DAMES & MOORE

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REMEDIAL ACTION OPTIONS FEASIBILITY STUDY - FINAL REPORT

FOR THE ASHLAND LAKEFRONT SITE

PREPARED FOR
NORTHERN STATES POWER
ASHLAND, WISCONSIN

MARCH 1, 1999

Dames & Moore Project No.
05644-084

CERTIFICATION

I, David P. Trainor, hereby certify that I am a registered professional engineer in the State of Wisconsin, registered in accordance with the requirements of ch, A-E 4, Wis. Adm. Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wis. Adm. Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code.

WISCONSIN DAVID P. TRAINOR E-22440 MADISON, WI PROFESSIONAL ENGINEER

David P. Trainor 22440 3/1/99

David P. Trainor, P.E. P.E. Number Date
Senior Project Manager

I, Karen B. Richardson, hereby certify that I am a registered professional engineer in the State of Wisconsin, registered in accordance with the requirements of ch, A-E 4, Wis. Adm. Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wis. Adm. Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code.

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Karen B. Richardson E-26134 3-1-99

Karen B. Richardson, P.E P.E. Number Date
Project Engineer

I, Mark S. McColloch, hereby certify that I am a Hydrogeologist as that term is defined in s. NR 712.03(1) Wis. Adm. Code, and that, to the best of my knowledge, all of the information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code.

WISCONSIN MARK S. McCOLLOCH G-216 MADISON, WI PROFESSIONAL GEOLOGIST

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Mark S. McColloch, P.G. P.G. Number Date
Hydrogeologist

LIST OF ABBREVIATIONS

Abbreviations used in Feasibility Study

ARAR	Applicable or Relevant and Appropriate Requirement
ASTM	American Society of Testing Materials
BETX	Benzene, Ethylbenzene, Toluene, and Xylene
bgs	below ground surface
BTU	British Thermal Unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
ch. NR 140	WAC Chapter Natural Resources 140 - Groundwater Quality
ch. NR 720	WAC Chapter Natural Resources 720 - Soil Cleanup Standards
ch. NR 722	WAC Chapter Natural resources 722 - Standards for Selecting Remedial Actions
CFR	Code of Federal Regulations
CHMM	Certified Hazardous Materials Manager
CTE	Central Tendency Exposure
D&M	Dames & Moore Inc.
DCOM	Wisconsin Department of Commerce
DHFS	Department of Health and Family Services - State of Wisconsin
DNAPL	Dense Non Aqueous Phase Liquid
DW	Dry Weight
EPA	Environmental Protection Agency (USEPA)
ERA	Ecological Risk Assessment
ERM	Effects Range - Median
EIS	Environmental Impact Statement
ES	ch. NR 140 Enforcement Standard
FS	Feasibility Study for Remedial Action Options
GLI	Great Lakes Initiative
HA-28	*Hyallela azteca* 28 day Toxicity Test
HEAST	Health Effects Assessment Summary Tables
HHRA	Human Health Risk Assessment
IRIS	Integrated Risk Information System
LNAPL	Light Non Aqueous Phase Liquid
mg/kg	milligram/kilogram
mg/l	milligram/liter
MGP	Manufactured Gas Plant
MSL	Mean Sea Level
NAPL	Non Aqueous Phase Liquid
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
NET	Northern Environmental Technologies, Inc.
NOAA	National Oceanic and Atmospheric Administration
NOC	Normalized to Organic Carbon
NSE	No Standard Established
NSP	Northern States Power Company
OMM	Operations Maintenance and Monitoring

ORNL	Oak Ridge National Lab
PAH	Polynuclear Aromatic Hydrocarbons
PE	Professional Engineer
PEL	Probable Effects Level
PG	Professional Geologist
ppb	parts per billion
PPE	Personal Protective Equipment
ppm	parts per million
RCL	ch NR 720 Residual Contaminant Level
RCRA	Resource Conservation and Recovery Act
RME	Reasonable Maximum Exposure
SEH	Short Elliott Hendrickson Inc.
SVE	Soil Vapor Extraction
TBC	To Be Considered
TCLP	Toxicity Characteristic Leaching Procedure
TOC	Total Organic Carbon
TPAH	Total Polynuclear Aromatic Hydrocarbons
TSCA	Toxic Substances Control Act
TSS	Total Suspended Solids
TU	Toxic Units
μg/kg	microgram/kilogram
μg/l	microgram/liter
USEPA	United States Environmental Protection Agency
UV	ultraviolet
VOC	Volatile Organic Compound
WAC	Wisconsin Administrate Code
WDNR	Wisconsin Department of Natural Resources
WPDES	Wisconsin Pollution Discharge Elimination System
WWTP	Wastewater Treatment Plant

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EXECUTIVE SUMMARY

This report presents an alternative Remediation Action Options Feasibility Study (FS) to the December, 1998 Short Elliot Hendrickson Inc. (SEH) document of the same title, for the Ashland Lakefront Property consisting of the Kreher Park property and the near-shore contaminated sediments. The purpose of this alternative FS report is to fulfill the requirements of Paragraph 1(h) of the June 22, 1998 Spill Response Agreement between the Wisconsin Department of Natural Resources (WDNR) and Northern States Power (NSP). This FS includes: (1) a review of the December 1998 SEH report (Appendix A); (2)the application of SEH remedial standards for sediments, as well as Dames & Moore remedial standards for sediments, to proposed sediment cleanup options (SEH remedial standards are based upon its October 1998 Ecological Risk Assessment (ERA); (3) the application of Dames & Moore remedial standards for sediments based upon an alternative ERA submitted under separate cover); (4) evaluation of applicable or relevant and appropriate requirements (ARARs); (5) identification and screening of potential remedial technologies; (6) detailed evaluation of selected technologies and a comparison of selected technologies, and (7) a recommendation for a remedial option based upon the foregoing.

The Ashland Lakefront site includes the area defined by Kreher Park and the adjacent bay sediments. This area is bounded by Prentice Avenue and a jetty extension of Prentice Avenue to the east, the Wisconsin Central Limited (WCL) railroad to the south, Ellis Avenue and the marina extension of Ellis Avenue to the west, and Chequamegon Bay to the north. The affected sediment area is a confined inlet created by the jetty and marina extensions.

The Kreher Park area is reclaimed land formerly part of Chequamegon Bay. It consists of waste wood, demolition debris and fill soils placed there in the 19th and early 20th centuries. It formerly was the site of lumber and wood treatment operations until 1939, when Ashland County took title to the site. The County subsequently transferred title to the City of Ashland in 1942. The City used a portion of the property for a solid waste disposal facility, as well as the City's waste water treatment plant (WWTP), located along the north shore. Both facilities are not operational at the present time. The park area consists predominantly of open grassed areas.

A former manufactured gas plant (MGP) operated by Lake Superior District Power (LSDP) operated adjacent to the park area from about 1885 until 1947. Coal tar by-product was generated by the MGP, some of which was sold. The remainder was used as boiler fuel at the MGP, or otherwise discarded. SEH concludes in its report that the predominant source of contamination at the Lakefront and in the bay sediments was caused by the MGP, although acknowledging that other identified potential sources may exist.

NSP has shown through sworn eyewitness testimony, as well as historic Sanborn maps, that other sources of contamination (creosote wood treatment, oil houses) were present during lumber processing operations at Kreher Park. Based upon the data developed by SEH for Kreher Park and the sediments, and by Dames & Moore for the former MGP, these other sources of contamination (i.e., direct discharge) are significant. Contamination from coal tar by-product at the former MGP site is present in an upper fill aquifer and lower confined aquifer. Groundwater contamination in the upper fill aquifer continues to migrate onto the Kreher Park site. However, the contamination in the confined aquifer is hydraulically separate, and provides no connection to the fill aquifer at the Park.

Contamination at Kreher Park presents a potential direct contact risk to contaminant exposure at the surface in an area called the "seep." This risk has been minimized because of fencing placed around the area by NSP. The source of this contamination is likely caused by dense non-aqueous liquid (DNAPL) consisting of coal tar/creosote wastes measured in shallow water table wells in this area. However, the remainder of the Kreher Park site is currently capped by one to two feet of clean fill, preventing any direct contact risk. The only remaining risk scenario would be potential direct contact to utility workers exposed via open excavations.

SEH developed its ERA for the sediments evaluating the risks to individuals of characteristic select species. The results of this ERA showed that an area encompassing approximately nine acres will require remediation. Dames & Moore developed an alternative ERA using an USEPA sanctioned method evaluating risks to characteristic species populations. These results indicate that an area encompassing approximately five acres will require remediation.

This alternative FS provides a detailed evaluation of nine targeted remedial alternatives. These range from a no action alternative, to capping of the sediments using partial bay filling along with an armored cap for the remainder of the affected sediments, and "hot spot" removal for source elimination, along with ozone sparging for groundwater remediation at Kreher Park. For comparison, SEH sediment cleanup limits and Dames & Moore sediment cleanup limits are evaluated separately. The list of evaluated alternatives include the following:

- Option A - No Further Action
- Option B1 - Institutional Controls/Source Removal at Seep/Institutional Controls on Groundwater/Cap Sediments - SEH ERA Limits
- Option B2 - Institutional Controls/Source Removal at Seep/Institutional Controls on Groundwater/Cap Sediments - D&M ERA Limits
- Option C1 - Institutional Controls/Source Removal at Seep/Cap Sediments/ Ozone Sparge at Kreher Park - SEH ERA Limits
- Option C2 - Institutional Controls/Source Removal at Seep/Cap Sediments/Ozone Sparge at Kreher Park - D&M ERA Limits
- Option D1 - Institutional Controls/Source Removal at Seep/Institutional Controls on Groundwater/Partial Filling of Bay/Cap Sediments- SEH ERA Limits
- Option D2 - Institutional Controls/Source Removal at Seep/Institutional Controls on Groundwater/Partial Filling of Bay/Cap Sediments - D&M ERA Limits
- Option E1 - Institutional Controls/Source Removal at Seep/Partial Filling of Bay/Cap Sediments/Ozone Sparge at Kreher Park - SEH ERA Limits
- Option E2 - Institutional Controls/Source Removal at Seep/Partial Filling of Bay/Cap Sediments/Ozone Sparge at Kreher Park - D&M ERA Limits

A scoring system for each of the evaluation criteria described in ch. NR 722, Wisconsin Administrative Code (WAC), was developed for each alternative evaluated. The alternative yielding the most desirable score is C1/C2. However, NSP has chosen to recommend an alternative with a higher score, E1/E2. The only criterion that yields a difference in scoring between the C series and E series is cost, as all other criteria score the same. Accordingly, Dames & Moore recommends alternative E2, which is based on the Dames & Moore sediment remedial standards.

1.0 INTRODUCTION

This Remediation Action Options Feasibility Study (FS) has been prepared as an alternative to the December, 1998 Short Elliot Hendrickson Inc. (SEH) document of the same title, for the Ashland Lakefront Property consisting of Kreher Park and near-shore contaminated sediments. This alternative report has been prepared in accordance with the June, 1998 Spill Response Agreement between the Wisconsin Department of Natural Resources (WDNR) and Northern States Power Company (NSP).

1.1 Purpose

Contamination in the form of coal tar, creosote and oils have been investigated by SEH at the City of Ashland's Kreher Park property (Ashland Lakefront) and the adjacent near-shore sediments of Chequamegon Bay (Ashland Lakefront), since 1994. Contaminant concentrations exceeding groundwater standards in ch. NR 140, Wisconsin Administrative Code (WAC), and residual contaminant levels for soil as determined in ch. NR 700, WAC, have been measured at the Ashland Lakefront. Codified standards for sediments have not yet been promulgated in Wisconsin; however, SEH provided standards for sediments based upon its December 1998 Ecological Risk Assessment (ERA) of the bay sediments. (SEH also performed a Human Health Risk Assessment (HHRA) on the contaminants at the park. The HHRA concluded that unacceptable risk was present from exposure to contaminants at the seep, and to contaminants in subsurface soils and groundwater under certain exposure scenarios.) These risk based standards, along with the WAC standards for Kreher Park, were used by SEH to develop remedial action alternatives for the site.

NSP has been engaged in investigating its property concerning for coal tar contamination since 1995. The NSP site occupies land adjacent to Kreher Park that is the site of a former Manufactured Gas Plant (MGP), owned by Lake Superior District Power (LSDP), a predecessor company of NSP. In 1995, NSP received a responsible party (RP) letter from the WDNR alleging that NSP was also responsible to investigate and respond to the contamination at Kreher Park. Since that time, NSP has gathered historic information concerning former wood treatment operations conducted at the Lakefront property by Schroeder Lumber Company, which operated at the site from 1901 to the mid to late 1930s.

In 1998, WDNR and NSP entered into a Spill Response Agreement. A condition of the Agreement allows NSP to review the SEH FS and submit an alternative FS for the Ashland Lakefront Property to the WDNR for review and consideration by March 1, 1999. To adequately meet its obligation under the Spill Response Agreement, NSP decided to prepare an alternative ERA to present remedial sediment standards utilizing an alternative (but USEPA sanctioned) method. This FS -- which offers options based on both the SEH and the Dames & Moore sediment standards -- completes this condition as specified in the Spill Response Agreement. A detailed response to the SEH FS is contained in Appendix A.

1.2 Scope of Work

This FS was prepared in accordance with the ch. NR 722, WAC requirements, and in conformance with the National Oil and Hazardous Substance Pollution Contingency Plan (NCP), defined in the Code of Federal Regulations 40 CFR Part 300.430(e) and (f). This FS was developed as follows:

- Review of past SEH documents prepared for the Kreher Park and bay sediments areas;
- Development of an alternative ERA for the bay sediments (prepared as a separate document);
- Identification of remedial action objectives using standards developed by (I) SEH and (ii) Dames & Moore;
- Evaluation of applicable or relevant and appropriate requirements (ARARs);
- Identification and screening of potential remedial technologies;
- Detailed evaluation of potential remedial technologies applying criteria defined in ch. NR 700 and the NCP;

- Comparison of remedial alternatives; and

- Recommendation of a remedial alternative.

2.0 BACKGROUND INFORMATION

2.1 Site Location and Description

The Ashland Lakefront Property (Site) is located in S 33, T 48 N, R 4W in Ashland County, Wisconsin (Figure 2-1). The site is bounded by Prentice Avenue and a jetty extension of Prentice Avenue to the east, the Wisconsin Central Limited (WCL) railroad to the south, the Ellis Avenue and the marina extension of Ellis Avenue to the west, and Chequamegon Bay to the north. The site contains an offshore area with impacted sediments. The offshore area of the bay sediments is an inlet created by the jetty and marina extensions previously described.

Kreher Park

The Kreher Park area is reclaimed land of which the south boundary defined the original lake shoreline. Beginning in the mid to late 1800's, this area was filled with a variety of materials including slab wood, concrete, demolition debris, municipal and industrial wastes, and earth fill that created the land now occupied by the park. This land was used for lumbering and sawmill activities by a number of lumber companies. At least the last lumber company, Schroeder Lumber, conducted wood treatment activities at the site. At the present time, the park area is predominantly grass covered. A gravel overflow parking area for the marina occupies the west end of the property, while a recently constructed miniature golf facility occupies the east end of the site. The former Ashland waste water treatment plant (WWTP) and associated structures fronts the bay inlet on the north side of the property. The entire subject land area occupies approximately 13 acres.

Near-Shore Bay Sediments

The inlet area where the subject sediments are located confines the affected sediments. Contaminated sediments have not been encountered beyond the northern edges of the jetties. The affected sediments consist of lake bottom sand and silts, and are overlain by a layer of wood chips, likely originating from the former lumbering operations. The chips layer varies in thickness from 0 to seven feet, with an average thickness of nine inches. The entire area of sediments requiring remediation encompasses approximately nine acres, using the standards developed by SEH, or alternatively, encompasses five acres, using the standards developed by Dames & Moore in its ERA.

2.2 Site History

Historically, Chequamegon Bay has been utilized as a vital transportation route for the shipment of various materials to and from Ashland including iron ore, lumber, pulp, and coal. During the 19th century, Ashland was one of the busiest ports on the Great Lakes. In recent times, the shipping industry through the bay has declined because of the decline in the mining and lumber industries in the region.

As previously described, the Kreher Park area was constructed in the mid to late 19th century of fill materials to create land for the lumber operations that subsequently followed at the site. Several lumber operations occupied the property, but the largest facility and longest tenured was the John Schroeder Lumber Company. Schroeder Lumber occupied the site from 1901 until 1939, when Ashland County took title to the site and sued to eject Schroeder. Schroeder's operations were extensive. Schroeder's "articles of incorporation" stated that one of the companies business purposes was to "...manufacture and deal in preservative chemicals, to own and operate wood preservation plants and plants for the manufacture and stillization of wood-byproducts, to explore and develop lands for gas, minerals, ores and oils, and to collect, work, use, and treat any timber and all forest and other vegetable products." Based on research performed by NSP, Schroeder's Ashland plant was the company's only wood processing facility. Schroeder's Ashland Sawmill/Wood Processing facility was described as "one of the largest and best equipped mills in the greater northwest." (Bell, 1998) Details of the Schroeder operation including the physical location of facility appurtenances were obtained from interviews of eyewitnesses, review of historic documents, as well as fire insurance (Sanborn) maps. This information indicates that an above-ground structure or structures used for creosote dipping or treatment of railroad ties, telephone poles and the like was located in the west-central area of the present Kreher Park. Additionally, oil houses (the functions of which have not yet been definitively identified) were located in the east central part of Kreher Park as shown on Sanborn Maps.

Following Schroeder Lumber's tenure, Ashland County transferred title to the City of Ashland in 1942, which has owned the site since. During some time in the 1940's and 50's, the City operated a portion of the site in the present northwest area as a waste disposal facility (landfill). In 1951, the WWTP was constructed, and operated as the City's sewage treatment facility until 1989. During the mid-1980's, the marina extension of Ellis Avenue was completed, which created more usable land to permit establishment of a marina with full service boat slips, fuel and dock facilities and a ship store. During exploratory work to expand the WWTP into the Kreher Park area in 1989, soil and groundwater contaminated with creosote/coal tar compounds were encountered. The City notified the WDNR, and subsequently closed the WWTP relocating the current facility a few miles away from Kreher Park. In 1994, the WDNR authorized SEH to initiate an investigation and evaluation of the area to characterize the extent of contamination at the site, which heretofore had been referred to as a creosote contaminated site.

SEH produced several documents from this time through 1998. SEH most recently concluded that the primary source of contamination at the property was caused by releases from the historic MGP. They based this, in part, on the following:

- The identification of MGP appurtenances such as former gas holders and storage tanks shown on historic Sanborn maps;

- The physiographic location of the MGP in relation to Kreher Park (on an upgradient bluff overlooking the park area);

- The identification of a former ravine that transected the MGP site and opened onto the park area during part of its operating life that may have been a pathway for contaminants, and

- The identification of a 2-inch diameter pipe on the former MGP property on Greeley and Hansen engineering drawings for the 1951 construction of the WWTP. This pipe, labeled by Greeley and Hansen as "2" Tar to For. Dump, " was shown in cross-section and plan view crossing beneath St. Claire Street, and appeared to align with the location of an area labeled as "waste tar dump" shown on the Greeley and Hansen drawings north of the seep area at Kreher Park.

Dames & Moore has investigated the MGP site to characterize the extent of contamination since 1995. Additionally, we have augmented historical research for NSP on the operations of the MGP. The latest findings of this work has been described in a separate Supplemental Investigation and Remediation Action Options Report for the NSP property. The salient information from this report as well as earlier studies is as follows:

- Releases of coal tar product occurred during the lifetime of the MGP. Dense non-aqueous phase liquid (DNAPL) has been found in the form of coal tar contaminated soils at the base of the former ravine below the water table. This DNAPL is restricted to the area south of St. Clair St. below the current NSP service garage. DNAPL has not been found north of St. Clair in this geologic unit in the former ravine. However, DNAPL is present in the fill aquifer at a surface water seep, north of where the ravine opens onto Kreher Park. The source of contamination at this seep is separate from the source identified in the former ravine below the NSP facility (i.e., the seep is not in communication with the former ravine).

- The MGP operated primarily as a manufacturer of water gas or associated derivatives from about 1885 to 1947. This process resulted in a lack of nitrogen containing compounds (e.g., cyanides, phenols) found at other gas plant sites that used coal carbonization methods.

- The product consists primarily of coal tar residue. Other typical MGP by-products (purifier box waste, clinker waste, etc.) are not predominant. This is consistent with the MGP process discussed above;

- DNAPL is found in a confined aquifer below a clay unit (the Miller Creek formation) directly beneath the former MGP. This confined aquifer (the Copper Falls formation), does not have a hydraulic connection with the fill aquifer at Kreher Park;

- Groundwater discharges from the mouth of the former ravine onto Kreher Park; coal tar contamination is present in this groundwater, but at levels several orders of magnitude below what is measured either in upgradient wells south of St. Clair St., as well as downgradient wells at Kreher Park;

- The ravine was backfilled with uncontrolled fill (clay, cinders, brick) by 1909;

- The alleged 2" Tar Pipe, as labeled by Greeley and Hansen post-hoc, was investigated during the fall of 1998. The Greeley and Hanson drawings, as well as LSDP historical drawings, identified an underground pipe that began and ended on the LSDP property. No indication of it is shown on any drawings that depict conditions at Kreher Park. Additionally, the 1998 field investigation found an approximate 2" metal pipe along with two additional pipes that were known to transport propane below St. Claire St. following closure of the MGP. A section of this pipe was analyzed by a metallurgical firm, Crane Engineering and Forensic Science in Minneapolis, Minnesota. Crane concluded that the pipe was manufactured between 1920 and 1940 and likely carried water, steam or compressed air. There was no physical indication or residue of hydrocarbon to suggest the pipe historically carried hydrocarbons; (i.e. coal tars or coal tar emulsions). Appendix C includes the Crane firm's report.

Further information on the nature and extent of contaminants relating to the Kreher Park and sediments site, as well as the NSP site, are discussed in Section 3.0

2.3 Summary and Listing of Previous Studies and Reports

The following list describes work performed by SEH and others at the Kreher Park and Bay Sediments site:

- *Environmental Assessment Report - City of Ashland WWTP Site* (Northern Environmental Technologies, August, 1989);

- *Report of Test Pits at the Ashland WWTP* (NET, September 1991);
- *Remedial Investigation Interim Report - Ashland Lakefront Property* (SEH, July 1994);
- *Existing Conditions Report - Ashland Lakefront Property* (SEH, February, 1995);
- *Draft Remediation Action Options Feasibility Study - Ashland Lakefront Property* (SEH, February, 1996);
- *Sediment Investigation Report - Ashland Lakefront Property* (SEH, July, 1996);
- *Comprehensive Environmental Investigation Report - Ashland Lakefront Property* (SEH, May 1997);
- *Supplemental Investigation Report - Ashland Lakefront Property* (SEH, March, 1998):
- *Baseline Human Health Risk Assessment - Ashland Lakefront Property* (SEH, June 1998);
- *Ecological Risk Assessment - Ashland Lakefront Property Contaminated Sediments* (SEH, October 1998);
- *Remediation Action Options Feasibility Study - Ashland Lakefront Property and Contaminated Sediments* (SEH, December 1998)

Dames & Moore has developed documents that include review comments on selected SEH reports, as well as documentation for NSP on the historic MGP site. The following include a list of documents, excluding smaller correspondence, submitted to the WDNR :

- *Final Report - Ashland Lakefront/NSP Project* (D&M, March, 1995);
- *Site Investigation Report and Remedial Action Plan - Northern States Power* (D&M, August, 1995);
- *Design Report, Bidding Documents, Plans and Specifications for Interim Remedial Action - Northern States Power* (D&M, August, 1995);
- *SEH Draft Remediation Action Options Feasibility Study - Review Comments for Northern States Power Company* (D&M, May, 1996);
- *Supplemental Groundwater Investigation Final Report for Northern States Power Company* (D&M, August, 1996);
- *Copper Falls Aquifer Groundwater Investigation for NSP* (D&M, February, 1997);
- *Aquifer Performance Test and Groundwater Monitoring Results for Northern States Power* (D&M, October, 1997)
- *Aquifer Remedial Action Plan - Lower Copper Falls Formation er for NSP* (D&M, April, 1998)

2.4 Site Physiography

2.4.1 Surface Features

The Kreher Park area consists of a flat terrace adjacent to the Chequamegon Bay shoreline. The surface elevation of the park varies approximately 10 feet, from 601 feet mean sea level (MSL), to about 610 MSL at the base of the bluff overlooking the park. The bluff rises abruptly to an elevation of about 640 feet MSL, which corresponds to the approximate elevation of the NSP property. The lake elevation fluctuates about two feet, from 601 to 603 feet MSL.

2.4.2 Geology

The Ashland Lakefront and NSP property are underlain by fill soils of varying thickness, which in turn are underlain by fine-grained silts and clays of the Miller Creek Formation. At the lakeshore, the fill soils range from 0 to about 10 feet in thickness. The adjacent sediments beneath the lake were measured up to a thickness of about nine feet. The Miller Creek formation, which comprises the bluff located at the south end of Kreher Park, is the uppermost stratigraphic unit underlying the fill at Kreher Park and the sediments in Chequamegon Bay.

The Miller Creek varies in thickness from about six feet near the seep (north of the mouth of the former ravine), and thickens northward beneath the bay. The base of the Miller Creek at the lakeshore (Kreher Park) was measured at depths ranging from six feet up to 20 feet. SEH did not penetrate the depth of the Miller Creek during its sediment investigation. This unit is known to range up to 50 feet in thickness in the Ashland area. At the NSP property, the Miller Creek varied in thickness from approximately seven feet (at the mouth of the former ravine) to about 13 feet at St. Clair Street, where the ravine depth shallows. The ravine depth diminishes to the south; it is no longer present at the south end of the NSP property along U.S. Highway 2. However, the lithology of the Miller Creek becomes much less cohesive, and low plasticity silts and granular materials are found along this trace.

The Miller Creek Formation is underlain by granular, cohesionless materials comprising the Copper Falls Formation. The depth of the Copper Falls was not fully penetrated during any of the investigations performed by SEH or Dames & Moore. The maximum depth of the Copper Falls encountered in any of the investigation borings was approximately 135 feet south of St. Claire Street (MW-9A).

The Copper Falls is underlain by Precambrian sandstones of the Oronto Group. The thickness of this unit is unknown, but it is likely underlain by Precambrian basalt.

2.4.3 Hydrogeology

The fill materials overlying the Miller Creek Formation at Kreher Park and in the ravine contain a saturated water table condition. The low permeability fill soils in the ravine are in (10^{-6} to 10^{8} cm/sec) contrast to the wood waste/demolition waste materials at Kreher Park. The water table in the ravine is characterized by a fairly steep gradient that flows through the mouth of the former ravine onto Kreher Park. The water table in the fill at the park is characterized by high permeabilities (0.1 to 10^{-5} cm/sec), but with a very flat gradient, consistent with similar filled in lake bottom lands.

The seep has been investigated by SEH to determine its characteristics and possible source. It is a groundwater discharge point containing high levels of hydrocarbon and coal tar related contaminants. Because of its location near the mouth of the former ravine, it was initially believed to be a discharge for ravine groundwater intersecting a low permeability layer (i.e., the Miller Creek), causing it to discharge to the surface. However, SEH evaluated water levels in standpipes immediately adjacent to the seep and measured much lower head levels, indicating that the discharge is likely a buried subsurface pipe transmitting water from an unknown upgradient location through contaminated soils at the seep location.

The Miller Creek forms an aquitard along the lakeshore and bluff areas where the constituent soils are fine-grained, and have very low permeability conditions. The underlying Copper Falls aquifer is confined, yielding upward flowing head levels in piezometers installed in this area of the formation. Two continuous flowing artesian wells tap the formation, and are present near Kreher Park, one at the east side of the property along Prentice Avenue, and a second on the Ellis Avenue extension of the marina. Piezometers installed by Dames & Moore at both Kreher Park and the NSP property have yielded these upward gradients as well. Well yields in the Copper Falls vary from 10 to 100 gpm.

South of the NSP site at the head of the ravine, the Miller Creek Formation becomes cohesionless. Consequently, the confining conditions dissipate, and downward gradients in the Copper Falls Formation are measured.

3.0 NATURE AND EXTENT OF CONTAMINATION

3.1 Preliminary Site Scoping

3.1.1 Kreher Park

Kreher Park is characterized by varying levels of contamination in soils and groundwater, as is also the case with the bay sediments. This contamination consists primarily of volatile organic (VOC) and polynuclear aromatic (PAH) hydrocarbon compounds. Lower levels of metals are also found, likely resulting from characteristics of the fill material. SEH developed the range of remedial options evaluated in its FS based upon the extent of this contamination, the risk to both human health and the environment exposed to these contaminants, and the requirements to meet acceptable concentration levels of hazardous compounds within a reasonable duration following implementation of the remedy.

In general, as stated in the SEH report, "The extent of VOC and PAH impacted soils (at Kreher Park) approximates the area of shallow groundwater contamination depicted on Figure 3." (Figure 3 is an aerial view of the entire Lakefront and NSP properties.) SEH further states that "PAH soil contamination generally begins near the shallow groundwater surface, and extends to the top of the Miller Creek Formation." In addition, SEH identified emulsified NAPLs as well as an area of DNAPLs (near the seep) in wells at the park. SEH described that the park area was covered by a "1 to 2 foot layer of clean surficial soil (overlying) the contaminated fill which is comprised of soil mixed with slab wood and sawdust."

The HHRA developed for the Kreher Park area identified an unacceptable risk to populations exposed to (i) direct contamination at the seep; (ii) direct exposure to subsurface soil and groundwater under certain specific scenarios (e.g., utility workers exposed to contaminants in excavations). As described in the SEH FS, one to two feet of clean soil overlies contaminated material at the park. In addition, SEH indicates that the groundwater in the fill materials is not "commonly used as a water supply source." Because of these conditions, we have concluded that the remedial action at Kreher Park should (i) eliminate the direct contact risk from the exposure to contaminants at the seep; (ii) as well as the subsurface exposure pathway. This can be accomplished through a variety of targeted remedial methods ranging from "hot-spot" removal (at the seep), institutional controls, and active groundwater remediation.

3.1.2 Lake Sediments

The contaminated sediments generally yielded much higher levels of contaminants due to the presence of NAPLs in collected samples. SEH identified the highest concentrations of contaminants at the interface between the wood chip and underlying sand layer. Contamination levels generally decreased with depth, but the average thickness measured was about six feet across the area.

The SEH ERA established cleanup standards using a methodology to determine effects levels on individual benthic organisms. Alternatively, Dames & Moore developed effects levels using the data collected by SEH to determine effects levels to organism communities. Details on the method is addressed in the accompanying Ecological Risk Assessment prepared by D&M. Both the SEH and D&M methods are accepted and in use by USEPA. (The SEH method of evaluating individual organisms for toxicity, however, applies to threatened and endangered species. Since no such species are present in Chequamegon Bay, D&M's method is applicable.) Consequently, the evaluation of sediment remedial actions presents alternative remedies using both cleanup standard setting methods.

3.2 Kreher Park

3.2.1 Soils

The fill soils and materials at Kreher Park contain widespread VOC and PAH contamination. These contaminants are predominantly found below the saturated zone, and consist predominantly of VOC (BETX) and PAH compounds commonly found in coal tar and creosote. Metals contamination consisting of arsenic and lead was also found; however, metals contamination appeared to be most common along the north side of the park near the shoreline. TCLP tests were made on selected samples to determine if hazardous levels were present, but no TCLP exceedances were measured.

(One sample of soil collected from the fill in the former ravine on the NSP site yielded a TCLP exceedance for lead.)

3.2.2 Groundwater

The shallow groundwater at Kreher Park is contaminated with the same VOC and PAH contamination found in the site and fill materials. Exceedances of health standard compound limits as defined in ch. NR 140, WAC, are widespread. Additionally, lead, iron and manganese (the later two compounds are ch. NR 140, WAC, welfare standard compounds), were also measured. The occurrence of metals exceedances was not as widespread as the organic compound measurements. The most commonly measured VOC compounds included benzene, ethylbenzene and xylenes. The most commonly occurring PAH compound was naphthalene.

3.2.3 Non-aqueous Phase Liquids

SEH identified the highest levels of VOC and PAH contamination in groundwater to correspond to measurements of NAPL in several site wells. At the seep, DNAPL consisting of a dense, black oily hydrocarbon was measured in MW-7 at a thickness reported to be about five feet. At TW-9, a well located approximately 25 feet northwest of MW-7, about two feet of similar DNAPL was measured. No other DNAPL measurements have been made in other Kreher Park wells installed in the fill aquifer. (DNAPL measurements have been made in the ravine fill south of St. Clair St., as well as in deep piezometers in the Copper Falls.) SEH also reported emulsified NAPL clinging to sampling equipment in three other wells more distant from the seep area. However, no phase separation distinction was measured in these wells.

The DNAPL measured in these wells may correspond to a pool of product related to the former wood treatment area labeled as a "waste tar dump" on Greeley and Hansen 1951 WWTP drawings. This depicted area is in the same general location that several eyewitnesses identified a man-made aboveground structure used for Schroeder Lumber's wood treatment operations. Black tar deposits on soil samples excavated from test pits in this area may indicate the general location of wood treatment activities.

3.3 Lake Sediments

The contaminated lake sediments were identified by SEH to correspond to an area of approximately nine acres, encroaching north in the inlet in three distinct lobes. As previously described, the average depth of contamination was determined to be about six feet across this area. The contaminants consist of the same VOC and BETX compounds found in soils and groundwater at Kreher Park. However, the concentration levels of contaminants in the lake sediments are much higher than those found in samples collected at the park. These levels are for the most part much higher than the solubility limits for the subject compounds, indicating that pure product is present in the sediments over a wide area. This is consistent with SEH's observations made during the field sampling effort for the sediments.

These sediments, along with the seep area, the ravine area south of St. Clair St., and the Copper Falls Formation, comprise four impacted areas where discreet DNAPLs are found. The mechanism responsible for transporting these compounds to these locations is not readily understood. Based upon the separation between the DNAPL pools in the ravine, those at the seep, and in the sediments, it is likely indicate that they were transported to these respective locations by different, and perhaps non-naturally occurring means. The lithologic change in the Miller Creek aquitard south of St. Clair St. likely is responsible for the DNAPL in the Copper Falls, as it migrated from the upper ravine from releases at the MGP. However, the isolated area at Kreher Park (the seep) and the widespread sediment contamination cannot be easily linked. It is also unlikely, as described previously, that the alleged 2" pipe was responsible for any of these deposits.

3.4 Tar Quantities

Dames & Moore prepared an estimate of the total quantity of gas produced during the operating life time of the MGP, and then subsequently derived the total estimated quantity of tar generated from those gas production values. Details of these estimates are included in a December 4, 1998 letter, which is included in this report as Appendix C. That letter also includes a critique of the method SEH utilized to develop their residual tar quantities present in the environment, and tabulated in Appendix B of its December, 1998 FS. Although the critique was based on a draft estimate prepared by SEH prior to its final FS, the methodology used for its draft computations and the final computations presented in the FS did not change. Consequently, the conclusions presented in the December 4, 1998 letter apply.

4.0 REMEDIAL ACTION OBJECTIVES

4.1 Remedial Action Objectives

The remedial action objectives state the specific goals of the remedial actions which are presented in this report. The general goal of these objectives is to protect human health and environmental risks posed by the contaminants at the site.

- Minimize potential risk to human health and to aquatic and terrestrial animals and to the environment from exposure to contaminants.

- Limit future off site migration of contaminants.

- Limit, to the extent practicable, on site migration of contaminants.

- Minimize short term risk to human health and to aquatic and terrestrial animals and to the environment from exposure to contaminants during the implementation of the remedial action.

4.2 Cleanup Goals

Generic Residual Soil cleanup standards for BTEX compounds and for DRO are identified in Wisconsin Administrative Code NR 720. Case closure standards are provided in ch. NR 726, WAC. Specific PAH RCLs are suggested in (name reference). Groundwater standards are covered in WAC NR 140. A Risk Assessment has not been performed for soils or groundwater at this site for the purpose of calculating site specific clean up standards. Therefore, the abovementioned RCLs will be the soil cleanup standards, and the Enforcement Standards will be the groundwater enforcement standards.

Chemical Specific cleanup standards are not available for sediments. Therefore, a Risk Assessment was conducted to determine appropriate cleanup levels for the sediments. A Risk Assessment has been prepared by SEH, under its contract with the WDNR. In addition, Dames & Moore prepared a Risk Assessment. The SEH risk assessment identified a larger area of sediments requiring remediation than did the D&M risk assessment. The limits of sediments requiring remediation per the SEH risk assessment are indicated on Figure 3-1. The limits of sediments requiring remediation per the Dames & Moore risk assessment are indicated on Figure 3-2.

4.3 Remediation Action Boundaries

This report addresses the soils and groundwater associated with Kreher Park, which is bounded by a railroad track on the south side, by Ellis Avenue and the Ellis Avenue Marina to the west, by Prentice Avenue and the Kreher Park Boat Launch to the east and by Lake Superior to the north. The near-shore sediments addressed by this report begin at the Kreher Park shoreline and extend northerly into Lake Superior approximately 200 to 700 feet. The sediments are bounded to the west by a marina and to the east by a boat launch/dock.

4.4 Remediation Quantities

The SEH FS states that the contaminated park area covers approximately 10 acres, and that there is a 1 to 2 foot layer of clean fill overlying the contaminated fill. The depth of contamination ranges from 1 to 15 feet. The impacted fill is estimated at 150,000 cubic yards, and the volume of clean fill overlying the contaminated soils is estimated at 45,000 cubic yards.

The SEH Risk Assessment identifies an area of 410,000 square feet, or 9.4 acres, of sediments requiring remediation. The SEH FS states that a wood waste layer of 9-inch average thickness is present over the contaminated sediments, and that the sediments vary from 0 to 7 feet of thickness over the site. The volume of contaminated sediments is estimated at 152,000 cubic yards, including approximately 4000 cubic yards of wood waste.

The Dames & Moore Risk Assessment identifies an area of 224,100 square feet, or 5.14 acres, of sediments requiring remediation. Assuming a thickness of 7 feet of sediments and 9-inches of wood waste, the volume of contaminated sediments requiring remediation is estimated at 64,300 cubic yards, including 6,200 cubic yards of wood waste.

5.0 APPLICABLE REGULATIONS

Many regulations are potentially applicable or relevant and appropriate to the activities at the Kreher Park site. Typically, regulations can be roughly divided into those that are triggered by contaminants, and those that are triggered by location; however, the remedial action and other factors also result in the application of various regulations. In keeping with standard convention, the applicable or relevant and appropriate requirements (ARARs) summarized as those triggered by contaminants, and those triggered by location, are shown in Tables 5-1 and 5-2, respectively.

5.1 Requirements Triggered by Contaminants

The soil and groundwater at Kreher Park and sediments in Chequamegon Bay are known to have been impacted by VOCs and PAHs. Consequently, Table 5-1 lists ARARs that pertain to the remediation, storage, and disposal of these contaminants. Prior to remediation, full characterization of the contaminants will be completed, due in part to the potential for PCB impacts. Consequently, Table 5-1 also summarizes regulations pertaining to PCBs.

Several regulations have also been established to control the transport of the contaminants of concern. These have also been summarized in Table 5-1. Many of the regulations listed in Table 5-1 apply to the release of contaminants to the air. These regulations have been included due to the slight possibility that an ozone sparge system could result in the release of contaminants to the atmosphere, as could extensive excavation activities.

Table 5-1 also summarizes regulations pertaining to conducting site investigations and selection of remedial alternatives, and regulations and guidance for establishing cleanup objectives. These have been included in this table because they are generally driven by the contaminants of concern.

5.2 Requirements Triggered by Location

Table 5-2 summarizes ARARs that could be triggered by location, as well as other factors. Some ARARs listed in Table 5-2 are also dependent upon the contaminants present, and the concentrations at which they may be present in the waste streams. Because of the site's proximity to Chequamegon Bay, many of the location-specific ARARs pertain to impacts on surface waters. Additionally, because the remedial alternatives being considered for the sediments in Chequamegon Bay will require off-shore construction activities, several addition ARARs must be considered.

6.0 EVALUATION CRITERIA

Historic operations at Kreher Park have resulted in significant soil and groundwater contamination and that property and in the near-shore sediments. The following section screens potential remedial action options from a list of available remedial technologies. In accordance with NR 722.07(4), WAC, the remedial action options are then evaluated in accordance with the following six criteria, which are briefly described below:

6.1 Long Term Effectiveness

Long Term Effectiveness is the degree to which the toxicity, mobility, and volume of the contaminants are expected to be reduced. This criteria also considers the degree to which a remedial action option will protect public health, safety and welfare and the environment over time.

Long term impacts are considered for the site as well as for any wastes that are disposed of off site.

6.2 Short Term Effectiveness

The short term effectiveness of a remedial action option takes into account any adverse impact on public health, safety and welfare and the environment that may be posed during the construction and implementation period until case closure. This may include noise, odor, and traffic impacts created by removal or treatment of contaminants or installation of remedial systems.

6.3 Implementability

This criteria measures how well a remedial action is expected to be implemented. This factor assesses all of the following: a) the technical feasibility of construction and implementing the remedial action option at the site or facility; b) the availability of materials, equipment, technologies and services needed to conduct the remedial action option; c) the potential difficulties and constraints associated with on-site construction or off-site disposal and treatment; d) the difficulties associated with monitoring the effectiveness of the remedial action; e) the administrative feasibility of the remedial action option, including activities and time needed to obtain any necessary licenses, permits, or approvals; f) the presence of any federal or state threatened or endangered species; g) the technical feasibility of recycling, treatment, engineering controls or disposal; and h) the technical feasibility of naturally occurring biodegradation at the site or facility, if responsible parties evaluate this option.

6.4 Restoration Time Frame

This criteria considers the expected time frame needed to achieve the necessary restoration, taking into account all of the following qualitative criteria: a) proximity of contamination to receptors; b) presence of sensitive receptors; c) presence of threatened or endangered species or habitats, as defined by state and federal law; d) current and potential use of the aquifer, including proximity to private and public water supplies, e) magnitude, mobility and toxicity of the contamination; f) geologic and hydrogeologic conditions, g) effectiveness, reliability and enforceability of institutional controls, and h) naturally occurring biodegradation processes at the site or facility which are expected to reduce the total mass of contamination in an effective and timely manner and which have been demonstrated to be occurring at the site or facility, to the satisfaction of the department in the site investigation report.

6.5 Economic Feasibility

This criteria compares the cost of a remedial action to others which are being considered. Costs to be included are: a) capital costs, including direct and non-direct costs, b) initial costs, including design and testing costs, c) annual operation and maintenance costs, d) total present worth costs (a 30-year operation, maintenance, monitoring, and long term care period with a 7 percent discount rate, the latest USEPA procedure, as well as a 40-year, 5 percent discount rate, as used by SEH in its FS, is being assumed for all options).

6.6 Potential Future Liability

This criteria is a qualitative assessment of the risk that a future high cost liability would be incurred under an alternative.

7.0 IDENTIFICATION AND SCREENING OF POTENTIAL REMEDIAL TECHNOLOGIES

Table 7-1 identifies and screens potential remedial technologies which were considered for Kreher Park.

The technologies fall into the following general categories:

- **Institutional Controls** include means to prevent exposure to contaminants and to the site, including fencing, deed restrictions, and groundwater use restrictions.
- **Engineering Controls - Kreher Park** include physical means to prevent exposure to or leaching or migration of contaminants through soil and groundwater.
- **Engineering Controls - Sediments** include physical means to prevent exposure to sediments, or leaching or migration of contaminated sediments.
- **In situ treatment of soils** include means to reduce the toxicity, mobility, and volume of contaminants without excavation.
- **Excavation of soils** include removal of contaminated soils for off site disposal, or for ex situ treatment and replacement.
- **Transportation of excavated soils** include means to transport excavated soils to a disposal or treatment facility.
- **Ex situ soils treatments** include means to reduce the toxicity, mobility, and volume of contaminants in excavated soils.
- **Off site disposal of soils** include disposal of contaminated soils at an off site locating.
- **Off site Co-treatment of soils** include means to dispose of contaminated soils by burning them with other materials in an existing facility.
- **Excavation/Dredging of Sediments** include means to remove subsurface sediments.
- **Dewatering of Sediments** include means to remove water from dredged sediments such that the sediments can be disposed of or otherwise treated ex situ.
- **Groundwater pump and treat options** include means to remove contaminated groundwater, treat ex situ, and dispose of treated water.

- **In Situ Groundwater treatment options** include means to reduce the toxicity, mobility, or volume of contaminants in groundwater by in situ treatment.
- **Vapor control and treatment** includes means to capture and treat gasses and/or odors produced during remedial activities.

Based on this table, five remedial action alternatives were identified. Two of the options were evaluated based on both Ecological Risk Assessment values. Because the area of sediments requiring remediation is different for the SEH and for the Dames & Moore Risk Assessments, the costs differ significantly.

It should be noted that this FS does not intend to include all remedial options that could be considered. It is the intent of this FS to be much more focused on those options that have the highest likelihood of acceptance by all stakeholders. For example, SEH's FS identifies several other potential options, which are more complex, more expansive, redundant and consequently more costly. The alternatives identified in this more focused FS report represent options which will produce acceptable, environmentally responsive results at significantly lower costs than many of the SEH options. Dames & Moore does not believe the far more costly and elaborate options outlined by SEH are warranted at this site, nor supported by the data.

8.0 REMEDIAL ACTION OPTIONS

8.1 Option A - No Further Action

8.1.1 Description

This option involves doing nothing further to monitor or address contaminated soils, groundwater and sediments on Kreher Park and in the Bay.

8.1.2 Long Term Effectiveness

The long term effectiveness of this option will be low, because the toxicity, mobility, and volume of the contaminants will not be reduced (beyond any passive biodegradation which may be occurring). This remedial action option will not protect public health, safety and welfare and the environment over time. The most serious human health exposure risk is at the seep, which would not be addressed beyond the existing fencing which limits access to the area. The benthic community will continue to be exposed to unacceptable levels of contaminants portions of the contaminated sediments.

8.1.3 Short Term Effectiveness

The short term effectiveness of this remedial action option will be high. There will be no additional short term adverse impacts on public health, safety and welfare and the environment because nothing further will be done.

8.1.4 Implementability

The implementability of this option is medium, because although it is easily implemented, it is unlikely to be acceptable to NSP, the WDNR or the public.

8.1.5 Restoration Time Frame

Although natural biodegradation of the contaminants in the soils and groundwater may be occurring, it is not anticipated that restoration of the soils or groundwater will occur under this remedial action alternative. Therefore, the restoration time frame is long.

8.1.6 Costs

The costs for this option are zero, because no further action would take place.

8.1.7 Potential Future Liability

The potential for future liability of a No Further Action alternative is high (low rating - see Section 9 .0 and Table 9-1). The potential liability is expected in connection with potential human exposure to contaminants at the seep, and with potential benthic community exposure to contaminants in sediments. The potential liability in connection with contaminants in the Kreher Park soils and groundwater are also expected to be high. Although there are no direct exposure pathways to these contaminants, future subsurface development under a No Action alternative will be at risk of direct exposure.

8.2 Option B1 - Institutional Controls/Source Removal at Seep/Institutional Controls on Groundwater/Cap Sediments/SEH ERA Risk Assessment Limits

8.2.1 Description

This option is shown on Figure 8-1 and 8-1A and includes the following:

Institutional controls on soils

Existing institutional controls include the construction of a fence around the seep area to prevent access to contaminated water coming out of the seep, and signage of the bay to prevent boats from entering and disturbing the area. Rerouting of existing utilities is not proposed. Instead, new institutional controls would include posted warnings, and deed notices and restrictions and legal restrictions to require the use of safety controls when and if subsurface work is carried out.

Source Removal at Seep

The DNAPL identified in wells in the vicinity of the seep and contaminated soils in contact with the DNAPL will be removed via excavation and mechanical removal. The source of the seep will be investigated at the time of removal and properly contained (via pipe) to eliminate future discharge of contaminated water. It has been speculated that a buried pipe exists which allows contaminated groundwater from an area of higher hydraulic pressure to discharge to the surface at this location. In addition, a DNAPL pool has been measured at the adjacent MW-7 well, indicating a likely source of contaminants measured at the seep. It is anticipated that this source could be remediated by excavating the area, removing DNAPL in the excavation, exposing the pipe (if encountered), replacing the source of the seep and directing it to a discharge point to either the environment (if clean) or a treatment system (if contaminated). The excavated soils would be disposed at an approved landfill. The groundwater and DNAPL removed in conjunction with the construction work would be either treated on site and discharged to the City of Ashland Sanitary Sewer, or conveyed to another treatment facility. Removal of the seep would eliminate the only direct human exposure pathway to Kreher Park contaminated soils or groundwater.

Institutional Controls on Groundwater

Groundwater use restrictions will be placed on the Kreher Park property to prohibit potable groundwater wells from being installed on the property. The existing artesian wells (both) will be properly abandoned.

Cap Sediments

The contaminated sediments will be capped in place to prohibit benthic and fish populations from contacting the sediments. The limits of the cap under this option will extend to approximately 25 feet beyond the limits of the contaminated sediments identified in the SEH Risk Assessment.

The sediment cap design is proposed to consist of a one-foot thick grading layer over the sediments, a geotextile fabric layer, a one-foot thick layer of gravel, and 18-inches of riprap. The total proposed cap thickness is 3-1/2 feet. The actual cap design would be determined during the design phase. The design would consider the effects of wave action, the depth of the water, constructability, and availability of materials. Depending upon the design analyses, a thinner or thicker cap may be proposed. A variable thickness cap could also be proposed, which would be thicker near the shoreline and thinner in the deeper sections where the water forces are less.

A heavy duty geotextile fabric is recommended in favor of a geomembrane for several reasons. First, an underwater geomembrane would be very difficult to construct. The primary purpose of the sediment cap is to isolate the contaminated sediments from the fish and benthic populations. A cap utilizing a thick (3-1/2 foot) soil cap will effectively provide this isolation. Final design of the cap thickness would account for wave action. A geomembrane would prevent movement of water between the lake and the underlying sediments. This may produce an uplift pressure on the geomembrane, which could limit its effectiveness. The contaminants in the sediments are not very mobile, therefore, migration of contaminants through the geotextile should not be a concern.

The final design of the cap will also consider the benthic population. If a benthic population is desired, the cap may include thicker fine grained soils (i.e. sand) than gravels. However, if supporting a benthic population is not a concern, then the gravel and/or rip rap layers may be thicker.

It is recommended that a test section of the cap be built prior to final bidding of the project. This will help determine the most cost effective construction methods for the cap, and thus will likely lower the total cost of the cap.

Operation, maintenance and monitoring costs include annual underwater inspection of cap integrity, a survey of cap elevations to check for movement of cap materials, and annual costs to repair damage to the cap. In addition, the OM&M costs for all options include groundwater sampling on a semi annual basis at seven wells, and analyzing for VOCs, SVOCs, and metals.

8.2.2 Long Term Effectiveness

The Long Term Effectiveness of this option is considered medium. This option will not reduce the toxicity or volume of the contaminants, but it will reduce the mobility of the contaminants. The cap will be designed to prevent benthic and human populations from contacting the contaminated sediments.

8.2.3 Short Term Effectiveness

The Short Term Effectiveness of this option is considered high. Removal of the source at the seep will have an immediate positive impact on public health, safety and welfare by eliminating a direct contaminant exposure pathway. Cap installation activities will eliminate the existing exposure risk to the benthic community. Negative impacts include traffic impacts while imported fill is being brought to the site. A silt curtain will be installed to confine fine particles released from the placement of soil cap materials to the area of the cap installation.

8.2.4 Implementability

The implementability of this option is considered high. The proposed measures are not technically complex. Seep remedial/containment methods are somewhat of an unknown, since the source of the seep has not been confirmed; however, it should not create difficulty when evaluated during remediation. Additionally, there is some concern that the cap in shallower areas of the bay will be subject to damage by freezing.

8.2.5 Restoration Time Frame

It is not anticipated that the site will be restored within 100 years. However, the mobility of the contaminants in the sediments will be reduced by the sediment cap. Therefore, the restoration time frame is long.

8.2.6 Costs

The estimated initial capital costs for this option are $6,222,000. A detailed cost breakdown is presented in Appendix B.

The capping and fill options presented in this report have been prepared using the same unit costs as the SEH FS has for sand, gravel, rip rap materials. The geomembrane unit cost presented by SEH is $4.00 per square foot. This report estimates geotextile installation costs at $3.00 per square foot.

The annual operations, maintenance, and monitoring costs for this option are estimated at $44,000.

Capitalized total costs were calculated over a 30 year period, assuming a 7% discount rate, and are estimated at $6,762,000. Capitalized total costs were also calculated over a 40 year period, assuming a 5% discount rate (the same assumptions as SEH made), and are estimated at $6,969,000.

Annualized total costs were calculated at $545,000 for the 30 year, 7% discount rate, and at $406,000 for the 40 year, 5% discount rate.

8.2.7 Potential Future Liability

This option is considered to have medium potential future liability. The contaminants will not be reduced in volume or toxicity, but the mobility and exposure of contaminants will be greatly reduced. The potential liability expected in connection with potential human exposure to contaminants at the seep will be removed, as well as the potential benthic community exposure to contaminants in sediments. Institutional controls will effectively eliminate the utility worker exposure scenario. The potential future liability in connection with contaminants in the Kreher Park soils and groundwater are expected to be low; there are no direct exposure pathways to these contaminants, and removal of a contaminant source at the seep (DNAPL and associated soils) will allow natural restoration (albeit over a long time-frame) of the remainder of the Kreher Park soils.

8.3 Option B2 - Continue Institutional Controls/Source Removal at Seep/Institutional Controls on Groundwater/Cap Sediments/Dames & Moore Risk Assessment Limits

8.3.1 Description

This option is the same as Option B2, except that the limits of the cap will extend to 25 feet beyond the limits of the contaminated sediments identified in the Dames & Moore Risk Assessment. This option is shown on Figure 8-2 and 8-2A.

8.3.2 Long Term Effectiveness

The Long Term Effectiveness of this option is considered medium. This option will not reduce the toxicity or volume of the contaminants, but it will reduce the mobility of the contaminants. The cap will be designed to prevent benthic and human populations from contacting the contaminated sediments.

8.3.3 Short Term Effectiveness

The Short Term Effectiveness of this option is considered high. Removal of the source at the seep will have an immediate positive impact on public health, safety and welfare by eliminating a direct contaminant exposure pathway. Cap installation activities will eliminate the existing exposure risk to the benthic community. Negative impacts include traffic impacts while imported fill is being brought to the site. A silt curtain will be installed to confine fine particles released from the placement of soil cap materials to the area of the cap installation.

8.3.4 Implementability

The implementability of this option is considered high. The proposed measures are not technically complex. Seep remedial/containment methods are somewhat of an unknown, since the source of the seep has not been confirmed; however, it should not create difficulty when evaluated during remediation. Additionally, there is some concern that the cap in shallower areas of the bay will be subject to damage by freezing.

8.3.5 Restoration Time Frame

It is not anticipated that the site will be restored within 100 years. However, the mobility of the contaminants in the sediments will be reduced by the sediment cap. Therefore, the restoration time frame is long.

8.3.6 Costs

The estimated initial capital costs for this option are $3,946,000. A detailed cost breakdown is presented in Appendix B.

The annual operations, maintenance, and monitoring costs for this option are estimated at $44,000.

Capitalized total costs were calculated over a 30 year period, assuming a 7% discount rate, and are estimated at $4,486,000. Capitalized total costs were also calculated over a 40 year period, assuming a 5% discount rate (the same assumptions as SEH made), and are estimated at $4,693,000.

Annualized total costs were calculated at $362,000 for the 30 year, 7% discount rate, and at $274,000 for the 40 year, 5% discount rate.

8.3.7 Potential Future Liability

This option is considered to have medium potential future liability. The contaminants will not be reduced in volume or toxicity, but the mobility and exposure of contaminants will be greatly reduced. The potential liability expected in connection with potential human exposure to contaminants at the seep will be removed, as well as the potential benthic community exposure to contaminants in sediments. Institutional controls will effectively eliminate the utility worker exposure scenario. The potential future liability in connection with contaminants in the Kreher Park soils and groundwater are expected to be low; there are no direct exposure pathways to these contaminants, and removal of a contaminant source at the seep (DNAPL and associated soils) will allow natural restoration (albeit over a long time-frame) of the remainder of the Kreher Park soils.

8.4 Option C1 - Institutional Controls/Source Removal at Seep/Cap Sediments/Ozone Sparge at Kreher Park/ SEH ERA Limits

8.4.1 Description

This option is shown on Figure 8-3 and 8-3A and includes the following:

Institutional Controls/Source Removal at Seep

These conditions of Option C1 are the same as Options B1 and B2.

Cap Sediments

This condition of Option C1 is the same as Options B1 and B2.

Ozone Sparging to Address Kreher Park Groundwater

Due to its strong oxidation power, ozone has been widely used in the wastewater treatment process for disinfection. Recently, ozone has been used to treat hazardous wastes by direction ozonation (or oxidation). It can preferentially oxidize unsaturated organic compounds such as BTEX and PAHs. Ozone is generated by a corona discharge process using a dry air or pure oxygen. Pure oxygen can be generated by passing the dry air through molecular sieve. Ozone concentration produced from dry air is about 3 to 5%. Ozone concentration produced from pure oxygen is about 10 to 15%. Recently, ozone has been used as an in situ remediation process by means of ozone/air sparging. By introducing ozone into the impacted aquifer via ozone sparging, ozone can attack the dissolved organics such as BTEX and PAHs directly and oxidize them. After the reaction, ozone will convert to oxygen, which will increase the dissolved oxygen (DO) levels. The increase in DO will promote natural biodegradation of residual BTEX and PAHs in the aquifer.

An ozone sparging system will be installed to remediate dissolved phase contaminated groundwater beneath Kreher Park. It is proposed that two horizontal sparging wells will be installed parallel to the flow of groundwater. The depth of the wells would be determined by a pilot test, but would be approximately 10-12 feet below the water table elevation, which is 3-5 feet below the ground surface of Kreher Park. A groundwater remediation building, consisting mainly of an ozone generation unit, will be installed on site.

Soil Vapor Extraction of the vadose zone will be completed in conjunction with the sparging, to remove vapors from the vadose zone. Three horizontal wells are proposed, at a 40-foot spacing. In addition, the ground surface will be paved with an asphalt cover to a width of 80 feet. This will limit short circuiting of atmospheric air into the SVE system. Depending upon the uses of the area, different cap types could be used, such as a geomembrane/soil cap, a clay cap, or a geocomposite cap using a bentonite layer to provide a low permeability layer.

8.4.2 Long Term Effectiveness

The Long Term Effectiveness of this option is considered high. This option will not reduce the toxicity or volume of the soil or sediment contaminants, but it will reduce the mobility of the soil and sediment contaminants. This option will reduce the toxicity and volume of the dissolved groundwater contaminants. Removal of the source at the seep will reduce the mobility of the highly contaminated groundwater found at the seep.

8.4.3 Short Term Effectiveness

The Short Term Effectiveness of this option is considered medium. Removal of the seep will create some additional short term impacts which will be offset by the immediate positive impact on public health, safety and welfare by eliminating a direct contaminant exposure pathway. Cap installation activities will create traffic impacts while imported fill is being brought to the site.

8.4.4 Implementability

The implementability of this option is considered high. The proposed measures are not technically complex. Seep remedial/containment methods are somewhat of an unknown, since the source of the seep has not been confirmed; however, it should not create difficulty when evaluated during remediation. Additionally, there is some concern that the cap in shallower areas of the bay will be subject to damage by freezing.

8.4.5 Restoration Time Frame

It is not anticipated that the site will be restored within 100 years. However, the mobility of the contaminants in the sediments will be reduced by the sediment cap. Additionally, the contaminants in groundwater are reduced through active remediation. Although the restoration time frame will be long, it is an improvement over the B options.

8.4.6 Costs

The estimated initial capital costs for this option are $7,217,000. A detailed cost breakdown is presented in Appendix B.

The annual operations, maintenance, and monitoring costs for this option are estimated at $116,000.

Capitalized total costs were calculated over a 30 year period, assuming a 7% discount rate, and are estimated at $8,657,000. Capitalized total costs were also calculated over a 40 year period, assuming a 5% discount rate (the same assumptions as SEH made), and are estimated at $9,207,000.

Annualized total costs were calculated at $698,000 for the 30 year, 7% discount rate, and at $537,000 for the 40 year, 5% discount rate.

8.4.7 Potential Future Liability

This option is considered to have low potential future liability. The contaminants in the soils and sediments will not be reduced in volume or toxicity, but the mobility of contaminants will be greatly reduced. The contaminants in groundwater will be reduced in volume and toxicity, eliminating the potential exposure risk for future subsurface development.

8.5 Option C2 - Institutional Controls/Source Removal at Seep/Cap Sediments/Ozone Sparging to address Kreher Park Groundwater/ Dames & Moore Risk Assessment Limits

8.5.1 Description

This option is the same as Option C1, except the limits are based on the Dames & Moore Risk Assessment. The option is shown on Figure 8-4 and 8-4A and includes the following:

Institutional Controls/Source Removal at Seep/Institutional Controls on Groundwater

These conditions of Option C2 are the same as Options B1 and B2.

Cap Sediments

This condition of Option C2 is the same as Options B1 and B2.

Ozone Sparging to Address Kreher Park Groundwater

This is the same as for Option C1.

8.5.2 Long Term Effectiveness

This is the same as for Option C1.

8.5.3 Short Term Effectiveness

This is the same as for Option C1.

8.5.4 Implementability

This is the same as for Option C1.

8.5.5 Restoration Time Frame

This is the same as for Option C1.

8.5.6 Costs

The estimated initial capital costs for this option are $4,942,000. A detailed cost breakdown is presented in Appendix B.

The annual operations, maintenance, and monitoring costs for this option are estimated at $116,000.

Capitalized total costs were calculated over a 30 year period, assuming a 7% discount rate, and are estimated at $6,381,000. Capitalized total costs were also calculated over a 40 year period, assuming a 5% discount rate (the same assumptions as SEH made), and are estimated at $6,932,000.

Annualized total costs were calculated at $514,000 for the 30 year, 7% discount rate, and at $404,000 for the 40 year, 5% discount rate.

8.5.7 Potential Future Liability

This is the same as for Option C1.

8.6 Option D1 - Institutional Controls/Source Removal at Seep/Institutional Controls on Groundwater/Partial Filling of Bay/Cap Remaining Sediments/SEH ERA Limits

8.6.1 Description

This option is shown on Figure 8-5 and 8-5A and includes the following:

Institutional Controls/Source Removal at Seep/Institutional Controls on Groundwater

These conditions of Option D1 are the same as Options B1 and B2.

Partial Filling of Bay/Cap Remaining Sediments

A portion of the contaminated sediments will be covered with imported fill until the area of the lake is filled above the water level. This will isolate the contaminants and also serve to create usable land area. A breakwater will first be constructed of soil and heavy rip rap, and will serve to isolate the filling activities from the rest of the bay waters. A heavy geotextile fabric will be installed above the contaminated sediments. The geotextile will be backfilled with clean imported fill. As water is displaced during the filling operations, it will be filtered to remove any sediments and pumped into Lake Superior. The geotextile will serve two purposes; first, to keep the sediments from pumping up through the clean imported fill, and to provide a firmer base on which to place the fill.

The sediments which remain outside of the new shoreline limits will be capped in place as described for Option B1 in Section 8.2.1.

The depth of the lake at the new shoreline will be a minimum of 8 feet. This will allow for 4-1/2 feet of ice to form before the top of the cap is affected by frozen water.

8.6.2 Long Term Effectiveness

The Long Term Effectiveness of this option is considered high. This option will not reduce the toxicity or volume of the soil or sediment contaminants, but it will reduce the mobility of the soil and sediment contaminants. Removal of the source at the seep will reduce the mobility of the highly contaminated groundwater found at the seep. Elimination of the groundwater source will ultimately result in reduced groundwater contaminant levels.

8.6.3 Short Term Effectiveness

The Short Term Effectiveness of this option is considered medium. Removal of the source at the seep will create some additional short term impacts which will be offset by the immediate positive impact on public health, safety and welfare by eliminating a direct contaminant exposure pathway. Bay filling and cap installation activities will create traffic impacts while imported fill is being brought to the site.

8.6.4 Implementability

The implementability of this option is considered high. The proposed measures are not technically complex. Seep remedial/containment methods are somewhat of an unknown, since the source of the seep has not been confirmed; however, it should not create difficulty when evaluated during remediation.

8.6.5 Restoration Time Frame

It is not anticipated that the site will be restored within 100 years. However, the mobility of the contaminants in the sediments will be reduced by the sediment cap. Therefore, the restoration time frame is long and considered similar to the B options.

8.6.6 Costs

The estimated initial capital costs for this option are $12,106,000. A detailed cost breakdown is presented in Appendix B.

The annual operations, maintenance, and monitoring costs for this option are estimated at $44,000.

Capitalized total costs were calculated over a 30 year period, assuming a 7% discount rate, and are estimated at $12,646,000. Capitalized total costs were also calculated over a 40 year period, assuming a 5% discount rate (the same assumptions as SEH made), and are estimated at $12,853,000.

Annualized total costs were calculated at $1,020,000 for the 30 year, 7% discount rate, and at $749,000 for the 40 year, 5% discount rate.

8.6.7 Potential Future Liability

This option is considered to have medium potential future liability. The contaminants will not be reduced in volume or toxicity, but the mobility and exposure of contaminants will be greatly reduced. The potential liability expected in connection with potential human exposure to contaminants at the seep will be removed, as well as the potential benthic community exposure to contaminants in sediments. Institutional controls will effectively eliminate the utility worker exposure scenario. The potential future liability in connection with contaminants in the Kreher Park soils and groundwater are expected to be low; there are no direct exposure pathways to these contaminants, and removal of a contaminant source at the seep (DNAPL and associated soils) will allow natural restoration (albeit over a long time-frame) of the remainder of the Kreher Park soils.

8.7 Option D2 - Institutional Controls/Source Removal at Seep/Institutional Controls on Groundwater/Partial Filling of Bay/Cap Remaining Sediments -Dames & Moore ERA Limits

8.7.1 Description

This option is the same as Option D1, except the limits are based on the Dames & Moore Risk Assessment. The option is shown on Figure 8-5 and 8-5A and includes the following:

Institutional Controls/Source Removal at Seep/Institutional Controls on Groundwater

These conditions of Option D2 are the same as Options B1 and B2.

Partial Filling of Bay/Cap Remaining Sediments

This is the same as for Option D1, except that the limits of the fill are based upon the Dames & Moore Ecological Risk Assessment. The area of the fill is approximately the same as for the SEH limits; however, the area of the sediment cap is about half of the limits for the SEH option.

8.7.2 Long Term Effectiveness

This is the same as for Option D1.

8.7.3 Short Term Effectiveness

This is the same as for Option D1.

8.7.4 Implementability

This is the same as for Option D1.

8.7.5 Restoration Time Frame

This is the same as for Option D1.

8.7.6 Costs

The estimated initial capital costs for this option are $11,406,000. A detailed cost breakdown is presented in Appendix B.

The annual operations, maintenance, and monitoring costs for this option are estimated at $44,000.

Capitalized total costs were calculated over a 30 year period, assuming a 7% discount rate, and are estimated at $11,946,000. Capitalized total costs were also calculated over a 40 year period, assuming a 5% discount rate (the same assumptions as SEH made), and are estimated at $12,153,000.

Annualized total costs were calculated at $963,000 for the 30 year, 7% discount rate, and at $708,000 for the 40 year, 5% discount rate.

8.7.7 Potential Future Liability

This option has the same potential future liability conditions as described for Option D1.

8.8 Option E1 - Institutional Controls/Source Removal at Seep/Partial Filling of Bay/Cap Sediments/Ozone Sparge at Kreher Park - SEH ERA Limits

8.8.1 Description

This option is shown on Figure 8-7 and 8-7A and includes the following:

Institutional Controls/Source Removal at Seep

These conditions of Option E1 are the same as Options B1 and B2.

Partial Filling of Bay/Cap Remaining Sediments

These conditions of Option E1 are the same as Options D1 and D2.

8.8.2 Long Term Effectiveness

The Long Term Effectiveness of this option is considered high. This option will not reduce the toxicity or volume of the soil or sediment contaminants, but it will reduce the mobility of the soil and sediment contaminants. This option will also reduce the toxicity and volume of the dissolved groundwater contaminants. Removal of the source at the seep will reduce the mobility of the highly contaminated groundwater found at the seep.

8.8.3 Short Term Effectiveness

The Short Term Effectiveness of this option is considered medium. Removal of the source at the seep will create some additional short term impacts which will be offset by the immediate positive impact on public health, safety and welfare by eliminating a direct contaminant exposure pathway. Filling of the bay and cap installation activities will create traffic impacts while imported fill is being brought to the site.

8.8.4 Implementability

The implementability of this option is considered high. The proposed measures are not technically complex. Seep remedial/containment methods are somewhat of an unknown, since the source of the seep has not been confirmed; however, it should not create difficulty when evaluated during remediation.

8.8.5 Restoration Time Frame

It is not anticipated that the site will be restored within 100 years. However, the mobility of the contaminants in the sediments will be reduced by the sediment cap. Source removal at the seep eliminates a future contaminant source for groundwater. Additionally, the active remediation of groundwater will reduce the volume and toxicity of dissolved groundwater contaminants. The restoration time-frame is long, but provides a time-frame similar to the C options.

8.8.6 Costs

The estimated initial capital costs for this option are \$13,531,000. A detailed cost breakdown is presented in Appendix B.

The annual operations, maintenance, and monitoring costs for this option are estimated at \$116,000.

Capitalized total costs were calculated over a 30 year period, assuming a 7% discount rate, and are estimated at \$14,971,000. Capitalized total costs were also calculated over a 40 year period, assuming a 5% discount rate (the same assumptions as SEH made), and are estimated at \$15,521,000.

Annualized total costs were calculated at \$1,206,000 for the 30 year, 7% discount rate, and at \$905,000 for the 40 year, 5% discount rate.

8.8.7 Potential Future Liability

This option is considered to have low potential future liability. The contaminants in the soils and sediments will not be reduced in volume or toxicity, but the mobility of contaminants will be greatly reduced. The contaminants in groundwater will be reduced in volume and toxicity, eliminating the potential exposure risk for future subsurface development.

8.9 Option E2 - Institutional Controls/Source Removal at Seep/Partial Filling of Bay/Cap Sediments/Ozone Sparging to address Kreher Park groundwater/SEH Risk Assessment Limits

8.9.1 Description

This option is the same as Option E1, except the limits are based on the Dames & Moore Risk Assessment. The option is shown on Figure 8-8 and 8-8A and includes the following:

Institutional Controls/Source Control at Seep

These conditions of Option E2 are the same as Options B1 and B2.

Partial Filling of Bay/Cap Remaining Sediments

These conditions of Option E2 are the same as Options C1 and C2.

8.9.2 Long Term Effectiveness

This is the same as for Option E1.

8.9.3 Short Term Effectiveness

This is the same as for Option E1.

8.9.4 Implementability

This is the same as for Option E1.

8.9.5 Restoration Time Frame

This is the same as for Option E1.

8.9.6 Costs

The estimated initial capital costs for this option are $12,808,000. A detailed cost breakdown is presented in Appendix B.

The annual operations, maintenance, and monitoring costs for this option are estimated at $116,000.

Capitalized total costs were calculated over a 30 year period, assuming a 7% discount rate, and are estimated at $14,248,000. Capitalized total costs were also calculated over a 40 year period, assuming a 5% discount rate (the same assumptions as SEH made), and are estimated at $14,799,000.

Annualized total costs were calculated at $1,148,000 for the 30 year, 7% discount rate, and at $862,000 for the 40 year, 5% discount rate.

8.9.7 Potential Future Liability

The same potential future liability conditions as those described for Option E1 apply.

9.0 COMPARISON OF REMEDIAL ACTION OPTIONS

Table 9-1 summarizes the alternatives which were considered for the Ashland Lakefront property. Each alternative is given a numerical score as high (1), medium (2) or low (3), representing the best to worst possible condition, based upon the evaluation criteria. These three ratings are chosen because the ranking system is subjective and qualitative. Further delineation, such as a 1 to 10 rating system, is not supportable.

9.1 Long Term Effectiveness

The long term effectiveness of the options range from low to high. Option A, No Further Action, has a low long term effectiveness. The B options are assigned a medium category since the integrity of the cap may be compromised in the long term due to normal seasonal (ice movement and storm) events. The remainder of the options are assigned a high long term effectiveness. Although the C options provide a sediment cap no different from the B options, the long term cap integrity issue is offset by the gain in the improvement of groundwater quality from active groundwater remediation at Kreher Park. Similarly, the D and E options are also assigned a high rating since partial filling of the bay will prevent any potential future compromises of the cap.

9.2 Short Term Effectiveness

The short term effectiveness of options A and B are considered high since they represent the minimum impact during construction. The C, D and E options are considered medium since substantial activity during construction will cause disruption at the Lakefront.

9.3 Implementability

The implementability score for option A is medium because, as previously explained, it will not be acceptable to all parties. The other options are all considered easily implementable because the applied technologies are well known and understood.

9.4 Restoration Time Frame

Restoration time-frames for the A, B, and D options are considered low since no active groundwater process (except for source removal) is proposed. The C and E options are considered medium because they include active groundwater remediation.

9.5 Costs

The costs for Option A is given the highest rating ($0); costs for the B and the C options are considered medium since the spread of costs from the lowest to highest cost is about 50 percent of the most expensive option, C1 (about $9,000,000). The costs for the D and C options are all considered high, because of the material requirements to partially fill the bay.

9.6 Potential Future Liability

The potential future liability for Option A is considered high (low rating). The B and D options are rated medium. The C and E options are considered to have low potential future liability (high rating).

9.7 Recommended Alternative

The scoring matrix indicates that the C options yield the most favorable score. However, the only difference between the score assigned to the C options is due to cost. NSP has therefore elected to recommend the next favorable rating, the E options, for implementation. NSP believes that in conjunction with a remedial strategy that includes capping and groundwater monitoring for the ravine fill (operable unit 1) at the NSP site, the most favorable remedial activities that are protective of human health and the environment, and are cost-effective, will yield the best results. Accordingly, Dames & Moore recommends Option E2.

10.0 REFERENCES AND RESOURCES

A description of references for this report is listed in Section 2.3

TABLE 5-1
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS TRIGGERED BY CONTAMINANTS OR REMEDIAL ALTERNATIVE KREHER PARK/CHEQUAMEGON BAY REMEDIAL ALTERNATIVES

REGULATION	DESCRIPTION	COMMENTS
Water Quality Criteria (WQC) (40 CFR Part 131, Quality Criteria for Water, 1976, 1980, 1986)	Sets criteria for water quality based on toxicity to aquatic organisms and human health.	WQCs are relevant and appropriate if groundwater is discharged to surface water. MCLs take precedence unless WQCs are more stringent (according to the U.S. Fish and Wildlife Service). If WPDES permit is needed for treated effluent discharge, WQCs must be adhered to.
Identification and Listing of Hazardous Waste (40 CFR Part 261)	Defines those solid wastes that are subject to regulation as hazardous waste under 40 CFR Parts 262-275 and Parts 124, 270 and 271.	Removal of seep and/or bay sediments and DNAPLs could result in the generation of listed wastes.
Land Disposal Restrictions (LDRs) (40 CFR Part 268)	Establishes restrictions for land disposal or listed and characteristic wastes.	Removal of seep and/or bay sediments and DNAPLs could result in the generation of listed wastes.
Clean Air Act (CAA) (42 USC Sect. 7401-7642) Regulations on National Emission Standards for Hazardous Air Pollutants	Establishes standards for various hazardous air pollutants and sources.	Remediaion of seep and/or bay sediments and DNAPLs could geneerate air emissions, as could discharge from an ozone sparge system.
Criteria for Classification of Solid Waste Disposal Facilities and Practices (40 CFR Part 257)	Establishes criteria for use in determining which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on health and thereby constitute prohibited open dumps.	If an alternative developed would involve the land disposal of solid waste (e.g., excavated materials), this part is applicable.
Hazardous Waste Management Systems General (40 CFR Part 260)	Establishes procedures and criteria for modification or revocation of any provision in 40 CFR Part 260-265.	Identifies those substances considered to be hazardous wastes. Any substances considered to be hazardous wastes would have to be handled as such. Regulation would be applicable if excavated materials are characteristic wastes.
Standards Applicable to Generators of Hazardous Wastes (40 CFR Part 262)	Establishes standards for generators of hazardous wastes.	If an alternative developed would involve generation of hazardous materials, these standards would be applicable.

REGULATION	DESCRIPTION	COMMENTS
Standards Applicable to Transporters of Hazardous Wastes (40 CFR Part 263)	Establishes standards that apply to persons transporting hazardous wastes within the U.S. if the transportation requires a manifest under 40 CFR Part 262.	If an alternative would involve offsite transportation of hazardous materials (e.g., excavated soil), these standards would be applicable.
Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities (40 CFR Part 264)	Establishes minimum national standards that define the acceptable management of hazardous waste for owners and operators of facilities that treat, store or dispose of hazardous waste.	If excavated materials or extracted DNAPLs are characteristic wastes, then these regulations would be applicable.
Land Disposal Restrictions (40 CFR Part 268)	Identifies hazardous wastes that are restricted from land disposal and defines those circumstances under which an otherwise prohibited waste could continue to be land-disposed.	If removal of DNAPLs and impacted soil from seep area would involve disposal of characteristic wastes, this part would be applicable.
Clean Air Act National Ambient Air Quality Standards (40 CFR Parts 50, 52, 53, 60 and 61)	Treatment technology standards for emissions to air.	If an alternative involved emissions governed by these standards, then the requirements would be applicable.
Hazardous Materials Transportation Regulations (49 CFR Parts 107, 171-177)	Regulates transportation of hazardous materials.	If an alternative developed would involve transportation of hazardous materials, these requirements would be applicable.
TSCA (40 CFR Part 761)	Controls the use, storage and disposal of hazardous substances.	Excavation of sediments and removal of DNAPLs could cause this regulation to be applicable.
OSHA (29 USC Sect. 651)	Mandates a hazard analysis of sites and site-specific health and safety plans for projects.	Applies to all site investigation and remedial action options.
Wisconsin Groundwater Quality Standards (NR 140)	Establishes groundwater quality standards for substances detected in or having a reasonable probability of entering the groundwater resource of the state. Specifies procedures for testing and for evaluating data. Also establishes ranges of responses the department may require if a groundwater standard is exceeded.	Removal and treatment of the site's groundwater is necessary to protect the public health and the environment. Removal or cleanup to these standards would be required if they are more stringent than the federal standards.
Wisconsin Environmental Response Rules (NR 550)	Establishes the Wisconsin environmental response and repair plan, which contains methods for maintaining a list of potential sites that threaten the environment,	The selected remedial option will need to comply with the criteria set forth in this regulation.

REGULATION	DESCRIPTION	COMMENTS
	conducting investigations and analysis to determine the extent of pollution, criteria for ranking the sites, criteria to evaluate potential health hazards, methods for determining cost-effective remediation, and the appropriate roles of federal, state, and local government.	
Immediate and Interim Actions (NR 708)	Establishes criteria for immediate and interim actions taken by responsible parties for the protection of public health, safety and welfare and the environment.	If the remedial action plan results in an interim action being taken this regulation will apply.
Standards for Selecting Remedial Actions (NR 722)	Establishes the minimum standards for the identification and evaluation of remedial options.	This is the overall controlling regulation in the development of the remedial action plan.
Remedial and Interim Action Design, Implementation, Operation, Maintenance and Monitoring Requirements (NR 724)	Establishes standards for the design, implementation, operation, maintenance and monitoring of remedial actions.	This regulation will apply to all activities taken after the completion of the remedial action plan.
Wisconsin Organic Compound Emissions Rule (NR 419, NR 425)	Categorizes volatile organic compound air contaminant sources and establishes emissions limitations and time tables for compliance to protect air quality.	If volatile organic compounds are released to the air during remediation, this regulation would apply.
Wisconsin Ambient Air Quality Standards (AAQS) (NR 404)	Establishes geographic air regions, air standards, and ambient air increments, specifies the methods to be used to measure air quality, to interpret air quality data, and to establish guidelines for the application of air standards.	Some contaminants may be released into the air as a result of remedial activities. If these regulations for specific contaminants are more stringent than federal air standards, Wisconsin's AAQS will be applicable.
Wisconsin Hazardous Air Pollutants Emissions Standards (NR 445, NR 446, NR 449, NR 484)	Establishes emission limitations for hazardous pollutants such as mercury, beryllium, and vinyl chloride. Also incorporates testing, monitoring, and other technical standards established by the federal government.	If remedial activities result in the release of any of the regulated pollutants to the air, these regulations will apply.
Wisconsin General and Portable Sources of Air Pollution Control Rules (NR 400, NR 401, NR 406-410, NR 490-494)	Establishes permit requirements for operation and construction of a potential source of air contamination.	Treatment technologies used to remediate the site may release contaminants into the air and, therefore, would have to meet these requirements if they are more stringent than federal standards.

REGULATION	DESCRIPTION	COMMENTS
Wisconsin Prevention of Significant Deterioration Rules (NR 405)	Establishes the requirements and procedures for reviewing and issuing air pollution control permits to all new major stationary sources and all major modifications to major sources located in areas designated at attainment or unclassified.	Treatment technologies used to remediate the site may release contaminants into the air. These standards would be applicable if they are more stringent that federal standards.
Wisconsin New Stationary Sources Performance Standards (NR 440)	Enables the WDNR to implement and enforce standards of performance for new stationary sources.	Treatment technologies used at the site may release contaminants into the air. These standards would be applicable if they are more stringent than federal standards.
Incorporation by Reference (NR 484)	Incorporates testing, monitoring, and other technical standards for air emissions established by the federal government and technical societies and organizations, by reference, into rules NR 400 to NR 499.	Possible technologies being considered for the site may emit contaminants into the air.
Wisconsin Hazardous Waste Rules (NR 600)	Establishes criteria for identifying the characteristics of hazardous waste and standards defining acceptable hazardous waste management practices.	Criteria would be used to classify the contaminated media at the site and to ensure that proper management of the media takes place.
Wisconsin Regulations on Hazardous Substance Discharges (NR 158, NR 551)	Establishes contingency plan to provide for efficient, coordinated, and effective action to minimize damage caused by the discharge of hazardous substances and establishes a contingency plan to respond to abandoned containers of hazardous materials.	Excavated sediments or extracted DNAPLs could constitute hazardous or characteristic wastes.
Wisconsin Reports and Fees Regulations (NR 101)	Establishes requirements for submission of reports and payment of discharge environment fees by person discharging industrial wastes, toxic and hazardous substances, or air contaminants.	If a treatment option results in the release contaminants into the air, a report of the concentration and quantity of contamination would have to be submitted.
Laboratory Certification and Registration (NR 149)	Establishes a program for the certification and registration of laboratories that sample and test water.	Samples taken at the site would have to be analyzed at a registered laboratory.
Personnel Qualified for Conducting Environmental Response Actions (NR 712)	Sets minimum standards of experience and professional qualifications for people performing certain tasks and scientific evaluations.	This regulation will apply to any and all environmental consultants involved in the design, construction and implementation of the remedial action.
Management of Solid Wastes Excavated	Sets standards for storage, transportation and treatment	If the chosen remedial option results in the generation

REGULATION	DESCRIPTION	COMMENTS
during Response Actions (NR 718)	of wastes excavated during environmental response actions.	of excavated wastes (e.g., during drilling or dredging activities), this regulation will apply.
PCB management (NR 157)	Regulates the storage, processing, transportation, and disposal of PCBs and PCB-containing materials.	Excavated materials could contain PCBs, requiring observance of this regulation.
Discharge of Hazardous Substances (NR 706)	Establishes procedures for notification of hazardous materials.	This regulation will apply if contaminated soils or sediments are excavated.
Site investigations (NR 716)	Defines the requirements for site investigations, comparable to the NCP.	This regulation must be followed for all site investigation activities.
Soil remediation (NR 720)	Establishes residual contaminant levels (RCLs) for soil remediation of selected contaminants, and procedures for establishment of site-specific RCLs.	This regulation will be instrumental in the establishment of cleanup goals for all unsaturated materials.
Polynuclear aromatic hydrocarbon (PAH) RCLs (WDNR Publ. RR-519-97)	Interim guidance for the remediation of PAHs in soils.	This guidance will be instrumental in the establishment of cleanup goals for all unsaturated materials.
Remedial action selection (NR 722)	Establishes criteria for the selection of remedial actions.	This regulation will pertain to all remedial activities.
Wastewater Treatment Conveyance (NR 108)	Requires WDNR approval of wastewater conveyance systems prior to construction.	This regulation will apply to any remedial option that generates a wastewater stream.

TABLE 5-2
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
TRIGGERED BY LOCATION, REMEDIAL ALTERNATIVE OR OTHER FACTORS
KREHER PARK/CHEQUAMEGON BAY REMEDIAL ALTERNATIVES

REGULATION	DESCRIPTION	COMMENTS
Federal Water Pollution Control Act (Clean Water Act - CWA) (33 USC Sect. 1251-1376) National Pollutant Discharge Elimination System (40 CFR Parts 122, 125)	Requires permits for the discharge of pollutants from any point source into waters of the United States.	A permit would be required if an alternative developed would discharge into a surface water.
Great Lakes Water Quality (CWA Part 118, 40 CFR Part 132)	Sets standards for water quality in the Great Lakes.	Discharges to Chequamegon Bay, or disturbance of sediments in the bay would cause this ARAR to be effective.
Dredge and Fill (CWA Part 404)	Controls discharge of dredge and fill materials to U.S. surface waters.	Dredging activities in Chequamegon Bay would be regulated by these standards.
Dredging/filling construction activities (CWA Parts 401, 404; 40 CFR Parts 230; 33 CFR Parts 320 - 330)	Regulates and coordinates construction activities near navigable waters.	These regulations apply to the remedial options under consideration for the sediments of Chequamegon Bay.
Floodplain protection (40 CFR Part 6; Executive Order 11988)	Authorization for federal agencies to take action to protect floodplains.	These requirements could apply to activities in Kreher Park.
Wetland protection (40 CFR Part 6; Executive Order 11990)	Authorization for federal agencies to take action to protect wetlands.	These requirements could apply to activities in Kreher Park and Chequamegon Bay.
Great Lakes Water Quality Initiative (40 CFR Part 132)	Sets water quality standards for Great Lakes waters.	This regulation would apply to effluent discharges to Chequamegon Bay and to release of contaminants to the waters of the bay caused by disturbance of sediments during dredging or capping activities.
Fish and wildlife (16 USC Sect. 61-66; 40 CFR Part 30)	Directs federal agencies to evaluate impacts of impoundments or other modifications on fish and wildlife, and to take action, if necessary.	Applies to dredging and sediment capping activities.

REGULATION	DESCRIPTION	COMMENTS
National Archaeological Historical Preservation Act (16 USC Sect. 469)	Directs that significant scientific, prehistorical and archaeological data be preserved in the course of federally approved construction projects.	Applies to activities associated with the Chequamegon Bay remedial options.
Endangered Species Act (59 CFR Parts 17, 81, 222, 225, 402, 453)	Requires that threatened or endangered species be protected.	Potentially applicable to all remedial alternatives.
Coastal Zone Management Act (16 USC Sect. 1451-1464)	Directs the management of dredging and other construction activities within a coastal zone.	Applies to activities associated with the Chequamegon Bay remedial options.
National River and Harbor Act (33 USC Sect. 403)	Regulates activities below the mean high water mark of navigable tidal waters.	Applies to activities associated with the Chequamegon Bay remedial options.
Wisconsin Water Quality Standards for Surface Water (NR 100, NR 102, NR 103, NR 104, NR 105, NR 106)	Establishes water quality standards for surface water and describes the designated use categories for surface waters and the water quality criteria necessary to support these uses. Establishes methods for developing criteria for toxic substances to protect public health, welfare and the propagation of fish and aquatic life. Also explains how bio-accumulation factors are used in deriving water quality criteria for toxic and organoleptic substances.	These regulations will apply to any waste stream that discharges to surface waters.
Wisconsin Water Pollution Control Regulations (NR 200-239); Categories and Classes of Point Sources and Effluent Limitations, Subchapter III - Effluent Limitations for Uncategorized Point Sources (NR 220.2)	Authorizes WDNR to establish effluent limitations for point sources not identified in Subchapter I and that are achievable by the application of the best available technology (BAT) limits and requirements (best practicable treatment technology currently available or best available control technology economically achievable).	These regulations will apply to any waste stream that discharges to surface waters. The effluent would be required to meet the more stringent of either the BAT requirements established by the WDNR or the surface water quality-based limits.
Environmental Analysis and Review Procedures for Departmental Actions (NR 150)	Establishes a policy to ensure governmental consideration of the short- and long-term environmental and economic effects of policies, plans, and programs upon the quality of the	WDNR's input on actions taken at the site would be required.

REGULATION	DESCRIPTION	COMMENTS
	human environment.	
Public Information and Participation (NR 714)	Sets the requirements for public participation and involvement.	Compliance with the NCP requires public notice and participation.
Shoreland Management (NR 115, 117)	Minimum standards for shoreland management.	This regulation will apply to any remedial option that can potentially impact the shoreline.
Floodplain Management (NR 116)	Minimum standards for floodplain management.	This regulation will apply to any remedial option that can potentially impact the floodplain.
Non-Point Source Pollution Abatement (NR 120)	Program for the reduction/elimination of non-point source pollution.	This regulation could pertain to continued discharge of impacted groundwater to Chequamegon Bay, as well as overland flow of contaminants to the bay.
General Permit Program (NR 322)	Minimum design and specification requirements for projects included under general permits.	This has potential applicability to all remedial options.
Dredging Fees (NR 346)	Procedures and criteria for the dredging of material from natural lakes and outlying waters. Applicable when a State contract is required.	This regulation will apply to the dredging and capping options being considered for the sediments in Chequamegon Bay.
Sediment Sampling and Analyses (NR 347)	Requirements for sampling, analyses, disposal and monitoring of dredged materials.	This regulation will apply if dredgingactivities are conducted in Chequamegon Bay.

Table 7-1
General Response Actions - Technology Screening
Kreher Park Property

General Response Action	Technology	Implementability	Relative Cost	Status
Institutional Controls	Deed Restrictions	No significant issues	Low	Retained
	Groundwater Use Restrictions	No significant issues	Low	Retained
Engineering Controls - Kreher Park				
Capping	NR 500 Clay Cap	Limited Availability of Clay/Contaminated Soils generated	Medium	Not Retained
	Geomembrane	No significant issues	Low	Not Retained
	Geocomposite Cap	No significant issues	Medium	Not Retained
	Asphalt	poor aesthetics	Low	Retained
	Concrete	poor aesthetics	Medium	Not Retained
Containment	Sheet Piling	Potential to penetrate Miller Creek Formation	High	
	Slurry Wall	None	High	
Engineering Controls - Sediments				
Capping	Thick Soil Cap	No significant issues	Medium	Retained
	Thin Soil Cap	No significant issues	Low	Retained
	Geomembrane/Soil Cap	Constructability	Medium	Not Retained
	Geotextile/Soil Cap	No significant issues	Low	Retained
In Situ Treatment of Soils - Kreher Park	Soil Vapor Extraction	variability of soils may limit effectiveness	Low	Not Retained
	Steam Stripping	Noise issues	High	Not Retained
	Hot Water Flushing	Generation of contaminated water requiring collection and treatment	High	Not Retained
	Six Phase Heating	Soil contaminant mass not thick enough to be effective	High	Not Retained
Excavation and Ex Situ Treatment of Soils - Kreher Park	Solidification/Stabilizaton	No significant issues	High	Not Retained
	Soil Washing	Treatment and Disposal of washwaters generated	High	Not Retained
	Thermal Desorption	Odors, Noise	High	Not Retained
	Enhanced Bioremediation	Treatability Study Required	Medium	Not Retained
Transportation of Excavated Soils	Trucks	Noise, traffic impacts	Medium	Retained
	Railroad	Available route to disposal location	Mdeium	Not Retained
	Barge	Available route to disposal location	Mdeium	Not Retained
Off Site Disposal of soils	Landfill	Landfill acceptance	Medium	Not Retained
Off Site Co-Treatment	Asphalt Batch Plant	No significant issues	Low	Not Retained
	Utility Boiler Co-Burning	Ability of boiler to accept soils	Medium	Not Retained
Excavation/Dredging of Contaminated Sediments	Hydraulic Dredging	Treatment and disposal of waters generated	Medium	Not Retained
	Dragline/Clamshell Dredging	Treatment and disposal of waters generated	Medium	Not Retained
Dewatering of Sediments	Drying Beds	Odors, available space	Medium	Not Retained
	Vacuum Belt/Drum Filtration	Noise	High	Not Retained
Groundwater Treatment - Ex Situ	Low Profile Air Stripper	No significant issues	Low	Not Retained
	Granulated Activated Carbon	No significant issues	Low	Not Retained
	Advanced Oxidation	No significant issues	Medium	Not Retained
	Fixed Film Bioreactors	No significant issues	Medium	Not Retained

	Ultrasound Destruction	No significant issues	High	Not Retained
Groundwater Treatment - In Situ	Ozone Sparging	No significant issues	Low	Retained
	Air Sparging	Less effective than ozone	Low	Not Retained
Vapor Control and Treatment	Temporary Structures	Ability to construct on site	High	Not Retained
	Thermal Oxidation	Noise	High	Not Retained
	Granulated Activated Carbon Adsorption	No significant issues	Low	Not Retained
	Air Scrubbing	No significant issues	Medium	Not Retained

Table 9-1
Comparison of Remedial Action Options
Kreher Park Site

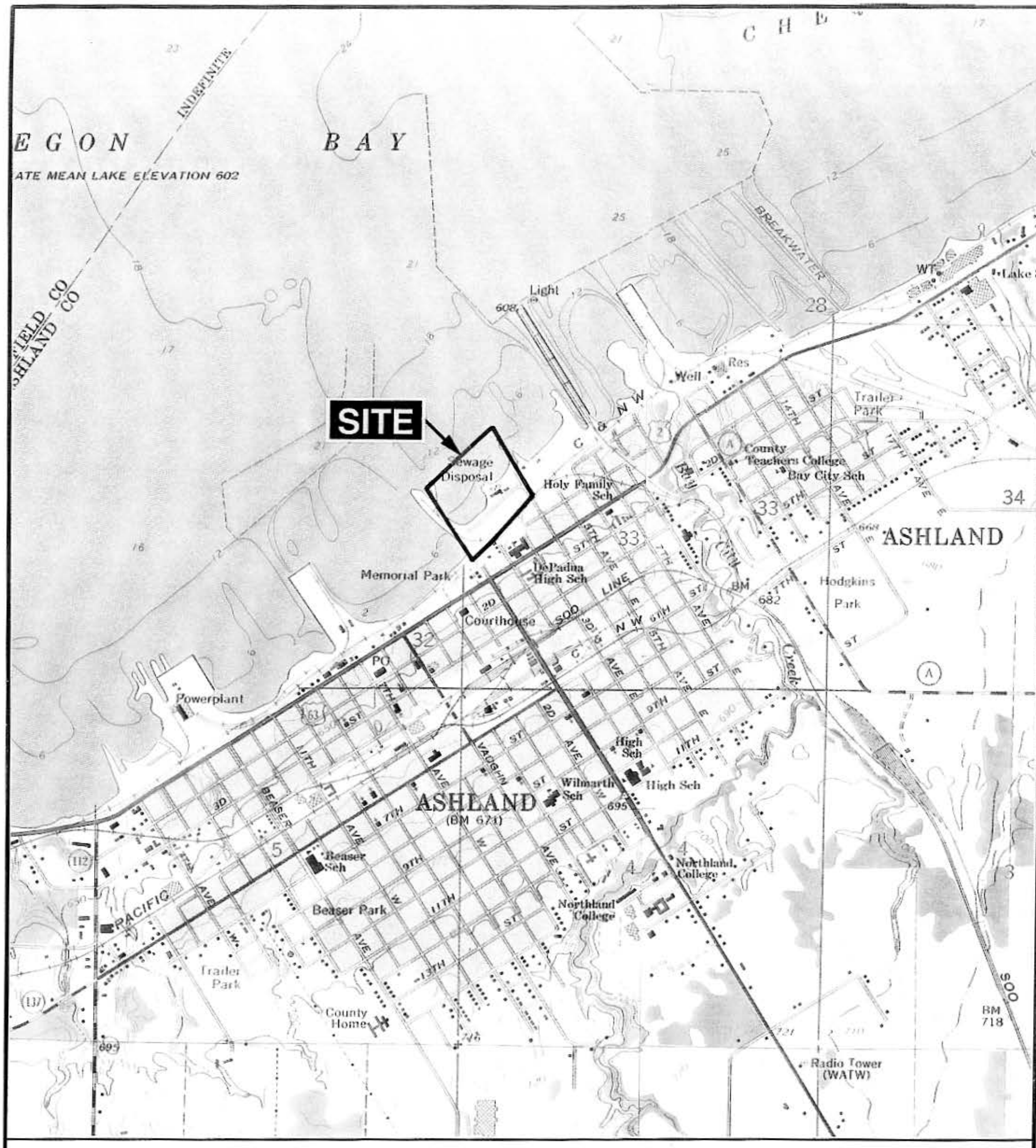
Remedial Action Options	Option A **No Further Action**		Option B1 **Institutional Controls/Source Removal at Seep/Institutional Controls on Groundwater/Cap Sediments/SEH ERA Limits**		Option B2 **Institutional Controls/Source Removal at Seep/Institutional Controls on Groundwater/Cap Sediments/Dames & Moore ERA Limits**		Option C1 **Institutional Controls/Source Removal at Seep/Cap Sediments Place/Ozone Sparge at Kreher Park/ SEH ERA Limits**		Option C2 **Institutional Controls/Source Removal at Seep/Cap Sediments Place/Ozone Sparge at Kreher Park/ Dames & Moore ERA Limits**	
	Rating	Score	Rating	Score	Rating	Score	Rating	Score	Rating	Score
Technical Feasibility										
Long Term Effectiveness	Low	3	Medium	2	Medium	2	High	1	High	1
Short Term Effectiveness	High	1	High	1	High	1	Medium	2	Medium	2
Implementability	Medium	2	High	1	High	1	High	1	High	1
Restoration Time Frame	Low	3	Low	3	Low	3	Medium	2	Medium	2
Economic Feasibility										
Estimated Initial Capital Costs	0		$6,222,000		$3,946,000		$7,217,000		$4,942,000	
Annual Operation, Maintenance, and Monitoring Costs	0		$44,000		$44,000		$116,000		$116,000	
Annualized Total Costs (40 years, 5%)	0		$406,000		$274,000		$537,000		$404,000	
Capitalized Total Costs (40 years, 5%)	0		$6,969,000		$4,693,000		$9,207,000		$6,932,000	
Annualized Total Costs (30 years, 7%)	0		$545,000		$362,000		$698,000		$514,000	
Capitalized Total Costs (30 years, 7%)	0	1	$6,762,000	2	$4,486,000	2	$8,657,000	2	$6,381,000	2
Potential Future Liability	Low	3	Medium	2	Medium	2	High	1	High	1
Score		2.17		1.83		1.83		1.50		1.50

Scoring System: 1=best rating, 3=worst rating for an individual category11

Table 9-1 (cont.)
Comparison of Remedial Action Options
Kreher Park Site

Remedial Action Options	Option D1 **Institutional Controls/Source Removal at Seep/Institutional Controls on Groundwater/Partial Filling of Bay/Cap Sediments/SEH ERA Limits**		Option D2 **Institutional Controls/Source Removal at Seep/Institutional Controls on Groundwater/Partial Filling of Bay/Cap Sediments/Dames & Moore ERA Limits**		Option E1 **Institutional Controls/Source Removal at Seep/Partial Filling of Bay/Cap Sediments/ Ozone Sparge at Kreher Park/SEH ERA Limits**		Option E2 **Institutional Controls/Source Removal at Seep/Partial Filling of Bay/Cap Sediments/ Ozone Sparge at Kreher Park/Dames & Moore ERA Limits**	
	Rating	Score	Rating	Score	Rating	Score	Rating	Score
Technical Feasibility								
Long Term Effectiveness	High	1	High	1	High	1	High	1
Short Term Effectiveness	Medium	2	Medium	2	Medium	2	Medium	2
Implementability	High	1	High	1	High	1	High	1
Restoration Time Frame	Low	3	Low	3	Medium	2	Medium	2
Economic Feasibility								
Estimated Initial Capital Costs	$12,106,000		$11,406,000		$13,531,000		$12,808,000	
Annual Operation, Maintenance, and Monitoring Costs	$44,000		$44,000		$116,000		$116,000	
Annualized Total Costs (40 years, 5%)	$749,000		$708,000		$905,000		$862,000	
Capitalized Total Costs (40 years, 5%)	$12,853,000		$12,153,000		$15,521,000		$14,799,000	
Annualized Total Costs (30 years, 7%)	$1,020,000		$963,000		$1,206,000		$1,148,000	
Capitalized Total Costs (30 years, 7%)	$12,646,000	3	$11,946,000	3	$14,971,000	3	$14,248,000	3
Potential Future Liability	Medium	2	Medium	2	High	1	High	1
Score		2.00		2.00		1.67		1.67

Scoring System: 1=best rating; 3=worst rating for an individual category



0 1/2 1

Scale in miles

N

Figure 2-1

Site Location Map

Northern States Power
Ashland, Wisconsin

Project No.: 05644-084

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

REFERENCE: USGS 7.5 Minute Series Topographic Maps: "Ashland East, Wisconsin" and "Ashland West, Wisconsin" Quadrangles, Photorevised 1975.

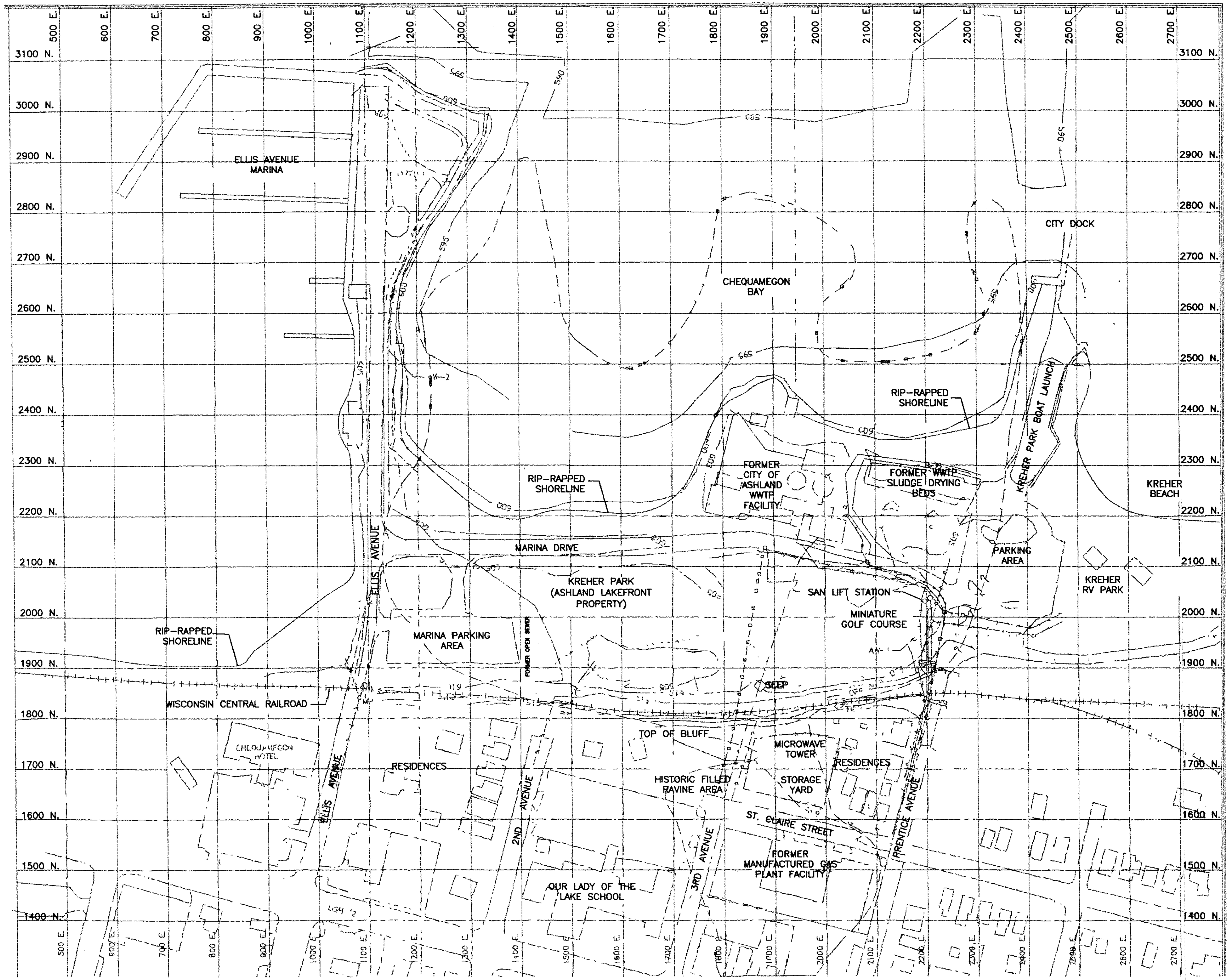


Figure 2-2
Site Layout

Northern States Power
Ashland, Wisconsin

Project No.: 05644-084

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

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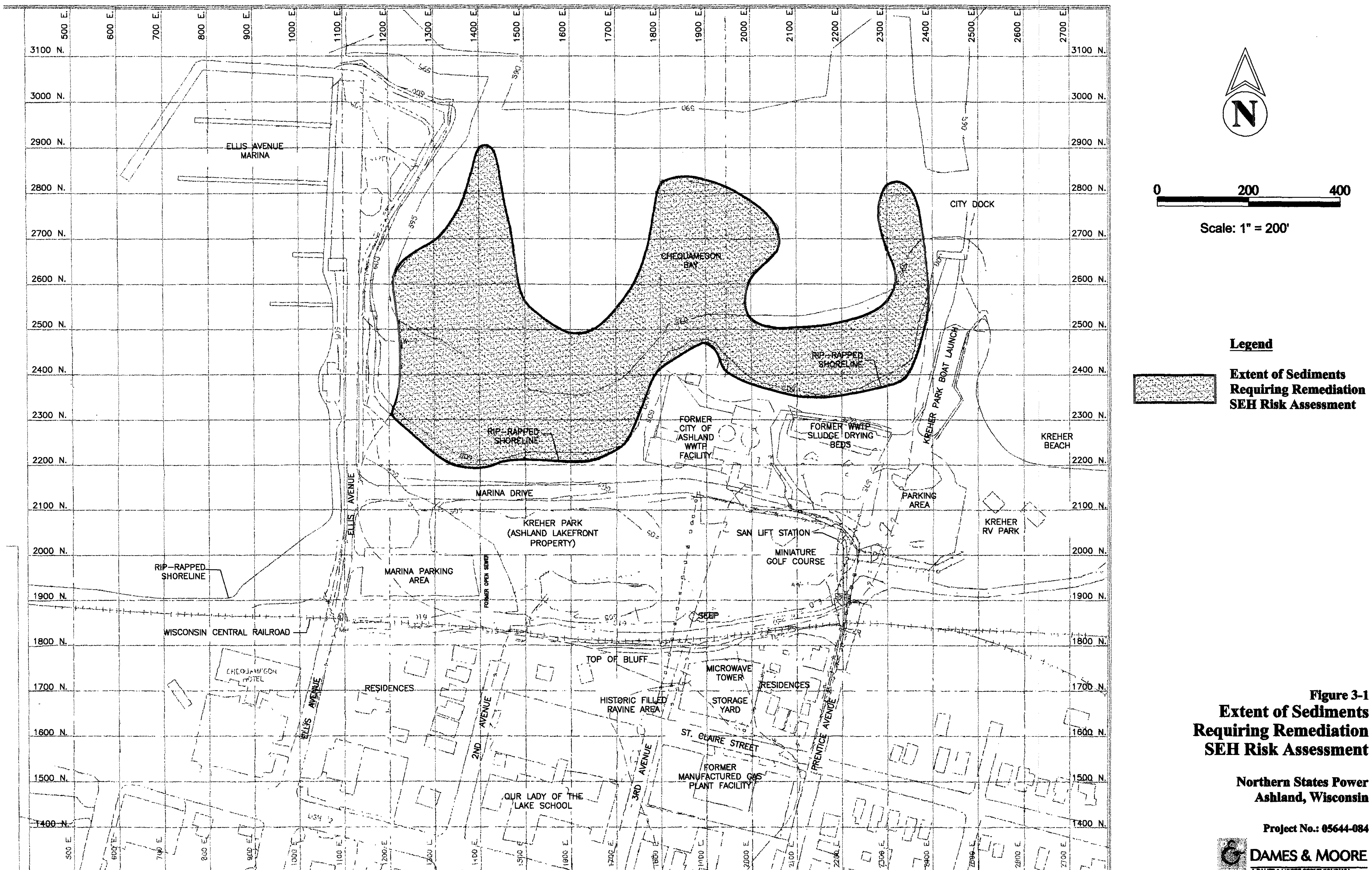

Figure 3-1
Extent of Sediments Requiring Remediation SEH Risk Assessment

Northern States Power
Ashland, Wisconsin

Project No.: 05644-084

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

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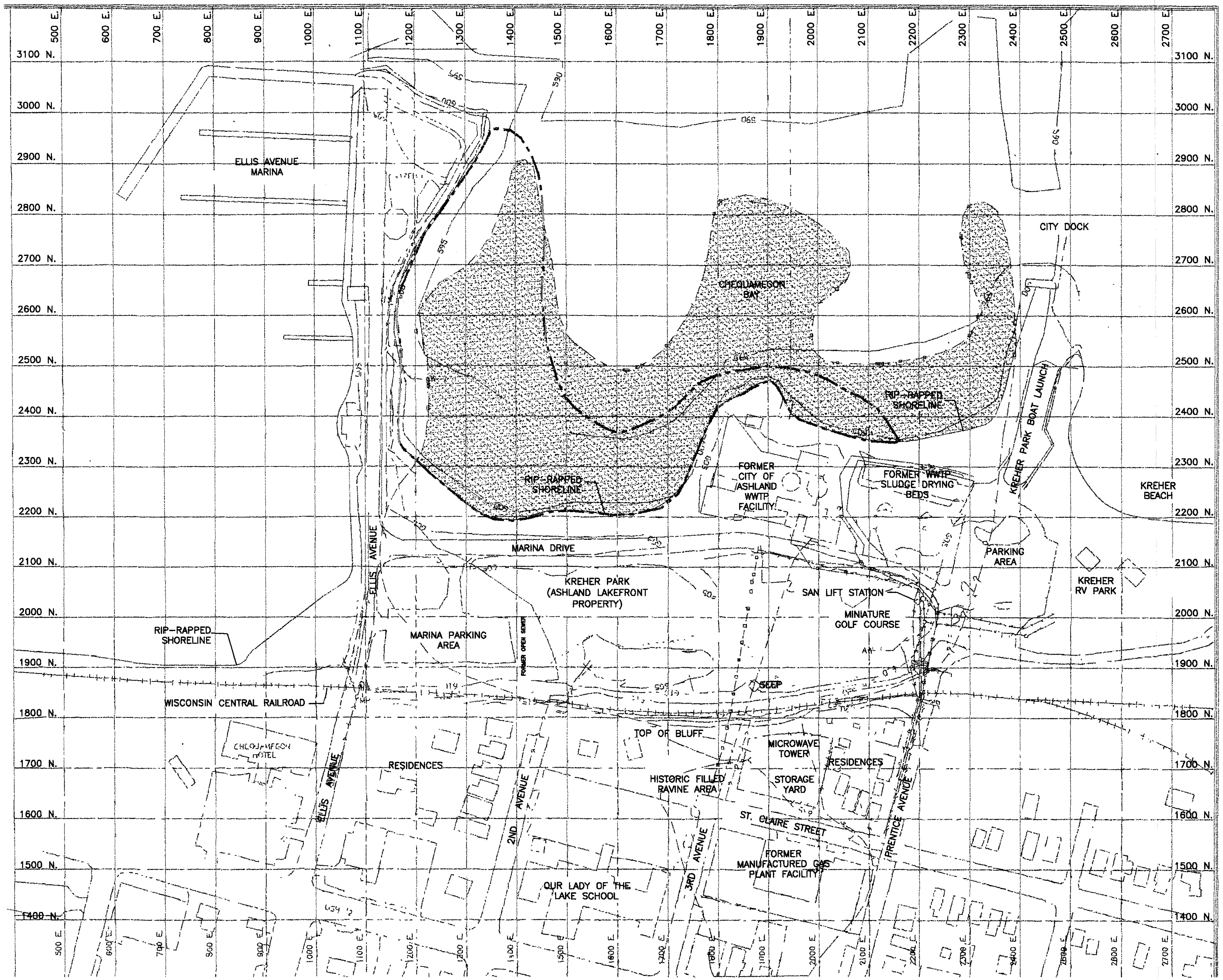

N

0 200 400

Scale: 1" = 200'

Legend

Extent of Sediments Requiring Remediation Dames & Moore Risk Assessment

Extent of Sediments Requiring Remediation SEH Risk Assessment

Figure 3-2

Extent of Sediments Requiring Remediation Dames & Moore Risk Assessment

Northern States Power
Ashland, Wisconsin

Project No.: 05644-084

DAMES & MOORE
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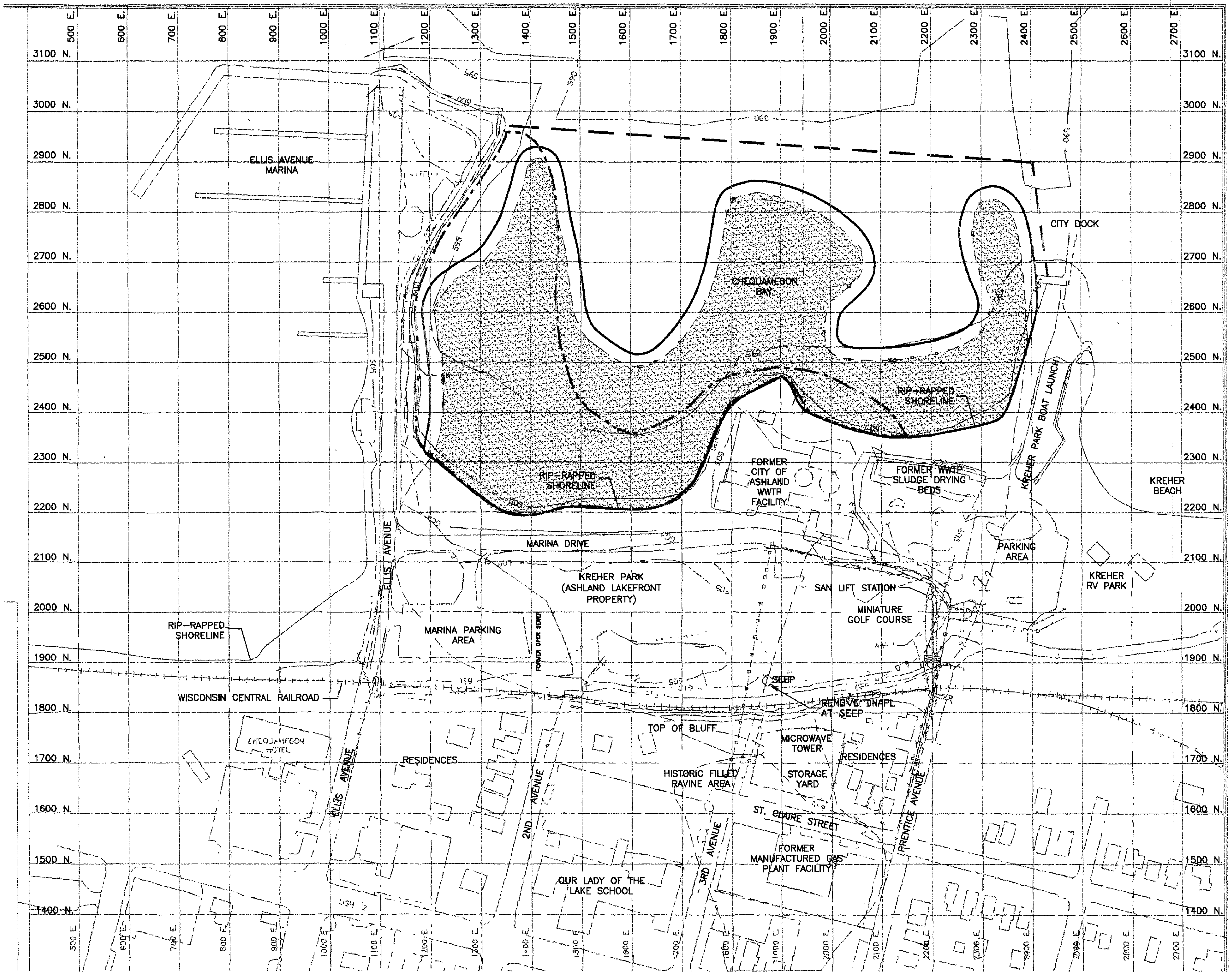

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Scale: 1" = 200'

Legend

- (solid line) **Area of Sediment Capping**
- (dashed line) **Silt Curtain**
- (dash-dot line) **Extent of Sediment Requiring Remediation Dames & Moore Risk Assessment**
- (stippled area) **Extent of Sediments Requiring Remediation SEH Risk Assessment**

Figure 8-1
Option B1 Sediment Cap SEH Risk Assessment Limits

Northern States Power
Ashland, Wisconsin

Project No.: 05644-084

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

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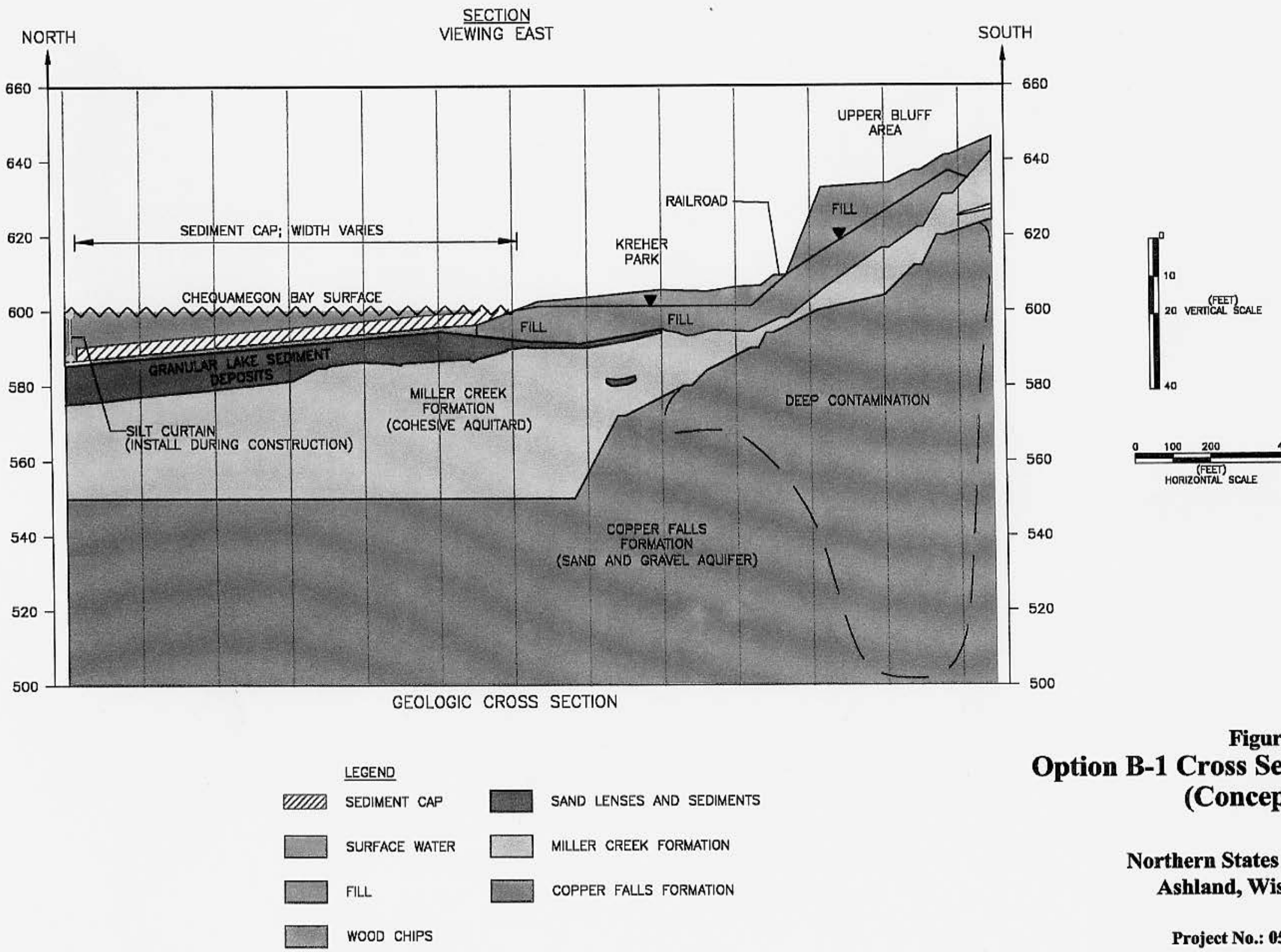

Figure 8-1A

Option B-1 Cross Section (Conceptual)

Northern States Power
Ashland, Wisconsin

Project No.: 05644-084

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

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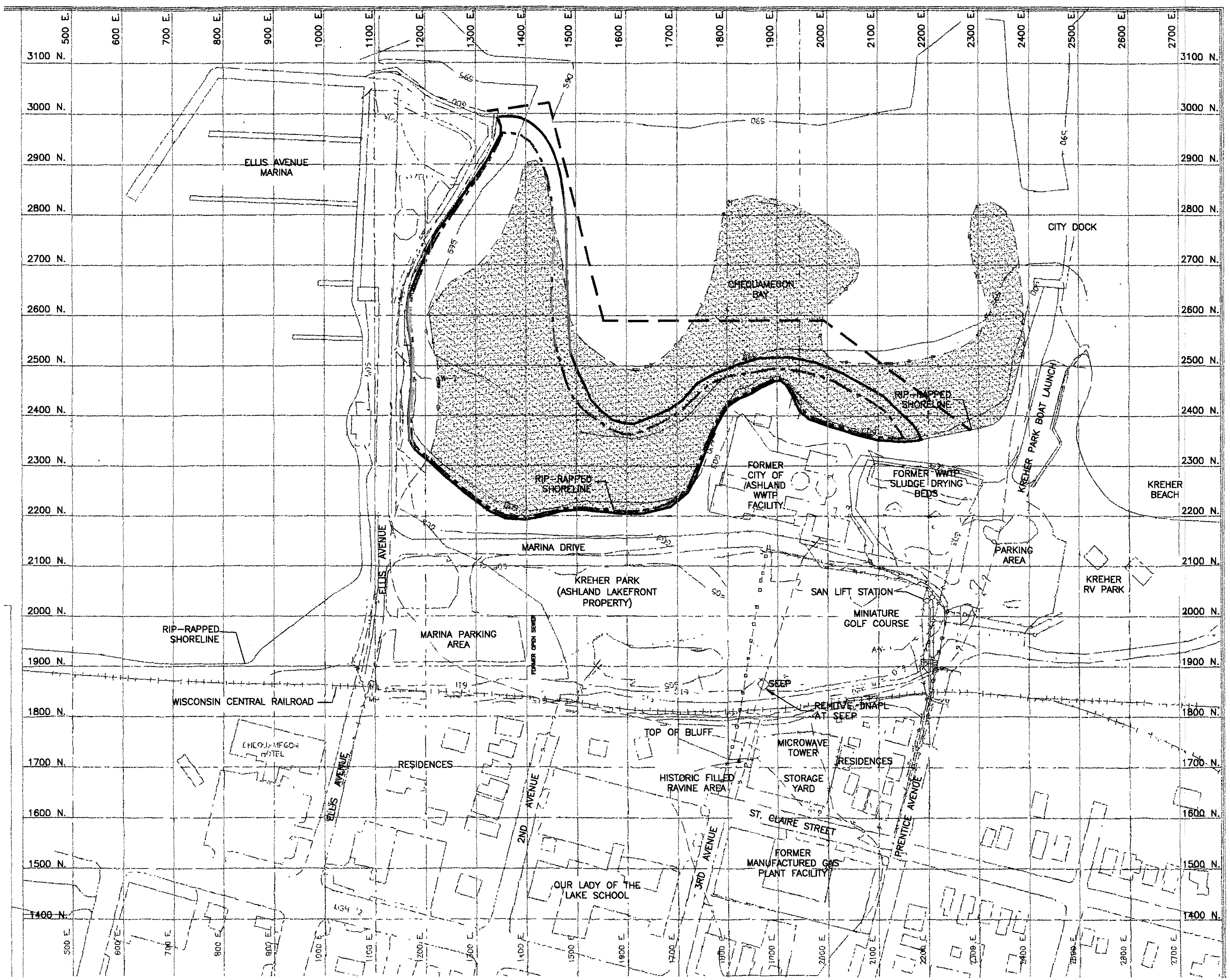

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Scale: 1" = 200'

Legend

- Area of Sediment Cap Limits
- Silt Curtain
- Extent of Sediments Requiring Remediation Dames & Moore Risk Assessment Limits
- Extent of Sediments Requiring Remediation SEH Risk Assessment

Figure 8-2
Option B2
Sediment Cap
Dames & Moore
Risk Assessment Limits

Northern States Power
Ashland, Wisconsin

Project No.: 05644-084

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

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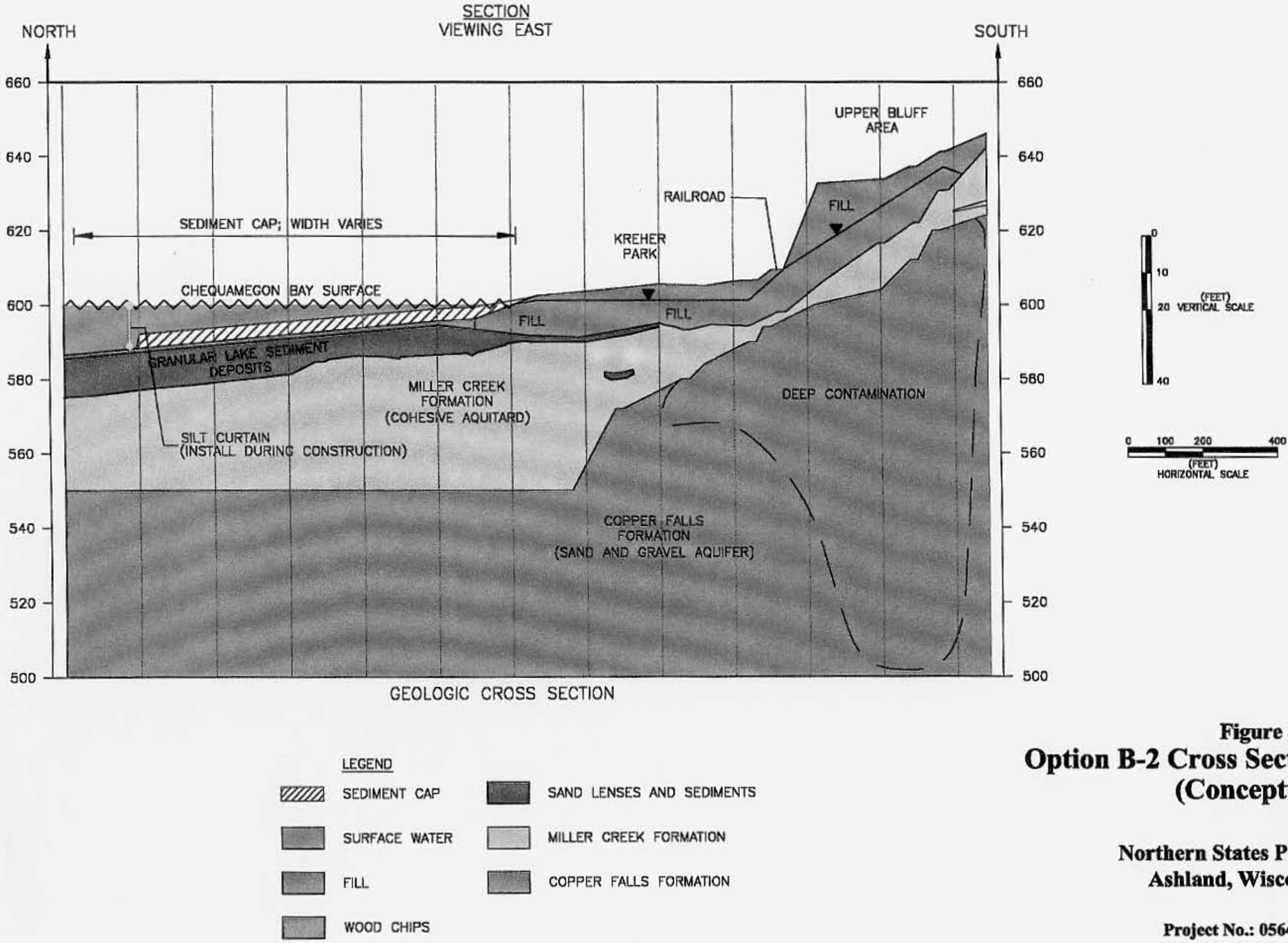

Figure 8-2A

Option B-2 Cross Section (Conceptual)

Northern States Power
Ashland, Wisconsin

Project No.: 05644-084

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

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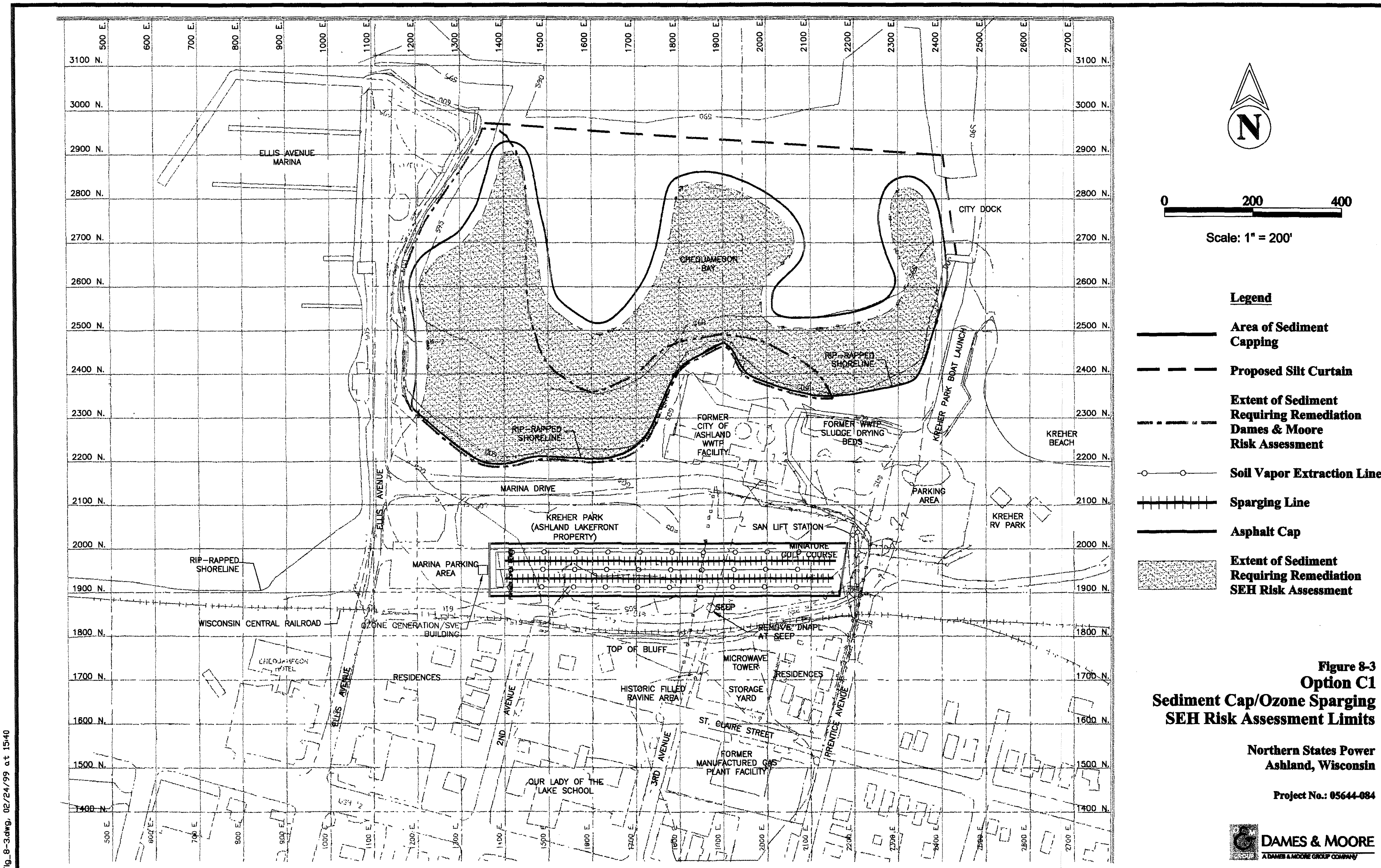

Figure 8-3

Option C1

Sediment Cap/Ozone Sparging SEH Risk Assessment Limits

Northern States Power
Ashland, Wisconsin

Project No.: 05644-084

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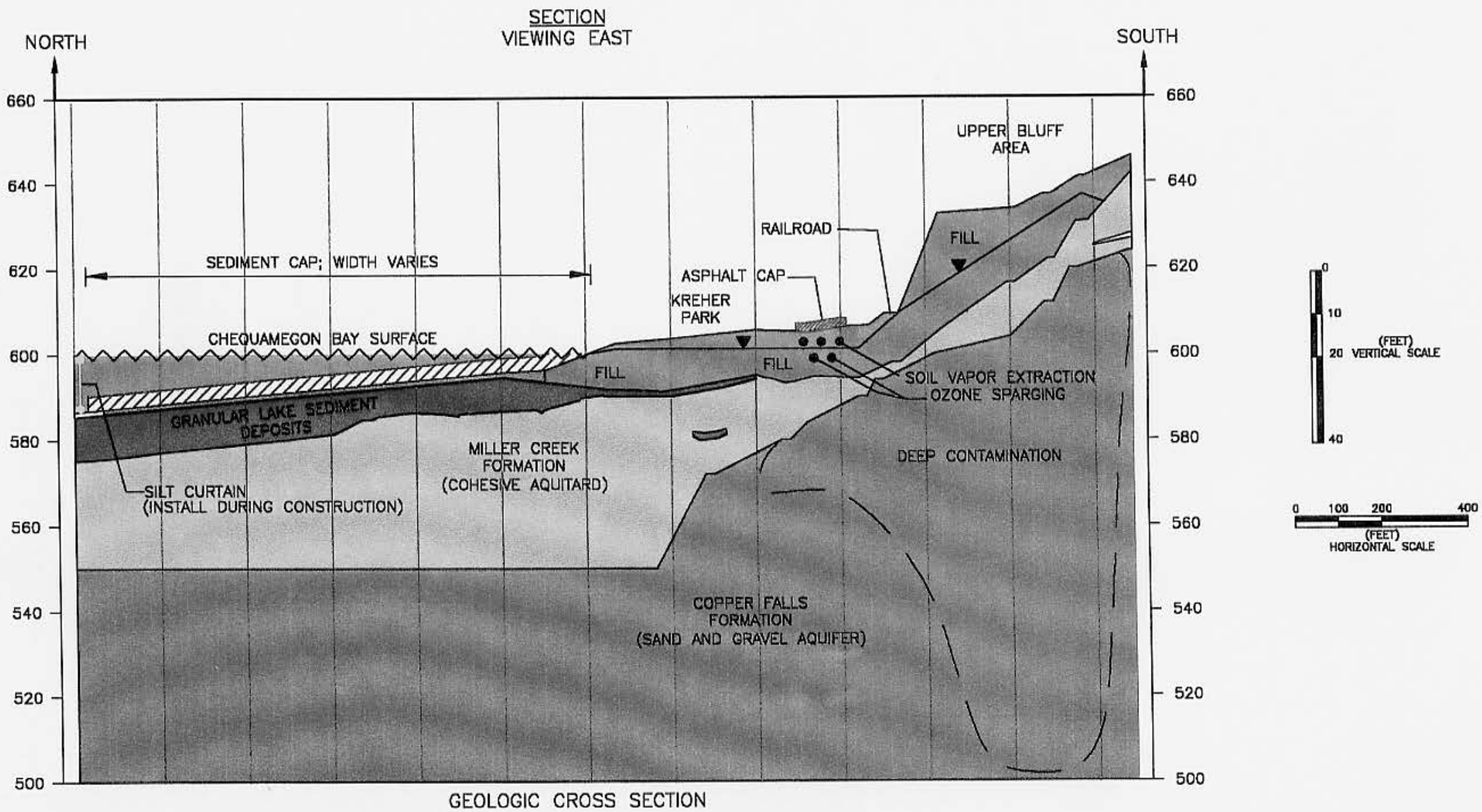

LEGEND

- SEDIMENT CAP
- SURFACE WATER
- FILL
- WOOD CHIPS
- SAND LENSES AND SEDIMENTS
- MILLER CREEK FORMATION
- COPPER FALLS FORMATION

Figure 8-3A

Option C-1 Cross Section (Conceptual)

Northern States Power
Ashland, Wisconsin

Project No.: 05644-084

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

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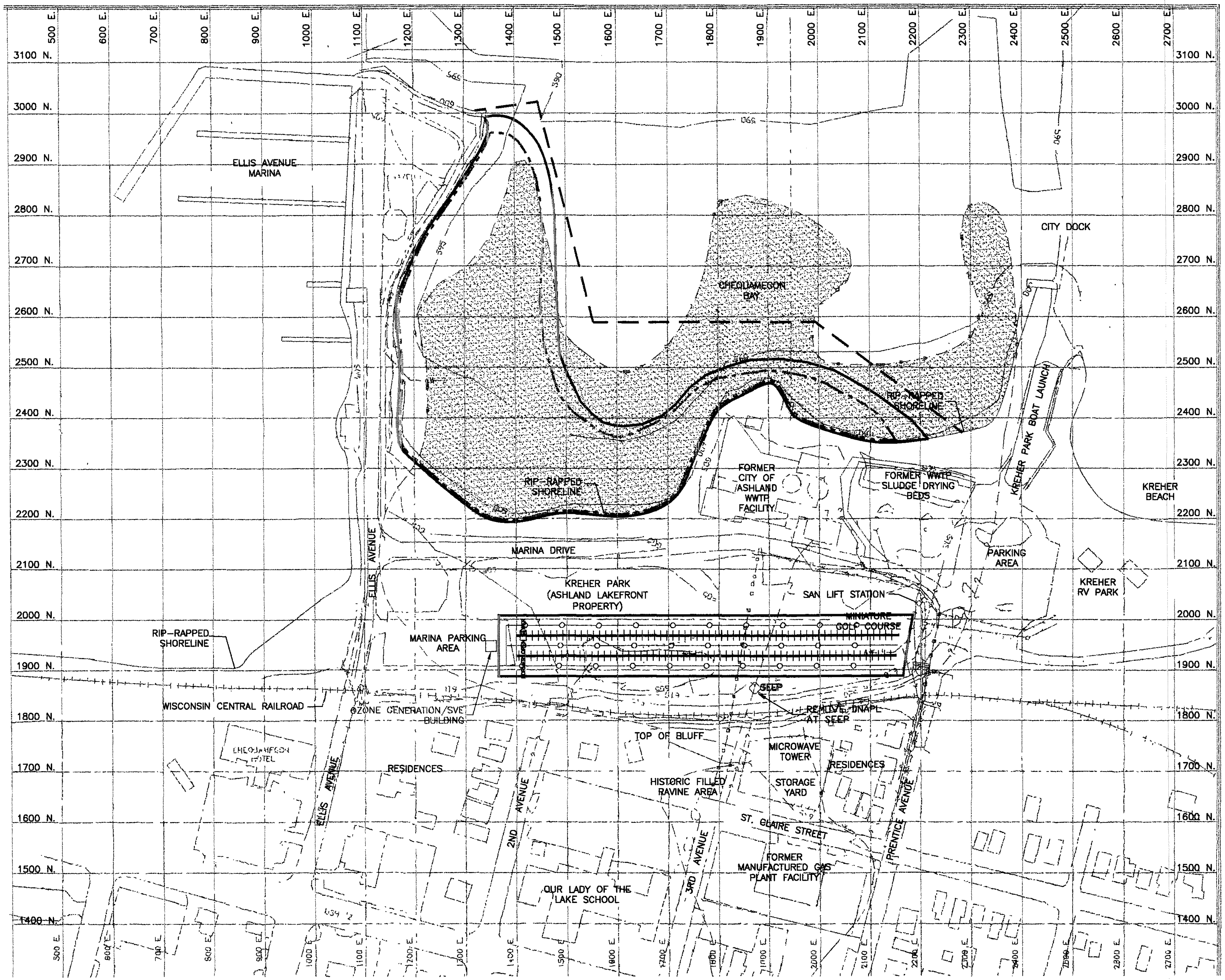

N

0 200 400

Scale: 1" = 200'

Legend

- **Area of Sediment Capping**
- **Proposed Silt Curtain**
- **Extent of Sediments Requiring Remediation Dames & Moore Risk Assessment Limits**
- **Soil Vapor Extraction Line**
- **Sparging Line**
- **Asphalt Cap**
- **Extent of Sediments Requiring Remediation SEH Risk Assessment**

Figure 8-4
Option C2
Sediment Cap/Ozone Sparging Dames & Moore Risk Assessment Limits

Northern States Power
Ashland, Wisconsin

Project No.: 05644-084

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

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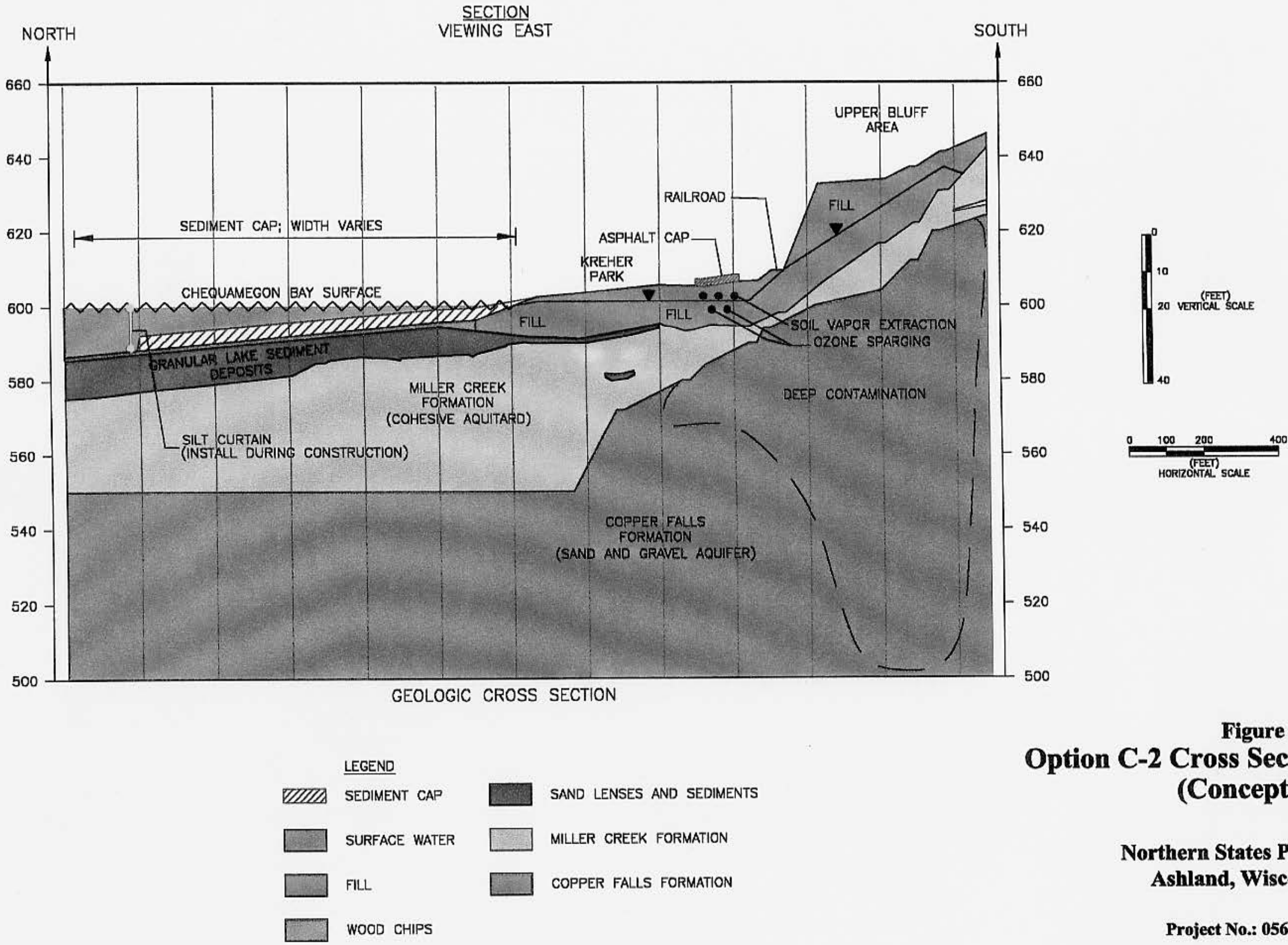

Figure 8-4A
Option C-2 Cross Section (Conceptual)

Northern States Power
Ashland, Wisconsin

Project No.: 05644-084

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

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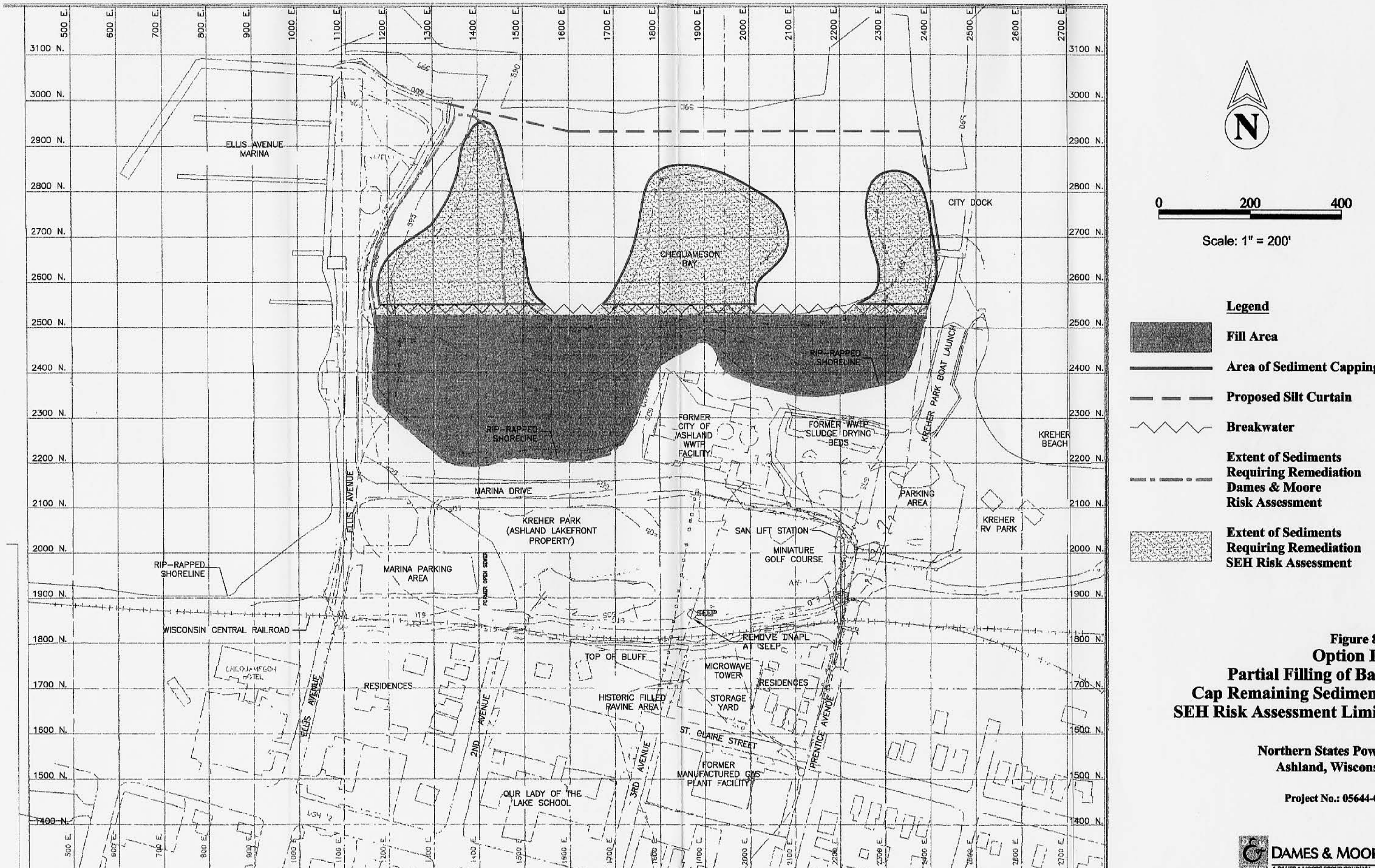

Figure 8-5
Option D1
Partial Filling of Bay/ Cap Remaining Sediments SEH Risk Assessment Limits

Northern States Power
Ashland, Wisconsin

Project No.: 05644-084

DAMES & MOORE
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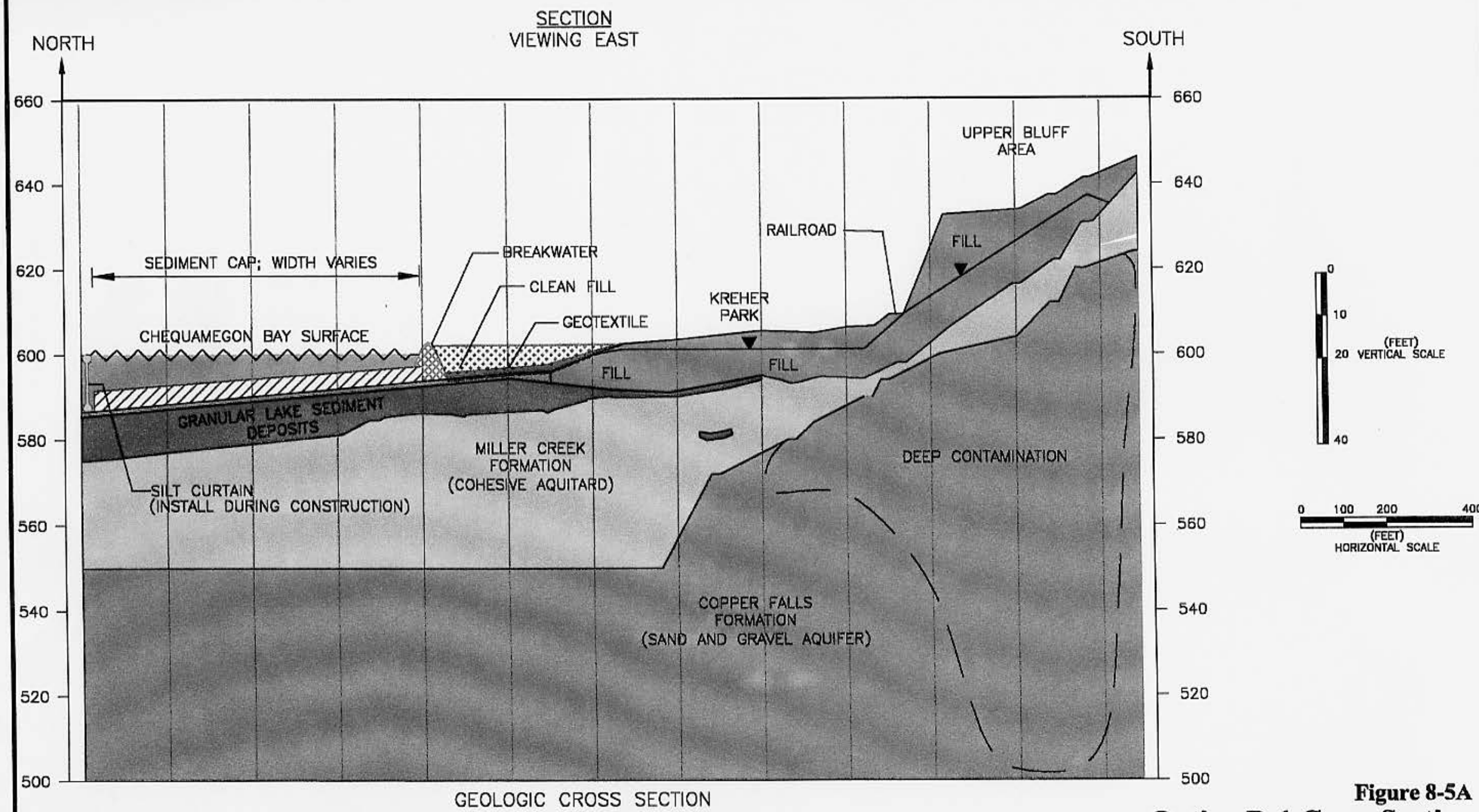

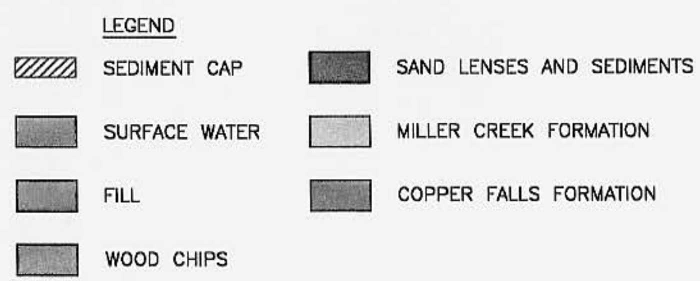

Figure 8-5A
Option D-1 Cross Section (Conceptual)

Northern States Power
Ashland, Wisconsin

Project No.: 05644-084

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

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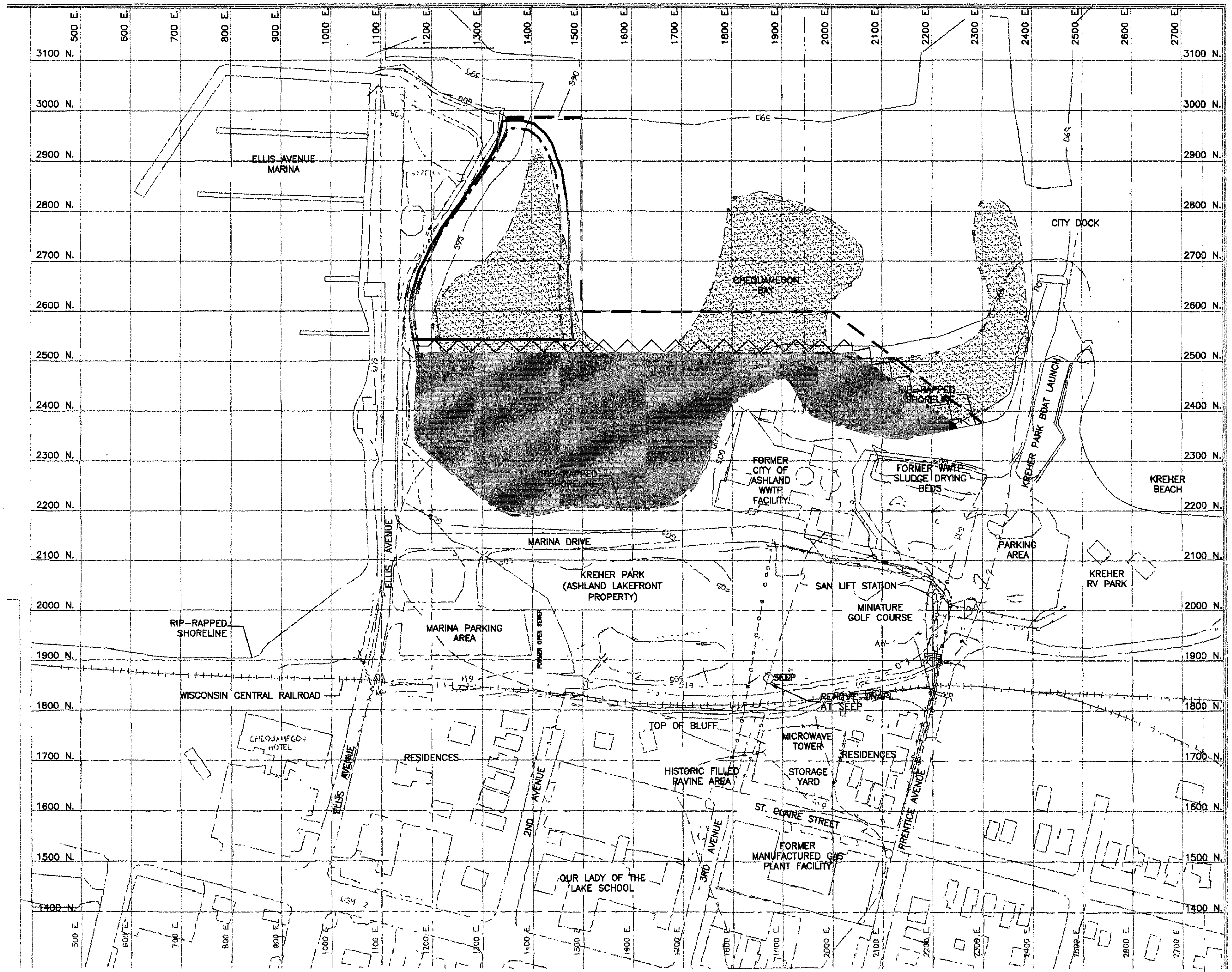

N

0 200 400

Scale: 1" = 200'

Legend

- Fill Area
- Area of Sediment Capping
- Proposed Silt Curtain
- Breakwater
- Extent of Sediments Requiring Remediation Dames & Moore Risk Assessment
- Extent of Sediments Requiring Remediation SEH Risk Assessment

Figure 8-6
Option D2
Partial Filling of Bay/ Cap Remaining Sediments Dames & Moore Risk Assessment Limits

Northern States Power
Ashland, Wisconsin

Project No.: 05644-084

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

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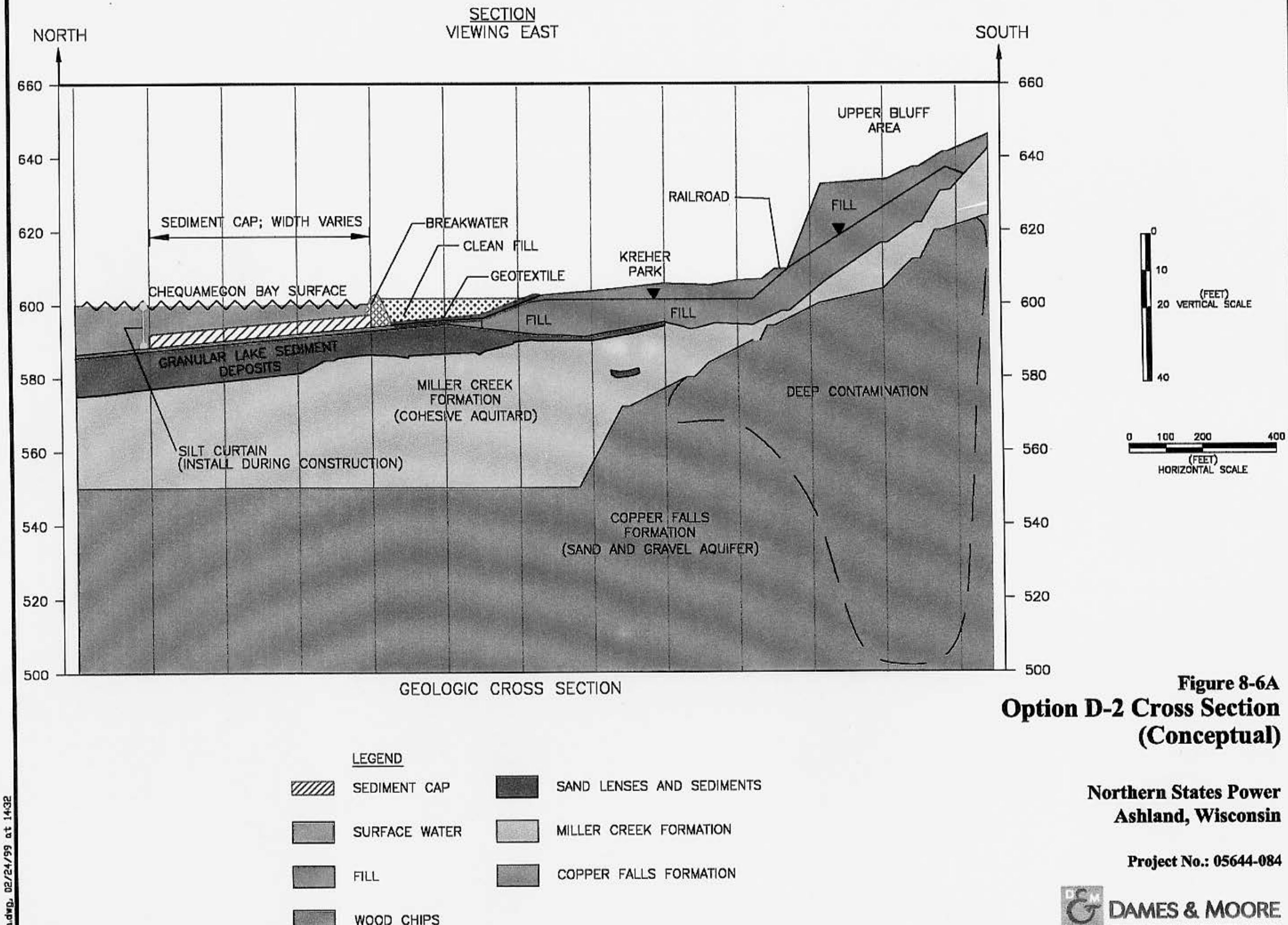

Figure 8-6A

Option D-2 Cross Section (Conceptual)

Northern States Power
Ashland, Wisconsin

Project No.: 05644-084

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

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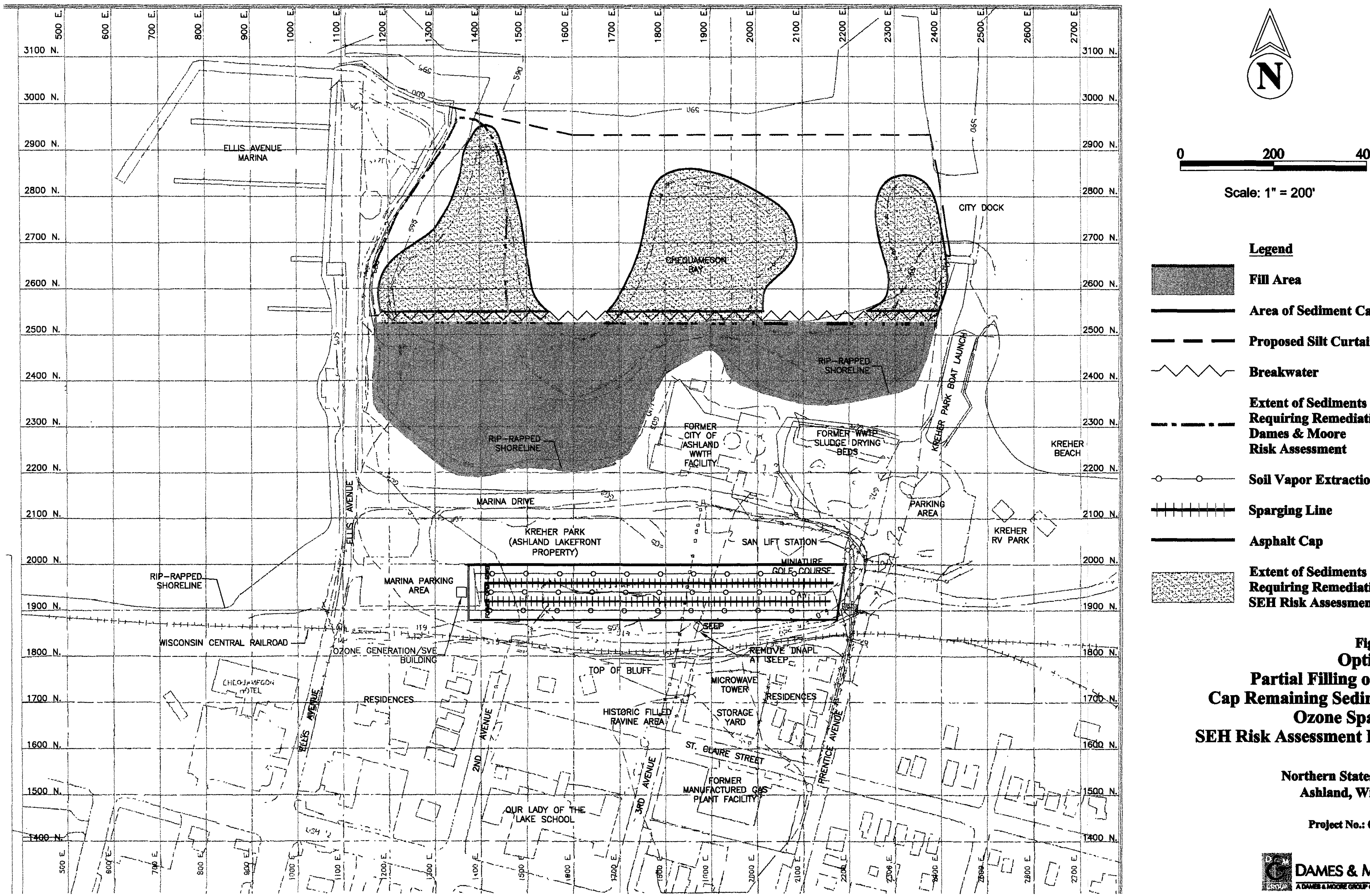

Legend

- Fill Area
- Area of Sediment Capping
- Proposed Silt Curtain
- Breakwater
- Extent of Sediments Requiring Remediation Dames & Moore Risk Assessment
- Soil Vapor Extraction Line
- Sparging Line
- Asphalt Cap
- Extent of Sediments Requiring Remediation SEH Risk Assessment

Figure 8-7

Option E1
Partial Filling of Bay/ Cap Remaining Sediments/ Ozone Sparging SEH Risk Assessment Limits

Northern States Power
Ashland, Wisconsin

Project No.: 05644-084

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

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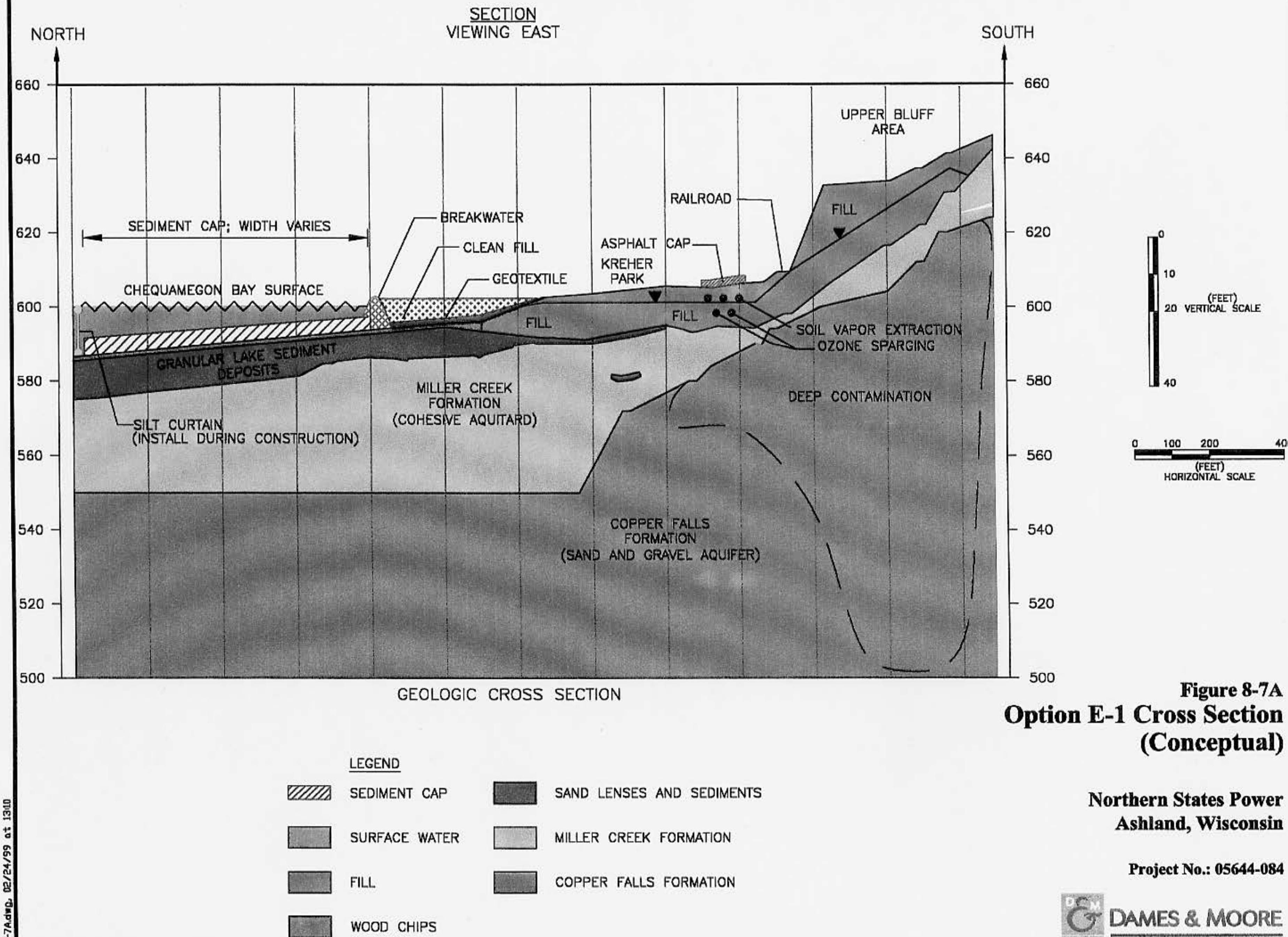

Figure 8-7A

Option E-1 Cross Section (Conceptual)

Northern States Power
Ashland, Wisconsin

Project No.: 05644-084

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

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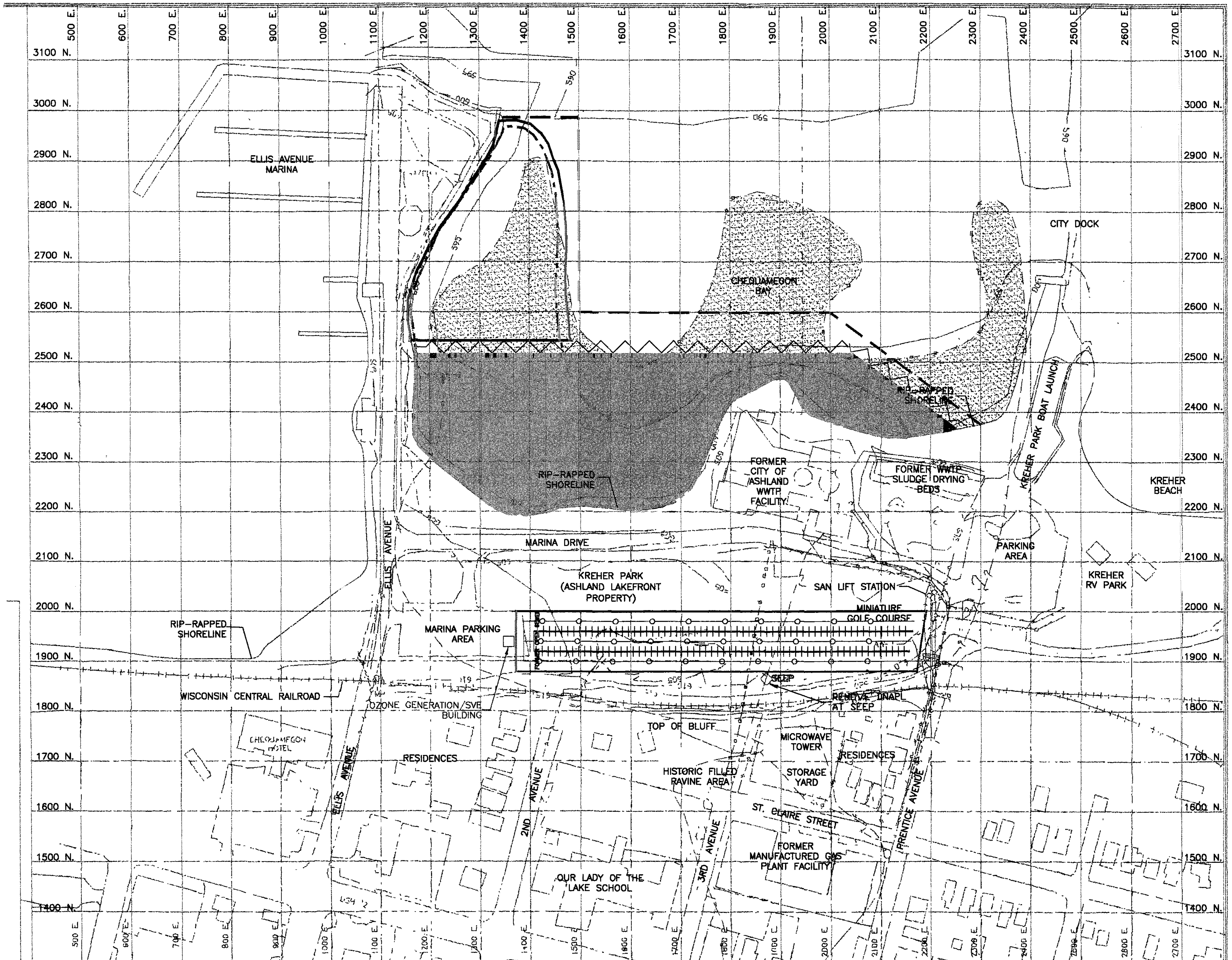


Legend

- Fill Area
- Area of Sediment Capping
- Proposed Silt Curtain
- Breakwater
- Extent of Sediments Requiring Remediation Dames & Moore Risk Assessment
- Soil Vapor Extraction Line
- Sparging Line
- Asphalt Cap
- Extent of Sediments Requiring Remediation SEH Risk Assessment

Figure 8-8

Option E2 Partial Filling of Bay/ Cap Remaining Sediments/ Ozone Sparging Dames & Moore Risk Assessment Limits

Northern States Power
Ashland, Wisconsin

Project No.: 05644-084

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

Fig_8-8.dwg, 02/26/99 at 1300

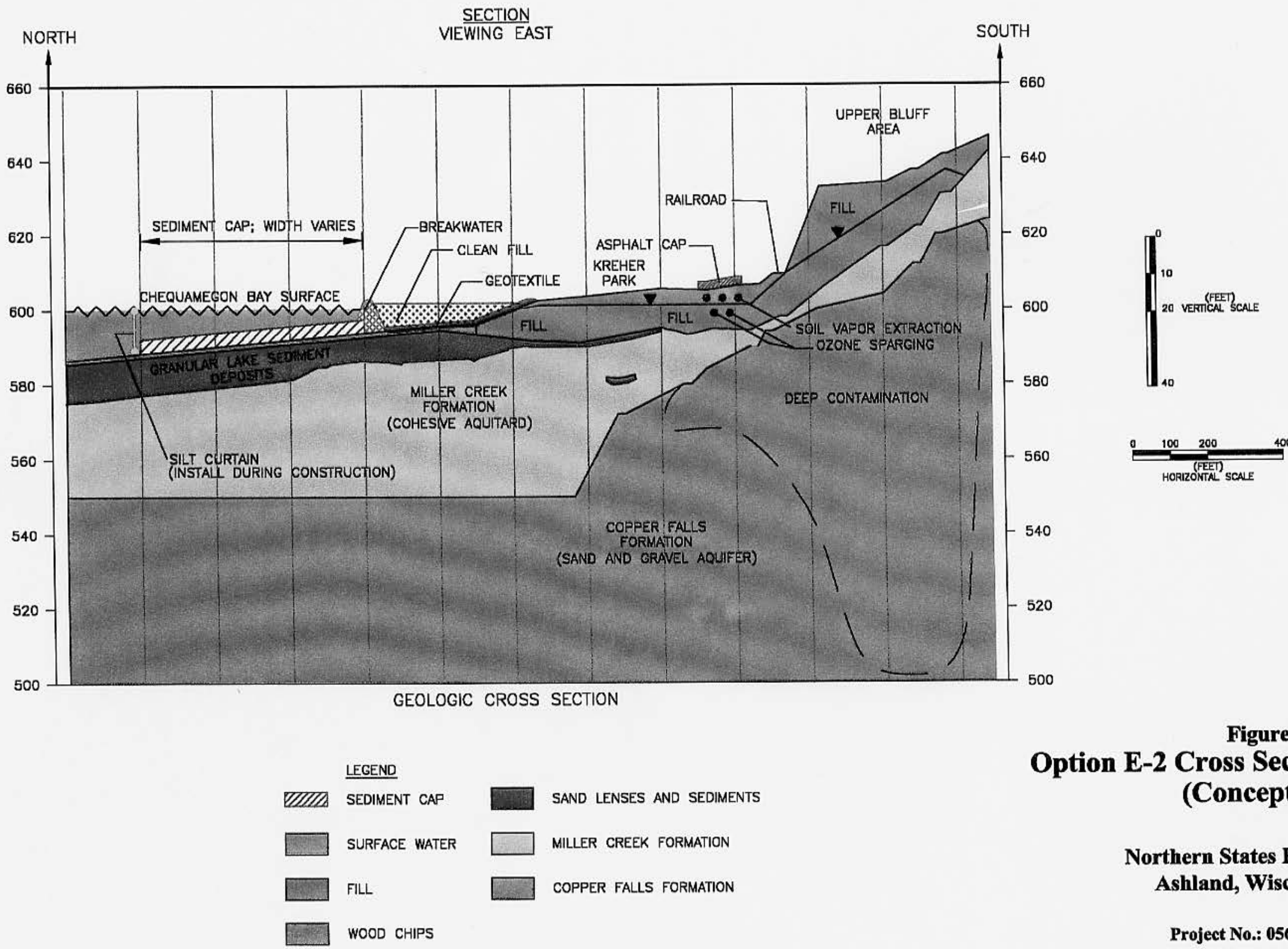


Figure 8-8A

Option E-2 Cross Section (Conceptual)

Northern States Power
Ashland, Wisconsin

Project No.: 05644-084

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

Fig_8-8A.dwg, 02/24/99 at 13:11

APPENDIX A

SEH REMEDIATION ACTION OPTIONS FEASIBILITY STUDY REVIEW COMMENTS

SEH Remediation Action Options Feasibility Study

Review Comments

General Comments

Options Overview

1. The SEH Remediation Action Options Feasibility Study (FS) presents nine options evaluated in detail ranging from a "no action" alternative to complete removal and ex-situ treatment of all contaminants. The evaluated alternatives include access/institutional controls with minimal site disturbance (with the exception of sewer rerouting and construction of a breakwater to isolate the sediments area), to complete confinement of all affected media (capping). Although the initial screening of alternatives identified other technologies that may be effectively applied at the site, these technologies were either not retained or were deferred to a value-added engineering phase during a future design effort. The cleanup criteria for affected media referenced were chs. NR 140 (groundwater) and NR 720 (soils), WAC, as well as the results of SEH's Ecological Risk Assessment study of the sediments. Additionally, the results of SEH's Human Health Risk Assessment on the Kreher Park area was referenced to justify restrictions to affected media at Kreher Park.

   The estimated costs presented for access restrictions/institutional controls (Option B1) are about $4,000,000. The next alternative in order of cost is the engineering controls/armored cap option (C2), at approximately $24,000,000. Subsequent options in order of cost range from $28,000,000 for engineering controls/thick cap (C1) to $93,000,000 for complete removal and treatment (E1). These remedial costs approach and even exceed comparable cleanup costs for the nation's most heavily contaminated Superfund sites.

   The capping/confinement options are conventional landfill closure technologies. These technologies contain and isolate the contaminants, but do not actively remediate the site. Consequently, the restoration time-frame (i.e., time to meet cleanup standards) for all the options (with the exception of complete removal) is estimated by SEH as more than 100 years.

   A significant portion of the costs for those options more complex than Option B1 are materials costs, where the costs of the cap materials constitute the bulk of the overall costs. SEH's FS does not present measures that could be taken to reduce costs for these options by reducing the cap size and materials volume, while still not compromising the environmental protection goal. We believe this can be done and our alternative FS attempts to do so. Noticeably absent from SEH's FS is the option of targeted "hot spot" removal at Kreher Park (such as at the "seep" where dense non-aqueous phase liquid (DNAPL) has been measured in well MW-7, and the "former tar dump" or wood treatment area, where DNAPL has been measured in well TW-9), coupled with access restrictions and capping restricted to the affected sediments.

Direct Contact Human Health Risk

2. A fundamental assumption presented in the SEH FS is that unacceptable risk exists at the property from surface/subsurface soil exposure, as well as groundwater exposure, as derived from the SEH Human Health Risk Assessment for both current and future conditions. However, the only area of true direct contact risk at Kreher Park is the "seep." This area is singled out as potentially affecting all populations at risk. There is no question that the seep area presents an environmental threat, because of observable contamination at the surface, as well as DNAPL in nearby shallow well MW-7. However, SEH describes on page 21 that its Human Health Risk Assessment contains such uncertainties that its utility is questionable:

> "Because of the conservative nature of many of the risk assessment assumptions calculated risk is generally thought to result in an overestimation of risk. However, site specific uncertainties may well underestimate the risk at this site."

Additionally, an apparent contradiction between the risk conditions described in the FS with regard to surface soil exposure is found in Section 3.4, Remediation Quantities (pg.25):

> "The contaminated park area covers approximately 10 acres, including the former WWTP building. In general across the site, a 1 to 2 foot layer of clean surficial soil overlies the contaminated fill which is comprised of soil mixed with slab wood and sawdust. The depth of contamination ranges from approximately 10 to 15 feet. Approximately 45,000 cubic yards of relatively clean fill overlies the impacted fill. The impacted fill occupies a volume of approximately 150,000 cubic yards, including approximately 49,000 cubic yards of wood waste." (Emphasis added)

The FS describes, in effect, that the Kreher Park site (with the exception of the seep), is already capped. Consequently, other than the contaminants at the seep which can be addressed through removal (see below), the direct contact risk described is non-existent, This renders the capping regimes described in the FS for Kreher Park largely redundant.

"Hot Spot" Removal at Kreher Park

3. Because of the existing cap at Kreher Park, the risk conditions at the Park are reduced to those potentially affected populations exposed to subsurface soil and groundwater. Once the DNAPL areas are remediated (hot spot removal and/or treatment), city utility workers could be provided personal protective equipment in accordance with OSHA requirements to eliminate the direct exposure pathway. Because the WWTP is no longer in use, most of the utilities are abandoned, indicating the need for utility rerouting and potential repair unnecessary. Additionally, the only other potential population at risk to affected media - recreational individuals exposed to groundwater - could be protected through appropriate groundwater use restrictions. This alternative, which would substantially reduce the costs below the $24,000,000 described by SEH for C2, should also reduce the restoration time-frame to meet ch. NR 140 standards to a duration less than the >100 years shown in the FS.

This would occur because natural degradation processes would not be impeded by a low permeability cap.

Sediment Remediation as Priority

4. By advocating the above option for Kreher Park, we do not diminish the need to aggressively propose active remediation for the sediments. Northern States Power has prepared an alternative FS to which these comments are appended evaluating alternative sediment capping options for two separate sediment cleanup standards. (Capping is proposed as the sediment remedial action because it most effectively satisfies the NR 720 and NCP criteria.) These sediment cleanup standards include those proposed by SEH, as well as standards proposed by Dames & Moore, which used the SEH data to develop an alternative Ecological Risk Assessment. Variations of the general approach for cleanup at Kreher Park described above are also evaluated. The costs for these options should be considered reasonable given the environmental conditions present at the site.

SEH Design Issues

5. A design component of many of the options discussed by SEH is the installation of an impermeable cutoff wall around the contaminated area to confine the contaminants and prevent further migration. Low flow pumping would be performed within this area to maintain an inward gradient. A grading layer would then be installed across the entire area (including the contaminated sediments), followed by a geomembrane and an additional soil cap (three feet or more when performing complete filling of the bay). Because no further detail of these conceptual plans are provided, several questions are generated addressing the practicality of these designs. First, we have been unable to locate contractors or other completed projects where a large scale geomembrane barrier could be installed underwater. Geotextiles have been installed at other contaminated sediment sites, followed by armor stone to protect the fabric. However, geomembranes with restrictive seaming and quality assurance requirements would make underwater installation extremely difficult. Additionally, maintaining an inward gradient given the high permeabilities of the fill at Kreher Park, as well as the presence of the lake, would not be possible with low flow pumping. The water levels could be lowered if the area were covered to prevent infiltration, or alternatively, the lake could be dewatered with high flow pumping, to allow geomembrane installation. Nothing in the FS addressed these potential impediments.

6. SEH recommends that the WDNR consider selecting either its D1 or D2 option for remediation at the site. These options include isolation of the area via a cutoff wall, filling of the bay (D1 describes complete filling; D2 describes creation of a sediment disposal area south of the 2500N line, dredging of sediment north of that line and placement in the sediment disposal area), followed by active remediation of the product and groundwater in the Kreher Park and newly created sediment aquifer. The alternative FS prepared by NSP does not consider these options nor a variation of them because we do not believe they are supportable given the existing conditions and all other considerations.

As described earlier, the environmental benefit provided by these options is not justified based upon the low level of existing risk (to both human health and the environment), the heightened risk and annoyance to the public during construction (as well as nuisance impacts), and the cost ($40,000,000 for D1, $51,000,000 for D2). The Kreher Park aquifer, as well as the new aquifer created by filling the bay, is not a usable water source. The effort and disruption caused by implementation of this option, the potential dislocation of surrounding operations such as the marina and the Kreher Park beach, and the permitting required for this large undertaking, will make these options prohibitive. SEH has not included the costs for these disruptions such as the loss of the adjacent operations during construction and the permitting requirements in its cost analyses. Additionally, dredging the sediments and the resultant impact from resuspension has not been fully evaluated by SEH (Section 6.2 of its report). Comparing these options to the environmental benefit gained, when the elimination of the current and future risks can be accomplished by a much less disruptive and much more cost-effective means (as described in the report to which these comments are attached) is not supportable. In our view, the SEH conclusions are overly protective and conservative in terms of a remedial solution.

Specific Comments

Executive Summary

1. The following statement is made in the section entitled **Site Limits:**

"The site was owned by various lumber companies until 1936."

Ashland County did not take tax deed for the property until 1939. The County chose to file a lawsuit to eject Schroeder mill workers from possession of the site in July, 1939.

2. Under **Site Background**, a reference to the Manufactured Gas Plant (MGP) is made as follows:

"During the time the MGP operated, a former ravine extending from the MGP site through the bluff to the southern edge of the Ashland Lakefront property was filled."

This statement implies that the ravine could have been open for a much longer period of time than it actually was. As documented in previous Dames & Moore reports, inspection of the Sanborn maps shows that it was filled no later than 1909.

3. Under **Site Background** the following statement is made:

"Other sources of VOC and PAH contamination may exist as well, but definitive evidence of other major sources has not been identified to date."

The use of the terms "definitive" and "major" is subjective and makes a conclusion about which NSP and the Agency are in current disagreement. It is our understanding that "definitive" evidence has been construed by SEH to mean physical remnants of underground tanks, enclosures, etc. Eyewitness accounts indicate that wood treatment operations occurred in above ground, wood enclosed structures. Thus no physical remnants are present. Accordingly, SEH's conclusion is not accurate.

4. Under **Site Background** the following sentence appears:

"This may indicate the former open sewer acted as a conduit for contaminant movement from the south side of the Ashland Lakefront Property into Chequamegon Bay and the associated near shore sediments."

This is qualified speculation that in itself is not troubling. However, the section does not state that other mechanisms may have resulted in contaminant discharges (such as former wood treatment activities, and/or direct disposal of creosote/coal tar wastes) into the bay. As with the previous statement in 4. (above), the narrative attempts to dismiss other sources. As such this language implies a direct link from the MGP site to the bay. This is not correct. The latest data developed during the fall of 1998 at the MGP site confirms that the DNAPL at the seep and that measured in the near surface fill soils at the MGP site are discreet and not connected.

5. The FS cites under the **Cleanup Goals** section that cleanup standards are established in chs. NR 140 and 720, WAC. However, very few soil cleanup standards are established in NR 720, including the majority of the contaminants measured at Kreher Park. As described in NR 700, where no specific soil, sediment or other environmental standard exists, a risk assessment or other similar procedure is used to establish site specific soil cleanup standards, before an FS is produced. Regardless, this section concludes as follows:

"Site specific cleanup goals may be established once the remedial action option has been selected."

Without setting site specific soil cleanup standards for vadose zone soils and sediments (since soil contamination above the water table is usually considered as a contaminant source), it is impossible to select an action, unless it is assumed that the remedial action is limited to contaminant removal or encapsulation. Accordingly, this approach is what SEH has taken in this FS and this approach conflicts with the process established in NR 700.

Background Information (Section 2.0)

6. This section describes the filling of Kreher Park as follows (pg. 2):

"The fill materials consisted primarily of wood slabs, pieces, and sawdust mixed with earthen fill. Some solid waste fill (e.g., bottles, brick, concrete pieces) is also present at various site locations."

Despite the amount of documentation previously provided to the Agency that Kreher Park was used as an unrestricted municipal disposal and demolition debris site, there is no mention of this historic land filling. This further attempts to skew the FS discussion on site history toward the MGP as the only documented source of contaminants.

7. Under the **Upper Bluff Area** section the following statement is made (pg. 3):

"The ravine was filled some time between 1901 and 1923 based on review of historical Sanborn Fire Insurance Maps."

As in comment 2. above, the ravine was filled no later than 1909.

8. Under the **Current and Future Land Use Conditions**, the following sentence discusses the City's position on the site (pg. 4):

"Based on discussion with the City Engineer, the City has been opposed to commercial or residential development of the property."

This comment is not consistent (with regard to commercial development) with the position the City expressed to NSP in connection with the Brownfield Grant Application submitted to the Wisconsin Department of Commerce jointly with NSP. We are unsure whether the City Engineer can speak to the overall position of the City as to development. NSP will continue to work with the City to consider alternatives not discussed in the SEH FS.

9. The **Site History** section is inaccurate with respect to the Schroeder Lumber Company. The site was owned by Schroeder until 1939. Lumber processing operations did not cease in 1930. Schroeder continued limited operations into the late 1930's. The county did not take title to the property until 1939 and sued to eject Schroeder from possession that year.

SEH makes the following statement in this same section (pg. 4):

"...no physical evidence of wood treatment facilities (e.g., historical maps, evidence of pits or tanks), has been identified at the site to date."

Sanborn maps of the lakeshore (1923) have shown oil houses at the Kreher Park site during Schroeder Lumber's tenure. Additionally, NSP has submitted sworn testimony in the form of affidavits to the WDNR of eyewitness accounts of an above ground structure where creosote treatment of railroad ties took place (1995 affidavit of Gordon Parent). Further eyewitnesses to this treatment have also recently been located (1998 Selner and Roy).

Later in this same section, SEH states the following (pg. 5):

"A 2" tar pipe has been identified on an historic (1951) set of site drawings running from the former MGP property toward the Ashland Lakefront Property. The 2" pipe aligns with an historic 'Waste Tar Dump' depicted at the Ashland Lakefront Property on the same set of site drawings."

SEH attempts to conclude that this pipe transported tar to the "Waste Tar Dump" at Kreher Park. SEH fails to mention that this pipe is shown on these drawings as only existing on the NSP property; it is not shown on the cross-section for the 3rd Street sewer extension for Kreher Park, which it would have to cross to discharge to the area labeled as "Waste Tar Dump" as alleged by SEH. SEH also fails to mention that later Lake Superior District Power (LSDP) drawings also appear to show the same 2" pipe on the NSP property, located east of two underground propane lines. Further, there is no mention in this section of NSP's subsurface investigation in the fall of 1998, which was designed to shed light on this issue. A series of trenches were excavated in the storage yard area north of St. Claire St. Three abandoned pipe lines were located. Two of these pipes were confirmed as the propane lines; a third unknown steel pipe was located west of the propane lines (no pipes were encountered east of the two propane lines). A Crane Engineering and Forensic Sciences (Minneapolis, Minnesota) report of this investigation was submitted to the Agency in November, 1998, and included a study on this unknown steel pipe that concluded that no residual tar was present, and that this pipe likely carried water or steam.

10. The section titled **Previous Studies and Reports** (pg. 6) does not reference the several review comments offered by NSP through Dames & Moore on past SEH reports.

11. The section titled **Geology** discusses the ravine in relation to the Miller Creek aquitard. It states the following (pg. 8):

"...However, the thickness of these soils (Miller Creek) has been measured at as little as four feet at one soil boring location. It is unknown whether the Miller Creek Formation exists along the base of the former ravine."

The referenced boring is at the location of the MW-5 well nest on the NSP property, near the mouth of the former ravine. Strong upward gradients have been measured north of the MW-4 well nest (located in the alley between St. Clair St. and Lakeshore Drive), in the Copper Falls Aquifer, along the axis of the ravine at all locations (including the MW-5 well nest) into Kreher Park at the MW-2(NET) well nest. South of the MW-4 well nest, the Copper Falls becomes unconfined as shown by downward gradients in the MW-6 well nest. There is a documented change in lithology from fine-grained to coarse grained soils proceeding south of the MW-4 nest that explains these hydraulic conditions. It is also this lithologic variability that likely allowed the DNAPL measured in the Copper Falls below the NSP building to penetrate to these depths.

These hydraulic conditions are described in the subsequent section titled **Hydrogeology**. Consequently, the earlier discussion on the thin Miller Creek aquitard at the MW-5 nest, and this implied relation to the unknown presence of the Miller Creek along the base of the entire ravine, is inaccurate and contradictory. Upward gradients in the Copper Falls would not be possible if the Miller Creek aquitard was not present. Additionally, the change in lithology south of the MW-4 nest has been well documented.

12. The seep is discussed on page 10. in the **Hydrogeology** section. The discussion concludes that a pipe transmitting flow from a higher head is the most plausible explanation, even though no physical evidence for this pipe has been found. Dames & Moore has stated this as a possibility for the seep since 1995. We have also theorized that this discharge could result from the northward flowing water table being forced to the surface as a result of an impermeable barrier. We have not advocated that a breech in the Miller Creek is a possible cause, since this would mean that the water table and potentiometric surface in the Copper Falls (which is several feet above the ground surface at the seep), would necessarily converge at the ground surface. Such a singularity in the flow field (where water is removed from the flow field at a point, such as at a well) could not occur naturally.

13. In the section entitled **Nature and Extent of Contamination**, SEH makes the following statement (Pg. 11):

"In addition, several areas of apparently grossly contaminated soils (e.g., 'coal tar saturated soils' in Dames & Moore borings B-19 and B-20) which were not analyzed for total concentrations of VOCs (TCLP analysis was performed) were identified during investigation of the former ravine area."

This reference is to the Dames & Moore August 1995 Site Investigation Report that clearly describes in the text and appendices that these particular soil sample composites were collected from below the water table, where matrix interference from groundwater makes soil total concentrations highly suspect. Additionally, these samples were identified as coal tar contaminated soils, not coal tar saturated soils. This is significant since no DNAPL has been measured in the ravine soils north of St. Clair St., where these two borings were advanced.

14. In the section entitled **Dense Non-Aqueous Phase Liquids**, SEH makes the following conclusion (pg. 13):

"The lack of residual DNAPL on the inside of the well casings prior to SEH's evaluation indicates the presence of DNAPL may not have previously identified."

The date of this DNAPL evaluation is not presented in this report. However, it must have occurred after SEH' first DNAPL evaluation during September, 1997, which is presented in the SEH March 1998 Supplemental Investigation Report. If the intent of this statement is that Dames & Moore did not identify this DNAPL, it is not only unprofessional but incorrect, since DNAPL measurements are first discussed at the MGP site in the Dames & Moore February 1997 report on the Copper Falls Aquifer. If the thrust of SEH's comment is that no one measured DNAPL in these wells, then they have omitted their previous work.

15. In this same section, SEH makes the following statement (pg. 14):

"The apparent low viscosity of the DNAPL and emulsified NAPL observed in the monitoring wells and piezometers indicates the potential for significant mobility of NAPLs within the subsurface."

The latest data developed by Dames & Moore during the fall of 1998 confirms that the DNAPL is restricted to discreet areas. These include the ravine south of St. Clair St., the seep, and the Copper Falls. Despite its apparent low viscosity, the current condition of the DNAPL is that it is not migrating.

16. In the section titled **Fate and Transport** (pg. 15), SEH refers to its 1997 Comprehensive Investigation report as the source for this abbreviated discussion. It goes on to say that the "...media affected by the contamination includes soil, sediment, surface water and groundwater." It should be noted that the 1997 report states clearly in the discussion entitled **Fate and Transport Summary** that the "surface water quality of Chequamegon Bay has not been assessed." Subsequent surface water data collection and analysis was performed by SEH in 1998 as part of the Ecological Risk Assessment. Twelve surface water samples were collected from below the ice; only one sample yielded a detection of one compound (benzene - 0.88 μg/l) at a level well below any standard listed. One other sample, collected during high wave action, yielded several compounds, but only one compound (benzo(a)anthracene - 0.29 μg/l) was measured above a Tier II acute level, and one other compound (benzo(a)pyrene - 0.33 μg/l) was measured above the Tier II chronic level. Based upon this data, surface water impacts appear extremely limited. (This is a significant issue with regard to the Ecological Risk Assessment, which has been addressed separately in Dames & Moore's December 1998 review comments letter to Jamie Dunn on this report.)

17. In this same section, SEH claims that DNAPL migration in the ravine fill likely occurred under the influence of gravity. As described in 15. above, this is again speculative, since no DNAPL has been identified north of St. Clair St. in the ravine.

18. In this same section, SEH attributes variations in concentration and distribution of individual PAHs or VOCs to different waste sources (MGP versus wood treatment wastes), and historic operations at the MGP (switching from coal carbonization to carbureted water gas). Note that the plant primarily operated as a water gas or carbureted water gas plant. Only for one year (1917), operating records indicate a small amount of coal gas production.

19. In the section titled **Risk Assessment** (pg. 18), under the discussion on the Human Health Risk Assessment, the last two paragraphs attempt to recognize that uncertainties caused by the variability of the contaminants studied along with the lack of information on the "immiscible tar-like organic fraction," may lead to site risks that are not accurate in predicting risk from exposure to the mixture. This statement is critical to the further discussion of alternatives, since SEH assumes that the risks presented in the Human Health Risk Assessment for Kreher Park warrant either a $40,000,000 or $51,000,000 dollar remediation requiring encapsulation and in-situ remediation. During a public meeting on July 25, 1998, the Wisconsin Department of Health and Social Services (DHSS) stated that

the direct risks to human health at the site are not significant, except at the seep. The uncertainty of risk to which SEH has admitted as described in its Human Health Risk Assessment makes its recommendation highly questionable, and suggests that it may have overstated the actual risk.

20. In this same section under the discussion on the Ecological Risk Assessment SEH concludes that impacts to the benthic and fish communities could occur because of exposure to contaminated sediments and water. Dames & Moore has previously commented on the Ecological Risk Assessment. We reiterate that the SEH' conclusion that an unacceptable risk from exposure to contaminated water is present is speculative, since surface water samples yielded very few compounds, only two of which exceeded proposed limits.

21. In the section entitled **Remedial Action Objectives** (pg. 24), SEH presents sediment cleanup goals at "10 HA-28 NOC toxicity units (which) correlate to a total PAH concentration between 2500 to 3000 μg/g on a dry weight basis and 80 μg/g TOC on a total organic carbon normalized basis (assuming 3.5% TOC)." As stated in our comments on the Ecological Risk Assessment, we believe these standards are inappropriate because these limits are based on effects to individuals. We present a methodology establishing effects to populations, which USEPA has sanctioned at other sites.

22. SEH writes in this same section as they have previously (see 5. above), that site specific cleanup goals (for sediment) "may be established once a remedial option is selected." This is contradictory with the SEH statement described in 21. above, where SEH provides a cleanup standard for sediment.

23. In the subsection titled **Remediation Quantities** (pg. 25), SEH describes its methodology used to compute the amount of tar in the environment. Two methods are used: One attempts a direct calculation of residual NAPL by extrapolating an average tar thickness measured in various media; the second calculates the original tar released based on the fraction of benzo(a)pyrene (B(a)P) measured in samples collected at Kreher Park and the sediments. The first yields a range of 45,000 to 155,000 gallons of waste tar present. SEH does not state how the average thicknesses of waste tar used for this calculation was derived. Consequently, we are unable to provide a meaningful critique of this method.

    With regard to the second method, SEH states that B(a)P was selected because its recalcitrance would provide concentrations most representative of the tar material when first released. They compare these B(a)P concentrations in representative samples to a total BAP fraction of 0.1% to 0.3% in MGP tars, to yield a range of about 136,000 to 394,000 gallons. This method is inherently flawed because of the following:

    (a.) In the *Handbook on Manufactured Gas Plant Sites* (Environmental Research & Technology, Inc., 1984) the range presented for the B(a)P fraction of coal tars varies from 0.176% to 3.0%. Applying this range to the unit volumes derived by SEH causes the range of coal tar at the site to vary by more than an order of magnitude (from about 200,000 to nearly 4,000,000 gallons). Consequently, the variation in the reported coal tar fraction for this compound prevents a meaningful calculation

(b.) If the recalcitrant behavior of B(a)P allows its current measured concentrations to indicate the true volume of coal tar released, a sensitivity analysis using other coal tar constituents with established coal tar fractions should yield quantity values lower than those for B(a)P. This is because these components would have decreased over time due to natural processes. An example compound would be naphthalene, for which the same source mentioned in (a.) above gives a coal tar fraction of about 10.9%. Initial tar quantities calculated from measured concentrations of naphthalene could not be greater than those computed from B(a)P levels, unless they originated from some other source than coal tar. However, when the same samples that SEH utilized for the B(a)P levels are evaluated using naphthalene levels, much higher tar quantities are computed (see Section 3.4 of this report).

24. In the **Treatability Studies** section under the **Sediment Settling and Contaminant Dispersion** subsection (pg. 33), SEH describes a series of lab tests performed to evaluate the settling properties of the contaminated sediments if dredged. SEH concludes the subsection stating that "...details of the study are currently being documented and will be released as a separate report." This is another reference in the document where a later analysis could be used (with regards to dredging) to affect remedy selection. It is common in the FS process to defer details needed for design of a remedy to a pilot test or design phase. However, there should be sufficient information for the FS to compare options and allow the document to be a tool to select a remedy. However, when an entire range of options or technologies (e.g., dredging) is not discussed because of the lack of data, it makes the FS incomplete at best.

25. In the Comparison of **Remedial Action Options**, SEH states the following (pg. 62):

"The scoring system provides a balanced system to give equal weight to the six technical and economic criteria specified in s. NR 722.07(4)."

No description of the methodology used or the factors considered to assign a certain score to a criterion within the 1 - 10 range is provided. Consequently, the assigning of arbitrary numbers to each criterion for each option can skew the analysis such that the separation between total scores is questionable (e.g., the difference between a score of eight or nine is indeterminate). Please see Section 9.0 to which these comments are appended for an alternative scoring technique.

Specific comments with regard to the detailed evaluation of the nine selected options are not discussed. Please refer to the <u>General Comments</u> presented at the beginning of this review.

APPENDIX B

DETAILED REMEDIAL OPTION COST ESTIMATES

Summary of Estimated Costs
Alternative B-1

Initial Capital Construction Costs			
Institutional Controls		20,000.00	
Seep Removal		83,500.00	
Cap Installation		3,976,229.50	
Subtotal		4,079,729.50	
Contingency	20.0%	815,945.90	
Planning & Permitting	7.5%	305,979.71	
Engineering	10.0%	407,972.95	
Construction Oversight	10.0%	407,972.95	
Cap Installation pilot test	5.0%	203,986.48	
Subtotal, Capital Costs Alternative B-1		$6,221,587.49	
LongTerm Operations, Maintenance, and Monitoring Costs			
Groundwater Sampling		16,290.00	
Cap Maintenance		20,000.00	
Subtotal		36,290.00	
Contingency	20%	7,258.00	
Subtotal Annual OM&M Costs		$43,548.00	
Capitalized Costs			
Operation Period, N (years)		40	30
Assumed Discount Factor, i		5%	7%
Present Worth Factor (for i,N)		17.1591	12.4090
Annual OM&M Costs		43,548.00	43,548.00
Present Worth, OM&M		747,243.89	540,388.93
Intitial Capital Costs		6,221,587.49	6,221,587.49
Capitalized Total Costs		6,968,831.38	6,761,976.41
Annualized Costs			
Operation Period, N (years)		$40	$30
Assumed Discount Factor, i		5%	7%
Amoritization Factor, (for i, N)		0.0583	0.0806
Initial Capital Costs		6221587.488	6221587.488
Amortized Capital Costs		362582.6783	501375.3597
Annual OM&M Costs		43548	43548
Annualized Total Costs		406130.6783	544923.3597

Summary of Estimated Costs
Alternative B-2

Initial Capital Construction Costs			
Institutional Controls		*20,000.00*	
Seep Removal		*83,500.00*	
Cap Installation		*2,484,049.50*	
Subtotal		*2,587,549.50*	
Contingency	*20%*	*517,509.90*	
Planning & Permitting	*7.5%*	*194,066.21*	
Engineering	*10%*	*258,754.95*	
Construction Oversight	*10%*	*258,754.95*	
Cap Installation pilot test	*5%*	*129,377.48*	
Subtotal, Capital Costs Alternative B-2		*$3,946,012.99*	
LongTerm Operations, Maintenance, and Monitoring Costs			
Cap Maintenance		*20,000.00*	
Groundwater Sampling		*16,290.00*	
Subtotal		*36,290.00*	
Contingency	*20%*	*7,258.00*	
Subtotal Annual OM&M Costs		*$43,548.00*	
Capitalized Costs			
Operation Period, N (years)		*40*	*30*
Assumed Discount Factor, i		*5%*	*7%*
Present Worth Factor (for i,N)		*17.1591*	*12.4090*
Annual OM&M Costs		*43,548.00*	*43,548.00*
Present Worth, OM&M		*747,243.89*	*540,388.93*
Intitial Capital Costs		*3,946,012.99*	*3,946,012.99*
Capitalized Total Costs		*4,693,256.88*	*4,486,401.91*
Annualized Costs			
Operation Period, N (years)		*$40*	*$30*
Assumed Discount Factor, i		*5%*	*7%*
Amoritization Factor, (for i, N)		*0.0583*	*0.0806*
Initial Capital Costs		*3946012.988*	*3946012.988*
Amortized Capital Costs		*229966.3808*	*317994.9949*
Annual OM&M Costs		*43548*	*43548*
Annualized Total Costs		*273514.3808*	*361542.9949*

Summary of Estimated Costs
Altemative C-1

Initial Capital Construction Costs			
Institutional Controls		*20,000.00*	
Seep Removal		*83,500.00*	
Ozone Sparge System		*652,981.80*	
Cap Installation		*3,976,229.50*	
Subtotal		*4,732,711.30*	
Contingency	*20.0%*	*946,542.26*	
Planning & Permitting	*7.5%*	*354,953.35*	
Engineering	*10.0%*	*473,271.13*	
Construction Oversight	*10.0%*	*473,271.13*	
Cap Installation pilot test	*5.0%*	*236,635.57*	
Subtotal, Capital Costs Altemative C-1		*$7,217,384.73*	
LongTerm Operations, Maintenance, and Monitoring Costs			
Groundwater Sampling		*16,290.00*	
Cap Maintenance		*20,000.00*	
Sparge O&M		*60,360.00*	
Subtotal		*96,650.00*	
Contingency	*20%*	*19,330.00*	
Subtotal Annual OM&M Costs		*$115,980.00*	
Capitalized Costs			
Operation Period, N (years)		*40*	*30*
Assumed Discount Factor, i		*5%*	*7%*
Present Worth Factor (for i,N)		*17.1591*	*12.4090*
Annual OM&M Costs		*115,980.00*	*115,980.00*
Present Worth, OM&M		*1,990,110.84*	*1,439,200.60*
Intitial Capital Costs		*7,217,384.73*	*7,217,384.73*
Capitalized Total Costs		*9,207,495.57*	*8,656,585.33*
Annualized Costs			
Operation Period, N (years)		*$40*	*$30*
Assumed Discount Factor, i		*5%*	*7%*
Amoritization Factor, (for i, N)		*0.0583*	*0.0806*
Initial Capital Costs		*7217384.733*	*7217384.733*
Amortized Capital Costs		*420615.9106*	*581623.0783*
Annual OM&M Costs		*115980*	*115980*
Annualized Total Costs		*536595.9106*	*697603.0783*

Summary of Estimated Costs
Alternative C-2

Initial Capital Construction Costs			
Institutional Controls		*20,000.00*	
Seep Removal		*83,500.00*	
Cap Installation		*2,484,049.50*	
Ozone Sparge System		*652,981.80*	
Subtotal		*3,240,531.30*	
Contingency	*20%*	*648,106.26*	
Planning & Permitting	*7.5%*	*243,039.85*	
Engineering	*10%*	*324,053.13*	
Construction Oversight	*10%*	*324,053.13*	
Cap Installation pilot test	*5%*	*162,026.57*	
Subtotal, Capital Costs Alternative C-2		*$4,941,810.23*	
LongTerm Operations, Maintenance, and Monitoring Costs			
Cap Maintenance		*20,000.00*	
Groundwater Sampling		*16,290.00*	
Sparge O&M		*60,360.00*	
Subtotal		*96,650.00*	
Contingency	*20%*	*19,330.00*	
Subtotal Annual OM&M Costs		*$115,980.00*	
Capitalized Costs			
Operation Period, N (years)		*40*	*30*
Assumed Discount Factor, i		*5%*	*7%*
Present Worth Factor (for i,N)		*17.1591*	*12.4090*
Annual OM&M Costs		*115,980.00*	*115,980.00*
Present Worth, OM&M		*1,990,110.84*	*1,439,200.60*
Intitial Capital Costs		*4,941,810.23*	*4,941,810.23*
Capitalized Total Costs		*6,931,921.07*	*6,381,010.83*
Annualized Costs			
Operation Period, N (years)		*$40*	*$30*
Assumed Discount Factor, i		*5%*	*7%*
Amoritization Factor, (for i, N)		*0.0583*	*0.0806*
Initial Capital Costs		*4941810.233*	*4941810.233*
Amortized Capital Costs		*287999.6132*	*398242.7135*
Annual OM&M Costs		*115980*	*115980*
Annualized Total Costs		*403979.6132*	*514222.7135*

Summary of Estimated Costs
Alternative D-1

Initial Capital Construction Costs			
Institutional Controls		20,000.00	
Seep Removal		83,500.00	
Cap Installation		2,289,804.00	
Lake Fill Area		3,745,058.72	
Breakwater		1,800,000.00	
Subtotal		7,938,362.72	
Contingency	20%	1,587,672.54	
Planning & Permitting	7.5%	595,377.20	
Engineering	10%	793,836.27	
Construction Oversight	10%	793,836.27	
Cap Installation pilot test	5%	396,918.14	
Subtotal, Capital Costs Alternative D-1		$12,106,003.15	
LongTerm Operations, Maintenance, and Monitoring Costs			
Cap Maintenance		20,000.00	
Groundwater Sampling		16,290.00	
Subtotal		36,290.00	
Contingency	20%	7,258.00	
Subtotal Annual OM&M Costs		$43,548.00	
Capitalized Costs			
Operation Period, N (years)		40	30
Assumed Discount Factor, i		5%	7%
Present Worth Factor (for i,N)		17.1591	12.4090
Annual OM&M Costs		43,548.00	43,548.00
Present Worth, OM&M		747,243.89	540,388.93
Intitial Capital Costs		12,106,003.15	12,106,003.15
Capitalized Total Costs		12,853,247.04	12,646,392.07
Annualized Costs			
Operation Period, N (years)		$40	$30
Assumed Discount Factor, i		5%	7%
Amoritization Factor, (for i, N)		0.0583	0.0806
Initial Capital Costs		12106003.15	12106003.15
Amortized Capital Costs		705515.6025	975579.2546
Annual OM&M Costs		43548	43548
Annualized Total Costs		749063.6025	1019127.255

Summary of Estimated Costs
Alternative D-2

Initial Capital Construction Costs			
Institutional Controls		*20,000.00*	
Seep Removal		*83,500.00*	
Cap Installation		*2,289,804.00*	
Lake Fill Area		*3,436,050.72*	
Breakwater		*1,650,000.00*	
Subtotal		*7,479,354.72*	
Contingency	*20%*	*1,495,870.94*	
Planning & Permitting	*7.5%*	*560,951.60*	
Engineering	*10%*	*747,935.47*	
Construction Oversight	*10%*	*747,935.47*	
Cap Installation pilot test	*5%*	*373,967.74*	
Subtotal, Capital Costs Alternative D-2		*$11,406,015.95*	
LongTerm Operations, Maintenance, and Monitoring Costs			
Cap Maintenance		*20,000.00*	
Groundwater Sampling		*16,290.00*	
Subtotal		*36,290.00*	
Contingency	*20%*	*7,258.00*	
Subtotal Annual OM&M Costs		*$43,548.00*	
Capitalized Costs			
Operation Period, N (years)		*40*	*30*
Assumed Discount Factor, i		*5%*	*7%*
Present Worth Factor (for i,N)		*17.1591*	*12.4090*
Annual OM&M Costs		*43,548.00*	*43,548.00*
Present Worth, OM&M		*747,243.89*	*540,388.93*
Intitial Capital Costs		*11,406,015.95*	*11,406,015.95*
Capitalized Total Costs		*12,153,259.84*	*11,946,404.87*
Annualized Costs			
Operation Period, N (years)		*$40*	*$30*
Assumed Discount Factor, i		*5%*	*7%*
Amoritization Factor, (for i, N)		*0.0583*	*0.0806*
Initial Capital Costs		*11406015.95*	*11406015.95*
Amortized Capital Costs		*664721.6357*	*919169.8036*
Annual OM&M Costs		*43548*	*43548*
Annualized Total Costs		*708269.6357*	*962717.8036*

Summary of Estimated Costs
Alternative E-1

Initial Capital Construction Costs		
Institutional Controls		*20,000.00*
Seep Removal		*83,500.00*
Cap Installation		*2,289,804.00*
Lake Fill Area		*3,745,058.72*
Breakwater		*1,800,000.00*
Ozone Sparge System		*652,981.80*
Subtotal		*8,591,344.52*
Contingency	*20%*	*1,718,268.90*
Planning & Permitting	*7.5%*	*644,350.84*
Pilot Testing	*5%*	*429,567.23*
Engineering	*10%*	*859,134.45*
Construction Oversight	*10%*	*859,134.45*
Cap Installation pilot test	*5%*	*429,567.23*
Subtotal, Capital Costs Alternative E-1		*$13,531,367.62*

LongTerm Operations, Maintenance, and Monitoring Costs		
Cap Maintenance		*20,000.00*
Groundwater Sampling		*16,290.00*
Sparge O&M		*60,360.00*
Subtotal		*96,650.00*
Contingency	*20%*	*19,330.00*
Subtotal Annual OM&M Costs		*$115,980.00*

Capitalized Costs		
Operation Period, N (years)	*40*	*30*
Assumed Discount Factor, i	*5%*	*7%*
Present Worth Factor (for i,N)	*17.1591*	*12.4090*
Annual OM&M Costs	*115,980.00*	*115,980.00*
Present Worth, OM&M	*1,990,110.84*	*1,439,200.60*
Intitial Capital Costs	*13,531,367.62*	*13,531,367.62*
Capitalized Total Costs	*15,521,478.45*	*14,970,568.22*

Annualized Costs		
Operation Period, N (years)	*$40*	*$30*
Assumed Discount Factor, i	*5%*	*7%*
Amoritization Factor, (for i, N)	*0.0583*	*0.0806*
Initial Capital Costs	*13531367.62*	*13531367.62*
Amortized Capital Costs	*788583.2229*	*1090444.251*
Annual OM&M Costs	*115980*	*115980*
Annualized Total Costs	*904563.2229*	*1206424.251*

Summary of Estimated Costs
Alternative E-2

Initial Capital Construction Costs			
Institutional Controls		20,000.00	
Seep Removal		83,500.00	
Cap Installation		2,289,804.00	
Lake Fill Area		3,436,050.72	
Breakwater		1,650,000.00	
Ozone Sparge System		652,981.80	
Subtotal		8,132,336.52	
Contingency	20%	1,626,467.30	
Planning & Permitting	7.5%	609,925.24	
Pilot Testing	5%	406,616.83	
Engineering	10%	813,233.65	
Construction Oversight	10%	813,233.65	
Cap Installation pilot test	5%	406,616.83	
Subtotal, Capital Costs Alternative E-2		$12,808,430.02	
LongTerm Operations, Maintenance, and Monitoring Costs			
Cap Maintenance		20,000.00	
Groundwater Sampling		16,290.00	
Sparge O&M		60,360.00	
Subtotal		96,650.00	
Contingency	20%	19,330.00	
Subtotal Annual OM&M Costs		$115,980.00	
Capitalized Costs			
Operation Period, N (years)		40	30
Assumed Discount Factor, i		5%	7%
Present Worth Factor (for i,N)		17.1591	12.4090
Annual OM&M Costs		115,980.00	115,980.00
Present Worth, OM&M		1,990,110.84	1,439,200.60
Intitial Capital Costs		12,808,430.02	12,808,430.02
Capitalized Total Costs		14,798,540.85	14,247,630.62
Annualized Costs			
Operation Period, N (years)		$40	$30
Assumed Discount Factor, i		5%	7%
Amoritization Factor, (for i, N)		0.0583	0.0806
Initial Capital Costs		12808430.02	12808430.02
Amortized Capital Costs		746451.7489	1032185.31
Annual OM&M Costs		115980	115980
Annualized Total Costs		862431.7489	1148165.31

APPENDIX C

CRANE ENGINEERING PIPE SECTION ANALYSIS REPORT

CRANE
ENGINEERING AND
FORENSIC SERVICES

3905 Annapolis Lane North, Plymouth, Minnesota 55447
(612) 557-9090 (24 Hours)
Fax (612) 557-0710
1-800-538-2797

RECEIVED
OCT 19 1998

October 15, 1998

Mr. David P. Trainor
Dames & Moore
25 Kessel Court, Suite 201
Madison, WI 53711-6227

RE:	Crane Lab No.:	98N-533
	Crane File No.:	M3137K
	Your P.O. No.:	MSN-5-0998-0125

Examination of Excavated Pipe Sample

Crane Engineering and Forensic Services received a section of pipe on September 29, 1998. The pipe section was reportedly excavated from a site near Ashland, Wisconsin. We were asked to: 1) determine if hydrocarbon residues could be detected inside the pipe, 2) determine the composition of the pipe, and 3) estimate the age of the pipe.

Solvent Extraction Tests

The pipe interior was extracted by rinsing the I.D. several times with approximately 100-ml of methylene dichloride (dichloromethane). One end of the pipe was then blocked, an additional 100-ml of methylene dichloride was added, and the pipe was agitated for three minutes to further extract the I.D. surfaces.

The extracts were combined and analyzed by Gas Chromatography using a Mass Spectrometer detector (GC/MS). The data indicated that the extraction solvent *did not contain any organic materials.*

Pipe Composition

A segment was cut from the pipe and analyzed to determine the chemical composition. Table I shows the composition of the pipe along with the specified limits from ASTM A53, Type F, Furnace Welded Pipe.

Table I. Chemical Composition

Element, %	Pipe Sample	ASTM A53 (Maximum)
Carbon	0.07	0.30
Manganese	0.43	1.20
Phosphorus	0.060	0.05
Sulfur	0.028	0.045
Silicon	0.03	--
Chromium	0.01	0.40
Nickel	0.01	0.40
Molybdenum	0.01	0.15
Copper	<0.01	0.40
Vanadium	<0.01	0.08
Aluminum	<0.01	--

The phosphorus content is slightly high on the pipe sample. This could indicate an older steel manufactured when melting practices did not give the phosphorus control common with current steel making technology. All other elements are well within the specified limits.

Visual Examination

The pipe sample was sectioned in order to more closely examine the interior condition. Photos 1 through 6 show the sectioned pipe and the rusty residues on the inside walls. The arrows in photo 6 indicate the weld seam. The O.D. of the pipe is nominally 2.37" and the wall thickness is 0.16" to 0.17." This would conform to NPS 2 Schedule 40 pipe or standard 2" pipe of ASTM A53.

Microstructural Examination

A small section at the weld seam was mounted in plastic, ground, polished, and etched for microstructural examination. Photos 7 and 8 show the steel microstructure at the weld region (the arrows indicate the weld line). The microstructure is ferrite with a small amount of pearlite indicative of a low carbon steel. The weld fusion line is narrow and typical of a furnace butt weld.

SUMMARY

Solvent extraction testing with GC/MS indicates no hydrocarbon residues in this pipe. The pipe composition and weld characteristics indicate a common black pipe grade often used for water, compressed air, natural gas, and steam. The rusty residue indicates water had collected in this pipe section at one time.

The exact age of the pipe is uncertain. Furnace butt welded pipe has been used since prior to World War I. ASTM A53 was originally issued in 1915. This type of pipe was qualified for steam service in the 1920's. The slightly high phosphorus and the low copper would indicate an acid open hearth steel. This melting practice was common prior to World War II. This pipe was most likely manufactured between 1920 and 1940.

CONCLUSIONS

Based on these test results, this pipe section is a common grade of welded steel pipe. The pipe was furnace butt welded. The pipe was probably used to transport water, steam or compressed air at low pressure. There is no evidence that the pipe ever transported hydrocarbons. It is highly unlikely that this pipe was manufactured prior to 1920.

Please contact me should you have any questions or require further information.

Respectfully submitted,

CRANE ENGINEERING AND FORENSIC SERVICES

Dave Kramer

Dave Kramer, P.E.
Metallurgical Engineer
Minnesota License No. 10526

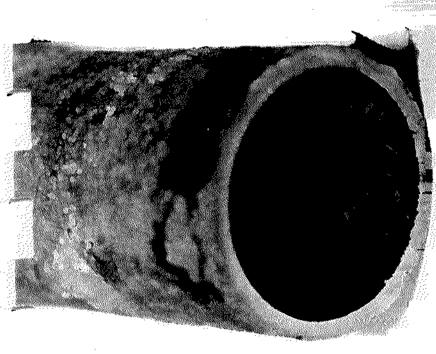
DK:jfd

Attachments: (8) photographs

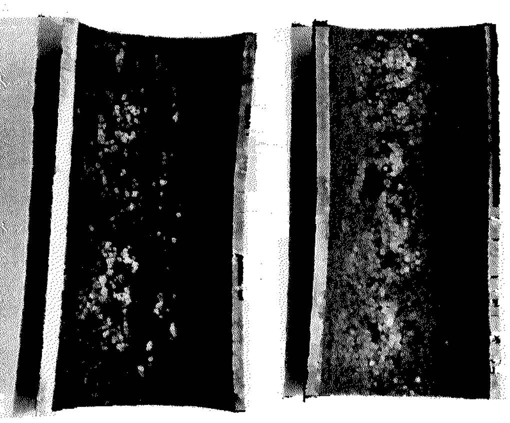
1

2

3



4



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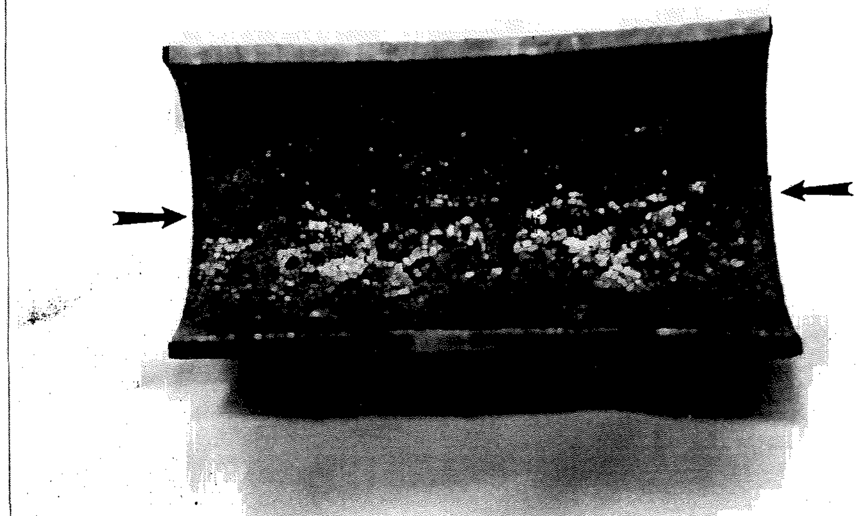
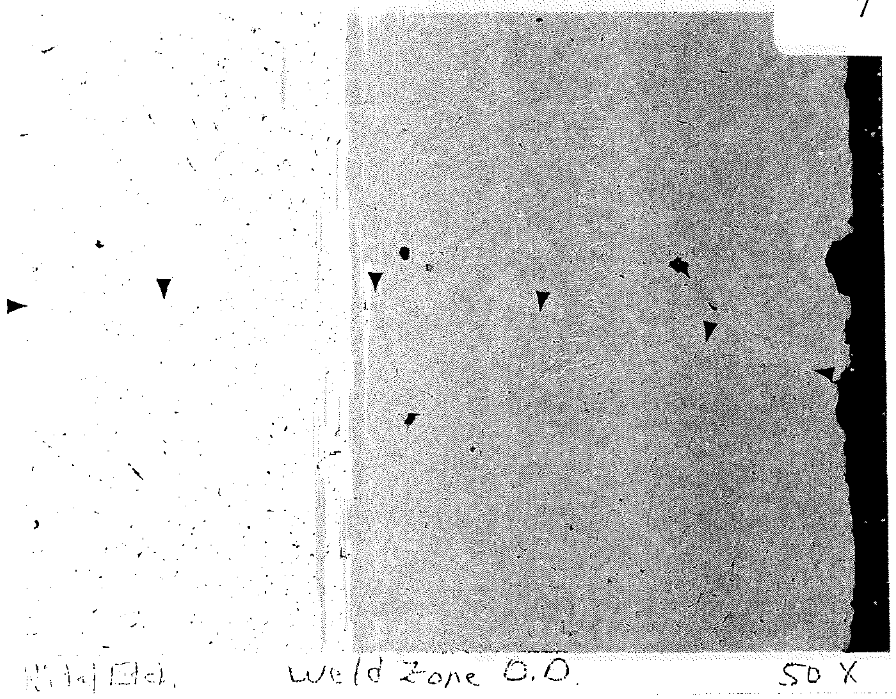
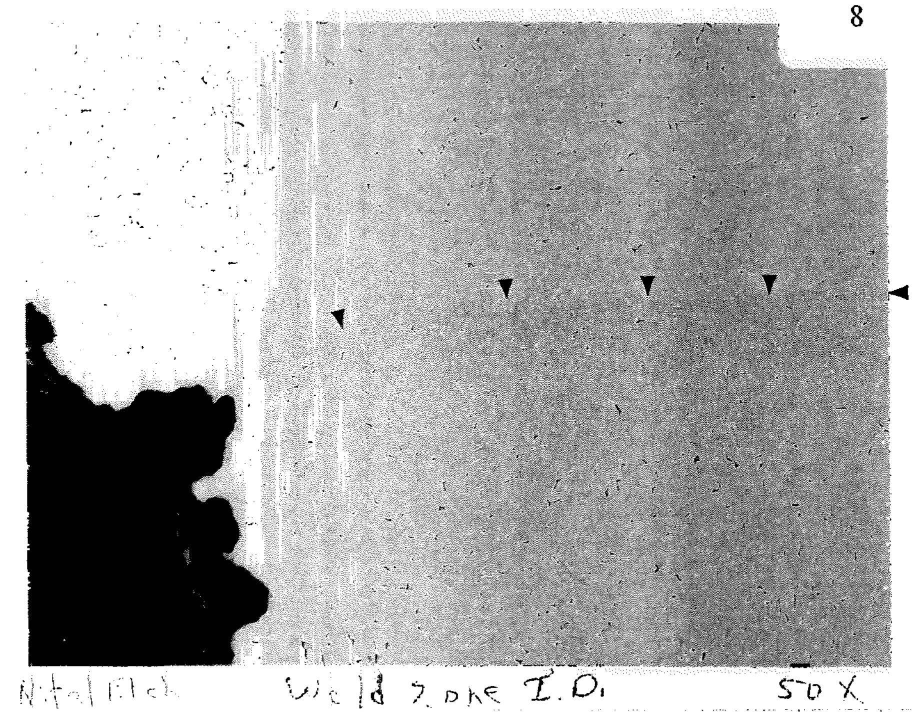
6



7



8



APPENDIX D
GAS AND TAR PRODUCTION AND RELEASE INFORMATION

DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

25 Kessel Court, Suite 201
Madison, Wisconsin 53711-6227
608 273 2886 Tel
608 273 3415 Fax

December 4, 1998

Mr. Dave Crass
Michael Best & Friedrich
One South Pinckney
P.O. Box 1806
Madison, WI 53701-1806

RE: Gas and Tar Production and Release Estimates
Former MGP - NSP Ashland

Dear Dave:

This letter summarizes the results of our research into the operation and production of manufactured gas and tars at the former LSDP manufactured gas plant (MGP) facility in Ashland, Wisconsin. Information is presented that substantiates the gas production for each year of operation from 1885 - 1946, the likely quantity of tar produced in from the manufacturing process, and the quantity of coal tar product residue measured in the environment near the former MGP and near the former Schroeder Lumber operations.

I. Gas Production

Historic Operating Reports

In our March 2, 1998 letter to the WDNR, we computed a total gas production quantity of 1,371,968 mcf of gas produced at the plant during it's 62 year operating life. This was based primarily on data provided following NSP's review of Brown's Directories of Gas Statistics on American Gas companies for the years 1899 - 1947-48. In that letter, for those years where data was unavailable (as for years 1885-97), we assumed an annual gas production quantity equal to the first year's reported data (1898). For other years where data was missing (1899, 1915, 1939) a gas production volume was interpolated from previous and subsequent years' data.

To refine these calculations, we reviewed the further documentation you provided. Documents reviewed included Brown's Directories for all years between 1899 and 1947-48 (corresponding to production years 1898 - 1946), and LSDP annual operating and financial reports to the Railroad Commission of Wisconsin (for several years prior to 1923).

The results of these reviews are summarized on the attached table. Unlike the previous study described in the March 2 letter, gas production data from Brown's was available for 1899 and 1939. Additionally, data was available for production years 1908, 1921, 1922, 1931-1933, 1938-1939, and 1944 which was not previously reviewed. For comparison purposes, annual records for each registry are shown. Note that for each entry where both records are available, the values are either identical or nearly so. The only year for which values differ significantly between the two is for 1908, which is the first year for which LSDP data are is available. For this year, Brown's reports the same value as that for the previous year. Note that this same result occurs in 1932 and 1938; the Brown's data in those years are is the same as the previous year's reported value. Consequently, LSDP values in lieu of Brown's values were used for those years.

This more complete database yields a total gas production quantity of 1,392,496.70 mcf over the life of the MGP. This value compares to a total volume of 1,371,968 mcf reported in the March 2 letter, an increase of 20,528.7 mcf, or less than 1.5 percent of the value computed in the March 2 letter.

Sales Versus Production Quantities

The March 2 letter was prompted by a WDNR letter of February 20 (and amendment of February 24) which computed a total quantity of 1,562,961 mcf. This was based on one year of gas production data in Brown's (1935), as well as one year of earlier NSP data (Dames & Moore, March 1995), that reported several years of gas sales versus gas production quantities. The WDNR's total gas production volume assumed a 13 percent differential between gas production and gas sales data for all years as reported in the March 1995 report. This difference was based on the 1935 Brown's information. Although gas sales data were used for some of these years in the earlier report, the Department's estimate was flawed because this assumption was applied to the entire plant operating life. This revised estimate of 1,392,496.70 mcf is considerably more accurate because it is based on contemporaneously reported production data.

II. Tar Production

Background

The above total gas production volume estimate is important because of the bearing it has on the total tar quantity produced over the operating life of the MGP. Our March 2 letter provided a total tar production value of 602,294 gallons during the plant life, based upon an average ratio of 0.439 gallons tar/mcf of gas produced. This ratio was arrived at by comparing the total gas produced against the total tar produced for those years (1939, 1941 and 1944) for which both values were recorded. Our recent research did not yield additional tar production records. Consequently, we evaluated the gas production processes used at the MGP in conjunction with published tar-to-gas ratio data references to validate our earlier tar production estimates.

Gas Production Processes

The gas production process utilized at the MGP is listed in the Brown's Directories, and is shown in the second column of the attached table. The Brown's Directories identify changes in the plant's gas production processes that appear to be variants on the Lowe process, first reported from 1898 to 1901. For example, from 1902 to 1908, the method listed is *Moses(water)*, and then from 1909 to 1911 is *Lowe(Moses)*. From 1912 to 1916, the method named is *Oil*, followed by *Oil and Coal* through 1920, where in turn the method is listed as *Water Gas* through 1946.

Our March 1995 report presumed that the plant manufactured gas using a carbonization process until 1920, when the process was changed to gasification. Carbonization was the conventional coal gas process, and gasification resulted in carbureted water-gas (CWG). Based on what has been recently reviewed, we now believe the plant operated as a CWG plant during its entire life.

As shown, several process changes occurred at the Ashland MGP after production methods first were reported in 1898. Nothing specific about the first reported method (Lowe) is known; however, USEPA[1] (1988) identifies Lowe as the inventor of CWG in 1875. It is also important to note that when LSDP operating report data for years after 1908 was recently reviewed, the manufactured gas process reported is water gas, not coal gas. LSDP operating reports show standard ledger sheets with coal gas input values blank, whereas water gas values for all years except 1917 are the same as those entered for total gas production values. This indicates that for all years except 1917, water gas was produced.[2]

[1] *U.S. Production of Manufactured Gases: Assessment of Past Disposal Practices*, USEPA, Research Triangle Institute, Research Triangle Park, NC, 1988.

[2] The one exception is for 1917, when a small portion of the total gas production stream that year (less than 15 percent) is reported as coal gas. However, subsequent years again indicate only water gas production. Note that from 1913 through 1916 Brown's reported that the Ashland MGP "will construct coal gas plant of 14,000,000 c.f. (i.e., 14,000 mcf) capacity per annum." From 1917 on, there is no mention of this coal gas operation in the Brown's Directories. (Note also that Brown's reported only gas sales data from 1909 through 1920. Because LSDP data was available for this period, this information was utilized in our estimates.

The Carbureted Water Gas Process

USEPA indicates that two materials were needed for CWG production: solid carbon and liquid hydrocarbon (see USEPA, page 34). Through World War One, the common source for the solid carbon was anthracite (coal) or coke from bituminous (coal). After WWI, process changes prompted by increasing anthracite costs enabled some plants to burn bituminous directly. (All plants did not convert, however, because many had coke production ovens on site.) USEPA reported that the preferred source of the liquid hydrocarbon was naphtha, a light-weight crude fraction. However, more plants used a heavier fraction called gas-oil after 1895. The increased demand for gasoline after 1930 (a fraction of gas-oil) prompted the MGP industry to convert to yet heavier fuels (i.e., heavy fuel oil). USEPA (1988, pg. 125) indicates that these conversions to heavy fuel oils "were better absorbed by larger plants," since tar quantities increased by as much as 25 percent. Conversion to heavy oils was resisted by smaller plants principally because of operating cost. Based on the above and the tar generation data reviewed, it is our conclusion that for the Ashland plant employed the oil-gas CWG process throughout its operational life.

Tar Production at the Ashland Plant

For the three years for which tar production is reported, Brown's also reports the quantity of gas oil used and the quantity of bituminous used as a water gas generator. USEPA reports (Table 35) that for oil gas feedstocks in CWG systems, the quantity of tar produced per gallon of oil feedstock used yielded ratios of 0.16 to 0.18. For these three years the actual ratios based on reported data were 0.20 for 1939, 0.13 for 1941, and 0.14 for 1944, for an average of 0.155. This falls within the range given in the USEPA report. (Table 35 presents a tar to oil feedstock ratio of 0.23 for heavy fuel oil CWG systems, with a tar generation estimate of 800-1,000 gallons produced for each mcf $\times 10^3$ gas produced. Note that this tar to feedstock ratio is too high for any of the years for which data are reported for the Ashland plant, indicating heavy fuel oil was not used.)

Table 35 in the USEPA report also indicates that for these CWG oil gas processes, from 470-640 gallons of tar were produced for each mcf $\times 10^3$ gas produced (or 0.470 - 0.640 per mcf as we reported in the March 2 letter). This is a separate ratio from that provided for the tar to feedstock ratio, and compares to the 0.439 ratio we used in the March 2 letter. The tar generation values presented in this letter and shown on the attached table for each year of operation assume this same 0.439 ratio.

Based on the foregoing, we conclude:

- The MGP originally implemented and then maintained with some variation a CWG process, and oil gas was the predominant liquid feedstock throughout the entire plant life.
- Coal gas (as manufactured in the carbonization process) was never a major product, manufactured briefly during 1917, and constituted only 15 percent of that year's production.
- The tar production ratios the Department used in its their February 20 and 24 letters for the time periods before and after 1918 are completely erroneous.[3]
- Applying the 0.439 ratio to the "revised" total gas production quantity yields a total of 611,306 gallons of tar produced during the plant lifetime. This compares to the 602,294 gallons tar produced described in the March 2 letter, an increase of only 1.5 percent.

A final point on the assumed CWG process at the Ashland site during it's operating life needs to be mentioned. Although only a few samples have been analyzed, cyanides have not been detected at the site. USEPA reports that CWG tars "contain many of the compounds present in coal tar, but they contain no tar acids (phenolics) and only traces of coal nitrogen compounds...(consequently) very small amounts of ammonia and cyanide appeared in the gas from (CWG) operations, and this is reflected by low concentrations of these compounds in byproducts." This is further support for our conclusion that the Ashland plant operated as a CWG plant.

III. Product Estimates Present in Bay Sediments and the Copper Falls Aquifer

Product Present in the Bay Sediments

The March 2 letter provided an estimate of more than 2,000,000 gallons of residual tar product present in the sediments, based upon the data and analysis of the sediments provided by SEH in its July 1996 report. That data indicated that the most contaminated area of sediment covered an area of about 7 acres at an average depth of six feet. To compute this quantity, a porosity value of 0.3 (volume of void/total volume) was assumed. Also, high levels of VOC and PAH contamination (concentrations as high as 1000 mg/kg) indicated the presence of pure product. Accordingly, we assumed that 50 percent of the available void space was occupied by residual product, resulting in

[3] The Department assumed coal carbonization-horizontal gas retort production methods prior to 1918, and used an average tar production ratio of 0.955; for the period after 1918, they assumed an oil gas CWG process, and used 0.555. These values were taken as averages for these methods presented in the USEPA Table 35 described above, and are not based on actual production records.

a quantity in excess of 2,000,000 gallons. SEH calculated a range of 39,000 to 583,000 gallons of tar present in the bay sediments and soils at Kreher Park. A critique of these estimates is attached to this letter.

Product Present in the Copper Falls Aquifer

The final estimate presented here of tar in the environment is the product volume currently present in the Copper Falls aquifer. The quantities needed to determine this mass are the thickness of dense non-aqueous phase liquids (DNAPL) measured in wells screened in the Copper Falls, and an estimate of the aerial extent of the DNAPL mass. In our Remedial Action Plan for the Lower Copper Falls Aquifer (Dames & Moore, April 1998), we described an elliptical DNAPL plume approximately 350 feet by 170 feet in plan view. The greatest thicknesses of DNAPL has been measured in well 13B on St. Claire St., at thicknesses varying from 13.5 to 16.5 feet. The intermediate well 13A in the same well nest has yielded approximately 2 feet of DNAPL. A well on the leading edge of the plume (7A) has yielded samples with high contaminant levels, but not at levels to indicate DNAPL (DNAPL has not been measured in this well). The other wells screened in the Copper Falls Aquifer are beyond the flanks of the plume.

The release point of the coal tar product that formed the plume is likely in the area of the extraction well EW-1. At this location, the plume is thickest (near 13B), but likely thins to the north in the direction of groundwater flow. Based upon this limited data, an approximate thickness of two feet is assumed for the DNAPL area shown in the RAP. The approximate area of the ellipse is 50,000 square feet. This translates to a volume of 100,000 cubic feet. At a porosity of 0.25 for the Copper Falls, the volume of DNAPL present is 25,000 cubic feet, or 187,000 gallons. Recognize that this estimate has a potentially high error margin because of the limited data.

THEY HAVE ABSOLUTELY NO IDEA!

Further Product Adjustments

For the three years for which LSDP operating data on tar generation is available (1939, 1941 and 1944), the same records indicate that 19,034, 10,000 and 17,814 gallons of tar, respectively, were sold. Additionally, approximately 7,000 gallons of tar product residual from the former MGP were disposed in 1993 when a concrete tar reservoir was excavated from the NSP property and disposed off site. This totals nearly 54,000 gallons. Assuming that the Copper Falls estimates above are off by 25 percent (i.e., only a total of 140,000 gallons are present), nearly 200,000 gallons, or approximately one-third of the 611,000 gallons generated during the life of the MGP, are not present in the sediments. The remaining 400,000 gallons fall significantly below the 2,000,000 gallons previously shown present in the sediments. For these comparisons, no other reduction in tar volume is assumed for any unreported tar sold, or burned as boiler fuel[4], since no other records exist. The reported tar volume sold (46,848 gallons) constitutes about 7.5 percent of the total tar production volume. This compares to the 1984 Radian study [5] which reported that, on average, 76 percent of all tar generated from MGPs nationwide was sold as a by-product.

IV. Conclusion

The calculations presented in this letter confirm that contamination in the sediments cannot be restricted to releases of tar from the MGP. As described in previous documents, much of the plant's tar was reburned as boiler fuel and sold/recycled as a product. The total tar production of approximately 611,000 gallons during the MGP's lifetime is not sufficiently large to account for the volume of residual tar present in the environment. The volumes currently present in the offshore sediments and soils at Kreher Park are too large, and the concentrations too high to have originated solely from the former gas plant.

This summarizes the results. Please call with any questions.

Sincerely,

DAMES & MOORE

David P. Trainor
Principal

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[4] USEPA (1988) reports that "the principal use of CWG tars was as a fuel. The CWG tars could be burned in the plant boilers, replacing the coal that would normally have to be consumed. (These) tars...would be burned if they could not be sold for a price that exceeded the fuel value of the tars."

[5] *Survey of Tar Waste Disposal and Locations of Town Gas Producers,* Radian Corporation, Austin, TX., 1984

LSDP/NSP MGP GAS AND TAR PRODUCTION DATA				
YEAR	GAS PROCESS (REPORTED IN BROWN'S)	ANNUAL PRODUCTION MCF (LSDP & BROWN'S)	TAR PRODUCTION (GALS.)	NOTES
1885	UNKNOWN	(6,000.00)	(2,634)	(1)
1886	UNKNOWN	(6,000.00)	(2,634)	
1887	UNKNOWN	(6,000.00)	(2,634)	
1888	UNKNOWN	(6,000.00)	(2,634)	
1889	UNKNOWN	(6,000.00)	(2,634)	
1890	UNKNOWN	(6,000.00)	(2,634)	
1891	UNKNOWN	(6,000.00)	(2,634)	
1892	UNKNOWN	(6,000.00)	(2,634)	
1893	UNKNOWN	(6,000.00)	(2,634)	
1894	UNKNOWN	(6,000.00)	(2,634)	
1895	UNKNOWN	(6,000.00)	(2,634)	
1896	UNKNOWN	(6,000.00)	(2,634)	
1897	UNKNOWN	(6,000.00)	(2,634)	
1898	LOWE	6,000.00	2,634	(2)
1899	LOWE	7,800.00	3,424	
1900	LOWE	9,000.00	3,951	
1901	LOWE	10,000.00	4,390	
1902	MOSES	11,000.00	4,829	(3)
1903	MOSES	12,000.00	5,268	
1904	MOSES	13,000.00	5,707	
1905	MOSES	14,000.00	6,146	
1906	MOSES	15,000.00	6,585	
1907	MOSES	19,000.00	8,341	
1908	MOSES	**20,186.90**	8,862	(4)
1909	LOWE(MOSES)	**18,978.14**	8,331	
1910	LOWE(MOSES)	**19,081.86**	8,377	
1911	LOWE(MOSES)	**15,527.40**	6,817	
1912	OIL	**16,535.08**	7,259	
1913	OIL	**16,637.13**	7,304	
1914	OIL	**16,000.00**	7,024	
1915	OIL	**(17,461)**	(7,744)	(5)
1916	OIL	**18,921.55**	8,307	
1917	OIL AND COAL	**18,794.54**	8,251	(6)
1918	OIL AND COAL	**17,228.00**	7,563	
1919	OIL AND COAL	**17,983.72**	7,895	(7)
1920	OIL AND COAL	**19,196.40**	8,427	(8)
1921	WATER GAS	**21,852.00**	9,593	
1922	WATER GAS	**21,698.14**	9.525	(9)
1923	WATER GAS	21.698.54	9.526	
1924	WATER GAS	21.698.54	9.526	

LSDP/NSP MGP GAS AND TAR PRODUCTION DATA				
1925	WATER GAS	27,978.60	12,283	
1926	WATER GAS	30,498.08	13,389	
1927	WATER GAS	32,009.30	14,052	
1928	WATER GAS	28,329.00	12,436	
1929	WATER GAS	39,534.00	17,355	
1930	WATER GAS	40,442.00	17,754	
1931	WATER GAS	**37,614.00**	16,513	(10)
1932	WATER GAS	**36,220.00**	15,901	
1933	WATER GAS	**33,988.60**	14,921	
1934	WATER GAS	34,262.40	15,041	
1935	WATER GAS	37,023.60	16,253	
1936	WATER GAS	42,922.80	18,843	
1937	WATER GAS	42,922.80	18,843	
1938	WATER GAS	**45,909.00**	20,154	(11)
1939	WATER GAS	**45,925.00**	**25,000**	(12)
1940	WATER GAS	49,925.00	21,917	
1941	WATER GAS	49,925.00	**16,500**	
1942	WATER GAS	38,925.00	17,088	
1943	WATER GAS	36,932.20	16,213	
1944	WATER GAS	**39,264.40**	**17,814**	
1945	WATER GAS	42,037.80	18,455	
1946	WATER GAS	46,629.16	20,470	
TOTAL GAS PRODUCTION		**1,392,496.7 MCF**		
	TOTAL TAR PRODUCTION		**611,306 Gals.**	(13)

(1) Brown's directories unavailable for years 1885-1897. Annual gas production quantities are assumed to equal the first year reported (1898), and are shown with ( ) as an assumed quantity. LSDP gas quantity operating records are shown in bold, when available. For those years where both Brown's and LSDP production levels are reported, LSDP records are shown and used in quantity calculations.

(2) Actual gas product type (e.g., coal gas, water gas, Pacific Coast oil gas specified in USEPA report (1988)) for years 1885-1898 is unknown. Manufactured gas process reported in 1899 is referred to as *Lowe* in Brown's. For purposes of tar production, assume the plant operated as a manufacturer of carbureted water gas using conventional oil gas feedstock since 1885 with minor process augmentation (see text).

(3) Manufactured gas process from 1902-1908 reported in Brown's as *Moses(water)*. Assume process is a variation of original Lowe-water gas method.

(4) LSDP operating records for years 1908-1918 are reported for fiscal year July 1-June 30. For purposes of these production estimates, LSDP production values for these years represent the previous calendar year.

(5) No LSDP or Brown's data available for 1915. Assume interpolated production value of 17,461.0 mcf as in March 2, 1998 Dames & Moore letter to Jamie Dunn.

(6) Production value shown is the total of 16,069.41 mcf water gas and 2,725.13 mcf coal gas reported by LSDP. Subsequent years' data reported by LSDP are restricted to water gas only, although Brown's reports *Oil and Coal* 1917-1920.

(7) Only six months of data (July-December) reported by LSDP. Figure shown is double the reported value.

(8) LSDP reported gas production levels correspond to calendar years 1920-1922.

(9) LSDP gas production levels correspond to data summed from two separate operating reports (May 31, 1922 and December 31, 1922).

(10) LSDP gas production levels reported in LSDP Annual reports in 1932, 1933.

(11) LSDP gas and tar production data obtained from reprints of production and material usage ledgers provided by NSP for years 1938, 1939, 1941 and 1944.

(12) Actual tar production quantities reported are shown in bold (1939, 1941, 1944).

(13) Total tar generation quantity shown is ratio of gallon of tar produced per mcf of gas generated times total gas production quantity ((0.439)×(1,392,496.7)).

CRITIQUE OF SEH TAR QUANTITY ESTIMATES

In a draft spreadsheet submitted to the WDNR SEH provided (see attached table) an estimate of residual product based upon the concentration of benzo(a)pyrene (BaP) measured in sediments and in soils at Kreher Park. SEH subdivided the subject area into several zones, including two areas each within the unsaturated and saturated zones at Kreher Park, and three areas of sediments. Using BaP as an indicator parameter, SEH computed a total residual product quantity present in the entire affected Kreher Park and sediment areas from about 39,000 to 580,000 gallons. As described in a meeting between NSP and SEH with the WDNR on March 26, 1998, SEH chose BaP because of its low solubility, low volatility and recalcitrance compared to other constituents in coal tar.

Following the SEH spreadsheet for the "Hot Contaminated Sediments" zone, a range for the Original Tar Deposit of from 5,849 gallons to 87,730 gallons of tar is presented. This assumes an area of 410,000 square feet at a uniform depth of four feet. To compute these values, two numbers must be known: (1) the percent constituent mass of BaP in coal tar, and (2) the density of coal tar. Values for BaP given in the literature[1] range from 0.175 percent up to 3.0 percent of the coal tar mass. Values for the specific gravity of CWG tars provided by USEPA range from 1.06 to 1.125. Accordingly, this information was used to duplicate SEH's calculations.

The SEH July 1996 Sediment Investigation report shows BaP ranging from mostly non-detect levels up to 49 mg/kg (ppm). An average value of 1 mg/kg is selected for this exercise.

The volume of contaminated sediments is (as shown on the SEH spreadsheet)

$$4(410{,}000) \ = 1{,}640{,}000 \text{ cft}$$

A typical value assumed for the dry density of the sediments is 90 lbs/cft

The total mass of the affected sediments is

$$90(1{,}640{,}000) = 1.48 \times 10^8 \text{ lbs} = 3.2 \times 10^8 \text{ kgs}$$

The total mass of BaP in the sediments is

$$1 \text{ mg/kg}(3.2 \times 10^8) = 3.2. \times 10^8 \text{ mg}$$

Based on the literature, assume BaP constitutes an average of 1 percent of the total coal tar mass. Therefore the mass of coal tar originally deposited is:

$$(3.2 \times 10^8)/(0.01) = 3.2 \times 10^{10} \text{ mg}$$

[1] *Handbook on Manufactured Gas Plant Sites*, Utility Solid Waste Activities Group, prepared by Environmental Research & Technology, Inc., Pittsburgh, 1984

Using the specific gravity of coal tar at 1.1 (110 mg/ml), this mass can be converted to an original volume:

$$(3.2 \times 10^{10}\,\text{mg})/(110\ \text{mg/ml})(1000\text{ml/l}) = 2.9 \times 10^{5}\ \text{l}$$

$$= 76{,}858\ \text{gallons}$$

This value is equivalent to the high value (87,730 gals) from SEH's range for this affected zone. Note that average values were used for this calculation, specifically for the percentage of BaP in coal tar and the measured BaP concentration in sediment. Also, note that by lowering the percentage of BaP in coal tar to 0.2 percent, and increasing the average BaP to 5 mg/kg, the computed coal tar mass increases by 10 times to 768,580 gallons.

The weaknesses in the assumptions for this BaP analysis are ~~is~~ (1) the range of percentages the literature provides for BaP in coal tar and how it affects the outcome, and (2) the absence of positive detections for BaP in the samples measured. Comparing the occurrence of BaP in the samples to those of other PAHs shows that naphthalene was found more often, and constituted a greater portion of the entire PAH compound suite. Based upon a review of the SEH report data, naphthalene was found more often at concentration levels from low ppm ranges to as high as 600 ppm. The specific gravity of naphthalene is about the same as water (1 s.g. unit, or 1 gm/ml). Using a value of 50 mg/kg as a representative naphthalene level in the most contaminated sediments (an average of 71 mg/l has been computed for all detections in samples collected south of 2600 N, the most contaminated area), the volume of naphthalene present in the sediments can be calculated as follows:

$$50\ \text{mg/kg}(\,3.2 \times 10^{8}\,\text{kg}) = 1.6 \times 10^{10}\ \text{mg}$$

Using a density of 1 gm/ml (100 mg/ml) yields the following:

$$(1.6 \times 10^{10}\,\text{mg})/100\ \text{mg/ml} = 1.6 \times 10^{8}\,\text{ml} = 160{,}000\ \text{l}$$

$$= 42{,}270\ \text{gallons}$$

The coal tar present in sediments at the Ashland site was deposited decades ago, and degradation of naphthalene has occurred in the intervening time. Additionally, nothing is known about coal tar emulsions in the waste products from the MGP, and how they were treated. The literature shows that naphthalene comprises from 5 to 15 percent of coal tar (one reference stated 10.9 percent for oil gas tars[1]). Regardless, assuming a 10 percent naphthalene fraction of the coal tar yields a minimum original coal tar deposit of nearly 500,000 gallons. Note again that this value is sensitive to both the concentration and the constituent percentage used to determine the contaminated sediment mass. Consequently, these variations make this method of determining contaminant mass present indeterminate.

[1] *Handbook on Manufactured Gas Plant Sites*, Utility Solid Waste Activities Group, prepared by Environmental Research & Technology, Inc., Pittsburgh, 1984

DRAFT 3/26/98 MJB DRAFT 3/26/98 MJB

Ashland Lakefront Feasibility Study
Volume Estimates:

	Area (sft)	Volume (cft)	Approx Mixed Fill (cft)	Approx Wood Waste (cft)	Pore Water (gallons)	low range Original* Tar Deposit (gallons)	high range Original* ar Deposit (gallons)
Contaminated Vadose Zone	18,000	36,000	36,000	0	0	972	14,573
Hot Contaminated Vadose Zone	400,000	1,200,000	1,200,000	0	0	2,313	34,699
Hot Contaminated Saturated Zone:	40,000	320,000	64,000	256,000	957,440	18,300	274,506
Contaminated Saturated Zone:	378,000	3,024,000	604,800	2,419,200	9,047,808	5,829	87,441
Hot Contaminated Sediments (0-4)	410,000	1,640,000	492,000	1,148,000	4,906,880	5,849	87,730
Medium Contaminated Sediments (4 -8)	30,000	120,000	120,000	0	359,040	4,395	65,928
Lightly Contaminated Seds (4-8)	380,000	1,520,000	1,520,000	0	4,547,840	1,172	17,581
Total:						38,831	582,458

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*Note: Tar deposit based upon mass of Benzo(a)Pyrene present in subsurface. BaP selected because of its low solubility, low volatility,and high biorecalcitrance.

Tar range based upon varying reported percentages of BaP in coal tar and range of mass calc for BaP.