PRESERVATION PLANS FOR LIMESTONE REVETMENT
PROMONTORY POINT
54th TO 57th STREETS (EXTENDED) AND LAKE MICHIGAN SHORE
CHICAGO, ILLINOIS

prepared for the
Hyde Park Historical Society
under the direction of the
Executive Committee of the Community Task Force
for Promontory Point

by
Cyril Galvin, Coastal Engineer
Box 623, Springfield Virginia 22150, USA
703-569-9187
galvincoastal@juno.com

1 October 2002
Copy Edited Version

SUMMARY

There are three principal shore protection structures on the perimeter of Promontory Point: a rock platform retained by round wooden piles with a steel wale, a step-stone revetment in four or five tiers rising from the platform to the parkland, and a concrete platform which replaced the original rock platform along the most exposed edges of the Point, on its east side. The rock platform was constructed by 1926; the step-stone revetment by 1937-38, and the concrete platform around 1960(?). [No later than 1964.]

All three structures continue to function as intended, but all three structures are deteriorating. Wave-driven water motion created cavities under the concrete platform. This problem needs more immediate attention, and it could be remedied by grouting. The lake side of the concrete platform (5 feet thick, 21 feet across shore) is supported in part by round wooden piles installed no later than 1926.

The step-stone revetment has been undermined and tilted back by erosion in many places. This can be remedied by introducing a sheet pile partition at the land side of the concrete or rock platforms to prevent wave action from undermining the step stone, and by using bedding stone underlain by filter cloth.

It is feasible to replace the old wooden piles. The existing rock platform has settled to relative equilibrium, which means that these piles do not have to be tied to deadmen, if driven deep.

Access for the disabled is possible throughout, but railings are not advised along the lakeward edge of the platform. Swimming access should depend on a study of three types of bathers: waders, beach bathers, and deepwater swimmers. Swimming policy needs the concurrence of the City.

Published predictions of high erosion rates along this shore have no factual basis. They lack credibility.

At least three quarters of existing limestone block on the Point is reusable, and new limestone is a feasible purchase. A good renovation of the rock perimeter can be done in 20 months for under $4.5 million.

CONTENTS

CONTENTS (cont'd)

This is a copy-edited version of the report by the same name dated 1 October 2002. Suzanne Erfurth did the editing. No substantive changes have been made, and all material in the version issued on 1 October 2002 retains same text and pagination in this version except that pages 30 and 31 are reversed and the two bottom paragraphs on page 30 are new.

INTRODUCTION

Location. The project concerns the limestone revetment around Promontory Point, located on the shore of Lake Michigan between 54th and 57th Streets (extended), Chicago, Illinois, in the Hyde Park – Kenwood area of Chicago, approximately seven miles south-southeast of the Sears Tower. Promontory Point is a man-made peninsula. A 50th Anniversary brochure prepared by the Hyde Park Historical Society shows that the Point was under construction in "the early 1920's" and generally finished by May 1938. The south shore of Promontory Point is approximately coincident with 55th Street extended, and immediately north of the 59th Street Harbor. Details of the Hyde Park area are shown on the Jackson Park Quadrangle, a 1:24,000 map published by the US Geological Survey (1998).

Client/Coastal Engineer. The Client is the Hyde Park Historical Society (HPHS), administering a grant from the Richard H. Driehaus Foundation to conduct an engineering study to assess the feasibility of preserving the limestone revetment at Promontory Point.

In what follows, the term 'Coastal Engineer' means Cyril Galvin, Coastal Engineer. Information on professional experience and qualifications of the Coastal Engineer has been transmitted separately to HPHS.

Problem. The limestone revetment is now at least 65 years old (construction completed not more recently than 1938). It is deteriorating because the 80-year old wood crib structure that encloses the revetment foundation is in various stages of failure. The Corps of Engineers and City of Chicago have a construction project intended to provide flood protection for Lake Shore Drive (Federal Highway Route 41). Segments of this project already constructed near Promontory Point have an appearance and function that is unacceptable to the Historical Society. In response to community concerns, the City of Chicago has delayed construction at Promontory Point for one year to give the community, represented by the HPHS, time to examine the problem and propose an alternative solution.

The HPHS wishes to retain the limestone revetment in its natural existing condition, and has strong objections to extending construction onto Promontory Point with the style of the replacement structures recently constructed in the vicinity of Promontory Point.

The HPHS wants an engineering study to develop "feasible and aesthetically pleasing ways to correct this problem and save the limestone." This study should answer four questions:

1. What can be done to stabilize intact sections of the limestone revetment?
2. How can failed sections of the limestone revetment be rehabilitated?
3. What is the cost comparison for a rehabilitation compared to the City plan of a complete replacement with concrete?
4. How can the limestone blocks be integrated in a structure which provides access for the disabled.

Goal. HPHS wants the following (21 April 2002 fax):

> We seek a rehabilitation plan which would: restore, rebuild, repair, or otherwise treat the existing limestone revetment design, using existing or new limestone and existing or new foundation structures, to produce a limestone revetment which is consistent with the objective of preserving and protecting the beauty, usefulness, and historical character of the Point; create integrated access for the disabled; ensure extensive swimming access; and meet reasonable standards of durability, such that the rehabilitated revetment appears much as the original 1930's limestone revetment did, and, in fact, such that all visible surfaces of the revetment are limestone.

To accomplish this goal, the HPHS hired Cyril Galvin, Coastal Engineer, to make an engineering study and report on it.

Coastal Engineer's Actions. Cyril Galvin has done the following:

1. Reviewed documentation and records on the project supplied by the Client.

2. Made detailed review of House Document 103-302, which provides the justification for federal involvement in the shore protection project along the entire Chicago waterfront.

3. Made a detailed aerial inspection of Promontory Point, and a reconnaissance aerial inspection of the Lake Michigan shore from Gary, Indiana, to Evanston, Illinois (18 June 02).

4. Made detailed ground investigation of the existing shoreline of Promontory Point, and a reconnaissance ground inspection of selected shore sites north of Promontory Point (18, 19, 20 June 02, and 23 Sep 02).

5. Met with representatives of the Corps of Engineers at the office of the Chicago District, Corps of Engineers (18 Jun 02).

6. Collected representative samples of the step-stone revetment at Promontory Point, had two thin sections professionally made from selected samples, and engaged an expert in carbonate petrology to study the thin sections.

7. Consulted experts on midwest limestone at the Indiana Geological Survey and consulted a geologist from the Illinois Geological Survey familiar with the Chicago shoreline. Consulted about eight people connected with quarrying limestone in Indiana. Visited four limestone quarries in the primary limestone-producing area of Indiana (24 Sep 02).

8. Examined in detail the water-revetment interface at Promontory Point, including in-water inspection of undermined portions of the revetment (23 Sep 02).

9. In a continuing effort throughout the study, considered different options to repair the revetment in accordance with the HPHS goals.

10. Considered wave and water level data, as the data affects the revetment.

11. Developed sequences of repairs.

12. Developed approximate costs, on a per linear foot basis.

Acknowledgments. This work has benefited from so much contributed effort that it is dangerous to identify anyone for fear of slighting others. Many of those helping I have never met. But I am indebted at least to the following people:

City and Federal officials who facilitated this work. Members of the Hyde Park Historical Society and their Community Task Force for Promontory Point.

Jack Spicer, particularly for developing the document which is the contract under which I do this work, for arranging the aerial inspection with a fine pilot (*Parker Catlow*), and for day-to-day management of the work. *Bruce Johnstone* for measurements in the field with me on 19, 20 June 2002, and other measurements on 28 Sep 02. *Matt Frank* for in-Lake assistance in June and September. Matt's valuable help in getting actual facts could not easily be duplicated. *Fred Blum* for participating in the meeting at the offices of the Chicago District Corps of Engineers, and for discovery of an early map of Promontory Point. *Greg Lane* for a meeting in Springfield, Virginia, and for participating in the Corps of Engineers meeting. *Connie Spreen* for assisting with the 22 questions and for being the Scribe on 23 September 2002.

The limestone investigation benefited from *Marco van Gemeran*, Mineral Optics Lab, Wilder, Vermont, who made the thin sections, and from Professor *Rick Diecchio*, Professor of Geology, George Mason University, who studied the thin sections and hand samples. *Jim Owens*, Indiana Limestone Institute for information, and representatives of four quarries who conducted my visits on 24 Sep 02. *Nelson* and *Kathy Shaffer* and *Todd Thompson*, all of the Indiana Geological Survey, and *Mike Chrystowski*, Illinois Geological Survey, all assisted in limestone investigation.

Mike Buckley and his staff at FEMA searched their records for data.

Dennis Galvin, PE, and *Daphne Galvin*, PE, reviewed this work from their perspectives as municipal engineers.

Suzan Yow prepared this report, made travel arrangements, and did other work on the project.

TWENTY-TWO QUESTIONS WITH ANSWERS

The Community Task Force for Promontory Point, the designated contact with HPHS, developed in a series of meetings a list of questions that outline their concerns. These questions are repeated here verbatim. They are an excellent presentation of how the conditions at the Point affect citizens of Chicago. A few questions may present misconceptions, but they are retained as representative of what other citizens may believe.

1. What is the general condition of the Point?

To answer this question, you have to know how the questioner uses the Point. Let us divide the users into four classes: (1) residents of Hyde Park and Kenwood areas who rarely go to the Point and for whom the Point is a familiar backdrop to their spatial perception of this part of Chicago; (2) commuters and other travelers on Lake Shore Drive passing in the vicinity of the Point between 54th and 57th Streets; (3) active visitors to the Point; and (4) government officials whose responsibilities include the Point.

How does the present condition of the rock perimeter affect these users? For class (1), the local residents who rarely visit the Point, the general condition is good. For class (2), the people who see the Point from inside a car, the general condition is good. For class (3), the general condition of the Point for people walking or running, people with bicycles, or people who come to picnic or enjoy the view, is good. For those members of class (3) who swim, who actively interact with the shoreline, and especially for those with disabilities, the present condition of the shore has difficulties presented by irregular displacements of the limestone block, by lack of access, and by nearshore variations in depth. Finally, for members of class (4), the government figures who must be concerned with the future, the perimeter of the Point, as it now exists, has reached the closing years of useful life and needs renovation for the Point to have optimum future use.

For all four classes, the integrity and distinctiveness of the Point is determined by its rock perimeter, which is slowly deteriorating. For the City as a whole, the integrity of the Point adds value to life in the south of Chicago. This value determines real estate prices, and thus tax resources for the City.

2. What is going to happen to the Point if nothing is done?

Nothing drastic will happen in the short run, say, in the next decade. The severity of outcome will depend on future lake level and on future ice cover. High lake levels and low ice cover on Lake Michigan are bad for the rock perimeter of the Point, and ultimately for the Point as a whole. Given a worst-case future, if water levels in Lake Michigan were to rise to record levels, and if there were two relatively ice-free winters while this high water condition continues, the movement of the limestone blocks would increase noticeably, there is a good chance that the concrete platform surrounding the northeast corner of the Point would deteriorate rapidly, and overtopping would erode grass on the immediate landside of the limestone revetment. These outcomes could be mitigated by prompt action. Given a typical, plain-vanilla future, if Lake levels remain average and ice cover is at least moderate in winter, conditions at the rock perimeter will gradually deteriorate, some block movement will occur, and there will be local failure in the concrete platform. Given a best-case future, if Lake levels drop lower, and if winter ice cover is moderate or heavy, only minor changes would occur over the next decade.

Because of its past history, the rock perimeter at the Point is now in a condition where it is better able to resist future storms during average or below-average Lake levels than when the Point first was built.

3. What can be done temporarily to stabilize the Point until another plan is developed?

I strongly recommend against any 'temporary' action. Such temporary action is not needed, and it would divert resources and community attention from doing the necessary work. However, it is possible that some lower-cost (not low-cost) actions such as landscaping (french drains) on the upland part of the Point, or the addition of sand to the shore on the north side of the Point, might provide benefits that would fit well with work for long-term solutions.

4. What is the life expectancy of the temporary measures?

See the answer to Question 3 above.

5. Is the rock at the Point limestone?

The step-stone rock revetment is limestone. In some places, repairs may have been made with dolomite. Some limestone contains small percentages of the mineral dolomite. But it is clear that the architectural character of the rock perimeter at the Point is derived from limestone quarried almost exclusively in the general vicinity of Bloomington, Indiana.

(Limestone, the rock, consists almost entirely of the mineral calcite. Dolomite, the rock, consists mostly of dolomite, the mineral.)

6. How available is limestone?

New limestone is reasonably available at Indiana quarries, for a price: $25 to $29/ton, loaded on truck at quarry, plus truck transport to Chicago. However, the majority of limestone needed is already on the Point in the existing step-stone revetment.

7. Is limestone durable?

Yes, if it is the quality of limestone from the Indiana area. Almost all Federal Buildings in the Washington DC metropolitan area are clad in this Indiana limestone. This use began in the late 19th century and continues today with good durable results. Indiana limestone quarries provided stone for the rebuilding (now complete) of the Pentagon sector damaged in the 9-11 plane impact.

8. What are the advantages and disadvantages of constructing a revetment with limestone vs concrete? The answer below concerns new (rather than re-used) limestone.

Advantages of limestone:	Proven record of use, natural appearance, fit with existing structure, simplicity of manufacture, placement that can be modified without major unwanted consequences. Good re-used limestone blocks have the advantage of being on site.
Advantages of concrete:	Near-universal availability, familiarity of work force with technology, ability to be formed in different shapes and sizes.

Disadvantages of limestone: For new stone, the necessity for long-distance transport; necessity for quality control to eliminate stone with dis abling partings or low density; at least in the beginning, relative unfamiliarity of work force with large scale masonry; mix of available sizes. All but one limestone quarry closes during the winter.

Disadvantages of concrete: Necessity to build an exposed structure having many contacts between steel and concrete; sterile, unnatural appearance; uniformity of design and surface. Monolithic form that cannot be modified. The concrete design proposed by the Corps has not been tested over the decades as the limestone design has been.

Note: Each material has lobbyists that will bring out the best points of their material, while implying that the other material is inferior. In addition, proponents of some materials are often better connected with local politicians and fit better with the local work force. Thus, it is necessary to carefully examine any claim about materials.

9. What is relative cost of limestone vs concrete.

Cost depends on the unit of measure used. It is typical to sell stone by the ton, concrete by the cubic yard, and steel sheet by the pound (converted to length). To provide a common basis, these material costs must be combined with labor costs, and computed on the basis of annualized total cost per foot of lake shoreline. Annualized costs include costs of maintenance and expected useful life.

Typical structural concrete is about $85 per cubic yard delivered; cast-in-place with forms, about $250/cubic yard. Heavy concrete weighs about two tons per cubic yard, or for simple cast in-place concrete, about $125/ton. Stone loaded on truck at the quarry is about $27 per ton, about 20 tons per load. At $2.00 per loaded mile and 230 miles from the quarry, this comes to about $53 per ton of new limestone block, delivered on a flatbed truck at the Point.

or removed from Pt

10. Is $20 million enough to rebuild the existing structure? (Posed differently, what would $20 million get us in rebuilding the Point?)

$20 million will get you a complete renovation.

11. How do the maintenance costs of a limestone revetment compare to the maintenance costs of a concrete revetment?

There is a major difference between maintenance costs of the limestone revetment and a concrete-steel structure. The limestone revetment is more forgiving of partial damage than structures made of sheet pile. Displacement of limestone blocks by waves usually puts the displaced blocks where they continue to provide shore protection, and most of the displaced blocks are reusable. Displacement of even one sheet pile can lead to unraveling of the entire structure, and almost nothing is reusable.

The new sheet pile and concrete structure just north of the Point is well-constructed when viewed as a finished product. It should not require repairs for a decade or so, if constructed as designed. However, it does not serve the Point as a user-friendly, lake-front environment.

12. What grade of concrete is specified in this type of construction? Is this grade being used?

I do not now know the answer to either question. But the owner of a new concrete structure almost always requires that tests be made to verify that the concrete is up to specifications. This information should be available from the City or from the Corps of Engineers. Failure to conform to specs is a serious breach of contract.

The structures along the shore north of the Point which I have visited look good, look well -constructed, when viewed as finished products shortly after construction.

13. Are there large cavities under the Point? Is Promontory Point going to fall into the water?

Cavities are limited to the rock or concrete perimeter of the Point and do not extend landward of that perimeter. Observations by Matt Frank and by me verify that cavities under the concrete in the shape of thin horizontal wedges extend back as much as ten feet. In a few places, wave-driven water percolates back another ten feet to the landward edge of the platform.

The answer to the second question is an unqualified NO.

14. Is the settling of the stone structure related to wave action or to compaction?

Initially, I had been of the opinion that compaction was an important factor in causing tilting and movement of the stone. However, my observations made with Matt Frank and Connie Spreen on 23 September 2002 conclusively indicate that erosion by wave-driven water under the concrete platform is the main cause.

15. Is the Point going to wash away? Is it eroding? What erosion rate should be expected? Is this the erosion rate that the City/Army Corps is employing?

It is possible to answer these four questions with a high degree of certainty, based on facts in the field and in published documents.

(a) Wash away? NO WAY.

(b) Eroding? Yes.

(c) The Point as it exists now is eroding slowly. In terms of shoreline retreat, it is eroding almost not at all. In terms of volume removed from the shore front, small quantities are being lost each year. It is likely that small volumes of upland soil on the Point are also being lost annually from soil erosion in storms.

(d) The erosion rates predicted by the Corps of Engineers in their House Document 103 302 dated 1994 have not occurred. Those (1994) erosion rates from the Corps of Engineers for the entire project have no credibility, and that fact was known in 1994.

16. Is it possible to build a limestone revetment that will last?

Yes.

17. Why did the existing structure fail? Is it the result of poor design, poor maintenance, or some other factor?

Most engineers who had studied the history of Promontory Point would not agree that the structure failed. For an acceptable design, the engineer considers how to withstand reasonable risks imposed by the environment (structural design) while performing a task that society wishes done (functional design), all at costs that society is willing and able to pay.

Citizens of early 20th-century Chicago wished to create parkland along the south shore of Chicago. An expedient way to do that was to fill Lake Michigan bottom to create new land. To do this, a structure was needed to retain the often-soupy fill within a perimeter, and to prevent wave and water level combinations from eroding the fill before it dried out. The original structure that performed these functions in the early 1920s is still there, still functioning today. Those early engineers and contractors succeeded in both objectives rather well. Promontory Point has existed for nearly 80 years on an area that was formerly the bottom of Lake Michigan. If no other work is done, Promontory Point (the Point as a whole) will still be there, with storm-induced modification to its rock perimeter, for decades into the future.

So objectives of the original structural and functional design of Promontory Point have been achieved. The structure has not failed. But it is in need of repair.

Added to those original objectives were the aesthetic objectives of a landscape architect, possibly Alfred Caldwell. The style of the step-stone revetment, the meadow, and the council rings at the Point is the style used by Alfred Caldwell, but we have not found direct evidence to link Caldwell to the rock perimeter. The stepped-stone revetment around the perimeter rested on and was slightly landward of the original perimeter structure that contained the fill. The step-stone revetment finished in 1937-1938 served as protection against waves and overtopping water and as an aesthetically pleasing perimeter. It does this today to a remarkable degree after 65 years. In particular, aerial views of the Point in 2002 strike me as aesthetically very pleasing, and (on balance) show the revetment still to be intact.

Locally, waves have damaged the shore near the northeast corner of the Point and repairs have been made in the form of the concrete platform around the most exposed segment of the perimeter. The concrete platform now needs further repair. The segment of the perimeter stepped stone revetment on the south shore of the Point is in remarkably good shape for a 65-year old structure along the Lake Michigan shore.

There is no evidence of poor design. The northeast segment of the rock perimeter would have been built stronger if designed new today. Continuous maintenance would have better preserved the original alignment of the stepped-stone revetment, but probably that maintenance would have been costly in terms of real benefits, and would have delayed the present condition by only a decade or so.

18. The City has designed the new concrete revetment to withstand a 200-year wave. Do we need to plan for a 200-year wave? Is this a reasonable way to plan a revetment? What is the worst we can expect from Lake Michigan?

I have not documented this question to find where the City has designed for a 200-year wave, as the average citizen would understand that phrase. The most damaging wave to hit the stepped-stone revetment will be the wave just breaking a short distance offshore. Whether the design wave in the middle of Lake Michigan is the 200-year wave or the 50-year wave is not likely to make much difference to a structure on the shore of Lake Michigan because bigger waves will break offshore, and thus will be relatively harmless by the time they reach the revetment. Thus, if the City has actually designed for a 200-year wave at the Point, then at worst they have wasted a little time and a little money in the design phase, but it should all come out in the wash if proper procedures were used.

The most damaging wave would be on the order of 10 feet high, a vertical distance from highest crest to lowest trough. Larger waves would break harmlessly offshore, smaller waves would do less harm. Most of the limestone revetment could withstand limited durations of direct hits from such ten-foot waves.

19. Is there danger of flooding of Lake Shore Drive from water overtopping the Point?

No.

20. Can disabled access be integrated into limestone preservation?

Yes.

21. How can swimming access be integrated into limestone preservation?

There is no intrinsic obstacle to providing swimming access from the limestone revetment. However, it seems to me, as an outsider having long-term experience with recreational use of the shoreline, that two things need to be done before designing specific access:

• First, there should be a poll of swimmers to see what they like and what they do not like about the present situation. There are at least three classes of swimmers to consider: the non-swimming swimmers who enjoy walking in the water (those perhaps include many seniors and young children); the beach bathers (teenagers, families); and serious deepwater swimmers (primarily adults of all ages).

• Second, some permanent accommodation needs to be made with the City government on the right to swim from the Point. It is understood that the City prevents swimming from the east end of the Point (the deepest end) for good reasons. By allowing swimming from elsewhere on the Point, the City may add a potential liability that all citizens in Chicago would have to bear. Yet, deepwater swimming is a unique feature of the Point that adds variety and interest and should be accommodated.

22. Can the revetment be structurally supported without the use of steel sheet pile?

Yes, it will be possible to get by without visible steel sheet pile in all but a few places. There may be some local areas where steel sheet pile is necessary.

FIELD OBSERVATIONS

Comments on Plates 1 through 6. Six plates are included in the rear of this report. Photos on these plates all show the Point, a peninsula bordered by limestone block revetment. The limestone block revetment is a candidate (or may be a candidate) for listing on the National Register of Historic Sites.

The construction on the near side (south) of the Point in Plate 1 involves an underpass under the highway. It is supposed to be independent of the Point and is not the concern of this report. The Corps proposes a concrete and steel shore protection as shown in Plate 3 (bottom). The local community objects to this type of construction at the Point.

The Point is on a north-south shore. The outer edge of the Point faces east. Because the Lake extends 100 miles or more to the north and only 20 miles or so to the south, bigger waves approach the north and east shores, which are more damaged, significantly more damaged, than the south side.

Plate 5 illustrates three phases of construction: a rock platform which was built by 1926, the original (1937-38) limestone blocks in five tiers, fronted by a concrete platform (1960-65?). The concrete platform has oblong concrete blocks fixed on them (locally called 'coffins'). The platforms are supported by one row of wood piles and by bedding stone. The platform is locally undermined, so that locally a rod can be inserted up to 10 feet under the platform. The piles partly support the platform. (Local mythology has the undermining extending back to the grass.)

Some of the limestone blocks tilt back at steep angles. This is due to undermining, by wave-driven water percolating under the concrete.

Construction Considerations.

(1) *Access*: Local interests want to preserve the trees on the Point. The shore is generally ice-bound in January and February, at least, but some years have hardly any ice. Access for construction equipment and delivery requires care.

(2) *Crane Access*: There are two possibilities for access. On the concrete platform, use 20-foot long pre-fabricated truss bridges and truck-mounted cranes to manouver over the coffins. If these trusses are unsuitable on the rock platforms, build a gravel fill road, the fill resting over the existing rock platform. Move a crane out on the road; then work back to the mainland, using the gravel fill of the road as bedding to reset the stones, as the crane retreats.

(3) *Reusable Blocks*: It appears that not more than one quarter of existing limestone blocks need to be replaced. One alternative to buying new liimestone would be to construct concrete blocks with the average dimension of the limestone block, and use those concrete

blocks as the bottom layer of the revetment, largely out of sight. This option does not seem to have cost advantages over new limestone.

(4) *Undermining*: The undermined condition of some of the concrete platform needs attention. Grout the cavities to cut off access from waves, and partition off the upland to prevent undermining.

(5) *ADA Access*: Access for disabled persons seems possible anywhere on the rock and concrete perimeter, in principle. However, railings on the outer edge of the rock and concrete perimeter are not advisable. Winter ice and storm waves would make railings short-lived. Any improvements for access by the disabled would also be improvements for skateboarding and roller blading. But there is no intrinsic bar to access by the disabled.

(6) *Swimming Access*: There is no intrinsic bar to swimming access. There are at least three classes of swimmers that should be considered: waders, beach swimmers, and deepwater swimmers. Each class has different needs. The concurrence of the City is, of course, necessary for any plan to go forward. See also question 21 under "Twenty-two Questions…".

A HISTORY OF THE STEP-STONE REVETMENT

Chronology. In attempting to improve the existing step-stone revetment at Promontory Point, it is necessary to know the history that led to the present condition. From mainly secondary sources, a construction chronology is outlined in Table 1.

In general, the existing step-stone revetment came about as a sequence of three structures: the stone platform, the step-stone revetment, and the concrete platform. (1) A stone containment had been constructed around the Point by 1926 (item 1 of Table 1). This is the rock platform that today is in front of the step-stone limestone on south and northwest sides of the Point. (2) The step-stone limestone blocks were in place on the south side by at least May 1938, but as late as October 1938, blocks were not fully in place on the west end of the north side (see items 11 and 13 in Table 1). (3) The concrete platform on the east (exposed) side of the Point was constructed

Table 1. **CONSTRUCTION HISTORY AT THE POINT**

1.	1924 – 1926	Air Photo reprinted in 1987 brochure shows outline of Point with work boats and two cranes at east edge of Point. Perimeter looks quite finished. Brochure calls perimeter a seawall. "By 1926, the 55th Street Promontory, as it came to be called, had largely been filled with sand and garbage."
2.	March 1927	Plan of the Point, from a larger map entitled "General Layout Plan for LAKE FRONT EXTENSION From Jackson Park to 47th St." Scale 1 inch = 100 ft. Calls for rip-rap, not step-stone revetment at the Point perimeter.
3.	1929	"By 1929, grass was planted on the Promontory."
4.	Feb 1934 – Jan 1936	Caldwell worked in Dubuque, Iowa.
5.	1935	Promontory designated a WPA project.
6.	Jan 1936 – 1941	Caldwell worked for Chicago Park Districts as "senior draftsman."
7.	1936	Field House construction began. Finished next year
8.	1 Sep 36	Chicago Park District Landscape Plan for the Promontory "Planting Plan 55th St. Promontory Areas." Drawn by 'AC', traced by 'AC'. Original is 1" = 50 ft.
9.	September 1936	Air Photo. "Construction of the Promontory well underway. The paths are in place, the underpass has been built, and tons of new soil have been added."
10.	1937	Promontory opened to public.
11.	May 1938	View from roof of the Flamingo Hotel. "The Shelter is finished." Step-stone revetment is in place on south side. Cannot see the north or east sides.
12.	6 Aug 1938	Letter from Alfred Caldwell to Mr. Jens Jensen. Caldwell had just gotten the lowest grade of 18 applicants in an architectural exam. "You fellows have been signing my plans for two years. Native plants and Beachscapes and Prairies. Lincoln Park Extension, 55th St. Promontory. .... If I am incompetent a million dollars of landscape work is incompetent, most of it already planted, all of it approved."
13.	Oct 1938	View from Field House Tower shows limestone block at the shore west and northwest of Field House Tower, but not yet in step-stone arrangement.
14.	1946	Photo of Promontory Point looking east. Step-stone revetment visible on south side.

CG 29 Sep 02

The above information from the following sources:

Numbers 1, 3, 5, 7, 9, 11, 13:	From *Promontory Point, 1937–1987*, a brochure by John McDermott, Jr (Victoria Post Raney, ed.)
Numbers 4, 5, 6, 8, 10, 12, 14:	From Dennis Domer, 1997, *Alfred Caldwell*, JHU Press.
Number 2:	From map obtained by Fred Blum

more recently. I have not found firm evidence for a date, but an approximate consensus date is about 1960.

The construction details are believed to be as follows: sand, gravel, and stone fill was dredged from Lake Michigan and brought to the site by boat and spread as the foundation for a containment structure (information from Mike Chrystowski, Illinois Geological Survey). The row of now-submerged piles surrounding the east edge of the Point may have been used to moor such vessels and to anchor the offshore end of a drag line to move dumped fill material ashore.

When enough gravel and stone had accumulated to reach about lake level, a row of round piles, about 6 to 8 inches in diameter, were driven at the outer edge of the planned structure. These piles were anchored by tie rods to landward deadmen, and integrated by a channel section of good steel that acted as a wale (the horizontal tie that joins the piles together). The resulting cribbing had gaps between round piles of several inches.

This round pile structure was backfilled with cobble-sized stones that were large enough to be mostly retained by the pile cribbing. Then limestone blocks were set on the coarse bedding stone to form the stone platform, now also called the Promenade. The pile and wale structure developed circumferential tension, as much as a hoop around a barrel, to retain the stone in the platform. This work was complete in 1926 (item 1 of Table 1), and it remains in place today. Almost all of the tie rods have failed, and they no longer function as ties, but the round pile and steel channel still function to retain stone blocks. This is especially well shown on the south shore of the Point. Initially, this structure (rocks, piles, wale) functioned to confine the fill and repel wave attack.

About ten years later, in the 1936–38 time frame, limestone blocks were placed in step-stone fashion on the landward side of this rock platform. Where protected from the extreme wave action, these blocks are still in place; for example, on the south side and in some places on the west end of the north side of the Point.

At the east end (lakeward end) of the Point, the wave action is more severe, and waves damaged the revetment. Sometime around 1960 (?) major repairs were made. It appears that these repairs consisted of the following: the step-stone blocks were lifted and placed on the grass upland. The stone blocks that made up the rock platform were picked up and thrown in the water by the contractor. The round pile with channel steel wale was not disturbed (neither repaired nor removed). The bedding stone that had been under the blocks was repaired and leveled. Then a massive cast-in-place, reinforced concrete platform was constructed on top of the releveled bedding stone. This concrete was five feet thick, 21 feet in the cross-shore direction and separated into 22 blocks by expansion joints. The distance between expansion joints ranges from 21 to 42 feet along the lake side. The base of this concrete was below the pile tops and wales, so the pile tops and wale were, and still are, enclosed in the concrete.

Then the step-stone limestone blocks were reset, beginning at the land edge of the concrete platform, and going up the slope to the grassy parkland.

Record high lake levels occurred in the 1980s. It appears probable that wave action during high lake levels moved some stone from under the concrete. The porous bedding allowed water, driven by wave pressure, to percolate back to the rear edge of the concrete. This undermined the support for the step-stone blocks. Because the front edge of the lowest tier of blocks was firmly supported by the rear edge of the concrete platform, the blocks tilted backwards, their landward ends sinking as the supporting fill eroded from under them.

This, more or less, produced the present situation.

Corps of Engineers House Document 103-302. The justification for the coastal project on the Chicago Lake Michigan shore is contained in House Document 103-302, published by the US Government Printing Office in 1994. This document is subtitled "A letter from the Chief of Engineers, Department of the Army dated April 14, 1994, submitting a report with accompanying papers and illustrations." The April 1994 date is the date of publication; it presents results of a public meeting dated June 1993.

The document begins with 32 pages of front matter before page 1 is reached, and its last page is 358. In my bound copy of this House Document, pages 257 through 288 are missing. The missing pages include the closing pages of Environmental Assessment and the opening pages on Public Coordination and Local Sponsorship.

In the available public coordination part of this document, the overwhelming opinion is in support of the step-stone revetment and against the rubble mound structure which had been the structure first proposed by the Corps. Based on current (2002) opinions, there must have been a massive miscommunication in 1993, because most public commentators in 1993 congratulate the Corps on its willingness to go along with the step-stone revetment.

While the majority of the Public Comments agree with the Corps, there are strong objections from two people who seem qualified to offer an opinion. John P. Gnaedinger, a registered structural engineer, objects (pp 346-7) to several aspects of the design and makes a suggestion which he says could result in "savings of at least $1000 per foot, or a savings of $40,000,000" [for the entire Chicago project in 1993 dollars]. He says further that "the press releases issued on the project, obviously aimed at getting public support, predict that the shoreline will recede at an average rate of 20 feet per year, starting in 1998. This, in my opinion, is preposterous, and alarmist!" Several others (non-engineers) mention that same 20 ft/yr press release, but do not draw the same conclusions as Mr. Gnaedinger.

The most interesting negative letter is presented in the front matter of the House Document (pages xvii to xxiv). This is a letter dated "3 Jan 94" signed by Michael K. Buckley, PE, of FEMA, which presents an analysis by Dr. Robert Hallermeier, a contractor to FEMA. Mr. Buckley summarizes as follows: "The principal criticism we have with the feasibility study is the erosion rate of 20 ft/yr used in the study design. The erosion rate is fundamental to the study -- however nowhere in the report is it explicitly stated how the erosion rate was computed. … It is important to note that other sources suggest that 20 ft/yr is excessive." Mr. Buckley then goes on to cite references for his opinion, going first to a study by the same Corps of Engineers which shows, for the entire western shore of Lake Michigan, rates exceeding 2.3 ft/yr to be relatively rare. [The Chicago shoreline is 28 miles long, and it is eroding at 20 ft/yr average, according to the Corps, although for the entire west coast of Lake Michigan, it is rare for erosion to exceed 2.3 ft/yr, again according to the Corps.] Mr. Buckley goes on to question "other issues of note" including "the basic design event, optimum berm elevation, and estimated maintenance cost. In addition, other issues are raised regarding the potential misuse of a 20 ft/yr erosion rate throughout the study design."

Mr. Buckley identifies only Dr. Robert Hallermeier as an expert on whom he relies. I have known Mr. Buckley on a professional level for at least 20 years. I believe his professional opinion is informed and worth attending to. I knew Bob Hallermeier personally from 1970 to his death in 1999. He was an internationally known coastal expert, with a high degree of interest in the subject and a keen intellect.

One expects that the Corps would address such criticism in the published document. In this case they do not, and I have been unable to receive an explanation from sources who should provide it.

To indicate that the Corps is serious about these high rates, consider what the House Document says (p. 52) for Reach 4, which includes Promontory Point: "It is estimated that the structure's remaining useful life will not exceed 11 years, or 2003." Elsewhere (p. 55) it says that by 1997 "Reach 4: shore protection is expected to have undergone complete structural failure >90% LOA." This line is printed in bold type, lest you not notice. LOA means length over all of Reach 4.

The same page 55 further predicts: "2003 -- Reach 4 average annual recession of parkland shoreline is expected to be 35 ft/yr." [Thirty-five feet per year]

To echo Mr. Gnaedinger's statement made in 1993: "This, in my opinion, is preposterous." And that fact was known in 1993-94.

INDIANA LIMESTONE

Limestone Suppliers. On 24 September 2002, I visited four quarries producing limestone from the general vicinity of Bloomington, Indiana. I was met with courtesy by representatives of each quarry and allowed as much time as I wanted. In fact, I was allowed so much time that there was not enough time in the day to visit the fifth quarry I had planned to visit that day.

My inspections of these quarries, discussions with quarry officials, and related investigations changed radically the opinion that I had gathered from reading documents associated with the design of protection at the Point. I conclude from my quarry experience:

1. There are abundant supplies of new limestone appropriate for use as revetment on the Point.

2. These supplies are available at prices reasonable in comparison to costs of other materials.

3. As would be expected from such an ancient profession, the production of usable limestone from a quarry has many subtleties that have to be gained by experience. Statements about limestone by people who lack experience with quarries need careful study.

It is my conclusion from those quarry visits that a competitively bid contract will supply the Point with new usable rock at a good price. (This conclusion was not volunteered to me by any of the quarry managers that I talked with.) This conclusion can be subverted by making the limestone specifications unnecessarily strict. The work at the Point is likely to need rock at a slow, steady rate for more than one year. With proper specifications, the prospect of such an extended job should enable small as well as big quarries to compete, resulting in a good price.

Relatively little new rock will be needed. On 19-20 June 2002, Bruce Johnstone and I inspected and measured approximately 250 blocks at 13 sites along the perimeter of the Point. This experience impressed me with the quality of rock available in the existing step-stone revetment. The large majority of these rocks are in good reusable condition. Additional quantitative investigation on 23 September 2002 suggests that not more than a quarter of the existing step-stone blocks are unusable. That is, at least three of every four blocks on the revetment can be safely reused.

Limestone Costs.

1. Stone loaded on truck at quarry

• Costs may be given on $ per cubic foot or in $ per ton. Quarries selling at $ per cubic foot are probably dealing with higher-end rock, but they are likely to produce usable revetment rock as by-product.

• Assume a rock density of 150 pounds per cubic foot. If so, there are 13.3 cubic feet per ton. Therefore, cost in $/ton = 13.3 x cost in $/cubic foot.

• Assume $27.50 per ton in competitive markets.

2. Typical limestone block volume.

Rock A: 4 ft x 4 ft x 3 ft = 48 cubic feet

Rock B: 8 ft x 4 ft x 2 ft = 64 cubic feet

Rock C: 8 ft x 5ft x 2.5 ft = 100 cubic feet

At 150 lb/ft^3, the three rocks are

A = 720 lbs = 3.60 tons

B = 9600 lbs = 4.80 tons

C = 15000 lbs = 7.50 tons

At $27.50/ton

A = 3.6 x $27.50 = $99.00

B = 4.8 x $27.50 = $132.00

C = 7.5 x $27.50 = $206.25

Above costs are for stone loaded on truck at quarry.

3. Transport to the Point.

• Travel Distances	Quarry to Bloomington	10 mi.
	Bloomington to Gary	200 mi.
	Gary to the Point	20 mi.
	Total mileage	230 mi

• Transport on flatbed truck. Load limit is 20 tons. It is difficult to get a 20-ton load exactly. For example, two A + one B + one C = 19.5 tons.

Assume actual load will be 19 ton on average.

Cost of transport at $2.00 per loaded mile. $2 x 230 = $460/load. If the long-term average is 19 ton, then travel costs are $460/19 = $24.21/ton.

4. Total Cost, Quarry to Point

Load at Quarry	$27.50
Transport to Point	$24.21/ton
Total	$51.71/ton delivered

At this rate the three blocks cost:

A = 3.60 ton x 451.71 = $186

B = 4.80 ton x 51.71 = $248

C = 7.50 ton x 51.71 = $388

5. Cost per foot of shoreline.

For four tiers with two blocks of B and two of C laid longways perpendicular to shore, i.e., the blocks have shore front of 4 ft (B) and 5 ft (C), we have, per foot of shore, one quarter of block B and one fifth of block C, for two each.

$$2 \times \$248/4 + 2 \times 388/5 \;=\; \$124 + \$155 \;=\; \$279/\text{ft}$$

That is, the cost of new limestone at the site, but not in the revetment, is $279 per running foot of shore, if all the rock is new. If, as believed, only one quarter of the rock need be new, the cost is $70 per foot of shore. That is a reasonable investment.

About $70/foot of shore for new limestone

COMPARE COSTS

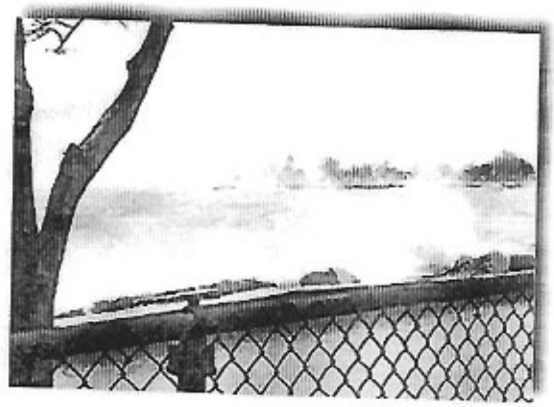
Costs of City/Corps Project.

On the web at http://www.ci.chi.il.us/Environment/shoreline/54to57.html, one can find a page entitled "54th street to 57th Street." See next page for a copy. This page suggests there are $22 million in estimated costs for reconstruction of the shore.

The improvements, according to the web page, "will include the construction of step stone revetment and a land expansion to accommodate a proposed new pedestrian underpass." The full statement suggests that a good deal of the $22 million could be intended for the shore opposite the proposed underpass.

On a raw average basis, $22 million/4200 ft equals $5238 per foot of shoreline. Considerable renovation could be done for much less than that. If we subtract out about one thousand feet for the work in front of the proposed underpass, about 3200 feet is left for the Point proper. Using the raw average, $5.24 million is the cost of work in front of the underpass, leaving about $16.76 million for the remaining 3200 feet at the Point.

54th Street to 57th Street



Project:	**54^{th} to 57^{th} Street**
Contracts Administered By:	**City of Chicago and Chicago Park District**
Project Description:	**Project consists of the reconstruction of 4,200 linear feet of shoreline. Improvements will include the construction of step stone revetment and a land expansion to accommodate a proposed new pedestrian underpass to be built as part of the South Lake Shore Drive reconstruction.**
Estimated Cost:	**$22 million**
Design Engineer of Record:	**STS Consultants, Ltd.**
Construction Contractor:	**Not yet determined**
Status:	**Due to unresolved issues relating to the proposed construction materials, this project is currently on hold.**

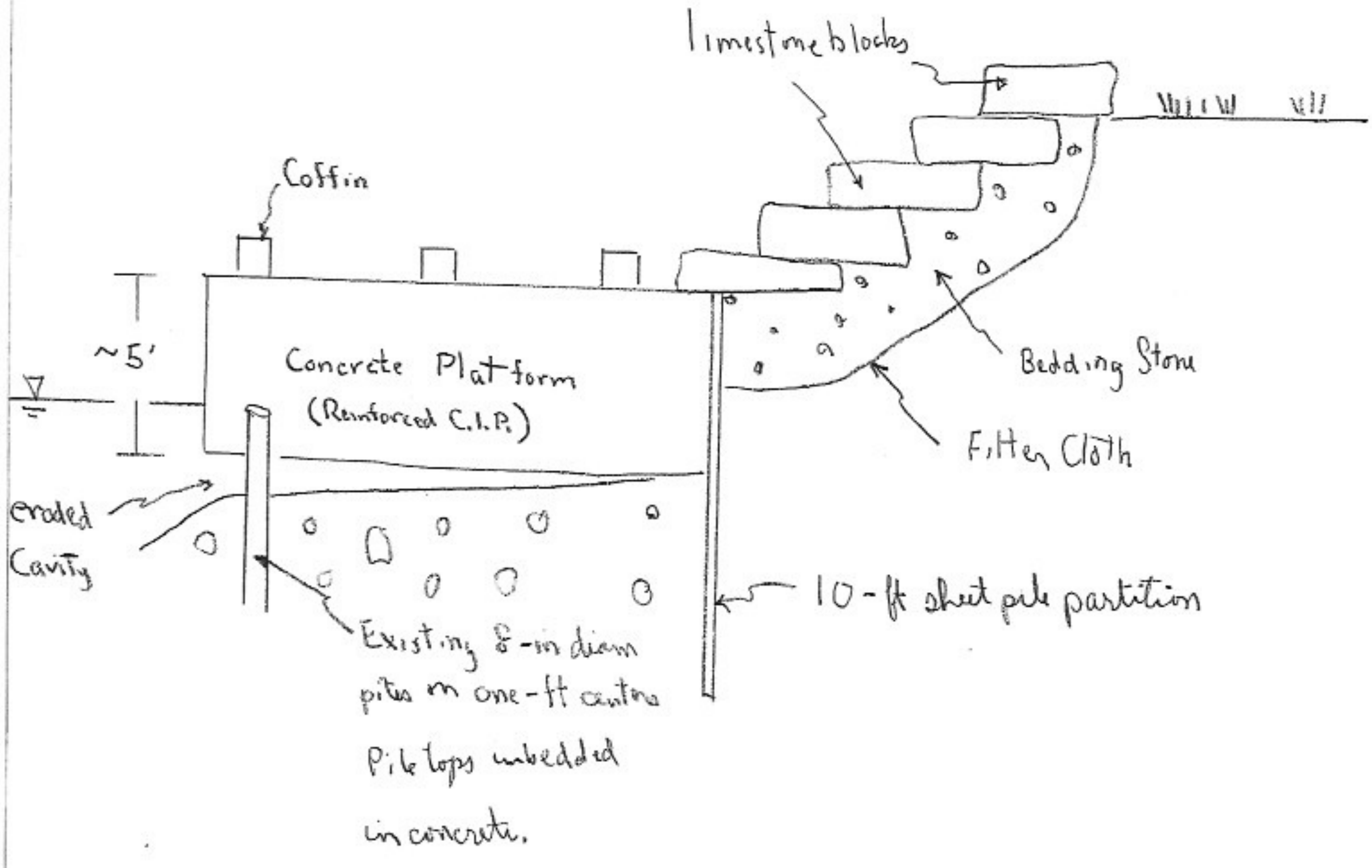
Repair Estimate at the Point.

Suppose that the renovation work employs four crews of workers, including a crew with a truck-mounted crane, a crew to take care of the piles, a crew to handle the sheet pile divider and stone, and a crew for other work, including access. If those four crews averaged, with equipment and supplies, \$2500 per crew per work day (four crews at \$10,000/day), and if the crews averaged ten feet of shore per day of renovation, then the following holds: work days = 3200/10 = 320 work days. Allow 30 days lost time for weather and 20 days mob and demob. Duration of Work = 320 + 30 + 20 = 370 work days = 74 work weeks (without holiday). Duration of Job ~ 20 months, if begun in spring. At \$10,000 per work day x 370 days = \$3.70 million. Extraordinary materials at \$100/ft = 3200 x 100 = \$320,000. Total cost for renovation ~ \$4.02 million. Add 10% for engineering ~ \$4.42 million. This is not a detailed estimate, and it tends to err on the high side, that is, it should over-estimate the costs in most places.

The tasks to be done are outlined on Tables 2 and 3, and on accompanying sketches (pages 31 to 34), except for construction needed to provide access for disabled persons. This access construction is covered separately.

Repair Tasks.

The following four pages describe the steps needed in the renovation for the concrete platform on the east end of the Point, and for the Promenade on the north and south sides of the Point.



CROSS-SECTION OF EXISTING CONCRETE PLATFORM AND LIMESTONE REVETMENT

(Typical of the most exposed segment of perimeter)

Table 2. RENOVATION TASKS AT CONCRETE PLATFORM

1. Prepare three portable truss bridges sufficiently high to clear coffins, and sufficiently strong to support truck-mounted crane. Each bridge 20 feet long.

2. With crane, lift limestone blocks and set on grass upland. May require freeing grout.

3. Inventory reusable blocks as work progresses.

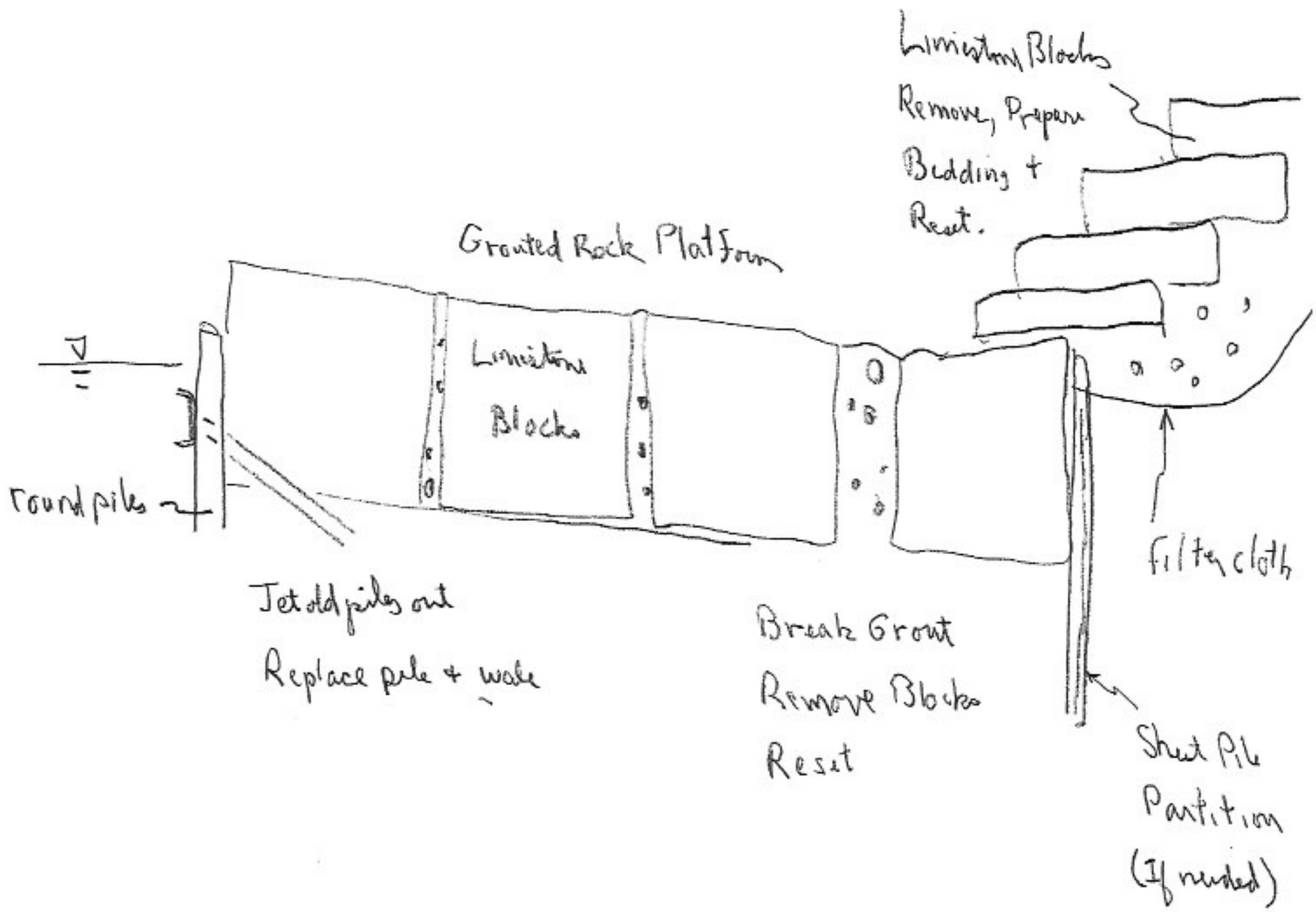
4. Grout cavities under concrete platform, with special effort to seal landward end of platform against water percolation. Caulk expansion joints.

5. Dig trench at landward side of concrete platform. Backfill with sand. Drive steel sheet as partition to eliminate undermining.

6. Prepare bedding stone landward of sheet pile. Include filter cloth.

7. Replace limestone blocks in five tiers.

8. Patch concrete on coffins and elsewhere as needed.



CROSS SECTION OF EXISTING PROMENADE (GROUTED ROCK PLATFORM) AND LIMESTONE REVETMENT
(Typical of South Side and parts of North Side)

Table 3. RENOVATION TASKS AT PROMENADE

1. Develop access to promenade, possibly by gravel road laid on promenade.
2. Remove limestone blocks from step stone revetment and set on grass.
3. Inventory reusable blocks.
4. Remove the two most seaward limestone blocks of promenade, and set on promenade.
5. Disconnect tie rods and wale. (Most tie rods have already failed.)
6. Jet out pile remnants and replace with new round piles. Piles to be deeply buried: 8 ft burial, 2 ft exposed.
7. Attach steel channel wale.
8. Trench landward edge of promenade and install sheet pile partition to eliminate erosion under limestone blocks.
9. Repair bedding stone along seaward side and reset blocks at edge of promenade.
10. Replace badly broken or missing blocks in rock platform.
11. In certain badly damaged areas, the rock promenade may have to be rebuilt.

APPENDIX

Frame 14
Roll 960

Frame 15
Roll 960

Plate 1. Both photos looking north over the Point, with underpass construction and 57th Street Beach in foreground.
Frame 14, Roll 960: Chicago skyline on horizon
Frame 15, Roll 960: View parallel to mean shoreline.

Plate 2

Frame 20
Roll 960

Frame 17
Roll 960

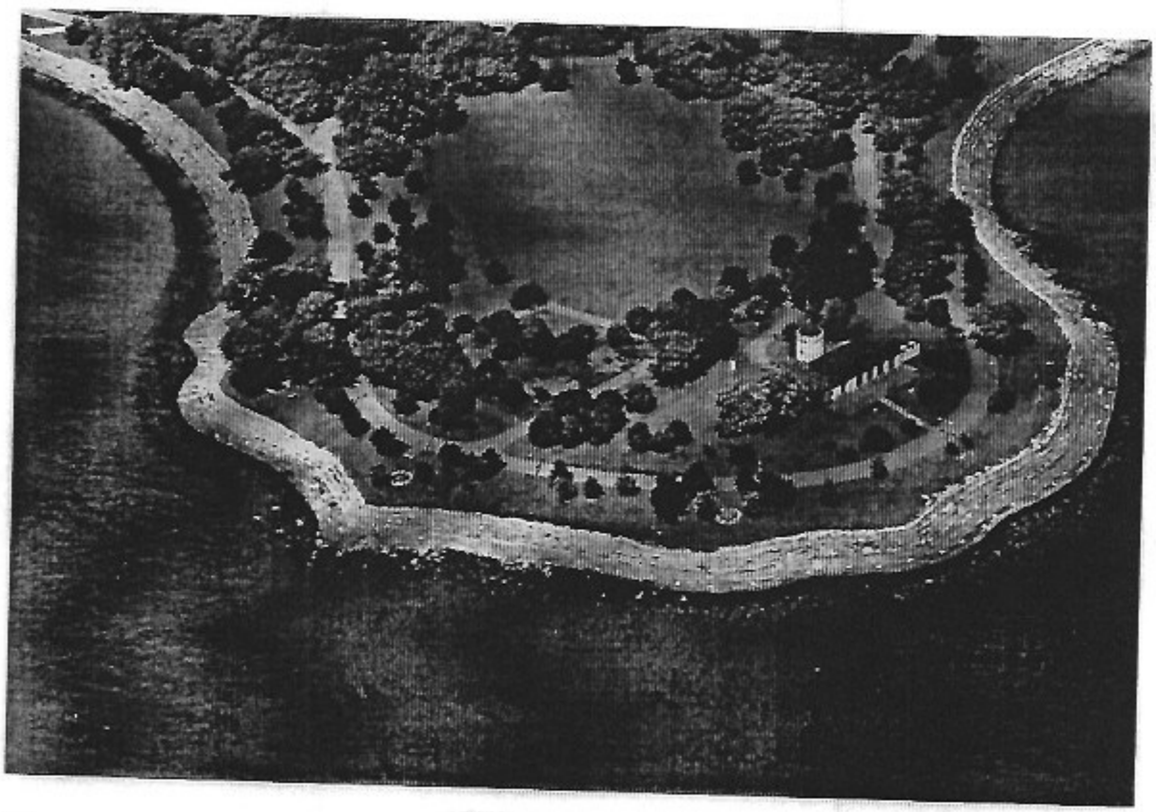
Plate 2. Frame 20, Roll 960: Look south at the Point, emphasizing the entire north shore of the Point.
Frame 17, Roll 960: Look north at the Point; Museum of Science and Industry and underpass construction in foreground.

Frame A19
Roll 962

Frame 21
Roll 960

Plate 3. Both photos contrast the new shore protection (white) with the historic shore protection at the Point.
Frame A19, Roll 962: View to northwest with south shore of the Point in center; new shore protection at top of photo.
Frame 21, Roll 960: View to south with new construction in center. Holding yard (?) for stone block in foreground

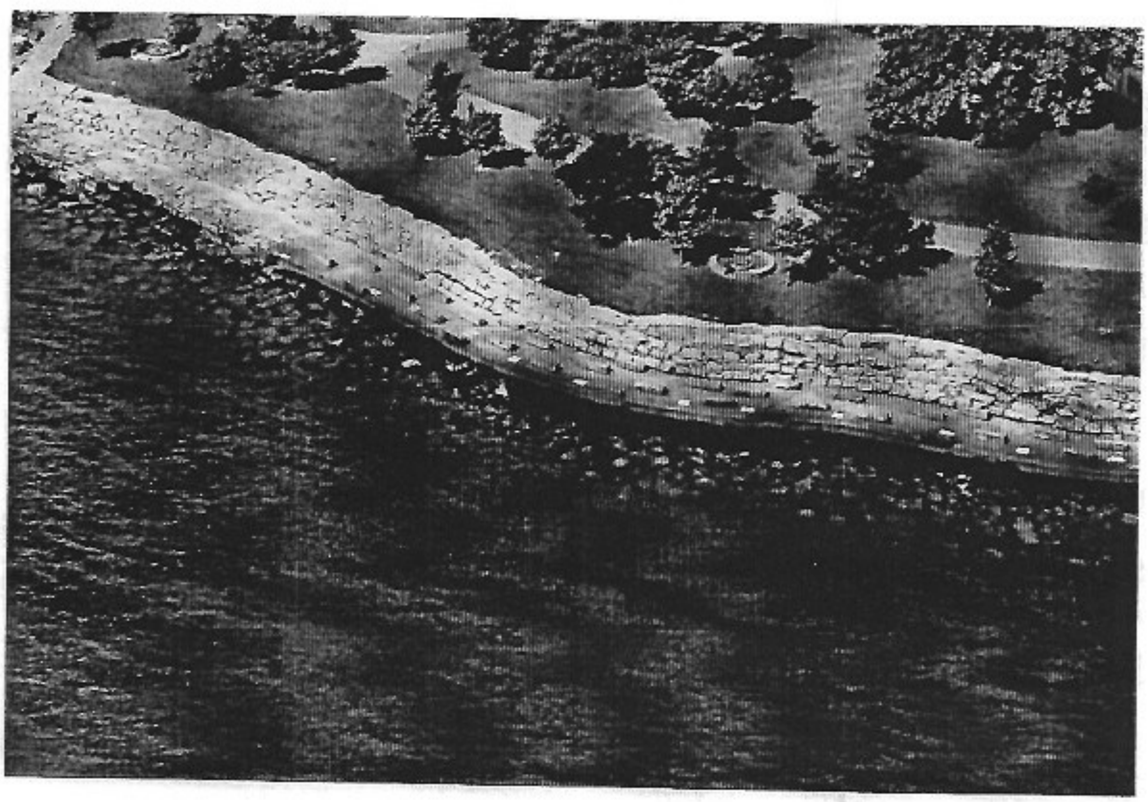
Frame 19
Roll 960



Frame A7
Roll 962

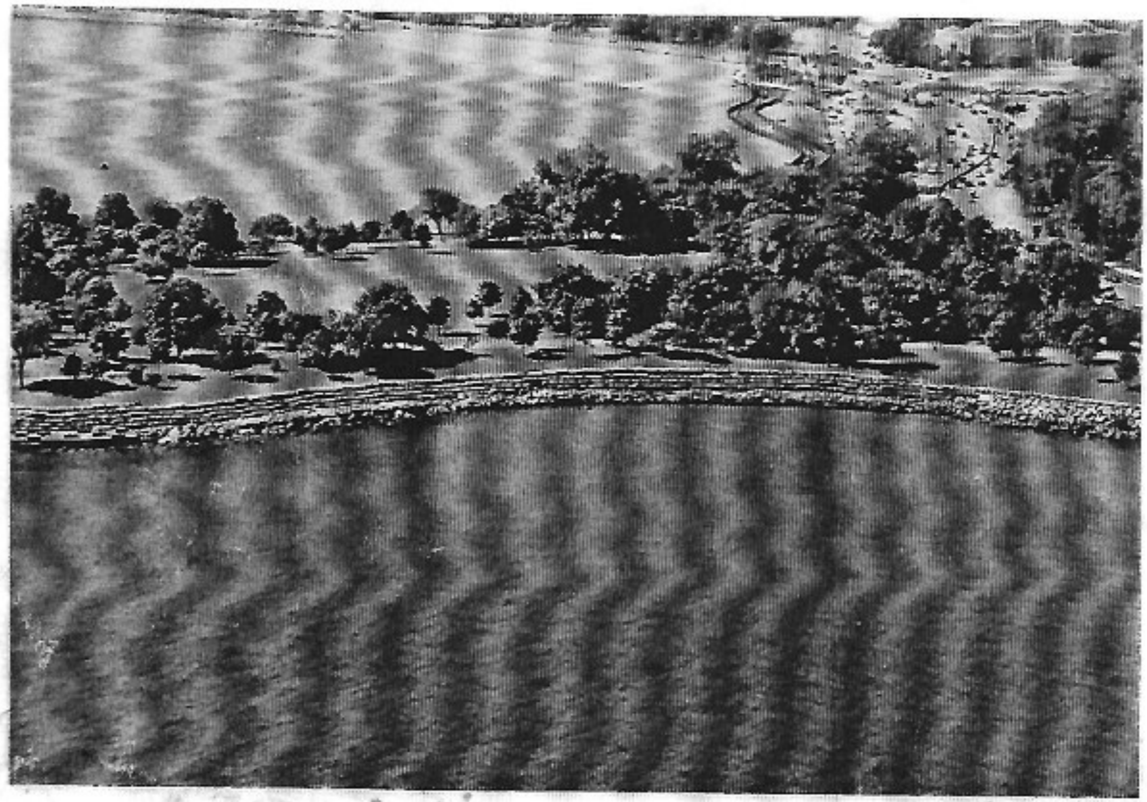
Plate 4. Two views of the Point as a whole.
Frame 19, Roll 960: View of entire Point, looking south. Lake Shore Drive on the right marks landward boundary of the Point.
Frame A7, Roll 962: View looking landward from over the Lake: south shore on left; east shore in foreground; north shore on right.

Frame A4
Roll 962

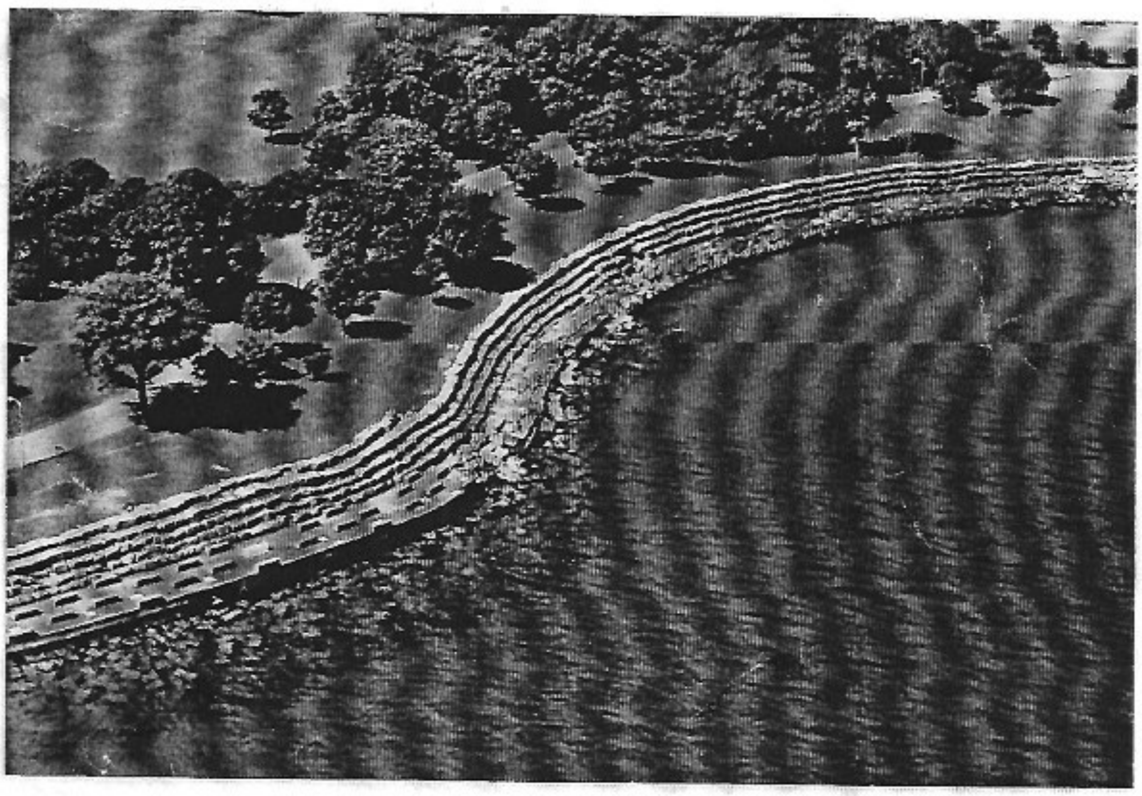


Frame A2
Roll 962

Plate 5. Both photos illustrate the concrete blocks on the Promenade, and areas of partial failure of the stepped-stone revetment (picked out by shadows).
Frame A4, Roll 962: Concrete blocks on Promenade along northeast sector of the Point shoreline. The white-painted block on the right edge of this photo is a benchmark that also appears on Plates 2, 4, and 6.
Frame A2, Roll 962: Outer (east) shore at the Point with Council Rings.



Frame A5
Roll 962



Frame A3
Roll 962

Plate 6. Both photos illustrate the stepped construction of the stone revetment which is a characteristic of the Point. The stone revetment has a fifth tier along the more exposed sector of the shore that ends at the left sides of both photos.
Frame A5, Roll 962: Stepped revetment along north shore.
Frame A3, Roll 962: Northeast sector of the shore at the Point. Promenade with concrete blocks (on left) could be the 1964 project mentioned in documents(?). Blocks visible underwater provide valuable protection against waves acting on the stepped-stone revetment.