INVENTORY OF PHYSICAL CHARACTERISTICS OF THE ILLINOIS SHORE NORTH OF CHICAGO

Charles Collinson
Patricia L. Drake
Charlene K. Anchor

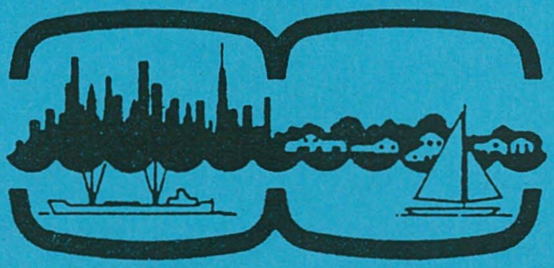
Prepared by the

ILLINOIS STATE GEOLOGICAL SURVEY

for

THE ILLINOIS COASTAL ZONE

MANAGEMENT PROGRAM



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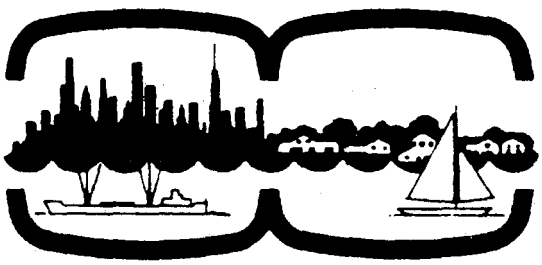

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INVENTORY OF THE PHYSICAL CHARACTERISTICS OF THE LAKE MICHIGAN SHORE NORTH OF CHICAGO

Charles Collinson, Patricia L. Drake, Charlene K. Anchor

ABSTRACT

Illinois' Lake Michigan shore north of Chicago has been classified according to conditions of stability, levels of erosion, state of the beaches, kinds of shore protection and the presence of hazards. Parcels of shore are differentiated according to their characteristics and are described by maps and tables. Prevailing problems and general conditions in each community are discussed along with prospects for future conditions.

The shore between Chicago and Winnetka, ranging from lake plain to low bluffs, is well-protected by bulkheads, riprap and beaches. Conditions generally are very good, but small areas are present where waves have caused minor erosion. In Winnetka, where the bluff rises to more than 70 feet above the lake, the shore is well-protected although several areas of significant erosion are present. Glencoe likewise is well-protected with a few small areas showing erosional effects.

Highland Park, with the highest bluffs along the entire shore, is almost entirely protected by groins and beaches. The beaches are depleted but still provide adequate protection. Between 15 and 20 percent of the shore has stability or erosion problems while 2 percent is classified as severely eroded, oversteepened and hazardous.

The shore at Fort Sheridan consists of relatively high stable bluffs protected by groins, beaches, seawalls and riprap. Nevertheless, much of the shore, mainly the southern part, suffers from wave erosion effects -- almost 20 percent is categorized as severely eroded.

Virtually the entire shore at Lake Forest is well-protected by bulkheads and groins, supported by mature vegetation on well stabilized bluffs. Only three areas of erosion are serious. One near Fort Sheridan is severe.

Of the 2½ miles of shore in Lake Bluff, more than 1½ miles are subject to severe erosion. They represent one of the major problems of the Illinois shore. North Chicago's shore is short and riprap-protected but with some erosion visible near the sewage plant. Waukegan's south

shore is well-protected by riprap, seawalls, jetties and beaches. The shore north of the harbor consists entirely of beaches that grow lakeward by natural accretion. The Illinois Beach Nature Preserve shore is one of broad beaches that are eroding in the north, but accreting in the south. Illinois Beach State Park, which now extends along the Zion and Winthrop Harbor shores, suffers serious erosion along its entire front.

Introduction

Basic to any comprehensive coastal management plan must be a description or inventory of the physical nature of the shore under consideration. As part of the physical data acquisition program for the Illinois Coastal Zone Management Development Program, Illinois Geological Survey personnel made an inventory of Lake Michigan beach conditions, shore erosion levels, lake bluff stability conditions, kinds of shore protection, and existing shore and water hazards. The study was conducted during summer and fall 1974, spring and summer 1975. Low level aerial photographs taken by Survey field parties in July, August, September and October 1974 as well as January and May 1975 were heavily utilized. Also used were 1/2400 scale aerial photographs taken by Chicago Aerial Survey through contract with the Illinois Division of Water Resources in June 1974. These combined with ground truth and ground photos provide the basis for the following classification and description of the shore. The description is mainly related to the highest water level recorded during 1974 (581.5'+) which occurred on August 7, 1974.

The categories used are tentative and serve as a first phase inventory which is presented for the purposes of critical review and trial use. During FY1976 it will be revised and expanded especially with respect to earth materials and lake bottom characteristics.

The inventory is in four parts:

1. A tentative set of inventory categories that are used to describe physical conditions on the shore (Table 1).

2. A set of nine maps that identify and locate specific parcels of shore that possess a distinct set of inventory characteristics. In addition the maps identify areas of special concern to the shore communities and to the Illinois Coastal Zone Management Project.

3. A table presents the inventory characteristics for each parcel of shore (Table 2) and relates them to map locations.

4. A narrative text summarizes the shore characteristics for each municipality or other governmental organization and calls attention to areas and conditions of particular concern.

TABLE 1 - INVENTORY CATEGORIES FOR ILLINOIS LAKE MICHIGAN SHORE

Beach Conditions

Normal beach, more than 50 feet wide or with the groin more than half full.

Narrow beach, less than 50 feet wide or with the groin less than half full.

Damaged beach, covered by fallen vegetation so its usefulness is seriously impaired, covered with rubble, or irregularly eroded and rough.

Absence of Beach.

Level of Erosion

Partial denudation, portions of the shore normally vegetated are bare.

Wave impact erosion, evidence of wave action by undercutting of the shore, removal of vegetation, or damage to beaches.

Complete denudation, virtually complete removal of vegetation.

Active erosion, slump, surface creep, sheetwash, surface water erosion.

Severe erosion, mass wasting, gravity falls, slump.

Condition of Stability

Stable, natural vegetation and topography.

Stable, landscaped or terraced, modified by man.

Incipiently unstable, signs of creep, and denudation. Fine sediment exposed directly to wave action. This category also generally includes unstabilized fills.

Unstable, active settlement or slumping, disturbance of vegetation.

Seeps or springs, signs of surface drainage of ground water.

Oversteepened and hazardous, slopes commonly greater than 30^{o}, much evidence of gravity falls, slides, slumps, and accumulation of fine material below steep faces.

TABLE 1 (CONTINUED)

Type of Shore Protection

Groins, permanent steel, wooden, concrete or stone.

Sheet piling, placed parallel to the shore, generally without tiebacks or splash aprons, not back-filled.

Temporary protective structures, gabions, sandbags, Longard tubes, barrels, etc.

Concrete, stone or brick seawalls.

Riprap and rubble mounds.

Bulkheads, structures that are tied back to the shore, have splash aprons and support the shore.

Piers and launching ramps.

Jetties and breakwaters.

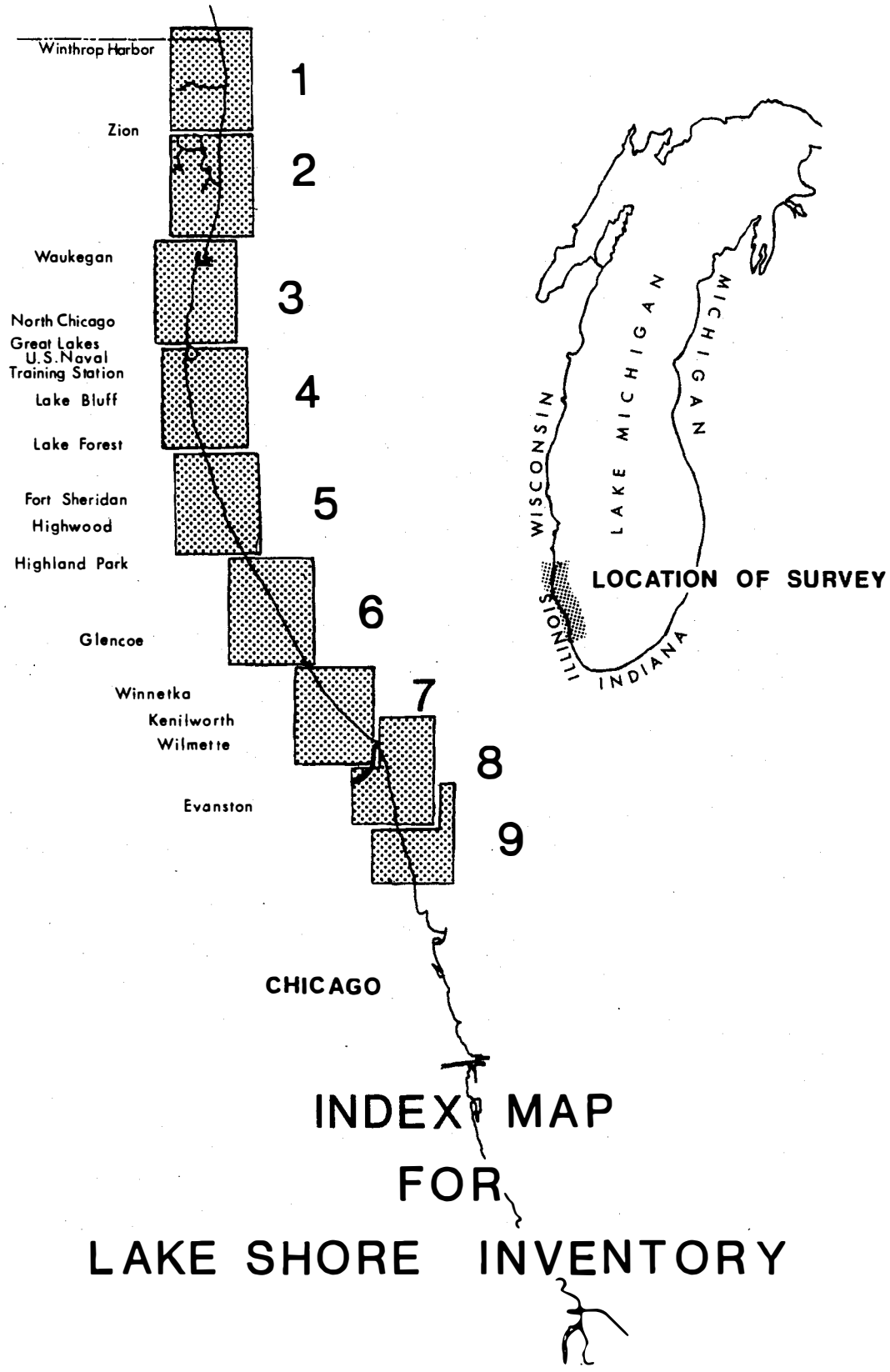
Conditions of Hazard

Submerged groins, groins completely submerged at least part of the time at 580.5 feet IGLD, depending on wind and weather conditions.

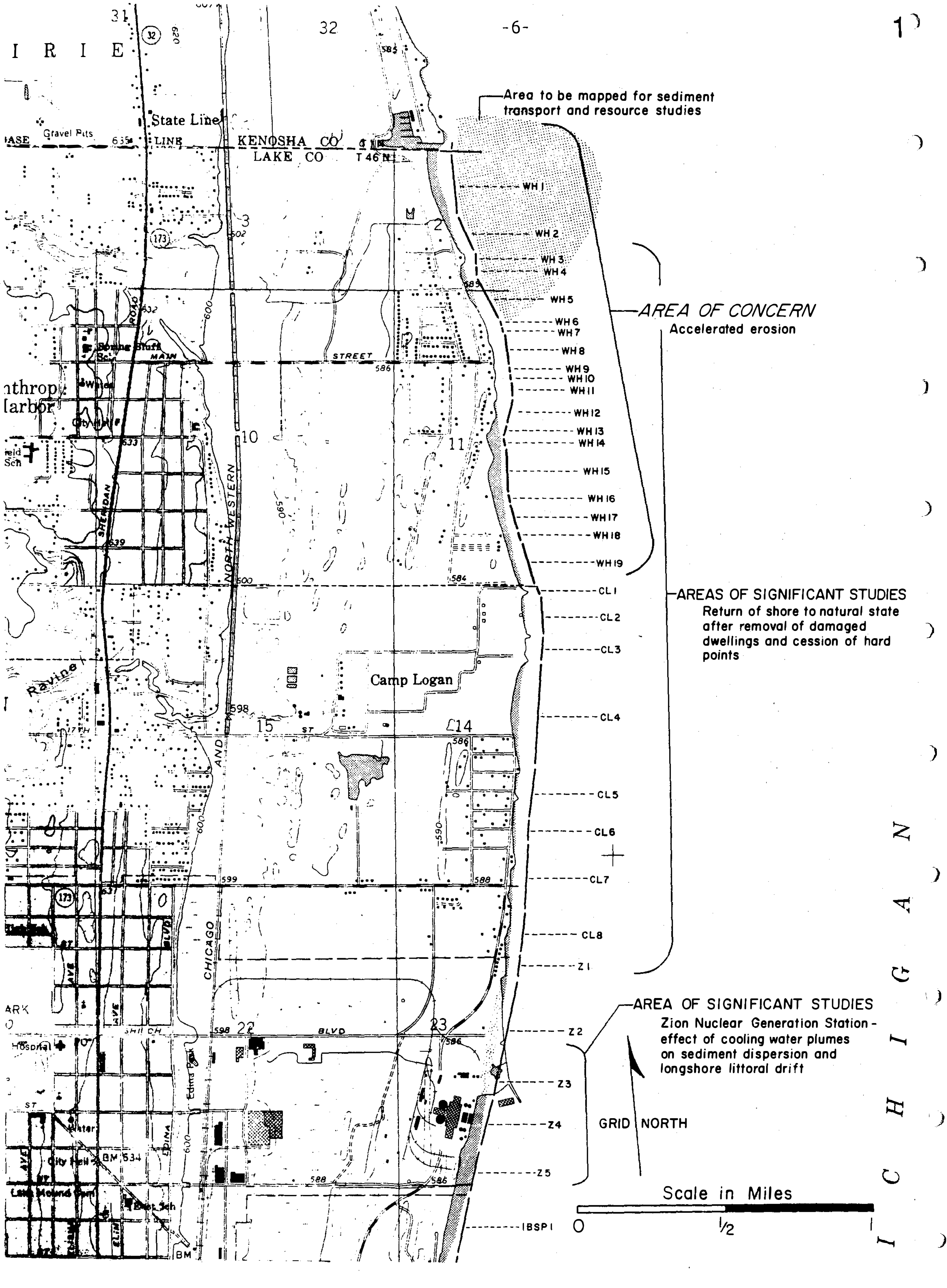
Submerged structures, structures partly or completely submerged at 580.5 feet IGLD that cannot be identified, debris from damaged piers, intakes, beach houses, dwellings, boat houses.

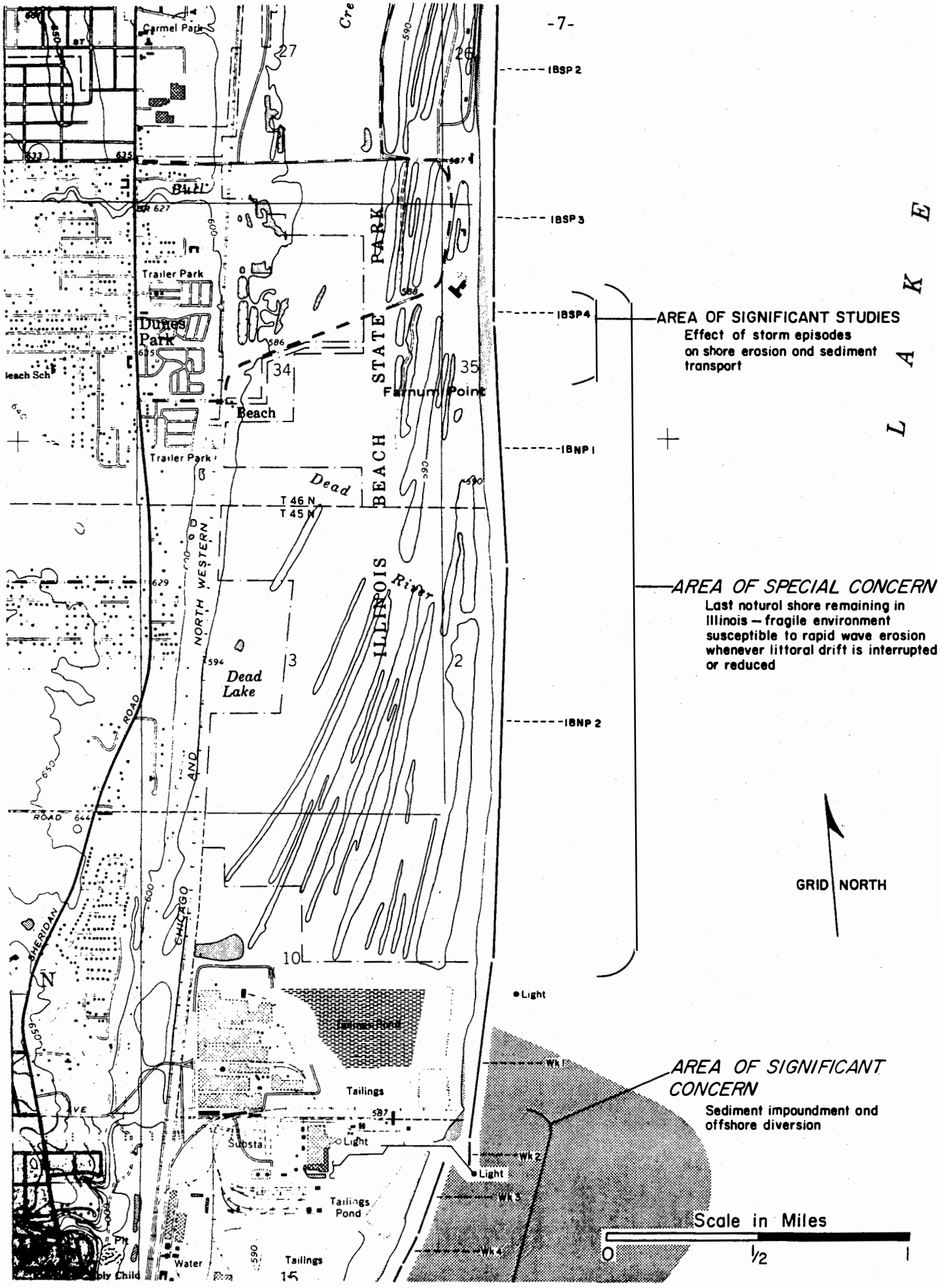
Oversteepened bluff with active slumps and gravity falls.

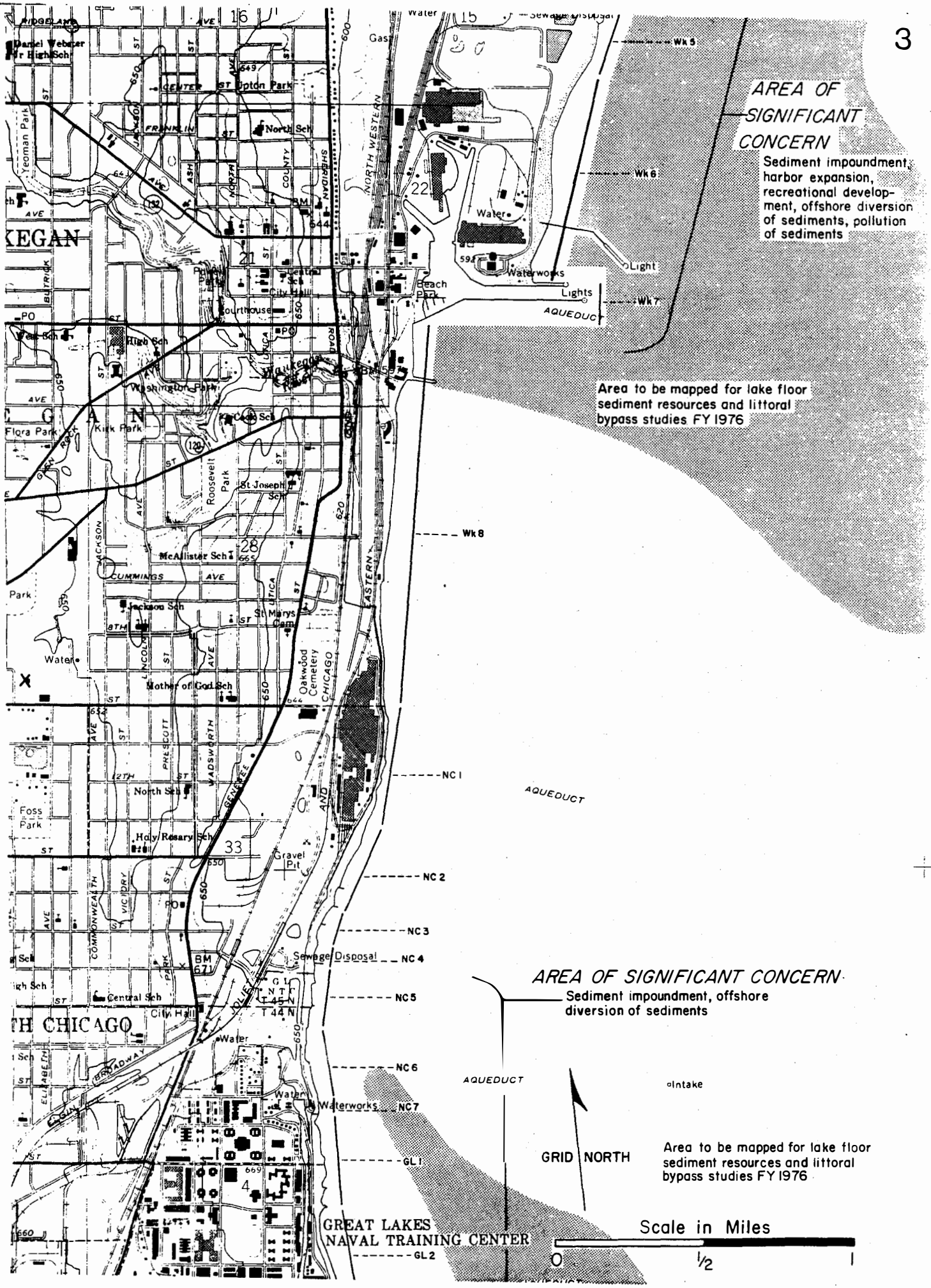
Unfenced bluff scarps.

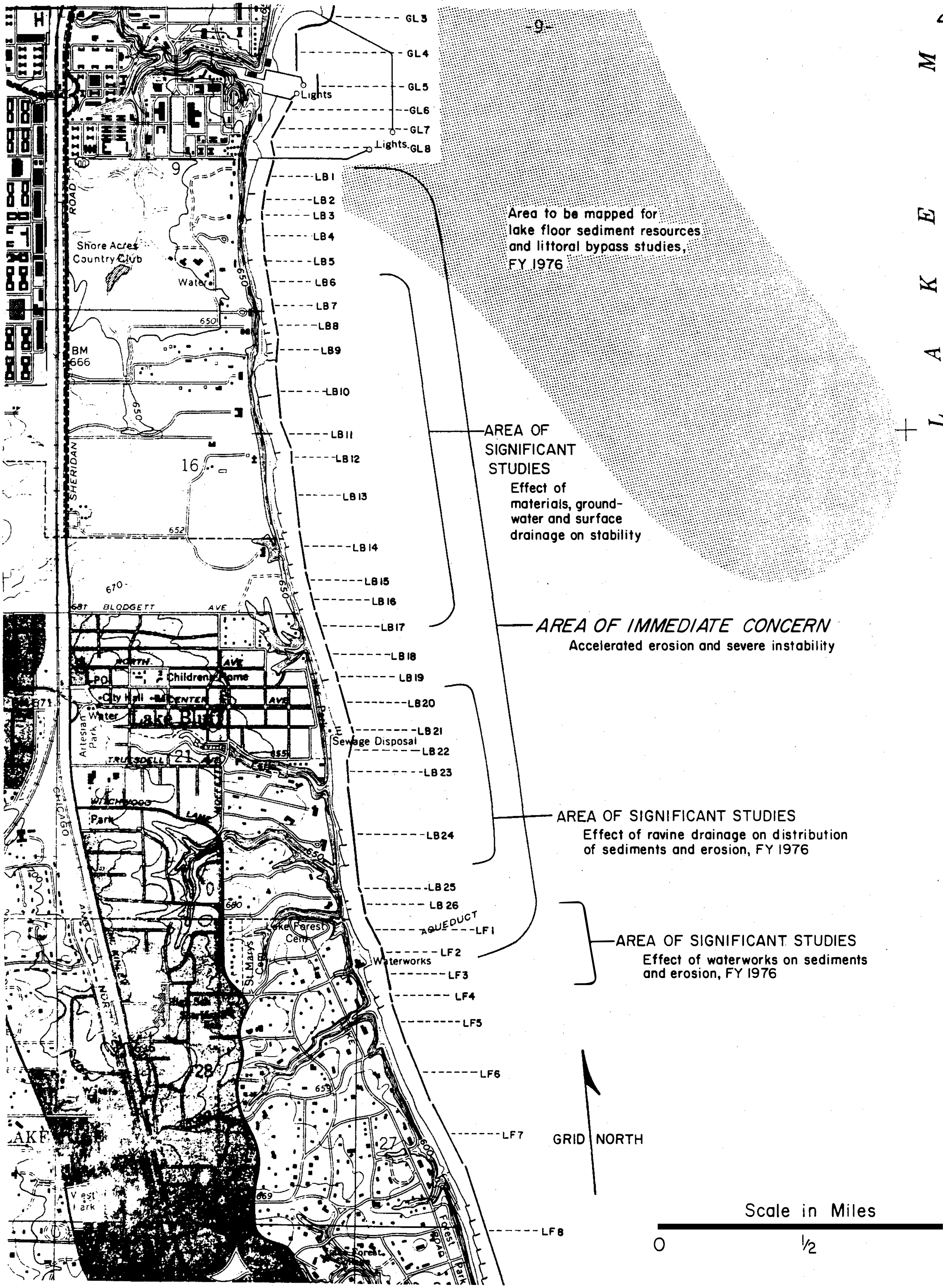


INDEX MAP FOR LAKE SHORE INVENTORY

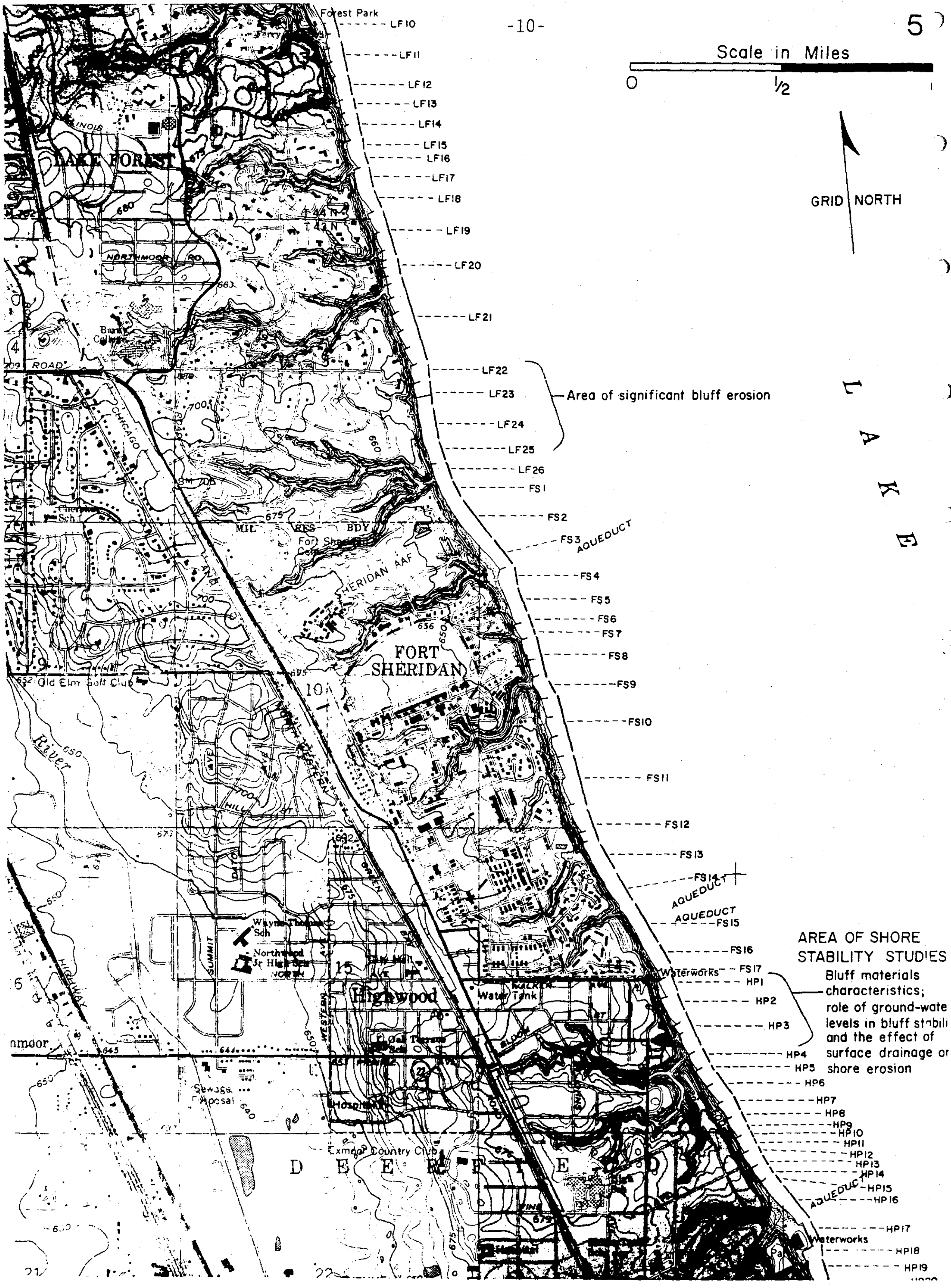

Area to be mapped for sediment transport and resource studies
AREA OF CONCERN
Accelerated erosion
AREAS OF SIGNIFICANT STUDIES
Return of shore to natural state after removal of damaged dwellings and cession of hard points
AREA OF SIGNIFICANT STUDIES
Zion Nuclear Generation Station - effect of cooling water plumes on sediment dispersion and longshore littoral drift
WH 1
WH 2
WH 3
WH 4
WH 5
WH 6
WH 7
WH 8
WH 9
WH 10
WH 11
WH 12
WH 13
WH 14
WH 15
WH 16
WH 17
WH 18
WH 19
CL 1
CL 2
CL 3
CL 4
CL 5
CL 6
CL 7
CL 8
Z 1
Z 2
Z 3
Z 4
Z 5
IBSP 1
GRID NORTH
Scale in Miles
0
1/2
1
MICHIGAN
State Line
KENOSHA CO
LAKE CO
Gravel Pits
Camp Logan
CHICAGO AND NORTH WESTERN
SHERIDAN ROAD
MAIN STREET
BLVD
Ravine

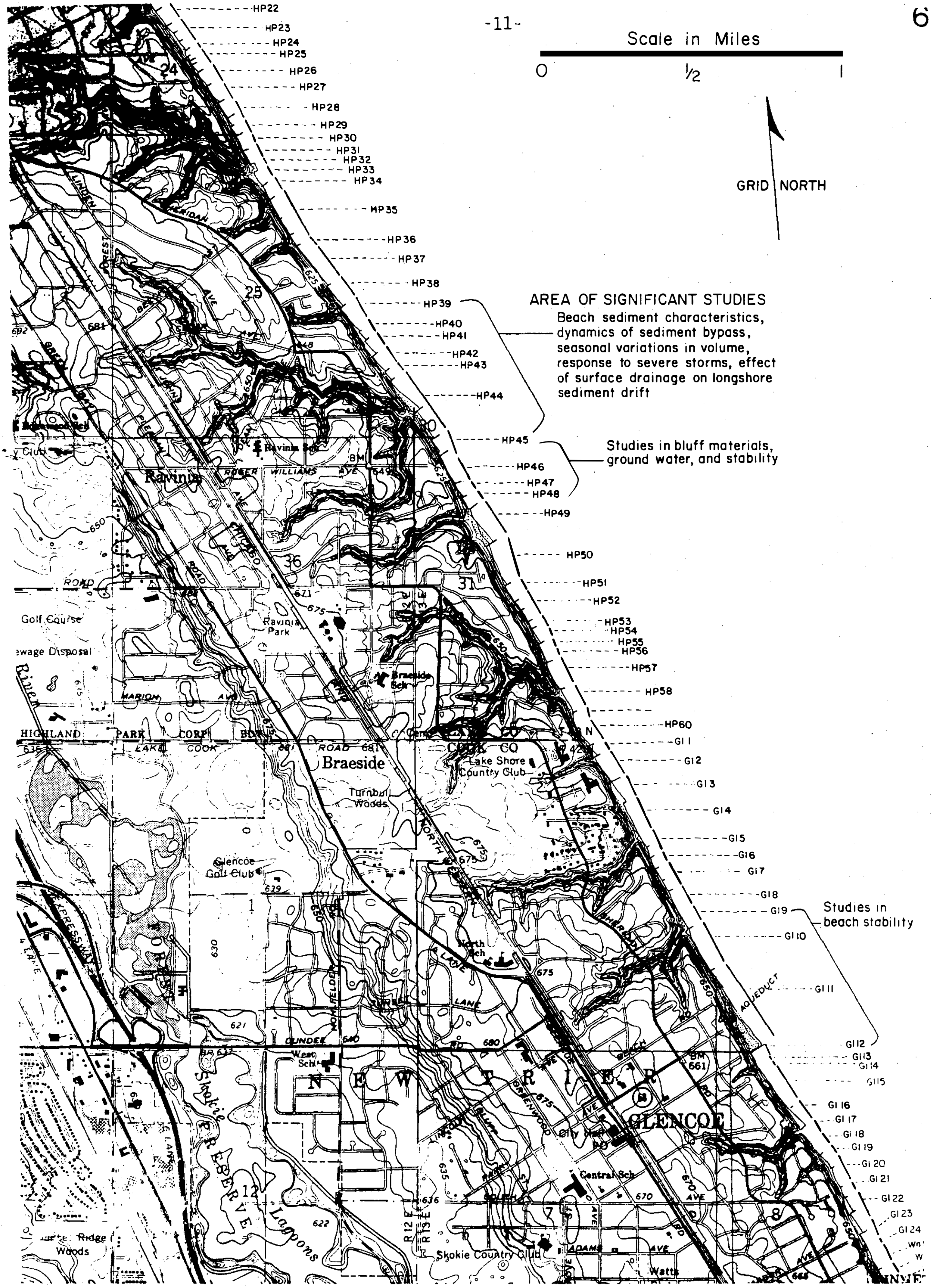

Carmel Park
Trailer Park
Dunes Park
Beach
Trailer Park
Dead
T 46 N
T 45 N
Dead Lake
NORTH WESTERN
CHICAGO AND
ILLINOIS
Illinois River
BEACH STATE PARK
Farnum Point
LAKE
IBSP 2
IBSP 3
IBSP 4
IBNP 1
IBNP 2
AREA OF SIGNIFICANT STUDIES
Effect of storm episodes on shore erosion and sediment transport
AREA OF SPECIAL CONCERN
Last natural shore remaining in Illinois — fragile environment susceptible to rapid wave erosion whenever littoral drift is interrupted or reduced
GRID NORTH
AREA OF SIGNIFICANT CONCERN
Sediment impoundment and offshore diversion
Wk 1
Wk 2
Wk 3
Wk 4
Light
Tailings Pond
Tailings
Substa
Water
Scale in Miles
0
1/2
1


AREA OF SIGNIFICANT CONCERN
Sediment impoundment, harbor expansion, recreational development, offshore diversion of sediments, pollution of sediments
Area to be mapped for lake floor sediment resources and littoral bypass studies FY 1976
Wk 5
Wk 6
Wk 7
Wk 8
NC 1
NC 2
NC 3
NC 4
NC 5
NC 6
NC 7
GL 1
GL 2
AQUEDUCT
Water
Waterworks
Light
Lights
Beach Park
Upton Park
North Sch
Central Sch
City Hall
Courthouse
High Sch
West Sch
Washington Park
Kirk Park
Flora Park
Roosevelt Park
St Joseph Sch
McAllister Sch
Jackson Sch
St Marys Cem
Mother of God Sch
Oakwood Cemetery
North Sch
Holy Rosary Sch
Gravel Pit
Sewage Disposal
Foss Park
Yeoman Park
Daniel Webster Jr High Sch
Waukegan
CHICAGO
GREAT LAKES NAVAL TRAINING CENTER
AREA OF SIGNIFICANT CONCERN
Sediment impoundment, offshore diversion of sediments
Intake
GRID NORTH
Area to be mapped for lake floor sediment resources and littoral bypass studies FY 1976
Scale in Miles
0
1/2
1

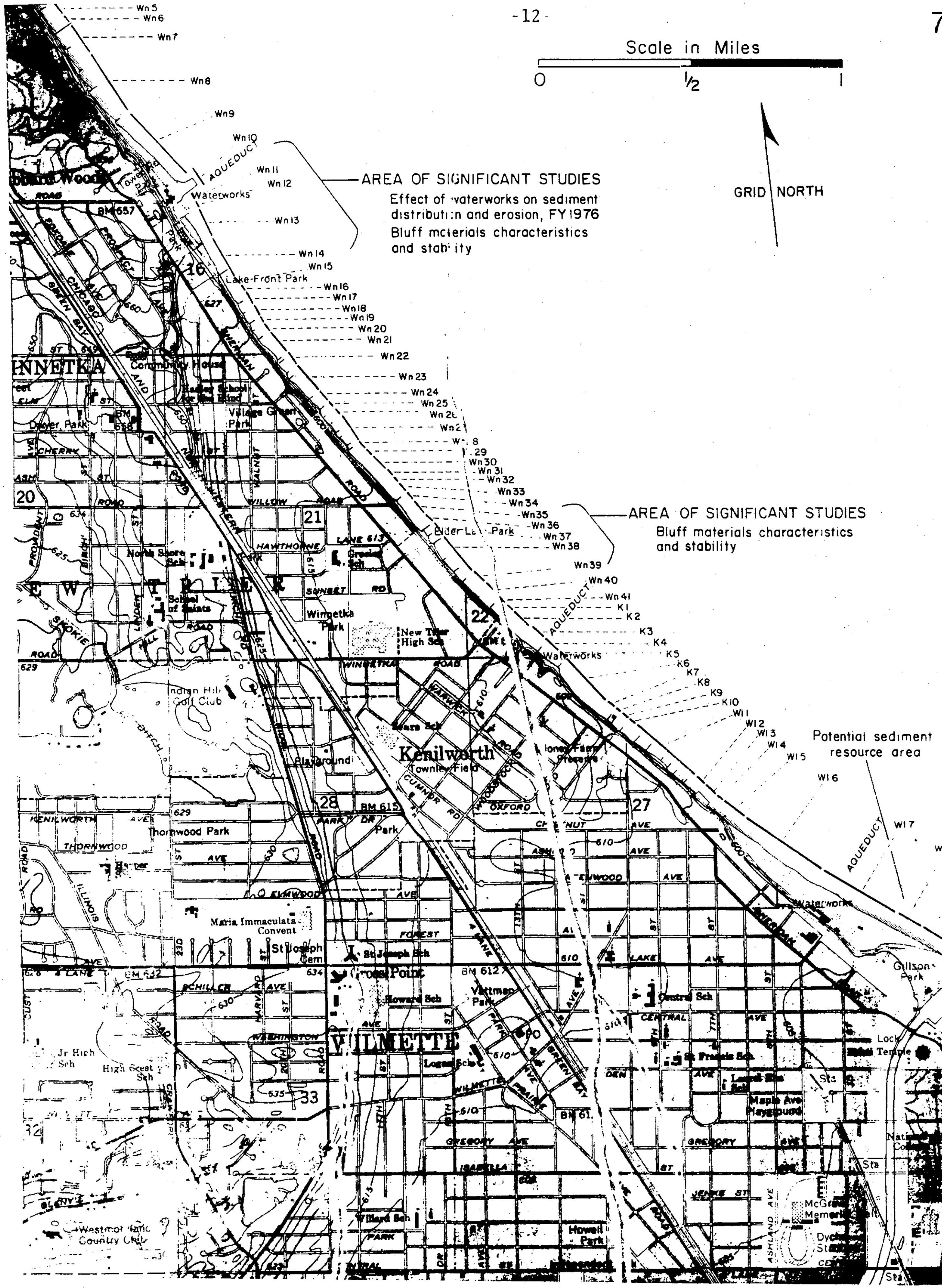

GL3
GL4
GL5
GL6
GL7
GL8
Lights
Lights
-9-
LB1
LB2
LB3
LB4
LB5
LB6
LB7
LB8
LB9
LB10
LB11
LB12
LB13
LB14
LB15
LB16
LB17
LB18
LB19
LB20
LB21
LB22
LB23
LB24
LB25
LB26
LF1
LF2
LF3
LF4
LF5
LF6
LF7
LF8
LAKE M
Area to be mapped for lake floor sediment resources and littoral bypass studies, FY 1976
AREA OF SIGNIFICANT STUDIES
Effect of materials, ground-water and surface drainage on stability
AREA OF IMMEDIATE CONCERN
Accelerated erosion and severe instability
AREA OF SIGNIFICANT STUDIES
Effect of ravine drainage on distribution of sediments and erosion, FY 1976
AREA OF SIGNIFICANT STUDIES
Effect of waterworks on sediments and erosion, FY 1976
Shore Acres Country Club
Water
SHERIDAN ROAD
BM 666
BLODGETT AVE
NORTH AVE
Children's Home
PO
City Hall
CENTER AVE
Lake Bluff
Artesian Park
Water
Sewage Disposal
TRUESDELL AVE
Witchwood Park
AQUEDUCT
Lake Forest Cem
St Marys Cem
Waterworks
West Park
Forest Park
GRID NORTH
Scale in Miles
0
½

5


Scale in Miles
0
1/2
1
GRID NORTH
LAKE
Forest Park
LF10
LF11
LF12
LF13
LF14
LF15
LF16
LF17
LF18
LF19
LF20
LF21
LF22
LF23
LF24
LF25
LF26
Area of significant bluff erosion
FS1
FS2
FS3
AQUEDUCT
FS4
FS5
FS6
FS7
FS8
FS9
FS10
FS11
FS12
FS13
FS14
AQUEDUCT
AQUEDUCT
FS15
FS16
FS17
Waterworks
HP1
HP2
HP3
HP4
HP5
HP6
HP7
HP8
HP9
HP10
HP11
HP12
HP13
HP14
AQUEDUCT
HP15
HP16
HP17
Waterworks
HP18
HP19
AREA OF SHORE STABILITY STUDIES
Bluff materials characteristics; role of ground-wate levels in bluff stabili and the effect of surface drainage or shore erosion
LAKE FOREST
NORTHMOOR RD.
Barat College
ROAD
CHICAGO
MIL RES BDY
FORT SHERIDAN
HERIDAN AAF
Old Elm Golf Club
River
Highwood
Water Tank
Wayne Thomas Sch
Northwood Jr High Sch
Oak Terrace Sch
Hospital
Sewage Disposal
Exmoor Country Club
D E E R F I E L D


Scale in Miles
0
½
1
GRID NORTH
AREA OF SIGNIFICANT STUDIES
Beach sediment characteristics, dynamics of sediment bypass, seasonal variations in volume, response to severe storms, effect of surface drainage on longshore sediment drift
Studies in bluff materials, ground water, and stability
Studies in beach stability
HP22
HP23
HP24
HP25
HP26
HP27
HP28
HP29
HP30
HP31
HP32
HP33
HP34
HP35
HP36
HP37
HP38
HP39
HP40
HP41
HP42
HP43
HP44
HP45
HP46
HP47
HP48
HP49
HP50
HP51
HP52
HP53
HP54
HP55
HP56
HP57
HP58
HP60
GI1
GI2
GI3
GI4
GI5
GI6
GI7
GI8
GI9
GI10
GI11
GI12
GI13
GI14
GI15
GI16
GI17
GI18
GI19
GI20
GI21
GI22
GI23
GI24
Ravinia
Ravinia Park
Braeside
Braeside Sch
Turnbull Woods
Lake Shore Country Club
Glencoe Golf Club
Golf Course
North Sch
West Sch
GLENCOE
Central Sch
Skokie Country Club
N E W T R I E R
HIGHLAND PARK CORP BDY
LAKE CO
COOK CO
ROGER WILLIAMS AVE
MARION AVE
DUNDEE RD
Skokie Lagoons
AQUEDUCT
R12E
R13E

7


Scale in Miles
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½
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GRID NORTH
AREA OF SIGNIFICANT STUDIES
Effect of waterworks on sediment distribution and erosion, FY 1976
Bluff materials characteristics and stability
AREA OF SIGNIFICANT STUDIES
Bluff materials characteristics and stability
Potential sediment resource area
AQUEDUCT
Waterworks
Lake-Front Park
Elder Lane Park
Village Green Park
Dwyer Park
Winnetka Park
New Trier High Sch
Indian Hill Golf Club
Kenilworth
Townley Field
Thornwood Park
Maria Immaculata Convent
St Joseph Cem
Gross Point
Vattman Park
WILMETTE
Central Sch
Logan Sch
Howard Sch
Willard Sch
Howell Park
Gillson Park
Lock
Bahai Temple
Maple Ave Playground
Westmoreland Country Club
High Crest Sch
Jr High Sch
Harper
Playground
School of Saints
North Shore Sch
Greeley Sch
Hadley School for the Blind
Community House
WINNETKA
NEW TRIER
Wn 5
Wn 6
Wn 7
Wn 8
Wn 9
Wn 10
Wn 11
Wn 12
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Wn 14
Wn 15
Wn 16
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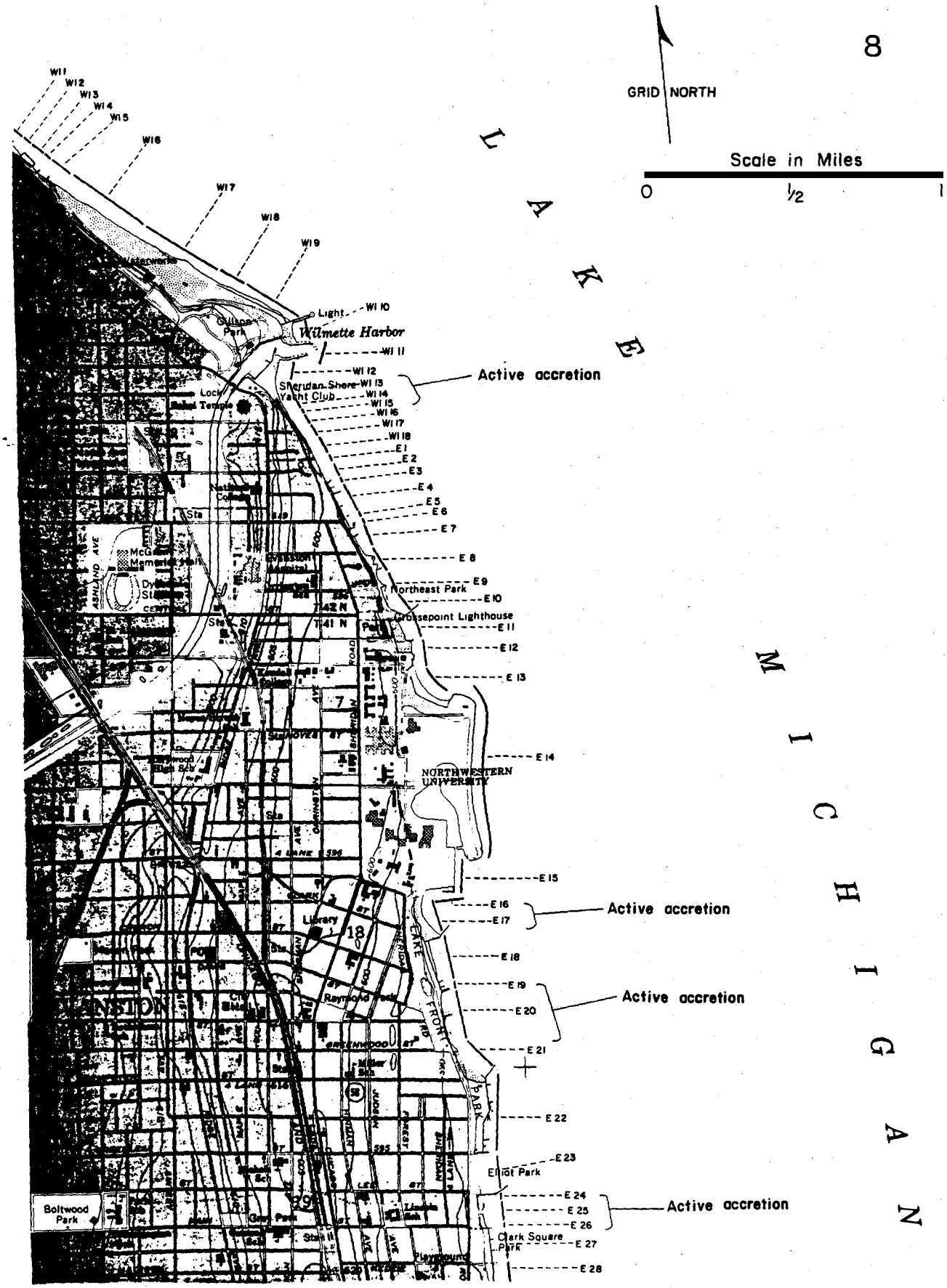
Wl 6
Wl 7
Wl 8


GRID NORTH
Scale in Miles
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1
LAKE MICHIGAN
W1
W2
W3
W4
W5
W6
W7
W8
W9
W10
W11
W12
W13
W14
W15
W16
W17
W18
E1
E2
E3
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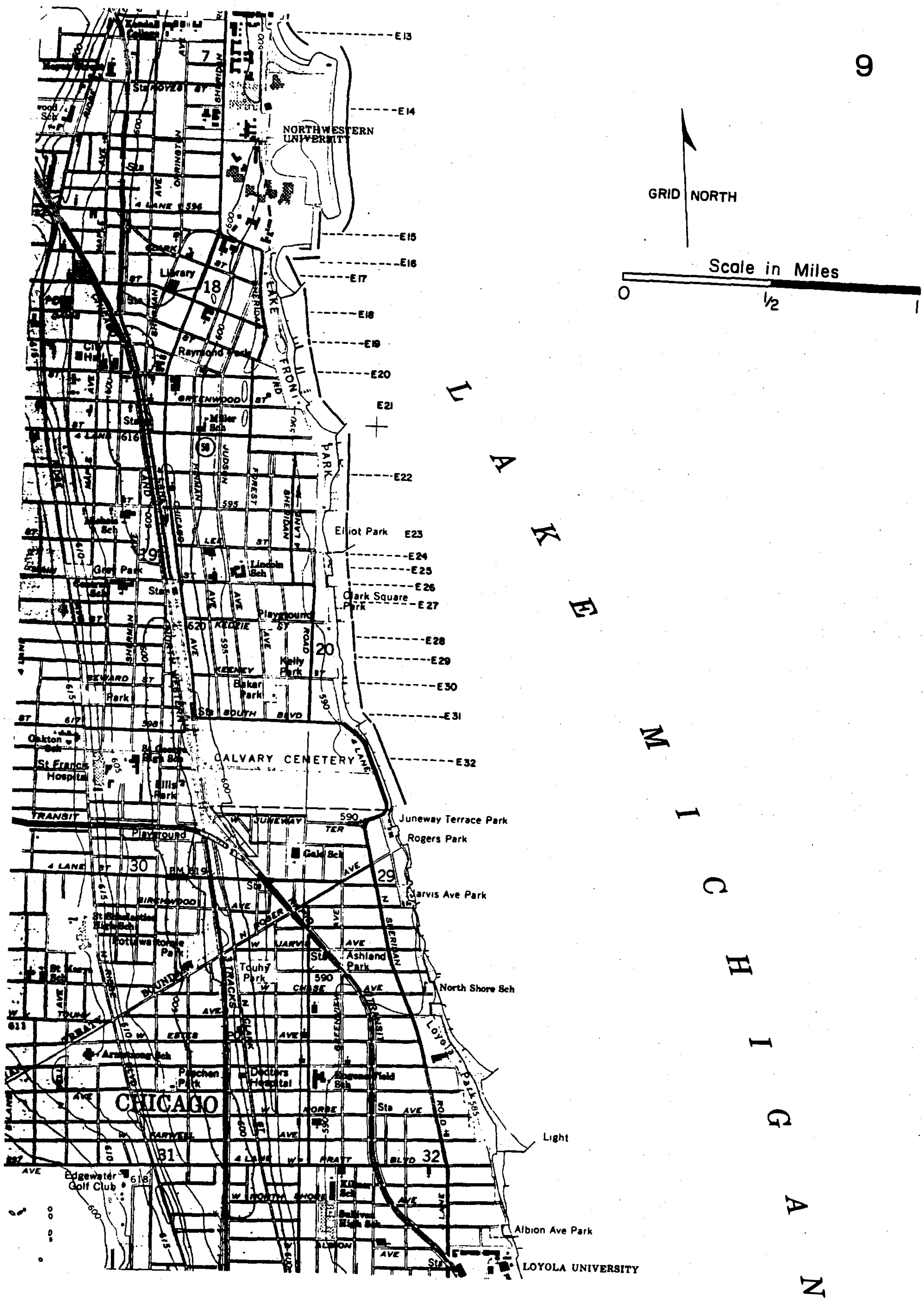
E13
E14
E15
E16
E17
E18
E19
E20
E21
E22
E23
E24
E25
E26
E27
E28
Active accretion
Active accretion
Active accretion
Active accretion
Light
Wilmette Harbor
Gillson Park
Sheridan Shore Yacht Club
Northeast Park
Grosse point Lighthouse
NORTHWESTERN UNIVERSITY
Library
Elliot Park
Clark Square Park
Boltwood Park
Playground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GRID NORTH
Scale in Miles
0
1/2
1
NORTHWESTERN UNIVERSITY
E13
E14
E15
E16
E17
E18
E19
E20
E21
E22
E23
E24
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E26
E27
E28
E29
E30
E31
E32
LAKE MICHIGAN
Elliot Park
Clark Square Park
CALVARY CEMETERY
Juneway Terrace Park
Rogers Park
Jarvis Ave Park
North Shore Sch
Light
Albion Ave Park
LOYOLA UNIVERSITY
CHICAGO
Edgewater Golf Club
St Francis Hospital

TABLE 2 - CHARACTERISTICS OF THE ILLINOIS SHORE KEYED TO INVENTORY MAPS

CITY	TRIDENT HARBOR	TH 1
BEACH CONDITION	Normal Beach	
	Narrow Beach	
	Damaged Beach	
	No Beach	•
BLUFF EROSION	Partly Denuded	
	Wave Impact	
	Denuded	
	Active Erosion	
	Severe Erosion	
SHORE STABILITY	Stable, Natural Vegetation	
	Stable Landscaped	
	Incipiently Unstable	
	Active Slumping	
	Seeps	
	Oversteep, Hazardous	
STRUCTURAL PROTECTION	Groins	
	Sheet Pile	
	Temporary Protection	
	Concrete or Stone Wall	
	Riprap	
	Bulkhead	
	Pier or Launching Ramp	
	Jetty or Breakwater	•
HAZARDS	Groins Submerged at 580+ Feet	
	Debris in Water	
	Slump Hazard	
	Unfenced Scarp	

TABLE 2 (CONTINUED)

CITY	WINTHROP HARBOR	WH 1	WH 2	WH 3	WH 4	WH 5	WH 6	WH 7	WH 8	WH 9	WH 10	WH 11	WH 12	WH 13	WH 14	WH 15
BEACH CONDITION	Normal Beach	•			•											•
	Narrow Beach		•			•		•		•		•	•		•	
	Damaged Beach		•												•	
	No Beach			•			•		•		•			•		
BLUFF EROSION	Partly Denuded															
	Wave Impact	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Denuded															
	Active Erosion															
	Severe Erosion															
SHORE STABILITY	Stable, Natural Vegetation															
	Stable Landscaped															
	Incipiently Unstable															
	Active Slumping	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
	Seeps															
	Oversteep, Hazardous															
STRUCTURAL PROTECTION	Groins															
	Sheet Pile															
	Temporary Protection															
	Concrete or Stone Wall															
	Riprap			•	•		•		•		•		•	•		
	Bulkhead															
	Pier or Launching Ramp															
	Jetty or Breakwater															
HAZARDS	Groins Submerged at 580+ Feet															
	Debris in Water															
	Slump Hazard															
	Unfenced Scarp															

TABLE 2 (CONTINUED)

CITY	BEACH CONDITION				BLUFF EROSION					SHORE STABILITY						STRUCTURAL PROTECTION									HAZARDS			
	Normal Beach	Narrow Beach	Damaged Beach	No Beach	Partly Denuded	Wave Impact	Denuded	Active Erosion	Severe Erosion	Stable, Natural Vegetation	Stable Landscaped	Incipiently Unstable	Active Slumping	Seeps	Oversteep, Hazardous	Groins	Sheet Pile	Temporary Protection	Concrete or Stone Wall	Riprap	Bulkhead	Pier or Launching Ramp	Jetty or Breakwater	Groins Submerged at 580+ Feet	Debris in Water	Slump Hazard	Unfenced Scarp
WINTHROP HARBOR Continued																												
WH 16		•				•						•																
WH 17	•					•						•																
WH 18		•	•			•						•																
WH 19		•				•						•																

TABLE 2 (CONTINUED)

CITY	BEACH CONDITION				BLUFF EROSION					SHORE STABILITY								HAZARDS										
	Normal Beach	Narrow Beach	Damaged Beach	No Beach	Partly Denuded	Wave Impact	Denuded	Active Erosion	Severe Erosion	Stable, Natural Vegetation	Stable Landscaped	Incipiently Unstable	Active Slumping	Seeps	Oversteep, Hazardous	Groins	Sheet Pile	Temporary Protection	Concrete or Stone Wall	Riprap	Bulkhead	Pier or Launching Ramp	Jetty or Breakwater	Groins Submerged at 580+ Feet	Debris in Water	Slump Hazard	Unfenced Scarp
CAMP LOGAN																												
CL 1	•					•						•				•	•											
CL 2	•					•						•				•												
CL 3				•							•					•	•											
CL 4	•					•						•				•												
CL 5				•		•						•								•								
CL 6		•	•			•						•																
CL 7				•		•						•								•								
CL 8		•	•			•						•								•								

TABLE 2 (CONTINUED)

CITY	ZION	Z 1	Z 2	Z 3	Z 4	Z 5
BEACH CONDITION	Normal Beach					•
	Narrow Beach	•	•	•	•	
	Damaged Beach	•				
	No Beach					
BLUFF EROSION	Partly Denuded					
	Wave Impact	•	•			
	Denuded					
	Active Erosion					
	Severe Erosion					
SHORE STABILITY	Stable, Natural Vegetation					
	Stable Landscaped				•	
	Incipiently Unstable	•	•	•		•
	Active Slumping					
	Seeps					
	Oversteep, Hazardous					
STRUCTURAL PROTECTION	Groins					
	Sheet Pile					
	Temporary Protection					
	Concrete or Stone Wall					
	Riprap			•		•
	Bulkhead				•	
	Pier or Launching Ramp					
	Jetty or Breakwater					
HAZARDS	Groins Submerged at 580+ Feet					
	Debris in Water					
	Slump Hazard					
	Unfenced Scarp					

TABLE 2 (CONTINUED)

CITY	ILLINOIS BEACH STATE PARK	IBSP 1	IBSP 2	IBSP 3	IBSP 4
BEACH CONDITION	Normal Beach	•		•	
	Narrow Beach		•		•
	Damaged Beach		•		
	No Beach				
BLUFF EROSION	Partly Denuded				
	Wave Impact		•	•	•
	Denuded				
	Active Erosion				
	Severe Erosion				
SHORE STABILITY	Stable, Natural Vegetation				
	Stable Landscaped				
	Incipiently Unstable	•	•	•	•
	Active Slumping				
	Seeps				
	Oversteep, Hazardous				
STRUCTURAL PROTECTION	Groins				
	Sheet Pile				
	Temporary Protection				
	Concrete or Stone Wall				
	Riprap		•		•
	Bulkhead				
	Pier or Launching Ramp				
	Jetty or Breakwater				
HAZARDS	Groins Submerged at 580+ Feet				
	Debris in Water				
	Slump Hazard				
	Unfenced Scarp				

TABLE 2 (CONTINUED)

CITY	BEACH CONDITION				BLUFF EROSION					SHORE STABILITY								STRUCTURAL PROTECTION										HAZARDS		
	Normal Beach	Narrow Beach	Damaged Beach	No Beach	Partly Denuded	Wave Impact	Denuded	Active Erosion	Severe Erosion	Stable, Natural Vegetation	Stable Landscaped	Incipiently Unstable	Active Slumping	Seeps	Overseteep, Hazardous	Groins	Sheet Pile	Temporary Protection	Concrete or Stone Wall	Riprap	Bulkhead	Pier or Launching Ramp	Jetty or Breakwater	Groins Submerged at 580+ Feet	Debris in Water	Slump Hazard	Unfenced Scarp
WAUKEGAN																													
Wk 1	•										•												•						
Wk 2				•																			•						
Wk 3		•									•												•						
Wk 4				•		•					•																		
Wk 5		•									•																		
Wk 6	•										•												•						
Wk 7				•																			•						
Wk 8				•							•									•			•						

TABLE 2 (CONTINUED

CITY	ILLINOIS BEACH NATURE PRESERVE	IBNP 1	IBNP 2														
BEACH CONDITION	Normal Beach	•	•														
	Narrow Beach																
	Damaged Beach																
	No Beach																
BLUFF EROSION	Partly Denuded																
	Wave Impact	•															
	Denuded																
	Active Erosion																
	Severe Erosion																
SHORE STABILITY	Stable, Natural Vegetation		•														
	Stable Landscaped																
	Incipiently Unstable	•															
	Active Slumping																
	Seeps																
	Oversteep, Hazardous																
STRUCTURAL PROTECTION	Groins																
	Sheet Pile																
	Temporary Protection																
	Concrete or Stone Wall																
	Riprap																
	Bulkhead																
	Pier or Launching Ramp																
	Jetty or Breakwater																
HAZARDS	Groins Submerged at 580+ Feet																
	Debris in Water																
	Slump Hazard																
	Unfenced Scarp																

TABLE 2 (CONTINUED)

CITY	NORTH CHICAGO	NC 1	NC 2	NC 3	NC 4	NC 5	NC 6	NC 7
BEACH CONDITION	Normal Beach						●	
	Narrow Beach							
	Damaged Beach							
	No Beach	●	●	●	●	●		●
BLUFF EROSION	Partly Denuded					●		
	Wave Impact		●					
	Denuded			●				
	Active Erosion			●		●		
	Severe Erosion							
SHORE STABILITY	Stable, Natural Vegetation							
	Stable Landscaped	●	●		●			●
	Incipiently Unstable						●	
	Active Slumping		●			●		
	Seeps							
	Oversteep, Hazardous							
STRUCTURAL PROTECTION	Groins							
	Sheet Pile							
	Temporary Protection							
	Concrete or Stone Wall							
	Riprap	●	●	●	●			●
	Bulkhead							
	Pier or Launching Ramp							
	Jetty or Breakwater							
HAZARDS	Groins Submerged at 580+ Feet				●			
	Debris in Water		●	●	●	●		
	Slump Hazard							
	Unfenced Scarp			●				

TABLE 2 (CONTINUED)

CITY	GREAT LAKES	GL 1	GL 2	GL 3	GL 4	GL 5	GL 6	GL 7	GL 8
BEACH CONDITION	Normal Beach			•					
	Narrow Beach								
	Damaged Beach								
	No Beach	•	•		•	•	•	•	•
BLUFF EROSION	Partly Denuded								
	Wave Impact								
	Denuded								
	Active Erosion								
	Severe Erosion								
SHORE STABILITY	Stable, Natural Vegetation								
	Stable Landscaped	•	•	•	•		•	•	•
	Incipiently Unstable								
	Active Slumping								
	Seeps								
	Oversteep, Hazardous								
STRUCTURAL PROTECTION	Groins								
	Sheet Pile								
	Temporary Protection								
	Concrete or Stone Wall		•					•	
	Riprap	•	•		•		•		•
	Bulkhead								
	Pier or Launching Ramp								
	Jetty or Breakwater			•	•	•	•		
HAZARDS	Groins Submerged at 580+ Feet								
	Debris in Water								
	Slump Hazard								
	Unfenced Scarp								

TABLE 2 (CONTINUED)

CITY	BEACH CONDITION				BLUFF EROSION					SHORE STABILITY						STRUCTURAL PROTECTION										HAZARDS			
LAKE BLUFF	Normal Beach	Narrow Beach	Damaged Beach	No Beach	Partly Denuded	Wave Impact	Denuded	Active Erosion	Severe Erosion	Stable, Natural Vegetation	Stable Landscaped	Incipiently Unstable	Active Slumping	Seeps	Oversteep, Hazardous	Groins	Sheet Pile	Temporary Protection	Concrete or Stone Wall	Riprap	Bulkhead	Pier or Launching Ramp	Jetty or Breakwater	Groins Submerged at 580+ Feet	Debris in Water	Slump Hazard	Unfenced Scarp
LB 1		•								•													•					
LB 2							•		•						•	•										•	•	
LB 3				•						•											•	•						
LB 4				•			•		•						•	•										•		
LB 5				•			•					•									•					•		
LB 6				•			•	•	•						•	•												
LB 7				•						•											•	•						
LB 8				•	•			•					•								•	•						
LB 9				•	•			•					•								•					•		
LB 10							•		•						•											•	•	
LB 11		•	•			•				•																		
LB 12				•		•				•						•					•	•			•			
LB 13		•	•			•				•						•										•		
LB 14		•			•			•					•			•					•				•	•		
				•		•						•				•					•							

TABLE 2 (CONTINUED)

CITY	BEACH CONDITION				BLUFF EROSION					SHORE STABILITY							STRUCTURAL PROTECTION										HAZARDS				
LAKE BLUFF Continued	Normal Beach	Narrow Beach	Damaged Beach	No Beach	Partly Denuded	Wave Impact	Denuded	Active Erosion	Severe Erosion	Stable, Natural Vegetation	Stable Landscaped	Incipiently Unstable	Active Slumping	Seeps	Oversteep, Hazardous	Groins	Sheet Pile	Temporar Protection	Concrete or Stone Wall	Riprap	Bulkhead	Pier or Launching Ramp	Jetty or Breakwater	Groins Submerged at 580+ Feet	Debris in Water	Slump Hazard	Unfenced Scarp
LB 16				•			•	•	•				•	•	•	•	•				•									
LB 17				•	•			•	•				•	•	•						•				•					
LB 18				•			•	•	•				•	•	•							•			•					
LB 19		•			•	•						•											•							
LB 20	•									•						•								•						
LB 21				•							•					•						•									
LB 22				•		•	•		•					•		•					•				•	•	•			
LB 23				•	•	•	•		•					•	•	•	•					•			•	•	•	•			
LB 24		•		•		•	•		•					•	•	•									•	•	•	•			
LB 25				•			•		•				•	•			•					•									
LB 26		•				•	•		•					•	•	•											•				

TABLE 2 (CONTINUED)

CITY	BEACH CONDITION				BLUFF EROSION					SHORE STABILITY						STRUCTURAL PROTECTION										HAZARDS			
	Normal Beach	Narrow Beach	Damaged Beach	No Beach	Partly Denuded	Wave Impact	Denuded	Active Erosion	Severe Erosion	Stable, Natural Vegetation	Stable Landscaped	Incipiently Unstable	Active Slumping	Seeps	Overseteep, Hazardous	Groins	Sheet Pile	Temporary Protection	Concrete or Stone Wall	Riprap	Bulkhead	Pier or Launching Ramp	Jetty or Breakwater	Groins Submerged at 580+ Feet	Debris in Water	Slump Hazard	Unfenced Scarp
LAKE FOREST																												
LF 1	•									•																		
LF 2				•							•										•							
LF 3		•			•			•						•	•	•												•
LF 4		•								•						•												
LF 5		•			•	•		•				•				•	•				•							
LF 6		•								•						•					•							
LF 7		•	•							•						•	•			•					•			
LF 8	•									•						•												
LF 9		•								•						•								•				
LF 10				•							•					•				•		•						
LF 11		•	•			•				•						•									•			
LF 12		•								•						•									•			
LF 13		•								•						•					•							
LF 14	•											•				•	•											
LF 15				•	•																							

TABLE 2 (CONTINUED)

CITY	BEACH CONDITION				BLUFF EROSION					SHORE STABILITY						STRUCTURAL PROTECTION									HAZARDS			
LAKE FOREST Continued	Normal Beach	Narrow Beach	Damaged Beach	No Beach	Partly Denuded	Wave Impact	Denuded	Active Erosion	Severe Erosion	Stable, Natural Vegetation	Landscaped Stable	Incipiently Unstable	Active Slumping	Seeps	Oversteep, Hazardous	Groins	Sheet Pile	Temporary Protection	Concrete or Stone Wall	Riprap	Bulkhead	Pier or Launching Ramp	Jetty or Breakwater	Groins Submerged at 580+ Feet	Debris in Water	Slump Hazard	Unfenced Scarp
LF 16		•			•								•			•					•						
LF 17				•		•						•				•								•			
LF 18	•									•						•								•			
LF 19		•								•						•											
LF 20		•				•						•				•		•									
LF 21		•								•						•											
LF 22		•			•	•		•				•				•											
LF 23		•				•						•				•											
LF 24				•			•	•					•	•	•											•	•
LF 25		•	•			•						•															
LF 26				•	•	•		•					•											•			

TABLE 2 (CONTINUED)

CITY	FORT SHERIDAN Continued	FS 16	FS 17
BEACH CONDITION	Normal Beach	●	
	Narrow Beach		
	Damaged Beach		
	No Beach		●
BLUFF EROSION	Partly Denuded	●	
	Wave Impact		
	Denuded		
	Active Erosion		
	Severe Erosion		
SHORE STABILITY	Stable, Natural Vegetation	●	
	Stable Landscaped		●
	Incipiently Unstable		
	Active Slumping	●	
	Seeps		
	Oversteep, Hazardous		
STRUCTURAL PROTECTION	Groins		
	Sheet Pile		
	Temporary Protection		
	Concrete or Stone Wall		
	Riprap		●
	Bulkhead		●
	Pier or Launching Ramp		
	Jetty or Breakwater		
HAZARDS	Groins Submerged at 580+ Feet	●	
	Debris in Water		
	Slump Hazard		
	Unfenced Scarp		

TABLE 2 (CONTINUED)

CITY	FORT SHERIDAN	FS 1	FS 2	FS 3	FS 4	FS 5	FS 6	FS 7	FS 8	FS 9	FS 10	FS 11	FS 12	FS 13	FS 14	FS 15
BEACH CONDITION	Normal Beach			●		●	●	●			●					
	Narrow Beach		●		●				●			●	●	●	●	●
	Damaged Beach															
	No Beach	●								●						
BLUFF EROSION	Partly Denuded	●												●	●	
	Wave Impact	●												●	●	●
	Denuded															●
	Active Erosion	●													●	●
	Severe Erosion															
SHORE STABILITY	Stable, Natural Vegetation					●		●	●							
	Stable Landscaped		●	●	●					●	●		●			
	Incipiently Unstable						●					●				
	Active Slumping	●												●	●	
	Seeps															●
	Oversteep, Hazardous															●
STRUCTURAL PROTECTION	Groins					●	●	●	●	●	●	●	●			
	Sheet Pile															
	Temporary Protection															
	Concrete or Stone Wall			●	●											
	Riprap								●							
	Bulkhead									●						
	Pier or Launching Ramp				●											
	Jetty or Breakwater															
HAZARDS	Groins Submerged at 580+ Feet	●		●	●								●		●	●
	Debris in Water		●						●					●		
	Slump Hazard															●
	Unfenced Scarp															

TABLE 2 (CONTINUED

CITY	BEACH CONDITION				BLUFF EROSION					SHORE STABILITY							STRUCTURAL PROTECTION											HAZARDS			
	Normal Beach	Narrow Beach	Damaged Beach	No Beach	Partly Denuded	Wave Impact	Denuded	Severe Erosion	Active Erosion	Stable, Natural Vegetation	Stable Landscaped	Incipiently Unstable	Active Slumping	Seeps	Oversteep, Hazardous	Groins	Sheet Pile	Temporary Protection	Concrete or Stone Wall	Riprap	Bulkhead	Pier or Launching Ramp	Jetty or Breakwater	Groins Submerged at 580+ Feet	Debris in Water	Slump Hazard	Unfenced Scarp
HIGHLAND PARK																															
HP 1	•											•				•														
HP 2		•			•	•			•				•			•														
HP 3		•								•						•								•						
HP 4	•									•						•														
HP 5				•						•						•								•						
HP 6	•									•						•									•					
HP 7		•	•							•						•									•					
HP 8				•		•				•						•									•					
HP 9		•				•				•						•														
HP 10				•		•				•						•		•							•					
HP 11		•				•				•						•				•										
HP 12				•		•						•				•				•					•					
HP 13				•		•						•				•									•					
HP 14		•				•						•				•														
HP 15				•	•	•			•				•			•									•					

TABLE 2 (CONTINUED)

CITY	BEACH CONDITION				BLUFF EROSION				SHORE STABILITY						HAZARDS				STRUCTURAL PROTECTION									
	Normal Beach	Narrow Beach	Damaged Beach	No Beach	Partly Denuded	Wave Impact	Denuded	Active Erosion	Severe Erosion	Stable, Natural Vegetation	Stable Landscaped	Incipiently Unstable	Active Slumping	Seeps	Oversteep, Hazardous	Unfenced Scarp	Slump Hazard	Debris in Water	Groins Submerged at 580+ Feet	Jetty or Breakwater	Pier or Launching Ramp	Bulkhead	Riprap	Concrete or Stone Wall	Temporary Protection	Sheet Pile	Groins
HIGHLAND PARK Continued																											
HP 16		•									•							•					•				
HP 17				•							•										•	•					
HP 18		•								•									•								
HP 19				•		•						•						•									•
HP 20		•			•	•		•					•														•
HP 21		•				•				•																•	•
HP 22		•				•				•																	•
HP 23		•				•				•												•					•
HP 24		•				•						•							•								•
HP 25		•			•	•		•					•														•
HP 26				•	•	•				•		•														•	•
HP 27				•		•						•														•	•
HP 28		•				•				•																	•
HP 29				•		•				•														•			•
HP 30		•				•				•																	•

TABLE 2 (CONTINUED)

CITY	BEACH CONDITION				BLUFF EROSION				SHORE STABILITY							STRUCTURAL PROTECTION									HAZARDS			
	Normal Beach	Narrow Beach	Damaged Beach	No Beach	Partly Denuded	Wave Impact	Denuded	Active Erosion	Severe Erosion	Stable, Natural Vegetation	Stable Landscaped	Incipiently Unstable	Active Slumping	Seeps	Oversteep, Hazardous	Groins	Sheet Pile	Temporary Protection	Concrete or Stone Wall	Riprap	Bulkhead	Jetty or Breakwater	Pier or Launching Ramp	Unfenced Scarp	Slump Hazard	Debris in Water	Groins Submerged at 580+ Feet
HIGHLAND PARK Continued																												
HP 31		•				•				•						•												
HP 32				•							•										•						•
HP 33		•								•						•	•				•					•	
HP 34				•		•				•						•	•									•	
HP 35				•	•	•		•					•			•	•										•
HP 36				•		•				•							•										•
HP 37		•		•		•				•									•							•	•
HP 38				•						•						•					•						
HP 39				•	•	•		•					•			•										•	
HP 40		•								•						•											
HP 41	•		•			•						•				•										•	
HP 42	•											•				•											
HP 43	•											•				•											
HP 44	•	•								•	•					•										•	•
HP 45				•	•	•		•					•			•											

TABLE 2 (CONTINUED)

CITY	BEACH CONDITION				BLUFF EROSION				SHORE STABILITY						STRUCTURAL PROTECTION										HAZARDS			
	Normal Beach	Narrow Beach	Damaged Beach	No Beach	Partly Denuded	Wave Impact	Denuded	Active Erosion	Severe Erosion	Stable, Natural Vegetation	Stable Landscaped	Incipiently Unstable	Active Slumping	Seeps	Oversteep, Hazardous	Groins	Sheet Pile	Temporary Protection	Concrete or Stone Wall	Riprap	Bulkhead	Pier or Launching Ramp	Jetty or Breakwater	Groins Submerged at 580+ Feet	Debris in Water	Slump Hazard	Unfenced Scarp
HIGHLAND PARK Continued																												
HP 46		•				•				•						•					•			•				
HP 47		•								•						•												
HP 48				•							•					•	•					•						
HP 49	•	•								•						•						•			•			
HP 50		•				•				•						•									•			
HP 51		•			•	•		•					•			•												
HP 52		•				•				•		•				•					•			•				
HP 53		•		•						•	•					•		•			•							
HP 54		•				•					•					•												
HP 55		•			•	•						•				•												
HP 56		•								•						•												
HP 57				•		•	•	•						•	•	•									•			•
HP 58	•									•						•									•			
HP 59				•	•			•					•							•								
HP 60				•	•							•									•							

TABLE 2 (CONTINUED)

CITY	GLENCOE	Gl 1	Gl 2	Gl 3	Gl 4	Gl 5	Gl 6	Gl 7	Gl 8	Gl 9	Gl 10	Gl 11	Gl 12	Gl 13	Gl 14	Gl 15
BEACH CONDITION	Normal Beach			•				•				•				
	Narrow Beach	•			•	•	•	•		•	•					
	Damaged Beach					•	•			•	•					
	No Beach		•						•				•	•	•	
BLUFF EROSION	Par-ly Denuded						•		•							
	Wave Impact		•			•	•		•		•		•		•	
	Denuded															
	Active Erosion								•							
	Severe Erosion															
SHORE STABILITY	Stable, Natural Vegetation	•	•		•	•				•	•	•	•	•	•	
	Stable Landscaped															
	Incipiently Unstable			•				•								
	Active Slumping						•		•							
	Seeps															
	Oversteep, Hazardous															
STRUCTURAL PROTECTION	Groins	•		•	•	•	•	•	•	•	•	•	•			
	Sheet Pile													•	•	
	Temporary Protection															
	Concrete or Stone Wall		•													
	Riprap		•										•			
	Bulkhead						•									
	Pier or Launching Ramp															
	Jet:y or Breakwater															
HAZARDS	Groins Submerged at 580+ Feet															
	Debris in Water				•						•			•	•	
	Slump Hazard															
	Unfenced Scarp															

TABLE 2 (CONTINUED)

CITY	GLENCOE Continued	G1 16	G1 17	G1 18	G1 19	G1 20	G1 21	G1 22	G1 23	G1 24				
BEACH CONDITION	Normal Beach						•							
	Narrow Beach	•		•		•		•	•					
	Damaged Beach													
	No Beach		•		•			•	•	•				
BLUFF EROSION	Partly Denuded													
	Wave Impact	•			•			•	•					
	Denuded													
	Active Erosion													
	Severe Erosion													
SHORE STABILITY	Stable, Natural Vegetation	•	•	•	•	•	•		•	•				
	Stable Landscaped							•						
	Incipiently Unstable													
	Active Slumping													
	Seeps													
	Oversteep, Hazardous													
STRUCTURAL PROTECTION	Groins	•	•	•	•	•	•	•	•					
	Sheet Pile		•											
	Temporary Protection													
	Concrete or Stone Wall													
	Riprap													
	Bulkhead				•	•		•	•	•				
	Pier or Launching Ramp					•								
	Jetty or Breakwater													
HAZARDS	Groins Submerged at 580+ Feet													
	Debris in Water	•			•									
	Slump Hazard													
	Unfenced Scarp													

TABLE 2 (CONTINUED)

CITY	BEACH CONDITION				BLUFF EROSION				SHORE STABILITY						STRUCTURAL PROTECTION									HAZARDS		
	Normal Beach	Narrow Beach	Damaged Beach	No Beach	Partly Denuded	Wave Impact	Denuded	Severe Erosion	Active Erosion	Stable, Natural Vegetation	Stable Landscaped	Incipiently Unstable	Active Slumping	Seeps	Overseep, Hazardous	Groins	Sheet Pile	Temporary Protection	Concrete or Stone Wall	Riprap	Bulkhead	Pier or Launching Ramp	Jetty or Breakwater	Debris in Water	Groins Submerged at 580+ Feet	Slump Hazard	Unfenced Scarp
WINNETKA																											
Wn 1				•		•						•				•					•			•	•		
Wn 2				•	•	•			•			•				•			•					•			
Wn 3				•		•				•							•										
Wn 4		•				•				•						•								•			
Wn 5				•		•						•				•											
Wn 6		•	•			•				•											•						
Wn 7				•						•						•	•				•	•		•	•		
Wn 8		•								•						•			•								
Wn 9	•									•						•											
Wn 10				•							•						•					•					
Wn 11	•									•																	
Wn 12				•							•											•					
Wn 13		•									•					•	•							•	•		
Wn 14		•								•						•						•			•		
Wn 15																											

TABLE 2 (CONTINUED)

CITY	WINNETKA Continued	Wn 16	Wn 17	Wn 18	Wn 19	Wn 20	Wn 21	Wn 22	Wn 23	Wn 24	Wn 25	Wn 26	Wn 27	Wn 28	Wn 29	Wn 30
BEACH CONDITION	Normal Beach												●			
	Narrow Beach			●		●		●	●	●	●	●			●	
	Damaged Beach					●				●					●	
	No Beach	●	●		●	●	●							●		●
BLUFF EROSION	Partly Denuded															●
	Wave Impact	●				●		●		●	●		●	●	●	●
	Denuded															
	Active Erosion															
	Severe Erosion															
SHORE STABILITY	Stable, Natural Vegetation	●						●	●	●	●	●	●			●
	Stable Landscaped		●	●	●	●	●									
	Incipiently Unstable									●				●	●	●
	Active Slumping															
	Seeps															
	Oversteep, Hazardous															
STRUCTURAL PROTECTION	Groins		●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Sheet Pile													●		●
	Temporary Protection															
	Concrete or Stone Wall	●	●							●						
	Riprap					●										
	Bulkhead		●	●	●		●		●			●				
	Pier or Launching Ramp															
	Jetty or Breakwater															
HAZARDS	Groins Submerged at 580+ Feet								●							
	Debris in Water	●	●		●			●						●		●
	Slump Hazard															
	Unfenced Scarp															

TABLE 2 (CONTINUED)

CITY	BEACH CONDITION				BLUFF EROSION					SHORE STABILITY							STRUCTURAL PROTECTION								HAZARDS			
	Normal Beach	Narrow Beach	Damaged Beach	No Beach	Partly Denuded	Wave Impact	Denuded	Active Erosion	Severe Erosion	Stable, Natural Vegetation	Stable Landscaped	Incipiently Unstable	Active Slumping	Seeps	Oversteep, Hazardous	Groins	Sheet Pile	Temporary Protection	Concrete or Stone Wall	Riprap	Bulkhead	Pier or Launching Ramp	Jetty or Breakwater	Groins Submerged at 580+ Feet	Debris in Water	Slump Hazard	Unfenced Scarp
WINNETKA Continued																												
Wn 31				•			•					•								•					•			
Wn 32				•		•	•	•					•							•								
Wn 33				•			•					•				•				•					•			
Wn 34				•		•						•				•			•	•					•			
Wn 35	•										•					•												
Wn 36		•									•					•					•							
Wn 37	•									•						•												
Wn 38		•									•					•				•								
Wn 39				•							•					•					•							
Wn 40		•									•					•		•		•								
Wn 41				•	•	•					•					•			•									

TABLE 2 (CONTINUED)

HAZARDS				STRUCTURAL PROTECTION										SHORE STABILITY							BLUFF EROSION						BEACH CONDITION				CITY
Unfenced Scarp	Slump Hazard	Debris in Water	Groins Submerged at 580+ Feet	Jetty or Breakwater	Pier or Launching Ramp	Bulkhead	Riprap	Concrete or Stone Wall	Temporary Protection	Sheet Pile	Groins	Stable, Natural Vegetation	Stable Landscaped	Incipiently Unstable	Active Slumping	Seeps	Oversteep, Hazardous	Stable, Natural Vegetation	Stable Landscaped	Incipiently Unstable	Active Slumping	Seeps	Oversteep, Hazardous	Partly Denuded	Wave Impact	Denuded	Active Erosion	Severe Erosion	Partly Denuded	No Beach	Narrow Beach	Damaged Beach	Normal Beach	KENILWORTH
						•							•																•				K 1
						•	•						•																•				K 2
								•			•		•																	•			K 3
						•					•		•																•				K 4
								•			•		•																	•			K 5
			•			•					•		•																•				K 6
		•				•					•		•																	•			K 7
					•	•					•		•																	•			K 8
						•					•		•																	•			K 9
									•		•				•							•		•	•		•		•				K 10

TABLE 2 (CONTINUED)

CITY	WILMETTE	W1 1	W1 2	W1 3	W1 4	W1 5	W1 6	W1 7	W1 8	W1 9	W1 10	W1 11	W1 12	W1 13	W1 14	W1 15
BEACH CONDITION	Normal Beach		●					●			●		●			
	Narrow Beach				●	●	●		●							
	Damaged Beach															
	No Beach	●		●						●		●		●	●	●
BLUFF EROSION	Partly Denuded					●				●				●	●	
	Wave Impact	●			●	●			●	●				●	●	●
	Denuded															
	Active Erosion															
	Severe Erosion															
SHORE STABILITY	Stable, Natural Vegetation															
	Stable Landscaped	●	●	●	●	●	●	●	●	●	●		●	●	●	●
	Incipiently Unstable															
	Active Slumping															
	Seeps															
	Oversteep, Hazardous															
STRUCTURAL PROTECTION	Groins	●		●	●	●										
	Sheet Pile				●				●	●					●	●
	Temporary Protection															
	Concrete or Stone Wall		●													
	Riprap	●								●				●	●	
	Bulkhead	●		●												
	Pier or Launching Ramp															
	Jetty or Breakwater									●	●	●	●			
HAZARDS	Groins Submerged at 580+ Feet															
	Debris in Water					●										
	Slump Hazard															
	Unfenced Scarp															

TABLE 2 (CONTINUED)

CITY	BEACH CONDITION				BLUFF EROSION					SHORE STABILITY						STRUCTURAL PROTECTION									HAZARDS			
	Normal Beach	Narrow Beach	Damaged Beach	No Beach	Partly Denuded	Wave Impact	Denuded	Active Erosion	Severe Erosion	Stable, Natural Vegetation	Stable Landscaped	Incipiently Unstable	Active Slumping	Seeps	Oversteep, Hazardous	Groins	Sheet Pile	Temporary Protection	Concrete or Stone Wall	Riprap	Bulkhead	Pier or Launching Ramp	Jetty or Breakwater	Groins Submerged at 580+ Feet	Debris in Water	Slump Hazard	Unfenced Scarp
WILMETTE Continued																												
Wl 16				•							•										•							
Wl 17				•	•	•					•						•											
Wl 18				•	•						•						•				•							

TABLE 2 (CONTINUED)

CITY	BEACH CONDITION				BLUFF EROSION				SHORE STABILITY							STRUCTURAL PROTECTION									HAZARDS			
	Normal Beach	Narrow Beach	Damaged Beach	No Beach	Partly Denuded	Wave Impact	Denuded	Active Erosion	Severe Erosion	Stable, Natural Vegetation	Stable Landscaped	Incipiently Unstable	Active Slumping	Seeps	Overseteep, Hazardous	Groins	Sheet Pile	Temporary Protection	Concrete or Stone Wall	Riprap	Bulkhead	Pier or Launching Ramp	Jetty or Breakwater	Groins Submerged at 580+ Feet	Debris in Water	Slump Hazard	Unfenced Scarp
EVANSTON																												
E 1				•	•	•					•						•			•								
E 2				•							•					•					•						
E 3				•		•					•										•						
E 4				•							•					•					•				•		
E 5				•		•					•						•										
E 6				•							•						•		•								
E 7				•		•					•										•				•		
E 8				•		•					•									•				•			
E 9				•		•					•										•			•			
E 10	•										•					•											
E 11	•										•					•											
E 12				•							•									•	•						
E 13	•										•																
E 14				•							•									•							
E 15				•							•										•						

TABLE 2 (CONTINUED)

CITY	BEACH CONDITION				BLUFF EROSION					SHORE STABILITY						STRUCTURAL PROTECTION										HAZARDS			
	Normal Beach	Narrow Beach	Damaged Beach	No Beach	Partly Denuded	Wave Impact	Denuded	Active Erosion	Severe Erosion	Stable, Natural Vegetation	Stable Landscaped	Incipiently Unstable	Active Slumping	Seeps	Oversteep, Hazardous	Groins	Sheet Pile	Temporary Protection	Concrete or Stone Wall	Riprap	Bulkhead	Pier or Launching Ramp	Jetty or Breakwater	Groins Submerged at 580+ Feet	Debris in Water	Slump Hazard	Unfenced Scarp
EVANSTON Continued																												
E 16				•							•					•				•								
E 17	•	•									•					•												
E 18				•							•					•				•				•				
E 19				•							•					•						•						
E 20				•							•									•				•	•			
E 21	•										•					•												
E 22				•							•					•				•				•				
E 23	•										•					•												
E 24		•									•					•				•								
E 25				•							•										•				•			
E 26	•										•																	
E 27				•							•									•				•				
E 28				•		•					•									•					•			
E 29				•		•					•										•							
E 30				•							•					•				•				•				

TABLE 2 (CONTINUED)

CITY	EVANSTON Continued	E 31	E 32
BEACH CONDITION	Normal Beach		
	Narrow Beach	•	
	Damaged Beach		
	No Beach		•
BLUFF EROSION	Partly Denuded		
	Wave Impact	•	
	Denuded		
	Active Erosion		
	Severe Erosion		
SHORE STABILITY	Stable, Natural Vegetation		
	Stable Landscaped	•	•
	Incipiently Unstable		
	Active Slumping		
	Seeps		
	Oversteep, Hazardous		
STRUCTURAL PROTECTION	Groins		
	Sheet Pile		
	Temporary Protection		
	Concrete or Stone Wall		
	Riprap		•
	Bulkhead		
	Pier or Launching Ramp		
	Jetty or Breakwater		
HAZARDS	Groins Submerged at 580+ Feet	•	•
	Debris in Water		
	Slump Hazard		
	Unfenced Scarp		

EVANSTON

Evanston has a population of more than 80,000 and occupies about 3.7 miles of shore. From Calvary Cemetery northward to the Northwestern University Campus the shore trends approximately N.10°W. From north of the campus to Wilmette it trends N.30°W. Virtually all of the shore is artificially filled, armored or lined with man-made beaches. The unarmored portion (10%) is protected by beaches. Consequently, the entire reach is exceedingly stable even at high lake levels.

Most of the shore is part of the Chicago Lake Plain (Willman, 1971) which represents a floodable elevated lake terrace (Fig. 1) that in general lies less than 5 feet above the 1974 high water level. The shore is composed mainly of glacial or lake bottom clays, silts, sands and gravels that are exceedingly weak. Despite the fact that the shore is low, only 13% of it shows signs of wave wash or impact damage. This minor damage is confined to the residential area north of Grossepoint Lighthouse (E1-3,7-9).

Riprap comprises the most extensive shore protection by far, amounting to 62%. It lines the shore beginning at Calvary Cemetery on the south (E52) and continues northward to the north end of Clark Square Park (E27). It protects major portions of Lake Front Park (E16,18,20,22) and the south side of the Northwestern University Campus (Fig. 2) As an organized rubble wall, riprap also protects most of the eastern part of the campus landfill (E14). In all of these places the riprap is well-placed and no flooding or wave damage is discernible. In the residential area north of Northeast Park (E8), however, riprap is used but is low and not well-maintained. In places, the protective blocks have been topped by waves with resulting erosion.

Steel and concrete bulkheads are used in Kelly Park (E29), north of Clark Square Park (E25), on the Northwestern Campus (E15), and near the waterworks (E11,12). In the residential area in the north part of the town (E2-4,7), seawalls, retaining walls and sheet piling complete the protection (E2,4-6).

Evanston's beaches (E10,11,13,17,21,23), which are well contained by long groins (Fig. 3), have been somewhat reduced in size by high water levels but are in excellent condition. Because of the stable nature of the shore, it is doubtful that changes on the reaches of shore updrift from the city will significantly affect it for many years. Nevertheless, sedimentological, remote sensing and hydrographic studies to be completed as part of the Illinois Coastal Zone Management Program during FY1976 will measure the littoral drift budget as well as identify sites of potential nearshore sediment resources.

At present, low level aerial photos and preliminary soundings show substantial submarine accretion of sediments just north of the Northwestern University landfill. In addition, sediment distribution maps made of the nearshore lake bottom between Wilmette and south Evanston in 1950-52 (Illinois

Division of Waterways, 1952) seem to indicate that significant quantities of sand may be present in water deeper than 20 feet. The sediment sampling program planned for FY1976 includes this area.

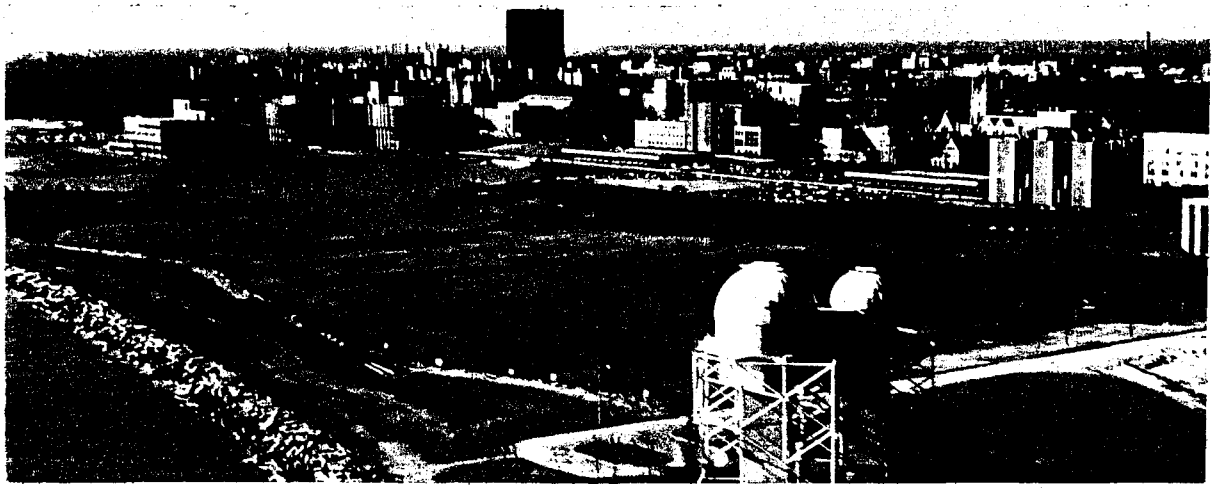
WILMETTE

The shore at Wilmette (population more than 32,000) is dominated by an extensive beach and park area that occupies (WI6-9) nearly half of the 1.9 miles of shore. The area covers the northern part of the Wilmette propromontory created by the mouth of the North Branch, Chicago River. The river was diverted westward early in the century but its mouth serves as Wilmette Harbor. The promontory is a major diversion point for southward drifting littoral sediment. Sediment accumulates along Gillson Park Beach and between the harbor jetties (WI10) as well as just south of the harbor mouth where eddies drop the material that bypasses the jetties. Satellite images as well as aerial photography show that sediment is diverted southeastward offshore from the harbor during strong winds. Some sediment plumes extend several miles into the lake. The lake bottom sediment distribution map prepared by the Illinois Division of Waterways (1952, p.8) shows deposits of coarse to fine sand approximately 1½ miles southeast of Wilmette Harbor in water deeper than 20 feet. Field studies planned for FY1976 call for measurement and mapping of littoral drift and potential resources in these areas.

The top of the Chicago Lake Plain that forms the shore north and south of Gillson Park ranges in elevation from 600 to more than 605 feet (MSL) and 19 to 25 feet above the August 1974 high water level. It therefore is categorized as a low erodible bluff.

More than 60% of the shore is protected by sheet piling, seawalls or bulkheads while 54% is fronted by beaches. The entire shore has been filled, landscaped or modified to some extent.

South of Wilmette Harbor the shore is protected by sheet piling and bulkheads from Evanston as far north as Linden Avenue (WI14-18). In several places (WI14,15,17) the protection has been topped by waves, resulting in impact and washover damage. Opposite the Bahai Temple (WI13) riprap has been used to guard a partly denuded low bluff scarp. North of the harbor, riprap has slowed erosion south of the Gillson Park Beach area (WI9). Low sheet piling acts as a retaining wall for much of the beach but commonly is topped by waves. The broad beach (without groins) and the terraced bluff serve as principal protection for residences as far north as Chestnut Avenue (WI6). The area north of Chestnut Avenue is occupied by a half-dozen large multiple-dwelling condominiums, guarded by bulkheads, splash aprons, groins and riprap (WI1-3). Nevertheless, they suffer wave splash and impact damage and during 1974 protection was increased. Infrared photos of wave action in the area indicate that wave reflection patterns may at times be responsible for concentrating wave energy in specific areas, thereby increasing wave effects. The area merits special study for these reasons. The Wilmette shore is es-



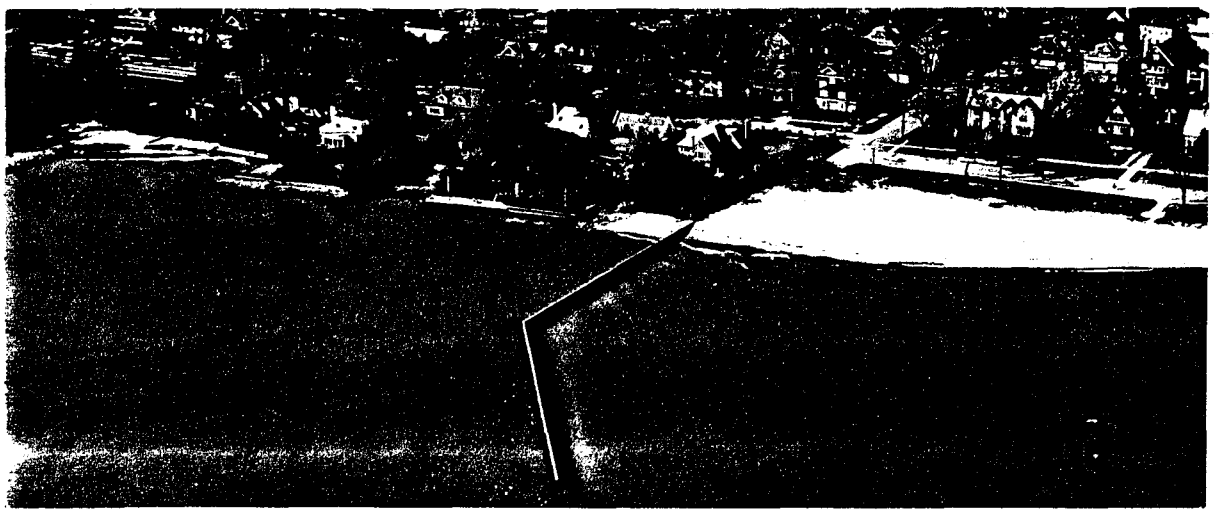


Fig. 1 - (top) Lake Front Park (E18-20) in Evanston. The riprap seawall is characteristic of the shore and protects the low Chicago Lake Plain behind it.

Fig. 2 - (middle) View, looking southwest, at the Northwestern University landfill and lagoon area (E14). The fill is well protected by organized rubble mound seawalls. The area projects more than a ,000 feet into the lake and is one of the major promontories on the shore. Some littoral sediment is impounded on its north side, whereas other sediment is deflected into deeper water. Current and sediment distribution studies may lead to discovery of usable sediment resources associated with the structure.

Fig. 3 - (bottom) View of Elliot Park in Evanston (E23-26) showing characteristic groin configuration for holding beaches in a stable state. This design is used with notable success in the area. The bulkheads, likewise, are characteristic of the Evanston shore.

pecially free from submarine hazards. The only submerged structure recorded is at the sailing club at Chestnut Avenue (WI5).

In general, Wilmette has more natural sandy beach shore than any other municipality south of Illinois Beach Nature Preserve. Because of its location on a promontory, it serves as a natural depositional site for southward-moving littoral sand as does the south end of Illinois Beach Nature Preserve. If the natural sand drift should be reduced by improved stabilization of the shore north of Wilmette, the Wilmette beaches almost certainly will require artificial replenishment after a few years of high lake levels. Second-year studies for the Illinois Coastal Zone Management Program are considering this anticipated problem by measuring the amount of material being received from updrift and the amount of potential replenishment resources on the nearshore lake bottom.

KENILWORTH

Kenilworth's population of 2,980 persons occupies little more than a half-mile of N.45°W. trending shore. The shore is a low erodible bluff, that lies 25 to 30 feet above the lake (elevation 608 to 610 feet MSL) and is a continuation of the Chicago Lake Plain. The wave-cut surface lies on gray till mantled by thin lake clays, silts and sands. The shore is almost entirely landscaped as well as protected by bulkheads, seawalls and riprap. In only one small area has any significant erosion been identified--that (K10) is in the small undeveloped reach belonging to the Mahoney Farm Preserve at the south boundary of the village.

Kenilworth has very little beach frontage. There are two narrow groin beaches (K3,5) at the waterworks and a single groin beach (K9) near the south end of the village. Structures that have become submerged during present high water levels represent hazards at K7 and K6.

Because of the armored nature of its shore and the small public beach area that must be maintained, few significant problems can be foreseen for Kenilworth as the Illinois shore is increasingly stabilized and developed. If water levels remain high as they are expected to do for at least another year, some foundation protection may be needed for the waterworks. In addition bulkheads and seawalls will require attention until water levels recede.

WINNETKA

The mile-long shore of Winnetka (population 13,998) trends N.33°W. in the south and N.25°W. in the north. South of Lloyd Park, the top of the bluff ranges between 625 and 610 feet elevation (MSL), whereas northward from there it lies between 655 and 660 feet. The surface of the lower part represents the wavecut terrace of the Chicago Lake Plain, whose ancient shore-

line runs through Lloyd Park. The higher surface, which extends northward into Lake Forest, is developed on somewhat younger, browner glacial till that has been identified as part of the Highland Park Moraine. The higher bluffs are inherently less stable than the lower wave-leveled shore in that they contain water-deposited clays, sands and silts in their upper part as well as a relatively weak silty brown till. Thus, bluff stability increasingly is a problem northward along the shore as far as Waukegan. The shore of Winnetka is relatively stable--88% is classified as stable and only 1% as actively slumping. The shore also is well-protected (Fig. 4). Fifty-four percent is fronted by beaches. A third of the beaches is classified as normal despite the high water levels of 1973-75.

Only a very small part of the shore shows serious denudation and slumping. One area of significant instability is north of Willow Road on the southern part of the shore (WN31,32). The eroded bluff in parcel WN31 has been filled and repaired since summer 1974. The second seriously eroded area is located in the northernmost part of town (WN2) where low sheet piling and a bulkhead have been topped by waves and the foot of the bluff has been eroded enough to cause instability higher on the slope.

Wave impact erosion is common. A third of the shore shows evidence of it. On the beach between Willow Road and Oak Street, wave erosion was recorded at a number of sites (WN24,25,27-30,32). Damage is also found north of there (WN16,20.22), but the greatest damage is recorded at the northern end of the shore (WN1-6).

The main sources of littoral drift in Winnetka lie to the north at Fort Sheridan and Lake Bluff. As those shores are stabilized during the coming years a source of replenishment beach sand may be required. No areas of promise are now known along the Winnetka shore. Significant amounts of sand apparently extend between 400 and 1000 feet offshore but they represent no great reserve. Detailed mapping of these resources goes forward during studies for FY1976.

GLENCOE

Glencoe, whose shore extends nearly 2 miles in a north-northwest direction, lies near the south end of the high erodible bluff shore that begins at Lloyd Park in Winnetka and extends to North Chicago. In this location Glencoe is approximately 5 miles south of the nearest significant source of littoral sediments at Fort Sheridan and more than 9 miles south of the most abundant source at Lake Bluff. As a partial consequence, more than 1/3 of the Glencoe shore has no beaches. In addition, 2/3 of the beaches present have been narrowed by conditions associated with high lake levels. Furthermore, one beach in seven has suffered damage that has significantly limited its use.

Fig. 4 - (top) Area south of Lake Front Park in Winnetka (WN17-21) showing the terraced low bluffs characteristic of that shore. The bulkhead and groin combination is very successful along the entire Illinois shore. Where little protection is present, on the left, waves have oversteepened the bluff.

Fig. 5 - (middle) High erodible bluff in south Glencoe (GL18-20) showing a well vegetated stable shore protected by bulkheads and groins. The beach on the left is an example of a narrow beach while the one north of it is considered normal.

Fig. 6 - (bottom) Example of a high eroding bluff in Highland Park (HP35). The photo was taken in August, 1974. The foot of the bluff has been undercut by waves that have topped the low sheet piling. Note the submerged groins and the lack of beaches. The upper part of the bluff shows evidence of creep and denudation.

The southern half of the Glencoe shore (Fig. 5), between Winnetka and the Glencoe Waterworks (GL12-24), is almost entirely armored by sheet piles, seawalls, bulkheads and riprap. The bluff which consists of gray homogeneous till is stabilized by natural wooded slopes and landscaped terraces. Shore armor is lacking in a few places. The most significant area of erosion is located just south of Glencoe public beach (GL12). There, despite riprap and rubble, an open scarp about 20 feet high exists. The presence of the beach groin north of the location and a ravine drainage outlet on the south probably contributes to the erosion. A second small erosion scarp located 1400 feet south of the Glencoe beach groin was noted in August, 1974. A gap in protective sheet piling was responsible and it subsequently has been repaired.

Just north of Hawthorne Avenue (extended) (GL15) some damage was noted at the foot of the bluff in August, 1974. Photos taken in May, 1975 revealed a new seawall built to protect that reach of shore.

Much of the southern shore is without beaches (GL12-15,17,19,22-24). Narrow beaches are found at five locations (GL16,18,20,22,23) whereas only one normal beach (GL21 was identified.

The most interesting feature of the Glencoe shore is the 1/3 mile long Glencoe public beach (GL11) located at the end of Park Avenue. The beach containes an estimated 3/4 million cubic yards of sand and, unlike most beaches, varies little with the seasons or minor changes in lake level. From the water's edge, the sand extends lakeward 900 to 1300 feet. Near the southern end a low submarine bar is commonly present 100 to 150 feet offshore. Off the waterworks building, bedrock dolomite of Silurian age crops out on the lake bottom at a highwater depth of about 17 feet, some 900 feet from the shore. Additional lake floor bedrock exposures appear to extend from northernmost Winnetka northward to about Aspen Lane, south of Lake Shore Country Club. These outcroppings appear to range from 1500 to 2000 feet offshore at depths greater than 20 feet. Because of its unusual stability, Glencoe beach is marked for detailed study during FY1976. At present its durability is attributed to its N.25°W. trend, which may provide stability in the face of severe fall and spring storm waves that arrive from the northeast and east. The irregular bedrock outcroppings not far offshore, in addition, may absorb energy from the larger waves.

The shore north of Glencoe public beach is distinctly less stable than that to the south. Several areas of significant instability have been identified. Just south of the large ravine that parallels Sylvan Road, more than 200 feet of bluff (GL6) is partially denuded while the foot of the slope shows signs of wave erosion and beach damage (GL5,6). Southward (GL7), the bluff shows signs of incipient creep and slump. Further south (GL9), there is no beach for about 400 feet, the foot of the bluff is undercut and the bluff is oversteepened and actively slumping.

Beaches are missing from parts of the northern reach of shore (GL2,8). Many are narrow (GL1,4,5.7,9) and a number are debris covered or

otherwise damaged (G15,6,9,10). Only a single normal beach was identified--that south of the synagogue at GL13.

HIGHLAND PARK

Highland Park (population 32,263) extends along an essentially straight bluff-lined shore that trends N.30°W. and is more than 4 miles long. The community is bordered on the south by the Lake-Cook county line and by Highwood and Fort Sheridan on the north.

The shore consists of high erodible bluffs that range from 55 feet in height on the south to 75 feet on the north. Bluff-top elevations range between 645 feet MSL (south) and 665 feet MSL (north). During August, 1974, when this inventory was made, the base of the bluffs was near 582.2 feet elevation.

The glacial materials that form the bluff are part of the Highland Park Moraine and belong to the Wadsworth Till Member of the Wedron Formation (Lineback, Ayer and Gross, 1970). They consist almost entirely of gray silty till which is a relatively stable material when dry (DuMontelle, Stoffel and Brossman, 1975). In some places, such as in the vicinity of the Central Park Waterworks, up to 10 feet of tan and gray medium-size sand has been found at the top of the bluff. Not far south of the Highwood Waterworks 10 feet of reddish-brown silty till were found to overlie the gray till. Compared to materials in other parts of the shore, such as at Lake Forest and Lake Bluff, bluff materials in Highland Park are stable. When vegetated, they maintain relatively steep slopes.

In general, the Highland Park bluffs (Fig. 6) are steep with slopes that range between 20° and 30°. More than 80% of the shore is well vegetated--deciduous trees are the main cover. Only 2% of the bluff has been classified as oversteepened and hazardous whereas 14% is categorized as actively unstable. An additional 17% is listed as incipiently unstable. Only 5% of the shore is entirely denuded and an additional 9% shows vegetation loss. Nearly 1/2 of the shore shows signs of direct wave impact, mostly in the form of uprooted trees and steepened or notched bluffs.

Virtually the entire shore is protected by groins and the beaches held behind them (Fig. 7E). Net littoral sediment drift is from north to south so beaches are held on the updrift (north) side. Despite high water conditions, 14% of the shore has normal beaches and nearly half of the shore is still protected by narrow beaches. In a few places (HP39,40,44,50,52), the beaches have been narrowed to the extent that active bluff erosion by wave impact has occurred.

Highland Park has few erosion sites that call for emergency measures but does have many areas where erosion has made inroads and may develop rapidly if lake levels should remain high. The report on bluff recession rates

by Berg and Collinson (1975) provides a measure of the time required for major bluff erosion to occur. The most southerly site of bluff damage lies along a very short undeveloped reach of shore just north of the Lake-Cook county line (HP58) where much of the bluff is entirely barren and greatly oversteepened. The absence of any protective structures in the area, combined with the presence of a bulkhead up-drift, may explain the situation.

The largest example of bluff erosion in the city extends along 500 feet of near-vertical and barren bluff that forms a low spur between Lake Michigan and the lowermost part of Deer Park Ravine not far north of the county line (HP55). Inasmuch as no property is yet endangered, no immediate action is indicated.

Northward from Deer Park Ravine for about 1000 feet, beaches built behind groins have been so narrowed by high-water conditions that waves are reaching the base of the bluff in a number of places--especially at the narrow north ends of the beaches.

Farther north, opposite Clavey Road and near Lakeview Terrace, waves washing over a narrow beach have notched the base of the bluff to the extent that a 300 foot long scarp has developed along with signs of slump high on the still-vegetated face. Early action at this site could restore stability.

Hydrographic surveys made of the Highland Park nearshore (Collinson et al., 1975) provide information on the shallow-water lake floor. In general it is sand-covered to depths of more than 20 feet. Submarine bars are rare--the only ones recorded during the 1974 season were off the old sewage plant at Ravine Drive and off Hazel Avenue. Neither bar extended for more than 1/4 mile. Both were in 10 feet of water, about 300 feet offshore. In general, the lake floor slopes rapidly to depths greater than 10 feet within 200 or 300 feet of the shore. North of Vine Avenue, nearshore slopes are steeper than elsewhere, dropping to depths greater than 7 feet within 100 feet of shore. Beyond the relatively steep slopes, the lake floor drops gradually to 20 foot depths between 1500 and 2000 feet offshore.

Bottom topography along the entire Highland Park shore is essentially smooth. Significant irregularities are few. The largest, which may represent bare till or bedrock bottom, occurs 1200 to 1500 feet offshore between South Deerpark Drive and North Deerpark Drive in 15 feet of water. This elongate area is about 200 feet wide. Another area lies closer to shore, 850 feet off North Deerpark Drive in 15 feet of water. At Lakewood Avenue another such area was recorded (900 to 1500 feet offshore) in 20 feet of water. A shallow depression about 1300 feet long and 200 to 300 feet at its greatest width lies 1000 feet offshore in the vicinity of the Highland Park Waterworks aqueduct. It may represent a scour phenomenon or a construction artifact.

HIGHWOOD

The village of Highwood (4,973 population), using an access corridor along Walker Avenue to the village waterworks at the south edge of Fort Sheridan, occupies only a few hundred feet of shore (FS17 and part of FS16) that support the waterworks which in 1974 was protected by two groins and a bulkhead. Subsequently, the northern groin has been reinforced with rip-rap and a rubble mound seawall has been added to protect the waterworks.

FORT SHERIDAN

The bluff at Fort Sheridan ranges between 60 and 75 feet in height. It is composed almost entirely of brown to gray clayey and silty glacial till with few lenses of sand and gravel. The bluff is basically stable for foundation support. Near the south end of the reservation (FS15), the bluff has been terraced to the extent that it is reduced to a height of less than 30 feet.

The length of shore in Fort Sheridan is about 1.6 miles. Beaches front more than 90% of it and nearly 1/3 are of normal width. Even where bluffs are steep and eroding, beaches are common. More than 70% of the shore is classified as vegetated and stable. This follows from the fact that the shore is well protected by groins (70%), concrete seawalls (9%) and bulkheads (2%). Nevertheless, a significant portion of the shore (40%) shows denudation and/or wave impact erosion. Nine percent is entirely denuded whereas 20% of the shore is classified as suffering from severe erosion. Virtually all of the latter is along the southern part of the shore where 800 feet of the bluff (FS15) is rapidly receding. Measurement of recession rates for parcel FS15 indicates that approximately 15 feet of recession has taken place since 1969. The 500 foot reach adjacent northward (FS14) also is in a serious state due to wave impact and surface slumping. Northward, an additional 400 feet (FS13) show signs of denudation and erosion. Groins that formerly protected this 1700 foot reach have been submerged or damaged to the extent that they no longer offer protection. Plans are going forward for construction of new groins in the near future.

In addition to the large area in the southern part of the reservation, some erosion and denudation have been recorded near the northernmost part (FS1). This reach is part of a larger, rapidly receding unprotected area that extends northward into Lake Forest.

The topography of the nearshore lake bottom off Fort Sheridan is characterized by alternating areas of bare irregular till bottom and smooth broad sand areas. A sand apron extends 2000 to 2500 feet outward from the shore into depths of 20 to 25 feet. Beyond this, in water generally deeper than 20 feet, a hard irregular till bottom extends lakeward. In addition, there are bare till areas in the alongshore sand apron. These occur in 9

to 11 and 15 to 20 foot depths. In some places they are only 100 feet wide, in others they range up to 700 feet in width. Longshore currents and storm wave patterns apparently account for them. The FY1976 study program includes bottom sediment studies where samples will be dredged, analyzed and plotted.

LAKE FOREST

Lake Forest (population 15,642) extends along 3 miles of high forested bluff shore that is almost entirely protected by orderly beaches, groins, sheet piling and bulkheads. The bluff is generally 70 feet or more in height--the elevation of the top ranges between 640 and 600 feet (MSL). The glacial materials that comprise the bluff have been studied in some detail north of the waterworks where some 50 feet of grayish-brown silty clay till lie at the bottom of the bluff. The till is overlain by 14 to 18 feet of glacial outwash sand, silt, gravel, cobbles and boulders that form a reentrant in the bluff and provide porosity for the flow of ground water. Seeps at the top of the underlying till result in slumps, surface creep and freeze-thaw weathering. On top of the outwash materials, 4 to 5 feet of yellowish-brown silty till cap the bluff, forming an overhang.

The Lake Forest shore is cut by a half-dozen deep ravines that extend westward as far as a mile, and a few short ones that extend only a few hundred feet. Surface drainage from these ravines in general does not seem to interfere significantly with or damage beaches. The shore is generally stable with ample mature vegetation even though bluffs are at a natural slope of approximately 30 degrees. The excellent condition of the Lake Forest shore can probably be attributed to (1) the uniformly spaced, well-maintained effective groin and bulkhead system, (2) the mature vegetation that stabilizes the steep slopes and (3) the abundance of littoral sediment. Except for areas of serious erosion near Fort Sheridan (LF22,24,26) and south of the waterworks (LF3), as well as a lesser area nearly 1/2 mile south of 2300 Forest Park (LF15,16), the Lake Forest shore is free from significant erosion.

The area of erosion at the south end of the shore is shared with Fort Sheridan and extends for about 1/2 mile (LF22,24,26). The location, referred to as the Lake Forest Nature Preserve area, has been described in detail by Berg and Collinson (1975) in an Illinois Coastal Zone Management Report. Over a broad reach the bluff is directly exposed to wave attack and is undercut, oversteepened and rapidly receding. Berg and Collinson estimated that more than 30 feet of recession have occurred since 1973 and that cumulative recession over the last 100 years has been more than 100 feet. The area is devoid of shore protection and calls for early remedial action.

At the north end of the shore (LF3), just south of the Lake Forest Waterworks, a denuded scarp has developed since 1972. The foot of the bluff is undercut and active slumping is in progress. Surface creep

and sheet wash are active. The close updrift proximity of the Lake Forest Waterworks probably starves the area of littoral sediment, causing depletion of the protective beaches. Additional structural protection is probably required.

Located just downdrift from Lake Bluff, Lake Forest is well-supplied with sediments. Consequently, the submarine sand apron that extends outward from the shore is 1/2 mile wide in places. Opposite Forest Park, however, it narrows to only 400 feet in places and a large area of bare till is exposed lakeward on the lake floor. Twelve hundred feet north of Westleigh Road, a similar but smaller patch of till is exposed the same distance from shore. Small submarine sand bars are commonly present along the shore from Forest Park southward. They lie 100 to 150 feet offshore in about 8 feet of water.

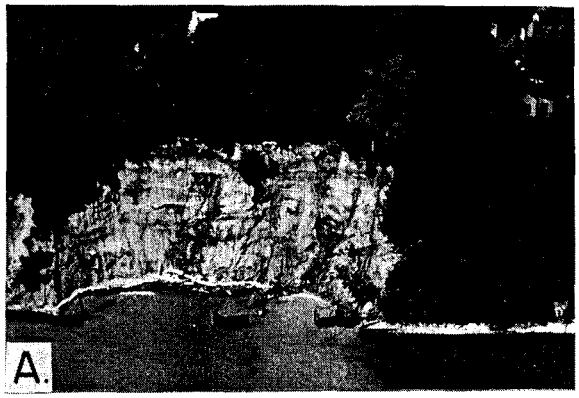
The Lake Forest shore is well-maintained and withstands high water levels well. If in the future the shore at Lake Bluff should be stabilized and sediments from there should be diminished, the Lake Forest beaches may be depleted by extended high water stages. At present, action is being taken by the Illinois Coastal Zone Management Program to establish sediment bypasses at updrift impoundment points, thereby insuring littoral sediment passage along the entire shore.

LAKE BLUFF

Lake Bluff with a population of only 5008 extends along 2.5 miles of shore that lie immediately south of the Great Lakes Naval Training Center. The entire shore consists of a uniformly high bluff about 70 feet high (Fig. 7) whose top lies at an elevation of 650 feet MSL. Several deep ravines cut the southern 1/3 of the shore which is fairly well-drained. The northern 2/3, however, are exceedingly flat with poor drainage. In addition to relatively poor drainage, the upper 1/3 to 1/2 of the bluff is composed of soft porous glacial outwash sand, silts, gravel and silty till that are exceedingly weak. The sands and gravels also are conductors of ground water that manifests itself as springs and seeps on the bluff face and that contributes greatly to its recession (Fig. 7A). The lower 1/2 to 2/3 of the bluff consists of stable homogeneous gray silty till (Fig. 7D), the Wadsworth Till Member of the Wedron Formation. All belong to the Highland Park Moraine. In addition to bluff instability, nearly 1/3 of the shore is without protection.

Beaches line more than 1/3 of the Lake Bluff shore but the only one classed as normal is that at Lake Park (LB20). Subsequent to this inventory, a new groin beach was constructed just south of the sewage plant at LB22. All other beaches are narrow and/or damaged.

More than 1/2 of the Lake Bluff shore is classified as suffering from severe erosion and rapid recession. An additional 26% is marked as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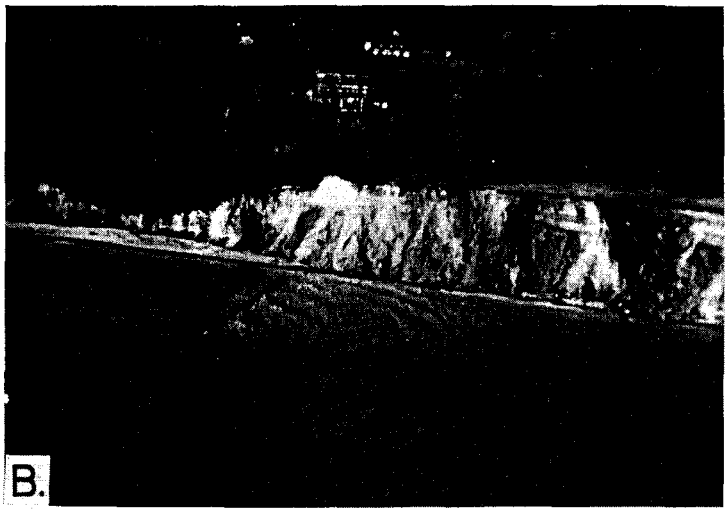
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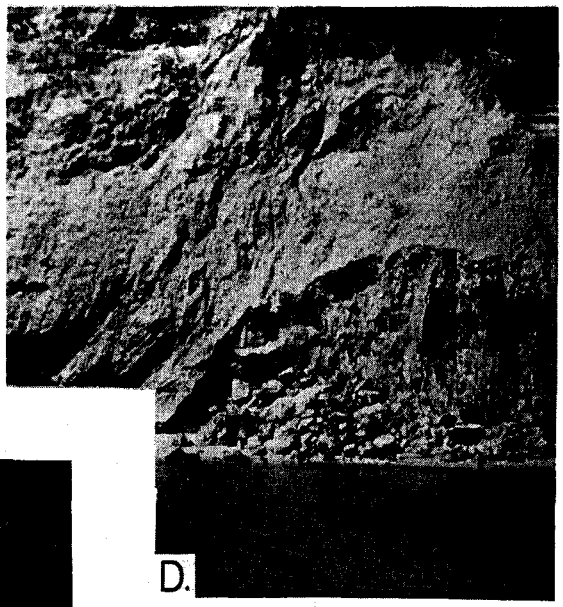
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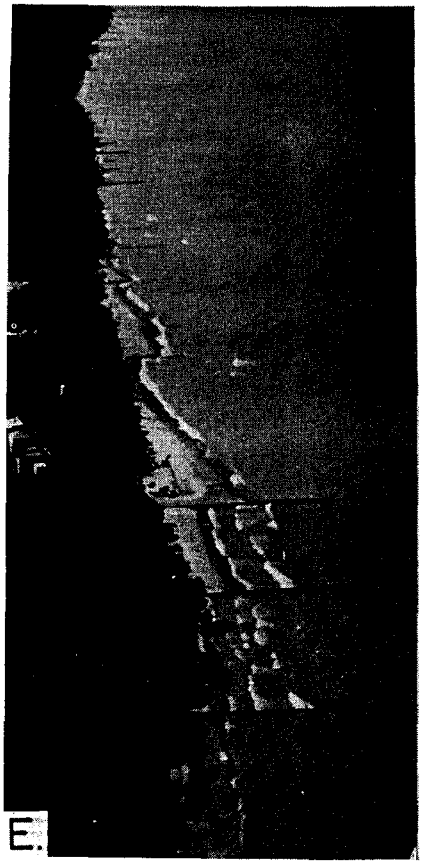
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Fig. 7 - (opposite) Views of the Illinois Shore at Lake Bluff and at Highland Park:

A. A high bluff reentrant at LB23 in Lake Bluff. The bulkhead failed in 1969 and the reentrant has formed since then. The dark areas mark seeps. This photo was taken August, 1974. Rubble-fill has been added during 1975.

B. View of south shore of Lake Bluff (LB24) showing truncation of deep ravine through rapid shore recession. Also note the reflected wave pattern that helps scour groin beaches.

C. High bluff just south of the sewage plant at Lake Bluff (LB22). Just beneath the trees, the dark irregular lines on the face mark seeps along the contact between sand and glacial till. Photo was taken August, 1974. A new groin and beach have been constructed subsequent to this photo.

D. Photo showing bluff slump in glacial till after waves have undercut the bluff.

E. Rosewood-Cary Avenue beach complex in Highland Park (HP37-45) showing depletion of sand in groins downdrift from long groins.

denuded and actively eroding. Because of the serious nature of the problem, Berg and Collinson (1975) have studied Lake Bluff recession rates in detail. They find the average recession rate of the denuded areas to be about 30 feet in 10 years, involving a loss of nearly 700,000 cubic yards of material. More than 250 feet of recession was measured since 1872 involving more than 6 million cubic yards. Berg and Collinson concluded that the plight of Lake Bluff's shore, now the most serious in Illinois, is the result of:

1. high lake levels
2. loss of protective vegetation
3. inadequate shore protection
4. natural weakness of the bluff materials
5. oversteepened slopes
6. groundwater seep and springs
7. deprivation of littoral drift sediments due to shore structures to the north.

The nearshore lake floor at Lake Bluff is generally sand-covered except for an area extending from Blodgett Avenue northward for 1/4 mile. There bare till apparently lies within 300 or 400 feet of shore and extends lakeward beyond 20 foot depths. North of that area, extending as far north as the Great Lakes Naval Training Center jetty, a large sand apron extends nearly 3/4 miles offshore. Twenty-foot depths are nearly 1/2 mile offshore. South of Blodgett Avenue the nearshore sand apron extends some 1000 feet offshore to a depth of about 18 feet. Beyond that, patches of till run roughly parallel to the shore in depths ranging between 16 to 25 feet. The large sand area just south of the Great Lakes jetty may represent a usuable resource and is programmed for detailed study during FY1976. Similarly, erosion and stability problems of the bluffs continue to be studied.

GREAT LAKES NAVAL TRAINING CENTER

The Naval Training Center has a shoreline of about 1.2 miles, if the target range (0.1 mile) near the North Chicago sewage plant is considered as part of that city. The entire shore is protected by harbor jetties. (Fig. 8) or by rubble, riprap, walls and groins northward to the North Chicago Waterworks.

The jetties extend 1/3 mile into the lake. Their effect on longshore littoral sediment drift is the subject of detailed study for FY1976. As can be seen in Fig. 8, plumes of sediment are deflected into the open lake as well as impounded north of the harbor. Detailed hydrographic mapping is part of the FY1976 study.

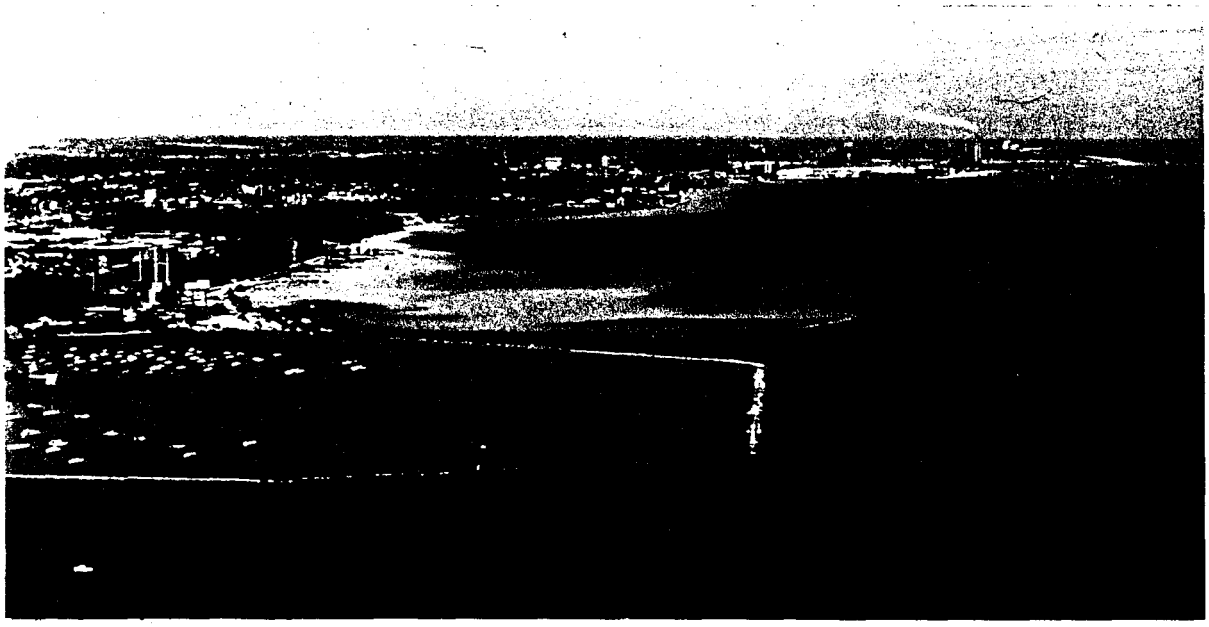

Fig. 5 - View of Great Lake Naval Training Center harbor jetties, showing shallow water turbidity within the harbor. North of the harbor a sediment plume drifts offshore in the face of a northeast wind.

Fig. 6 - View of Waukegan harbor showing the outer jetties and the inner channel (left). This is the south end of the Zion beach ridge complex.

NORTH CHICAGO

In North Chicago (population 47,275), the high bluff continues as far north as the city sewage plant (NC4) and then turns westward away from the shore. From there it continues northward along the west side of the Chicago and Northwestern Railroad tracks to beyond the Wisconsin state line. The shore between the sewage plant and Waukegan Harbor is only 10 to 20 feet high and consists of gray till, sand and fill.

Of the 1.38 miles of shore, more than 60% is protected by riprap, 16% is protected by a single beach and the remaining 21% is unprotected. The city waterworks is armored by well-placed riprap at the south end of the shore. Northward, along the high bluff at Foss Park (NC6), a normal beach extends almost to the Great Lakes Training Center target range (NC5). Although all but the northern part of the Foss Park bluff is protected by the beach, the face shows numerous signs of instability and partial denudation. In addition, the beach has been narrowed at its northern end, exposing a few hundred feet of bluff to direct wave impact. Along the target range, the foot of the bluff is notched and some slumping has occurred. At the north end, between the range and the sewage plant, serious recession amounting to 15 feet or more is evident. The erosion there appears to be aggravated by current eddies produced by discharge from the adjacent sewage plant.

The sewage plant (NC4) is well-protected by riprap, but the shore adjacent on the north (NC3) has suffered serious erosion. Several groins along this reach are in a state of disrepair and are partially submerged at high lake levels. South of the U. S. Steel wire plant (NC2), the shore is oversteepened and slumping, but is protected at its foot by rubble, riprap and trash. From this area northward (NC1), a riprap seawall extends along the main plant and nearly 1000 feet beyond. It provides excellent protection.

The North Chicago nearshore lake bottom is patchy and irregular due partly to discharges from installations on the shore. Sand extends offshore for several hundred feet along Foss Park. Near the sewage plant, sand has been scoured so that depths exceeding 10 feet occur within 50 feet of shore. The bottom near the U. S. Steel wire plant likewise is scoured to depths exceeding 10 feet within 50 feet of the shore. A sand apron extending lakeward a few hundred feet stretches between the two areas.

In summary, more than 60% of the shore at North Chicago is protected by riprap while a single beach protects an additional 16%. The remaining portion of the shore is subject to denudation, erosion by wave impact, surface creep and slump. Inasmuch as no structures are threatened, the eroding portions do not require emergency measures but will rapidly deteriorate if high lake levels persist.

WAUKEGAN

Waukegan's 3.4 miles of shore, which are divided equally between industrial and recreational uses, is almost entirely man-made or man-modified. It is exceedingly stable and well-protected. The shore south of the harbor is armored by riprap and rubble. The harbor area (Fig. 9) is protected by jetties and breakwaters whereas broad beaches provide recreation and shore protection north of the harbor. Beaches, which comprise more than half of the shore, extend as far north as the Waukegan Power Station. Because of harbor breakwaters, power plant jetties and the eroding sand shore that lies north of the city, the Waukegan north shore has been one of accretion.

The Waukegan nearshore bottom is characterized by broad sand-flat shallows that extend offshore nearly 1/2 mile. South of the intake at the Waukegan Power Station (WK3), 5 foot depths are found nearly 800 feet offshore while shallows of less than 5 feet extend 200 feet lakeward at the public beach area (WK6) to the south. Ten foot depths lie nearly 1000 feet offshore. Multiple submarine bars are common north of the harbor breakwater.

The nearshore area south of the harbor is a large undulating sand-flat that lies in 14 to 19 feet of water and extends nearly a mile southward. A very shallow area extends for several hundred feet both north and south of the Waukegan River mouth--5 foot depths lie 400 feet off the mouth. Southward along the remainder of the shore, 10 foot depths lie close to shore.

The harbor jetties and breakwater represent one of the several promontories on the Illinois shore that intercept and shunt significant amounts of littoral sediment offshore. The U. S. Army Corps of Engineers has a program of harbor maintenance whereby the harbor mouth is dredged at required intervals. These dredgings provide a measure of littoral sediment drift in the vicinity of the harbor. In addition, hydrography, sediments and currents are being studied in detail in the Waukegan area as part of the FY1976 Illinois Coastal Zone Management Program. A plan is sought whereby usable lake bottom sediment may be reclaimed or bypassed for shore replenishment without disturbing regional longshore drift patterns.

ILLINOIS BEACH NATURE PRESERVE, ILLINOIS BEACH STATE PARK, ZION AND WINTHROP HARBOR

Extending from the Johns-Manville industrial site northward to the Wisconsin line, 7.4 miles of shore lie along the sandy Zion Beach Ridge Complex (Figs. 10-13). The complex has been described in detail by Hester and Fraser (1973) and Fraser and Hester (1974) while the history of shore recession has been described by a recent U. S. Corps of Engineers preliminary erosion study (1975). Presently, the complex is subject to further detailed study as part of the Illinois Coastal Zone Management Program.


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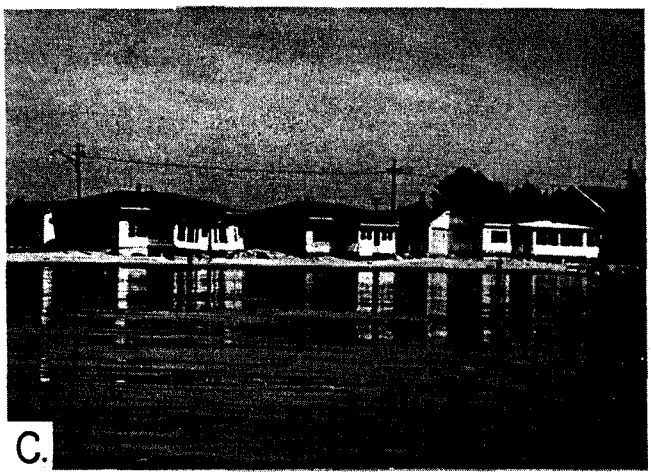
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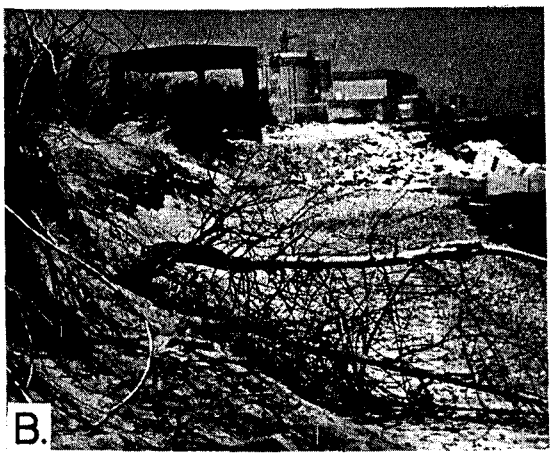
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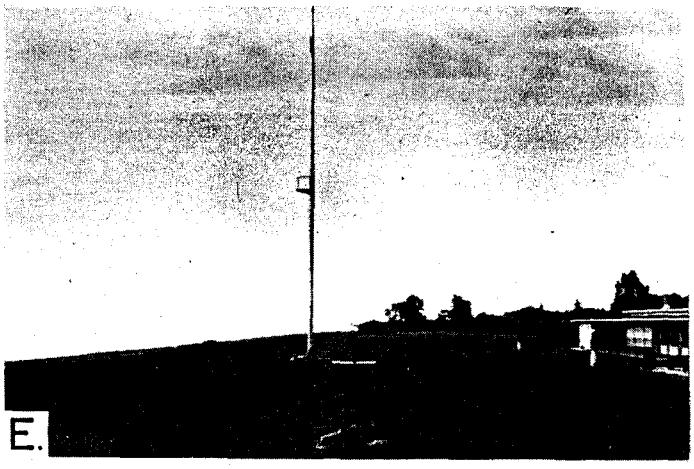
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Fig. 10 - (opposite) Views of Illinois Beach State Park at Zion:

A. Riprap groins and seawalls constructed as emergency measures along the shore in front of park bathhouses (IBSP2) during high water levels in 1972-73. Later storms required the addition of more riprap and fill. The shore approached to within 50 feet of the bathhouses and destroyed portions of the service road. Narrow beaches now line the lakeward side of the riprap but the shore remains vulnerable.

B. View from near Bathhouse 3, May, 1972. Riprap was placed along the shore. As it was placed, erosion was accelerated just beyond its end thereby requiring additional riprap.

C. Houses located just north of the Zion Generation Station (Z1). These were protected by 100 feet of grassy lawns, trees and patios in 1972. This picture was taken in July, 1973. In 1974, all were undermined and were subsequently demolished.

D. House located on Lakefront Drive in Zion (CL7). The house was protected by many cubic yards of concrete but was outflanked by waves running up as much as eight feet above lake level in April, 1973.

E. The main beach (IBSP3) at Illinois Beach State Park in October, 1971. The beach was especially wide because of the addition of material eroded by drift in the northern part of the park.

F. The main beach (IBSP3) at Illinois Beach State Park in January, 1974. Almost 150 feet of recession has occurred since 1971. The rocks and posts in the left foreground mark the 1951-53 high water levels and were covered and forgotten for thirty years. The flag pole and main bathhouse were undermined during spring 1974.

The area (Fig. 13) consists of a series of subparallel beach ridges separated by depressions that commonly contain marshes and bogs. The sediment, some of which is wind-blown, consists of medium to fine lake sand that is very susceptible to wave erosion. In addition, the entire complex is subject to flooding by storm wave washover and surface drainage. Broad gently-sloping beaches and an ample littoral sediment supply are the shore's main protection. Consequently, beaches may recede locally as much as 120 feet during a single storm episode.

The southernmost reach (WK1) is at the Johns-Manville plant where the low natural beach is growing lakeward at a rate of 3 to 10 feet per year. The same is true of the shore northward toward Dead River (IBNP2), although the rate of accretion decreases northerly to zero near the river. Northward from there, the beach-lined shore is backed by vegetated dune-ridges that somewhat slow the advance of wave erosion which measures 1 to 4 feet annually at Illinois Beach Lodge (IBSP4). The Lodge, which is now less than 200 feet from the shore, is protected from storm wave run-up by a low sand dike but it may be in some danger if high water levels remain and repeated severe wave storms should occur.

Shore recession rates between the Lodge (IBSP4) and the Zion Nuclear Generation Station (Z4) 1 1/2 miles to the north, range between 2 and 6 feet per year. During the present high-water cycle the main beach at the north end of IBSP3 (Figs. 10D,10E) has receded more than 250 feet. The reach of shore in front of the park bathhouses (IBSP2) has been temporarily protected by riprap and rubble (Figs. 10A,10B) while the reach between the northernmost bathhouse and the reactor (IBSP1) has been protected by sheet piling that is largely buried by recently deposited sand. The reactor (Z4) is shielded by a bulkhead that permits littoral sand to bypass freely.

North of the Zion Generation Station as far as the Wisconsin line, shore property has been acquired by the State of Illinois and is being included in Illinois Beach State Park. Severe and rapid shore recession, resulting from present high lake levels, has undermined houses and roads (Figs. 10C,10D) along the entire reach so that most of the houses shown along the shore on Inventory Map 1 have been demolished or moved. Hard points and rubble remain where owners attempted to protect their property, but the shore is being returned to a natural configuration by the Illinois Department of Conservation and by the action of the lake. Camp Logan, which is protected by groins and a bulkhead, also has been acquired by the Department of Conservation. The protective structures there apparently will not be demolished.

Although it is highly variable because of hard points that remain on the shore, recession measured between the generation station and Camp Logan ranges from 2 to 9 feet per year. North of Camp Logan (Fig. 12) rates are higher. Just north of the camp (WH12-19), where hard points are few, recession measures between 7 and 16 feet per annum. Between parcels Wh6 and WH11, hard points are numerous and recession rates range from 1 to 7 feet per year. Northward toward the state line (WH1-10) rates are between 1 and 5 feet per

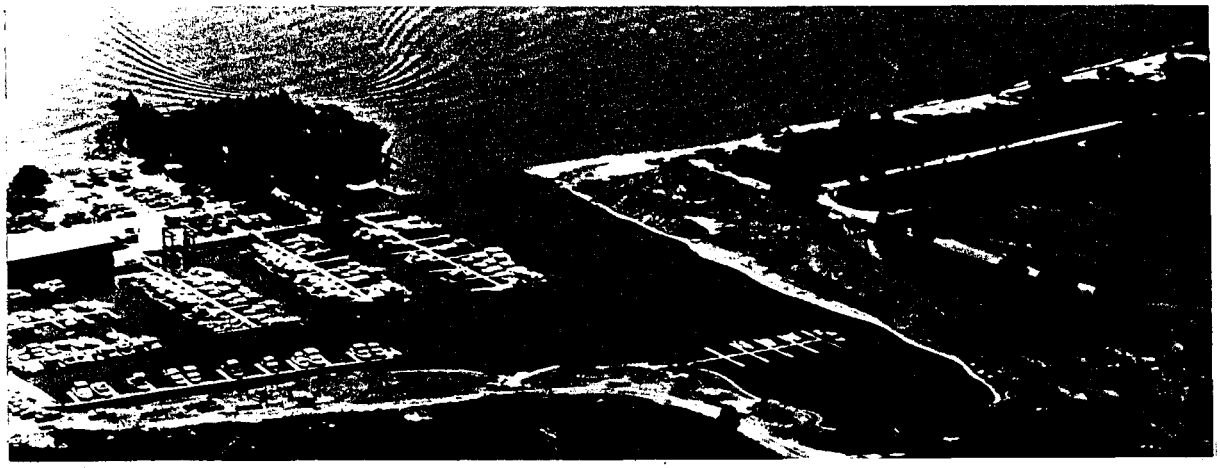
year. Approximately 800 feet of recession has occurred in this latter area during the past 100 years. If present conditions remain, the shore will continue to recede at rates between 1 and 11 feet per year until a regional plan can be formulated that will insure an adequate supply of littoral drift sediment or will provide structural protection.

The nearshore lake bottom along the Zion Beach Ridge Complex is entirely sand covered for more than a mile lakeward. North of the Zion Generation Station, the bottom contours are irregular because of the numerous hard points along the shore. A very low submarine bar is discontinuous 200 to 250 feet offshore in 7 to 10 feet of water. In general, the bar is low with 2 to 4 feet of relief and is quite variable in cross section.

Twenty foot depths generally lie approximately 1000 feet offshore while 10 foot depths range from 50 to 400 feet and 5 foot depths lie close inshore, commonly less than 100 feet. Near hard points, the bottom descends steeply.

From the Zion Nuclear Generation Station southward to the Waukegan Power Station, the lake bottom is smooth and regular. Except for an area just south of the nuclear station where there is a large sand-flat close to shore, the entire shore is paralleled by a submarine bar that lies between 300 and 400 feet offshore in 5 to 10 feet of water. It is shallowest near the main beach at Illinois Beach State Park and descends to 10 feet at the south end of Illinois Beach Nature Preserve. The bar has a relief of 3 to 4 feet. Its trough lies in 8 to 14 feet of water.

The 20 foot depth line, which marks the outer limit of significant littoral sediment movement, lies about 1400 feet offshore at Illinois Beach Lodge. It swings lakeward to 1800 feet north of Dead River and then closes to only 1030 feet along the Johns-Manville property (WK1).



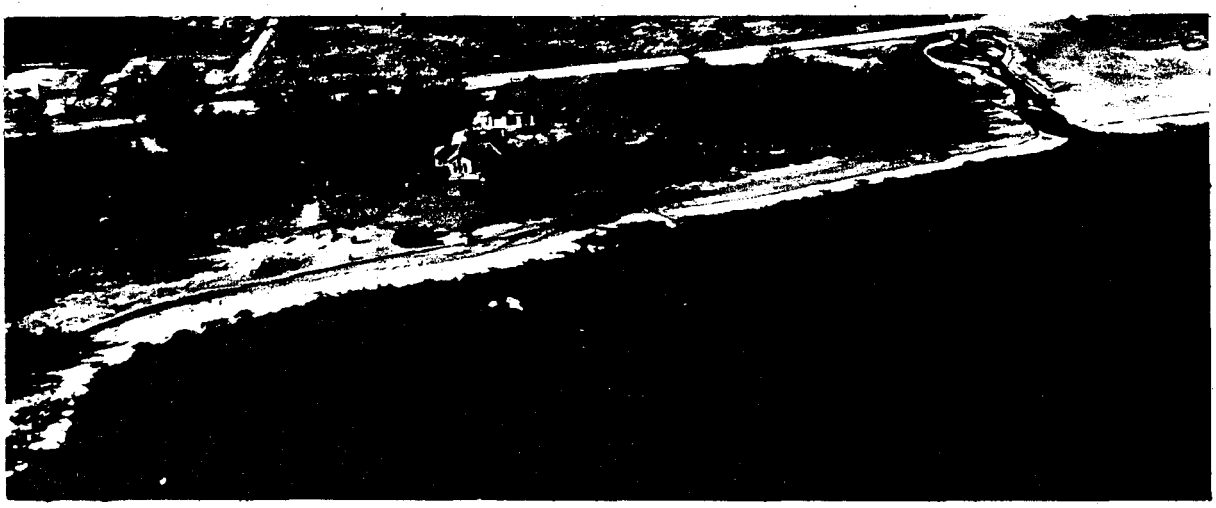


Fig. 11 - (top) View of Trident Harbor from the northwest. The Wisconsin-Illinois boundary is at the south shore of the harbor. The area just south of the harbor has shown the greatest rate of erosion on the Illinois shore during the past 100 years--more than 500 feet.

Fig. 12 - (middle) View of the low floodable shore at Winthrop Harbor (WH2). The shore consists of medium to fine sand that is easily eroded by wave impact. Stabilization of the shore is highly dependent on longshore littoral drift to replenish sand as it is removed.

Fig. 13 - (bottom) View of the Illinois Beach Nature Preserve (IBNP1,2) from the southwest. This area is known as the Zion Beach Ridge sand complex. It consists of ancient beach ridges and marshes between the ridges. Dead River can be seen in the middle left The shore north of Dead River is eroding. That south of the river is accreting.

Bibliography

Berg, R. C., and C. Collinson, 1975, Bluff erosion, recession rates, and volumetric losses on the Lake Michigan shore in Illinois: Illinois Coastal Zone Management Development Project FY1975 Report, 39 p.

Collinson, C., et al., 1975, Hydrographic maps of the Illinois shore between Wisconsin and Wilmette: Illinois Coastal Zone Management Development Project FY1975 Report Appendix, 32 p.

DuMontelle, P. B., K. L. Stoffel, and J. J. Brossman, 1975, Foundation and earth materials of the Lake Michigan till bluffs: Illinois Coastal Zone Management Development Project FY1975 Report, 20 p.

Fraser, G. S., and N. C. Hester, 1974, Sediment distribution in a beach ridge complex and its application to artificial beach replenishment: Illinois Geol. Survey, Environmental Geology Note 67, 26 p.

Hester, N. C., and G. S. Fraser, 1973, Sedimentology of a beach ridge complex and its significance in land-use planning: Illinois Geol. Survey, Environmental Geology Note 63, 14 p.

Lineback, J. A., 1975, Observations on movement of sediment in southern Lake Michigan via SKYLAB and LANDSAT satellites: Illinois Coastal Zone Management Development Project FY1975 Report, 22 p.

Lineback, J. A., N. J. Ayer, and D. L. Gross, 1970, Stratigraphy of unconsolidated sediments in the southern part of Lake Michigan: Illinois Geol. Survey, Environmental Geology Note 35, 35 p.

U. S. Army Corps of Engineers, 1953, Illinois shore beach erosion control study: House Document 28, 83rd Congress, 1st Session, U. S. Govt. Printing Office, Washington, D.C.

U. S. Army Corps of Engineers, 1975, Interim report on Illinois shoreline erosion: Preliminary Report, Chicago District, Corps of Engineers, 138 p.

Willman, H. B., 1971, Summary of the geology of the Chicago area: Illinois Geol. Survey, Circ. 460, 77 p.