	·	·	·	·
					·	●	◢	◢	◑	◑	■	●	●	◢	■	■	●	◢	■
	Significant regional concentration of wildlife spp S	SE2,PE1,PE3,PE7, DE2,DE3,DE4	Ensure maintenance of wildlife/recreation value	E-IC	◪	■	·	·	◪	◇	◪	·	·	·	◇	·	·	·	·
					·	○	○	·	○	◑	○	●	●	●	●	◢	●	●	◢
	Presence of ecologically beneficial spp SN	SE2,PE3,PE7,DE2 DE3,DE4	Regulate use and manage to protect habitat	E-IIIA	■	◇	·	·	■	◇	·	·	·	·	·	·	·	·	·
					·	●	●	●	◑	○	●	◢	◑	●	●	●	◑	●	◢
	Very high rec. value due to abundant wildlife, diverse, open, low tolerance veg	DT6,DT9	Regulate use and manage to maintain value	E-IIA	◪	■	·	·	◪	■	◪	·	·	·	◇	·	·	·	·
					·	●	◢	◢	◑	◑	◑	◢	◢	◢	■	■	◢	◢	■
Veg./Wet Meadow (Island Airport)	Presence of unusual plant species 3,5,9,10	PE1,PE7	Ensure survival	E-ID	◪	◇	·	·	◪	▨	■	·	·	·	·	·	·	·	·
					·	●	◢	◢	◑	◑	■	◢	◢	◢	■	■	◢	◢	■
Veg./Wet Meadow (Gibralter Point)	Presence of unusual plant species 3,6,9	PE1,PE7	(Same as above)	E-ID	◪	◇	·	·	◪	▨	■	·	·	·	·	·	·	·	·
					·	●	◢	◢	◑	◑	■	◢	◢	◢	■	■	◢	◢	■
Veg./Lagoon Edge (Long Pond)	Presence of unusual plant species 3	PE1,PE7	(Same as above)	E-ID	◪	◇	·	·	◪	▨	■	·	·	·	·	·	·	·	·
					·	●	◢	◢	○	○	■	◢	◢	◢	■	■	◢	◢	■
Veg./Lagoon Edge (Round Pond)	Presence of unusual plant species 3,6	PE1,PE7	(Same as above)	E-ID	◪	◇	·	·	◪	▨	■	·	·	·	·	·	·	·	·
					·	●	◢	◢	○	○	■	◢	◢	◢	■	■	◢	◢	■
Veg./Lagoon Edge (St Andrews Cut)	Presence of unusual plant species 4,12	PE1,PE7	(Same as above)	E-ID	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
					·	·	·	·	·	·	·	·	·	·	·	·	·	·	·
Wildlife/Open Water	Presence of protected wildlife spp 1	SE2,PE1,PE3,PE7*, DE2,DE3	Ensure protection of habitat	E-IA	◪	◇	·	·	◪	·	·	·	·	·	·	·	·	·	·
					·	○	·	◑	◑	·	·	◑	·	·	·	·	·	●	●
	Presence of sensitive breeding colonies of wildlife spp. 1,GH	SE2,PE1,PE3,PE7*, DE2,DE3	Ensure survival	E-IB	◪	◇	·	·	◪	·	·	·	·	·	·	·	·	·	·
					·	○	·	◑	◑	·	·	◑	·	·	·	·	·	●	●
	High recreation value due to abundant wildlife	DT6,DT9	Regulate use and manage to maintain value	E-IF	■	◇	·	▨	■	·	·	■	·	·	·	·	·	·	·
					·	·	·	◑	◑	·	·	○	·	·	·	·	·	●	●
	Presence of nuisance spp Cg	SE1	Manage to curb nuisance	E-IIIB	·	·	·	·	◇	·	·	·	·	·	·	·	·	·	·
					·	·	·	◑	◑	·	·	·	·	·	·	·	·	●	●
Wildlife/Principal Migration Corridors	Valuable for continued presence of wildlife	SE2,PE1,PE3,PE4*, PE5,PE7*,DE2,DE3	Regulate use and manage to maintain value	E-IE	◇	◇	·	·	■	·	◇	·	·	·	·	·	·	·	·
					·	·	·	·	·	·	·	◑	·	·	○	●	■	◑	◑
Wildlife/Major Resting Areas	Valuable for continued presence of wildlife	SE2,PE1,PE3,PE4*, PE5,PE7*,DE2,DE3	Regulate use and manage to maintain value	E-IE	◪	■	·	·	◪	◇	■	◇	·	·	·	·	·	·	·
					·	◑	●	●	·	◑	◑	·	◑	●	●	◢	●	●	●
Wildlife/Fishing and Spawning	High recreation value	PH2,PE6,DE3	Regulate use to maintain value	E-IF	◇	■	·	▨	◇	■	·	◇	·	·	·	·	·	◢	·
					·	·	·	◑	·	○	·	◑	◑	·	·	·	·	■	·
	Valuable for continued presence of wildlife (fish)	SE2,PH2,PE6,PE7, DE2,DE3	Regulate use and manage to protect habitat	E-IF	◪	◇	·	■	◪	◪	·	·	·	·	·	·	·	◢	·
					·	●	·	●	○	○	·	◢	◢	·	·	·	·	■	·
Wildlife/Winter Duck Areas	Limited recreation value	DE2,DE3,DT6	Regulate use to maintain value	E-IF	◇	◇	·	▨	◇	·	·	◇	·	·	·	·	·	·	·
					·	·	·	◑	·	·	·	◑	◑	·	·	·	·	●	◢

*Applies only to selected areas

OPPORTUNITIES Most ⟶ Least

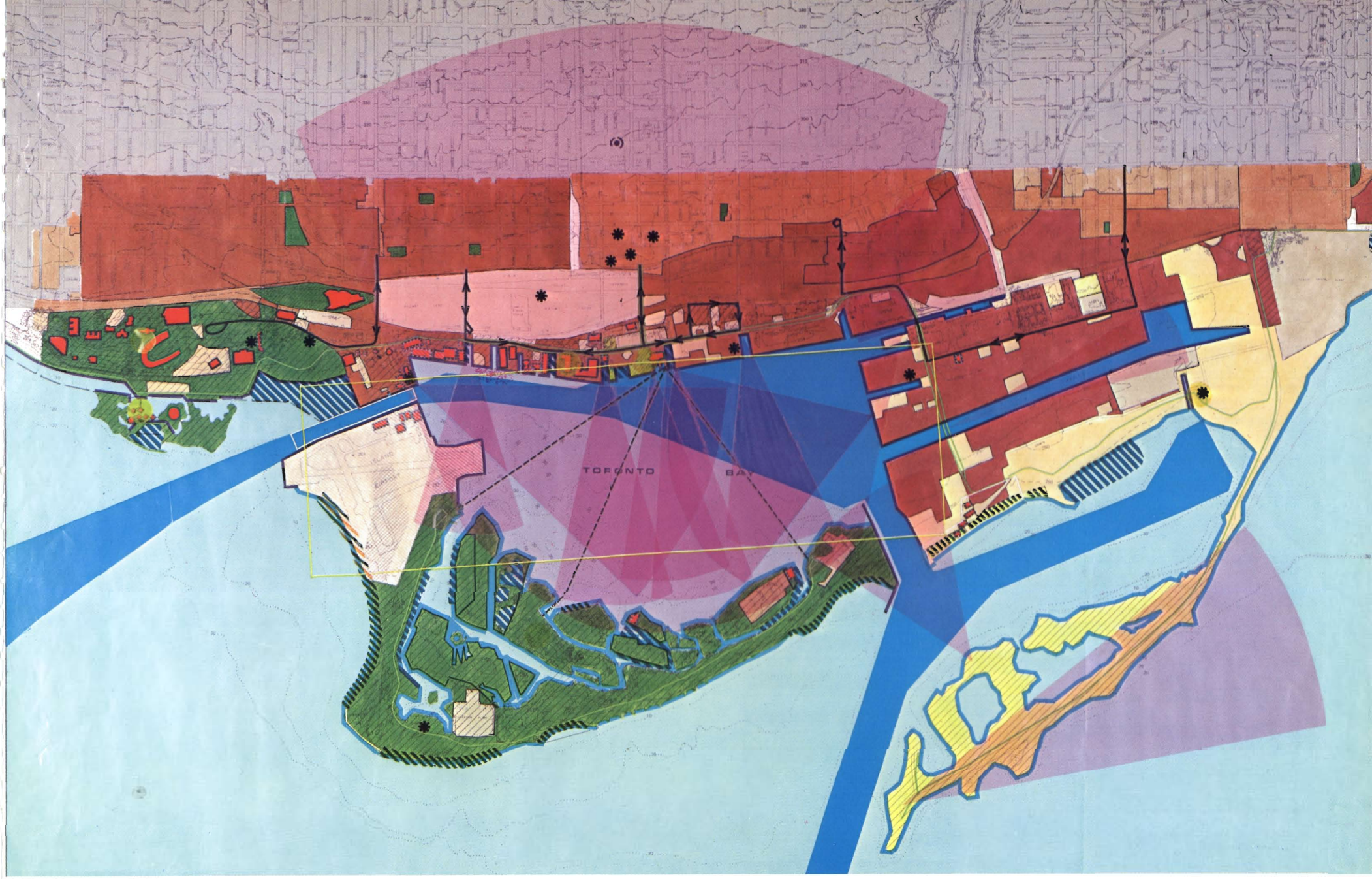
CONSTRAINTS Least ⟶ Most

Lagoon Edge, Lowland Woods, Grassy Park, Old Field, Residential, and Hedgerow; two are unvegetated: Rocky Areas and Open Water. The characteristics of species resident within these habitats are shown on the Life: Wildlife legend, including the occurrence of "protected" species, sensitive breeding colonies, significant regional concentrations of certain species, "beneficial," and "nuisance" species. The relative number of species within each habitat is also illustrated, as well as their frequency of occurrence in terms of whether they nest or winter within the habitat, or use it during a migration period. It should be noted that species identification on the Life: Wildlife map is heavily oriented towards birds, since there is presently more information available on avian species.

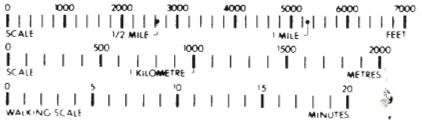
Some areas within the Central Waterfront are important for migrating wildlife, who use the waterfront as a movement corridor and resting area. Migrating birds, bats, and butterflies fly east-west along the shoreline or across Lake Ontario. Areas at the ends of peninsulas or on offshore islands serve as resting and feeding places. Generalized migration corridors and observed resting spots are identified on the Life: Wildlife map. Large concentrations of migrating wildlife may be seen in these areas every year.

Localized areas of open water are significant fish and spawning areas. Although fish occur throughout the Central Waterfront, the sheltered Island Lagoons and the area affected by the thermal plume of the Hearn outfall are productive spawning areas. Maintenance of water quality and minimization of disturbance from sedimentation or disruption of adjacent shorelines is essential to ensure continued use of these areas for spawning.

The vegetation and wildlife communities of the Central Waterfront are a unique resource valuable to the citizens of Toronto for recreation. Additionally, these are of wide regional and sometimes national significance. Future action must ensure that while the citizens of Toronto utilize fully the recreational potential of these resources, the survival of this complex array of vegetative and animal life forms is sustained. Regulated use and responsible management policies need to be followed. These are outlined in Resource Interpretation and described in detail in Performance Requirements for Future Actions.


TORONTO

LOCATION


0 1000 2000 3000 4000 5000 6000 7000
SCALE 1/2 MILE 1 MILE FEET
0 500 1000 1500 2000
SCALE 1 KILOMETRE METRES
0 5 10 15 20
WALKING SCALE MINUTES

LOCATION

Features of the Central Waterfront's natural environment identified in sections on Air, Land, Water, and Life are a result of natural processes in which man plays a critical, but minor, role, Each of these natural features has been assigned a specific social value. Selective natural features acquire an additional and different value when man uses them for a specific purpose in a particular location. The Location map illustrates both natural and cultural features in specific locations which have been assigned a value because of their present use by man (e.g., beaches, boating areas, parkland). The map also illustrates ownership of land (public or private), the organization of man's use of land (e.g., residential, commercial), and man-made artifacts which have been assigned a social value (e.g., landmarks, historic structures).

These locationally specific resources are ascribed values which often override those values assigned to their component natural features. Although it is not the purpose of this study to resolve competing or conflicting social objectives pertaining to Location resources, they need to be included in a comprehensive inventory of environmental resources.

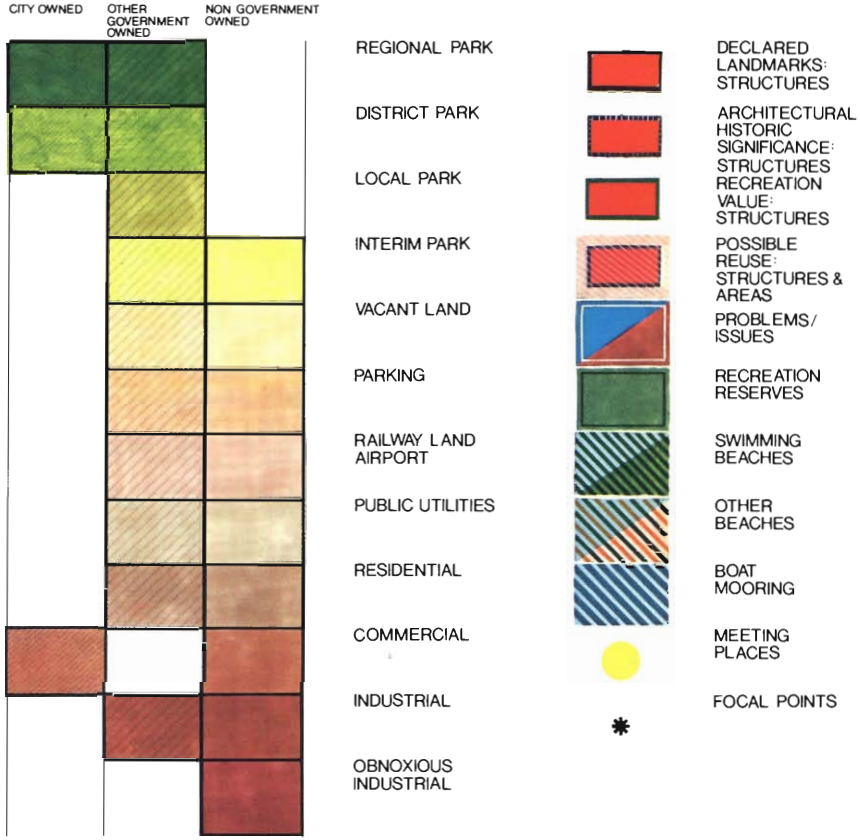
Unlike the features of the natural environment, the Location resources are not derived from the C.W.P.C. Information Base. They are resources identified in publications of the City of Toronto, the C.W P.C., regional agencies, and provincial government. A list of features was compiled from these references, and the features were mapped by C.W.T.C. staff.

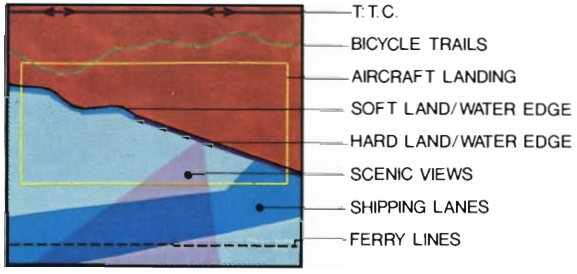
The features displayed on the Location map identify all land and waters within the Central Waterfront in terms of their availability for change of their present use. The hatched areas denote public ownership, either by the City or by other levels of government. Government-owned lands mainly coincide with parklands, and are important as a public resource. Any alteration of the present use in these publicly-owned lands is easily regulated. Absence of texture indicates private ownership, where regulation of use to ensure public welfare is less easily achieved.

In addition to ownership, it is important to identify the extent to which land areas are currently committed to specific land uses which

LOCATION

SOURCE: CENTRAL WATERFRONT PLANNING COMMITTEE, 1976





DATA INTERPRETATION: LOCATIONAL RESOURCE

Region/ Feature	Social Value	Social Objectives Reference	Performance Required
Land Regional, District and Local	Designated exclusively for recreation purposes	PA2,PL2,PE7*, DH7*	Exclude incompatible use
Land Interim Park	Valuable for recreation	DH2,DT6	Maintain amenity value by retaining current use
Land: Vacant Land	Valuable for development	PA2,DL2	Ensure productive resource utilization
Land Parking Airport, Railway Yards	Potentially available for development	PA2,PL1,PT5*	None
Land: Public Utilities	Valuable public service	PA2,DH1	Regulate incompatible use
Land Residential Areas	Committed use	PA2,PL3,DT13	Regulate incompatible use
Land Commercial Areas	Committed use	PA2,DT13,DT14	Regulate incompatible use
Land Industrial and Obnoxious Industrial Areas	Committed use	PA2,PL4,DA3,DT12	Regulate incompatible use
Land: City and Other Government Owned Lands	Potentially available for public facilities development	PL2*	Ensure productive resource utilization
Water General Region	Valuable unique resource	SH5,PT1,PT4,DE6*	Ensure productive resource utilization
Water Shipping Lanes	Valuable for commercial industrial use		Ensure productive resource utilization
		SH5,PH6	Maintain resource value
Land/Water Soft Edge	Valuable for recreation	ST1,ST2,PT2,DH2	Ensure productive use
Land/Water Hard Edge	Valuable for recreation and commercial use	DH2	Ensure productive use
	Potential hazard	ST1,ST2	Regulate human use and maintain in good repair
Structures. Declared Landmarks	Unique cultural resource	PL1*,DT1*	Ensure protection of resource value
Structures Architectural/ Historic Significance	Same as listed under Declared Landmarks		
Structures Recreation Value	Valuable for recreation	DH2	Regulate incompatible use
Structures and Areas. Possible Reuse	Potentially valuable for development	DL1	Ensure productive use
Areas. Problems/ Issues	Specific values and required performance for each designated area		

Implications for Land Use
RC RP RR RM RS AL AT AH AU DP DS DH WG WL WS

*Applies only to selected areas

OPPORTUNITIES Most → Least

CONSTRAINTS Least → Most

DATA INTERPRETATION: LOCATIONAL RESOURCE (Continued)

Region/ Feature	Social Value	Social Objectives Reference	Performance Required
Areas Recreation Reserves	Designated exclusively for specified recreation	PE1*,DH2,PE3*	Exclude incompatible use
Areas Swimming Beaches	Unique resource of high value for recreation	SE1,SE2,PT1,DH2	Exclude incompatible use
		SE1,SE2,PT1,DH2	Maintain resource value
Areas Other Beaches	Unique resource valuable for recreation	SE1,SE2,PT2,DH2	Same as those listed for Swimming Beaches
	Potential health hazard	SE2,PT1	Regulate human use and improve quality
Areas Boat Moorings	Unique resource of high value for recreation	PH3,DH2	Maintain resource value
Areas Scenic Views	Unique resource of high value for recreation	DH2,DL1,DT1	Regulate use to ensure pleasant vistas
Areas: Aircraft Landing	Noise nuisance and potential hazard	SL1	Regulate use to minimize hazard
Elements TTC Bicycle Trails and Ferry Lines	Valuable public services	PT1,DL2,DL3*	Regulate incompatible use
Elements: Meeting Places and Focal Points	Unique cultural resource	PL1*	Regulate use to maintain resource value

Implications for Land Use
RC RP RR RM RS AL AT AH AU DP DS DH WG WL WS

*Applies only to selected areas

OPPORTUNITIES Most → Least

CONSTRAINTS Least → Most

are in conformity with existing zoning. Vacant land and other areas of interim or low intensity use (pale yellow) are subject to change. Future uses in these areas need to be regulated to ensure that all social objectives are met. Most industries (brown) are located in the Bayfront and Port area, and parkland (green) occurs on the Eastern Headland, the Toronto Islands, and in Exhibition Place and Ontario Place. Since documented social objectives favour the retention of both industrial and recreational activities, planning for the Central Waterfront will have to accommodate both in such a way that the resource value of and for neither is diminished.

Certain waterfront recreation areas which are used and valued by citizens of Metropolitan Toronto represent a unique and valuable resource. These are mapped as Beaches, Boat Moorings, Recreation Reserves, Meeting Places, and Bicycle Trails. Most of these are located in parkland, the Bicycle Trails pass through industrial and commercial areas as well. To ensure continued availability of these features for their valued recreation use, regulation of these and adjacent uses is necessary. Regulations are also necessary for several types of structures which have been singled out because of their cultural, recreational, or potential development value. These are mapped as Declared Landmarks, Structures of Architectural or Historical Value, Structures of Recreational Value, and Structures for Possible Reuse.

Toronto is endowed with a remarkable scenic resource. Major streets from Downtown end at Bayfront slips with vistas of the Bay and Islands beyond. In reverse, the downtown skyline, perceived across the Bay from the Islands, provides Toronto with a special sense of identity Protection of this valuable resource is of paramount importance. The major scenic views are identified in purple on the Location map, regulation of all uses within these must be ensured. The Focal Points within the views are highlighted; their environs should be assigned the greatest attention.

Several transportation systems serve the waterfront. The T.T.C. links the Central Waterfront to Central Toronto and the region, and ferry lines connect the Toronto Islands to the mainland. The Ship Channel is a dredged and maintained waterway which serves Central Waterfront industries. A small airport on the Islands is used by commercial and recreation aircraft. The aircraft landing pattern is identified. Land uses and building heights within this area need to be regulated to ensure public safety and minimize discomfort due to associated high noise levels. Appropriate health and safety regulations need to be considered for other transportation networks.

Currently defined "problem" areas are highlighted in white on the Location map. These relate to issues which are specifically identified in social objective statements as requiring immediate attention Resolution of these issues as well as detailed explication of other implied performance requirements pertaining to Location resources must await formulation of an Official Plan for the Central Waterfront. The relationship of the Location features to social objectives, the consequent performance requirements, and opportunities and constraints for future uses are identified in a format consistent with Air, Land, Water, and Life resources.

INTERPRETATION

RESOURCE INTERPRETATION

INTRODUCTION

The reorganization of available data into five resource categories in the preceding step has established a reference to which all data assembled in the future may be related. The format developed for relating explicit social objectives to available environmental resources, with resultant performance requirements and implications for land use, provides a comprehensive framework. The utility of this framework is that it permits the formulation of requirements for immediate action, but may also be easily amended in the future to accommodate additional data or changes in social objectives.

As new information becomes available, or as existing information is refined, it can be integrated into the framework. New or refined information may better define the role played by a specific environmental feature or it may entail redefinition of a resource category. In either case, the change may be accommodated, and the Data Interpretation Charts will identify the necessary alterations to the performance requirements. Performance requirements may also be revised in response to changing social objectives without undermining the basic framework.

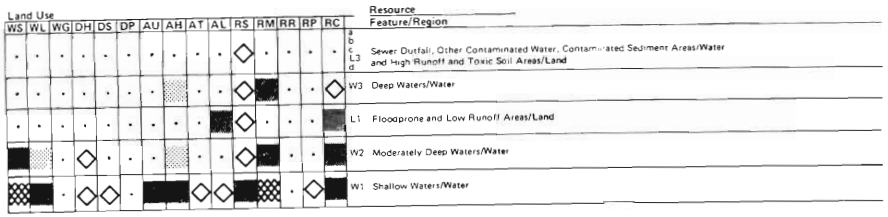
The following examples illustrate how additional data or revised performance requirements may be integrated into the framework presented in this study At present, available data on water contamination is limited to a few sampling stations, and the hydrodynamics governing current movements are unknown. Thus areas of contaminated water are mapped in small, isolated pockets. If future studies reveal that other water areas are directly affected by adjacent contaminated waters because of identifiable current movements, then the affected areas should be mapped. The social objectives and performance requirements relating to areas of contaminated water may then be extended to include the newly identified areas. In another instance, if the current M.O.E. standards for water quality are revised, the available information must be reexamined and reclassified to conform with the new standards. A larger or smaller area of water may therefore be classified as contaminated, with no additional measurements of water quality or water movement.

Future courses of action necessary to achieve current social objec-

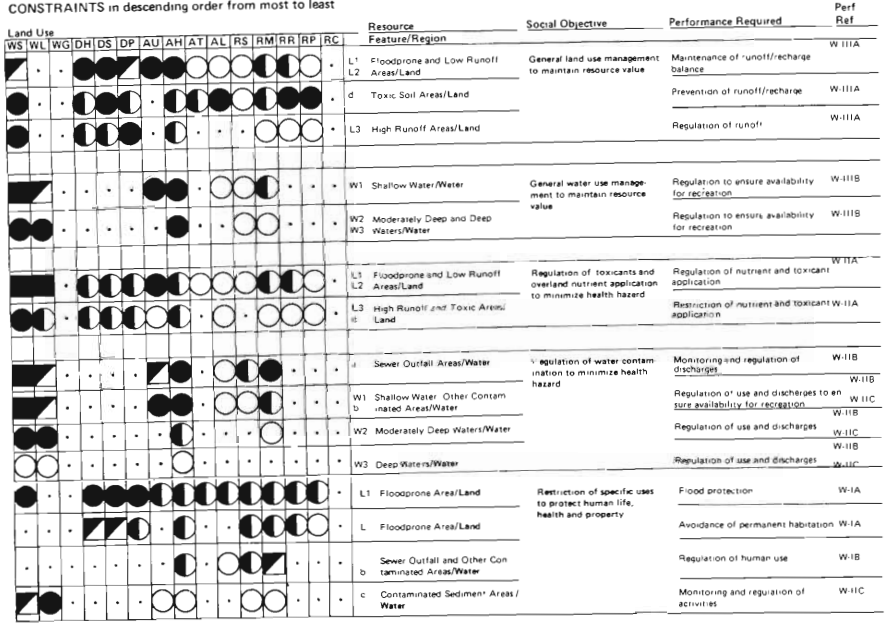
Resource Interpretation: Key to Charts

Region/Feature	is an identifiable element of homogeneous environmental characteristics. Features are mapped within the resource categories of Air, Land, Water, Life, and Location.
Social Objective	identifies the general regulation required to maintain specific social values.
Performance Required	outlines the performance required of all future actions to sustain the social value of a specific feature.
Perf. Ref	identifies by code the performance requirements described in Performance Requirements for Future Action.
Land Use	identifies the "Opportunities and Constraints" represented by each resource feature for prospective uses.

RESOURCE INTERPRETATION: WATER
OPPORTUNITIES in ascending order from least to most



RESOURCE INTERPRETATION: WATER
CONSTRAINTS in descending order from most to least



Opportunity results when the social value of the resource feature is a

- Critical factor in determining the location of a particular land use
- Highly desirable factor in determining the location of a particular land use
- Desirable factor in determining the location of a particular land use
- ◇ Desirable factor in satisfying the needs of a specific land use
- • Factor of no concern

Constraint results from the amount of effort involved in meeting the performance requirements necessary to sustain the social value of the resource feature. The resultant cost may imply.

- ■ Probable prohibition of a particular land use
- ◪ Permission of a particular land use only as a special variance due to exceptional social reasons, nevertheless severely restricted
- ● Severe restriction of a particular land use due to stringent development controls
- ◐ Moderate restriction of a particular land use due to development guidelines
- ○ Modification of a particular land use in response to recommended design or management strategies
- • Unrestricted use

Prospective uses are defined as discrete use categories. A future Land Use will be a combination of more than one of the following uses:

Recreation

RC Conservation with limited recreation. Human use needs to be regulated and restricted to well-defined areas. Maintenance of the environment in its present state is implied.

RP General low intensity recreation, including hiking, picnicking Moderate modification of the environment to accommodate human activities is implied.

RR Intensive recreation for specific organized activities on land, including playfields and exhibition plazas. Extensive modification of the environment is implied.

RM Intensive recreation for specific water-related activities, including boating and swimming. Extensive modification of the environment may be necessary.

RS Special recreation for specific reasons, including outlooks for scenic views and interpretation areas for educational recreation.

Amenity

AL Landscaping, including the establishment of new planting and modification of existing vegetation.

AT Minor roads and trails to accommodate limited traffic.

AH Major roads and transit systems, including highways and ferries, to accommodate high intensity traffic.

AU Utilities, including sewer, gas, electricity, telephone, and water lines.

Development

DP Extensive paving, generally associated with parking.

DS Small, low residential, commercial, or institutional structures.

DH Heavy, mid- or high-rise residential, commercial, institutional, or industrial structures.

Waste Disposal

WG Gaseous, particulate, odourous, or noise emissions to the air.

WL Discharge of waste materials to water.

WS Disposal of solid wastes, including dredge and fill.

tives are identified on the Data Interpretation Charts. In the Resource Interpretation Charts this information is reorganized in a format which facilitates its use for planning. All resource features which represent opportunities for future uses are listed in ascending order. The resource feature appearing at the top of the Resource Interpretation Opportunities Chart offers few opportunities for future uses, the feature at the bottom provides the most opportunity for the greatest number of prospective uses. If a feature does not appear on the chart, it offers no opportunities for any use. An examination of the chart for Resource Interpretation Water reveals that shallow water offers the most opportunity, while contaminated water is essentially devoid of opportunity, except for uses related to the study of pollution

All constraining features are aggregated in a similar fashion. Since constraints result from the need for meeting performance requirements related to discrete social objectives, features pertaining to the same social objective are grouped together. Within each category the feature listed at the top represents pronounced constraints to the greatest number of prospective uses. The same feature may appear within more than one category, if it is related to more than one social objective.

Although characteristics of a particular resource feature may impose constraints upon its use, these same characteristics may also offer opportunities. For example, the Island Parks have a "tempered" climate, cool in summer, sheltered in winter. To maintain this resource it is necessary to preserve the existing vegetation pattern which provides shelter and channels lake breezes. The constraints imposed upon uses which require extensive clearing of vegetation are therefore very restrictive. On the other hand, opportunities are great for recreation activities like picnicking, where outdoor comfort is important

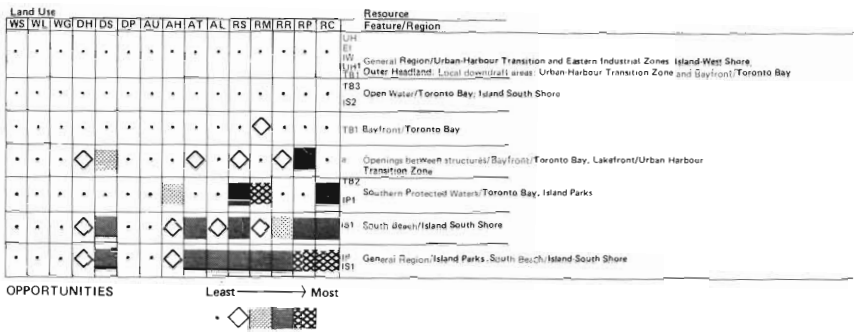
The primary purpose for the reorganization of features in the Resource Interpretation Charts is to provide a useful planning tool. At least two codes are assigned to each feature on the charts. The first identifies the feature on a Resource Interpretation map; the others, listed under Perf. Ref, refer to the relevant development and management regulations described In Performance Requirements for Future Actions. All performance requirements can be related to specific areas of the waterfront through the use of these charts and the accompanying resource maps. These maps are in a reproducible form which will facilitate their use for planning and will increase their availability to government agencies and private groups. This permits the use of the maps for many different purposes A graphiC demonstration of the aggregated opportunities and constraints for the waterfront's Water resource appears in the Synthesis section of this report (page 117). The encoded, mapped information can also be easily digitized for computerization and retrieved for a multiplicity of purposes, including the testing of future planning alternatives and their resultant impact in terms of the performance requirements. A demonstration of this potential computerization is presently underway

AIR

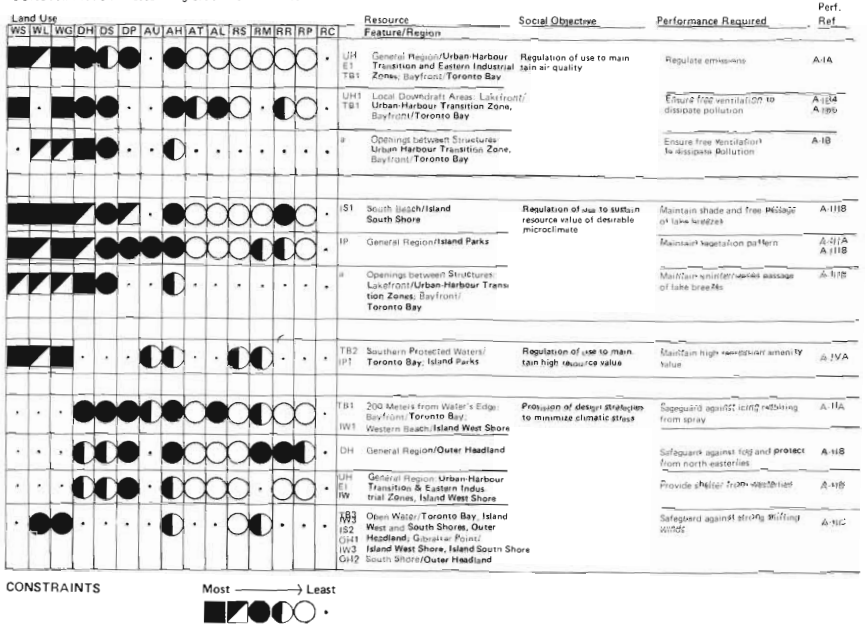
Opportunities The sheltered environment of the Toronto Islands is the only notable opportunity area in the waterfront which is related to Air resources. The adjacent waters of the Island lagoons and Toronto Bay are also protected from strong winds and are a resource for water related uses. On the mainland, opportunity areas are confined to openings between structures along the Bayfront which benefit from the passage of lake breezes.

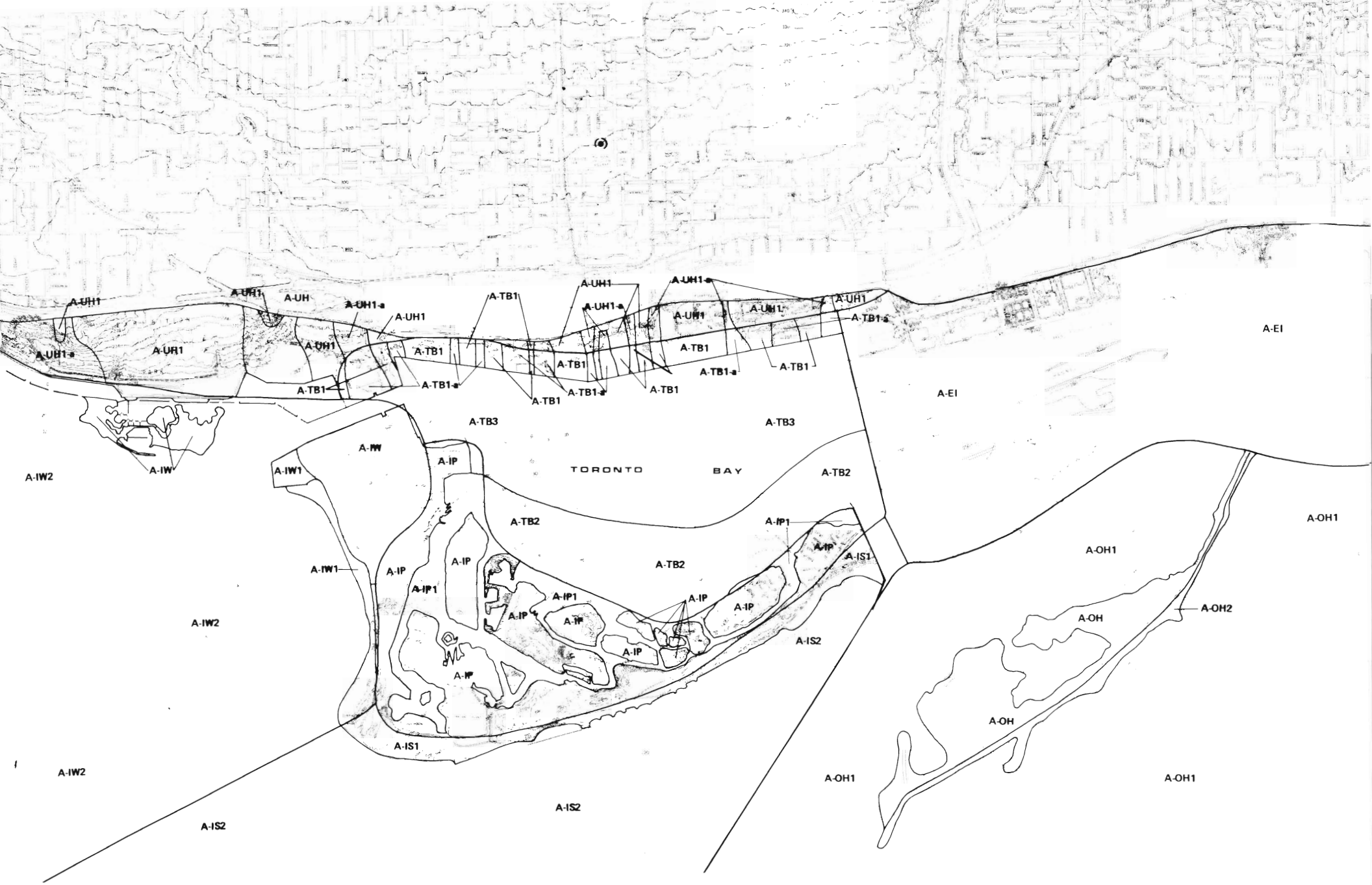
Constraints: Most of the mainland areas are subject to regulations pertaining to emissions of gaseous and particulate pollutants, odours, and noise. These emissions need to be regulated in order to ensure maintenance of air quality. Although the sheltered environment of the Toronto Islands offers an opportunity for some uses, constraints are imposed on others. These constraints derive from the desirability of maintaining the resource value of this sheltered environment. Thus constraints are imposed upon uses requiring extensive clearing of existing tree cover. The exposed situation of the waterfront and the resultant harsh climatic phenomena—strong winds, icy spray, and fog—can not be altered. However, their impact should be mitigated by adaptive strategies such as specially designed structures and sheltered walkways. The areas which require regulations to reduce such climatic stress are Open Waters, the Outer Headland, the Island Airport, and windy shore areas.

RESOURCE INTERPRETATION: AIR
OPPORTUNITIES in ascending order from least to most



RESOURCE INTERPRETATION: AIR
CONSTRAINTS in descending order from most to least

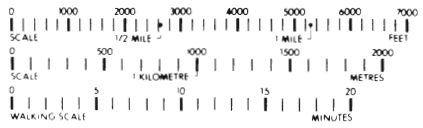




AIR

a: Openings Between Structures

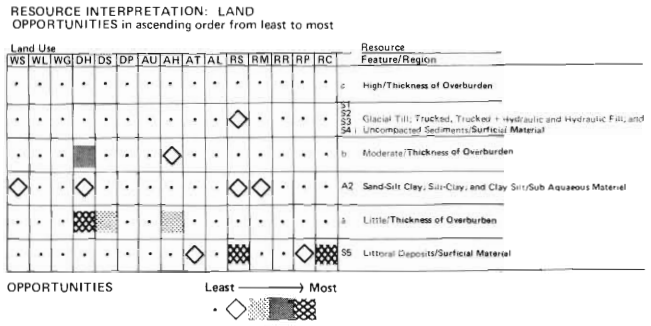
TB	TORONTO BAY ZONE	IW	ISLAND WEST SHORE	OH	OUTER HEADLAND
TB1	Bayfront	IW1	Western Beach	OH1	Open Water
TB2	Southern Protected Waters	IW2	Open Water	OH2	South Shore
TB3.	Open Water	IP	ISLAND PARKS	IS	ISLAND SOUTH SHORE
UH	URBAN HARBOUR TRANSITION ZONE	IP1	Southern Protected Waters	IS1	South Beach
UH1	Lakefront	E1.	EASTERN INDUSTRIAL ZONE	IS2	Open Water

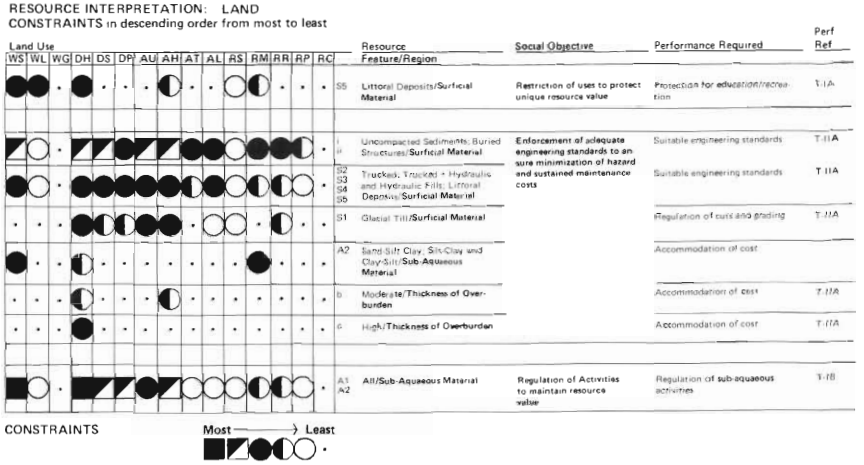


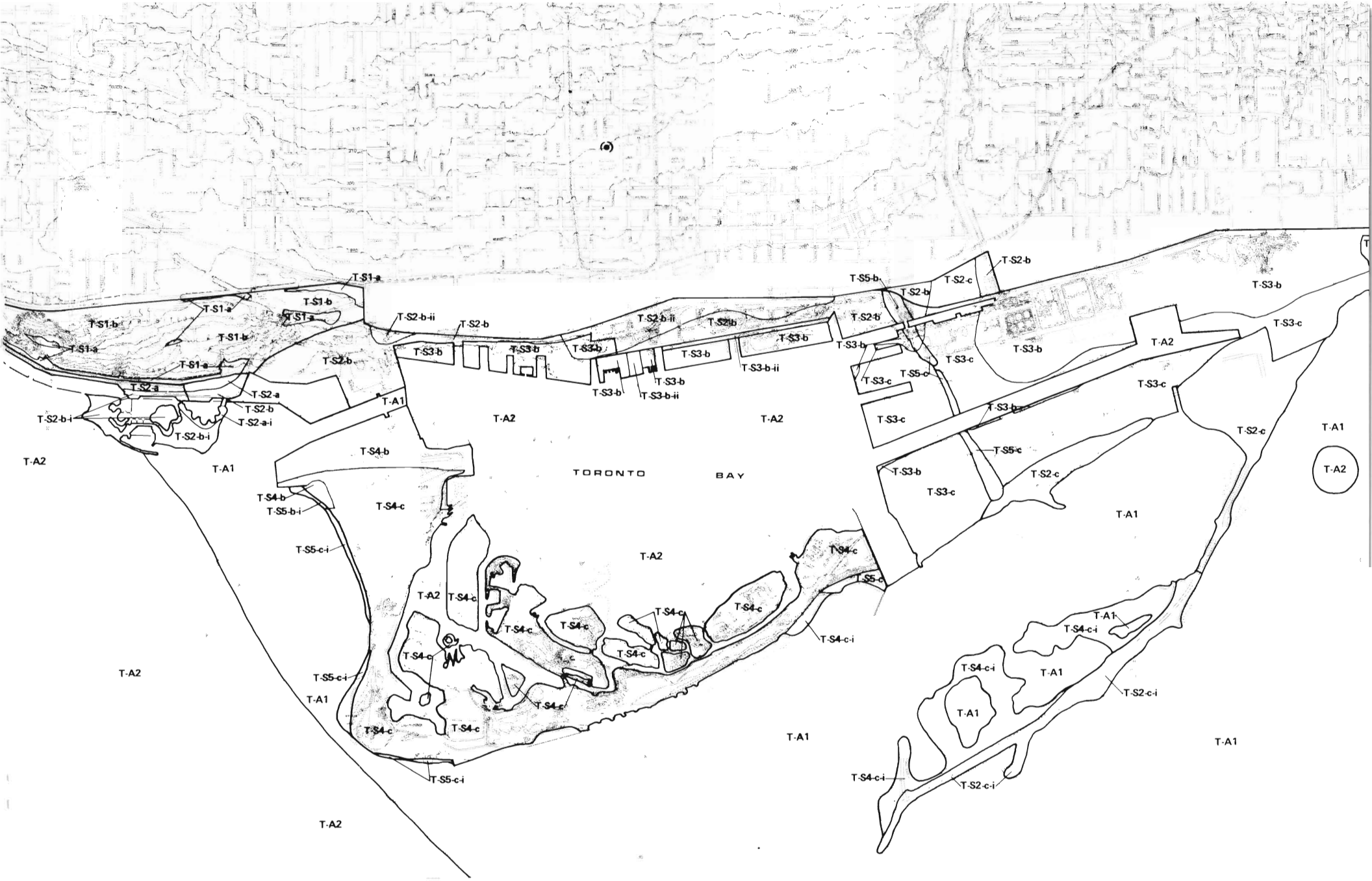
LAND

Opportunities: The relative lack of differentiation of Land resources in the Central Waterfront, combined with the fact that detailed information is limited, yield relatively few opportunities. Recent littoral deposits from the waterfront's beaches are a notable resource for recreation and education. Remnants of historic littoral deposits occur in the Port area. These have a scientific and educational value. The unstable nature of fill materials in many areas of the waterfront necessitates foundations supported on bedrock. Areas with little overburden therefore represent an opportunity for savings of development costs associated with building foundations. These areas are limited to the Bayfront and parts of the Port area and Island Airport. Some subaqueous materials may provide a slight advantage for fill disposal and for foundations of special structures.

Constraints Since littoral deposits represent a recreational and educational resource, their use needs to be regulated to avoid their loss for recreation and special educational studies. The use of subaqueous sediments should be regulated to ensure their availability as a source for uncontaminated landfill. Other constraints relate to the reduction of hazard and development costs. Extensive soil explorations and suitable engineering standards are required in most areas of the waterfront, in order to prevent hazards due to slope failure and building settlement and to avoid high development and maintenance costs.







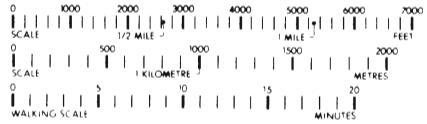
T LAND

SURFICIAL SEDIMENTS
- S1 Glacial Till
- S2: Trucked Fill
- S3: Trucked & Hydraulic Fill
- S4: Hydraulic Fill
- S5: Littoral Deposits

SUBAQUEOUS SEDIMENTS
- A1 Sand, Sand-Silt
- A2 Sand-Silt Clay; Silt-Clay, Clay-Silt

THICKNESS OF OVERBURDEN
- a Little 0-60'
- b Moderate 20-60'
- c High 60'+

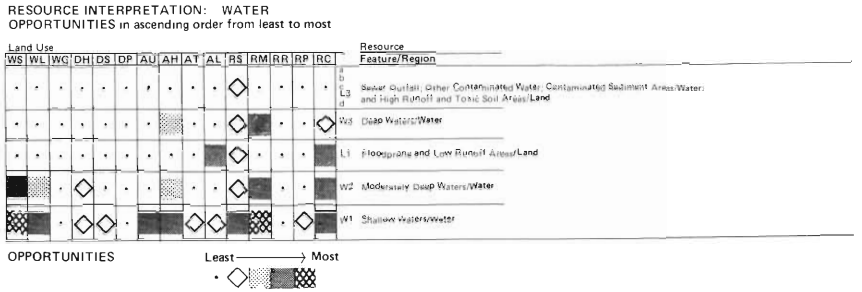
COMPACTION
- i Uncompacted Sediments
- ii Buried Structures

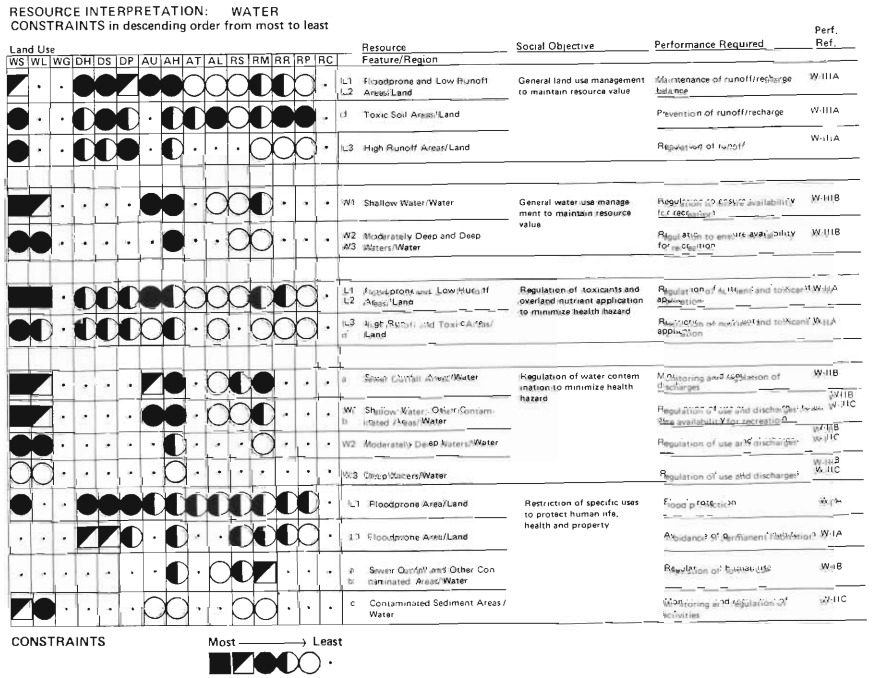


WATER

Opportunities Shallow near-shore waters provide the greatest opportunity for a variety of activities, particularly those associated with recreation and the creation of new land by landfill operations. Opportunities decrease with deeper waters. Floodprone areas provide an opportunity for recreation, due to their proximity to the water; opportunities are especially high for conservation.

Constraints: Water resources require careful management to maintain their resource value for existing and future uses, to maintain water quality, and to reduce hazards due to flooding and contamination. The use of shallow water and adjacent land areas requires the most regulation. Shallow waters are particularly vulnerable to the build-up of sediments and the concentration of pollutants. The discharge of toxicants and nutrients to water, either through sewer outfalls or direct runoff needs to be carefully regulated. The application of toxicants and nutrients on land also requires regulation, since the contaminants may be absorbed into the ground, thereby entering the groundwater and eventually affecting surface waters. Water areas which currently exhibit contamination represent a health hazard. Human uses in these areas, such as fishing and water contact sports, should therefore be restricted. Human uses should also be restricted in floodprone areas in order to reduce hazards to life and property.





H WATER

WATER DEPTH
- W1 Shallow 0-10'
- W2 Moderately Deep 10-30'
- W3 Deep 30'+

LAND AREAS
- L1 Floodprone
- L2 Low Runoff
- L3 High Runoff

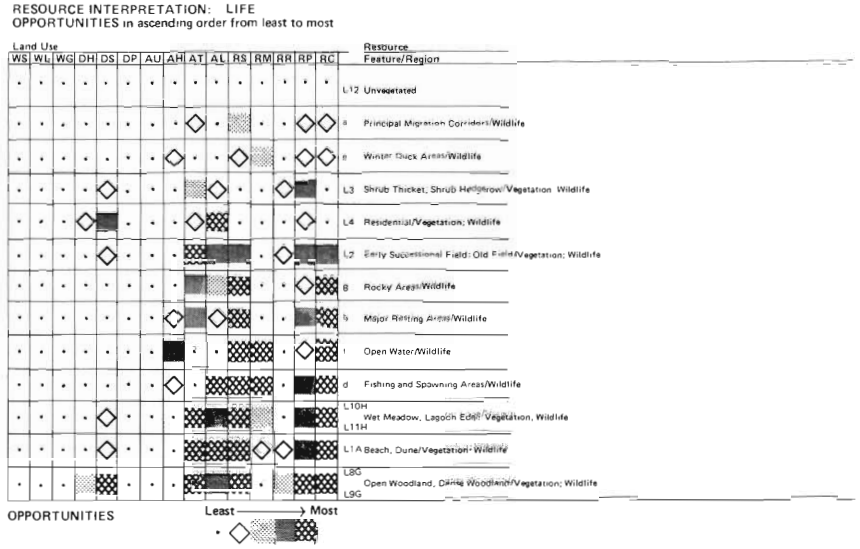
CONTAMINATED AREAS
- a Sewer Outfall
- b Other Water
- c Sediments
- d Toxic Soils

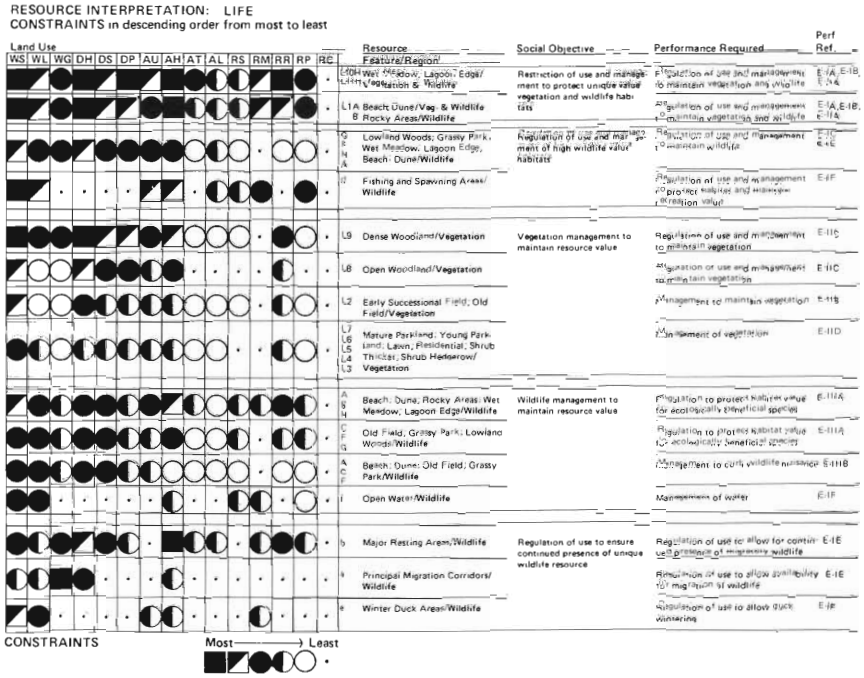
SCALE 0 1000 2000 3000 4000 5000 6000 7000 FEET — 1/2 MILE — 1 MILE
SCALE 0 500 1000 1500 2000 METRES — 1 KILOMETRE
WALKING SCALE 0 5 10 15 20 MINUTES

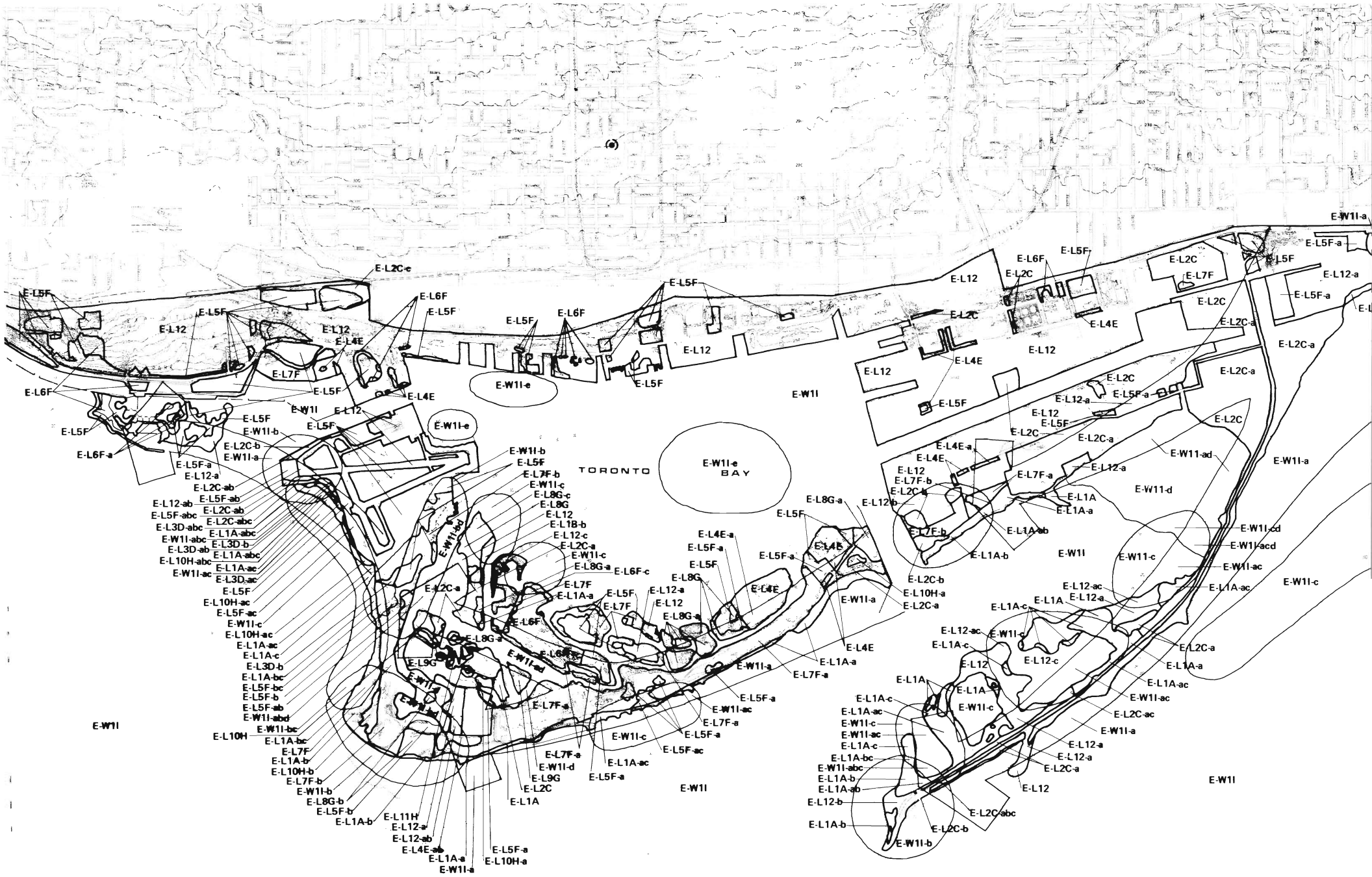
LIFE

Opportunities: The diversity of vegetation and associated wildlife provides a pleasant setting for recreation and other human activities. The shoreline areas—Beach, Dune, Lagoon Edge, Wet Meadow—and remnant natural woodlands are particularly valuable resources and offer great opportunities for low intensity recreation and conservation.

Constraints. Vegetation and wildlife resources are concentrated mainly on the Toronto Islands, therefore constraints are generally absent on the mainland. The same resources which offer the greatest opportunities impose the most constraints, since unregulated use will result in the depletion or degradation of their resource value. All regulations required for Life resources are related to the need to protect and preserve valuable resources. The unusual and diverse vegetation and wildlife along the shoreline is a resource of regional and national significance. These features are also highly intolerant of human activities, and therefore require strict regulation of human use. Constraints are therefore higher for most high intensity uses. Those areas used by migrating wildlife as movement corridors and for resting and feeding also have national significance and require restriction of use during migration seasons. Other vegetation and wildlife resources, although not unique, are nonetheless valuable, and require management to ensure their surivival. The constraints imposed on human uses range from severe to slight, depending on the relative tolerance of the resource feature for human use.







E LIFE

L 1 thru 12 VEGETATION ASSOCIATION

A thru H WILDLIFE HABITAT

VEGETATION ASSOCIATIONS AND WILDLIFE HABITATS

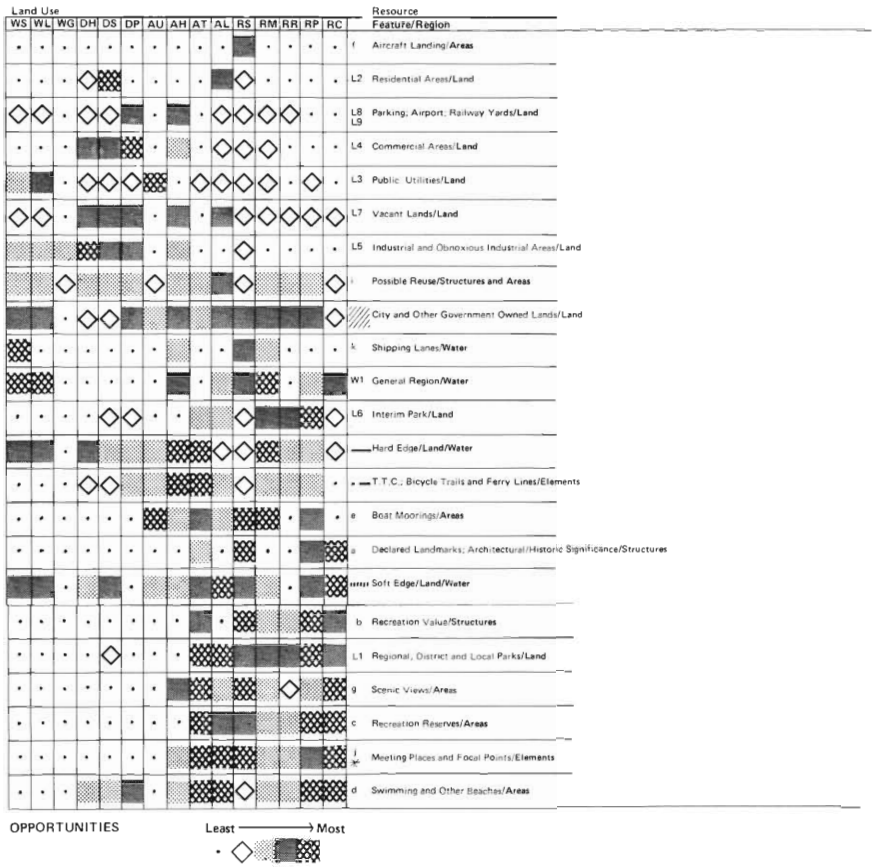
L1. A. Beach, Dune
B. Rocky Areas
L2: C Old Field
L3: D Shrub Thicket and Hedgerow
L4: E Residential
L5: F Lawn/Grassy Park
L6: F Young Parkland/Grassy Park
L7: F Mature Parkland/Grassy Park
L8: G Open Woodlands
L9: G Dense Woodlands
L10: H Wet Meadow
L11: H. Lagoon Edge
L12. Unvegetated
W1: I Water

SPECIAL WILDLIFE INTEREST

a Principal Migration Corridors
b Resting Areas
c: Nesting Areas
d Fish and Spawning Areas
e: Winter Duck Areas

SCALE 0 1000 2000 3000 4000 5000 6000 7000 FEET (1/2 MILE, 1 MILE)
SCALE 0 500 1000 1500 2000 METRES (1 KILOMETRE)
WALKING SCALE 0 5 10 15 20 MINUTES

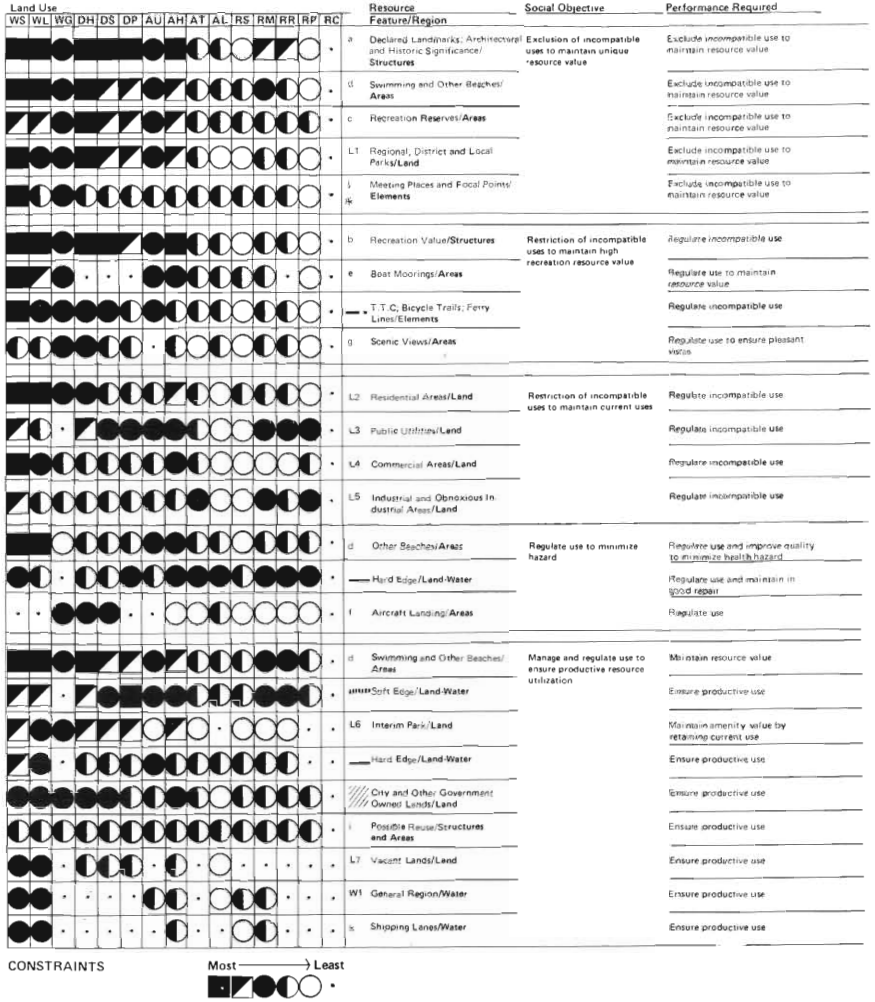
RESOURCE INTERPRETATION: LOCATION
OPPORTUNITIES in ascending order from least to most



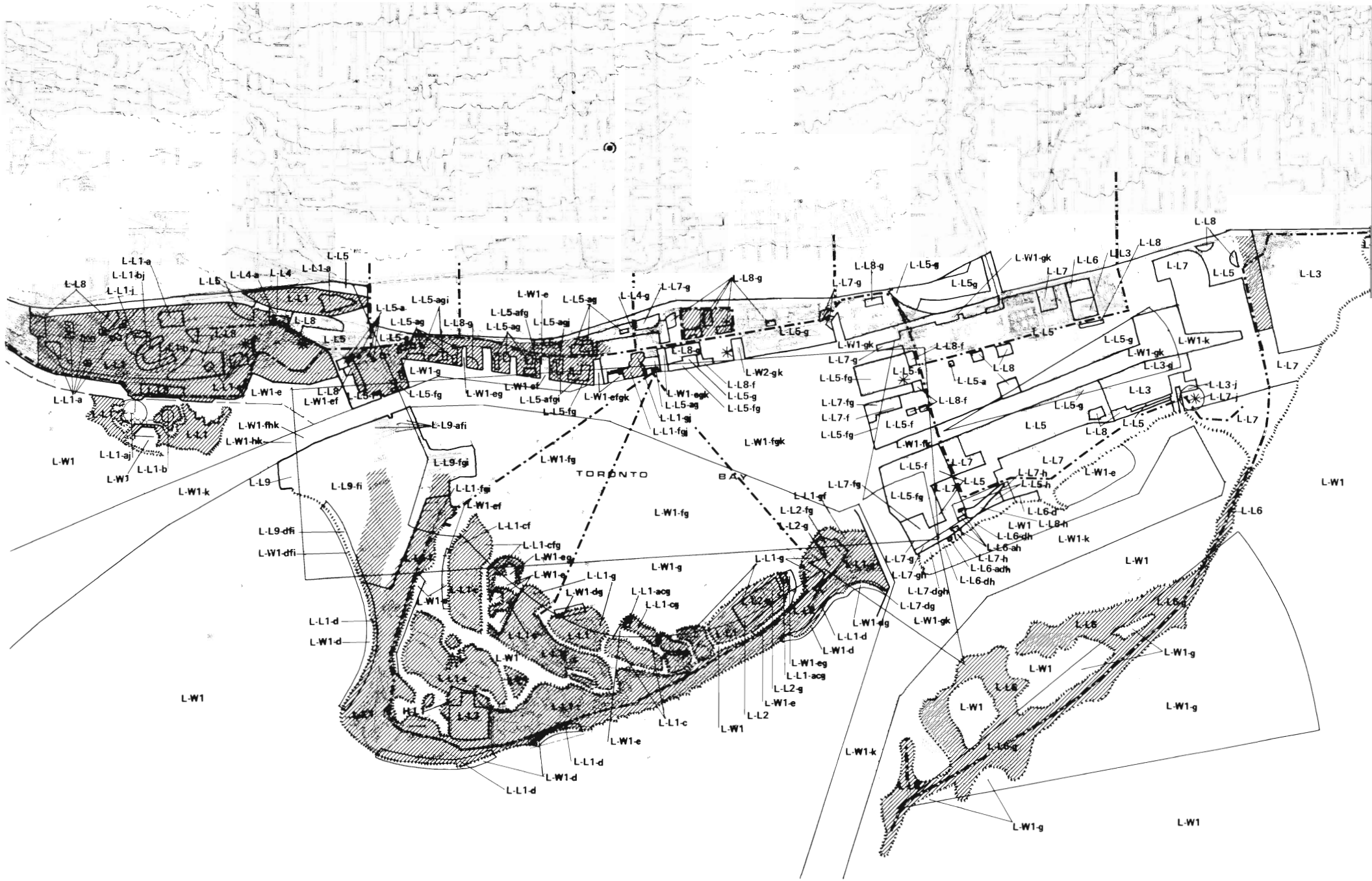
LOCATION

Opportunities: The determination of social values for Location features is dependent on public policies. The greatest opportunities related to Location resource features are for recreation. Beaches, Meeting Places, Recreation Reserves, Scenic Views, Boat Mooring facilities, and shorelines all offer the highest opportunity for many different forms of recreation. Opportunities for public uses, ranging in intensity from conservation to public utilities are greatest in lands presently in public ownership. Land presently zoned for industrial and commercial uses, uncommitted vacant lands, and existing transportation elements provide opportunity for future development.

RESOURCE INTERPRETATION: LOCATION
CONSTRAINTS in descending order from most to least



Constraints: Features which have been identified as highly valued resources require the restriction of incompatible uses to maintain their value to society. Recreation is the most compatible use for these features. Other regulations are required to maintain current uses, to avoid hazards, and to ensure the productive utilization of resources. Detailed performance requirements for future actions similar in form to those specified for Air, Land, Water, and Life will be determined by future planning decisions.



LOCATION

✳ FOCAL POINT
HARD SHORE-Dock Walls
SOFT SHORELINE
TTC, Ferry; Bicycle Trail

L1	Parks
L2	Residential
L3:	Public Utilities
L4	Commercial
L5	Industrial
L6	Interim Parks
L7	Vacant Land
L8	Parking
L9	Airport
W1	Water

a	Landmarks; Significant Structures
b:	Recreation Structures
c:	Recreation Reserves
d	Beaches
e:	Boat Moorings
f.	Aircraft Landing
g	Scenic Views
h:	Problems/Issues
i:	Dense Areas and Structures
j	Meeting Places
k	Ship Channel

Hatched areas represent government owned lands.

INTERPRETATION

PERFORMANCE REQUIREMENTS FOR FUTURE ACTION

INTRODUCTION

This environmental study of the Toronto Central Waterfront started with the premise that it is possible to integrate an understanding of the natural environment into an already complex urban planning process.

The existence of an elaborate environmental data base facilitated the inventory of natural resources. A detailed review of social objectives defined the current values assigned by the C.W.P.C. to these resources. This study provides the means to ensure that the value of these resources is sustained.

Additional information is needed to understand more clearly the relationship of environmental features, and a further explication of social objectives will be needed to resolve competing demands for resources. Nevertheless, it is possible to formulate guidelines for future actions based upon the synthesis of available knowledge. This section of the environment synthesis study describes performance requirements for future actions which relate to specific environmental features within each resource category.

In order to maintain its resource value, a feature must be maintained in a certain state. If degraded or lowered below that state, its value to society may be lost or diminished. Performance requirements specify those human actions necessary to maintain the resource at the "norm" at which its value to society is undiminished. A "norm" may be a very specific legal standard-20 tons per square mile over 30 days for dustfall, an accepted guideline, or an official recommendation. If there is no legal precedent or if insufficient data exists to specify a quantifiable "norm", a general statement must suffice.

The amount of effort necessary to maintain the resource at, or return it to, a "norm" state may impose such costs on an action that it becomes prohibitive. On the other hand, the amount of effort required may be minimal. Between the extremes of prohibition and total permissibility, varying amounts of effort may be required to maintain the established "norm." Thus, future activities may take place with severe restrictions, moderate regulations, or slight modifications.

Restriction implies mandatory development controls which ensure public welfare and are legally enforced.

Regulation implies development guidelines which benefit both public weifare and the agent initiating the action, and which are implemented through an advise and review process.

Modification implies adaptive strategies which primarily benefit the initiator of the action, but are also desirable for public welfare.

For example, a concern for maintaining air quality requires the following procedure:

1. Definition of the "norm" for a specific air quality parameter, such as dustfall. In this case, the Ontario Ministry of Environment has established a standard of 20 tons per square mile over 30 days.
2. Identification of geographic areas (on the Air resource map) where the current dustfall concentration exceeds the "norm" (M.O.E. standards). The performance requirement in these areas is to reduce dustfall concentrations below the "norm," or at least not to further aggravate the currently unhealthy state. Actions which are likely to generate dustfall should be prohibited or severely restricted.
3. Identification of geographic areas (on the Air resource map) where the current dustfall concentration does not exceed the "norm." The performance requirement in these areas is to regulate the generation of dustfall so that concentrations remain within the "norm."

The result of the performance requirement for one parameter is uniform since it relates to a specified constant. However, the effort required to meet the performance requirement may be greater for one type of activity or for one area than for another. For example, a landfill site produces a great amount of dust, whereas a negligible amount results from a playfield. Micro-environmental conditions, such as local downdraft areas which are likely to entrap particulate matter, may impose restrictions on even modest uses such as playfields. Other areas which have better ventilation will produce no restrictions on playfields, and may even permit landfill operations with moderate restrictions (such as periodic hosing down).

The following pages describe the performance requirements related to specific attributes and features of the Central Waterfront's four resource categories: Air, Land, Water, and Life. The performance requirements for the Location category will result from the integration of future planning decisions.

Performance requirements for each resource category are listed in sections which relate to discrete social objectives. For example, Air has sections on maintenance of air quality, minimization of climatic stress, maintenance of desirable microclimate, and protection of resource value. Within each major section are subsections relating to environmental characteristics. For example, within the major section, Maintenance of Air Quality, there are two subsections, Emissions and Ventilation. A uniform coding system is employed so that each performance requirement can be related to mapped features within a resource category. The adjacent table identifies the codes and titles of the major sections and subsections. within each resource category. The codes which identify each performance requirement also appear on Data and Resource Interpretation Charts in the preceding sections of this study. The areas to which each performance requirement applies can be identified by referring to the Data and Resource Interpretation Charts and accompanying maps.

The performance requirements for future actions provide a framework for the next step, the formulation of detailed design strategies and guidelines. There will be more than one way to satisfy a performance requirement, some methods entailing *more* and cost than others. Adaptive design strategies and guidelines will identify means of satisfying the requirement with the minimum effort and cost.

The performance requirements which appear in this section have not been fully compared with existing legislation. The legal implementing mechanism will be investigated by planning staff of the C.W.T.C. during the next phase of their work.

Performance Requirements for Future Actions

A.	AIR	I. Maintenance of Air Quality	A. Emissions
			B. Ventilation
		II. Minimization of Climatic Stress	A. Icy Spray
			B. Strong Winds
			C. Strong Shifting Winds
			D. Fog
		III. Maintenance of Desirable Microclimate	A. Tempered Local Climate
			B. Lake Breezes
			C. Winter Sun
		IV. Protection of Resource Value	A. Southern Protected Waters
T.	LAND	I. Protection of Resource Value	A. Littoral Deposits
			B. Subaqueous Sediments
		II. Minimization of Development Cost	A. Foundation and Site Engineering
H.	WATER	I. Minimization of Hazard	A. Flooding
			B. Contaminated Water
		II. Maintenance of Water Quality	A. Applications over Land
			B. Water Discharges
			C. Fill Operations
		III. Protection of Resource Value	A. Runoff·Recharge
			B. Water Use
E.	LIFE	I. Protection of Unique Resources	A. Protected Wildlife
			B. Sensitive Breeding Colonies
			C. Regionally Significant Concentrations of Wildlife
			D. Unusual Plant Species
			E. Seasonal Wildlife Interest
			F. Aquatic Life
		II. Maintenance of Vegetation Resource	A. Shore Associations
			B. Successional Associations
			C. Woodlands
			D. Parkland and Other Urban Related Vegetation
		III. Maintenance of Wildlife Values	A. Maximum Ecological Benefit
			B. Minimum Nuisance

A.AIR

A-I. Maintenance of Air Quality

Air quality in the Central Waterfront is generally within Ministry of the Environment (M.O.E.) standards for most parameters except dustfall, which greatly exceeds the M.O.E. standard. To safeguard continued human health and welfare, it is important that air quality be maintained to keep down the levels of contamination which are injurious to human health. In addition, certain other qualitative parameters require control because, even though they do not produce demonstrable pathologies, they may cause discomfort. Dust, odours and noise are examples of such qualitative elements. Some contaminants are also known to cause direct damage to non-human aspects of the environment, such as vegetation and corrosion of certain building materials.

While the recommendations for continued air quality monitoring are being followed, it is important that accumulations of contaminants be prevented. The following performance requirements for the regulation of contaminant discharges (gases, particulate matter, odours and noise) into the air are recommended.

A-IA. EMISSIONS

A-IA1. Meet M.O.E. Standards for Emitted Contaminants for gaseous, particulate, and odorous emissions to the air to ensure achievement of M.O.E. Criteria for Desirable Ambient Air Quality as specified under Ontario Regulation 15.

Standards for Emitted Contaminants

Source: The Environmental Protection Act, Statutes of Ontario, December, 1974.

Name of Contaminant	Unit of Concentration	Concentration at Point of Impingement-- Half Hour Average
Acetic Acid	Micrograms of acetic acid per cubic metre of air	2,500
Acetylene	Micrograms of acetylene per cubic metre of air	56.000
Ammonia	Micrograms of ammonia per cubic metre of air	3.600
Antimony	Total micrograms of antimony in free and combined form per cubic metre of air	7S
Arsenic	Total micrograms of arsenic in free and combined form per cubic metre of air	7S
Arsine	Micrograms of arsine per cubic metre of air	30
Benzene	Micrograms of benzene per cubic metre of air	10,000
Beryllium	Total micrograms of beryUium in free and combined form per cubic metre. of air	0.03
Boron Tribromide	Micrograms of boron tribromide per cubic metre of air	100
Boron Trichloride	Micrograms of boron trichloride per cubic metre of air	100
Boron Trifluoride	Micrograms of boron trifluoride per cubic metre of air	5.0
Boron	Total micrograms of boron in and combined form per cubic metre of air	100
Bromine	Micrograms of bromine cubic metre of air	70
Cadmium	Total micrograms of cadmium in and combined form per cubic metre of air	5.0
Calcium Hydroxide	Micrograms of calcium hydroxide per cubic metre of air	27
Calcium Oxide	Micrograms of calcium oxide per cubic metre of air	20
Carbon Black	Micrograms of carbon black per cubic metre of air	25
Carbon Disulphide	Micrograms of carbon disulphide per cubic metre of air	330
Carbon Monoxide	Micrograms of carbon monoxide per cubic metre of air	6,000
Carbon Tetrachloride	Micrograms of carbon tetrachloride per cubic metre of air	20.000
Chlorine	Micrograms of chlorine per cubic of air	300

Name of Contaminant	Unit of Concentration	Concentration at Point of Impingement—Half Hour Average
Chlorine Dioxide	Micrograms of chlorine dioxide per cubic metre of air	85
Chromium	Total micrograms of chromium in free and combined form per cubic metre of air	30
Copper	Total micrograms of copper in and combined form per cubic metre of air	100
Cresols	of cresols per cubic metre of air	230
Decaborane	Micrograms of decaborane per cubi,' metre of air	50
Detergent Enzyme (Subtilisin)	Micrograms of subtilisin per cubic metre of air	1.0
Diborane	Micrograms of diborane per cubic metre of air	20
Dicapryl Phthalate	Micrograms of dicapryl phthalate per cubic metre of air	100
Dimethyl Disulphide	Micrograms of dimethyl disulphide per cubic metre of air	40
Dimethyl Sulphide	Micrograms of dimethyl sulphide per cubic metre of air	30
Dioctyl Phthalate	Micrograms of dioctyl phthalate per cubic metre of air	100
Dustfall	Micrograms per square metre	8.000
Ethyl Acetate	Micrograms of ethyl acetate metre of air	19,000
Ethyl Acrylate	Micrograms of ethyl acrylate per cubic metre of air	4,5
Ethylene Oxide	Micrograms of ethylene oxide cuhi,' metre of air	28,500
Ferric Oxide	Micrograms of ,erne oxide per cubic of air	75
Fluorides, (Gaseous) (April IS to October IS)	Micrograms of gaseous, inorganic fluoride per cubic metre of aIr expressed as hydrogen fluoride	4.3
Fluorides, (Total) (Apnl IS to October IS)	Total micrograms of inorganic fluonde per cubic metre of air expressed as hydrogen t1uonJe	8 6

Name of Contaminant	Unit of Concentration	Concentration at Point of Impi'ngement- Half Hour Average
Fluorides. (Total) (October 16 to April 14)	Total of t1uoride per cubic metre of air expressed as hydrogen fluoride	172
Formaldehyde	Micrograms of formaldehyde metre of air	65
Hydrogen Chloride	Micrograms of hydrogen chloride per cubic metre	100
Hydrogen Cyanide	Micrograms of hydrogen cyanide per cubic metre of air	1,150
Hydrogen Sulphide	Micrograms of hydrogen sulphide per cubic metre of air	30
Iron (metallic)	Micrograms of metallic iron per cubic metre of air	10
Lead	Told.l micrograms of lead in free and combined form per cubic metre of air	10
Lithium Hydrides	fotal of lithium hydrides per metie of air	75
Lithium	Total micrograms of lithium in other than hydnde compounds per cubic metre of air	60
Magnesium Oxide	Total micrograms of magnesium oxide per cubic metre of air	too
Manganese	Total micrograms of manganese in free and combined form per cubic metre of air	100
Mercaptans	Total micrograms of mercaptans per cubic metre of air expressed as methyl mercaptans	20
(alkyl)	Total micrograms of mercury compounds per cubic metre of air	t 5
Mercury	Total micrograms of mercury m free and combined fonn per cubic metre of air	5,0
Methyl Acrylate	Micrograms of methyl acrylate per cubic metre of air	4,0
Methyl Chloroform (1-1-1 Trichloroethane)	Micrograms of methyl chlorofonn per cubic metre of air	350,000
Methyl Ethyl Ketone (2-Butanone)	Micrograms of methyl ethyl ketone per cubic metre of air	31,000

of Contaminant	Unit of Concentration	Concentration at Point of Impingement - Half Hour Average
Methyl Methacrylate	Micrograms of methyl methacrylate per cubic metre of air	860
Milk Powder	Micrograms of milk powdt>r per metre of air	20
Nickel	Total micrograms of nickel in free and combined form per cubic metre of air	5
Nickel Carbonyl	Micrograms of nickel carbonyl per cubic metre of air	1 5
Nitric Acid	Micrograms of nitric acid per cubic metre of air	100
Nitrogen Oxides	Micrograms of nitrogen oxides per cubic metre of air expressed as	SOO
Ozone	Micrograms of ozone per cubic metre of air	200
Pentaborane	Micrograms of pentaborane per cubic metre of air	3.0
Pentachloraphenol	Micrograms of pentachloraphenol per cubic metre of air	90
Phenol	Micrograms of phenol per cubic metre of air	100
Phosgene	Micrograms of phosgene per cubic metre of air	130
Phosphoric Acids	Micrograms of phosphoric acids per cubic metre of air expressed as PIO.	100
Phthalic Anhydride	Micrograms of phthalic anhydride per cubic metre of air	100
Silver	Total micrograms of silver in free and combined form per cubic metre of air	3
SUlphur Dioxide	Micrograms of sulphur dioxide per cubic metre of air	830
Sulphuric Acid	Micrograms of sulphuric acid per cubic metre of air	100
Suspended Particulate Matter (particulate less than microns in size)	Total micrograms of suspended particulate matter per cubic metre of air	100
Tetrahydrofuran	Micrograms of tetrahydrofuran per per cubic metre of air	93.000
Tin	Total micrograms of tin in free and combined fonn per cubic metre of air	30

Name of Contaminant	Unit of Concentration	Concentration at Point of Impingement Half Hour Average
Titanium	Total micrograms of titanium in free and combined form per cubic metre of air	100
Toluene	Micrograms of toluene per cubic metre of air	2.000
Toluene Di-isocyanate	Micrograms of toluene di-isocyanate per cubic metre of air	10
Trichloroethylene	Micrograms of trichloroethylene per cubic metre of air	85,000
Trifluorotrichloro Ethane	Micrograms of triftuoro trichloroethane per cubic metre of air	2.4 million
Vanadium	Total micrograms of vanadium in free and combined form per cubic metre of air	5.0
Vinylidene chloride (I,] Dichloro Ethene)	Micrograms of vinylidene chloride per cubic metre of air	26,000
Xylenes	Micrograms of xylenes per cubic metre of air	2,300
Zinc	Total micrograms of zinc in free and combined form per cubic metre of air	100

Criteria for Desirable Ambient Air Quality

Source: The Environmental Protection Act, Statutes of Ontario, December, 1974.

Name of Contaminant	Unit of	Average Amount of Concentration or Total Amount of Contaminant	Period of Time	Approximate Equivalent at 10° C and 760 mm Hg pressure
Arsenic	Micrograms of Arsenic per cubic metre of air	25	24 hours	
Cadmium	cadmium per cubic metre of air	2.0	24 hours	
Carbon MonOXIde	Parts of carbon monoxide per one million parts of air by volume	30 13	1 hour 8 hours	36,100 ug/m³ 15,700 ug/m³
Dustfa!l	Tons of dustfall per square mile per month	20 Total 13	30 days I year	

Name of Contaminant	Unit of Measurement	Average Amount of Concentration or Total Amount of Contaminant	Period of Time	Approximate Equivalent at 10°C and 760 mm Hg pressure
Fluorides (Gaseous) April IS to October IS	Parts of fluorides per billion parts of air by volume (Expressed as HF)	1.0 04	24 hours JO days	0.86 ug/m' 0.34 ug/m'
Total Fluorides (Gaseous and Particulate) April IS to October IS	Parts of fluorides per one billion parts of air by volume (Expressed as HF)	2.0 0.8	24 hours JO days	1.72 ug/m' 0.69 ug/m^{s}
Total Fluorides (Gaseous and Particulate) October 16 to April 14	Parts of fluorides per one billion parts of air by volume (Expressed as HF)	4.0 1.6	24 hours JO days	3.44 ug/m' 1.38 ug/m'
Fluorides in Forage for Consumption by Livestock	Parts of total fluorides per one million parts forage (dry weight)	35	Individual Sample	
fluoridation (total) April IS to October IS	Micrograms of total fluo- collected by 100 sq centimetres of paper	40	30 days	
FIuoridation (total) October 16 to April 14	Micrograms of total fluo- 100 of limed filter paper	80	30 days	
Hydrogen Sulphide	Parts of hydrogen sui phlde per one million of aIr volumt'	002	I hour	30 ug m^{3}
Lead	Micrograms of lead per cubic metre of air	SO mean	24 hours 30 days	
Mercaptans	Parts of mercaptans per million parts of air by volume (Expressed as methyl mercaptan)	001	I hour	20 ug m^{3}
Mercury	Micrograms of mt'rcur}' cuhic metre of air	20	24 hours	
Nickel	Micrograms of cubic metre of aIr	20	24 hours	
Nitrogen Dioxide	Parts of nitrogen dioxid.· per one million parts of air bv volume	020 010	I hour 24 hours	400 ug m' 200 ug m'

Name of Contaminant	Unit of Measurement	Average Amount of Concentration or Total Amount of Contaminant	Period of Time	Approximate Equivalent at 10°C and 760 mm Hg pressure
Oxidants (total)	Parts of total oxidants per one million parts or air by volume	010	I hour	
Ozone	Parts (If o100.· per one !Tullion parts of air h\ volume	008	I hour	m^{3}
Soiling	Coefficient of H,lZt' per 1.000 feet of air	1.0 OS	24 hours I year	
Sulphation	Milligrams of sulphur trioxide per 100 sq. cm of exposed lead peroxid.' per day	07	30	
Sulphur Dioxide	Parts of sulphur dioxide per one million parts of air by volume	025 010 0.02	I hour 24 hours I year	690 ug,m' n5 ug/m^{3} 55 ug'm^{3}
Suspended Particulate Matter	Micrograms of suspended particulate matter per cubic metre of air	120 60 geometric mean	24 hours I year	
Vanadium	Micrograms of vanadium per cubic metre of air	2.0	24 hours	

A-IA2. Stabilize areas of bare soil, which are sources of wind-blown dust, to ensure maintenance of dustfall concentrations below M.O.E. Standards.

Soil or recent fill which is not anchored by vegetation is subject to wind erosion. Wind-blown soil contributes to the high levels of dustfall in the waterfront, Bare soil should therefore be seeded, sodded, or planted with appropriate, rapidly established vegetation, This is a crucial precaution where bare soil consists of dredged fill contaminated by high levels of heavy metals such as lead, copper, cadmium, or zinc which will become airborne with the wind-blown soil. Contaminated dredgeate should be covered with clean fill and vegetation should be established immediately,

A-IA3. Regulate emissions of noxious odours not controlled under

Ontario Regulation 15 to ensure avoidance of nuisance to the local population.

Odours not associated with toxic air pollutants may be difficult to control by legal standards. However, odours which are shown to be a direct cause of human discomfort, of loss of enjoyment or of normal use of property, or which interfere with the normal conduct of business should be regulated.

A-IA4. Regulate emissions of noise to ensure avoidance of nuisance to the local population.

Noise (any undesired sound) is a subjective phenomenon which depends on individual perceptions and environmental context. What is noise to one person, may be unobjectionable to another. What is noise in a residential neighborhood may not be objectionable noise in an industrial setting. Certain limits, however, can be set. Noise which is shown to be a direct cause of human discomfort, of loss of enjoyment, or of normal use of property, or which interferes with the normal conduct of business should be regulated.

To avoid this nuisance, noise levels in a given setting should conform to the typical ambient noise levels for the existing land use category. Wilson, Ihrig and Associates, Inc., accoustical consultants, have established typical ambient noise levels for selected urban land uses, and have applied them successfully to the City of Chicago. The Ontario Ministry of Environment has published guidelines for indoor areas, and in addition has recommended that in areas where enjoyment of the outdoors is a primary concern sound levels should not exceed 52 dBA for L50 (noise level exceeded 50 percent of the time), and 55 dBA for LEO (Equivalent Sound Level).

Noise impact should be an important consideration in determining the suitability of a proposed land use in a given area. New uses should not exceed the ambient noise levels for the existing land use category. The impact of an intense noise source on surrounding areas should also be determined. Certain areas of the Central Waterfront are very quiet. Noise levels in these "quiet areas" should be main-

Ambient Noise Levels for Selected Urban Land Uses

Use Category	Expected Typical Ambient Noise Levels During the Day	Expected Typical Ambient Noise Levels at Night
Quiet urban residential, and suburban residential area	40-50 dBA	35-40 dBA
Average urban residential areas, apartments and hotels in quiet areas, open space recreational areas	45-55 dBA	40-50 dBA
Noisy urban residential or average semi-residential/commercial areas	50-60 dBA	45-55 dBA
Commercial areas with office buildings, retail stores, etc., and with primarily daytime occupancy. Open space parks, and suburban areas near highways or high speed boulevards with distant residential buildings.	60-70 dBA	55-65 dBA
Industrial or Freeway and Highway Corridors with either residential or commercial areas adjacent	over 65 dBA	over 60 dBA

Source: Wilson, Ihrig and Associates, Inc.

Criteria for Indoor Noise Levels

Type of Space	Equivalent Sound Level, LEQ,dBA
Bedrooms, sleeping quarters, hospitals, etc. (11 :00 a.m.-7:00 p.m.l	40
Living rooms, hotels, motels, etc. (7:00 a.m.-11 :00 p.m.l	45
Individual private or semi-private offices, small conference rooms, reading rooms, etc. (7:00 a.m.-11 :00 p.m.l	45
General offices, reception areas, retail shops and stores (7 :00 a.m.-11 :00 p.m.l	50

Source: Ontario Ministry of the Environment.

tained below M.O.E. guidelines of 52 dBA for L50 and 55 dBA for LEO.

If an existing noise source cannot be controlled and noise levels exceed those recommended for a given land use, then the noise should be modified. The most effective way to accomplish noise reduction is to shield the source with a barrier-an earthen berm or wall. Vegetation is only effective as a noise barrier if the planted buffer is very dense and very wide.

"It turns out that any airport boundary barrier greater than 20 feet high of nearly any construction should attenuate the sound enough. The only exception is the tree-covered earth berm, which appears to be poorer because sound is scattered by the trees over the top of the barrier into its shadow. Undoubtedly, a very thick grove of trees surrounding a barrier can increase its effectiveness but sparsely planted trees intended as a visual screen appear to be deleterious to barrier performance. Highway builders and industrialists should take note of these findings when constructing sound barriers around their projects." (Lyon, "Environmental Noise and Acoustical Modeling," Technology Review, March 1976)

A-IB. VENTILATION

A-IB1. Ensure free passage of ventilating breezes from the lake to the Urban-Harbour Transition Zone and Urban Core.
Good air quality is dependent on adequate ventilation as well as emission control. Lake breezes and southwest winds now reach the Urban-Harbour Transition Zone and are channelled by north-south avenues to the Urban Core. These breezes disperse concentrations of air pollution by promoting air circulation.

A-IB2. Regulate the height, density, and orientation of buildings in the Bayfront and Urban-Harbour Transition Zone to ensure penetration of ventilating lake breezes.
Openings should be retained between buildings in the Bayfront and Urban Harbour-Transition Zone to permit passage of lake breezes. A study will be conducted by the Air Management Branch of the M.O.E. to determine resulting air quality for various potential building heights in the Bayfront. The conclusions of this research will provide a sound basis for height and density guidelines.

A-IB3. Maintain north-south avenues as lake breeze channels between the Central Waterfront and the Urban Core.
The slips at the foot of north-south streets should not be blocked unless it is shown that penetration of the lake breeze to the city core will not be impeded.

A-IB4. Ensure ventilation in downdraft areas of the Urban-Harbour Transition Zone.
Downdraft areas often occur to the northeast of tall buildings. Air becomes trapped in these areas unless ventilation is ensured. During inversion episodes, these areas are air pollution hazard zones. Uninterrupted passage of relieving winds into these areas should be provided.

A-IBS. Regulate height, density, and orientation of buildings to ensure ventilation in downdraft areas.
See Air, A-I B1.

A-II. Minimization of Climatic Stress
To ensure public welfare by minimizing hazard and discomfort, it is important to regulate all actions relating to known features of climatic stress. The Central Waterfront receives the full force of adverse lakeshore weather-strong and shifting winds, fog, and icy spray along the water's edge. Although the basic weather features cannot be changed, their impact can and should be reduced.

A-IIA. ICY SPRAY

A-IIA1. Safeguard against icy spray in the Bayfront region of the Toronto Bay Zone.

A-IIA2. Provide winter protection from icy spray along streets, pedestrian routes, and in outdoor areas within 200 metres of the water's edge.
Icy spray may be hazardous to pedestrians and vehicular traffic, especially when accompanied by strong winds from the southern quadrant. Screening barriers and low heat

conductive materials are recommended. Where necessary local heating should be provided to ensure public safety.

A-liB. STRONG WI NOS

A-IIB1. Provide shelter from westerlies in the Urban-Harbour Transition, the Eastern Industrial, the Island West Shore, and Toronto Bay Zones.

Winds from the southwest, west, and northwest blow 50-60 percent of the time throughout the year. The west and southwest winds, which have a long fetch over open water, are especially strong, and the average winter wind speed at the Toronto Island Airport is 20 kph. Shelter from these winds, particularly in winter, is therefore very important. Although the overall wind pattern cannot be altered, winds may be diverted and speeds reduced near the ground by windbreaks or by the form and orientation of structures and roads.

A-IIB2. Shelter major pedestrian routes, outdoor activity areas, and building entrances from westerly winds.

A sheltered area may be created by means of a windbreak. "A windbreak diverts the air currents upward, and while they soon turn back and again sweep the ground, an area of relative calm is created near the ground. The most protected part of this area is fairly close to the windbreak on the leeward side; it becomes more exposed as the distance from the windbreak increases until a point is reached where the air currents have again reached full velocity." (Olgyay, Design With Climate, 1963). The density and height of the windbreak determine its effectiveness in reducing wind speeds, the size of the protected area, and the location of that area in relation to the windbreak.

If the windbreak is dense, a small calm area will be created on the windward side as well as the leeward side. If the windbreak is open underneath, as in a row of trees, the windward side will have no protection and the protected area on the leeward side will be reduced. Solid walls, however, cause eddies over the top which reduce their effectiveness. The most effective windbreak is a dense stand of trees. Wind speeds may be reduced up to 30 percent of original velocities in the protected area. The second most effective windbreak is a row of trees. Although wind speeds are reduced by only 50 percent, the protected area is extensive. A vertical wall may reduce wind speeds by 50 percent but the protected area is relatively small. (Olgyay, Design With Climate, 1963)

Existing woodlands and rows of trees may be utilized as windbreaks, or new windbreaks may be constructed or planted. The effectiveness of the windbreaks will be increased if dense understory trees and shrubs are planted beneath mature trees. Pedestrian routes could utilize the wind shadows cast by existing vegetation. They should therefore be located to the east of wooded areas within the wind shadow. Paths could also be located along the eastern sides of low buildings. Caution needs to be exercised in locating next to high rise structures, because of possible local downdrafts and sideflows. Fences, walls, berms, and evergreen trees or shrubs should be utilized for windbreaks where maximum winter protection is essential.

Shelters should be built at selected points along pedestrian routes where a continuous windbreak is not feasible. These shelters may be provided at bus stops or other locations where people must wait outside. Shelter openings should face south to southeast. If shelters open to any other direction, the openings must be protected.

Outdoor activity areas should be located to the east of buildings or existing woodland. If the area to be protected has a dimension greater than seven times the building or tree height, a series of parallel north-south windbreaks should be employed.

It should be noted that northeast winds are also a problem in the Central Waterfront. Consequently, in some areas a double windbreak may be required, one for westerlies and one for northeasterlies.

In all instances of attempted modification of wind behavior, it is recommended that wind tunnel testing of proposed design solutions be carried out.

A-IIB3. Shelter low buildings from westerly winds.
Heating bills can be substantially reduced if structures are protected from winds. "The Lake States Forest Experimental Station conducted experiments in Nebraska with two identical test houses. One was exposed to the wind; the other protected from it. As the exact fuel requirements were recorded, it was possible to calculate the savings. Under 70 degrees F constant house temperature the amount of fuel saved by the protected house was 22.9%. With good protection on three sides of the house it was estimated that the fuel saving might have run as high as 30%." (Olgyay, Design With Climate, 1963)

The same windbreak principles should be observed for protecting a structure as for outdoor areas. (See A-IIB2.) The structure must be placed in the protected area created by the windbreak. If improperly placed, winds may be directed against rather than over the building.

A-IIB4. Regulate the geometry and orientation of new structures, landscaping, and streets to minimize wind speeds and prevent channelization of westerly winds.
The north and south faces of buildings in the waterfront tend to be very windy. In westerly gales, these areas can become extremely hazardous. Pedestrian routes and entrances located along north or south building faces should be protected. Landscaping should be designed to provide shelter from westerly winds, not to funnel them. East-west street or other movement corridor alignments should be avoided in order to reduce wind channelization.

A-IIB5. Provide shelter from strong northeastern winds.
Strong northeastern winds are often accompanied by stormy weather. Building entries and pedestrian routes should be sheltered from these storm winds. Outdoor activity and recreation areas, however, need not be shielded to the northeast, since they will not be used in stormy weather.

A-1186. Shelter major pedestrian routes and building entrances from northeastern winds.
See A-II B2.

A-IIB7. Shelter low buildings from northeastern winds.
See A-II B3.

A-IIB8. Regulate the geometry and orientation of new structures, landscaping, and streets to minimize wind speeds and prevent channelization of northeastern winds.
See A-II B4.

A-IIB9. Protect the Toronto Islands from exposure to winter storm winds.
Although the Toronto Islands are presently the most sheltered area in the Central Waterfront, they are particularly vulnerable to strong winds. A vegetation pattern which will sustain the shelter provided by existing trees should be maintained. See guidelines for Life E-IIC and E-IID.

A-IIC. STRONG SHIFTING WINDS

A-IIC1. Safeguard against strong shifting winds along the shore and open water.
Small craft launching areas should not be located in water areas subject to strong shifting winds. These areas experience a 20 percent frequency of 20 knot (35 kph) winds, and are dangerous locations for marina or boat launching facilities. Launching facilities, especially for less experienced sailors, should be located in protected areas, well removed from the open water.

A-IiD. FOG

A-IID1. Safeguard against fog in the Outer Headland Zone to ensure safety against accidents caused by reduced visibility.
Fog occurs on the Outer Headland approximately 50 days per year, more than twice the frequency for other areas in the waterfront. Pedestrian and vehicular routes should be well-defined by landscaping, fences, and lights so that the path or road edge may be clearly perceived in fog. Pedestrian and vehicular routes should be separated by a wide strip or barrier.

A-IID2. Safeguard against water accidents due to decreased visibility in fog.

Marina mooring facilities should be well lit. Water access to these should be properly marked.

A-III. Maintenance of Desirable Microclimate

To ensure continued comfort for humans within the Central Waterfront, it is important that the limited presence of beneficial climatic features be sustained. Summer lake breeze, winter sun and vegetation are the principal ameliorating features.

A-IIiA. TEMPERED CLIMATE

A-IiIA1. Maintain a vegetation pattern in the Toronto Island Parks and South Shore which will sustain the currently tempered local climate.

Due to the extensive tree cover, the Toronto Islands have the most pleasant microclimate in the waterfront. They are sheltered by trees from storm winds and summer sun, yet the trees also channel the cooling lake breezes. Many of the mature park trees were planted in the early twentieth century and should now be replaced. See guidelines for Life E-IIC and E-IID.

A-IIIB. LAKE BREEZE

A-IIIB1. Maintain breeze corridors in the Toronto Island Parks and Island South Shore to channel cooling lake breezes.

Even moderate lake breezes get carried through the Islands because of channelization resulting from openings between tree groups. Uninterrupted passage of these should be ensured.

A-IIIB2. Maintain shade along the water's edge of the Island South Shore to enhance breezes.

Local breezes are generated along shaded sites near the beach by the temperature contrast between shaded and exposed sandy ground. Retention of shade and its free passage landward should be ensured.

A-IIIB3. Ensure free passage of cooling lake breezes within the Toronto Bay and Urban-Harbour Transition Zone.

See A-I B.

A-IIIC. WINTER SUN

A-IIIC1. Ensure that winter sun reaches areas in the Urban-Harbour Transition, the Toronto Bay, and the Eastern Industrial Zones.

Outdoor areas, pedestrian routes, streets, and parking lots should receive as much winter sun as possible. Sites in constant shade may become damp spots where surfaces remain moist or icy for extended periods after rain or snow.

A-IIIC2. Regulate the height and form of new structures and landscaping to minimize shaded areas in winter.

The accompanying chart facilitates the computation of the angle and length of shadows cast by buildings or trees for different times of the day and year. New structures should not cast winter shade on existing plazas or outdoor activity areas. New plazas or parks should not be planned in areas receiving little winter sun.

A-IV. Protection of Resource Value

To ensure optimal public benefit, resources should not be degraded. Climatic features uniquely suited for specific purposes should be properly utilized.

A-IVA. SOUTHERN PROTECTED WATERS

A-IVA1. Maintain the high recreational value of Southern Protected Waters within the Toronto Bay.

The southern portion of Toronto Bay, including the island lagoons, is the most protected water area in the Central Waterfront. Within these sheltered waters, the east facing shoreline is protected from westerly winds and is the best location for permanent marina facilities.

A-IVA2. Maintain the protective value of the land configuration and vegetation pattern of Toronto Islands.

The present configuration of the Toronto Islands buffers the impact of winds and waves on the southern waters of Toronto Bay. The woodlands and wooded parkland on the Islands increase the effectiveness of the land buffer. New water channels should not be made which would funnel

waves and winds from Lake Ontario into the Southern Protected Waters. Woodlands and wooded parkland on the Toronto Islands should be maintained. See guidelines for Life E-IICandE-IID.

A-IVA3. Prevent degradation of water in the Southern Protected Waters.

The water quality of the Southern Protected Waters is directly affected by the quality of storm water runoff and ground water. The quality of overland runoff and subsurface water entering protected waters should be regulated to ensure the protection of their value for recreation. See guidelines for Water

Toronto Sun Chart

Source: C.w.P.C. Information· Base, Climate, 1976.

(Latitude: 43 degrees, 40 minutes, North)

EST Eastern Standard Time (underlined in column under 'Time') to be used for March 21 and December 21

DST Daylight Saving Time, to be used for June 21 and September 21

Alt. The altitude is the angle, expressed in degrees, measured vertically, between the sun and the horizontal plane of the horizon

Az. The azimuth is the angle, expressed in degrees, measured horizontally from the North meridian. For morning hours, it is measured in an easterly direction; for afternoon hours, westerly.

530 Shadow Length Multiplier. Multiply height of building by 5.30 for shadow length.

Time	March 21 Alt.	Az.	June'21 Alt.	AZ.,	Sept. 21 Alt.	Az.	Dec. 21 Alt.	Az.
4:18 AMI 8:18 PM *5:18 amI* 9:18 pm			Sunrise- 5:35 nST Sunset- 9:04 nST					
5:18 AMI 7:18 PM *6:18 amI* 8:18 pm			6.1 9.37	117.0				
6:18 AMI 6:18 PM *7:18 amI* 7:18 pm	Sunrise- 6:20 EST Sunset- 6:31 EST		16.0 3.48	107.3	Sunrise- 7:20 DST Sunset- 7:31 DST			
7:18 AMI 5:18 PM *8:18 amI* 6:18 pm	10.7 5.30	79.5	26.6 2.00	97.8	10.7 5.30	79.5	Sunrise- 7:50 EST Sunset- 4:42 EST	
8:18 AMI 4:18 PM *9:18 amI* 5:18 pm	21.2 2.59	68.1	37.3 1.31	87.7	21.1 2.59	68.1	3.1 18.5	52.7
9:18 AMI 3:18 PM *10:18 amI* 4:18 pm	30.6 1.69	55.2	48.0 .900	75.8	30.6 1.69	55.2	11.0 5.14	41.4
10:18 AMI 2:18 PM *11:18 amI* 3:18 pm	38.5 1.25	39.7	58.0 .624	59.9	38.5 1.25	39.7	17.2 3.23	28.7
11:18 AMI 1:18 PM *12:18 pml* 2:18 pm	44.0 1.03	21.1	66.0 .445	35.8	44.0 1.03	21.1	21.2 2.58	14.8
12:18 PM 1:18 pm	*46.Q* 0.96	0	69.4 .375	0	46.0 0.96	0	22.6 2.40	0

T. LAND

T-1. Protection of Resource Value

To ensure the highest public benefit, it is important that resources be used for purposes for which they are best suited. Remnants of littoral processes occur in the Central Waterfront. These littoral deposits are relatively scarce and have a high educational value as evidenced by the formation of the waterfront in the past and of processes occurring in the present. Incompatible use can easily obliterate this value. Lakebottom sediments are a resource which also require wise utilization. These sediments are a potential source of fill and building materials.

T-IA. LITTORAL DEPOSITS

T-IA1. Regulate the use of littoral deposits to ensure their availability for education and recreation.

Remnant littoral deposits are evidence of historic beaches, while their current deposition forms present beaches. Most of the historic beaches, formed by littoral deposits many years ago, are now buried under layers of fill. One exception is the remnant of the spit which originally formed at the mouth of the Don River and extended out into Lake Ontario, enclosing Toronto Bay. The land on either side of this spit has been filled, but a remnant of the spit itself remains. This historic littoral deposit is an educational resource for the entire Toronto Metropolitan region. Its continued availability for this purpose should be ensured. Incompatible uses, such as filling and extensive paving, should be prohibited.

Existing beaches are a recreation resource which should be maintained for the Toronto Metropolitan region. Excavation of littoral deposits should be severely restricted, since it might induce considerable beach erosion. Limited excavation could be permitted when it can be demonstrated that erosion will not result. Excavation should be permitted only for the replenishment of beaches in other areas of the waterfront, and should be prohibited for commercial purposes.

T-IA2. Manage littoral deposits to ensure the maintenance of resource value.

Restrict impervious surfaces on littoral deposits. Impervious surfaces should not be constructed on recent littoral deposits which form present beaches. Clean sand fill may be added to recent littoral deposits to replenish beaches.

T-IB. SUBAQUEOUS SEDIMENTS

T-IB1. Restrict dumping of sediments with a high clay content in areas of sand and sand-silt subaqueous sediments.

Sand and sand-silt subaqueous sediments pose fewer constraints to development than sediments with a high clay content. Development on subaqueous sediments may involve filling to create new land or special construction which needs to be located within areas presently under water. Sand and sand-silt subaqueous sediments have a low shrink-swell capacity and are more easily developed than soils containing clay colloids. These sediments are also a potential source of high quality fill material. Any degradation of this resource should be prevented.

T-IB2. Regulate all activities which are likely to result in the contamination of subaqueous sediments and thereby diminish their resource value.

Subaqueous sediments may become degraded by the dumping of contaminated sediments in water or by the discharge of water contaminated by heavy metals or high nutrient levels. The following performance requirements described in the Water section must be enforced to prevent degradation of this resource: H-IIA, H-IIB, and H-IIC.

T-II. Minimization of Development Cost

To protect human safety and to minimize development cost, it is important to enforce suitable engineering standards. Certain characteristics of bedrock geology, ground water, and surficial sediments have implications for development type, cost, construction, and maintenance. If these implications are disregarded hazard to life and property may result, and public or private construction and maintenance costs may be incurred. If they are catered to, potential hazards may be avoided and substantial savings realized.

T-IIA. FOUNDATION AND SITE ENGINEERING

T-IIA 1. Determine the composition and load-bearing capabilities of surficial sediments and the chemical composition of ground water prior to proposing a specific site development.

To ensure that proposed development responds to the specific characteristics of a site, detailed data are required. Soil explorations will reveal the composition of underlying sediments, their bearing capacity and the chemical composition of ground water. This information will be needed to determine foundation type and design, and the suitability of the soil for grading and landscaping.

"In areas such as the Central Waterfront, where the surficial deposits represent a conglomeration of landfill materials placed over a number of years, it is doubtful that any two sites (with the exclusion of the Islands) could be found with the same soil/fill profiles. Historically no records were maintained on the content of fill as the Waterfront expanded into Toronto Bay." (C.W.P.C. Information Base, Physical Geography, 1976)

The fill types identified on the Land Resource map are generalizations based on borehole logs and historical accounts of filling operations. They are an indication of the conditions which are likely to occur, but are inadequate for detailed design work. Fill types in the Central Waterfront range from sandy hydraulic fill to trucked fill composed of rubble, sawdust or organic materials. There are also numerous structures, old wharves and jetties, sailing vessels and dockwalls which are buried underground, and whose exact location is unknown. The variable nature of waterfront fill materials makes it impossible to determine, without detailed site explorations, the bearing strength or precise composition of these sediments.

Landfill of unknown origin and composition is uncontrolled fill. Uncontrolled fills, such as those found in the Central Waterfront, are extremely variable in composition and may include voids or garbage. They are a treacherous material on which to found a building and must be explored with great care. The following guidelines for detailed site exploration are recommended. They are quoted from Sydney M. Johnson and Thomas Kavanagh's The Design of Foundations for Buildings, 1968, pp. 36-37:

"Where a building is to be supported on an uncontrolled fill, it is essential to determine if there are any inclusions of mud, garbage, organic materials, cans, debris, voids or other unsatisfactory deposits or lenses. The use of test pits or larger-diameter bore holes (4 inch minimum) is required for this purpose, and such pits or borings should be spaced approximately as required for the usual explorations, i.e., about 50 feet apart (1 per 2,500 square feet of building area). Continuous samples should be recovered from the boreholes as the conventional technique of recovering samples at 5-foot intervals is not adequate to assure reasonable detection of unsatisfactory inclusions. These borings or test pits should be considered as preliminary and should be supplemented by making a boring under each column (using standard techniques). If the preliminary borings or test pits were located under columns, then the supplementary borings may be omitted in the locations already explored. If either the preliminary borings or the succeeding explorations under each column show that the fill contains extensive inclusions of the type indicated, the situation is very treacherous indeed. Either the building should be carried on piles driven to bearing in strata below the fill or, if it must bear in the fill, the building should be designed: (1) with sufficient articulation and/or flexibility to conform to probable differential settlements without being damaged, or (2) as a stiff box capable of bridging any voids or inclusions of the maximum size of probable occurrence. If the fill appears to be free of unsatisfactory inclusions, the situation is vastly improved, and the material may be treated as a natural deposit of equivalent classification."

The chemical composition of ground water should also be determined to ensure that proposed foundation materials will be able to resist corrosion. This can be done when the soil exploration is undertaken, and is a normal practice when bore holes are made. This ground water analysis

should indicate pH and sulphate content.

"A low pH reading of the ground water indicates an acid situation that can be corrosive to both concrete and metal. Acid conditions arise on sites where coal is stored, but may also result from chemical reactions other than sulphur and water. A pH reading of 5.5 or less in the ground water indicates an acid situation that warrants concern for the possible corrosive effects to both concrete and metal. A pH reading of 9.5 or greater indicates an alkaline water solution which can have deteriorating effects on some forms of concrete." (C.W.P.C. Information Base, Physical Geography, 1976)

Potential chemical reactions caused by the association of electric current or methane gas with fluctuations in ground water level are other engineering problems that should be identified during soil explorations. "The presence of a high ground water level and high current sources such as the Hearn Generating Station or power substations can produce an electrolytic reaction which deteriorates sheet metal piling and other metal structures in the soil. Fill areas which contain large amounts of organic materials produce methane gas as the materials decompose. If the gas is identified in site investigations, it should be tested for the degree of explosiveness and then appropriate measures taken to vent the gases." (C.W.P.C. Information Base, Physical Geography, 1976)

The ground water level is very high throughout the waterfront. The water table reflects the water level of Lake Ontario and may fluctuate three to four feet or more annually. Piezometers should be installed in some of the bore holes to monitor variations of ground water level.

If pilings on bedrock are used to support building foundations, exploration of the bedrock is necessary. The bedrock underlying the Central Waterfront is the Meaford-Dundas formation of Ordovician age. lilt comprises a grey sedimentary sequence of shale or associated shaley rocks. Generally it consists of a thick sequence of thinly bedded or laminated shales, siliceous shales, calcareous shales, cementstones, calcareous mudstones, silt stones and very occasional sandstones. Frequent interbeds of siliceous or argillaceouslimestones are also known to occur.

Weathering of the rock is common near the surface, extending usually to a depth of 2 or 3 feet. Intermittent zones of weathering also occur at greater depth, particularly in association with rubbled zones created by bedding plane slip and other internal fracturing.

Horizontal bedding planes are usually well developed at an approximate frequency of 2 to 4 feet. The planes frequently contain a fine smearing of clay indicating that some lateral slippage has occurred along these planes in the geological past.

The bedrock sequence, especially at depth, is known to contain thin dark bituminous shales with small amounts of oil seepage and pockets of natural gas. This will become important only in the case of deep foundations into bedrock and requires further examination at the time of detailed study including boreholes into bedrock.

The following engineering properties for the shale component of the formation (weakest) are attributable based on published literature. The calcareous and siliceous shale components and the silt and stones are stronger and give higher values." (Peto MacCullum, Ltd., John Maryon and Partners, Ltd., St. Lawrence Study Report, Soils Analysis, 1975, pp. 5-6)

The following table gives a general description of bedrock properties. Further investigation is necessary.

General Properties for Shale

Unconfined compressive strength (Laboratory tests)	1300 p.s.i.
E. (unconstrained Modules of Elasticity in Laboratory Tests)	6×10^4 P.s.i.
E. (constrained), Plate Bearing Tests-composite for all layers	5×10^5 p.s.i.
Poisson's Ratio	0.15

Source: MacCallum-Maryon, Soils Analysis, 1975.

In some areas of the Central Waterfront the bedrock is overlain by a bouldery shale till. "This is a grey sandy clayey silt till containing many angular shale fragments and is in a dense state. This till is probably of Illinoian age and is locally referred to as the York till. The till is generally moist and produces minor seepage in excavations. Due to the bouldery nature of this till, it is possible that some of the boreholes may have refusal in this till rather than on bedrock." (MacCullum-Maryon, Soils Analysis, 1975, p. 6) Care must therefore be taken to insure that bedrock is reached by the borehole. Boreholes should penetrate below the intended depth of the piles.

T-IIA2. Provide suitable foundations which are adequate for the load-bearing requirements of the proposed development and which respond to soil, ground water, and bedrock characteristics.

load-bearing capabilities depend on the development type and vary between about 850 pounds per square foot for a paved pedestrian way to over 36,000 pounds per square foot for a structure larger than a fifteen-storey office complex. In cases where very high load-bearing capabilities are required (or where surficial materials offer very low capabilities), it may be desirable to support a structure by means of end-bearing piles driven to bedrock." (C.W.P.C. Information Base, Physical Geography, 1976, p. 3.21) All factors which must be considered before foundations can be designed are outlined in the preceding section (T-IIA1).

A review of studies concerning construction on the subgrade materials in the Toronto Islands was conducted by John Maryon and Partners in 1970. They concluded: "Buildings on existing (island) lands can be founded directly in the subsoil, provided soil-bearing values (requirements) do not exceed 2,000 pounds per square foot.,,

"Newly placed hydraulic fill must be either preconsolidated for a period of approximately one year, or an alternative foundation to spread footings must be provided if substantial buildings are to be built." (C.W.P.C. Information Base, Physical Geography, 1976) However, this recommendation refers only to development on the Toronto Islands, which consist primarily of sandy hydraulic fill.

In a study for the St. Lawrence Redevelopment project, John Maryon and Partners, Ltd. and Peto MacCullum, Ltd. looked at another portion of the Central Waterfront on the mainland just south of the original shoreline. This later study asserts that: "Any construction south of the old shoreline must be founded on some sort of piling as conventional spread footing foundations in this area are unlikely to perform satisfactorily. While optimum compaction has occurred in many places, the nature of the fill itself indicates that further settling might occur. Rotting timbers and hulls of old vessels along with old docks and rubbish make the fill materials highly unpredictable and potentially unstable. This dictates the need for foundation piles driven to bedrock." These potentially unstable fill materials can be found throughout most of the Central Waterfront, with the exception of the Toronto Islands and Exhibition Place, at a depth of 4 to 7 feet from existing grade.

"Since the shale bedrock may be weathered near its surface, excavation of up to ten feet of shale may be necessary for foundations placed directly on bedrock." (C.W.P.C. Physical Geography 1976, p. 3.25) ". . . the pile foundations should be designed to be stable in all directions against external forces. The loose fills and silts should not be relied upon to resist horizontal forces. Driving the piles will be relatively easy. The only difficulty will be interference from old wood piles and other debris that may be encountered at random locations in the old fill area. The choice of the piles and their anticipated capacities will be governed by the proposed structural design. We favour the use of steel 'H' piles, as they can penetrate obstructions with greater ease and extend into the rock surface. These piles should be designed as end bearing piles with permissible bearing stresses in point bearing of 10 k.s.i. Pile capacities per pile in the range of 150 to 200 kips can be attained using 12 BP 53 pounds, or similar piles. Once the pile type is chosen, we recommend carrying out a pile load test to arrive at the final design. Where the loads are heavy,

the use of rock points should be considered." (MacCullum-Maryon, Soils Analysis, 1975, p. 13)

The foregoing description refers to an area where bedrock is between 20 to 35 feet from the surface and may not apply to areas of the waterfront where bedrock depth is greater than 35 feet.

In areas where concrete or metal pilings may be subject to corrosion (see T-IIA1), corrosion resistant pilings or encased pilings should be used. Corrosion of steel pilings has been documented under the following conditions:

" 1. Where the soil contains appreciable amounts of decomposing organic materials. This includes garbage or other organic fill.
2. In cinder or slag fills where a residual content of acid or sulfur is present.
3. Where a condition of chemical seepage exists (coal piles, chemical plants, and like circumstances).
4. Where a bona fide condition of electrolytic action occurs. In this connection, it is noted that a search of available literature failed to reveal more than a handful of reports of actual problems of this type involving piles used to support buildings and fully embedded in the ground, under the limiting conditions above described.

Where one or more of these limiting conditions exists, unless there is some compelling economic or other reason, steel piles should not be used. If they must be used, protective measures must be taken. Indirect devices (for example, discounting 1/16 or 1/8 inch of metal, reduced values of allowable stress, minimum thickness provisions motivated by considerations of corrosion, etc.) are not satisfactory. Protective coatings appear to be of questionable value because they tend to be damaged in driving. casement appears to be the most effective preventive measure." (Johnson and Kavanagh, The Design of Foundations for Buildings, 1968, p. 337)

Since most proposed construction in the Central Waterfront must be supported on pilings, "forms of construction incorporating a standard structural grid of columns are far more practical than the use of load-bearing wall systems with major variations in the location of walls. The use of this type of architectural form would tend to increase foundation costs significantly." (John Maryon and Partners, Ltd., 1975, p. 11)

"Slabs on present grades and on placed fills are likely to perform unsatisfactorily and cannot be guaranteed. Therefore it would be preferable to utilize the lower floor for parking. It is recommended that where the floor slabs are used for other purposes, to float the slabs so that they can settle uniformly. Where new fill is added to raise the existing low grades significantly, such new loading will cause further settlement and any floors should preferably be supported structurally rather than floated. Partitions and other heavy loads should not rest on the slab but should be taken down to the hard stratum on deep foundations." (MacCullum-Maryon, Soils Analysis, 1975, p. 11-12)

T-IIA3. Minimize construction and maintenance problems caused by ground water and soil characteristics.

A high ground water level throughout the waterfront poses both construction and maintenance problems. Certain fill types create excavation, regrading, and settlement problems. Many of these construction and maintenance problems can be minimized with prudent architectural design and the application of suitable engineering standards. The following considerations are essential to preliminary planning throughout landfill areas of the waterfront. Many of these recommendations were made by Peto MacCullum, Ltd. and John Maryon and Partners, Ltd. in reference to the St. Lawrence Redevelopment area, but are generally applicable to most of the Central Waterfront.

"The major problem to be avoided is encountering groundwater in excavations. For this purpose it is desirable to keep the lowest excavation level (including grade beams, pile caps, service trenches) to approximately elevation 247± feet." (MacCullum-Maryon, Soils Analysis, 1975)

"Ground water control for excavations below the water

table to an extent of 2 to 3 feet can probably be achieved by pumping from sumps. For deeper excavations, depending on the amount and extent of draw-down required, either well point dewatering or pumping from deep wells can be used. The effects of such dewatering on nearby structures require further examination." (MacCullum-Maryon, Soils Analysis, 1975)

"For maintenance of underground construction below the water table, either the designs should be water tight and capable of resisting hydrostatic uplift pressures (Bath Tub Design), or a system of permanent drainage will be required. In general we recommend against construction below the water table, since the maintenance problems will be severe due to the proximity of the Lake." (MacCullum-Maryon, Soils Analysis, 1975)

"Excavation of the fills above the water level will present minimal problems. Normal equipment such as backhoes can be used. Excavation slopes of the order of 1 horizontal to 1 vertical can be maintained for construction purposes. Where there is insufficient space to maintain the slopes or where there are existing services in close proximity, it may be necessary to shore the trenches and/or support the services. The general guidelines provided in the Construction Safety and Trench Excavators Acts generally apply, subject to local city by-laws and inspection during construction." (MacCullum-Maryon, SoilsAnalysis, 1975)

'If it is desired to elevate certain of the existing areas for architectural planning, then fill should be placed and compacted early before general construction. Extra surcharge fills-to be removed and used elsewhere later-should be added and left for at least six months, if possible, to accelerate the settlement of new fill." (C.W.P.C. Information Base, Physical Geography, 1976)

"Installation of deep sewers below the water table is associated with expensive design and construction problems and should be avoided completely. Instead, preserving the existing grades, placing only minor fills, and utilizing pumping stations for sewage lift is recommended." (MacCullum-Maryon, Soils Analysis, 1975)

"The existing surface-crusted fill conceals a variety of very old fills, containing timbers, rubbish, some garbage, sands, silts and clays, all in a saturated condition below 4 to 7 feet from existing grade. Excavation to depths below 4 or 5 feet will expose a very undesirable subgrade, presenting variable and severe problems for construction traffic." (C.W.P.C. Information Base, Physical Geography, 1976)

The following considerations apply primarily to areas composed completely or partially of trucked fill:

"As the excavated soils will be mainly heterogeneous fills, in our opinion they are not suitable for site backfill purposes. They must be rejected. Any reuse will be subject to close full time inspection and excessive sorting." (MacCullum-Maryon, Soils Analysis, 1975)

"If it is desired to partially depress some areas, say, for semi-open but depressed parking, sunken gardens, etc., then the finished grades should not be lower than elevation 248. It would be necessary to excavate from existing grade, to strip to a depth of at least 2.5 feet below proposed finished grade and to place at least 2 feet of clean, well graded sand fill over the site as a construction mat. The surface should be covered with select crushed stone and then asphalted for car parking. Some differential movement of the asphalt surface would develop in time. (MacCullum-Maryon, Soils Analysis, 1975)

"Paved parking lots at the present time are in a reasonable state of maintenance. For constructing slabs-on-grade we anticipate minimal problems. We recommend examining the granular bases and increasing the thickness as necessary prior to placing the slab. However, if additional fills are placed settlement problems may be anticipated. Compaction of placed soils should meet the density requirements of 95 percent standard proctor value. The state of the existing fills should be examined and they should be compacted by reworking if necessary, during construction." (MacCullum-Maryon, Soils Analysis, 1975)

"Services should be placed as high as possible in the existing site soils and preferably no site services should be placed more than 6 feet below existing grade, nor below any areas to be raised with new fill. Strong consideration should be given to suspending building services from the underside of first-floor slab above grade, wherever practical." (C.W.P.C. Information Base, Physical Geography, 1976)

T-IIA4. Protect deep cuts and stabilize embankments in glacial till.
Bedrock and soil exposed in deep cuts are subject to weathering, erosion, and slump (downward movement). Unless they are stabilized, slides or excessive erosion may result. All cuts should conform to the angle of repose of the exposed material. The following table indicates the angles of repose for sediments of specific compositions. Exposed embankments should also be stabilized as soon as possible, preferably with vegetation. See guidelines for Life E-IIB and E-IID.

Slopes of Repose

KIND OF EARTH	SLOPE OF REPOSE Non-Submerged	Submerged
Sand, clean	1 on 1.5	1 on 2
Sand and clay	1 on 1.33	1 on 3
Clay, dry	1 on 1.75	
Clay		1 on 3.5
Clay, damp, plastic	1 on 3	
Gravel, clean	1 on 1.33	1 on 2
Gravel and clay	1 on 1.33	1 on 3
Gravel. sand, and clay	1 on 1.5	1 on 3
Soft, rotten rock	1 on 1	1 on 1
Hard rotten rock	1 on 1	
Hard rock. riprap		1 on 1
Bituminous cinders	1 on 1	
River mud		1 on 3 to 1 on 20
Anthracite Ashes	1 on 1.5 to 1 on 2	

Rule of thumb for submerged excavated slopes: Sand-1 on 2; Clay-1 on 1.5 to vertical, Stiff mud-1 on 1 to vertical, Sluiced mud-1 on 10 to 1 on 20

Source: Elwyn E. Seelye, Design, 1967.

T-IIA5. Account for additional costs in moderate and high thickness of overburden.
Most structures in the Central Waterfront must be founded on piles driven to bedrock (see T-IIA2). Cost will not be a constraining factor in areas where bedrock is less than 20 feet from the surface. However, pile foundations will be more costly when required in areaswhere bedrock is deeper than 20 feet. These foundation costs may determine the appropriate development type or density.

Foundations supported on piles driven to bedrock are not only desirable but completely economical in the Central Waterfront. Soil or fill depth for the entire Waterfront (with the exception of the Toronto Islands and the Don Valley) rarely exceeds the fifty-foot economic breaking point for the pile technique. It must be noted that the 50-foot economic breaking point does not apply to all development types; intensity of development also comes to bear in determining the economic breaking point. For example, it would not be economically feasible to place a two-storey apartment unit on fifty-foot piles; however, a twenty-storey complex would generate enough revenue to warrant construction. Engineering difficulties with piles greater than fifty feet in length become very great, severely inflating the associated costs. If end-bearing piles to bedrock are used, then bedrock bearing capacity rather than soil-bearing capacity would become the significant development determining factor.

The MacCullum-Maryon report examines the various foundation schemes feasible for the waterfront with respect to desirability and costing. Their findings are included in an Appendix to this report.

H. WATER

H-I. Minimization of Hazard

To protect human life, health, and property, specific activities must be restricted in certain areas of the Central Waterfront. Floodprone areas are subject to flooding during episodic storms. It is important that human use of floodprone lands be regulated in order to safeguard human life and property. Certain parts of the Lake and Harbour have polluted water; these represent a health hazard, and human use of these areas needs to be restricted.

H-IA. FLOODING

H-IA1. Avoid permanent habitation in floodprone **areas.**

To prevent loss of human life during flood events, permanent habitation in floodprone areas should be prohibited. If for exceptional social reasons human occupancy of these areas is permitted, flood rescue provisions must be ensured.

H-IA2. Ensurethat artifacts in floodprone areas are flood protected and do not aggravate flood hazard.

Structures and other human artifacts in floodprone areas are subject to wave action and elevated lake levels during flood events. As a minimum precaution, structures meant for human occupancy should have floor levels elevated above expected flood levels of 249 feet above sea level.

Flood hazard is likely to be increased by impediment to free flow of water within flooded areas. All structures, including buildings, highways and utilities, should be designed so that they do not act as impoundments or channels for movement of flood waters.

Flood damage is further intensified by the ramming action of floating artifacts. All structures and artifacts must be securely fixed through proper foundations and sound superstructureo

H-IB. CONTAMINATED WATER

H-IB1. Regulate human uses which entail water contact in sewer outfall and other contaminated water areas.

"The densities of coliform bacteria are commonly used as indicators of the potential presence of disease-causing organisms originating from fecal pollution. Some of the waterborne diseases which may be transmitted by bathing include gastro-intestinal disorders, ear, nose, eye and throat ailments, skin infections, and tuberculosis.

The Ministry of the Environment has put forward a criterion stipulating that water used for body contact recreation should not contain total coliform bacteria in excess of 1000 individuals per 100 mls of water, and fecal coliform bacteria in excess of 100 individuals per 100 mls of water. Although the total coliform group can be useful in assessment of general sanitary conditions of water, the fecal coliform group is a more precise bacteriological tool in assessing water quality.

Fecal streptococci alone are not reliable as indicators of sewage contamination, and should be monitored in conjunction with total coliform and fecal coliforms. When the fecal coliform count is greater than 10% of the total coliform count, contamination of the water can be assumed to be recent. When the fecal coliform to fecal streptococci ratio is greater than 4, the contamination can be assumed to be of human origin, whereas if the ratio were less than 0.7, one could assume the contamination is recent, was of animal origin, or from storm sewers." (C.W.P.C. Information Base, Water, 1976)

Water in Sewer Outfall Areas and a few other locations fail to meet these health standards. Marine recreation areas should not be located near these areas, unless no water contact is contemplated. In any case safety precautions should be taken for accidental water contact.

H-IB2. Fishing should be restricted in sewer outfall and other contaminated water areas.

"There is active sport fishing in the Central Waterfront Area. The Ministry of Natural Resources and the Metropolitan Toronto Parks Department have recently taken

steps to develop and improve fishing facilities. Available spawning areas are generally restricted to the Island lagoons; however, potential sites also exist in the Outer Harbour.

Many fish species present in the Central Waterfront area have been found to be safe for human consumption; however, cohoe salmon, and in some cases white sucker, alewife, rainbow smelt and carp have recently been found to have unacceptable levels of PCB's." (C.W.P.C. Information Base, Water, 1976)

To safeguard public health, regular fishing in these areas should be prohibited. Adequate warning signs should be posted to inform casual fishermen of the potential health hazard.

H-II. Maintenance of Water Quality

To ensure continued public welfare it is important that water quality be maintained within acceptable standards set by the Ministry of Environment. At present, only limited areas of the harbour fail to meet these standards. To sustain the quality of remaining clean water, careful regulation is required both of direct water discharges and fill operations within water areas, and also of toxicant and nutrient applications over land areas directly affecting the harbour waters.

H-IIA. APPLICATIONS OVER LAND

H-IIA1. Restrict application of toxicants in Toxic Soil Areas.

Extensive land areas within the harbour and along the Bayfront show high levels of toxicants, which are a result of past and current uses of these sites. Toxic levels must be reduced to conform to the MOE guidelines. In addition to undertaking detoxification measures, future toxicant application should be restricted to maintain toxicant levels in the soil below MOE standards.

Soil contamination by toxic heavy metals, such as lead, cadmium, copper, zinc, nickel and iron, is a frequent by-product of industrial activity. Soil contamination from oil, coal, and salt also occurs in the Central Waterfront. The contamination of soil by lead is also associated with highways.

"In most cases where it is expected that areas of previous industrial activity may undergo a change in land use to public or residential purposes, such as housing, parkland, or play areas, potential public health hazards must be more carefully examined. This careful examination would entail the sampling and analysis of soils in specific areas in order to adequately demark contaminated areas in need of remedial measures ...

Soil Toxicity Guidelines

Element	Health Hazard	Landscape Constraints	Building Constraints
Arsenic	40 ppm		
Cadmium	5 ppm		
Chlorine	0.1%		
Chromium	500 ppm		
Cobalt	25 ppm		
Copper	100 ppm		
Electrolysis Fluorine	400 ppm		
Iron	2.4%		
Lead	600 ppm		
Methane Gas			
Nickel	100 ppm		
Oil			pH < 9.5
pH			pH < 5.5
Salts			
Selenium	10 ppm		
Sulphur	0.1%		
Sulphate (S04)			0.0-0.1 negative
			0.1-0.2 positive
			0.2-0.5 considerable
			> 0.5 severe
Vanadium	50 ppm		
Zinc	400 ppm		
No Guidelines Established			

Source: M.O.E.· Phytotoxicology Section

Each site ... [should be] ... tested for lead, cadmium and copper because of their highly toxic nature to plants and people. Zinc and nickel are two other elements which should be taken into account because of their toxicity to plants in low concentrations. Oil ... is highly mobile in water-saturated soil and contains both plant toxic hydrocarbons and heavy metals.... in some areas, contaminated soils may exist beneath present buildings and between buildings and parking, and could prove hazardous should they be re-exposed and used for public purposes."
(C.W.P.C. Information Base, Phvsical Geography, 1976)

"Auto-related lead [i.e., concentration in soil] may be a significant factor in the Central Waterfront, most notably adjacent to Lake Shore Boulevard, the Gardiner Expressway, Queen's Quay and the major north-south routes, where lead levels may exceed 600 parts per million (considered excessive by the Ministry of the Environment).

Due to erosion of salt piles and to the leaching of rainwater through them, a quantity of salt water abounds in the [Port area] throughout the soil base. During periods of heavy rainfall, salt water runoff washes over the dockwall directly into the slip channel. Salt ... is injurious to vegetation, and salt-laden soil (a result of transportation and deposition of road and industrial salts by wind and rain) is hostile to vegetation growth.

Coal, which was in the past present in vast quantities throughout the Port area, and remains today in association with the Hearn Generating Station, presents a problem of its own. In combination with rain water, a mild acidic solution is formed which permeates surrounding soils and could impair vegetation growth." (C.W.P.C. Information Base, Physical Geography, 1976)

"Oil and other chemical storage along the waterfront also results in the contamination of soil to some extent. Seepage associated with these storage areas can be found, and while storage tanks are surrounded by berms to contain the bulk of any spills, seepage which occurs through the soil often creates conditions of local soil contamination. In addition, oil seepage from cars, trucks, and most notably trains, add to this problem in the Central Waterfront. The density of oil allows it to float and thus move on the surface of the ground water, and this affects both plant root growth and salt accumulation.... In areas of oil contamination, [the] adjustment condition for new plant material is hampered by the high concentration of hydrocarbons and heavy metals which retard the development of a new root system. The film of oil on top of the ground water also impedes the leaching of salt through the soil and hence its dispersal, leading to an accumulation of root-retarding deposits. Also associated with oil storage facilities and service stations is the seepage and trapping of explosive gases. If the presence of an explosive gas is detected, further tests on the degree of explosiveness will be required." (C.W.P.C. Information Base, Physical Geography, 1976)

H-IIA2. Toxicants should be disposed of in such a way that they will not cycle in the ecosystem or pollute ground water. Toxicant waste products should be pretreated in the best practicable manner before being applied to soil. If pretreatment is impractical, runoff containing toxicants should be collected and stored in a retention area that will prevent them from being discharged to soil or water, and then treated to remove toxicants.

H-IIA3. Regulate toxicant and nutrient application in floodprone and low runoff areas to maintain toxicant levels in the soil below Ministry of Environment guidelines. Floodprone and low runoff areas are especially vulnerable to pollution since toxicants and nutrients may easily move directly into Lake Ontario or into the ground water. The regulation of toxicant and nutrient application to soil in floodprone areas is particularly important, since anaerobic conditions may increase the mobility of some contaminants in the soils. These conditions may be created when the soil becomes waterlogged. For applicable standards see H-IIA1.

H-IIA4. Restrict use of septic tanks in floodprone and low runoff areas.

Septic tanks in floodprone areas should be prohibited due to seasonal high water tables and to the potential pollution hazard.*

Septic tanks in low runoff areas with a sandy soil profile should be restricted since sandy soils may not permit sufficient filtering of nutrients. Levels of nutrients and bacteria in nearby water should be monitored to determine whether water quality is being affected.

H-IIA5. Restrict the application of fertilizers to amounts which will be absorbed by local vegetation with little excess.
To prevent degradation of water quality, excessive use of fertilizers should be avoided. As a rule plants requiring little or no fertilizer should be used in landscaping. To ensure enforcement, levels of nutrients in nearby water should be periodically monitored to determine whether water quality is being affected.

H-IIB. WATER DISCHARGES

H-IIB1. Monitor and regulate bacterial, nutrient, and toxicant levels in sewer outfall areas.
"Since urban storm run-off is a possible source of significant amounts of both organic and inorganic waste materials, it is felt that more information on various aspects of storm and combined sewer overflow events is required to better understand the impact of these storm overflows into the lake and the resulting water quality changes. It is recognized that a precise characterization of the water may not be possible because of the variability in the character of storm, or combined wastewater, or both, and because of the many physical difficulties in representative sample collection.

A monitoring program for the Central Waterfront area is essential in order to define:

1. Pollutant concentration vs. duration of runoff and frequency of runoff.
2. Flow characteristics during and following weather events.
3. Effect of land use on the amount and types of pollutants present in runoff.
4. Quantities of pollution loads from storm and combined sewers for outfalls discharging directly to Lake Ontario and to the Don and Humber Rivers."

(C.W.P.C. Information Base, Water, 1976)

H-IIB2. Restrict discharge of toxicants and nutrients in other contaminated water areas and in shallow water.
To ensure water quality in near shore areas, it is important that all discharges in these waters be severely restricted. Discharges are likely to occur through sanitary and storm sewers, direct runoff from roads and transit networks, leakage from utility networks, and effluent discharge from boats. For applicable standards see W-II B1.

H-IIB3. Regulate discharge of toxicants and nutrients in moderately deep and deep water.
Deep offshore waters are less vulnerable to degradation by intermittent discharges than shallow water. However, a pollution hazard to near shore water may be created if the quality of deeper water becomes degraded. Standards specified in W-IIB1 should be used as a guideline to regulate discharge activities in deeper waters.

H-IIC. FILL OPERATIONS

H-IIC1. Restrict dumping or filling with contaminated sediments since toxicants and nutrients may readily desorb from soil colloids and contribute to water pollution.
"Contaminated sediments can lead to a variety of problems in the aquatic environment. Sediments high in organic substances and nutrients serve as an excellent substratum and energy source for bacteria whose respiration exerts a high oxygen demand on the overlying waters. Such a situation often leads to anoxic conditions in a stratified water

* 'The high water level of 248.2 feet in 1973, compounded by strong on-shore winds, caused some areas of the Islands to be inundated, severaly affecting the operation of septic bed systems for the park facilities. Constraints were also placed on septic tank systems servicing the island homes to prevent an upset situation which would lead to health problems. In response to the threat of disease from contaminated ground water, the City of Toronto Medical Officer of Health, in a report to City Council on April 12, 1973, stated that he would not endorse future proposals for sewage disposal that relied upon soil dispersion. The Metro Parks Department is presently installing a sanitary sewer system which will connect to the mainland and service all park facilities." (CW.P.C. Information Base, Physical GeographY,1976)

column which in turn detrimentally affects the survival of fish and all other oxygen dependent organisms.

"Toxic elements, such as heavy metals and PCB's, can become concentrated in the food web. The impact of this bio-magnification is greatest on top level predators. Ultimately, man can become affected through consumption of fish caught in an environment contaminated by these toxic elements.

"Determination of dredge spoil suitability for open water disposal is based on physical and chemical quality of the sediments to be disposed of and on the benthic conditions at the dredge disposal site. The Ontario Ministry of the Environment reviews these characteristics with a view to maintaining acceptable water quality for all users and ensuring the protection of fish and wildlife." (C.W.P.C. Information Base, Water, 1976)

The following guidelines may be used to identify contaminated sediments. No guidelines are presently available for cadmium, lead, zinc, copper, or PCB's in subaqueous sediments. Such guidelines should be applied as soon as they are established.

Sediment Quality Guidelines

Parameter	Concentration
Organic Cont.ent (as % loss on ignition)	6%
Total Kjeldahl Nitrogen	2 mg/g
Oil and Grease (Ether Soluble Substances)	1500 mg/kg
Total Mercury	.30 mg/kg

Source: C.W.P.C. Information Base, Water, 1976

H-IIC2. Regulate landfill operations.
The impact of landfill operations should be fully assessed before such projects are commenced. The impact of the proposed landfill project on harbour exchange rates, lake bottom sediment quality, on turbidity, and onerosion and accretion patterns should be examined.

H-III. Protection of Resource Value
Water is abundantly present within the Central Waterfront. Its resource value to Toronto is largely for recreation, for water related industry and transportation. To ensure the continued availability of this resource it is necessary that water quality be maintained, and that certain quantitative aspects of the water regimen be regulated. The land-water interface, where any disruptions of the prevailing regimen will produce immediate impact, requires the most critical attention. This land-water interface extends beyond the grossly perceived shoreline to all adjacent lands, since water moves towards the Lake overland (runoff) as well as through the ground (recharge). Direct use of water by individual major consumers must also be regulated to protect its resource value for other uses.

H-IIIA. RUNOFF-RECHARGE

H-IIiA1. Restrict the area covered by impervious surfaces to maintain high recharge in floodprone and low runoff areas.
Little runoff occurs in areas designated as low runoff* since most rainfall is retained at ground level by plants and leaf litter and gradually infiltrates the soil. This reduces erosion and flooding. Recharged water is filtered to some extent as it moves through the soil before reaching surface or ground waters. Rainfall over floodprone areas tends to move rapidly into Toronto Bay or Lake Ontario. It is desirable to retard this flow by encouraging it to move through the ground.

To ensure recharge of runoff in floodprone and low runoff areas extensive areas of paving or the disposal of fill

*Runoff coefficients as mapped in the C.W.P.C. Information Base, Phvsical Geography, are based on surface cover only; they do not take account of slope or soil profile. Low runoff areas are areas of bare sand or vegetation. "In areas such as the Central Waterfront, where the surficial deposits represent a conglomeration of land fill materials placed over a number of years, it is doubtful that any two sites (with the exclusion of the Islands) could be found with the same soil/fill profiles and hence the same percolation rates. This makes generalization of percolation rates for areas within the Central Waterfront an extremely impractical and highly undesirable approach to this soil parameter. Historically no records were maintained on the content of fill as the Waterfront expanded into Toronto Bay." (CW.P.C. Information Base, Physical Geography) A more complete study of soil profiles should be undertaken before development occurs to assess more precisely the amount of runoff generated from specific areas. In the meantime these estimated runoff-coefficients provide a useful guide in predicting the amount of additional runoff generated by a change in land use.

material which would increase runoff should be severely restricted and permitted only as a special variance due to exceptional social reasons.

H-IIIA2. Restrict the use of storm drainage systems which concentrate runoff and deposit runoff directly and rapidly into surface water.

The requirement of maintaining high recharge will be vitiated, if storm water were to be collected and conducted through storm sewers. Traditional storm drainage systems should therefore be avoided. Alternative methods of storm water drainage which ensure recharge of runoff through retention and delayed discharge should be considered.

H-IIIA3. Provide for recharge of excess runoff, if runoff is increased.

The addition of impervious surfaces-roads, structures, and paved areas-will increase runoff. Certain other activities such as clearing vegetation for gardens or intensive recreation uses such as playgrounds will also result in increased runoff due to compaction of the soil. This will be particularly pronounced over areas of soils which have a high clay content.

Whenever excess runoff is generated it should be directed to a retention area or pond where it can be held until it eventually gets recharged into the soil. The size of the pond or retention area depends upon the infiltration rate of the particular soil type and the acceptability of having standing water. A small deep pond will hold water longer than a shallow extensive retention area.

H-IIIA4. Prevent recharge of runoff in toxic soil areas.

To ensure avoidance of pollution, it is important that no recharge be permitted over areas presently covered by toxic soils. An impervious layer should be installed on these soil areas to prevent recharge. The runoff from these areas needs to be collected and treated to remove toxicants to meet standards established by the Ministry of Environment before discharging to surface water or overland.

H-IIIA5. Provide for retardation of excess runoff in high runoff areas.

Areas of high runoff coefficient, such as certain soils, paved areas and other impervious surfaces, produce excess runoff, which presents potential flooding, erosion, and pollution hazards. Little or no infiltration into the soil occurs. To avoid these ill effects, excess runoff from these areas should be collected and held locally for gradual discharge after the storm generating the excess runoff has abated.

A recommended practice for dealing with High Runoff Areas is to direct the excess runoff through surface grading to adjacent Low Runoff Areas, where it can be held for recharge as described in W-IIIA3. If there is no adjacent Low Runoff Area where excess runoff might be recharged, a recharge area can be constructed and lined with sand and gravel.

H-1118. WATER USE

H-11181. Regulate use of shallow waters to ensure maintenance of recreation value.

Near shore waters are in great demand to accommodate a variety of uses. Certain industry-related or other intensive uses, such as landfill, dredging, excessive and rapid water withdrawals and discharges, may degrade the high recreation value represented by these waters. In critical areas, identified under Life and Location resource categories, incompatible uses should be prohibited. In any case these should be strictly regulated to ensure safety and comfort for recreational uses.

H-III82. Regulate use of deeper waters to maintain their recreation value.

Although deeper waters are abundant and much less vulnerable than shallow waters, incompatible development-related uses, such as filling and dredging, may diminish their recreation value. Such uses should be regulated to minimize their potential adverse impact.

E. LIFE

E-I. Protection of Unique Resources

The land water interface represents the greatest opportunity for a variety of life forms to exist. In the Central Waterfront these opportunities are enhanced by the presence of extensive shorelines on the Toronto Islands and Outer Headland, and by the waterfront's location within the major intercontinental migratory routes. Human use of the waterfront has all but depleted the rich diversity of natural vegetation. Nevertheless, a few rare floral forms survive in isolated pockets, and a remarkable diversity of faunal types continue to use the available habitats. Presence of these resources within the urban confines of Toronto represents a unique resource, the protection and continued availability of which must be ensured.

E-IA. PROTECTED WILDLIFE

E-IA1. Restrict use of areas designated as important habitats for "protected" wildlife.

The presence of large numbers of nesting Ring Billed Gulls and Herring Gulls in the waterfront is noteworthy. These gulls, along with the Common Tern, have been identified as requiring "protection" in the wider region within which Toronto is located. Responsible conservation practices of the recent past have resulted in reversing the earlier trend of rapid depletion of their numbers in the region. To ensure full reinstatement of these species in their native habitat, it is necessary that their preferred habitats within the waterfront be protected. The rough shore edges, beaches, dunes and rocky areas are particularly important for gulis, while the tern utilizes these as well as open water.

Prohibition of high intensity and incompatible uses in these resoLirce areas is required to avoid their depletion. Even low intensity pedestrian and vehicular traffic needs to be regulated to ensure survival of plants which provide a natural and effective means of anchoring drifting sands. Plant species which can tolerate the difficult environmental conditions of a beach often are particularly susceptible to compressing or trampling. Dunes are vertically stabilized by these plants. Their survival and continued growth requires that foot traffic be diverted away from sand-binding plant species. Where necessary, special design solutions such as boardwalks should be employed.

E-IA2. Ensure proper management of the habitats important for continued presence of the protected wildlife species.

Continued presence of the gull and tern colonies requires provision of undiminished food and shelter provided within their preferred habitats. See guidelines for E-IIA.

E-IB. SENSITIVE BREEDING COLONIES

E-IB1. Restrict use of areas designated as sensitive breeding colonies of valuable wildlife.

Ring Billed Gulls, Herring Gulls, Common Tern, and the Great Blue Heron are nesting species which have breeding colonies sensitive to disturbance. The breeding occurs in their nesting habitats. and dunes are important for all of these species, rocky areas for the gulis and terns, open water for terns and herons, and wet meadows, marshes and lagoon edges for herons. These wetland edges are particularly important and vulnerable. It is recommended that margins with a minimum 200 feet width from the water's edge be left entirely undisturbed in these wetland habitats. Occasional human access to water could be provided through narrow boardwalk causeways. General restriction of recreational uses during breeding periods is also necessary in addition to the requirement listed under E-IA1.

E-IB2. Ensure proper management of the habitats important for continued presence of the sensitive breeding colonies.

Breeding species are particularly vulnerable to the degradation of their food sources and alteration of shelter characteristics within the nesting habitat. The latter requires strict enforcement of performance requirement E-IB1 regulating use of these habitats, while protection of the food source involves the whole region over which these species range. As a minimum, the immediate environs in the Central Waterfront must ensure maintenance of air and water quality as specified under A-IA and H-IIA, B and C. Locally, management requirements listed under

E-IIA must be met.

E-IC. REGIONALLY SIGNIFICANT CONCENTRATIONS

E-IC1. Ensure the continued presence of species currently seen in regionally significant concentrations.

Saw-whet Owl is an unusual species which is resident within the waterfront in regionally significant numbers. In addition a number of unusual hawk species and a variety of common shore birds provide seasonal interest, as significant populations of these pass through the area during annual migration periods. These species' preferred habitats include the wetland margins and also extend over woodlands and grassy areas. Their continued presence provides great recreation value and depends upon undiminished availability of the suitable habitats. The seasonal use of these habitats should be regulated and incompatible land uses should be restricted to ensure their availability as food and shelter sources for the migrating species. Incompatible land uses, such as extensive paving, are those which alter the habitat characteristics. General recreation uses, though normally permissible, need to be regulated during critical nesting periods to reduce noise nuisance and territorial invasion. This may entail restricting the number of people entering these areas and confining these intrusions to small, well defined sites.

E-IC2. Ensure proper management of the habitats important for continued presence of wildlife currently seen in regionally significant concentrations.

For required management of the wetland, woodland and grassy areas see E-IIA, E-IIC, and E-IID.

E-ID. UNUSUAL PLANT SPECIES

E-ID1. Restrict use of areas where unusual plant species are present. Regulate use of vegetation associations within which these unusual species are found.

A number of unusual plant species are found within Beach, Dune, Lagoon Edge and Wet Meadow vegetation associations. The rarity of these species is not only of local significance, but in some cases extends over Southern Ontario. To ensure their continued survival, selected parts of the association within which these are found should be left entirely undisturbed. In remaining areas, disturbance caused by all human uses should be carefully regulated to ensure continued availability of potential sites for colonization by these species. Management specified for these areas under E-IIA should be rigorously followed.

Rare Plantlife of the Natural Areas of the Toronto Islands

Dune Species:	Ocean-coastal species	Marram Grass Sea-rocket Seaside Spurge European Water Horehound
Beach Strand-Dune Species.	Great Lakes shoreline	Nelson's Horsetail Nut-rush Bicolores Sedge Baltic Rush Torrey's Rush Arrow Grass Schweinitz Sedge Bushy Cinquefoil Ladies'Tresses Sand Dropseed Panic Grass
	Prairie-like habitat also found in dry clearings in woodlands	Beard Grass Winged Pigweed Mountain Mint Switch Grass Sand Dropseed Bluestem
Wet Meadow Species:	Wildflowers	Fringed Gentian Nodding Ladies Tresses Lobelia False Dragonhead Purple Gerardia

Source: Catling-McKay (1974)

E-IE. SEASONAL WILDLIFE INTEREST

E-IE1. Ensure continued presence of seasonal wildlife interest in areas designated as Principle Migration Corridors and Resting Areas.

Although all parts of the Waterfront have seasonal wildlife interest, certain parts are of greater significance because of their special value for migrating wildlife. The land-water interface is an important movement corridor providing navigational aid and diverse food habitats for migrating species. The peninsular projections of the land mass are

favored resting areas. Certain near-shore locations, because of shoals or upwelling currents, provide abundant food, and thus attract large concentrations of migrating predators. These areas are regionally valuable for the survival of migratory populations and locally provide spectacular recreation interest. Use of these areas should be regulated to avoid dimunition of suitable habitat value for the migrating species. In addition to restricting incompatible land use of these habitat areas, their seasonal use should be regulated to ensure their availability as food and shelter sources for the migrating species. The implied restrictions to their use are similar to those for Regionally Significant Concentration Areas (E-IC 1).

E-IE2. Ensure proper management of the habitats within areas of seasonal wildlife interest.

For required management performance of the habitats within Principal Migration Corridors and Major Resting Areas see E-IIA, E-II B, E-IIC, and E-II D.

E-IF. AQUATIC LI FE

E-IF1. Regulate use of fishing and spawning areas to ensure continued availability of this scarce resource.

Despite abundance of water in the waterfront, notable fish populations are limited to sheltered waters of the lagoons within the Toronto Islands and the outfall area of the Hearn Generating Station. The shallowness of the water in the Island lagoons and the diversely vegetated margins provide rich habitats for spawning. The Hearn outfall area is also valuable for fishing and spawning, essentially because of local heating of water due to discharge from the Hearn Generating Plant. The natural recreation value of these areas is emphasized because of their scarcity, despite the fact that certain fish species may be declared unfit for human consumption because of local, seasonal or regional contamination. To ensure the value of these areas for sport fishing, use of these waters should be regulated to avoid undue disturbance of waters, underlying sediments and bordering land margins. Restriction of motor boat traffic and intensive development of land margins up to a minimum of 200 feet is indicated.

E-IF2. Ensure maintenance of water quality in fishing and spawning areas.

"Water quality requirements for the protection of aquatic life are given in the literature. Dissolved oxygen is considered "poor" below 5.0 ppm, "fair" between 5.0 and 7.0 ppm and "good" above 7.0 ppm. The pH of the water is rated "poor" below 6.0 and above 9.0, "fair" between 6.0 and 6.5 and between 8.5 and 9.0 and "good" between 6.5 and 8.5. Total dissolved solids are considered "good" below 200 ppm, "fair" between 200 and 500 ppm and "poor" above 500 ppm.

Aside from the above, definitive standards are not available for most water quality variables. Water temperature can be related to the preferred temperature ranges of fish species. Nutrient loads should not exceed 10 ppm for nitrate and 0.1 ppm for phosphate. Secchi disc readings are a relative measure of turbidity; high readings indicate low turbidity." (Ontario Ministry of Natural Resources, Operation Doorstep Angling, 1976). In addition, see guidelines for Water Quality, H-II B.

E-IF3. Ensure proper management of land margins of fishing and spawning areas.

Continued value of the fishing and spawning areas depends upon careful maintenance of the hydrologic balance and vegetation quality of their land margins. The hydrologic balance entails regulation of runoff recharge as specified under H-IIIA and toxicant and nutrient application listed under H-IIA. The bordering vegetation must be managed as specified in E-IIA, E-II B, E-IIC, and E-II D.

E-IF4. Regulate seasonal use of Winter Duck Areas.

Certain parts of the Bay are frequented by duck populations during the winter. Some of the species, e.g.,Oldsquaw, Bufflehead, and Greater Scaup, are self-sufficient. Others, e.g., Mallard and Black Duck owe their presence to misguided kindness* resulting from handouts of bread by human beings. Nevertheless, their presence represents

*Allan Wainio, The Cruelty of Kindness, Ontario Ministry of Natural Resources. District Release dated February 6, 1976.

wildlife related recreation value. To ensure their presence for this limited purpose, use of water areas favored by them should be regulated to minimize their disturbance.

E-II. Maintenance of Vegetation Resource

The unique visual and scenic resource value of the Central Waterfront is as much due to the dramatic land-water configuration as it is due to the "green" mantle of Islands floating on the not too distant horizon. The fact that this mantle also is invaluable for continued presence of myriad wildlife makes it an enormously precious resource. The natural diverse vegetation associations expected in such situations are totally absent within the Bayfront and the Eastern Industrial area and are severely depleted in the Islands due to extensive conversion into parkland. Remnants of the natural associations survive on the Islands and as a promise in prospective colonization of the Outer Headland. Rigorous management practices must be followed to ensure continued survival of vegetation forms where they exist today and, more importantly, to encourage a richer and more diverse vegetation resource for the future.

E-IIA. SHORE ASSOCIATIONS

E-IIA1. Manage all shoreline vegetation to ensure survival and self-replication of the natural vegetation within presently occurring Beach, Dune, Wet Meadow and Lagoon Edge vegetation association areas.

The most natural, self-regenerating vegetation occurs along the strands (the beaches), the dunes, the wet meadows and the lagoon edges. These represent several advancing successional stages, each one able to exist because of a particular set of environmental conditions. These areas are subject to natural, structural and compositional changes over time, which are only halted by deliberate action by man or by some unexpected disruption.

Each is responsive to external factors in their own specific way, although each and every community does function according to similar basic biological tenets. To maintain this mixture of strands, dunes, wet meadows and lagoon edges on the Islands, specific recommendations for replanting and management of existing vegetation should be followed, The beach vegetation IS In a constant stage of dynamic change. If human disturbance is minimized, no other action is necessary. But for areas already disturbed, a specific program for replanting beach grass (marrum grass) should be instituted. This species is dying out now, probably because of a decrease in moving sands. Although its disappearance is a natural occurrence, its retention is desirable and should be encouraged. A replanting program should include sowing the grass at the onset of the rainy season and making sure that, once established, free sand movement is not hampered. This should allow for nesting, as well as for a rough, protective cover for birds and small mammals. No motored boats should be allowed in the Island lagoons. Even mooring of sailboats and canoes in the lagoons should be restricted. No refuse dumping should be allowed in the lagoon areas, and littering strictly forbidden. No retaining walls, riprap or cement should be allowed to replace the vegetated edge of the lagoons.

E-IIA2. Maintain all physical processes critical for the continuance of ecological balance which is currently operative along the shoreline.

The interface of land and water is characterized by a dynamic interaction of the surface and subsurface hydrologic regimens. Strict enforcement of performance requirements pertaining to the hydrologic regimen is needed to ensure continued survival of valuable shoreline vegetation types. The toxicant and nutrient application and runoff recharge requirements listed under H-IIA, H-IIB, and H-IIIA should be followed.

E-IIA3. Restore and introduce appropriate shore associations along shorelines of the waterfront where they are absent.

The naturally occurring vegetation types are best suited to sustain maximum resource value of the shoreline for recreation and to ensure minimum maintenance cost. The institution of appropriate shore associations along all shorelines of the waterfront is recommended. The consequent limitation to human use of the shoreline necessitates careful identification of shore areas which must depart from the general recommendation to satisfy other social needs, such as certain intensive water-related recreation.

E-IIB. SUCCESSIONAL ASSOCIATIONS

E-IIB1. Manage all areas with successional associations to ensure their successional progress.

Recent fill areas and other vacant lands are colonized by a rich array of herbaceous plants and a variety of grasses characteristic of Early Successional Field association. Older fill areas and other areas where disturbance has been restricted for a few years progress towards an Old Field association with the presence of typical native woody species, such as cottonwoods, shrub willows and red osier dogwoods. In certain areas, in the limited space between mown areas and along other remnant spaces between differently owned and managed adjacent lands, the woody component of the Old Field association develops into Shrub Thickets and Shrub Hedgerows. Successional associations are notable for the presence of a diverse collection of pioneering plants which are able to thrive in hostile environments with little help from man. Their retention costs little and produces enormous benefits.

The areas covered by these successional associations are generally depleted of soils or soils have not had a chance to develop. Any attempt to replace them with more "desirable" parklike landscaping is enormously expensive due to the need for importing topsoil. The previously adopted policy of an intensive fertilization and watering programme for maintenance of vegetative cover such as lawns and ornamentals is not recommended. This practice does not produce much soil build up over time, is expensive to maintain and is likely to degrade water quality due to high levels of nutrients (fertilizers) required. The added nutrient load is likely to prove disastrous, if the substrate already contains phytotoxic contaminants. The recommended practice would be to allow continued presence of pioneering species, which are perfectly well adapted to the local conditions. Over time the pioneering species will transform the surface over which they grow through addition of organic matter, processes of soil building and creation of sheltered micro-environments which enable survival of higher and more stable vegetation forms. In the meantime, they perform a valuable role in preventing erosion and run-off, moderating microclimatic extremes and providing useful wildlife and recreation resource.

It must be realized that these associations are dynamically changeable in their species make-up. Any alteration of the existing disturbance, such as mowing or excessive compaction, will produce compositional change either towards more woody tree-like forms or more grasses. This dynamism can be harnassed to assure maintenance of vegetation forms considered to be appropriate for local needs. Where openness is desired, periodic mowing will be needed. For more sheltered needs, judicious addition of compatible species without wholesale removal of existing vegetation can be made to accelerate the successional processes. This planting method is relatively inexpensive as smaller-sized plants can be used, the chances of survival are assured, and the resulting landscape is rich and changeable as it matures over time.

The choice of species planted within a successional matrix should be made from detailed observations of plants found to be adventitious on that site or similar sites within the waterfront or the Toronto region. Requirements listed for Shore Associations (E-IIA) and Woodlands (E-IIC) can be used as guidelines for successional associations, as eventually these will be the natural outcome.

E-IIC. WOODLANDS

E-IIC1. Manage all woodland vegetation to ensure survival and self-replication of this scarce resource for its continued ecological and recreational value.

Despite apparent greenness of the Islands, true woodlands are scarce within the waterfront. The extensive parklands represent a desirable resource for accommodating large crowds of recreating people, but are a poor substitute for the rich, diverse, stratified natural woodlands. To ensure continued presence of this scarce valuable resource, it is important that all uses within dense woodlands should be severely restricted. Management of these should be restricted to removal of diseased and mature specimens only. The shrub layer, which has been eliminated in the open

woodlands by past management practices, should be reinstated. Often this can be accomplished by abandoning mowing in these areas and restricting human passage to well defined paths and rest areas. Introduction of shrub plantings in selected areas may be desirable to achieve quicker results. Small occasional clearings may also be desirable to diversify species choice, as cleared areas permit survival of herbaceous material.

E-IIC2. Maintain all physical processes critical for survival of the woodlands associations.

The prevention of excessive runoff, sheet erosion, and compaction is required to prevent damage to the valuable woodlands. Runoff recharge requirements listed under H-IIIA should be followed.

E-IID. PARKLAND AND OTHER URBAN ASSOCIATIONS

E-IID1. Manage all man-related vegetation associations to maintain their present recreation value and minimize maintenance cost.

Extensive parts of the Islands are occupied by parkland vegetation, some of which is reaching beyond its age of maturity. These are characterized by intensive management, most notably mowing. Lawn and other less "manicured" grassyareasexist elsewhere, such as the Island Airport. Other man-related vegetation exists in the form of small lawns and ornamental trees and shrubs associated with pockets of residential areas on the Islands and streets and parks elsewhere in the waterfront.

The local recreational value of these areas is evident. Their continued presence must be ensured. As the cost of maintaining them is high and the potential for their development into more diverse life forms remains unexploited, new planting guidelines recommended under E-IID2 should be followed to remedy this.

E-IID2. Introduce new planting to ensure greater diversification and low maintenance.

Although it is important to replace the older individual plants with viable younger ones in parkland and other man-related vegetation areas, this should not be done in such a fashion as to jeopardize any of the unusual species or combination of species which are there. Planting of interesting and unusual native and introduced species should be encouraged, although carefully weighted to consider all possible side effects. Generally, choice should be made from plants observed to be flourishing within the waterfront. Such lists as compiled by Professor W. E. Coats* could be used as additional sources for selecting new planting. Native shrub vegetation should be introduced where possible. Shrubs with unusual berries, cones and drupes provide year round interest for wildlife as well as human recreation. Care may need to be exercised in the use of such fruiting species in areas with highly contaminated soils and atmospheric fallout to prevent hazardous toxic effects on dependent wildlife populations.

In specific site locations, especially in industrial areas, careful consideration must be taken of soil toxicity and air pollutants in the immediate vicinity. Recent experience of high mortality in new street tree plantings, such as at Cherry Street, reinforce the need for such care.

E-III. Maintenance of Wildlife Values

While it is unquestionable that due protection is accorded to distinctive wildlife forms which represent discretely definable unique values covered under E-I above, it is equally important that more pervasive wildlife values are also attended to. These exist in the form of ecological benefit resulting from interdependency, especially predation, of various species which ensures population control. More immediately demanded and often misguided wildlife management is practiced in response to readily perceived nuisance represented by some species to man. To ensure that these essential management requirements are neither ignored nor capriciously practiced, regulated use and management of critical wildlife must be followed.

E-IIIA. MAXIMUM ECOLOGICAL BENEFIT

E-IIIA1. Safeguard presence of ecologically beneficial wildlife spe-

*W.E. Coates, Shrub Selection for Surface Mining Reclamation Projects, School of Landscape Architecture, University of Guelph, undated.

ies to ensure controlled populations of pest species.
Ring Billed and Herring Gulls, Saw-whet and Snowy Owls, Great Blue Heron, Hawks and Common Tern are some of the most notable species, which through scavenging and predation, ensure ecological balance. Requirements pertaining to their continued presence appearing under E-IA, E-IB, and E-IC should be followed.

E-IIIA2. Manage preferred habitats of ecologically beneficial species to ensure their continued presence.
Follow requirementsfor preferred habitats: Beach, Dune, Rocky Areas, Open Water, Wet Meadow, Lagoon Edge, Woodlands, Grassy Park and Old Field as listed under E-IIA, E-IIB, E-IIC, and E-IID.

E-IIIB. MINIMUM NUISANCE

E-IIIB1. Manage preferred habitats of nuisance species to limit the numbers of these species without sacrificing the value represented by these habitats for other wildlife, vegetation, and recreation interest.
In addition to the noticeable annoyance caused by burgeoning sedentary populations of Canada Geese, only a limited number of other wildlife species are perceived to be nuisance in the waterfront. The perceived nuisances in residential areas are generally due to damage caused to structures and garden crops by rodents, small mammals and large numbers of some avian species which are attracted by and nest within the shelter provided by the man-made environment. As the natural predators of these species are excluded from these environments, by their own choice or more often by human action, larger populations result. Nuisance is increased, as is also the potential hazard for disease communication. Cottontail rabbit, rock dove and starling are notable in this category. As a rule, their preferred habitats are highly disturbed man-related vegetation associations of Grassy Park, Old Field and Residential. Open Water and Beach/Dune associations need to be included, even though marginally. To ensure minimum nuisance, it is important that the population control of offending species be selectively practiced with great caution. A positive way of dealing with the problem is to diversify their habitats to encourage their use by healthy and viable wildlife communities which ensure presence of ecological beneficial species.

Maintenance of appropriate woody vegetation should contribute to encouraging creature diversity. Shrub and vine planting should be emphasized. This increases stratification and availability of habitats for other species. Increased wooded margins are an added help. Fruit bearing plants provide year round sustenance for a variety of wildlife.

Appropriate management requirements listed under E-IIA, E-IIB, and E-IID should be followed.

SYNTHESIS

OPPORTUNITIES AND CONSTRAINTS FOR FUTURE LAND USES

INTRODUCTION

The principal purpose of this study is to organize the information known about the environment of the Central Waterfront in such a way that is can be used for a wide range of planning purposes by government agencies, private groups, and individual citizens of Toronto. The previous steps of this study make explicit the values assigned to specific environmental resources and the consequences of future actions. Since the values are explicit, the study can be used by different groups with discrete needs and values. The features pertinent to the needs of any group or individual can readily be isolated. Since the consequences of future actions are made explicit, any resulting conflicts with overall values can be determined. This permits the formulation of public policy for the Central Waterfront which will ensure that forecastable conflicts are avoided and also focuses public discussion on environmental issues, competing land uses, and resulting consequences before any decisions are made.

Once public discussion has taken place and policies have been formulated, the relevant performance requirements for future actions are easily translated into by-laws or ordinances to regulate future activities in the Central Waterfront.

When the need for prospective land uses has been determined, the tools provided in this study can be used to identify the most suitable locations for specific activities or uses. This determination of suitabilities will aid in the development of an Official Plan for the Central Waterfront which will ensure that resources are utilized in the best public interest. The same tools can also be used to set priorities for public action, such as land acquisition, for the purpose of protecting critical resources, or for the development of public works, ranging from conservation to intensive industry. Since the implications of all future actions are clear, the assessment of the environmental impact of specific proposals is facilitated.

The study is also of use to the land developer, whether public or private. The most suitable uses for a particular parcel of land are easily identified, as well as the constraints which must be addressed. Specific design strategies and guidelines must be developed for a particular project to ensure meeting the specified performance requirements.

WATER RESOURCES: OPPORTUNITIES AND CONSTRAINTS

The application of this study for planning purposes is demonstrated in three examples. The first examines the opportunities and constraints imposed upon future actions by social values associated with one resource factor. The other two examples examine the suitability of many resource features for two land uses.

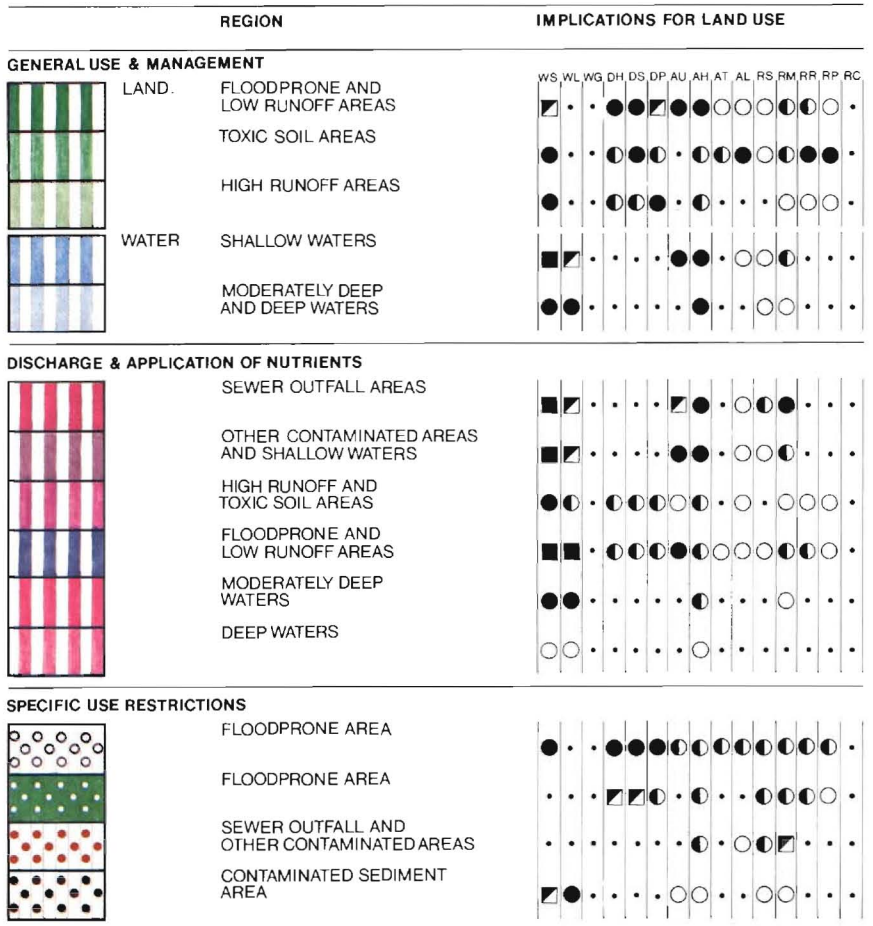
The first example illustrates the opportunities and constraints for prospective land uses which result from the social values assigned to Water resources. Opportunities for water-related recreation and development are greatest in shallow water and at the land-water interface. Constraints imposed upon future actions apply to both land and water features. Constraints for resource features which relate to the same social objective are grouped together on the legend. Similar performance requirements apply to the features within each group, and the categories follow the format of sections and subsections described in Performance Requirements for Future Actions.

General Use and Management refers to the need for protecting the resource value of water (H-III). This requires the regulation of runoff (H-IIIA) and water use (H-IIIB). All areas requiring runoff management are indicated on the map in vertical green stripes. All areas requiring the regulation of water use appear in blue vertical stripes. Regulation of Toxicants and Nutrients refers to the need to maintain water quality (H-II). To fulfill this objective, the application of toxicants and nutrients on land (H-IIA) must be restricted, as well as the discharge of toxicants to water (H-IIB). In addition, fill operations should be regulated (H-IIIC). Areas requiring regulation to maintain water quality appear in purple vertical stripes. Restrictions on Specific Uses are required to minimize hazard (H-I) resulting from flooding (H-IA) and contaminated water (H-IB).

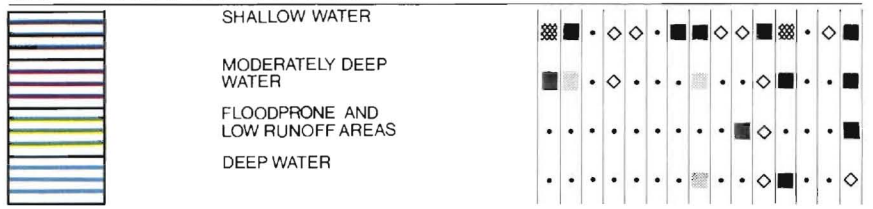
The synthesis of environmental data for one resource is useful to groups who are concerned with the management of one resource. The synthesis of all Water resource factors might be of particular interest to the Water Management Branch of the Ontario Ministry of Environment, for example, whereas a synthesis of Life resources would be valuable for a group like the Toronto Field Naturalists' Club. The C.W.P.C., charged with the responsibility of evaluating all resources in regard to many prospective land uses, will be concerned not just with one factor, but with the overlapping of all factors.

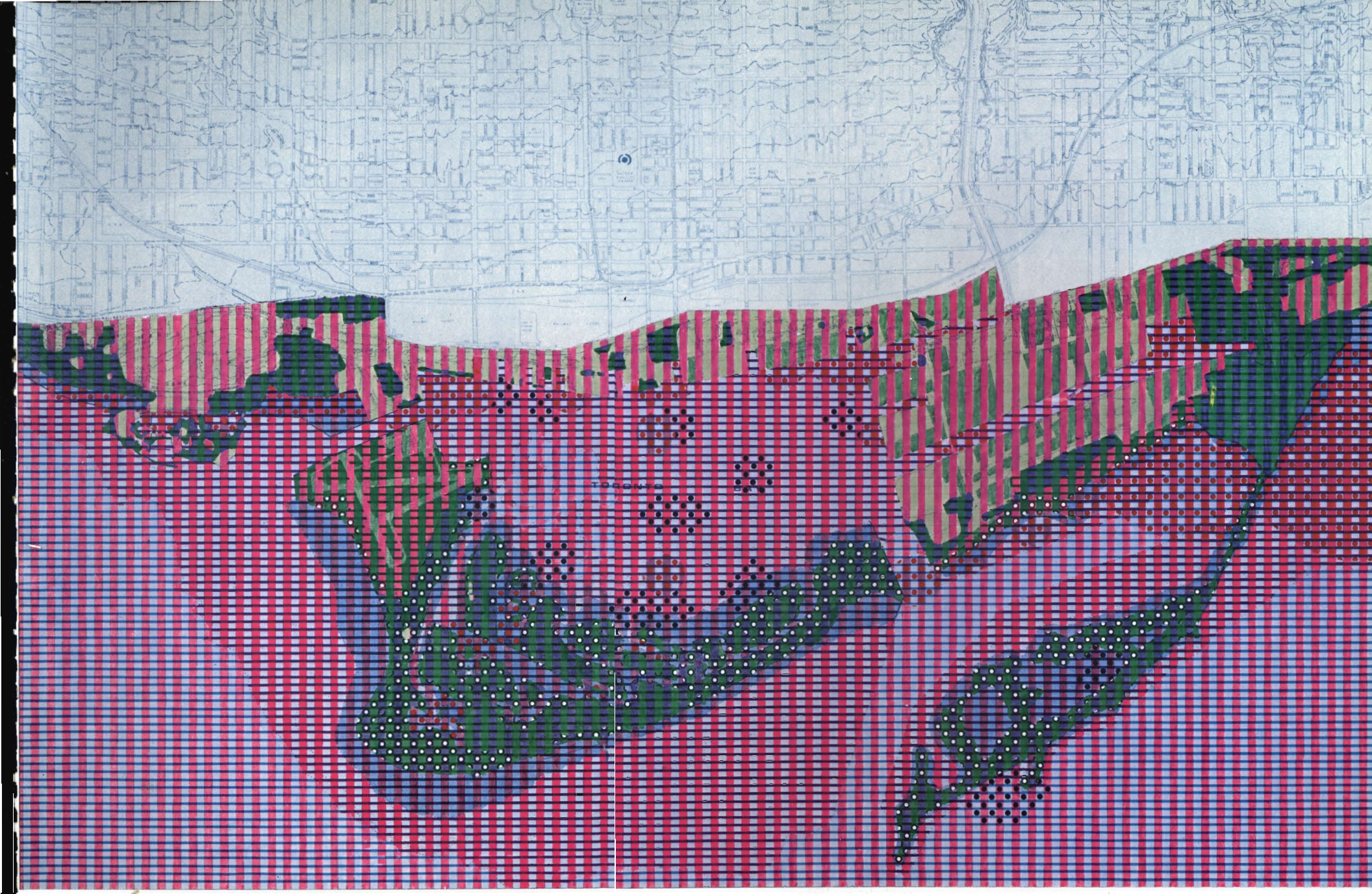
WATER RESOURCE

CONSTRAINTS

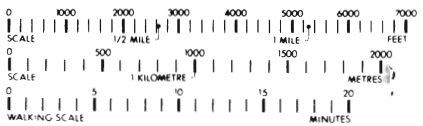


OPPORTUNITIES





WATER RESOURCE
OPPORTUNITIES & CONSTRAINTS



SUITABILITY FOR DEVELOPMENT AND RECREATION

The Development and Recreation Suitability syntheses result from the superimposition of all natural resource factors according to a specific set of rules. The human land use factor, Location, is not considered here since the imperatives imposed by it are likely to preempt consideration of all but one specific land use in a particular place. For example, the fact that the majority of the Toronto Islands are public parkland renders their suitability for development purposes of academic interest. Nevertheless, it is useful to identify the intrinsic suitability of the whole waterfront for the accommodation of development or any other land use. The limitations imposed on future actions by Location factors will be considered during the next planning step.

The purpose of the suitability synthesis is to determine those areas best suited for a particular land use. The synthesis procedure employed here is a two-step process. The first step is an inventory of all resource features which represent some opportunity or constraint for the specific land use under consideration. This is readily accomplished by a review of the Resource Interpretation Charts, on which opportunities and constraints are explicitly identified for a range of use categories. In order to use these charts, it is necessary to define a prospective land use in the same terms as the use categories on the charts. These categories are described in the Introduction to the Resource Interpretation section of this study (p. 68). Any land use is composed of a major use and one or more supporting uses. For example, a recreation complex such as a stadium is both an intensive recreation use (RR) and a heavy structure (DH). It requires supporting uses of extensive paving (DP) for parking and major roads and transit systems (AH), as well as minor supporting uses of utilities (AU) and landscaping (AL). A natural history study area, on the other hand, is a special recreation use (RS), which may also imply conservation (RC), and which requires only one supporting use—minor roads and trails (AT). To determine the applicable opportunities and constraints for the land use under consideration, all major and supporting use categories should be considered.

Once an inventory has been made of the opportunities and constraints applicable to each major and supporting use, it is possible to ascertain an overall suitability for the composite land use. Ideally, the most suitable location for the intended land use is where high opportunities exist for both major and supporting uses, with an absence of high constraints. If such an ideal concurrence is found, the search for the most suitable location is over. Failing such concurrence, a less suitable place must be found. If the search method is explicit in identifying the reason why a location is less than ideal—either through diminished opportunity and/or the occurrence of constraint—compensating actions may be considered which will overcome the limiting factor.

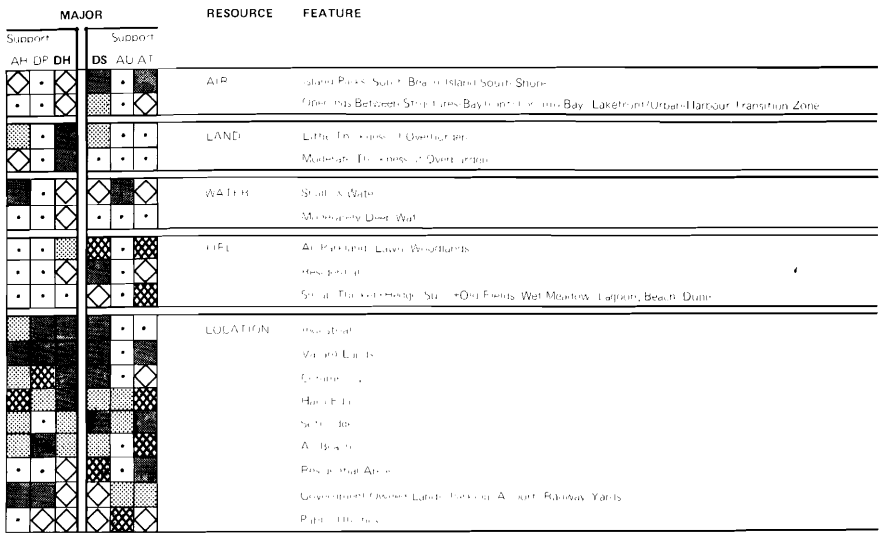
For example, a site may be extraordinarily endowed with resources which represent a great opportunity for water related recreation (such as swimming or sailing), but the fragile shoreline vegetation may pose a severe constraint to the construction of required supporting public facilities (access to water, bathhouses). The overwhelming need of catering to the social demand for such a facility may be met by designing the facilities in such a way that the fragile vegetation remains undisturbed. This may necessitate designing a special foundation for housing the required facilities and providing access by specially designed public use areas, such as boardwalks, which will minimize the loss of precious vegetation.

In another instance, the presence of good foundation conditions, spectacular scenic views, and accessibility to transportation may represent a great opportunity for some institutional use, while the absence of vegetation, the presence of toxic soils, and exposure to strong storm winds represent constraining site factors. In this case, the constraining features may be compensated for by special design features such as sheltered walkways and imported soils and landscaping. So long as limiting factors are made explicit, compensating actions may be considered.

The synthesis procedure is applied here to determine the most suitable locations in the Central Waterfront for two extremes in intensity of use. The requirements for accommodating high intensity industrial, commercial, residential, and transportation uses are examined under the general category of Development. Lower intensity uses which require little alteration of the existing environment are examined under the general category of Recreation. Although specific suitabilities will need to be identified in the future in response to detailed planning requirements, these general categories are sufficient for demonstration purposes.

DEVELOPMENT SYNTHESIS: OPPORTUNITIES

Development Type

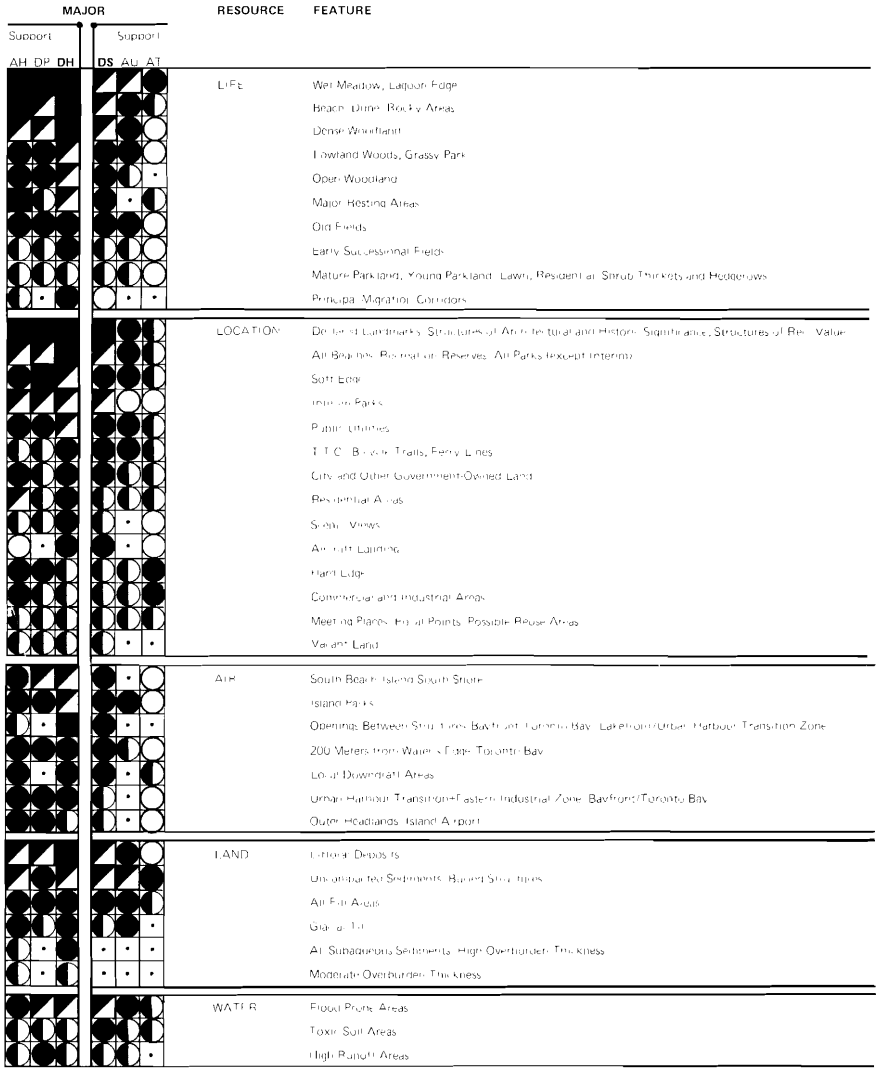


The first synthesis step for the Development Suitability Synthesis is the identification of the major and supporting use categories. The suitability for two dominant uses is examined: heavy structures (DH) and light structures (DS). Small residential, commercial, or institutional structures (DS) require supporting uses of minor roads (AT) and utilities (AU). Heavy apartment or office buildings or large industrial structures (DH) require extensive paved areas (DP) for parking or storage and major roads and transit systems (AH). All resource features which represent opportunities or constraints for these use categories are aggregated on the Development Suitability Charts.

In the second synthesis step, the resource features are examined to reveal their suitability for development, ranging from the greatest opportunity with the least constraint to the most constraint with the absence of opportunity. For example, woodlands vegetation represents an opportunity as a pleasant setting for development with concurrent constraints resulting from the need to restrict clearing, while floodprone areas are constraining due to measures which must be taken for flood protection with no simultaneous opportunity value. The list of resource features determining development suitability appears next to the Development Suitability map.

DEVELOPMENT SYNTHESIS: CONSTRAINTS

Development Type

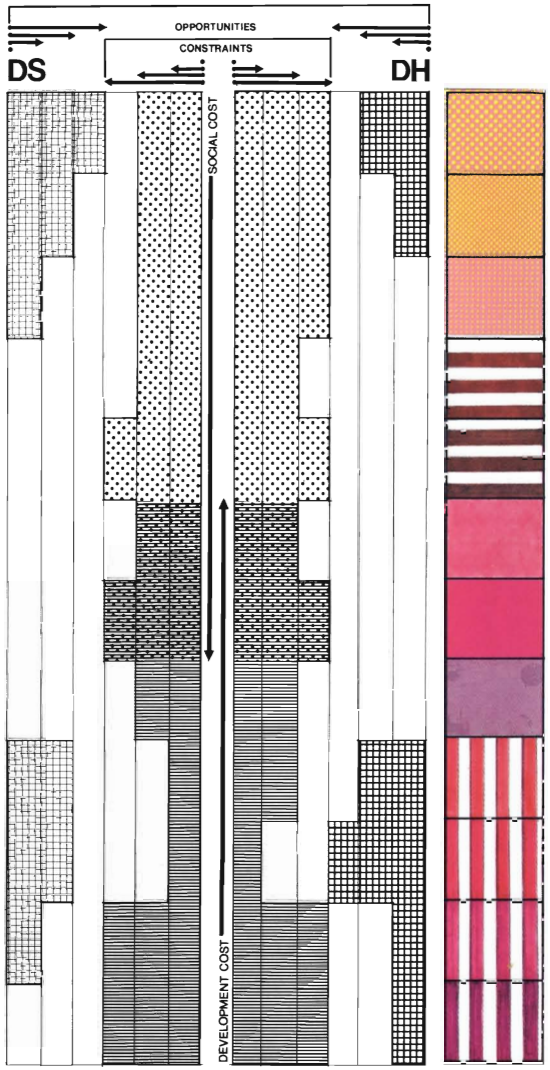


DEVELOPMENT SUITABILITY SYNTHESIS

Suitability = Opportunity / Constraint for Major Use + Minor Supportive Uses

Development Type

DEVELOPMENT SUITABILITY SYNTHESIS



FEATURE

(LIFE) Mature and Young Parkland,Lawn, Residential, Shrub Areas
Open Woodland
Lowland Woods, Grassy Park
Dense Woodland

(AIR) Island–South Shore
Island Parks
Openings Between Structures/Toronto Bay and Urban–Harbour Transition Zones

(LIFE) Early Successional Fields
Old Fields
Beach, Dune, Rocky Areas

(LIFE) Principal Migration Corridors
(AIR) Urban Harbour Transition and Eastern Industrial Zones, Bayfront/Toronto Bay Zone
(WATER) Toxic Soil Areas
(LIFE) Major Resting Areas

(LAND) Littoral Deposits

(AIR) Outer Headlands; Island Airport/ Island– West Shore
(WATER) High Runoff Areas
(AIR) 200 Metres from Water's Edge/Toronto Bay Zone and Island–West Shore

(WATER) Flood Prone Areas
(LAND) Uncompacted Sediments, Buried Structures

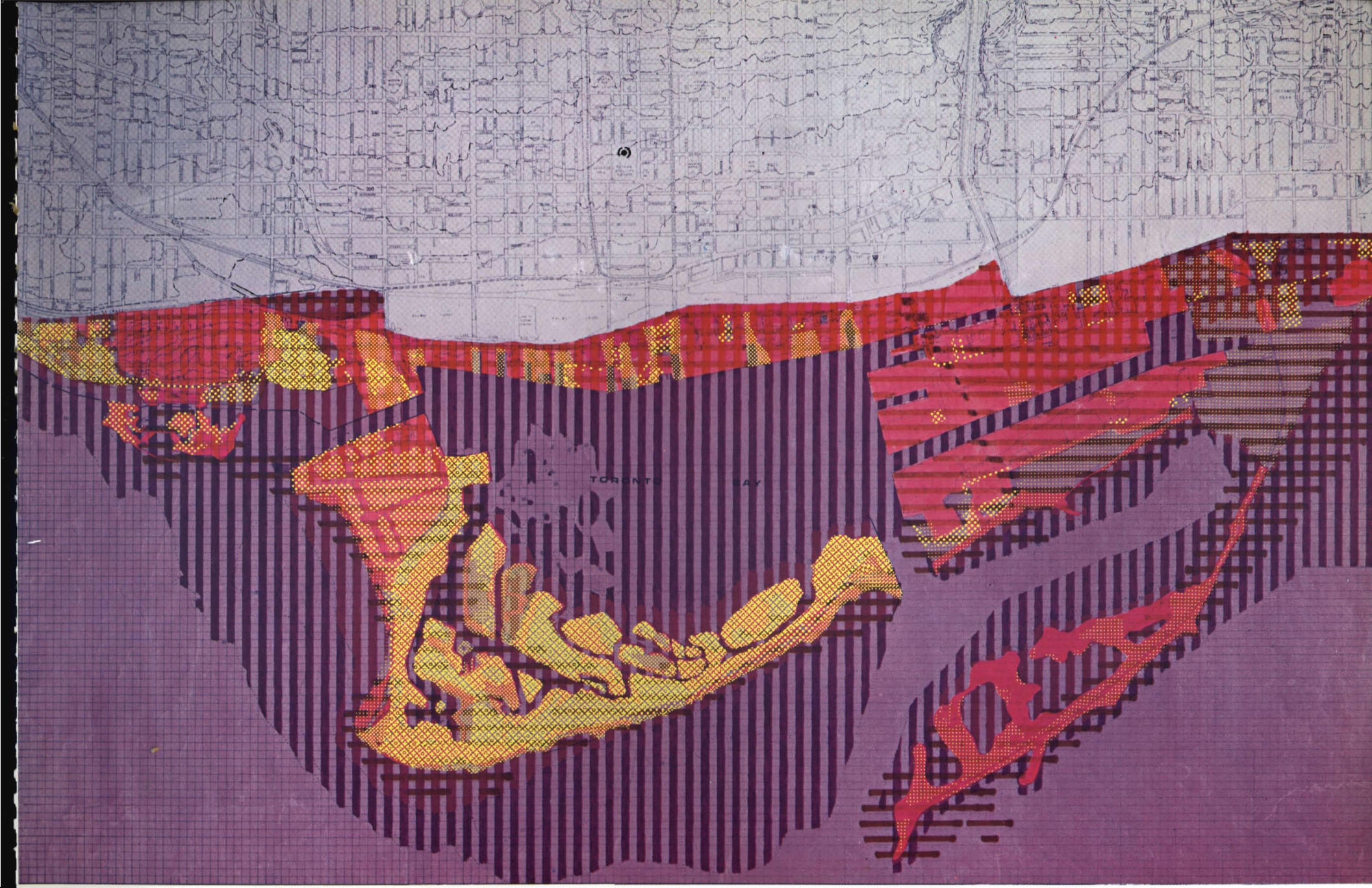
(LAND) All Sub-Aqueous Sediments, High Overburden Thickness
Glacial Till
All Fill Areas

(LAND) Moderate Overburden Thickness (20-60')

(LAND) Little Thickness of Overburden (up to 20')

(WATER) Shallow Water (0-10')

(WATER) Moderately Deep Water (10'-30')



DEVELOPMENT SUITABILITY
SYNTHESIS

It is evident that three distinct resource groups represent opportunities for development within the Central Waterfront. Selected vegetation types and "tempered" climatic zones offer opportunities for pleasant settings. Constraints related to these features entail regulations to ensure that the social values which they represent for the overall community are not compromised. These features are essentially confined to the Toronto Islands and the Outer Headlands and appear on the Development Suitability map as a yellow pattern. The second and third opportunity groups are related to the thickness of surficial deposits and the depth of water. The related constraints manifest themselves as real development costs, rather than social costs. These features are identified on the map in red and purple vertical stripes.

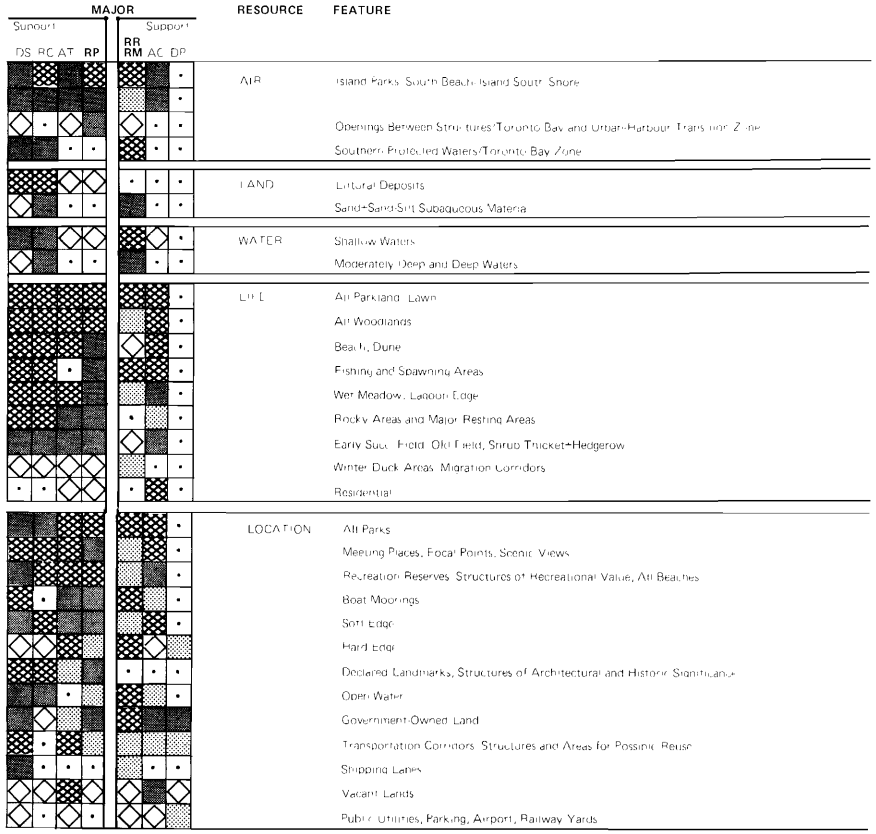
Underlying the opportunity areas are those resource features which represent constraints to development with no accompanying opportunities. These result from the requirements of protecting wildlife, maintaining air quality, and maintaining and protecting a unique geologic resource (littoral deposits), in order to minimize the loss of resources to society. These limiting factors are identified in brown on the map. The meeting of performance requirements for other resource features is necessitated to ensure avoidance of social cost, but also entails measurable development cost. Run-off management and protection against flooding, unstable land and inclement microclimate are such features. These are identified in pink-lavender on the map.

The Recreation Suitability Synthesis follows the same procedure as that employed in the Development Suitability Synthesis. The suitability for two major uses is examined: general, low intensity recreation (RP) and intensive recreation (RR/RM). The major category of general use recreation (RP) requires supporting uses of minor roads and trails (AT), conservation (RC), and special recreation (RS). Intensive recreation for specific uses can be land related (RR) or water related (RM) and requires supporting uses of landscaping (AL) and extensive paving for parking (DP). Resource features which represent constraints and opportunities for these use categories are aggregated in the Recreation Synthesis Charts.

The two distinct resource groups represent opportunities for recreation in the Central Waterfront. Water related opportunities are extensive, but qualified by constraints imposed by regulations to ensure health in contaminated water areas, to maintain water quality, and to minimize disturbance to aquatic wildlife. Deep blue stripes identify these areas on the Recreation Suitability map. Opportunities for land-based recreation are essentially related to the presence of vegetation and wildlife. Related constraints are minimal for passive use and moderate for intensive uses which must ensure minimum disturbance of vegetation and wildlife habitats. These resource features are identified in green textures on the map. The darker textures emphasize the resource values for both land and water-related recreation forms.

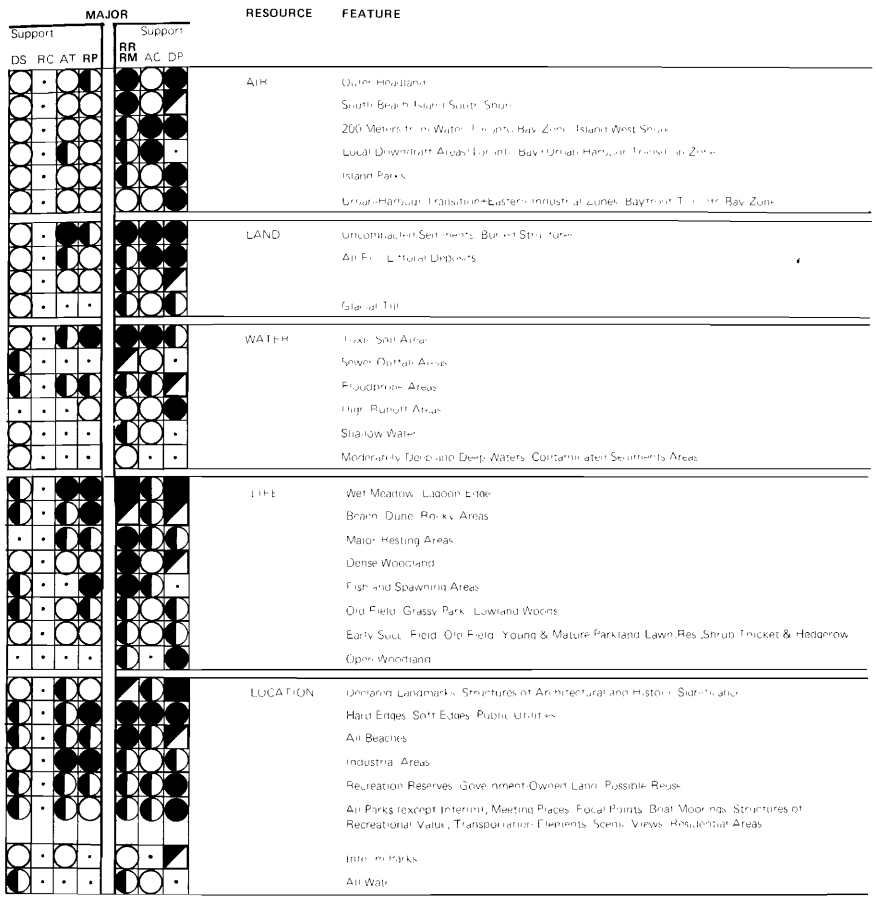
RECREATION SYNTHESIS: OPPORTUNITIES

Recreation Type



RECREATION SYNTHESIS: CONSTRAINTS

Recreation Type



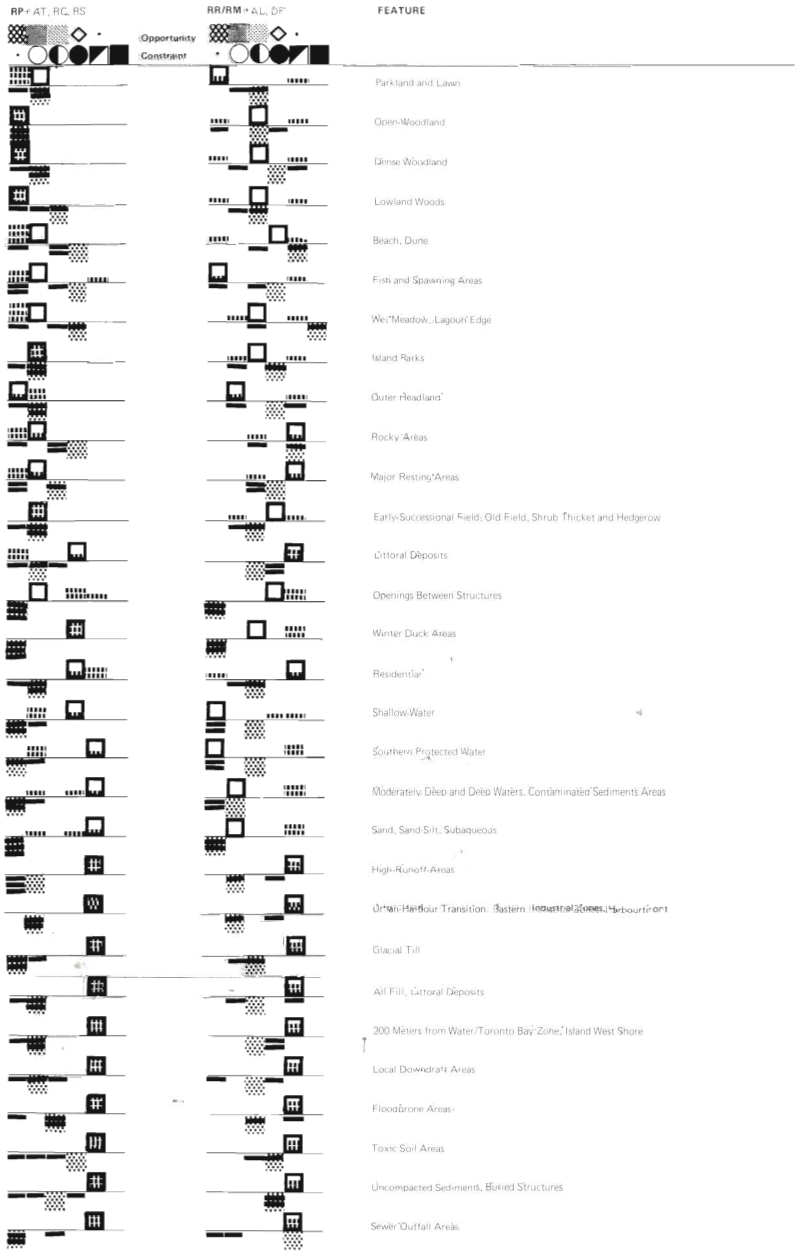
Extensive areas of the mainland represent little natural opportunity for recreation. In addition, the accommodation of recreation demand is constrained due to the need for avoiding hazards related to unstable land, toxic soils, flooding, pollution vulnerability, and inclement microclimate, and for maintaining the recharge of runoff. Deepening shades of brown on the map indicate the relative severity of constraints for recreation which are present within the waterfront.

The Development and Recreation Suitability Syntheses reveal all parts of the Central Waterfront to have opportunities and constraints for these uses. As far as possible, overlapping values have been mapped. The allocation of any site for a specific development or recreation type should entail the relative weighting of the concurrent values represented by environmental features on that site. Future planning action must address itself to the elucidation of the relative importance of competing values, and to the most feasible means for ensuring the maintenance of the assigned values. Decisions about allocations of these resources can then follow. In the end, the final synthesis which leads to a plan for the Central Waterfront will reflect the social and economic environments as well as the natural environment. This is a future task outside the scope of the present study.

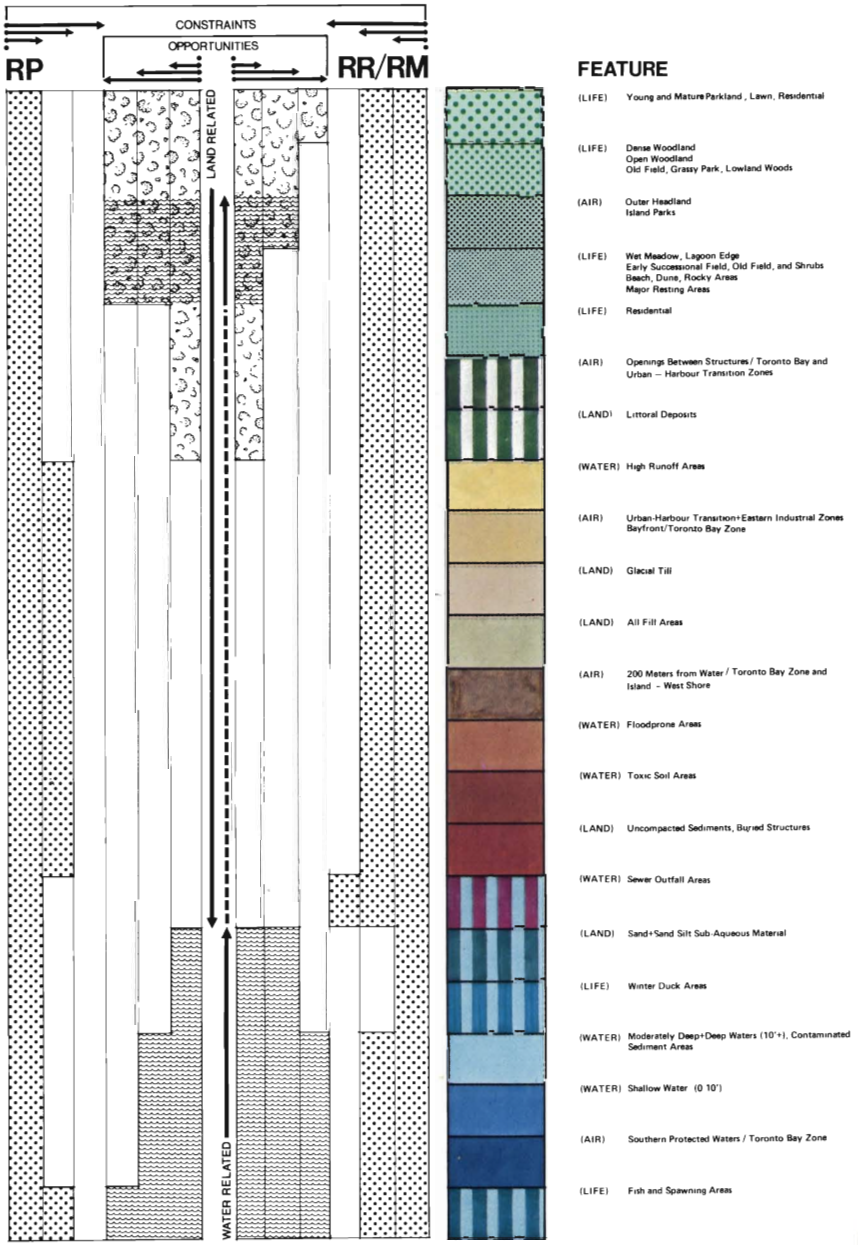
RECREATION SUITABILITY SYNTHESIS

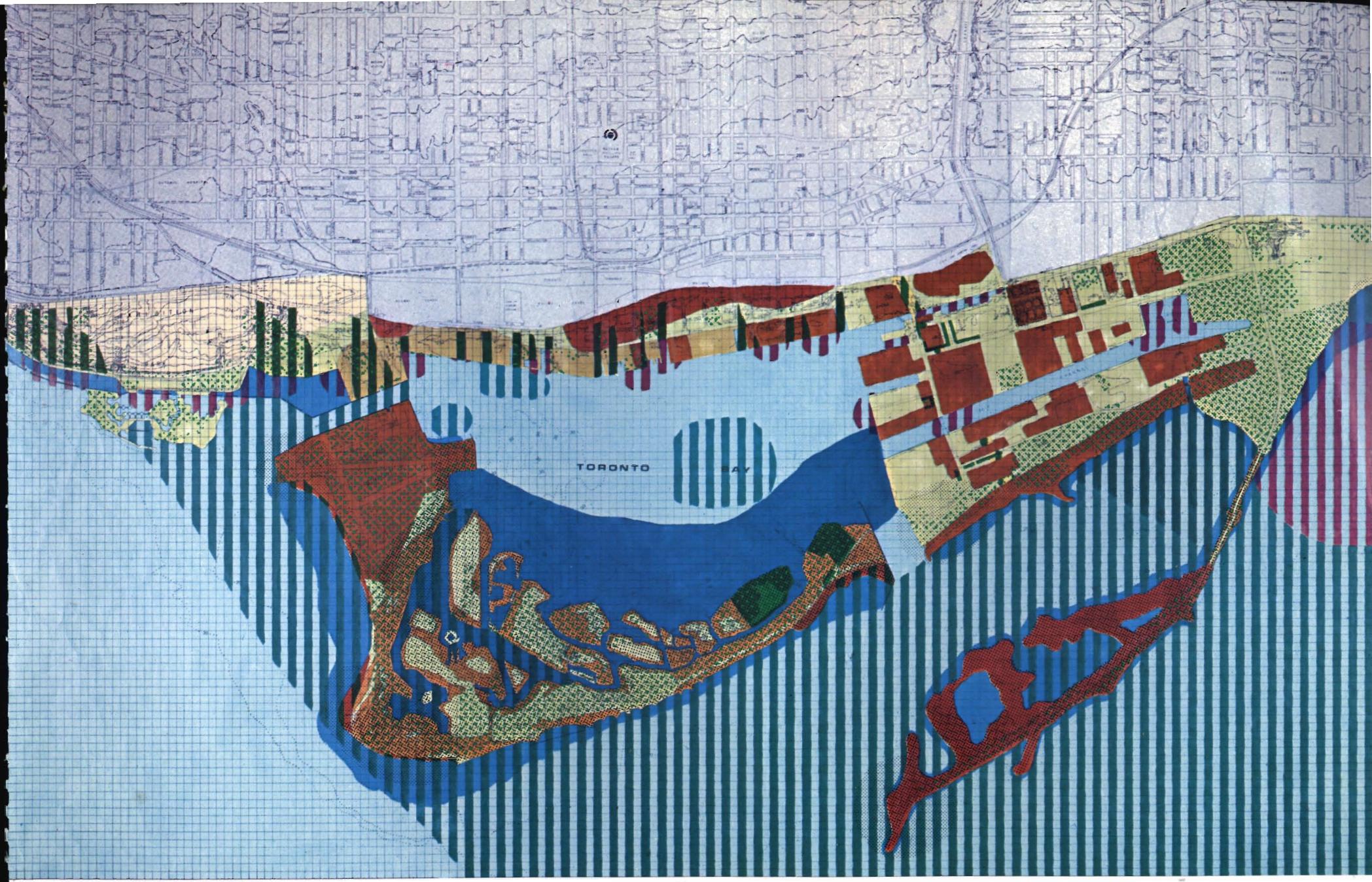
Suitability = Opportunity / Constraint for Major Use + Minor Supportive Uses

Recreation Type

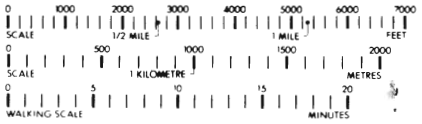


RECREATION SUITABILITY SYNTHESIS





RECREATION SUITABILITY
SYNTHESIS



SYNTHESIS

FUTURE PLANNING ACTION

The preceding suitability syntheses for development and recreation provide a base reference for future planning action. The rules employed in combining data have been explicitly defined and any weighting of competing values avoided. It is inevitable that, in the preparation of the Official Plan, conflicts between competing values will have to be resolved. The resolution of conflicting values will emerge from an evaluation of the consequent environmental impact of each proposed use. In some instances, identification of the full impact may not be possible because of insufficient data. It is therefore necessary that future planning action places a high priority on the completion of the data base as recommended in Inventory: Future Data Requirements.

Recommendations for the acquisition of additional data have been made to ensure a comprehensive understanding of the waterfront environment so that all social objectives may be addressed. During the course of the study, it became obvious that certain environmental factors are of particular and immediate concern. Most of these pertain to the locational features and some of these are identified as "Problem/Issue" features under the Location resource category. Specification of performance requirements for Location resources are the task of future planning action. At that time, the need for specific additional data will become evident. Some of these can be foreseen, and it is worthwhile to highlight them here for immediate future action.

Although air quality monitoring within the waterfront will continue and local air emissions will be regulated according to M.O.E. standards, the issue of cumulative effects must be addressed. This is especially important to downwind recipients of air emissions both within and outside the Central Waterfront.

Early resolution is needed of the conflict between two operative policies pertaining to noise control. The provincial policy of establishing noise criteria which requires conformity by all sources regardless of their location differs markedly from the City of Toronto's policy of designated noise zones within which "fit" uses are permitted. This issue is of particular relevance to the expressed objectives of protecting certain noise sensitive areas. Such areas need to be clearly defined and specific guidelines for them developed. Better definition of current noise characteristics also needs to be clearly established through weekday and weekend monitoring, as recom-

mended in Future Data Requirements.

The planned water quality studies by M.O.E. will contribute to a more comprehensive understanding of the water regimen within the waterfront and specific actions needed to ensure better water quality. In the meantime, early action should be undertaken in those areas where immediate problems are clearly evident. The prime contributor to the degradation of water quality within the waterfront is the discharge from the Don River. An immediate commitment must be made to improve the quality of the Don's lower reach through study and regulation of contributory uses. The value of beaches and the safety of prospective water contact sports is fully dependent upon maintenance of water quality in the Outer Harbour. This in turn is dependent upon the quality of water within the Turning Basin, which gets transferred to the Outer Harbour through the cooling system of the Hearn Generating Plant. Sewer and toxic runoff discharges into the Turning Basin should be immediately curtailed.

The sewer separation programme presently underway will alleviate the current problem of raw sewage entering the harbour waters during storm periods. Nevertheless, the quality of runoff from urban streets and developed areas still poses a threat to the maintenance of satisfactory water quality. An investigation must be made of the contributory effect of urban runoff upon water quality, and if necessary, a system should be devised for directing early storm runoff into the sewage system to ensure its treatment before discharge. The poor quality of water in the boating basin at Ontario Place, the northwest corner of the Inner Harbour, the slips at Spadina, Simcoe and Yonge Streets and the combined sewer discharge area between Jarvis and Parliament Streets is suspected to be partially a result of this runoff pollution.

To safeguard against far reaching effects of poor water quality, it is worth reiterating the recommendation made earlier that the water quality guidelines for the discharge of elemental and chemical toxins be related to the resultant exchangeable ions which permit the passage of these toxicants to other life forms through plant growth and animal ingestion.

The vegetation is the most grossly perceived aspect of the natural environment, thus its presence in sufficient numbers and quality is subject to public attention. The mature vegetation on the Toronto Islands requires immediate attention towards its renewal. Careful planting and management policies should be developed for early realization of mature vegetation. These policies should be compatible with the present vegetation and its current recreational use. On the mainland, the sparse vegetative resource needs to be augmented with careful regard to the current disturbed, sometimes toxic, local conditions. An extensive "greening" of the mainland parts of the waterfront can go a long way in providing micro-climatic amelioration and aesthetic and wildlife interest.

The rich wildlife resource value of the waterfront results from its location within the major lakeshore migration corridor. The sustained presence of migratory wildlife is assured due to responsible public policies which have ensured the protection of valuable rest areas within this corridor on either side of Toronto. The Toronto Islands and newly formed Outer Headlands also serve a similar function. Projected development of Aquatic Park on the Headlands and future management of the Toronto Islands must ensure that this valuable function is safeguarded.

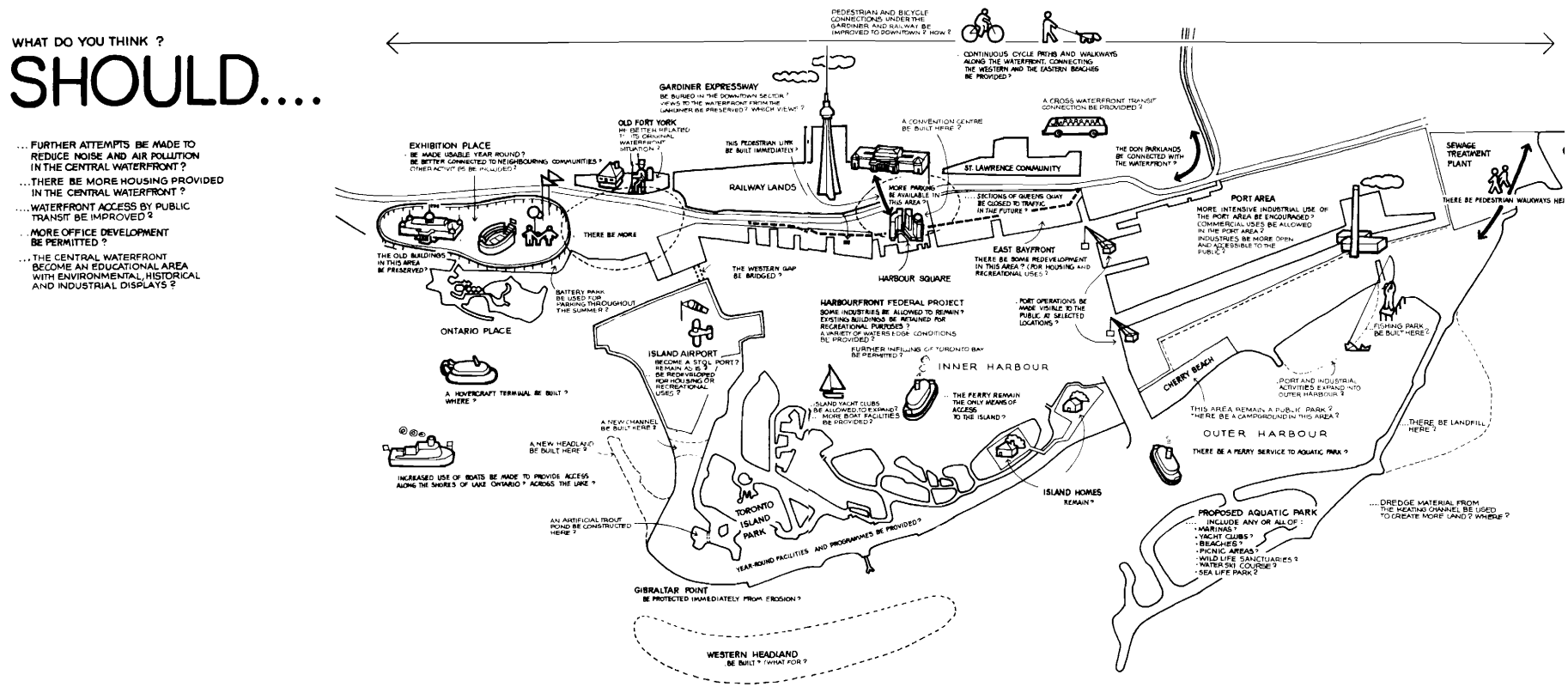
Decisions about current and future land uses are critical in determining the future of the waterfront environment. The City of Toronto Planning Board through its future planning actions will assume the responsibility for ensuring that this future is a source of pride for the citizens of Toronto. To this end, the outline of the future work by the Waterfront Staff of the City of Toronto Planning Board follows.

In August, 1976, the C.W.P.C. adopted a schedule for the completion of its second-phase work programme which saw preparation of Policy Proposals taking place in three stages following completion of the Information Base Reports and the Environmental Synthesis. The three stages would consist of the preparation by staff of Policy Advancement Papers for each sub-area (e.g., the Bayfront, Port and Outer Harbour areas), Draft Proposals, and Final Proposals. Each stage will be subject to comprehensive review. Policy Proposals are expected to be ready for public debate in July, 1977. This entire process is dependent on consensus being achieved by C.W.P.C. members on crucial issues such that the policy recommendations which emerge have the prior backing of the implementing agencies and the public. Without such backing there is little likelihood of any implementation.

The methodology put forward in this report should materially assist Planning Committee members and staff in this process. The C.W.P.C. and Area Task Group members should use the Information Base material to identify environmental issues particular to the sub-areas and those common to the entire Central Waterfront which must be resolved in the Official Plan policy development process. As their work advances to consideration of different policy choices, the C.W.P.C. will be able to use the synthesis tools to evaluate the environmental consequences of the proposals, and to assess the environmental capability of the various resource features for a range of land and water uses.

Section 1 of this report, Inventory, points out that there are data gaps, some quite serious. But the overall methodology is comprehensive and as further data become available it will not be difficult to make adjustments.

With respect to the future Information Base, there are two issues which must be resolved. First is the assignment of responsibility for conducting the further studies needed to fill information gaps described in this report. Conclusions must be reached early in 1977 to permit the designated agencies to allocate necessary funds for the 1977 Fiscal Year. Second is the need to incorporate the additional data into the framework established by the Environment Information Base and this synthesis study. Computerization of the data is a recommended next step. Again, responsibility for this work must be assigned (to one or more agencies) and funds allocated.



Planning Issues in the Central Waterfront

Source: C.W.P.C., Programme for Planning, 1974.

Computerization of the Synthesis stage for a portion of the Central Waterfront has been completed as a demonstration. Its purpose is to ensure a rapid response to planning questions regarding the synthesis material and to incorporate changes to the resource data or the social values attached to these. As matters stand, the method permits and accomplishes this manually. The manual procedure, in addition to being time-consuming, restricts the number of options which can be tested. The demonstration computer program has been designed for a small area, but can be extended to the entire Central Waterfront. This should be undertaken in 1977. The agency best suited to accomplish this task is ideally the one which is able to assume overall responsibility for data gathering, incorporation and computerization.

The performance requirements developed in this report will assist planning staff and Committee members in evaluating specific land use proposals and in working with proponents to ensure that the CWPC's social objectives are met. Implementation of the guidelines is likely to require extensive cooperation, as various jurisdictions will be involved in the legal aspects of implementation. The general performance requirements should be expanded particularly in areas such as the Harbourfront or the East Bayfront, where detailed, site specific guidelines are needed to maintain (or improve) environmental values. Preliminary Part I and II Official Plan work will identify areas where such detail is required, and, where vital, studies will be undertaken prior to development of final policy recommendations.

This approach to planning has wider applicability in the Metro Toronto region. Areas such as the Valley Lands, adjacent waterfronts, and regional watersheds should benefit from this approach. The responsible agencies should consider this and benefit from the experience gained over the last two years and the tools that have been developed.