DRAFT ROUND 10 DAM ASSESSMENT REPORT
LANSING BOARD OF WATER & LIGHT
ERICKSON STATION
ASH POND

APRIL 30, 2012

PREPARED FOR:

U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Washington, DC 20460

PREPARED BY:

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GZA File No. 01.0170142.30

DRAFT

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Engineers and
Scientists

April 30, 2012
File No. 01.0170142.30

Mr. Stephen Hoffman
U. S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Re: Round 10 Dam Assessment - Draft Report
EPA Contract No. EP10W001313
Lansing Board of Water & Light – Erickson Station
Ash Pond
Lansing, Michigan

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Dear Mr. Hoffman:

In accordance with our proposal 01.P000177.11, dated March 28, 2011, and U.S. Environmental Protection Agency (EPA) Contract No. EP10W001313, Order No. EP-B11S-00049, GZA GeoEnvironmental, Inc. (GZA) has completed our inspection of the Lansing Board of Water & Light (LBWL) Erickson Station (Site) Ash Pond located in Lansing, Michigan. The Site visit was conducted on May 19, 2011. The purpose of our efforts was to provide the EPA with a Site-specific inspection of the impoundments to assist EPA in assessing the structural stability of the impoundments under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act Section 104(e). We are submitting one hard copy and one CD-ROM copy of this Draft Report directly to the EPA.

At the time of our inspection the Ash Pond was dewatered and in the process of undergoing modifications which included excavation and removal of previously placed ash followed by disposal at an off-site Type II sanitary landfill. Therefore in accordance with EPA's direction, GZA has not assigned a condition rating for this impoundment structure at this time. Further discussion of our evaluation and recommended actions are presented in the Round 10 Dam Assessment Report. The report includes: (a) completed Field Assessment Checklists; (b) figures of the impoundments; and (c) selected photographs with captions. Our services and report are subject to the Limitations found in **Appendix A** and the Terms and Conditions of our contract agreement.

We are happy to have been able to assist you with this inspection and appreciate the opportunity to continue to provide you with dam engineering consulting services. Please contact the undersigned if you have any questions or comments regarding the content of this Round 10 Dam Assessment Report.

Sincerely,

GZA GEOENVIRONMENTAL, INC.

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DRAFT REPORT

EXECUTIVE SUMMARY

This Inspection Report presents the results of a visual inspection of the Lansing Board of Water & Light (LBWL) Erickson Station Ash Pond located in Lansing, Michigan. The inspection was performed on May 19, 2011 by representatives of GZA GeoEnvironmental, Inc (GZA), accompanied by LBWL representatives.

ASH POND

The Ash Pond is impounded by an earth fill embankment (dike) constructed on natural ground surface, with a crest length of approximately 4,400 feet and a maximum height of approximately 17 feet. Under U.S. Army Corps of Engineers (COE) guidelines, the Ash Pond is classified as a **Small** size structure.

The Ash Pond dike has been regulated under Part 315, Dam Safety, of the Michigan Natural Resources Environmental Protection Act (NREPA), Public Act 451 of 1994, as amended, since 2009, when the Michigan Department of Environmental Quality (DEQ) determined that it met the definition of a dam. The Ash Pond was given the Michigan Dam Inventory Identification No. 2680. The Ash Pond dike was assigned a low hazard potential rating by the DEQ and as such, the Ash Pond is required, by the Part 315 Rules to be inspected at a minimum frequency of every five years by a licensed engineer to evaluate its structural condition and hydraulic adequacy.

Similarly, under the U.S. Environmental Protection Agency (EPA) classification system, it is GZA's opinion that the dike at Ash Pond would be considered as having a **Low** hazard potential. This hazard potential rating was assigned because dam failure or misoperation would result in no probable loss of human life and low economic or environmental losses. Any economic or environmental losses would be primarily limited to the Erickson Station Property. Additionally, the Ash Pond has been dewatered and there are no current plans to refill it.

At the time of GZA's inspection the Ash Pond was dewatered and in the process of undergoing modifications which included excavation and removal of previously placed ash followed by disposal at an off-site Type II sanitary landfill. Because the status of the impoundment as a CCW facility is currently in a state of flux, the EPA has directed that GZA withhold assignment of a condition rating at this time.

Notwithstanding the assignment of a condition rating, the Ash Pond was found to have the following deficiencies:

1. Presence of a brush pile on the southeast side of the outer slope;
2. Several large stumps remaining on the interior and outer slopes;
3. The interior slope in the areas that had been excavated did not appear to be sloped at the design angle (3H:1V);
4. Leaking at the bottom ash discharge pipe;
5. No formal operation and maintenance plan or inspection checklist to observe and document the structural conditions of the dike;
6. Presence of vegetation and an apparent lack of an animal barrier in the emergency overflow pipe;

7. The discharge pipes from the discharge structure to the pump house, from the transfer structure to Clear Water Pond, and from the emergency overflow in Clear Water Pond to the emergency overflow outlet have not been inspected internally since they were installed;
8. There was an unknown pipe observed on the north side of the Ash Pond;
9. No Geotechnical computations with respect to the embankments' stability were made available to GZA for review; and
10. No Hydrologic/Hydraulic computations with respect to the impoundment's ability to safely pass the Spillway Design Flood (SDF) were made available to GZA for review.

The following recommendations and remedial measures generally describe the recommended approach to address current deficiencies at the Ash Pond. Prior to undertaking recommended maintenance, repairs, or remedial measures, the applicability of environmental permits needs to be determined for activities that may occur within resource areas under the jurisdiction of the appropriate regulatory agencies.

Studies and Analyses

GZA recommends the following studies and analyses:

1. If Ash Pond is refilled with ash after ash removal activities are completed, perform a geotechnical stability analysis of the embankments under all applicable loading conditions, including earthquake-induced loading.

2. If the Ash Pond is to be used as originally designed, perform a detailed hydrologic and hydraulic study using current methodology to evaluate the impoundment's ability to safely pass the SDF.

Operation & Maintenance Recommendations

GZA recommends the following operation and maintenance level activities:

1. Remove the brush piles and grind the stumps down and fill in the depressions left from the stump removal; Remove stumps and root balls and backfill with compacted fill.

2. Clear vegetation and logs from the emergency overflow outlet area and install a fence to prevent animals from nesting in the emergency overflow pipe, if a fence is not already installed;

3. If LBWL has the opportunity, inspect the discharge pipes from the discharge structure to the pump house, from the transfer structure to Clear Water Pond, and from the emergency overflow in Clear Water Pond to the emergency overflow outlet to verify that they are operating correctly and are in good condition. This may be performed by video photograph; and,

4. Create a formal checklist for visual inspections of the Ash Pond structure and maintain the inspection records on file.

5. Confirm that all dike embankments have not been overexcavated/or over filled during the ongoing ash removal operation. If the slopes have been excavated steeper than 3H:1V,

then the oversteep slope should be backfilled in controlled, compacted lifts of similar soils used for the original dike construction. If the slopes have been over filled, the excess material should be removed down to the original 3H:1V slope angle. Re establish the 12-inch thick layer of slope protection (i.e. riprap) and 6-inch layer of filter material on the interior slope between El. 886.5 and E. 880.5 where needed.

6. Remove unwanted vegetation from the 12-inch slope protection at the toe of the outer slope of the dike adjacent to the railroad tracks.

7. Repair the erosion and add erosion mitigation measures to prevent future erosion from occurring at the discharge end of the runoff pipe from the Coal Pile.

8. Confirm operability of the sluice gate in the drainage structure.

Repair Recommendations

GZA recommends the following repairs which may improve the overall condition of the Ash Pond, but do not alter the current design of the embankment. The recommendations may require design by a professional engineer and construction contractor experienced in embankment construction.

1. Repair the leaking bottom ash discharge pipe; and,

2. Evaluate the necessity of the unknown pipe found on the north side of the Ash Pond and remove the pipe if it is not needed.

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PREFACE

The assessment of the general condition of the embankment at the Lansing Board of Water and Light, Erickson Station Power Plant located in Lansing, Michigan is based upon available data and visual inspections. Detailed investigations and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of this report.

In reviewing this report, it should be realized that the reported condition of the embankment is based on observations of field conditions at the time of inspection, along with data available to the inspection team. In cases where an impoundment is lowered or drained prior to inspection, such action, while improving the stability and safety of the embankment, removes the normal load on the structure and may obscure certain conditions, which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is critical to note that the condition of the embankment depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the embankment will continue to represent the condition of the embankment at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Prepared by:

GZA GeoEnvironmental, Inc.

Walter Kosinski, P.E.
Principal
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ASH POND
LANSING BOARD OF WATER & LIGHT – ERICKSON STATION
LANSING, MICHIGAN

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1.0 DESCRIPTION OF PROJECT

1.1 General

1.1.1 Authority

The United States Environmental Protection Agency (EPA) has retained GZA GeoEnvironmental, Inc. (GZA) to perform a visual assessment and develop a report of conditions for the Lansing Board of Water & Light (LBWL, Owner) Erickson Station (ES, Site) Ash Pond in Lansing, Michigan. This inspection was authorized by the EPA under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 104(e). This assessment and draft report were performed in accordance with Round 10 of the Assessment of Dam Safety of Coal Combustion Surface Impoundments, RFQ-DC-16, dated March 16, 2011, and EPA Contract No. EP10W001313, Order No. EP-B11S-00049. The inspection generally conformed to the requirements of the Federal Guidelines for Dam Safety[1], and this report is subject to the limitations contained in **Appendix A** and the Terms and Conditions of our Contract Agreement.

1.1.2 Purpose of Work

The purpose of this assessment was to visually assess and evaluate the present condition of the Ash Pond and appurtenant structures and to identify conditions that may adversely affect their structural stability and functionality; to, note the extent of any deterioration that may be observed, review the status of maintenance and needed repairs; and to evaluate the conformity with current design and construction standards of care.

The assessment was divided into five parts: 1) obtain and review available reports, investigations, and data from the Owner pertaining to the impoundments and appurtenant structures; 2) perform an on-Site review with the Owner of available design, inspection, and maintenance data and procedures for the management unit; 3) perform a visual assessment of the Site; 4) prepare and submit a field assessment checklist; and, 5) prepare and submit a draft and a final report presenting the evaluation of the structure, including recommendations and proposed remedial actions.

1.1.3 Definitions

To provide the reader with a better understanding of the report, definitions of commonly used terms associated with dams are provided in **Appendix B**. Many of these terms may be included within this report. The terms are presented under common categories associated with dams which include: 1) orientation; 2) dam components; 3) size classification; 4) hazard classification; 5) general; and, 6) condition rating.

[1] FEMA/ICODS, April 2004: http://www.ferc.gov/industries/hydropower/safety/guidelines/fema-93.pdf

1.2 Description of Project

1.2.1 Location

The ES is located about eight miles southwest of the city of Lansing, Michigan, at the address 6725 South Canal Road, Lansing, Michigan 48917. The Ash Pond is located less than a mile south of the ES at latitude 42 41' 15" North and longitude 84 39' 14" West. A Site locus map of the ES, Ash Pond, and surrounding area is shown on **Figure 1**. An aerial photograph of the ES, Ash Pond, and surrounding area is provided as **Figures 2 and 3**. The Ash Pond can be accessed by vehicle from the ES.

1.2.2 Owner/Caretaker

The Ash Pond is owned and operated by ES, a wholly owned subsidiary of LBWL.

	Dam Owner/Caretaker
Name	Lansing Board of Water & Light, Erickson Station
Mailing Address	6725 South Canal Road
City, State, Zip	Lansing, MI 48917
Contact	Mark Matus
Title	Manager - Environmental Services
E-Mail	mwm@lbwl.com
Phone Number	(517) 702-6153

1.2.3 Purpose of the Ash Pond

The ES is a single-unit coal-fired power plant with a maximum generating capacity of approximately 159 megawatts. Commercial operation of the ES facility began in 1973. The Ash Pond was constructed in conjunction with the ES facility for the purpose of storing and disposing coal combustion byproducts. The Clearwater Pond was constructed in conjunction with the Ash Pond to provide a storage basin for wastewater prior to recycling it back to the ES. A pump house located on the northwest side of Clear Water Pond recycles the water back to the ES. During normal operating conditions, the water flow is a continuous loop between the ES, the Ash Pond, the Clear Water Pond, and back to the ES. An additional on-site pond, the Water Storage Pond, is used as a community fishery and is not part of the normal operations of the ES. However, in an emergency situation, the ES has the ability to pump water from the Water Storage Pond as part of an emergency fire suppression system.

Wastewater discharged from the Site is regulated under one National Pollution Discharge Elimination System (NPDES) permit[2]. However, no wastewater is discharged from the Ash Pond or Clear Water Pond as all water is recycled back to the ES.

[2] National Pollutant Discharge Elimination System (NPDES) Permit No. MI0005428, Erickson Station, Michigan Department of Environmental Quality, June 1, 2008.

The Ash Pond was constructed for the purpose of storing and disposing plant wastewater, ash sluice, boiler blowdown water, house service water, demineralizer regeneration water, and coal pile runoff. Wastewater is pumped at an average rate of 3.8 million gallons per day[3] (MGD) from the ES to the Ash Pond. Wastewater from Clear Water Pond is pumped to the ES at an average rate of 3.8 MGD.

1.2.4 Description of the Ash Pond and Appurtenances

The following description of the Ash Pond is based on the Owner interviews, design reports, as-built drawings, and field observations by GZA.

The Ash Pond is impounded by an earthfill embankment (i.e. dike) with a crest length of approximately 4,400 feet and a maximum height (from the lowest toe elevation to the top of embankment) of approximately 17 feet. Since the Ash Pond embankments were constructed on the natural ground surface, the structural height is approximately the same as the maximum height, 17 feet. A gravel road along the top of the dike has a width of approximately 12 feet and an elevation of approximately 886.5 feet, National Geodetic Vertical Datum of 1929 (NGVD 29)[4]. According to the construction specifications[5] for the Ash Pond, the natural ground surface, which also forms the liner, was stripped and scarified to provide a bond with the first layer of the dike fill. The outer and inner slopes of the embankment are approximately 3 horizontal to 1 vertical (3H:1V). The construction specifications indicate that the embankment was constructed primarily with selected on-site clay borrow material from the locations shown in **Figure 4** and placed/compacted under controlled conditions. Therefore, it is not likely that any part of the embankment foundation was built over wet ash, boiler slag, or other unsuitable materials, in GZA's opinion.

The Ash Pond has not been expanded since its construction in the 1970's. Beginning in 2009, LBWL implemented a plan to remove the stored coal combustion waste from the Ash Pond in order to potentially modify the size of the Ash Pond. The ash removal plan included dewatering the Ash Pond and physically excavating the coal ash from the Ash Pond and disposing it at a landfill. The ash removal activities were underway during GZA's assessment and the Ash Pond contained a minimal amount of water. Refer to Section 1.3.4 for further discussion of the ash removal plan.

There are two discharge structures in the Ash Pond, the transfer structure and the drainage structure. The transfer structure is a concrete spillway with stoplogs located along the eastern end of the southern embankment and was designed to transfer water from the Ash Pond to the Clear Water Pond as shown on **Figure 5**. The original design drawings provided by LBWL indicate that there is one 3-foot diameter ductile iron transfer pipe set at an invert elevation of 872 feet NGVD 29 at the outlet and inlet to transfer water between the Ash Pond and the Clearwater Pond . Two concrete cut-off collars were shown on the transfer pipe. Stop logs were shown on the design drawings at a normal operating elevation of the wastewater in the Ash Pond of approximately 881.5 feet. However, as a result of the ash removal activities, the Ash Pond has been dewatered and there are no current plans to refill it. During the Site assessment, there was a minimal amount of water in the Ash Pond and any wastewater within the Ash Pond was being transferred into the Clear Water Pond by a temporary pump.

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[3] Based on average flows from a Water Balance Diagram provided by LBWL personnel.

[4] Lansing Board of Water & Light Dam Safety Inspection Report, Erickson Electrical Power Generating Station, Inspecsol Engineering, Inc., October 30, 2009. Unless otherwise stated, elevations in this report are given in NGVD 29.

[5] Specification Section 4A – Excavation, Backfill, and Grading for Contract 57, undated.

The drainage structure is located along the western end of the southern embankment near the pump house and was designed to transfer water from the Ash Pond to the pump house. The drainage structure is a concrete spillway structure and also contains a sluice gate. The original design drawings provided by LBWL indicate that there was one 2-foot diameter ductile iron pipe set at an invert elevation of 871.0 feet NGVD 29 in the Ash Pond and sloped toward the pump house at a slope of approximately 3.7% to transfer water. Concrete seepage collars were shown every five feet for the first twenty feet of the piping run and every ten feet thereafter until the drainage pipe was within twenty feet of the pump house, where the frequency changed to every five feet until the pipe terminated at the pump house. During normal operations, the sluice gate was closed so that the stop logs in the transfer structure controlled the water elevation in the Ash Pond.

There is no emergency spillway or overflow structure in the Ash Pond. However, there is an overflow structure (refer to **Figure 5**) in Clear Water Pond that is designed to discharge near the toe of the outer dike in the event of emergency overflow. According to LBWL, the overflow structure utilizes one 3-foot diameter ductile iron pipe set at an elevation of 884.65 feet NGVD 29 for emergency discharge from the Clear Water Pond. Two seepage concrete cut-off collars are shown on the transfer pipe. According to LBWL, there has never been a discharge from this outlet.

Instrumentation at the Ash Pond includes a staff gauge on the drainage structure.

Further discussion of the hydrology and hydraulics of the Ash Pond are provided in Section 2.5.

1.2.5 Operations and Maintenance of the Ash Pond

The Ash Pond has been regulated under Part 315, Dam Safety, of the Michigan Natural Resources Environmental Protection Act (NREPA), Public Act 451 of 1994, as amended, since 2009, when the Michigan Department of Environmental Quality (DEQ) determined that it met the definition of a dam. The Ash Pond was given the Michigan Dam Inventory Identification No. 2680. The Ash Pond was assigned a low hazard potential rating by the DEQ and as such, the Ash Pond is required by the Part 315 Rules to be inspected at a minimum frequency of every five years by a licensed engineer to evaluate its structural condition and hydraulic adequacy. The first inspection report was completed in 2009[6]. Refer to Section 1.3.6 for further discussion of the 2009 inspection report.

During normal operating conditions, the water flow is a continuous loop between the ES, the Ash Pond, the Clear Water Pond and back to the ES.

LBWL personnel visually inspect the Ash Pond on an infrequent basis. The contractor removing the coal ash from the Ash Pond is at the Site on a daily basis and would report any unusual observations to LBWL personnel.

[6] Lansing Board of Water & Light Dam Safety Inspection Report, Erickson Electrical Power Generating Station, Inspecsol Engineering, Inc., October 30, 2009. Unless otherwise stated, elevations in this report are given in NGVD 29.

Based on GZA's discussions with LBWL personnel and a review of the inspection report (refer to Section 1.3.6), the operations and maintenance of the Ash Pond is consistent with the performance requirements of the Part 315 Rules.

1.2.6 Size Classification

For the purposes of this EPA-mandated inspection, the size classifications will be based on United States Army Corps of Engineers (COE) criteria. According to guidelines established by the COE, dams with a storage volume less than 1,000 acre-feet and/or a height less than 40 feet are classified as Small sized structures. Based on the maximum height of 17 feet and a storage volume of approximately 200 acre-feet, the Ash Pond is classified as a **Small** sized structure. It is noted that the State of Michigan does not provide a size classification rating for dams.

1.2.7 Hazard Potential Classification

The DEQ assigned the Ash Pond a **Low** hazard potential rating. Under the EPA classification system, as presented on page 2 of the EPA checklist (**Appendix C**) and Definitions section (**Appendix B**), it is GZA's opinion that the Ash Pond would be considered as having a **Low** hazard potential. This hazard potential rating was assigned because dam failure or misoperation would result in no probable loss of human life and low economic or environmental losses. Any economic or environmental losses would be primarily limited to the ES property. Additionally, the Ash Pond has been dewatered and there are no current plans to refill it. The overall Ash Pond is shown on **Figures 2 and 3**.

1.3 Pertinent Engineering Data

The Ash Pond is approximately bordered by Interstate I-96 and the Water Storage Pond to the west, the ES to the north, and a railroad to the south and east. It was reportedly constructed on clays and silts underlain by silts and sands underlain by bedrock (sandstone). According to the construction specifications[7] for the Ash Pond, the natural ground surface, which also forms the liner, was stripped and scarified to provide a bond with the first layer of the dike fill. The construction specifications indicate that the embankment was constructed primarily with selected on-site clay borrow material from locations shown in **Figure 4**. The fill was specified to be placed in layers of 8-inch loose thickness and compacted to 95% of the maximum dry density determined by ASTM standard D-1557.

Based on the calculations performed during the design of the Ash Pond, the surface area is 33 acres and the impoundment capacity is 200 acre-feet. The estimated approximate volume of material in the Ash Pond on March 23, 2009 was estimated to be approximately 100 acre-feet[8]. During the Site assessment, LBWL personnel estimated that two-thirds to three-quarters of the coal combustion waste had been removed from the Ash Pond.

[7] Specification Section 4 – Excavation, Backfill, and Grading for Contract 57, undated.
[8] LBWL Response to EPA Information Request for Information, March 27, 2009.

1.3.1 Drainange Area

The Ash Pond is an enclosed embankment built up from the natural ground surface. As such, the contributory drainage area is the surface area of the impoundment, approximately 33 acres. It also receives surface stormwater runoff from the on-site Coal Pile and from the roof drains of the ES. As such, the total drainage area for the Ash Pond, including the surface area of the impoundment, the surface area of the Coal Pile, and the surface area of the ES roof, is approximately 63 acres. Neither the Coal Pile nor the ES roof were visited by GZA during the Ash Pond assessment. The embankment is highlighted on **Figure 3**.

1.3.2 Discharges at the Site

Discharges at the Site are regulated under the previously noted NPDES Permit. However, no wastewater is discharged from the Ash Pond but instead is transferred to the Clear Water Pond. A pump house located on the northwest side of Clear Water Pond recycles the water back to the ES. An additional on-Site pond, the Water Storage Pond, is used as a community fishery and is not a part of the normal operations of the ES. During normal operating conditions, the water flow is a continuous loop between the ES, the Ash Pond, the Clear Water Pond, and back to the ES.

The overflow structure in Clear Water Pond is designed to discharge near the toe of the outer dike at a location known as Outfall 002 in the event of emergency overflow. Outfall 002 discharges to Holly Drain to the east. LBWL personnel indicated that there has never been a discharge from this outlet. However, if an overflow from Clear Water Pond were to occur, the NPDES Permit includes effluent limitations for the overflow water, including maximum limits for total suspended solids and a range of pH values. The frequency of analysis would be weekly for the TSS and daily for pH.

1.3.3 General Elevations

Ash Pond elevations presented in this report are taken from design drawings and reports provided by LBWL. Elevations are based upon the NGVD 29 vertical datum.

A. Top of Embankment	± 886.5 feet
B. Normal Operating Pool	± 881.5 feet
C. Current Operating Pool (Floor of Ash Pond)	± 870.0 feet
D. Emergency Overflow in Clear Water Pond	± 884.7 feet

1.3.4 Design and Construction Records and History of the Ash Pond

According to the information provided by LBWL, the Ash Pond was designed by Stanley Consultants. Construction of the Ash Pond was completed in 1973. The embankment was constructed to its full height prior to filling the impoundment with coal ash wastewater. The Ash Pond structure has not been modified since it was constructed. In the early 1980's, the ES switched to a dry fly ash handling system instead of the wet fly ash handling system that had been in use since 1973. The dry fly ash handling system decreased the volume of sluice water discharged to the Ash Pond.

Beginning in 2009, LBWL implemented a plan to remove the stored fly ash and bottom ash from the Ash Pond in order to potentially modify the size of the Ash Pond. The ash removal plan included dewatering the Ash Pond and physically excavating the coal ash from the Ash Pond and disposing it at a licensed Type II sanitary landfill. The ash removal activities were underway during GZA's assessment and the Ash Pond contained minimal amounts of water.

1.3.5 Operating Records

Minimal operating records are recorded by LBWL personnel. According to LBWL, no monitoring wells, piezometers, surface monuments, or slope indicators exist or are required at the Ash Pond.

1.3.6 Previous Inspection Reports

Since 2009, the DEQ has required that the Ash Pond be inspected every five years by a professional engineer in accordance with Part 315. The only inspection report completed for the Ash Pond was completed on October 30, 2009 by Inspecsol Engineering, Inc. (Inspecsol) and was reviewed by GZA for this report. In general, Inspecsol concluded that the Ash Pond was "stable and visually appears to be constructed and operated consistent with the original design[9]."

A summary of the key highlights and recommendations from the Inspecsol inspection report include the following:

- All trees and brush should be removed from the upstream and downstream slopes, and a low height vegetation of grass established in their place;
- Depressions in the ground surface of the slopes due to stump removal should be properly filled and compacted;
- Routine maintenance of the slopes once the trees and brush are removed should be completed;
- After the ash removal operations are complete, all upstream faces should be graded to the original design of 3H:1V;
- The ash should be removed from the drainage structure, and once exposed, the condition of the stop logs should be evaluated. Remove and replace as necessary;
- Complete routine checks on the operation of the sluice gate; and,
- Complete periodic (minimum once per year) visual inspections for signs of seepage, crest settlement, burrowing animals, slumps and slides, etc. or other signs of dam distress. Contact a professional engineer with dam experience immediately for further evaluation if noted.

[9] Lansing Board of Water & Light Dam Safety Inspection Report, Erickson Electrical Power Generating Station, Inspecsol Engineering, Inc., October 30, 2009. Unless otherwise stated, elevations in this report are given in NGVD 29.

2.0 INSPECTION

2.1 Visual Inspection

The Ash Pond was inspected on May 19, 2011 by Walter Kosinski, P.E, and Thomas Boom, P.E., of GZA. The weather was mostly cloudy with temperatures in the 50°s to 60°s Fahrenheit. Underwater areas were not inspected as this level of investigation was beyond GZA's scope of services. A copy of the EPA Checklist is included in **Appendix C**. Photographs to document the current conditions of the embankments were taken during the inspection and are included in **Appendix D**.

With respect to our visual inspection, there was no evidence of prior releases, failures, or embankment repairs observed by GZA. The Ash Pond was dewatered and it was evident that ash had been removed. The ash removal activities were ongoing during our visual inspection.

2.1.1 General Findings

As previously noted, at the time of GZA's inspection the Ash Pond was dewatered and in the process of undergoing modifications which included excavation and removal of previously placed ash followed by disposal at an off-site Type II sanitary landfill. Because the status of the impoundment as a CCW facility is currently in a state of flux, the EPA has directed that GZA withhold assignment of a condition rating at this time.

An overall Ash Pond plan showing the pertinent features, including the location and orientation of photographs provided in **Appendix D**, is detailed on **Figures 2 and 3**.

2.1.2 Outer Embankment Slope (Photo Nos. 2, 3, 5, 8 - 12, 17, 19, 23, 25, 27)

The outer embankment slope generally appeared to be in good condition. The slopes had been mowed recently and the majority of the trees and brush on the slope were removed in 2010. A brush pile was observed on the slope (Photo No. 37). No unusual movement or sloughing was observed in the slope. Standing and flowing water was observed in the ditch near the southeast and east toe of the slope (Photo Nos. 5, 6, 8, 9, and 10) which was likely the result of recent storm events as LBWL personnel commented during the Site assessment that they rarely observed water at this location. The slope of the dike facing Clear Water Pond (Photo No. 15) is steeper than 3H:1V. This slope is also the outer slope for the dike around Ash Pond.

2.1.3 Crest (Photo Nos. 2, 3, 4, 7, 16, 18, 19, 21, 23, 25, 27, 28)

The crest of the Ash Pond also functions as a road, part of which has a gravel cover and the other part is asphalt. The alignment of the top of the embankment appeared generally level, with no depressions or irregularities observed.

2.1.4 Interior of Embankment (Photo Nos. 1, 2, 4, 7, 13, 14, 15, 16, 17, 19, 22, 24, 26, 28, 29, 34)

According to LBWL, approximately two thirds to three quarters of the coal ash deposits have been removed from the interior of the Ash Pond. Several tree stumps or root structures were noted on the interior slope (Photo No. 30). It appeared that the bottom ash discharge pipe had leaked and created an erosion channel on the inner slope (Photo No. 29). Some erosion channels were noted on the interior slope (Photo Nos. 4 and 7). The interior slope in the areas that had been excavated did not appear to be sloped at the design angle (3H:1V). Erosion was observed on the interior slope where the runoff pipe from the Coal Pipe discharges to Ash Pond (Photo 34).

2.1.5 Appurtenant Structures (Photo Nos. 6, 14, 15, 19, 20, 21, 31, 38, 39, 40)

There are two discharge structures in the Ash Pond, the transfer structure and the drainage structure. Both of these structures were observed to be in good condition though neither one is currently in use due to the dewatering of the Ash Pond. During the Site assessment, there was a minimal amount of water in the Ash Pond and any wastewater within the Ash Pond was being transferred into the Clear Water Pond by a temporary pump near the transfer structure (the flexible pipe connected to the submerged pump is visible in Photo No. 39). The concrete in the transfer and discharge structures appeared intact. The interior of the transfer and discharge structures could not be observed to evaluate the level of ash within them. The transfer and discharge pipes could not be visually inspected during the assessment. LBWL reportedly has never had an issue with any of the discharge pipes since the Ash Pond was originally constructed. The stoplogs on the discharge structure appeared to be in good condition (Photo No. 40).

The overflow structure in Clear Water Pond appeared to be in good condition, but GZA was not able to observe if the inlet was clear of debris (Photo No. 15). The overflow structure outlet appeared to be in good condition with some small brush at the exit (Photo Nos. 37 and 38). GZA did not observe a fence installed at the exit to reduce the chance of animals nesting within the overflow pipe.

The pumphouse was not assessed during GZA's site visit as this was outside of the scope of work (Photo No. 19). An unknown pipe was observed on the north side of the Ash Pond (Photo No. 31).

2.2 Caretaker Interview

Maintenance of the dam is the responsibility of LBWL personnel. As detailed in previous sections, GZA met with LBWL personnel and discussed the current operations and maintenance procedures, regulatory requirements, and the history of the Ash Pond since it was constructed.

2.3 Operation and Maintenance Procedures

As discussed in Section 1.2.5, LBWL personnel are responsible for the regular operation and maintenance of the Ash Pond. There are no formal operation and maintenance procedures. The Ash Pond is typically observed at least once per week for anything unusual.

2.4 Emergency Action Plan

There is no Emergency Action Plan (EAP) developed for the Ash Pond. An EAP is not required by the Part 315 Rules.

2.5 Hydrologic/Hydraulic Data

GZA did not perform an independent assessment of the hydraulics and hydrology for the embankments as this was beyond our scope of services. No design documentation was available for the Ash Pond. During normal operating conditions, there is approximately sixteen feet of freeboard.

2.6 Structural and Seepage Stability

The original structural and seepage stability analyses, if any, were not available to GZA at the time of inspection. Slope stability analyses, seepage analyses, foundation liquefaction analyses, and settlement analyses reports were not available.

3.0 ASSESSMENTS AND RECOMMENDATIONS

3.1 Assessments

Because the status of the impoundment as a CCW facility is currently in a state of flux due to the ongoing ash removal and associated impoundment modifications underway during our visit, the EPA has directed that GZA withhold assignment of a condition rating at this time.

Notwithstanding the assignment of a condition rating, the Ash Pond was found to have the following deficiencies:

1. Presence of a brush pile on the southeast side of the outer slope;
2. Several large stumps remaining on the interior and exterior slopes;
3. The interior slope in the areas that had been excavated did not appear to be sloped at the design angle (3H:1V);
4. Leaking bottom ash discharge pipe;
5. No formal operation and maintenance plan or inspection checklist to observe the structural condition of the dike;
6. Presence of vegetation and an apparent lack of an animal barrier in the emergency overflow pipe;
7. The discharge pipes from the discharge structure to the pump house, from the transfer structure to Clear Water Pond, and from the emergency overflow in Clear Water Pond to the emergency overflow outlet have not been inspected internally since they were installed;
8. There was an unknown pipe observed on the north side of the Ash Pond;
9. No Geotechnical computations with respect to the embankments' stability were made available to GZA for review; and
10. No Hydrologic/Hydraulic computations with respect to the impoundment's ability to safely pass the Spillway Design Flood (SDF) were made available to GZA for review.

The following recommendations and remedial measures generally describe the recommended approach to address current deficiencies at the Ash Pond. Prior to undertaking recommended maintenance, repairs, or remedial measures, the applicability of environmental permits needs to be determined for activities that may occur within resource areas under the jurisdiction of the appropriate regulatory agencies.

3.2 Studies and Analyses

GZA recommends the following studies and analyses:

1. If the Ash Pond is to be used as originally designed, (i.e. refilled with ash following the ash removal activities), perform a geotechnical stability analysis of the embankments under all applicable loading conditions, including earthquake-induced loading.
2. If the Ash Pond is to be used as originally designed, perform a detailed hydrologic and hydraulic study using current methodology to evaluate the impoundment's ability to safely pass the SDF

3.3 Recurrent Operation & Maintenance Recommendations

GZA recommends the following operation and maintenance level activities:

1. Remove the brush piles and grind the stumps down and fill in the depressions left from the stump removal; Remove stumps and root balls and backfill with compacted fill.

2. Clear vegetation and logs from the emergency overflow outlet area and install a fence to prevent animals from nesting in the emergency overflow pipe, if a fence is not already installed;

3. If LBWL has the opportunity, inspect the discharge pipes from the discharge structure to the pump house, from the transfer structure to Clear Water Pond, and from the emergency overflow in Clear Water Pond to the emergency overflow outlet to verify that they are operating correctly and are in good condition. This may be performed by video photograph; and,

4. Create a formal checklist for visual inspections of the Ash Pond structure and maintain the inspection records on file.

5. Confirm that all dike embankments have not been overexcavated/or over filled during the ongoing ash removal operation. If the slopes have been excavated steeper than 3H:1V, then the oversteep slope should be backfilled in controlled, compacted lifts of similar soils used for the original dike construction. If the slopes have been over filled, the excess material should be removed down to the original 3H:1V slope angle. Re-establish the 12-inch thick layer of slope protection (i.e. riprap) and 6-inch layer of filter material on the interior slope between El. 886.5 and E. 880.5 where needed.

6. Remove unwanted vegetation from the 12-inch slope protection at the toe of the outer slope of the dike adjacent to the railroad tracks.

7. Repair the erosion and add erosion mitigation measures to prevent future erosion from occurring at the discharge end of the runoff pipe from the Coal Pile.

8. Confirm operability of the sluice gate in the drainage structure.

3.4 Repair Recommendations

GZA recommends the following repairs which may improve the overall condition of the Ash Pond, but do not alter the current design of the embankment. The recommendations may require design by a professional engineer and construction contractor experienced in dam and/or coal ash storage pond construction.

1. Repair the leaking bottom ash discharge pipe and eroded slope below the leak; and,
2. Evaluate the necessity of the unknown pipe found on the north side of the Ash Pond and remove the pipe if it is not needed.

3.5 Alternatives

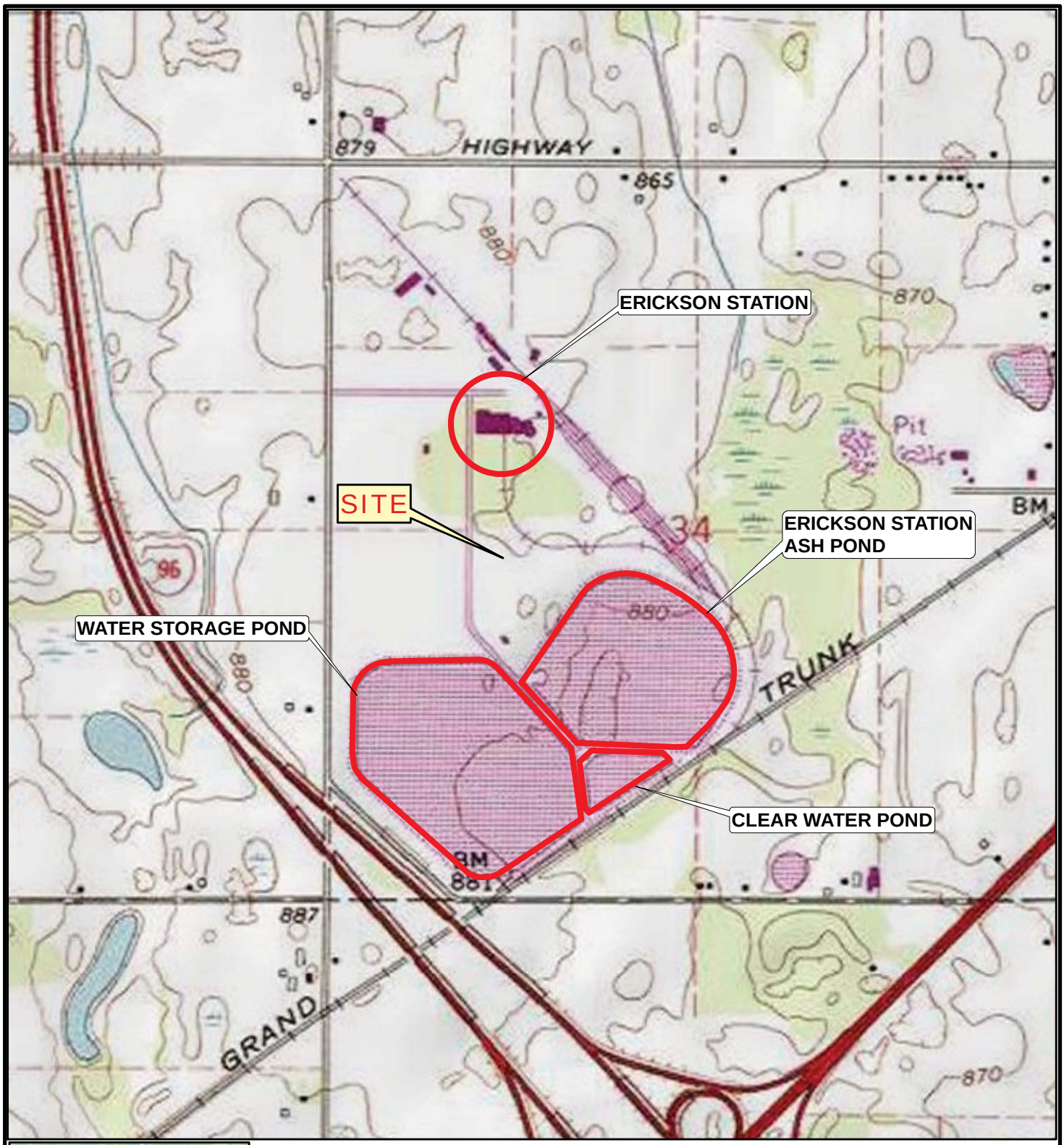
There are no practical alternatives to the repairs itemized above.

4.0 ENGINEER'S CERTIFICATION

As previously noted, at the time of GZA's inspection (May 19, 2011), the Ash Pond was dewatered and in the process of undergoing modifications which included excavation and removal of previously placed ash followed by disposal at an off-site Type II sanitary landfill. Because the status of the impoundment as a CCW facility is currently in a state of flux, the EPA has directed that GZA withhold assignment of a condition rating at this time.

Walter Kosinski, P.E.
Principal

Figures



SOURCE : This map contains the ESRI ArcGIS Online World Topographic Map service, Published February 2011 by ESRI ARCIMS Services. The service was compiled to uniform cartography using a variety of best available sources from several data providers,.

Data Supplied by : esri

0 500 1,000 2,000 3,000 Feet

N W E S

GZA	PROJ. MGR.: TRB DESIGNED BY: TRB REVIEWED BY: PHB OPERATOR: GAS DATE: 06-20-2011	LOCUS PLAN (USGS TOPOGRAPHIC QUAD)	JOB NO. 01.0170142.30
		LANSING BW&L - ERICKSON STATION 6725 S. CANAL ROAD LANSING, MICHIGAN	FIGURE NO. 1

SOURCE : This map contains the ESRI ArcGIS Online World Topographic Map service, Published February 2011 by ESRI ARCIMS Services. The service was compiled to uniform cartography using a variety of best available sources from several data providers,.

Data Supplied by : esri

0 500 1,000 2,000 3,000 Feet

N W E S

GZA	PROJ. MGR.: TRB DESIGNED BY: TRB REVIEWED BY: PHB OPERATOR: GAS DATE: 06-20-2011	LOCUS PLAN (DIGITAL ORTHOPHOTO/AERIAL IMAGERY)	JOB NO. 01.0170142.30
		LANSING BW&L - ERICKSON STATION 6725 S. CANAL ROAD LANSING, MICHIGAN	FIGURE NO. 2

LEGEND

4 PHOTO LOCATION / DIRECTION

N
W E
S

0 150 300 600 900
Feet

SOURCE : This map contains the ESRI ArcGIS Online World Topographic Map service, Published February 2011 by ESRI ARCIMS Services. The service was compiled to uniform cartography using a variety of best available sources from several data providers.

NO.	ISSUE / DESCRIPTION	BY	DATE
XX	XXXX	XX	XX

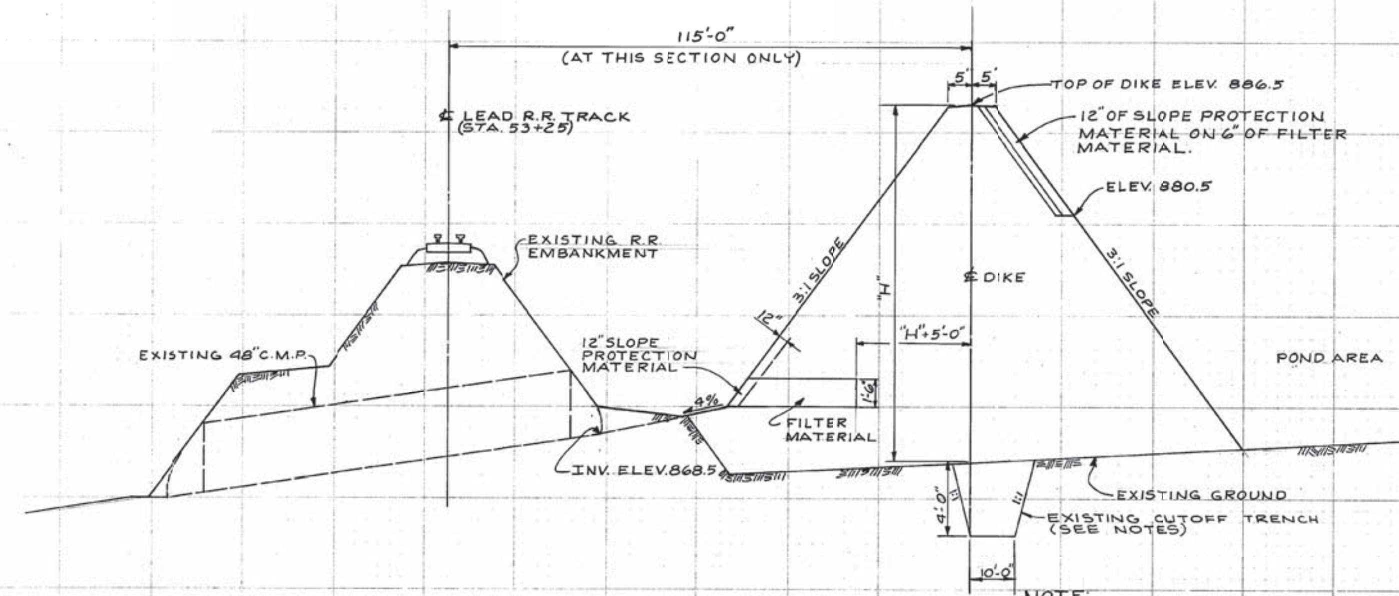
LANSING BW&L - ERICKSON STATION
6725 S. CANAL ROAD
LANSING, MICHIGAN

FLY ASH BASIN
OBSERVATIONS AND PHOTOLOG

PREPARED BY: GZA GeoEnvironmental, Inc. Engineers and Scientists www.gza.com		PREPARED FOR:	
PROJ MGR: TRB	REVIEWED BY: PHB	CHECKED BY: TRB	FIGURE 3
DESIGNED BY: TRB	DRAWN BY: GAS	SCALE: 1 in = 300 ft	
DATE: 07/13/2011	PROJECT NO. 01.0170142.30	REVISION NO.	

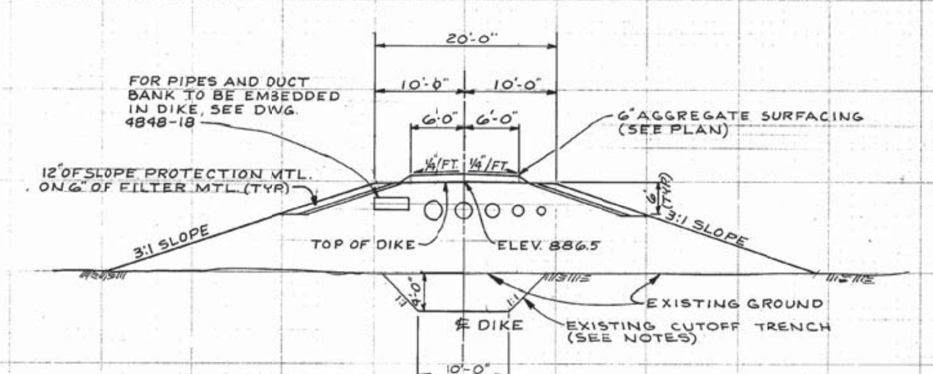
 J:\170,000-179,999\170142\170142-30 Round 10\Erickson Station, Lansing, MI\Figures\GIS\MXDs\01-170142-30 Site Plan -v2.mxd, 7/13/2011, 3:37:44 PM, gregory.scott

Figure 4
Ash Pond Earthwork – Contract 57



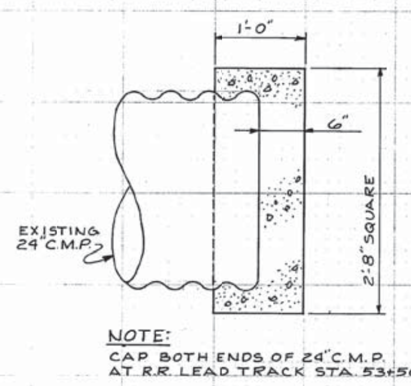
SECTION (E212/212)
SCALES: HORZ. 1"=20' VERT. 1"=5'

NOTE:
THIS DIKE SECTION APPLIES TO ALL DIKES ADJACENT TO R.R.



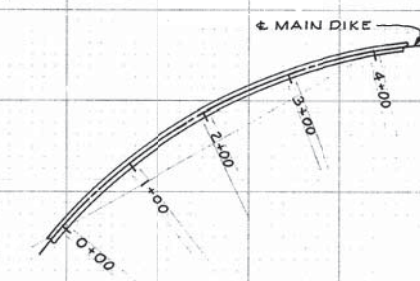
TYPICAL SECTION-DIKE ACCESS ROAD
NO SCALE

NOTE:
THIS DIKE SECTION APPLIES TO NEW DIKES ALONG THE NORTH AND WEST SIDES OF THE CLEAR WATER POND AND TO THE DIKE BETWEEN THE ASH POND AND THE WATER STORAGE POND.



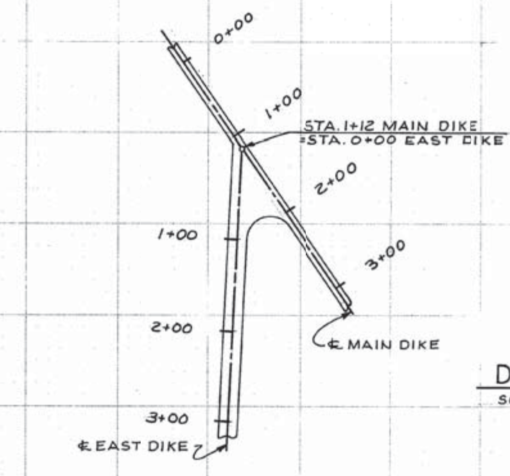
NOTE:
CAP BOTH ENDS OF 24" C.M.P. AT R.R. LEAD TRACK STA. 53+50.

C.M.P. CONCRETE CAP DETAIL
SCALE: 1"=1'-0"



℄ MAIN DIKE			
STA.	ELEV.	STA.	ELEV.
0+00	886.5	2+31	866.3
0+50	886.6	2+50	868.2
0+60	885.8	2+75	869.9
1+00	880.4	2+91	872.5
1+37	874.7	3+00	875.0
1-50	872.0	3+50	882.1
1+60	870.7	3+83	885.1
1-65	868.8	4+00	886.7
1-83	866.6		
2+00	866.3		

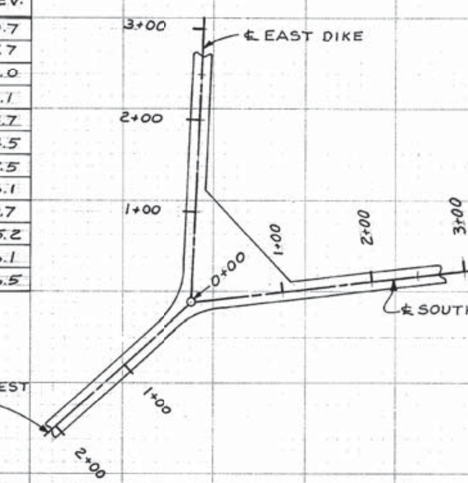
DETAIL (D212/212)
SCALE: 1"=100'



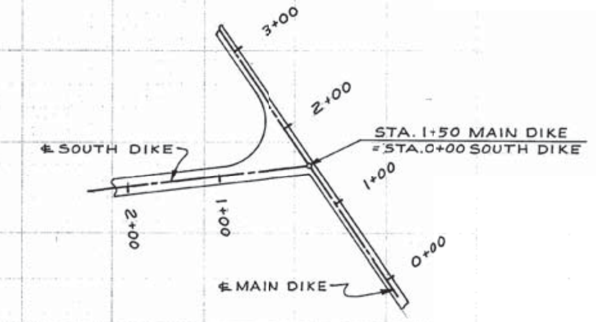
℄ MAIN DIKE		℄ EAST DIKE	
STA.	ELEV.	STA.	ELEV.
0+00	886.5	0+00	873.1
0+50	883.7	0+50	873.1
1-00	875.0	1+00	873.9
1+12	873.2	1+25	877.2
1-50	873.6	1+50	876.7
2+00	874.6	2+00	873.8
2+50	884.5	2+25	886.3
3+00	886.9	2+50	886.9

DETAIL (C212/212)
SCALE: 1"=100'

℄ NORTHWEST DIKE		℄ SOUTH DIKE		℄ EAST DIKE	
STA.	ELEV.	STA.	ELEV.	STA.	ELEV.
0+00		0+00	871.0	0-15	870.7
0+11	869.2	0+30	875.2	0-90	875.7
0+17	869.2	0+50	875.6	0+00	870.0
0+27	874.7	1+00	876.4	0+10	879.1
0+50	874.7	1+35	878.5	0+25	879.7
0+87	885.5	1+50	879.8	0+50	874.5
1+00	888.1	2+00	885.8	1+00	875.5
1+45	885.5	2+14	886.8	1+30	876.1
1+50	886.1	2+50	886.7	1+50	879.7
2+00	886.5			1+80	885.2
				2+00	886.1
				2+50	886.5



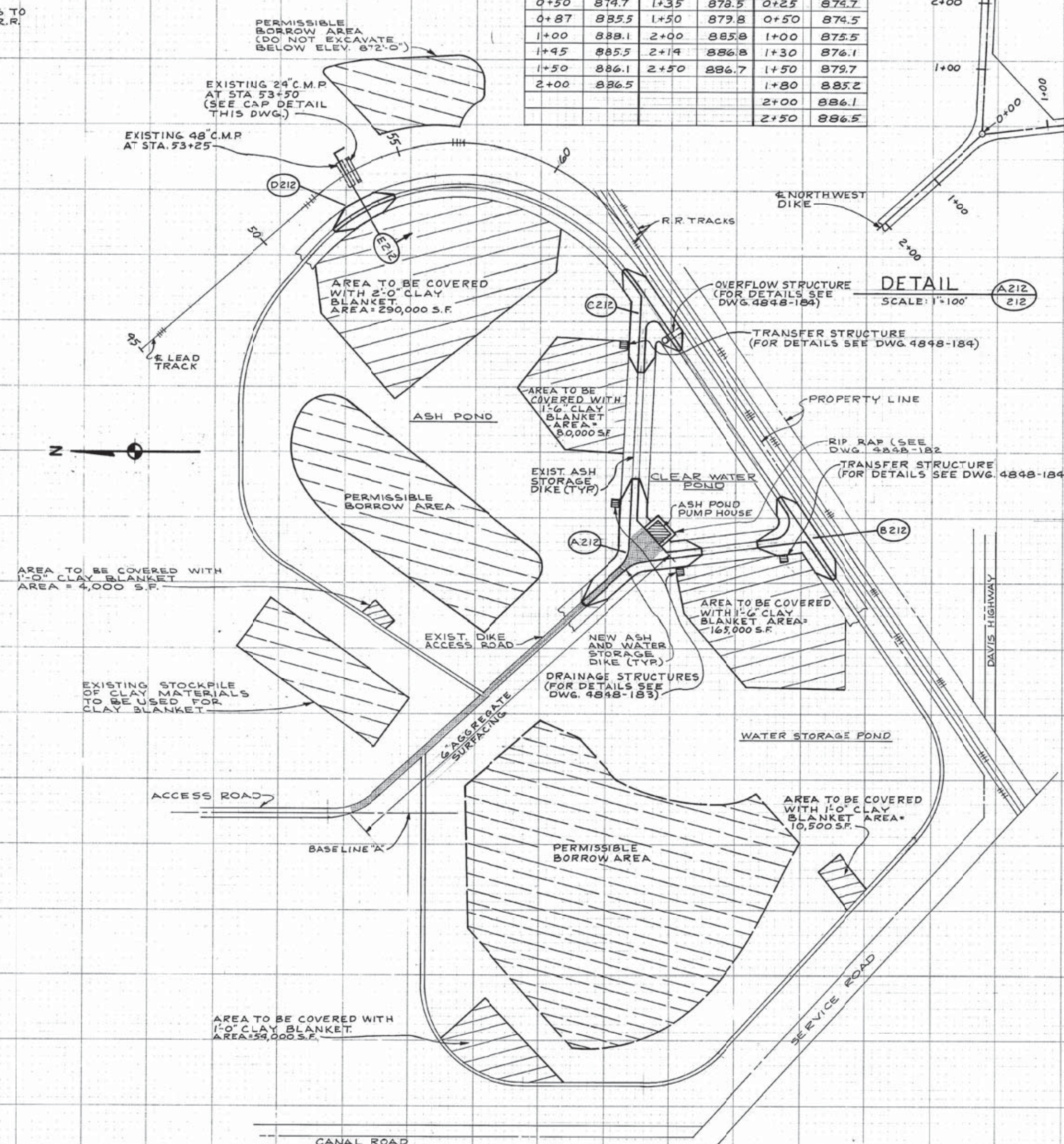
DETAIL (A212/212)
SCALE: 1"=100'



℄ MAIN DIKE		℄ SOUTH DIKE	
STA.	ELEV.	STA.	ELEV.
0+00	886.5	0+00	874.3
0+40	885.9	0+50	873.9
0+50	884.8	0+78	874.8
1+00	878.0	1+00	877.7
1+50	874.3	1+50	886.4
1+93	874.6	1+57	886.8
2+00	875.5	2+00	886.9
2+50	883.7		
2+77	886.3		
3+00	886.7		

DETAIL (B212/212)
SCALE: 1"=100'

EXISTING SURFACE ELEVATIONS



PLAN
ASH POND AREA
SCALE: 1"=200'

REFERENCE DRAWINGS
PLANT SITE GRADING — 4848-14
SECURITY FENCING — 4848-213

NOTES:
ALL WORK ON THIS DRAWING BY CONTRACT 57, UNLESS OTHERWISE NOTED.
THE 1ST PHASE OF ASH POND EARTHWORK IS SHOWN ON DRAWING 4848-14.
ALL ELEVATIONS SHOWN REFER TO SITE GRADING DATUM-, SITE GRADING ELEV. 882'-0" = PLANT DATUM 100'-0".
EXACT BOUNDARIES OF AREAS TO BE COVERED BY CLAY BLANKET WILL BE DETERMINED BY ENGINEER.
S.F. AREA OF CLAY BLANKET SHOWN DOES NOT INCLUDE SLOPING EDGES.
EXISTING CUTOFF TRENCHES:
1. CLEAN SAND AND LOOSE SOIL OFF BEFORE SCARIFYING TO PROVIDE BOND FOR FIRST LAYER OF FILL.
2. WHERE EXISTING TEMPORARY DRAINAGE DITCHES CUT THRU CUTOFF TRENCH, FILL DITCH WITH COMPACTED CLAY.

REVISIONS	DATE	DWN.	APP.	REVISIONS	DATE	DWN.	APP.	REVISIONS	DATE	DWN.	APP.
								1 FINAL	4-18-74	B.H.	MH

DRAWN RON DICKES
CHECKED D.C. Petersen
APPROVED D.C. Petersen
APPROVED M. D. Hona
DATE SEPT. 4, 1970

STANLEY CONSULTANTS
INTERNATIONAL CONSULTANTS IN ENGINEERING, ARCHITECTURE, PLANNING, AND MANAGEMENT

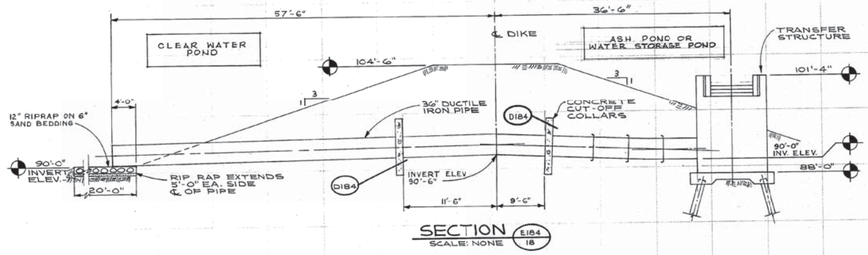
BOARD OF WATER AND LIGHT
LANSING — MICHIGAN
FIRST UNIT — ERICKSON STATION

ASH POND EARTHWORK - CONTRACT 57

SCALE AS NOTED
NO. 4848-212 REV. 1

MAC #0998

Figure 5
Ash Pond Structures – Sheet 2



SECTION (D184 / 18)
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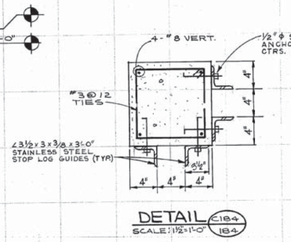
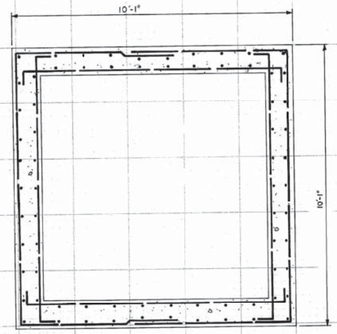
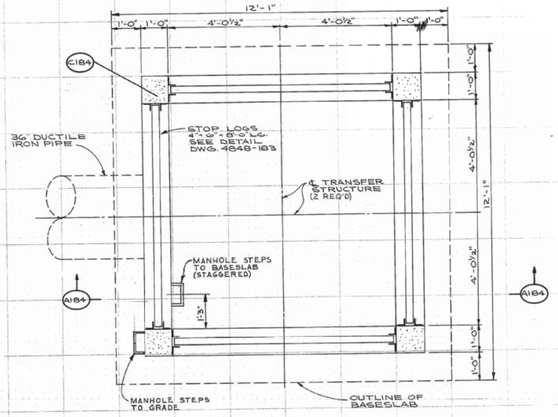


DETAIL (C184 / 184)
SCALE: ½"=1'-0"

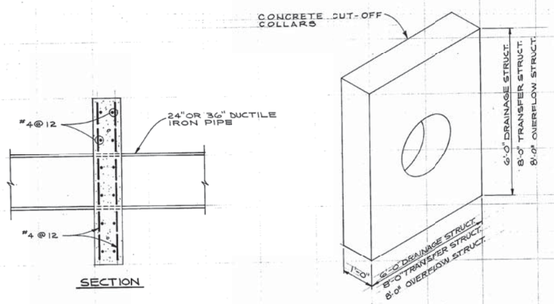


NOTE:
ALL REINFORCING #6 @ 12".

SECTION (B184 / 184)
SCALE: ½"=1'-0"

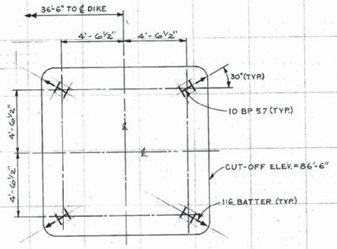


PLAN
SCALE: ½"=1'-0"



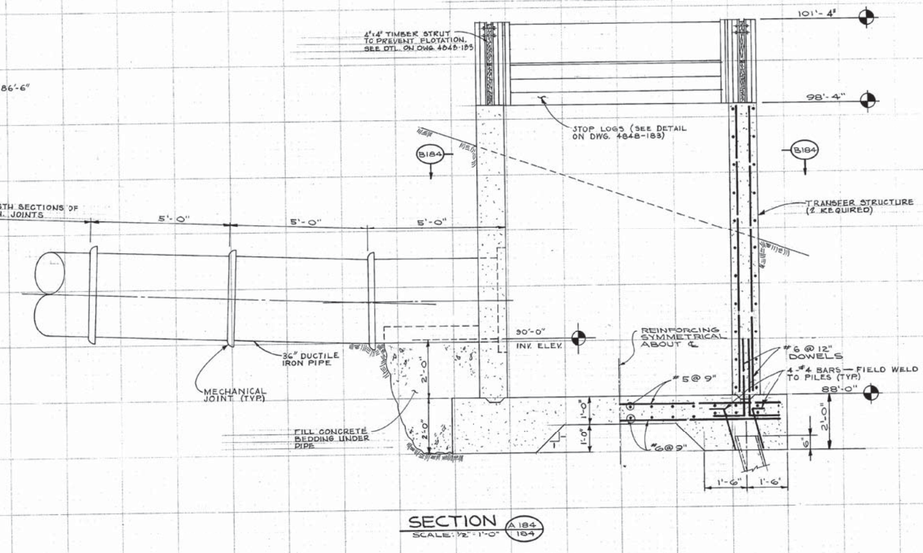
SECTION

DETAIL (D184 / —B3 & 184)
SCALE: NONE

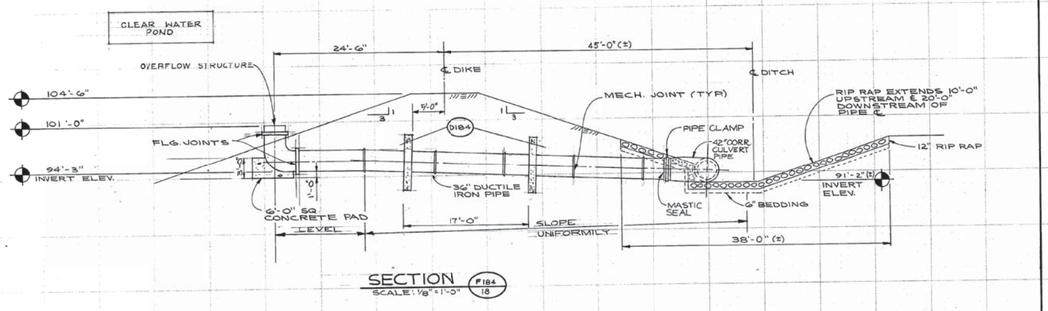


PILING PLAN
SCALE: ¼"=1'-0"

NOTE: PLACE 5 STOP LOGS IN EACH GROOVE FOR ASH POND (WEIR EL. = 99'-6½")
PLACE 7 STOP LOGS IN EACH GROOVE FOR WATER STORAGE POND (WEIR EL. = 101'-0½")



SECTION (A184 / 184)
SCALE: ½"=1'-0"



SECTION (F184 / 18)
SCALE: ⅛"=1'-0"

OPERATIONAL NOTE

INITIAL WATER LEVEL IN ASH POND AND CLEAR WATER POND SHALL BE AT MIN. ELEV. 99.58' PRIOR TO OPERATING ASH WATER PUMPS.

NOTES

ALL WORK ON THIS DRAWING BY CONTRACT 57 UNLESS OTHERWISE NOTED.

FOR REFERENCE DRAWINGS SEE DRAWING 4848-183

PROVIDE ELECTRICAL CONTINUITY BETWEEN A CONNECTION POINT AT TOP OF CONCRETE STRUCTURE AND ALL PIPE BY MEANS OF #8 BAR; WELD ALL CONTACT POINTS; WELDS SHALL PROVIDE CONTACT AREA EQUAL TO BAR CROSS-SECTIONAL AREA.

SCALE: 1-1/2"=1'-0" | SCALE: 1/2"=1'-0" | SCALE: 1/4"=1'-0" | SCALE: 1/8"=1'-0"

REVISIONS	DATE	DWN.	APP.	REVISIONS	DATE	DWN.	APP.	REVISIONS	DATE	DWN.	APP.
								FINAL	4-18-74	H.	TGB

DRAWN W.M. JOHNSON
CHECKED [illegible]
APPROVED [illegible]
APPROVED [illegible]
DATE SEPT 4, 1970

STANLEY CONSULTANTS
INTERNATIONAL CONSULTANTS IN ENGINEERING, ARCHITECTURE, PLANNING, AND MANAGEMENT

BOARD OF WATER AND LIGHT
LANSING — MICHIGAN
FIRST UNIT — ERICKSON STATION

ASH POND STRUCTURES
SHEET 2

SCALE AS NOTED
NO. 4848-184
REV. 1

AAC # 0971

Appendix A

Limitations

DAM ENGINEERING & VISUAL INSPECTION LIMITATIONS

1. The observations described in this report were made under the conditions stated herein. The conclusions presented in the report were based solely on the services described therein, and not on scientific tasks or procedures beyond the scope of described services or the time and budgetary constraints imposed by the United States Environmental Protection Agency (EPA).

2. In preparing this report, GZA GeoEnvironmental, Inc. (GZA) has relied on certain information provided by Lansing Board of Water & Light (LBWL) (and their affiliates) as well as Federal, state, and local officials and other parties referenced therein. GZA has also relied on certain information contained on the State of Michigan's website as well as Federal, state, and local officials and other parties which were available to GZA at the time of the inspection. Although there may have been some degree of overlap in the information provided by these various sources, GZA did not attempt to independently verify the accuracy or completeness of all information reviewed or received during the course of this work.

3. In reviewing this Report, it should be noted that the reported condition of the Ash Pond is based on observations of field conditions during the course of this study along with data made available to GZA. The observations of conditions at the Ash Pond reflect only the situation present at the specific moment in time the observations were made, under the specific conditions present. It may be necessary to reevaluate the recommendations of this report when subsequent phases of evaluation or repair and improvement provide more data.

4. It is important to note that the condition of a dam or embankment depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam or embankment will continue to represent the condition of the dam or embankment at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions may be detected.

5. Water level readings have been reviewed and interpretations have been made in the text of this report. Fluctuations in the level of the groundwater and surface water may occur due to variations in rainfall, temperature, and other factors different than at the time measurements were made.

6. GZA's comments on the history, hydrology, hydraulics, and embankment stability for the Ash Pond are based on a limited review of available design documentation for the Erickson Station. Calculations and computer modeling used in these analyses were not available and were not independently reviewed by GZA.

7. This report has been prepared for the exclusive use of EPA for specific application to the existing dam facilities, in accordance with generally accepted dam engineering practices. No other warranty, express or implied, is made.

8. This dam inspection verification report has been prepared for this project by GZA. This report is for broad evaluation and management purposes only and is not sufficient, in and of itself, to prepare construction documents or an accurate bid.

Appendix B

Definitions

COMMON DAM SAFETY DEFINITIONS

For a comprehensive list of dam engineering terminology and definitions refer to references published by the U.S. Army Corps of Engineers, the Federal Energy Regulatory Commission, the Department of the Interior Bureau of Reclamation, or the Federal Emergency Management Agency.

Orientation

Upstream – Shall mean the side of the dam that borders the impoundment.

Downstream – Shall mean the high side of the dam, the side opposite the upstream side.

Right – Shall mean the area to the right when looking in the downstream direction.

Left – Shall mean the area to the left when looking in the downstream direction.

Dam Components

Dam – Shall mean any artificial barrier, including appurtenant works, which impounds or diverts water.

Embankment – Shall mean the fill material, usually earth or rock, placed with sloping sides, such that it forms a permanent barrier that impounds water.

Crest – Shall mean the top of the dam, usually provides a road or path across the dam.

Abutment – Shall mean that part of a valley side against which a dam is constructed. An artificial abutment is sometimes constructed as a concrete gravity section, to take the thrust of an arch dam where there is no suitable natural abutment.

Appurtenant Works – Shall mean structures, either in dams or separate there from, including but not be limited to, spillways; reservoirs and their rims; low level outlet works; and water conduits including tunnels, pipelines, or penstocks, either through the dams or their abutments.

Spillway – Shall mean a structure over or through which water flows are discharged. If the flow is controlled by gates or boards, it is a controlled spillway; if the fixed elevation of the spillway crest controls the level of the impoundment, it is an uncontrolled spillway.

General

EAP – Emergency Action Plan - Shall mean a predetermined plan of action to be taken to reduce the potential for property damage and/or loss of life in an area affected by an impending dam break.

O&M Manual – Operations and Maintenance Manual; Document identifying routine maintenance and operational procedures under normal and storm conditions.

Normal Pool – Shall mean the elevation of the impoundment during normal operating conditions.

Acre-foot – Shall mean a unit of volumetric measure that would cover one acre to a depth of one foot. It is equal to 43,560 cubic feet. One million U.S. gallons = 3.068 acre feet.

Height of Dam – Shall mean the vertical distance from the lowest portion of the natural ground, including any stream channel, along the downstream toe of the dam to the crest of the dam.

Spillway Design Flood (SDF) – Shall mean the flood used in the design of a dam and its appurtenant works particularly for sizing the spillway and outlet works, and for determining maximum temporary storage and height of dam requirements.

Condition Rating

SATISFACTORY - No existing or potential management unit safety deficiencies are recognized. Acceptable performance is expected under all applicable loading conditions (static, hydrologic, seismic) in accordance with the applicable criteria. Minor maintenance items may be required.

FAIR - Acceptable performance is expected under all required loading conditions (static, hydrologic, seismic) in accordance with the applicable safety regulatory criteria. Minor deficiencies may exist that require remedial action and/or secondary studies or investigations.

POOR - A management unit safety deficiency is recognized for any required loading condition (static, hydrologic, seismic) in accordance with the applicable dam safety regulatory criteria. Remedial action is necessary. POOR also applies when further critical studies or investigations are needed to identify any potential dam safety deficiencies.

UNSATISFACTORY - Considered unsafe. A dam safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution. Reservoir restrictions may be necessary.

Hazard Potential

(In the event the impoundment should fail, the following would occur):

LESS THAN LOW HAZARD POTENTIAL: Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

LOW HAZARD POTENTIAL: Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

SIGNIFICANT HAZARD POTENTIAL: Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

HIGH HAZARD POTENTIAL: Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

Appendix C

Inspection Checklist

Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name:	Erickson Station Power Station	Date:	May 19, 2011
Unit Name:	Erickson Station Ash Pond	Operator's Name:	Lansing Board of Water & Light
Unit I.D.:	EPA I.C.R. 7300, MI Dam I.D. 2680	Hazard Potential Classification:	High Significant (Low)
Inspector's Name:	Walter Kosinski, P.E. & Thomas Boom, P.E.		

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	Every 5 years		18. Sloughing or bulging on slopes?	✓	
2. Pool elevation (operator records)?	883.5 ft		19. Major erosion or slope deterioration?		✓
3. Decant inlet elevation (operator records)?	883.5 ft		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	N/A		Is water entering inlet, but not exiting outlet?		✓
5. Lowest dam crest elevation (operator records)?	886.5 ft		Is water exiting outlet, but not entering inlet?		✓
6. If instrumentation is present, are readings recorded (operator records)?	N/A		Is water exiting outlet flowing clear?	N/A	
7. Is the embankment currently under construction?		✓	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation,stumps, topsoil in area where embankment fill will be placed)?	✓		From underdrain?	N/A	
9. Trees growing on embankment? (If so, indicate largest diameter below)		✓	At isolated points on embankment slopes?		✓
10. Cracks or scarps on crest?		✓	At natural hillside in the embankment area?		✓
11. Is there significant settlement along the crest?		✓	Over widespread areas?		✓
12. Are decant trashracks clear and in place?	✓		From downstream foundation area?		✓
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		✓	"Boils" beneath stream or ponded water?		✓
14. Clogged spillways, groin or diversion ditches?		✓	Around the outside of the decant pipe?		✓
15. Are spillway or ditch linings deteriorated?	N/A		22. Surface movements in valley bottom or on hillside?	N/A	
16. Are outlets of decant or underdrains blocked?	See Note		23. Water against downstream toe?	✓	
17. Cracks or scarps on slopes?		✓	24. Were Photos taken during the dam inspection?	✓	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Inspection Issue # Comments

6) No instrumentation is present.
8) According to construction drawings, foundation preparation was performed.
9) Trees growing on the embankment were removed in 2010.
13, 20) Minimum free water depth over deposited coal combustion waste. Most areas are not covered by water.
16) The outlet is submerged. As such, we were unable to observe it.
18) Some sloughing on the upstream slopes where the coal combustion waste has been removed.
23) Water was against the downstream toe during the inspection as a result of recent heavy precipitation.

U. S. Environmental Protection Agency

Coal Combustion Waste (CCW)
Impoundment Inspection

Walter Kosinski, P.E.

Impoundment NPDES Permit # N/A* INSPECTOR & Thomas Boom, P.E.

Date May 19, 2011 *sluice water is recycled back to the Erickson Station

Impoundment Name Erickson Station Power Station

Impoundment Company Lansing Board of Water & Light

EPA Region 5

State Agency (Field Office) Addresss 525 West Allegan Street
Lansing, MI 48909

Name of Impoundment Erickson Station Ash Pond

(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New X Update _____

	Yes	No
Is impoundment currently under construction?	_____	X
Is water or ccw currently being pumped into the impoundment?	X	_____

IMPOUNDMENT FUNCTION: Temporary storage of fly ash and bottom ash sluice.

Nearest Downstream Town : Name Dimondale

Distance from the impoundment 1.05 miles

Impoundment Location: Longitude 84 Degrees 39 Minutes 14 Seconds
Latitude 42 Degrees 41 Minutes 15 Seconds
State MI County Eaton

Does a state agency regulate this impoundment? YES X NO _____

If So Which State Agency? MDEQ, Dam I.D. 2680

HAZARD POTENTIAL (In the event the impoundment should fail, the following would occur):

_____ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

__X__ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

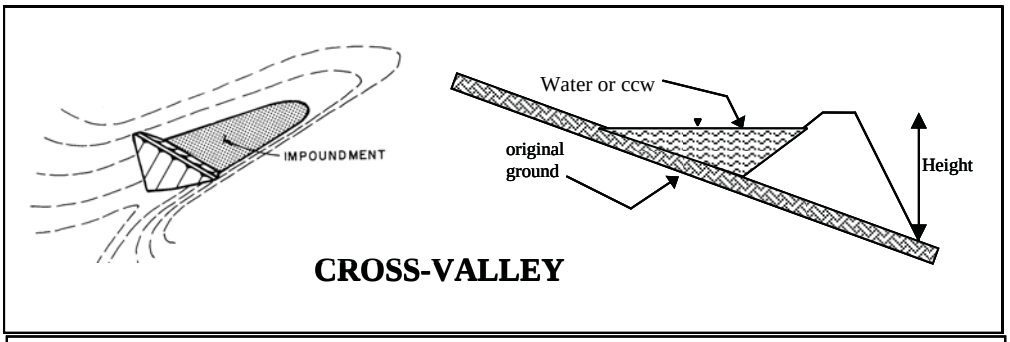
_____ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

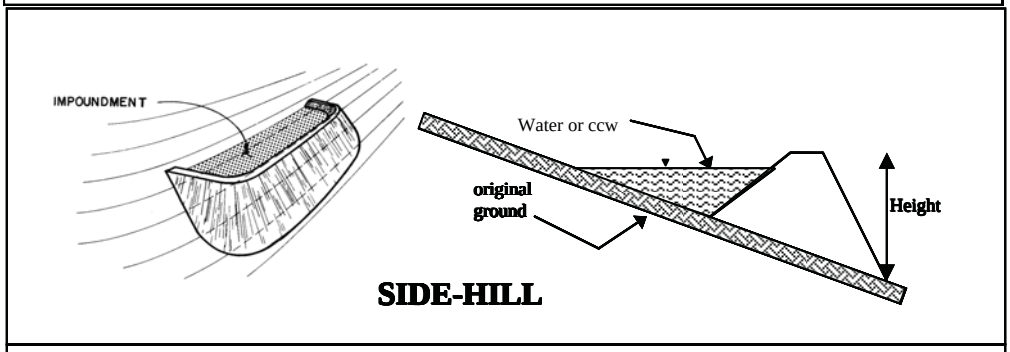
_____ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

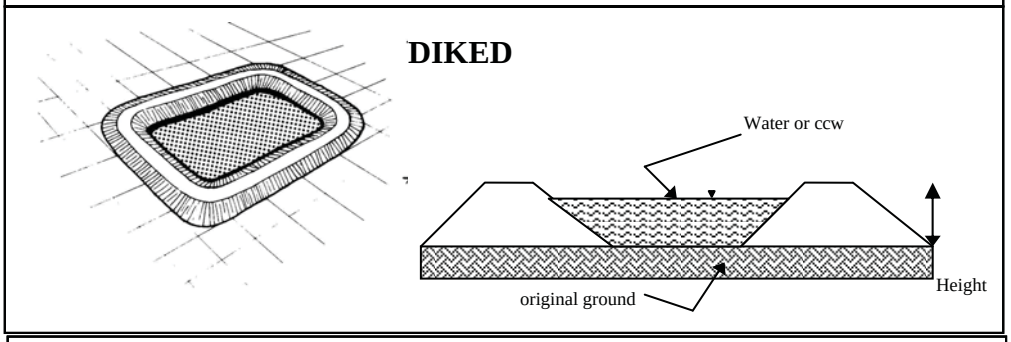
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

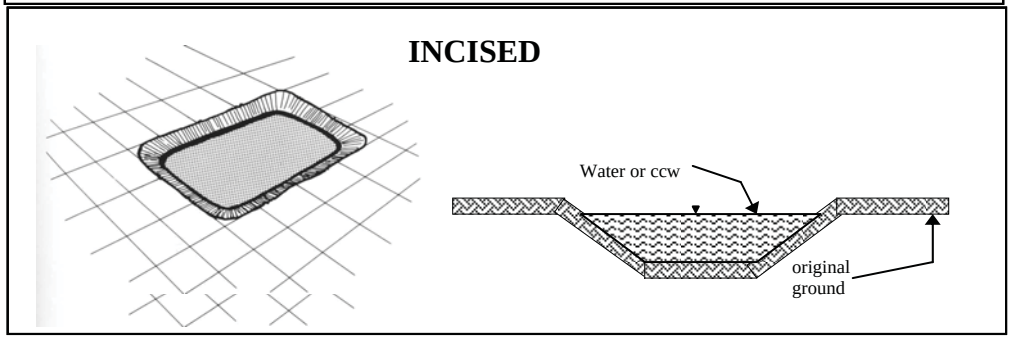
Dam failure or misoperation would result in no probable loss of human life and low economic or environmental losses. The losses would be primarily limited to the owner's property. Additionally, the impoundment has been dewatered and there are no current plans to refill it.

CONFIGURATION:









_____ Cross-Valley
_____ Side-Hill
__X__ Diked
_____ Incised (form completion optional)
_____ Combination Incised/Diked

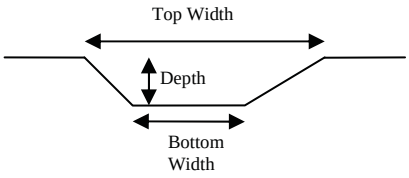
Embankment Height 17 feet Embankment Material Compacted clay
Pool Area built for 33 acres Liner Compacted clay
Current Freeboard 3* feet* Liner Permeability unknown

* Minimum free water depth over deposited coal combustion waste. Most areas not covered by water.

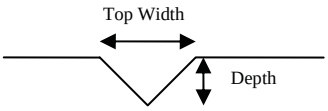
TYPE OF OUTLET (Mark all that apply)

__N/A__ **Open Channel Spillway**
_____ Trapezoidal
_____ Triangular
_____ Rectangular
_____ Irregular

TRAPEZOIDAL

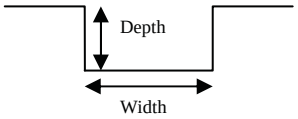


TRIANGULAR

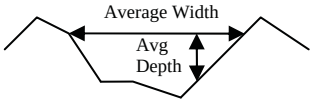


_____ depth
_____ bottom (or average) width
_____ top width

RECTANGULAR

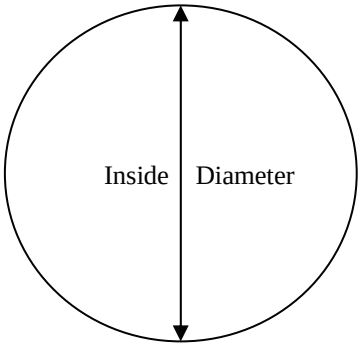


IRREGULAR



_____ **Outlet**

__3 ft__ inside diameter



Material
_____ corrugated metal
_____ welded steel
_____ concrete
_____ plastic (hdpe, pvc, etc.)
__X__ other (specify) __ductile iron__

Is water flowing through the outlet? YES _____ NO __X*__
*impoundment is currently empty

_____ **No Outlet**

_____ **Other Type of Outlet** (specify) _____

The Impoundment was Designed By __Stanley Consultants__

Has there ever been a failure at this site? YES _____ NO ___X_____

If So When? _____

If So Please Describe : _____

Has there ever been significant seepages at this site? YES _____ NO __X__

If So When? _____

IF So Please Describe: _____

Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site? No past seepages or breeches. YES _____ NO X

If so, which method (e.g., piezometers, gw pumping,...)? _____

If so Please Describe : _____

Appendix D

Photographs

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: Erickson Station Erickson Station Ash Pond Lansing, MI	Project No. 01.0170142.30

Photo No.	Date:
1	05/19/11

Direction Photo Taken:
Southeast

Description:
Fly ash removal activities and the former location of the inlet sluice pipe.

Photo No.	Date:
2	05/19/11

Direction Photo Taken:
East

Description:
Crest of embankment.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: Erickson Station Erickson Station Ash Pond Lansing, MI	Project No. 01.0170142.30

Photo No.	Date:
3	05/19/11

Direction Photo Taken:
West

Description:
Crest and outer slope of embankment.

Photo No.	Date:
4	05/19/11

Direction Photo Taken:
Southeast

Description:
Crest and inner slope of embankment. Some minor erosion channeling was present on the inner slope.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: Erickson Station Erickson Station Ash Pond Lansing, MI	Project No. 01.0170142.30

Photo No.	Date:
5	05/19/11

Direction Photo Taken:
East

Description:
Water against the downstream toe of the slope as a result of precipitation.

Photo No.	Date:
6	05/19/11

Direction Photo Taken:
East

Description:
Culvert that drains water from the toe of the slope to Holly Drain.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: Erickson Station Erickson Station Ash Pond Lansing, MI	Project No. 01.0170142.30

Photo No.	Date:
7	05/19/11

Direction Photo Taken:
South

Description:
Crest and inner slope of embankment. Some minor erosion channeling was present.

Photo No.	Date:
8	05/19/11

Direction Photo Taken:
North

Description:
Water along the downstream toe of the slope.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: Erickson Station Erickson Station Ash Pond Lansing, MI	Project No. 01.0170142.30

Photo No.	Date:
9	05/19/11

Direction Photo Taken:
South

Description:
Apparent coal spill at the toe of the slope.

Photo No.	Date:
10	05/19/11

Direction Photo Taken:
Southwest

Description:
Evidence of rip rap along the toe of the slope.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	**Site Location:** Erickson Station Erickson Station Ash Pond Lansing, MI	**Project No.** 01.0170142.30

Photo No.	Date:
11	05/19/11

Direction Photo Taken:
East

Description:
Alignment of the slope.

Photo No.	Date:
12	05/19/11

Direction Photo Taken:
South

Description:
Crest and embankment near Station 104+00. The shallow hole on the right of the photo was caused by a surveyor attempting to locate a surface monument.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: Erickson Station Erickson Station Ash Pond Lansing, MI	Project No. 01.0170142.30

Photo No.	Date:
13	05/19/11

Direction Photo Taken:
Northwest

Description:
Ash removal activities.

Photo No.	Date:
14	05/19/11

Direction Photo Taken:
West

Description:
Concrete transfer structure to transfer water from the Ash Pond to Clearwater Pond.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: Erickson Station Erickson Station Ash Pond Lansing, MI	Project No. 01.0170142.30

Photo No.	Date:
15	05/19/11

Direction Photo Taken:
Northwest

Description:
Transfer of water into Clear Water Pond and the emergency overflow structure in Clear Water Pond.

Photo No.	Date:
16	05/19/11

Direction Photo Taken:
West

Description:
Embankment between the Ash Pond and Clear Water Pond. The channel of water flow at the toe of the slope is sluice water from Erickson Station.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: Erickson Station Erickson Station Ash Pond Lansing, MI	Project No. 01.0170142.30

Photo No.	Date:
17	05/19/11

Direction Photo Taken:
Northwest

Description:
Ash that has been removed.

Photo No.	Date:
18	05/19/11

Direction Photo Taken:
East

Description:
Embankment between the Ash Pond and Clear Water Pond.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: Erickson Station Erickson Station Ash Pond Lansing, MI	Project No. 01.0170142.30

Photo No.	Date:
19	05/19/11

Direction Photo Taken:
West

Description:
Pump house that recirculates water from the Clear Water Pond back to Erickson Station.

Photo No.	Date:
20	05/19/11

Direction Photo Taken:
North

Description:
Concrete discharge structure in the Ash Pond with a site specific elevation scale to determine the height of water within the Ash Pond when it is operational.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: Erickson Station Erickson Station Ash Pond Lansing, MI	Project No. 01.0170142.30

Photo No. 21 | **Date:** 05/19/11

Direction Photo Taken:
Southeast

Description:
Concrete transfer structure in the Water Storage Pond.

Photo No. 22 | **Date:** 05/19/11

Direction Photo Taken:
Northwest

Description:
Interior slope of the Ash Pond embankment.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	**Site Location:** Erickson Station Erickson Station Ash Pond Lansing, MI	**Project No.** 01.0170142.30

Photo No.	Date:
23	05/19/11

Direction Photo Taken:
Northwest

Description:
Embankment between the Ash Pond and the Water Storage Pond.

Photo No.	Date:
24	05/19/11

Direction Photo Taken:
North

Description:
Inner slope of the Ash Pond embankment. The pipe shown is the discharge pipe for the bottom ash sluice.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: Erickson Station Erickson Station Ash Pond Lansing, MI	Project No. 01.0170142.30

Photo No.	Date:
25	05/19/11

Direction Photo Taken:
Northeast

Description:
Outer slope of the Ash Pond embankment.

Photo No.	Date:
26	05/19/11

Direction Photo Taken:
Southwest

Description:
Temporary road constructed in the Ash Pond to facilitate ash removal.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: Erickson Station Erickson Station Ash Pond Lansing, MI	Project No. 01.0170142.30

Photo No. 27 | **Date:** 05/19/11

Direction Photo Taken:
East

Description:
Outer slope and crest of Ash Pond embankment.

Photo No. 28 | **Date:** 05/19/11

Direction Photo Taken:
North

Description:
Crest of Ash Pond embankment and bottom ash discharge pipe that is placed inside the Ash Pond.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: Erickson Station Erickson Station Ash Pond Lansing, MI	Project No. 01.0170142.30

Photo No.	Date:
29	05/19/11

Direction Photo Taken:
South

Description:
Apparent leak in the bottom ash discharge pipe.

Photo No.	Date:
30	05/19/11

Direction Photo Taken:
East

Description:
Tree stump from a tree that was removed last fall.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: Erickson Station Erickson Station Ash Pond Lansing, MI	Project No. 01.0170142.30

Photo No.	Date:
31	05/19/11

Direction Photo Taken:
South

Description:
Unknown pipe near the toe of the outer slope of the Ash Pond embankment.

Photo No.	Date:
32	05/19/11

Direction Photo Taken:
Southwest

Description:
Water being discharged from the sump pumped from the Erickson Station.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: Erickson Station Erickson Station Ash Pond Lansing, MI	Project No. 01.0170142.30

Photo No.	Date:
33	05/19/11

Direction Photo Taken:
Northwest

Description:
Coal pile runoff pipe on the toe of the outer slope of the Ash Pond embankment.

Photo No.	Date:
34	05/19/11

Direction Photo Taken:
South

Description:
Discharge from the coal pile runoff pipe into the Ash Pond.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: Erickson Station Erickson Station Ash Pond Lansing, MI	Project No. 01.0170142.30

Photo No.	Date:
35	05/19/11

Direction Photo Taken:
Southwest

Description:
Water Storage Pond.

Photo No.	Date:
36	5/19/11

Direction Photo Taken:
Southeast

Description:
Fishing dock on the Water Storage Pond.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	**Site Location:** Erickson Station Erickson Station Ash Pond Lansing, MI	**Project No.** 01.0170142.30

Photo No.	Date:
37	5/19/11

Direction Photo Taken:
West

Description:
Brush pile and stumps piled on the outer slope near the emergency overflow outlet.

Photo No.	Date:
38	5/19/11

Direction Photo Taken:
South

Description:
Emergency overflow outlet from the Clear Water Pond. Note rip rap on slope.

GZA GeoEnvironmental, Inc.

PHOTOGRAPHIC LOG

Client Name: U.S. Environmental Protection Agency	Site Location: Erickson Station Erickson Station Ash Pond Lansing, MI	Project No. 01.0170142.30

Photo No.	Date:
39	5/19/11

Direction Photo Taken:
East

Description:
Transfer structure in the Ash Pond to transfer water to the Clear Water Pond. This transfer structure is not currently in use. Any water in the Ash Pond is pumped to the Clear Water Pond as shown in the picture.

Photo No.	Date:
40	5/19/11

Direction Photo Taken:
East

Description:
Stop logs in discharge structure.

Appendix E

References

LANSING BWL – ERICKSON STATION

REFERENCES

1. Safety Inspection and Structural Evaluation for the Erickson Dam, Lansing, Michigan, Inspecsol Engineering Inc., dated November 2, 2009.

2. March 27, 2009 response by Lansing Board of Water & Light to EPA Request for Information regarding the Erickson Station Power Station.

3. NPDES Permit No. MI0005428 for Lansing BWL – Erickson Station dated February 21, 2008.