

An aerial photograph of a coastal area, likely in Ozauc County, Wisconsin. The image shows a road curving along the shoreline of a large body of water, Lake Michigan. There are several buildings and structures visible, including what appears to be a large industrial or commercial building with a prominent roof structure. The water is dark and textured, and the land is a mix of paved areas, grass, and trees.

**ASSESSING COASTAL
DEVELOPMENT ALONG
OZAUKEE COUNTY'S
LAKE MICHIGAN
SHORELINE:
1978 - 1992**

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393
.W6
N55
1995

**Prepared for the Wisconsin
Coastal Management Program**

July 1995

Acknowledgements

FUNDED IN PART BY THE WISCONSIN COASTAL MANAGEMENT PROGRAM

Financial assistance for this *Research/Study Project* was provided by the Coastal Zone Management Act of 1972, as amended, administered by the Office of Ocean and Coastal Resource Management, National Oceanic and Atmospheric Administration pursuant to grant #NA370Z0349 and the **WISCONSIN COASTAL MANAGEMENT PROGRAM**.

THE WISCONSIN COASTAL MANAGEMENT PROGRAM, part of Wisconsin Department of Administration, and overseen by the **WISCONSIN COASTAL MANAGEMENT COUNCIL**, was established in 1978 to preserve, protect and manage the resources of the Lake Michigan and Lake Superior coastline for this and future generations.

The Project Team

This project required coordination and completion of several steps including map documentation, photo preparation, photo interpretation, digital area/linear measurement and data sheet preparation. The following students worked as a team to help complete this project.

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Invaluable help was provided by Karen Katers to coordinate preparation of the manuscript and project data sheets, and to manage student employment records. Her contribution deserves special recognition as part of the project team.

Also, a special thanks is made to the U.S. Army Corps of Engineers who allowed access to the aerial photos used in this project.

HT393.WIC.N55.188
5881-55M 3M.566LH

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Assessing Coastal Development Along Wisconsin's
Great Lakes Shoreline: 1978 - 1992

Coastal Management Program Contract No. 840005-501.15

INTRODUCTION

The Wisconsin Coastal Management Program mission includes developing an understanding of change along the state's Great Lakes shoreline. Such change, of course, can be natural or human-based. This study was undertaken to document natural and human-based development within the coastal zone of the state's Lake Michigan and Lake Superior shorelines. The Wisconsin legislature has defined coastal zone as land within 1,000' (304.8 meters) of the shoreline (Ordinary High Water Mark - OHWM).

Future coastal zone planning and risk assessment requirements defined the types of data to be collected. Assessment of risk to structures built in the coastal zone requires a temporal analysis of structural development and shoreline modification(s). Planning of the coastal zone requires, as well, determination of the natural resource base. This study utilized U.S. Army Corps of Engineers historic color aerial photographs taken in 1978 and 1992.

This report documents both the original and amended contract to assess natural and developmental change within the coastal zone of Wisconsin's Great Lakes shorelines. Although the original contracted work was interrupted to include elements of the amended contract, no attempt will be made in this report to keep separate original vs. amended objectives, procedures or results. Goals of the amended contract include and expand those of the original.

PROJECT GOALS

Planning and assessment of hazards within the coastal zone defined the goals of this study. Within the Lake Michigan and Superior coastal zones, project goals included:

- Development of land use databases for 1978 and 1992
- Development of 1978 and 1992 databases of human modification of the shorelines
- Develop a database of built structures for 1992

Additional goals included:

- Assess land use change within the coastal zone from 1978 to 1992
- Assess human modification of the shoreline from 1978 to 1992

STUDY AREA

The project study area comprises the Wisconsin portion of the Lake Michigan and Lake Superior coastal zone (Figure 1). In 1982, the Wisconsin state legislature defined coastal zone as being that land within 1,000 feet (304.8 meters) of lake shoreline. Accordingly, the study area represents a 1,000' wide



Figure 1. Coastal Counties of Lake Michigan and Lake Superior

zone, the landward boundary of which is parallel to the coastline.

PROJECT METHODS

Aerial Photography

Using aerial photos to assess coastal development requires clear statement of goals, appropriate definition of coastal zone, meaningful classification scheme, appropriate historical and current aerial photos, appropriate interpretation procedure and method of documentation, and trained personnel.

Application of aerial photography to assess urban and natural resource features is documented well (Smith, 1968; Avery and Berlin, 1985; Lo and Noble, 1990; Ciciarelli, 1991; Boge et al., 1992; Hinckley and Walker, 1993). Specific applications to urban/human activities cover a wide range including urban nonpoint pollution assessment (Kim and Ventura, 1993), gully erosion analysis (Welch et al., 1985), historical analysis of urban development into coastal wetlands (Niedzwiedz and Batie, 1984), identifying structural additions to urban residential property (Niedzwiedz, 1990), and studying agricultural land use (Marsh et al., 1990).

Aerial photos have been used to map archeological sites, urban features, and to document changes to the landscape (Smith, 1968). MacConnell (1975) reports the use of black and white aerial photography (scale 1:20000) to map 20 years of land use change within the state of Massachusetts, including the coastal zone. As part of a larger Great Lakes study, the International Joint Commission (1993) used 1:24000 scale photos to map land use features along the Berrien County, Michigan segment of the Lake Michigan shoreline. Results of the photo analysis were used to assess residential riparian erosion/recession rates caused by fluctuating water levels.

Wisconsin's coastal zone includes diverse land use, from forests and wetlands, to land devoted to agricultural or urban uses. The uses of aerial photos long have been applied to study such land uses. Befort and Viliman (1985) studied aerial photos to classify forest habitat. McCarthy et al. (1982) evaluated spruce-fir forests to aid management. Wetlands analysis is possible with aerial photos of appropriate format, scale and seasonal timing. Scarpace et al. (1981) used digitized aerial photos to map wetlands, while Ferguson et al. (1993) and Barrett and Niering (1993) have monitored sawgrass habitat and marsh vegetation change using aerial photos.

Extensive use of aerial photography has been directed at coastal resources. Scherz and Van Domelsen (1973) used aerial photos to help assess water quality in Lake Superior near Duluth, Minnesota. Numerous studies have been made with aerial photos to aid management of coastal resources (Benton et al., 1978; Hill et al., 1985; Norton et al., 1985; Welch et al., 1992), to address change in coastal wetlands (Lyon and Greene, 1992), and to

examine urban development into coastal wetlands (Niedziedz and Batie, 1984).

Project Aerial Photos

In 1978, the U.S. Army Corps of Engineers (USACE) obtained panchromatic color aerial photos of the Wisconsin portion of the Lake Michigan coastline. In 1992, USACE obtained color aerial photo coverage of the Wisconsin portion of both Lake Superior and Lake Michigan coastlines. Both the 1978 and 1992 photos were flown at a scale of 1:6000 (1" = 500') and enlargements made at 1:2400 (1" = 200'). The 1978 photos were taken April 16th. The 1992 photos were flown May 13th.

Unlike most historical aerial photos covering the same area and flown at the same scale, the USACE photos of 1978 and 1992 were not flown with coincident photo centers or coverage. No individual flight lines were documented for the 1978 photos. Beginning at the Michigan border, the 1978 photos were taken incrementally to the Illinois border. Photos are documented with the photo date and photo number on the northern edge of each photo.

Flight lines were documented for the 1992 photos. Flight line #1 begins just south of the Wisconsin-Illinois border. The northern edge of each 1992 photo displays the photo date, flight line and photo number.

Both the 1978 and 1992 photo contact prints (1:6000) were flown to produce stereo coverage of the coastline. Adjacent photos overlap (endlap) about 60% with each other. The enlarged photos (1:2400) available for this study represent every other photo contact print, therefore, only photographic, not stereo coverage, is provided by the enlarged photos. Approximately 1,800 photos (1:2400) cover Wisconsin's Lake Michigan shoreline, 900 for each flight year. About 1,200 photos covering the shoreline from Marinette to Sheboygan are on file at the Green Bay office of USACE. The Waukesha office of USACE has on file about 600 photos covering the shoreline from Sheboygan to the Illinois border.

Photo Preparation

Photos used in this study are owned by USACE. As a result, all photo documentation and interpretive work was applied to acetate affixed to each photo. Preparing photos for interpretation included the following:

1. Affix label and document photo number/flight line, photo date and Public Land Survey System (PLSS) information.
2. Mark photo fiducials (orange ink). Fiducials allow the registration of acetate overlays to the photos, if required.
3. Mark control points (orange ink). Typically these points are road intersections and, or buildings, stable objects

that could be referenced against controlled maps for future mapping applications.

4. Locate and mark interpretation boundary lines (black ink). These lines are used to denote a common boundary between adjacent photos. Land use interpretive lines end at these boundary lines, which eliminates redundant interpretive work.
5. Locate, mark and label PLSS section lines (red ink).
6. Locate, mark and label civil boundary lines (green ink).
7. Locate and mark 1,000' coastal zone boundary line (blue ink). A divider was used to scribe a line 1000' away and parallel to the line defined by land meeting water. In cases where large streams entered Lake Michigan, a straight dashed line was drawn to represent a continuation of the shoreline.
8. Locate and mark top of bluff, and bottom of bluff if slumpage is evident (black ink). In practice, these lines were not drawn until the shoreline portion of the classification scheme was applied to the photos. Refer to the section Photointerpretive Process (page 11) for additional discussion.

Aerial Photo Interpretation (API)

The landscape within the coastal zone can represent a complex mix of natural to urban uses. The land use classification scheme developed for this study addresses the complexity of Wisconsin's coastal zone. The scheme is a modification of the scheme developed by International Joint Commission (1993) and includes the general use categories of residential, commercial, industrial, transportation, extractive, agricultural, natural, open land and other uses. Land uses have been measured by area (acres, hectares). Structures per land use have been located and marked for spatial reference. Structures are tallied by type for 1992.

Modification of the shoreline also has resulted. Sea walls, revetments, groins and permanent docks have been constructed. Sea walls and revetments are linear types. Their interpretation and measurement are presented in feet (meters). Groins and docks were counted.

CLASSIFICATION SCHEME

Residential Land

All residential areas include infrastructure to service the area. Boundary placement is made to separate residential areas by type. No attempt is made to distinguish roads/streets from the residential areas they serve. This convention is true for other classification types as well.

- 111 Multi-Family: Medium to High Rise. Large residential structure of five (5) or more stories. Access roads, parking areas, open space and recreational facilities associated with the structure(s) would be included in the type.
- 112 Multi-Family: Low Rise. Large residential structures up to four (4) stories. Access roads, parking areas, open space and recreational facilities associated with the structure(s) would be included in the type.
- 113 Single Family, Duplex. Structures large and small used for residential use. The type includes lawn, landscaped areas, garage and driveways. Duplex structures are identified by twin driveways or a very wide driveway leading to an architecturally balanced structure.
- 115 Mobile Home Park. Residential area developed exclusively for mobile units.

Commercial and Industrial Land

Commercial land includes three (3) types: central business district; shopping center/mall; and, neighborhood business district. Each type includes all building structures, access roads/streets, parking facilities and other features commonly associated with each type.

- 121 Central Business District (CBD). Commercial land predominantly used for distribution or merchandizing of goods and services. Stores, hotels, office buildings, parking facilities and smaller warehouses constitute the components of this type. The CBD spatially is tight, vegetation is rare.
- 122 Shopping Center/Mall. These commercial areas have developed away from the CBD. The type includes both "strip" type development and malls. Structures can range from large, flat roofed and rectangular (centers) to large, geometrically shaped. Both types include large parking areas adjacent to or completely surrounding the commercial structures.
- 124 Neighborhood Business District (NBD). This type denotes small commercial areas within, or adjacent to residential areas. The type may be found in established or newer subdivision areas. NBD structures can range from conventional architecture to unusual geometric shapes. Small parking areas are associated with NBD commercial areas.

- 126 Institutional Land. The type reflects areas devoted to public or quasi-public uses. Examples include schools, churches, hospitals, prisons, etc., and their associated "grounds," green space, landscaping and parking facilities. When located within the CBD, public buildings without "grounds" often cannot be identified on aerial photos and would be classified as commercial (121).

Industrial Land

- 138 Industrial Park. The type includes both heavy and light industrial use areas.

Heavy industrial land contains facilities for the manufacture, storage and assembly of raw or partially processed products such as machinery, metals, chemicals, petroleum, or electrical power. Such industries often have large smokestacks and large storage areas. Warehouses and transportation facilities for bulk products and an open and interrupted street pattern characterize this type.

Light industrial land contains facilities for the manufacture or assembly of smaller, partially processed products such as electronics, appliances, and other secondary process products. Large smokestacks or raw material storage facilities are never present. Many modern light industries are well landscaped and are indistinguishable from commercial activity on aerial photographs.

Transportation Land

- 141 Air Transportation. Includes areas with airports and associated facilities, landing strips, hangers, parking areas and adjacent open areas.
- 142 Rail Transportation. This type includes railyards, terminal freight and storage facilities as well as stations for passengers. The type may include liquid storage facilities such as tank farms.
- 143 Water Transportation. This designation is applied to several water-based areas, including docks, warehouses and related land-based facilities for water transportation and commercial fishing. The type includes, as well, public marinas and their associated facilities: boat slips, buildings and parking areas.
- 143.1 Private Marina. Boat mooring areas adjacent to residential land are designated as private marinas. Often such areas include a protected slip(s), dredged waterway and, or a permanent docking structure built into the waterway.

- 143.2 Public Boat Landing. This type is applied to boat launching areas. Typically, facilities include only a ramp(s) from which boats may be launched and parking areas.
- 144 Divided Highway. This type includes transportation corridors with median strips between lanes. Typically, such roads are four or more lanes wide. Local streets are not included in this type.
- 145 Communications. Facilities and structures devoted to communications. These include radio/television towers, lighthouses and their grounds, buildings and parking areas.
- 146 Utilities. This type includes facilities for the production and distribution of energy. Such areas can include large buildings, towers, roads/parking facilities and, in the case of coal fired plants, large piles of raw coal.
- 147 Sewage Treatment Plant. Buildings, treatment lagoons, parking areas, access roads and grounds are included in this type.
- 148 Landfill. Landfill sites used to bury garbage define this type. Landfills cover an extensive area and are dominated by large excavated areas, mounds of exposed soil and access roads.

Extractive Land Use

- 171 Open Pit. The type represents open pit mining areas for extraction of sand, gravel, stone or rock. The type includes access roads and any structures.
- 172 Underground Mine. Mining of underground resources via shaft extraction. Surface features captured on aerial photos would be limited to small structures and access roads.
- 173 Well. Features associated with wells are limited. Identification of wells using only aerial photos is difficult.
- 179 Other Extractive Uses.

Agricultural and Natural Land

- 181 Abandoned Field (AF). These are agricultural units reverting to wild land. Woody vegetation and grass are abundant but tree crown cover is less than 30%. If tree crown cover were greater than 30%, the land would be classified as forest.

- 182 Agriculture Active (AG). Tilled or tillable crop land which is or recently has been intensively farmed. The boundaries on the ground usually are sharply defined and well maintained. The land supporting farm buildings is included as part of this type.
- 183 Forest (F). Areas of forest, deciduous, coniferous or mixed, having canopy closure of at least 30%. Areas with less than 30% canopy closure are classified as abandoned field.
- 184 Heath (H). Areas of heath plant community as well as grass, shrubs, and other low vegetation found on poor sandy soils.
- 185 Open Water (W). Areas of open water found in lakes, rivers and large streams. Water depth is greater than three feet during the growing season. The boundary of coastal water is located by drawing a line at the river mouth to connect the edges of the coastline, or man-made features like roads, railroads or bridges crossing rivers or inlets are used to establish such a line.
- 186 Rock Ledge (RL). Rock outcrop areas at the coastline or within the coastal zone. Such outcrops are common in Door County.
- 187 Slump Zone (SL). Land located between upland bluff and beach. Slump zones begin at the bluff line and slope down to the beach.
- 188 Wetland (WT). This type covers the full spectrum of wetlands. These include seasonally flooded flats, shrub swamps, meadows, bogs, shallow and deep marshes, and forested wetlands. Each is described below.
- Seasonally flooded basins or flats occur principally on stream floodplains. The most common plants are grasses and herbaceous species. The soil is waterlogged or covered with water during spring freshets, but well-drained during the growing season.
- Shrub swamps often have waterlogged soil during the growing season, as much as six (6) inches of water may be present. Vegetation types include elder, buttonbush, dogwood and willow. Sedges usually are present in tussocks.
- Meadows are vegetated with grasses, rushes and sedges. Soils are waterlogged through most of the growing season. Surface water is present only for a short period during the spring.
- Bogs are unique wetland types that support a distinctive plant community, including most of the following: heath shrubs, cranberries, pitcher plants and sedges. Scattered black spruce, tamarack and red maple may be present. A mat of sphagnum moss is the most common feature of bogs.

Shallow marsh is wetter than meadow. The soil is completely waterlogged and often covered with up to six inches of water during the growing season. The predominant vegetation is emergent, including such plants as cattails, bulrushes, burreed, pickerelweed and arrowhead with some grasses and sedges present. The type is common to open water bodies.

Deep marsh has water depth ranging from six inches to three feet. Fairly large open water areas are bordered by, or interspersed with, emergent vegetation like that found in shallow marsh. Floating and submergent plants such as water lilies, duckweed, watershield and pondweeds also are present.

Forested Wetlands. This type represents areas of moist to saturated soil covered by forest canopy. The type is difficult to identify without stereo photography and, or with "leaves-on" photography.

Open and Other Land

191 Outdoor-Public Assembly

192 Urban Open Lots. Urban open is undeveloped land lying idle in the midst of urban areas or adjacent to them. This type includes land which has been cleared for urban development of an unknown use.

193 Outdoor Recreation. Outdoor recreation types are either mainly for participation, mainly for spectators, or are environmental in character. Each recreational type includes the recreational complex: access roads, parking facilities, buildings and other related facilities.

194 Cemeteries

Shoreline Modification

Development along the lakeshore often means modification at, or near, the shoreline. Land along the lakeshore is exposed to significant erosional forces. Recession of land mass is common. Agricultural and urban land uses destabilize shoreland, in effect accelerating erosion and land recession. To protect real estate and property, many property owners have constructed walls or revetments along their shoreline. Some owners also have built non-flow-through docks at the shoreline to provide mooring and protection for their boats. Groins, large rock structures perpendicular to the shoreline, have been built along Wisconsin's Lake Michigan shoreline.

195 Sea Walls (V 195 V). These structures are built parallel to the shoreline and typically are well defined, linear

features. Construction materials can include concrete, wood or interlocking sheet steel.

- 196 Revetments (V 196 V). Large rock or slab structures built parallel to the shoreline. Interpretively, revetments are less well defined, and appear wider than do sea walls.
- 197 Groins (* [red]). Groins are large rock structures built perpendicular to the shoreline into the water. Except for their distinct orientation and placement, groins appear similar to revetments.
- 198 Non-Flow-Through Dock (* [blue]). Such docks are permanent structures built into near-shore waters. Typically these docks are straight, their upper surface wide and well defined.

Structures - Industrial, Commercial and Residential

On the 1992 photos, buildings within the coastal zone are classified by type and location. Using a template of rectangles, for each building, a rectangle is selected that best represents the area of the building's "footprint." The selected rectangle then is positioned so that the leading edge of the building (relative to the shoreline) is located. Buildings for 1978 were counted by type. However, due to photo format differences, comparison of 1978 and 1992 structural counts may be inaccurate.

THE PHOTOINTERPRETIVE PROCESS

After photo preparation, each photo was interpreted using the classification scheme defined above. Area (land uses), linear (shoreline modification) and point (urban structures, groins, docks) types are represented in this study. Lines and/or symbols were used to define all types. Area types are represented by perimeter boundary lines and symbols to define and identify the areas. Line types representing modification to natural shoreline were defined using both lines and symbols. All area and line type symbols are recorded in black ink. Point types are defined by symbols and colored ink (see above).

Modifications to the shoreline, such as sea walls or revetments, are delineated by placing (painting) the 'V' symbol at the beginning and end of the modification. The type of modification is represented by placing the appropriate number between the 'V' symbols. For example, 195 positioned between two 'V' symbols means that a sea wall has been built along this section of shoreline. Shoreline classification was conducted before land use so that land use boundary lines placed along the shoreline would not 'hide' shoreline information.

Groins and non-flow-through docks were defined by point symbols (see above). In both cases, the symbol was placed at the point where the structure meets land. As discussed above, for

1992, buildings also were classified using point symbols. The delineation of buildings represents the last API procedure.

MEASUREMENT OF AREA, LINE AND POINT TYPES LOCATED WITHIN THE COASTAL ZONE

Area types (land use polygons) and line types (shoreline modification) measurements were made using the hardware/software facilities of the GIS Lab at the University of Wisconsin-Green Bay. Photo acetate overlays were affixed to large-format digitizers and each land use polygon digitized along the perimeter. Measurements recorded in square inches were converted to acres/hectares. Line measurements (in inches) of shoreline modifications were made using digitizers as well. Linear inch measurements were converted to linear feet/meters for each type of modification.

Point types (groins, structures) simply were tallied by count for each type. The area covered by each acetate was broken into civil jurisdiction and PLSS section designations. Measurements (above) were separated by civil and PLSS designations as well, and documented permanently on each acetate overlay.

TALLY OF DATA

Measurements recorded on each photo acetate were transferred to data sheets. Three (3) levels of data sheets were used: PLSS Section Data; Civil Jurisdiction Summary Data; and County Summary Data (Appendix).

PLSS Section Data Sheet: One (1) PLSS Section Data sheet was used for each section located on a photo/acetate. Generally, 1-2 PLSS sections are located on a photo, however, up to four (4) sections per photo were recorded. Section level data sheets record photo documentation including photo year, photo number, county and community(ies) covered, and complete PLSS section location. Also recorded were number of residential, commercial, industrial and institutional structures (1992), area of land use by type, linear distance of sea walls and revetments, and the number of groins and non-flow-through docks.

Civil Jurisdiction Summary Data Sheet: This tally sheet summarizes the data for all PLSS section sheets found within each township, village or city. The sheet records photo year, county, name of civil jurisdiction, a complete listing of PLSS sections included in the summary, as well as all land use, shoreline and structure count data discussed above.

County Summary Data Sheet: The County Summary sheet summarizes all data for the towns, villages and cities located within the county. Documented information includes photo year, county name, an alphabetical listing of all civil jurisdictions within the county, and a summary of all land use, shoreline and

structure count data reported on Civil Jurisdiction Summary Data sheets.

LIMITATIONS AND SOURCES OF ERROR

The U.S. Army Corps of Engineers contracted for aerial photography of the Wisconsin portion of the Lake Michigan shoreline on April 21, 1978 and May 19, 1992. Both sets of photos are 1:6000 scale and panchromatic color, however, the 1978 photos are "leaves-off" while the 1992 photos are "leaves-on."

Copies of the original stereo photos (1:6000 scale) were not available for this study. Instead, enlargements (1:2400 scale) of the original photos were borrowed from Corps district offices in Green Bay and Waukesha. The enlargements provided photographic coverage only, not stereo coverage. Normally, for a project of this magnitude, photos would have been taken to meet the specific objectives of the study. The enlarged photos used for this project present limitations and introduce error beyond what would be reported with original photos flown specifically for this study. Limitations and errors associated with the photographs used are discussed below. Also presented below is discussion regarding methodological inconsistencies.

The following discussion of Limitations and Sources of Error is presented in an attempt to provide the reader a basic understanding of the issues. Any section of the discussion could apply to any of the results reported below. The Results sections of this report present findings without any comprehensive attempt to explain anomalies within, or between, the photo study years (1978 and 1992).

Photo Scale and Enlargements

All vertical aerial photographs not ratioed (enlarged or reduced to a common average scale) or rectified (common tilt/tip corrected to a horizontal reference plane) inherently are scale inaccurate. The original USACE photos (1978 and 1992) were not ratioed or rectified, therefore, their scale varies relative to topographic changes of the coastal zone, tip/tilt of the camera and changing elevation of the camera (aircraft). Enlargements of the original photos simply accentuate the inaccuracies found on the original photos.

Area and linear measurements taken off of the USACE enlarged photos reflect the inaccuracies inherent in those photos. Simple tests of shoreline distances for numerous PLSS sections within each county were conducted to establish linear accuracies of the photos. USGS topo sheets at 1:24000 scale were used to establish base shoreline distance measurements against which photo (1978 and 1992) shoreline distance measurements could be compared. No systematic errors were detected for the 1978 photos. However, only one (1) of 21 tests of the 1992 photos varied in the positive direction from USGS measurements. The remaining 20 tests varied in the negative direction and ranged from -0.8% to

-13.1%. The range of error, for 1978 was -5.3% to +9.6%, while the range of error for 1992 was -13.1% to +1.9% (see Table 1 page 17). Without a test of error for each photo used, there is no means to judge the direction or the amount of error relative to statistics associated with each photo. However, given the range of error found for the 1978 and 1992 photos, it is possible that 1,000 acres (405 ha) (actual) of coastal zone area could be reported as 1,096 acres (444 ha) in 1978 and 869 acres (352 ha) in 1992, a 227 acre (92 ha) difference.

"Leaves-On" Versus "Leaves-Off" Aerial Photography

There are distinct advantages and disadvantages of both "leaves-on" and "leaves-off" aerial photography. However, given the goals of this project, the 1978 "leaves-off" photography offers important advantages over the 1992 "leaves-on" photography. Vegetation in leaf can hide the details of built structures, including buildings and shoreline modifications. Roads can be hidden under tree crowns, as well as portions of lots landscaped and managed as residential land. Leaved canopies increase the effect of shadows. Shadows mask ground, understory and structural information leading to inaccurate interpretation. Land uses and/or structures hidden under the canopy of vegetation or masked by shadows can be underestimated in area, length or count. Land use types particularly affected (underestimated) are single family residential and wetland.

Stereo Versus Photographic Coverage

Both the 1978 and 1992 photo sets were taken to capture stereo (3-D) coverage of the Lake Michigan coastal area. This means that adjacent photos overlap approximately 60%. Stated another way, 60% of the shoreland area located on one photo also is located on an adjacent photo. The shoreland common to adjacent photos is "seen" from two different perspectives which allows stereo viewing (using a stereoscope).

The enlarged photos borrowed from USACE for this study represent photographic coverage only, or every other photo taken of shoreland. While photo (2-D) coverage at large scales can be used to interpret accurately many land use types (agricultural and most urban land), the lack of stereo viewing makes difficult the identification of wetland types and the exact location of bluff lines. Stereo viewing generally would have increased the interpretive accuracy of most land use, structural and shoreline features.

Incomplete Photo Coverage

For this study, the coastal zone is defined as a 1000' strip of land adjacent and parallel to the shoreline. Occasionally, photo coverage did not include all shoreland within 1000' of the water. As a result, total land area is underrepresented, the

exact land use types not covered are not known. In such cases, the area not captured on a particular photo was estimated by reference and comparison to coverage photos of the other flight year.

Missing Photo Coverage

Occasionally, photo coverage was missing from the USACE photo library. In such cases, as described above, coverage area missing was estimated by reference to photos of the other flight year. However, the exact land use types and shoreline features not represented on photos remain unknown.

Location of 1000' Coastal Zone Boundary

On each photo set, 1978 and 1992, a boundary line was drawn representing the 1000' coastal zone parallel to the shoreline. This line was located by scribing a landward line parallel to the line defined by the shoreline (where water meets land). The landward extent of the boundary line is a function of shoreline location, which in turn, is dependent on the water elevation of Lake Michigan. USACE (1978, 1992) reports that in April of 1978 Lake Michigan water elevation was about 578.4 feet (176.3 meters) and about 579.16 feet (176.5 meters) in May, 1992. The nine (9) inch difference in water elevation, while seemingly insignificant, could have shifted substantially landward the shoreline in extremely low slope beach or mud flat areas. The result of such a shift would be inclusion of inland areas NOT included in the 1978 coastal zone.

Lack of Beach Type in Classification Scheme

The width or extent of beach is dependent on slope of an area and water elevation. Since changes in the area of beach likely would reflect more the differences in 1978 and 1992 water levels (9 inches higher in 1992) than actual losses/gains due to erosion or development, no beach type was included in the study.

The lack of a beach type does affect measurement of area within the 1000' coastal zone. The landward extent of the coastal zone is 1000' from the shoreline. Any beach area lies between the shoreline and the base of the bluff, however area measurements of land use types were made only for those types lying between the base of the bluff and the interior boundary of the coastal zone. In most cases, beach strips represent only about five (5) acres per photo.

Positional Changes to the Shoreline: Natural vs. Urban Development

As discussed above, the landward extent of the 1000' coastal boundary is dependent on the location of the shoreline. Natural changes to shoreline position include both water elevation and

erosion/deposition of soil. Filling of coastal waters to accommodate urban development artificially changes shoreline location. In such cases, not only does the shoreline move "offshore," the interior coastal zone boundary line shifts toward the water. This "shift" in coastal boundaries skews area measurement. For example, in 1978 assume the coastal zone in an area to be all residential and that by 1992 100 acres of lake water is filled to develop commercial land. A "lakeward" shift in the location of the shoreline will occur due to the land filled for commercial use. However, this "shift" in the shoreline created by the filled commercial site also will result in a shift toward the water of the interior coastal zone boundary. The effect of the latter shift will be that 100 acres of residential land will not be included as part of the 1992 coastal zone. In such a case, the "raw" statistics misleadingly suggest that 100 acres of residential land use were eliminated to make room for 100 acres of commercial use.

RESULTS

Ozaukee County Statistics

Ozaukee County communities lying within the Lake Michigan coastal zone include the townships of Belgium, Grafton and Port Washington, the Village of Bayside, and the cities of Mequon and Port Washington. The area measured within the coastal zone of Ozaukee County was 3,001 acres (1,215 ha) in 1978 and 2,868 acres (1,162 ha) in 1992. This represents a difference of 133 acres (54 ha) or 4.4%. The discrepancy likely is the result of errors inherent in the enlarged aerial photos, as discussed on pages 12 through 15. Using USGS maps as control, tests were conducted on the linear accuracy of the Ozaukee County photos. Results of tests applied to the 1978 photos indicate some departure (+.2% and +1.3%) from USGS measurements. Results of tests applied to the 1992 photos indicate errors of -4.4% to -5.7%. The range of error could yield a 210 acre (85 ha) difference between the 1978 and 1992 totals (Table 1).

Statistical summaries for Ozaukee County and all communities included in this study are located in the Appendix.¹ Summary data sheets present land use types by area, structural counts by type (1992), shoreline modification types by length, and a count of shoreline structures by type. Data were collected at the PLSS section level. While the section level data sheets are not included in this report, copies are available upon written request.

¹Area figures used in the Results discussion reflect totals (not rounded) reported on the original tally sheets. Figures presented on the tally sheets found in the Appendix of this report have been rounded to the nearest whole number.

Table 1. County Results of Linear Accuracy Tests

Percent Deviation From USGS Base Map Measurements

<u>County</u>	<u>1978 Enlarged Photos (1:2400)</u>	<u>1992 Enlarged Photos (1:2400)</u>
Brown	-0.4% 0.03%	-8.5% -5.5%
Door	1.3% 3.9%	-1.1% -3.6%
Kenosha	-2.5% 3.1%	-9.0% -1.6%
Kewaunee	-1.5% 2.1%	-5.4% -9.6%
Manitowoc	-1.7% 2.0%	-6.4% -7.4%
Marinette (one test)	9.6%	-1.7%
Milwaukee	-4.9% -5.3%	-6.9% 1.9%
Oconto	2.9% 8.5%	-10.8% -13.1%
Ozaukee	0.2% 1.3%	-5.7% -4.4%
Racine	-3.0% 2.2%	-5.0% -0.8%
Sheboygan	-2.5% 4.6%	-1.2% -3.0%
Mean	0.95%	-5.18%
Range	-5.3% to 9.6%	-13.1% to 1.9%

Residential Land

Within the 1992 coastal zone of Ozaukee County, 1,058 residential structures were identified on 642 acres (260 ha) of land. Of the total were 755 residential units (single family or duplexes), 161 detached garages, 135 sheds and (7) barns. Since the 1992 photos are "leaves-on," these numbers likely underestimate the actual number of structures and area devoted to residential uses. In 1978, 507 acres (205 ha) of residential land were measured, 135 acres (55 ha) less than in 1992.

Commercial and Industrial Land

Commercial land represented 64 acres (26 ha) in 1992 and 57 acres (23 ha) in 1978. Fifty-four (54) commercial structures were noted within the coastal zone. Three (3) commercial types experienced modest growth over the 14 year period studied. The type central business district increased by 1.6 acres (.6 ha) while neighborhood business district increased by 2.1 acres (.9 ha). Institutional land grew by 4.2 acres (1.7 ha), from 34.9 acres (14.1 ha) in 1978 to 39.1 acres (15.8 ha) in 1992.

No industrial land was observed in 1978 or 1992.

Transportation Land

Forty-seven (47) structures were located on 46 acres (19 ha) of transportation land in 1992. In 1978, 37 acres (15 ha) of transportation land were reported. With the exception of public boat landing, land use types observed within this category experienced slight change. Land developed for public boating increased by about 8.6 acres (3.5 ha). An increase in area also was observed in land developed for sewage treatment facilities, from 1.4 acres (.6 ha) to 2.7 acres (1.1 ha). Area devoted to utilities remained stable at about 32 acres (12.8 ha) for each study year.

Extractive

No extractive land uses were observed for either 1978 or 1992.

Agricultural and Natural Land

In 1978, land uses within the category Agricultural and Natural represented 73% (2,192 acres, 887 ha) of all land within the coastal zone of Ozaukee County. In 1992, this category declined to 64% (1,922 acres, 779 ha).

Overall, 270 acres (109 ha) of agricultural and natural lands were reported lost from 1978 to 1992, a trend that continues nationally. Land actively being cultivated declined by 230 acres (93 ha) or by 37.6%. Abandoned fields decreased in area as well, from 616 acres (250 ha) in 1978 to 369 acres (149

ha) in 1992, a loss of 247 acres (100 ha) or 40%. Forest areas, on the other hand, grew substantially from 1978 to 1992, from 585 acres (237 ha) to 802 acres (325 ha). Heath vegetation declined from a 1978 total of 6 acres (2.5 ha) to no area in 1992.

Areas of erosion along Lake Michigan's shoreline are a major concern of coastal resource planners. Data show that slump zone area declined by about 18 acres (7.3 ha), from 278 acres (113 ha) to 260 acres (105 ha) for 1978 and 1992, respectively. Also of note is a 13.8 acre (5.6 ha) increase of wetland types. Given state, regional and national trends, this finding is unusual. Increases in wetland areas could be associated with the nine (9) inch rise in Lake Michigan water level.

Open and Other Land

Open and other land decreased from 208 acres (84 ha) in 1978 to 195 acres (79 ha) in 1992. Outdoor recreational land decreased during the period from 196 acres (79 ha) in 1978 to 188 acres (76 ha) in 1992. Land devoted to urban open lot declined from 11.6 acres (4.7 ha) to 6.7 acres (2.7 ha).

Shoreline Modifications

Ostensibly, sea walls and revetments are used to protect shorelines from erosion. Changes in both types of structures were reported. In 1978, 5,644 feet (1,721 m) of sea wall were reported compared to 5,497 feet (1,676 m) in 1992, representing a decrease of 147 feet (45 m). However, since 1978, revetments increased by 3,167 feet (966 m), or by 31%. Shoreline revetment was measured at 10,257 feet (3,127 m) in 1978 and 13,424 feet (4,093 m) in 1992.

Results by Community

Village of Bayside

Only a small portion of the village of Bayside falls within the Lake Michigan coastal zone. Land within the coastal zone was measured at 45 acres (18 ha) in 1978 and 46 acres (19 ha) in 1992. The source of the difference could be photo scale anomalies as discussed above.

In 1992, 46 residential structures were located on 30 acres (12 ha) of land. Most of these structures (38) were single family or duplex. Other structures associated with residential areas included (6) detached garages and (2) sheds. In 1978, there also were 30 acres (12 ha) of residential land observed.

No commercial, industrial, transportation, extractive or open/other types were located in 1978 or 1992.

Agricultural and natural areas remained stable over the period studied.

No shoreline modifications were detected for either 1978 or 1992.

Town of Belgium

The coastal zone within the town of Belgium covered 685 acres (277 ha) in 1978 and 657 acres (266 ha) in 1992. The difference of 28 acres (11.3 ha) is 4.1% of the 1978 total area.

The town of Belgium was one of the sites tested to determine linear accuracy of the enlarged photos. It was determined that the 1978 photos of Belgium deviated from USGS 1:24000 maps by +.2%. The 1992 photos deviated by -5.7% from the USGS basis.

In 1992, a total of 319 residential structures were identified on 100 acres (41 ha) of residential land. Of these, 196 were single family/duplex, 67 were detached garages and 54 were sheds. The apparent 30 acre (12 ha) loss of residential likely is not actual but a function of "leaves-on" 1992 aerial photos which tend to mask residential structures and lawn management.

Just under (5) acres (2 ha) of commercial land were recorded in 1992. This represents a (3) acre (1.2 ha) increase over the 1978 total of 1.7 acres (.7 ha). The area increase was observed in the neighborhood business district type.

For both 1978 and 1992, no area observations were recorded for commercial, industrial, transportation or extractive land uses. In 1978 and 1992, agricultural and natural uses covered 64% and 66% of the coastal zone, respectively. In each year, this category of land uses covered about 435 acres (176 ha). Both increases and decreases in area of individual category types were observed. In 1978, both abandoned fields and active agricultural areas declined, abandoned field by (8) acres (3.2 ha) from 121 acres (49 ha) to 113 acres (46 ha) and active agriculture by 78 acres (32 ha) from 194 acres (79) ha) to 116 acres (47 ha). Forested areas grew significantly from 95 acres (38 ha) in 1978 to 179 acres (73 ha) by 1992. Wetlands gained modestly, adding (2) acres (.8 ha) by 1992.

The open/other land use category also remained stable from 1978 to 1992 at about 116 acres (47 ha). In 1992, almost all of this area was observed in the type outdoor recreation.

The remaining notable change to be reported includes shoreline modifications. Results indicate a gain of 412 feet (126 m) of sea wall. The increase in sea wall from 1,506 feet (459 m) in 1978 to 1,918 feet (585 m) in 1992 represents 27%. Revetment structures increased by 1,598 feet (487 m) or by 27%, from 5,836 feet (1,779 m) in 1978 to 7,434 feet (2,267 m) in 1992.

Town of Grafton

The coastal zone within the town of Grafton covered 771 acres (312 ha) in 1978 and 720 acres (292 ha) in 1992. The difference of 51 acres (20.6 ha) is 6.6% of the 1978 total area. The town of Grafton was one of the sites tested to determine linear accuracy of the enlarged photos. It was determined that

the 1978 photos of Grafton deviated from USGS 1:24000 maps by +1.3%. The 1992 photos deviated by -4.4% of the USGS basis.

Residential land encompassed 132 acres (53 ha) in 1992. Over 130 structures, of which 82 were single family/duplex, were located within the 1992 coastal zone. Other structures included 20 detached garages and 29 sheds. In 1978, 70 acres (28 ha) of residential land were recorded. The increase of 62 acres (25 ha) represents 88.5%.

Less than (1) acre of coastal zone land was observed to be commercial in 1992. No commercial was observed in 1978. For both 1978 and 1992, no industrial, transportation or extractive uses were observed within the coastal zone area.

Substantial changes occurred to and within the category of agricultural and natural land. In 1978, these land uses covered almost 91% (700 acres, 284 ha) of the coastal zone area. By 1992, agricultural and natural land use covered only 76% (585 acres, 237 ha) of Grafton's coastal zone. The lost area represents 115 acres (46 ha) or 16.4% of the 1978 total. Within the category, abandoned field and active agricultural land lost area. Abandoned field lost 96 acres (39 ha), from 233 acres (94 ha) in 1978 to 137 acres (56 ha) in 1992. Active agriculture declined by 61 acres (25 ha), from 183 acres (74 ha) to 122 acres (49 ha). All other land use types observed within the category experienced modest to moderate increases in area. For example, forest land increased from 168 acres (68 ha) in 1978 to 197 acres (80 ha) in 1992, an increase of 29 acres (11.7 ha) or 17%. Modest increases of (2) acres (.8 ha) and 1.8 acres (.7 ha) were observed for the types open water and slump zone, respectively. From 1978 to 1992, wetlands increased by (9) acres (3.6 ha), from 17.3 acres (7 ha) to 26.3 acres (10.7 ha).

In the open/other land use category, (3) acres (1.2 ha) were identified in 1992.

Some shoreline modification has occurred since 1978. In 1978, no sea walls were recorded compared to 88 feet (27 m) in 1992. Revetments increased as well, from no observation in 1978 to 396 feet (121 m) in 1992.

City of Mequon

The coastal zone for the city of Mequon was determined to be 682 acres (276 ha) in 1978 and 684 acres (277 ha) in 1992, reflecting a difference of less than 1%.

The amount of residential land located within the coastal zone was 262 acres (106 ha) in 1992. Within the residential area were counted 294 structures, 231 of which were identified to be single family/duplex. Other structures observed were 36 detached garages, 26 sheds and (1) barn. Residential land increased by 69 acres (28 ha) or 36%, from 192 acres (78 ha) in 1978 to 262 acres (106 ha) in 1992.

For both 1978 and 1992, about 37 acres (15 ha) of commercial land were observed within the city's coastal zone.

No industrial, transportation or extractive land uses were identified for either year of study.

In 1978, agricultural and natural lands covered an area of 428 acres (173 ha). By 1992, 68 acres (27 ha) or nearly 16% of agricultural and natural area had been lost, dropping total area to 360 acres (146 ha). Except for forest, which increased from 101 acres (41 ha) in 1978 to 173 acres (70 ha) in 1992, all other land use types observed decreased in area. Land use cover types and their observed area losses include: abandoned field 113 acres (46 ha), active agricultural 19 acres (7.8 ha), open water .6 acres (.2 ha), slump zone (6) acres (2.4 ha) and wetland .3 acres (.1 ha).

Open/other land areas remained stable at 24 acres (9.7 ha) over the 14 year period covered by the study.

Both sea walls and revetments increased from 1978 to 1992. Sea walls increased by 143 feet (44 m), from 913 feet (278 m) to 1,056 feet (322 m). No revetments were recorded in 1978, however, by 1992, 576 feet (176 m) had been constructed.

City of Port Washington

The coastal zone of the city of Port Washington was determined to be 245 acres (99 ha) in 1978 and 235 acres (95 ha) in 1992. The 10.2 acre (4.1 ha) difference is 4.2% of the 1978 total.

Total residential land located within the 1978 coastal zone was 39 acres (15.8 ha) compared to 57 acres (23 ha) in 1992. In 1992, 151 structures were located within the residential area, of which were 127 single family/duplex units, 19 detached garages and (5) sheds. Commercial land remained quite stable over the period studied, having gained only about (2) acres (.8 ha). A total of 19.7 acres (8 ha) of commercial land was observed in 1992, of which 18.2 acres (7.4 ha) were central business district (CBD).

No industrial or extractive uses were observed within the city's coastal zone for both 1978 and 1992.

About 20 acres (8.1 ha) or nearly 23% of agricultural and natural lands were lost during the 14 year period studied. Abandoned field area declined from 31 acres (12.5 ha) to 27.5 acres (11.1 ha) while active agricultural areas declined from 15.8 acres (6.4 ha) to 2.2 acres (.9 ha). Two other types experienced losses of area. Open water declined from 8.1 acres (3.3 ha) to 7.7 acres (3.1 ha) and slump zone fell from 30 acres (12.2 ha) to 20.5 acres (8.3 ha). Results indicate that wetlands remained stable from 1978 to 1992 at just over (1) acre (.4 ha), however, forested areas increased by 6.7 acres (2.7 ha), from 3.6 acres (1.5 ha) to 10.3 acres (4.2 ha).

The area of open/other land use types declined by 18.2 acres (7.4 ha) or by nearly 30% from 1978 to 1992. Within the category, urban open lot declined from 10.3 acres (4.2 ha) to (3) acres (1.2 ha) and area of outdoor recreation declined from 51 acres (21 ha) to 40 acres (16 ha).

Shoreline modification of the type sea wall declined from 3,225 feet (983 m) in 1978 to 2,435 feet (742 m) in 1992. However, an increase of 922 feet (281 m) of revetment was observed for the same time period. In 1978, 3,767 feet (1,148 m) of revetment were observed along the city's shoreline. This compares to 4,289 feet (1,308 m) observed in 1992. While (3) groins were recorded in 1978, only (1) was logged in 1992.

Town of Port Washington

Land within the coastal zone of Port Washington was measured at 573 acres (232 ha) in 1978 and 526 acres (213 ha) in 1992. The source of the difference (47 acres, 19 ha) could be photo scale anomalies as discussed above.

In 1992, 116 residential structures were located on 62 acres (25 ha) of land. Most of these structures (81) were single family or duplex. Other structures associated with residential land include 13 detached garages, 19 sheds and (3) barns. In 1978, 46 acres (19 ha) of residential land were reported.

In 1992, 2.1 acres (.9 ha) of commercial area were reported compared to no commercial land reported in 1978. Results indicate that no industrial park or extractive lands were observed for either study year. For both years of study, less than one-tenth of an acre of transportation land (utilities) was observed.

Agricultural and natural areas decreased from 522 acres (211 ha) in 1978 to 456 acres (185 ha) in 1992. The types abandoned field, active agriculture and slump zone lost area during the 14 year period.

Abandoned field area fell by nearly 27 acres (10.9 ha), from 92 acres (37 ha) to 66 acres (27 ha) while active agricultural areas fell by 58 acres (23 ha) from 187 acres (76 ha) to 129 acres (52 ha). Areas of slump zone declined from 23.4 acres (9.5 ha) in 1978 to 19.4 acres (7.8 ha) in 1992. Land cover types gaining area included forest and wetland. Forest increased from 208 acres (84 ha) in 1978 to 231 acres (94 ha) in 1992. A (3) acre (1.2 ha) increase for the period boosted the 1992 wetland total to 10 acres (4.1 ha).

Two open/other land use types showed change during the period studied. Urban open lot areas increased from no area in 1978 to .4 acres (.2 ha) in 1992. The outdoor recreation type also increased from (5) acres (2 ha) in 1978 to (6) acres (2.4 ha) in 1992.

From 1978-1992, results suggest shoreline modification has increased within the township. No sea wall was observed for either study year, however, revetment increased from 654 feet (200 m) to 728 feet (222 m).

No groins or non-flow-through docks were recorded for either study year.

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APPENDIX

Lake Michigan Coastal Development Inventory Project:
1978 - 1992

County Summary Data Sheet

Year: 1978

County: Ozaukee

Coastal Civil Jurisdiction included in summary (in alphabetical order).

Village of Bayside
Town of Belgium
Town of Grafton
City of Mequon
City of Port Washington
Town of Port Washington

LAND USE CATEGORIES

	<u># of structures</u>	<u>Area</u>	
		<u>Acres</u>	<u>Hectares</u>
<u>11 Residential</u>			
111 Res. units			
garages			
sheds			
112 Res. units			
garages			
sheds			
113 Res. units	594	507	205
garages	121		
sheds	139		
barns	5		
115 Res. units			
garages			
sheds			
Subtotal	859	507	205
<u>12 Commercial</u>			
121 Central Business Dist	70	17	7
122 Shopping Center/Mall			
124 Neighborhood Business Dist	5	5	2
126 Institutional	4	35	14
Subtotal	79	57	23
<u>13 Industrial</u>			
138 Industrial Park			

	# of structures	Area	
		Acres	Hectares

14 Transportation

141 Air Transportation			
142 Rail Transportation			
143 Water Transportation			
143.1 Private Marina			
143.2 Public Boat Landing	2	3	1
144 Highways		<1	<1
145 Communications			
146 Utilities	11	33	13
147 Sewage Treatment Plant	2	1	1
148 Landfill			
Subtotal	15	37	15

17 Extractive

171 Open Pit			
172 Underground			
173 Well			
179 Other Extractive			
Subtotal			

18 Agricultural and Natural

181 AF Abandoned Field		616	250
182 AG Agriculture Active		611	248
183 F Forest		585	237
184 H Heath		6	3
185 OW Open Water		13	5
186 RL Rock Ledge			
187 SL Slump Zone		278	113
188 WT Wetland		83	33
Subtotal		2192	887

19 Open Land, Other

191 Outdoor-Public Assembly			
192 Urban Open Lots		12	5
193 Outdoor Recreation	13	196	79
194 Cemeteries			
Subtotal	13	208	84

Total Acres 3001
Total Hectares 1215

Shoreline Modifications

		Linear	
		Feet	Meters
195 Sea Walls		5644	1721
196 Revetments		10257	3127
197 Groins	# of Groins	3	
198 Dock Non-Flow-Through	# of Docks		

Lake Michigan Coastal Development Inventory Project:
1978 - 1992

County Summary Data Sheet

Year: 1992
 County: Ozaukee
 Coastal Civil Jurisdiction included in summary (in alphabetical order).

Village of Bayside
 Town of Belgium
 Town of Grafton
 City of Mequon
 City of Port Washington
 Town of Port Washington

LAND USE CATEGORIES

	<u># of structures</u>	<u>Area</u>	
		<u>Acres</u>	<u>Hectares</u>
<u>11 Residential</u>			
111 Res. units			
garages			
sheds			
112 Res. units			
garages			
sheds			
113 Res. units	755	642	260
garages	161		
sheds	135		
barns	7		
115 Res. units			
garages			
sheds			
Subtotal	1058	642	260
<u>12 Commercial</u>			
121 Central Business Dist	41	18	7
122 Shopping Center/Mall			
124 Neighborhood Business Dist	5	7	3
126 Institutional	8	39	16
Subtotal	54	64	26
<u>13 Industrial</u>			
138 Industrial Park			

	# of structures	Area	
		Acres	Hectares
<u>14 Transportation</u>			
141 Air Transportation			
142 Rail Transportation			
143 Water Transportation			
143.1 Private Marina			
143.2 Public Boat Landing	3	12	5
144 Highways			
145 Communications			
146 Utilities	37	32	13
147 Sewage Treatment Plant	7	3	1
148 Landfill			
Subtotal	47	46	19

<u>17 Extractive</u>			
171 Open Pit			
172 Underground			
173 Well			
179 Other Extractive			
Subtotal			

<u>18 Agricultural and Natural</u>			
181 AF Abandoned Field		369	149
182 AG Agriculture Active		381	155
183 F Forest		802	325
184 H Heath			
185 OW Open Water		14	6
186 RL Rock Ledge			
187 SL Slump Zone		260	105
188 WT Wetland		97	39
Subtotal		1922	779

<u>19 Open Land, Other</u>			
191 Outdoor-Public Assembly			
192 Urban Open Lots		7	3
193 Outdoor Recreation	9	188	76
194 Cemeteries			
Subtotal	9	195	79

Total Acres 2868
Total Hectares 1162

		Linear	
		Feet	Meters
195 Sea Walls		5497	1676
196 Revetments		13424	4093
197 Groins	# of Groins	1	
198 Dock Non-Flow-Through	# of Docks		

Lake Michigan Coastal Development Inventory Project:
1978 - 1992

Civil Jurisdiction
Summary Data Sheet

Year: 1978
County: Ozaukee
Township, Village or City name: Village of Bayside
PLSS section data sheets included in summary (give full description):

T9N R22E SEC 33

LAND USE CATEGORIES

	<u># of structures</u>	<u>Area</u>	
		<u>Acres</u>	<u>Hectares</u>
<u>11 Residential</u>			
111 Res. units			
garages			
sheds			
112 Res. units			
garages			
sheds			
113 Res. units	36	30	12
garages	6		
sheds			
barns			
115 Res. units			
garages			
sheds			
Subtotal	42	30	12

12 Commercial

121 Central Business Dist			
122 Shopping Center/Mall			
124 Neighborhood Business Dist			
126 Institutional			
Subtotal			

13 Industrial

138 Industrial Park			
---------------------	--	--	--

	<u># of structures</u>	<u>Area</u>	
		<u>Acres</u>	<u>Hectares</u>
<u>14 Transportation</u>			
141 Air Transportation	_____		
142 Rail Transportation	_____		
143 Water Transportation	_____		
143.1 Private Marina	_____		
143.2 Public Boat Landing	_____		
144 Highways	_____		
145 Communications	_____		
146 Utilities	_____		
147 Sewage Treatment Plant	_____		
148 Landfill	_____		
	Subtotal		

<u>17 Extractive</u>			
171 Open Pit	_____		
172 Underground	_____		
173 Well	_____		
179 Other Extractive	_____		
	Subtotal		

<u>18 Agricultural and Natural</u>			
181 AF Abandoned Field	_____	<1	<1
182 AG Agriculture Active	_____		
183 F Forest	_____	10	4
184 H Heath	_____		
185 OW Open Water	_____	<1	<1
186 RL Rock Ledge	_____		
187 SL Slump Zone	_____	5	2
188 WT Wetland	_____		
	Subtotal	16	6

<u>19 Open Land, Other</u>			
191 Outdoor-Public Assembly	_____		
192 Urban Open Lots	_____		
193 Outdoor Recreation	_____		
194 Cemeteries	_____		
	Subtotal		

Total Acres 45
Total Hectares 18

		<u>Linear</u>	
		<u>Feet</u>	<u>Meters</u>
<u>Shoreline Modifications</u>			
195 Sea Walls	_____		
196 Revetments	_____		
197 Groins	_____	# of Groins	
198 Dock Non-Flow-Through	_____	# of Docks	

Lake Michigan Coastal Development Inventory Project:
1978 - 1992

Civil Jurisdiction
Summary Data Sheet

Year: 1992
County: Ozaukee
Township, Village or City name: Village of Bayside
PLSS section data sheets included in summary (give full description):

T9N R22E SEC 33

LAND USE CATEGORIES

	<u># of structures</u>	<u>Area</u>	
		<u>Acres</u>	<u>Hectares</u>
<u>11 Residential</u>			
111 Res. units			
garages			
sheds			
112 Res. units			
garages			
sheds			
113 Res. units	38	30	12
garages	6		
sheds	2		
barns			
115 Res. units			
garages			
sheds			
Subtotal	46	30	12
<u>12 Commercial</u>			
121 Central Business Dist			
122 Shopping Center/Mall			
124 Neighborhood Business Dist			
126 Institutional			
Subtotal			
<u>13 Industrial</u>			
138 Industrial Park			

	# of structures	Area	
		Acres	Hectares
<u>14 Transportation</u>			
141 Air Transportation	_____	_____	_____
142 Rail Transportation	_____	_____	_____
143 Water Transportation	_____	_____	_____
143.1 Private Marina	_____	_____	_____
143.2 Public Boat Landing	_____	_____	_____
144 Highways	_____	_____	_____
145 Communications	_____	_____	_____
146 Utilities	_____	_____	_____
147 Sewage Treatment Plant	_____	_____	_____
148 Landfill	_____	_____	_____
	Subtotal	_____	_____

<u>17 Extractive</u>			
171 Open Pit	_____	_____	_____
172 Underground	_____	_____	_____
173 Well	_____	_____	_____
179 Other Extractive	_____	_____	_____
	Subtotal	_____	_____

<u>18 Agricultural and Natural</u>			
181 AF Abandoned Field	_____	<1	<1
182 AG Agriculture Active	_____	_____	_____
183 F Forest	_____	11	5
184 H Heath	_____	_____	_____
185 OW Open Water	_____	<1	<1
186 RL Rock Ledge	_____	_____	_____
187 SL Slump Zone	_____	5	2
188 WT Wetland	_____	_____	_____
	Subtotal	17	7

<u>19 Open Land, Other</u>			
191 Outdoor-Public Assembly	_____	_____	_____
192 Urban Open Lots	_____	_____	_____
193 Outdoor Recreation	_____	_____	_____
194 Cemeteries	_____	_____	_____
	Subtotal	_____	_____

Total Acres 46
Total Hectares 19

		Linear	
		Feet	Meters
<u>Shoreline Modifications</u>			
195 Sea Walls	_____	_____	_____
196 Revetments	_____	_____	_____
197 Groins	_____	# of Groins	_____
198 Dock Non-Flow-Through	_____	# of Docks	_____

Lake Michigan Coastal Development Inventory Project:
1978 - 1992

Civil Jurisdiction
Summary Data Sheet

Year: 1978
County: Ozaukee
Township, Village or City name: Town of Belgium
PLSS section data sheets included in summary (give full description):

T12N R22E SEC 25	T12N R23E SEC 6
SEC 36	SEC 7
	SEC 18
	SEC 19
	SEC 30

LAND USE CATEGORIES

	<u># of structures</u>	<u>Area</u>	
		<u>Acres</u>	<u>Hectares</u>
<u>11 Residential</u>			
111 Res. units			
garages			
sheds			
112 Res. units			
garages			
sheds			
113 Res. units	192	130	53
garages	51		
sheds	58		
barns	2		
115 Res. units			
garages			
sheds			
Subtotal	303	130	53
<u>12 Commercial</u>			
121 Central Business Dist			
122 Shopping Center/Mall			
124 Neighborhood Business Dist		2	1
126 Institutional			
Subtotal		2	1
<u>13 Industrial</u>			
138 Industrial Park			

		Area	
	<u># of structures</u>	<u>Acres</u>	<u>Hectares</u>

14 Transportation

141 Air Transportation	_____		
142 Rail Transportation	_____		
143 Water Transportation	_____		
143.1 Private Marina	_____		
143.2 Public Boat Landing	_____		
144 Highways	_____		
145 Communications	_____		
146 Utilities	_____		
147 Sewage Treatment Plant	_____		
148 Landfill	_____		
Subtotal			

17 Extractive

171 Open Pit	_____		
172 Underground	_____		
173 Well	_____		
179 Other Extractive	_____		
Subtotal			

18 Agricultural and Natural

181 AF Abandoned Field	_____	121	49
182 AG Agriculture Active	_____	194	79
183 F Forest	_____	95	38
184 H Heath	_____	2	1
185 OW Open Water	_____	1	<1
186 RL Rock Ledge	_____		
187 SL Slump Zone	_____		
188 WT Wetland	_____	24	10
Subtotal		437	177

19 Open Land, Other

191 Outdoor-Public Assembly	_____			
192 Urban Open Lots	_____			
193 Outdoor Recreation	_____	5	116	47
194 Cemeteries	_____			
Subtotal		5	116	47

Total Acres	685
Total Hectares	277

Shoreline Modifications

		Linear	
		<u>Feet</u>	<u>Meters</u>
195 Sea Walls	_____	1506	459
196 Revetments	_____	5836	1779
197 Groins	_____	# of Groins	
198 Dock Non-Flow-Through	_____	# of Docks	

Lake Michigan Coastal Development Inventory Project:
1978 - 1992

Civil Jurisdiction
Summary Data Sheet

Year: 1992
 County: Ozaukee
 Township, Village or City name: Town of Belgium
 PLSS section data sheets included in summary (give full description):

T12N R22E SEC 25	T12N R23E SEC 6
SEC 36	SEC 7
	SEC 18
	SEC 19
	SEC 30

LAND USE CATEGORIES

	<u># of structures</u>	<u>Area</u>	
		<u>Acres</u>	<u>Hectares</u>
<u>11 Residential</u>			
111 Res. units	_____		
garages	_____		
sheds	_____		
112 Res. units	_____		
garages	_____		
sheds	_____		
113 Res. units	196	100	41
garages	67		
sheds	54		
barns	2		
115 Res. units	_____		
garages	_____		
sheds	_____		
Subtotal	319	100	41
<u>12 Commercial</u>			
121 Central Business Dist	_____		
122 Shopping Center/Mall	_____		
124 Neighborhood Business Dist	2	5	2
126 Institutional	_____		
Subtotal	2	5	2
<u>13 Industrial</u>			
138 Industrial Park	_____		

	# of structures	Area	
		Acres	Hectares
<u>14 Transportation</u>			
141 Air Transportation			
142 Rail Transportation			
143 Water Transportation			
143.1 Private Marina			
143.2 Public Boat Landing			
144 Highways			
145 Communications			
146 Utilities			
147 Sewage Treatment Plant			
148 Landfill			
	Subtotal		

<u>17 Extractive</u>			
171 Open Pit			
172 Underground			
173 Well			
179 Other Extractive			
	Subtotal		

<u>18 Agricultural and Natural</u>			
181 AF Abandoned Field	113	46	
182 AG Agriculture Active	116	47	
183 F Forest	179	73	
184 H Heath			
185 OW Open Water	1	<1	
186 RL Rock Ledge			
187 SL Slump Zone			
188 WT Wetland	26	11	
	Subtotal	435	176

<u>19 Open Land, Other</u>			
191 Outdoor-Public Assembly			
192 Urban Open Lots	1	1	
193 Outdoor Recreation	116	47	
194 Cemeteries			
	Subtotal	118	48

Total Acres 657
Total Hectares 266

	Linear	
	Feet	Meters
195 Sea Walls	1918	585
196 Revetments	7434	2267
197 Groins	# of Groins	
198 Dock Non-Flow-Through	# of Docks	

Lake Michigan Coastal Development Inventory Project:
1978 - 1992

Civil Jurisdiction
Summary Data Sheet

Year: 1978
County: Ozaukee
Township, Village or City name: Town of Grafton
PLSS section data sheets included in summary (give full description):

T10N R22E SEC 3	SEC 21
SEC 9	SEC 28
SEC 10	SEC 32
SEC 15	SEC 33
SEC 16	

LAND USE CATEGORIES

	<u># of structures</u>	<u>Area</u>	
		<u>Acres</u>	<u>Hectares</u>
<u>11 Residential</u>			
111 Res. units			
garages			
sheds			
112 Res. units			
garages			
sheds			
113 Res. units	52	70	28
garages	10		
sheds	21		
barns			
115 Res. units			
garages			
sheds			
Subtotal	83	70	28
<u>12 Commercial</u>			
121 Central Business Dist			
122 Shopping Center/Mall			
124 Neighborhood Business Dist			
126 Institutional			
Subtotal			
<u>13 Industrial</u>			
138 Industrial Park			

	# of structures	Area	
		Acres	Hectares
14 Transportation			
141 Air Transportation			
142 Rail Transportation			
143 Water Transportation			
143.1 Private Marina			
143.2 Public Boat Landing			
144 Highways			
145 Communications			
146 Utilities			
147 Sewage Treatment Plant			
148 Landfill			
	Subtotal		

17 Extractive			
171 Open Pit			
172 Underground			
173 Well			
179 Other Extractive			
	Subtotal		

18 Agricultural and Natural			
181 AF Abandoned Field	233	94	
182 AG Agriculture Active	183	74	
183 F Forest	168	68	
184 H Heath			
185 OW Open Water	1	1	
186 RL Rock Ledge			
187 SL Slump Zone	98	40	
188 WT Wetland	17	7	
	Subtotal	700	284

19 Open Land, Other			
191 Outdoor-Public Assembly			
192 Urban Open Lots	1	<1	
193 Outdoor Recreation			
194 Cemeteries			
	Subtotal	1	<1

Total Acres 771
Total Hectares 312

		Linear	
		Feet	Meters
Shoreline Modifications			
195 Sea Walls			
196 Revetments			
197 Groins	# of Groins		
198 Dock Non-Flow-Through	# of Docks		

Lake Michigan Coastal Development Inventory Project:
1978 - 1992

Civil Jurisdiction
Summary Data Sheet

Year: 1992
County: Ozaukee
Township, Village or City name: Town of Grafton
PLSS section data sheets included in summary (give full description):

T10N R22E	SEC 3	SEC 21
	SEC 9	SEC 28
	SEC 10	SEC 32
	SEC 15	SEC 33
	SEC 16	

LAND USE CATEGORIES

	<u># of structures</u>	<u>Area</u>	
		<u>Acres</u>	<u>Hectares</u>
<u>11 Residential</u>			
111 Res. units	_____		
garages	_____		
sheds	_____		
112 Res. units	_____		
garages	_____		
sheds	_____		
113 Res. units	82	132	53
garages	20		
sheds	29		
barns	1		
115 Res. units	_____		
garages	_____		
sheds	_____		
Subtotal	132	132	53
<u>12 Commercial</u>			
121 Central Business Dist	_____		
122 Shopping Center/Mall	_____		
124 Neighborhood Business Dist		<1	<1
126 Institutional	_____		
Subtotal		<1	<1
<u>13 Industrial</u>			
138 Industrial Park	_____		

	# of structures	Area	
		Acres	Hectares
<u>14 Transportation</u>			
141 Air Transportation			
142 Rail Transportation			
143 Water Transportation			
143.1 Private Marina			
143.2 Public Boat Landing			
144 Highways			
145 Communications			
146 Utilities			
147 Sewage Treatment Plant			
148 Landfill			
	Subtotal		

<u>17 Extractive</u>			
171 Open Pit			
172 Underground			
173 Well			
179 Other Extractive			
	Subtotal		

<u>18 Agricultural and Natural</u>			
181 AF Abandoned Field		137	56
182 AG Agriculture Active		122	49
183 F Forest		197	80
184 H Heath			
185 OW Open Water		3	1
186 RL Rock Ledge			
187 SL Slump Zone		100	40
188 WT Wetland		26	11
	Subtotal	585	237

<u>19 Open Land, Other</u>			
191 Outdoor-Public Assembly			
192 Urban Open Lots		2	1
193 Outdoor Recreation	3	1	<1
194 Cemeteries			
	Subtotal	3	1

Total Acres 720
Total Hectares 292

		Linear	
		Feet	Meters
195 Sea Walls		88	27
196 Revetments		396	121
197 Groins		# of Groins	
198 Dock Non-Flow-Through		# of Docks	

Lake Michigan Coastal Development Inventory Project:
1978 - 1992

Civil Jurisdiction
Summary Data Sheet

Year: 1978
County: Ozaukee
Township, Village or City name: City of Mequon
PLSS section data sheets included in summary (give full description):

T9N R22E	SEC 4	SEC 21
	SEC 5	SEC 28
	SEC 8	SEC 29
	SEC 17	SEC 33
	SEC 20	

LAND USE CATEGORIES

	<u># of structures</u>	<u>Area</u>	
		<u>Acres</u>	<u>Hectares</u>
<u>11 Residential</u>			
111 Res. units			
garages			
sheds			
112 Res. units			
garages			
sheds			
113 Res. units	188	192	78
garages	33		
sheds	31		
barns	1		
115 Res. units			
garages			
sheds			
Subtotal	253	192	78

12 Commercial

121 Central Business Dist			
122 Shopping Center/Mall			
124 Neighborhood Business Dist	3	3	1
126 Institutional	3	34	14
Subtotal	6	37	15

13 Industrial

138 Industrial Park			
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	# of structures	Area	
		Acres	Hectares
<u>14 Transportation</u>			
141 Air Transportation			
142 Rail Transportation			
143 Water Transportation			
143.1 Private Marina			
143.2 Public Boat Landing			
144 Highways			
145 Communications			
146 Utilities			
147 Sewage Treatment Plant			
148 Landfill			
	Subtotal		

<u>17 Extractive</u>			
171 Open Pit			
172 Underground			
173 Well			
179 Other Extractive			
	Subtotal		

<u>18 Agricultural and Natural</u>			
181 AF Abandoned Field		139	56
182 AG Agriculture Active		33	13
183 F Forest		101	41
184 H Heath			
185 OW Open Water		1	1
186 RL Rock Ledge			
187 SL Slump Zone		121	49
188 WT Wetland		33	13
	Subtotal	428	173

<u>19 Open Land, Other</u>			
191 Outdoor-Public Assembly			
192 Urban Open Lots		<1	<1
193 Outdoor Recreation	1	25	10
194 Cemeteries			
	Subtotal	1	25

Total Acres 682
Total Hectares 276

		Linear	
		Feet	Meters
195 Sea Walls		913	278
196 Revetments			
197 Groins		# of Groins	
198 Dock Non-Flow-Through		# of Docks	

Lake Michigan Coastal Development Inventory Project:
1978 - 1992

Civil Jurisdiction
Summary Data Sheet

Year: 1992
 County: Ozaukee
 Township, Village or City name: City of Mequon
 PLSS section data sheets included in summary (give full description):

T9N R22E	SEC 4	SEC 21	
	SEC 5	SEC 28	
	SEC 8	SEC 29	
	SEC 17	SEC 33	
	SEC 20		

LAND USE CATEGORIES

	<u># of structures</u>	<u>Area</u>	
		<u>Acres</u>	<u>Hectares</u>
<u>11 Residential</u>			
111 Res. units			
garages			
sheds			
112 Res. units			
garages			
sheds			
113 Res. units	231	262	106
garages	36		
sheds	26		
barns	1		
115 Res. units			
garages			
sheds			
Subtotal	294	262	106
<u>12 Commercial</u>			
121 Central Business Dist			
122 Shopping Center/Mall			
124 Neighborhood Business Dist			
126 Institutional	6	38	15
Subtotal	6	38	15
<u>13 Industrial</u>			
138 Industrial Park			

	# of structures	Area	
		Acres	Hectares
<u>14 Transportation</u>			
141 Air Transportation			
142 Rail Transportation			
143 Water Transportation			
143.1 Private Marina			
143.2 Public Boat Landing			
144 Highways			
145 Communications			
146 Utilities			
147 Sewage Treatment Plant			
148 Landfill			
	Subtotal		

<u>17 Extractive</u>			
171 Open Pit			
172 Underground			
173 Well			
179 Other Extractive			
	Subtotal		

<u>18 Agricultural and Natural</u>			
181 AF Abandoned Field		25	10
182 AG Agriculture Active		13	5
183 F Forest		173	70
184 H Heath			
185 OW Open Water		1	<1
186 RL Rock Ledge			
187 SL Slump Zone		115	47
188 WT Wetland		33	13
	Subtotal	360	146

<u>19 Open Land, Other</u>			
191 Outdoor-Public Assembly			
192 Urban Open Lots			
193 Outdoor Recreation	2	24	10
194 Cemeteries			
	Subtotal	2	24

Total Acres 684
Total Hectares 277

		Linear	
		Feet	Meters
195 Sea Walls		1056	322
196 Revetments		576	175
197 Groins	# of Groins		
198 Dock Non-Flow-Through	# of Docks		

Lake Michigan Coastal Development Inventory Project:
1978 - 1992

Civil Jurisdiction
Summary Data Sheet

Year: 1978
County: Ozaukee
Township, Village or City name: City of Port Washington
PLSS section data sheets included in summary (give full description):

T11N R22E SEC 21
SEC 22
SEC 27
SEC 28
SEC 33

LAND USE CATEGORIES

	<u># of structures</u>	<u>Area</u>	
		<u>Acres</u>	<u>Hectares</u>
<u>11 Residential</u>			
111 Res. units			
garages			
sheds			
112 Res. units			
garages			
sheds			
113 Res. units	76	39	16
garages	14		
sheds	6		
barns			
115 Res. units			
garages			
sheds			
Subtotal	96	39	16
<u>12 Commercial</u>			
121 Central Business Dist	70	17	7
122 Shopping Center/Mall			
124 Neighborhood Business Dist	2	<1	<1
126 Institutional	1	1	<1
Subtotal	73	18	7
<u>13 Industrial</u>			
138 Industrial Park			

	# of structures	Area	
		Acres	Hectares
<u>14 Transportation</u>			
141 Air Transportation			
142 Rail Transportation			
143 Water Transportation			
143.1 Private Marina			
143.2 Public Boat Landing	2	3	2
144 Highways		<1	<1
145 Communications			
146 Utilities	10	33	13
147 Sewage Treatment Plant	2	1	1
148 Landfill			
Subtotal	14	37	15

<u>17 Extractive</u>			
171 Open Pit			
172 Underground			
173 Well			
179 Other Extractive			
Subtotal			

<u>18 Agricultural and Natural</u>			
181 AF Abandoned Field		31	13
182 AG Agriculture Active		16	6
183 F Forest		4	2
184 H Heath			
185 OW Open Water		8	3
186 RL Rock Ledge			
187 SL Slump Zone		30	12
188 WT Wetland		1	<1
Subtotal		90	36

<u>19 Open Land, Other</u>			
191 Outdoor-Public Assembly			
192 Urban Open Lots		10	4
193 Outdoor Recreation	7	51	21
194 Cemeteries			
Subtotal	7	61	25

Total Acres 245
Total Hectares 99

	Linear	
	Feet	Meters
195 Sea Walls	3225	983
196 Revetments	3767	1148
197 Groins	# of Groins	3
198 Dock Non-Flow-Through	# of Docks	

Lake Michigan Coastal Development Inventory Project:
1978 - 1992

Civil Jurisdiction
Summary Data Sheet

Year: 1992
County: Ozaukee
Township, Village or City name: City of Port Washington
PLSS section data sheets included in summary (give full description):

T11N R22E SEC 21
SEC 22
SEC 27
SEC 28
SEC 33

LAND USE CATEGORIES

	<u># of structures</u>	<u>Area</u>	
		<u>Acres</u>	<u>Hectares</u>
<u>11 Residential</u>			
111 Res. units			
garages			
sheds			
112 Res. units			
garages			
sheds			
113 Res. units	127	57	23
garages	19		
sheds	5		
barns			
115 Res. units			
garages			
sheds			
Subtotal	151	57	23
<u>12 Commercial</u>			
121 Central Business Dist	41	18	7
122 Shopping Center/Mall			
124 Neighborhood Business Dist	1	<1	<1
126 Institutional	2	1	1
Subtotal	44	20	8
<u>13 Industrial</u>			
138 Industrial Park			

	# of structures	Area	
		Acres	Hectares
<u>14 Transportation</u>			
141 Air Transportation			
142 Rail Transportation			
143 Water Transportation			
143.1 Private Marina			
143.2 Public Boat Landing	3	12	5
144 Highways			
145 Communications			
146 Utilities	36	32	13
147 Sewage Treatment Plant	7	3	1
148 Landfill			
Subtotal	46	46	19

17 Extractive

171 Open Pit			
172 Underground			
173 Well			
179 Other Extractive			
Subtotal			

18 Agricultural and Natural

181 AF Abandoned Field		28	11
182 AG Agriculture Active		2	1
183 F Forest		10	4
184 H Heath			
185 OW Open Water		8	3
186 RL Rock Ledge			
187 SL Slump Zone		21	8
188 WT Wetland		1	1
Subtotal		69	28

19 Open Land, Other

191 Outdoor-Public Assembly			
192 Urban Open Lots		3	1
193 Outdoor Recreation	4	40	16
194 Cemeteries			
Subtotal	4	43	18

Total Acres 235
Total Hectares 95

Shoreline Modifications

	Linear	
	Feet	Meters
195 Sea Walls	2435	742
196 Revetments	4289	1308
197 Groins	# of Groins	1
198 Dock Non-Flow-Through	# of Docks	

Lake Michigan Coastal Development Inventory Project:
1978 - 1992

Civil Jurisdiction
Summary Data Sheet

Year: 1978
 County: Ozaukee
 Township, Village or City name: Town of Port Washington
 PLSS section data sheets included in summary (give full description):

T11N R22E SEC 1	SEC 15
SEC 2	SEC 22
SEC 11	SEC 32
SEC 14	SEC 33

LAND USE CATEGORIES

	<u># of structures</u>	<u>Area</u>	
		<u>Acres</u>	<u>Hectares</u>
<u>11 Residential</u>			
111 Res. units			
garages			
sheds			
112 Res. units			
garages			
sheds			
113 Res. units	50	46	19
garages	7		
sheds	23		
barns	2		
115 Res. units			
garages			
sheds			
Subtotal	82	46	19

12 Commercial

121 Central Business Dist	
122 Shopping Center/Mall	
124 Neighborhood Business Dist	
126 Institutional	
Subtotal	

13 Industrial

138 Industrial Park	
---------------------	--

	# of structures	Area	
		Acres	Hectares
14 Transportation			
141 Air Transportation			
142 Rail Transportation			
143 Water Transportation			
143.1 Private Marina			
143.2 Public Boat Landing			
144 Highways			
145 Communications			
146 Utilities	1	<1	<1
147 Sewage Treatment Plant			
148 Landfill			
Subtotal	1	<1	<1

17 Extractive

171 Open Pit			
172 Underground			
173 Well			
179 Other Extractive			
Subtotal			

18 Agricultural and Natural

181 AF Abandoned Field	92	37
182 AG Agriculture Active	187	76
183 F Forest	208	84
184 H Heath	4	2
185 OW Open Water	1	1
186 RL Rock Ledge		
187 SL Slump Zone	23	10
188 WT Wetland	7	3
Subtotal	522	211

19 Open Land, Other

191 Outdoor-Public Assembly		
192 Urban Open Lots		
193 Outdoor Recreation	5	2
194 Cemeteries		
Subtotal	5	2

Total Acres 573
Total Hectares 232

Shoreline Modifications

	Linear	
	Feet	Meters
195 Sea Walls		
196 Revetments	654	200
197 Groins	# of Groins	
198 Dock Non-Flow-Through	# of Docks	

Lake Michigan Coastal Development Inventory Project:
1978 - 1992

Civil Jurisdiction
Summary Data Sheet

Year: 1992
 County: Ozaukee
 Township, Village or City name: Town of Port Washington
 PLSS section data sheets included in summary (give full description):

T11N R22E SEC 1	SEC 15
SEC 2	SEC 22
SEC 11	SEC 32
SEC 14	SEC 33

LAND USE CATEGORIES

	<u># of structures</u>	<u>Area</u>	
		<u>Acres</u>	<u>Hectares</u>
<u>11 Residential</u>			
111 Res. units			
garages			
sheds			
112 Res. units			
garages			
sheds			
113 Res. units	81	62	25
garages	13		
sheds	19		
barns	3		
115 Res. units			
garages			
sheds			
Subtotal	116	62	25
<u>12 Commercial</u>			
121 Central Business Dist			
122 Shopping Center/Mall			
124 Neighborhood Business Dist	2	2	1
126 Institutional			
Subtotal	2	2	1
<u>13 Industrial</u>			
138 Industrial Park			

	# of structures	Area	
		Acres	Hectares
<u>14 Transportation</u>			
141 Air Transportation			
142 Rail Transportation			
143 Water Transportation			
143.1 Private Marina			
143.2 Public Boat Landing			
144 Highways			
145 Communications			
146 Utilities	1	<1	<1
147 Sewage Treatment Plant			
148 Landfill			
Subtotal	1	<1	<1

17 Extractive

171 Open Pit			
172 Underground			
173 Well			
179 Other Extractive			
Subtotal			

18 Agricultural and Natural

181 AF Abandoned Field		66	27
182 AG Agriculture Active		129	52
183 F Forest		231	94
184 H Heath			
185 OW Open Water		1	1
186 RL Rock Ledge			
187 SL Slump Zone		19	8
188 WT Wetland		10	4
Subtotal		456	185

19 Open Land, Other

191 Outdoor-Public Assembly			
192 Urban Open Lots		<1	<1
193 Outdoor Recreation		6	2
194 Cemeteries			
Subtotal		6	3

Total Acres 526
Total Hectares 213

Shoreline Modifications

		Linear	
		Feet	Meters
195 Sea Walls			
196 Revetments		728	222
197 Groins	# of Groins		
198 Dock Non-Flow-Through	# of Docks		

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