

Inspection 12/19/07

**SEVENTH
FIVE-YEAR INDEPENDENT CONSULTANT
INSPECTION REPORT
(PER THE NORTH CAROLINA UTILITIES COMMISSION)**

**DUKE ENERGY
ALLEN STEAM STATION
253 Plant Allen Road
Belmont, North Carolina 28012
S&ME PROJECT NO. 1411-07-152**

Prepared For:



Prepared By:



**S&ME, Inc.
44 Buck Shoals Road, Suite C-3
Arden, North Carolina 28704**

September 12, 2008



September 12, 2008

Duke Energy
Allen Steam Station
253 Plant Allen Road
Belmont, North Carolina 28012

Attention: Gary Blevins, P.E.

Reference: **Five-year Independent Consultant Inspection Report**
Ash Basin Dikes, Allen Steam Station
Belmont, North Carolina
S&ME Project No. 1411-07-152

Dear Mr. Blevins:

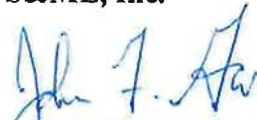
S&ME, Inc. is pleased to provide this report of ash basin dike observation services at the Allen Steam Station (Plant Allen) in Belmont, North Carolina. We have prepared this report according to the guidelines specified in our proposal dated November 28, 2007 and our existing *Professional Services Agreement (0233032.04/MI 1342 002)* with Duke Energy. This report is intended to assist in meeting the requirements of the North Carolina Utilities Commission (NCUC). As such, this reports constitutes the seventh, five-year independent consultant inspection of the plant Allen Ash Basin Dikes.

During our site observations, we noted no areas of immediate concern with regards to public safety or stability of the dikes. We have recommended further investigation and continued monitoring of a number of areas on the dikes. These areas are identified in Section 7 of this report along with our recommendations. Notably, cracks and increased seepage have developed on the North Dike at its eastern end. A detailed description of this condition is in Section 4 of this report.


S&ME, Inc. appreciates the opportunity to be of service to you and Duke Energy. If you have any questions regarding this report, or if we may be of further assistance, please do not hesitate to contact us.


Sincerely,

S&ME, Inc.


John F. Garner, P.E.
Project Engineer




William M. Miller, P.E.
Senior Engineer


Howard Perry, P.E.
Senior Engineer/Vice-President

JFG:LA:WMM:jmm

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1 INTRODUCTION

1.1 General

S&ME, Inc. has provided services to fulfill requirements for the five-year independent consultant inspection as required by the North Carolina Utilities Commission (NCUC) for facilities operated by Duke Energy in North Carolina, and not licensed by the Federal Energy Regulatory Commission (FERC). This report represents the seventh independent consultant inspection of the Active Ash Basin dikes at the Allen Steam Station. The previous inspections were performed by numerous consultants and have been documented in previous reports as shown below:

Year	Consultant	Date of Report
1977	Law Engineering	July 5, 1977
1982	Charles T. Main, Inc.	January 25, 1983
1987	Law Engineering	August 14, 1987
1992	Trigon Engineering Consultants	January 8, 1993
1997	Law Engineering & Environmental Services, Inc.	April 24, 1998
2002	Mactec Engineering and Consulting of Georgia, Inc.	January 15, 2003

This report presents our understanding of the history of the Active Ash Basin dikes, documents the existing condition of the ash basin dikes, identifies areas of concern, and provides our recommendations for monitoring, maintenance and remediation. The reports identified previously are included by reference in this report as a basis for: identification and observation of specific areas requiring ongoing attention; understanding the influence of plant operations on dike conditions; evaluating the presence and adequacy of maintenance activities. We performed the five-year independent consultant inspection in general conformance with the guidelines established by FERC for regulated structures as outlined in Part 12 – Safety of Water Power Projects and Project Works, Subpart D as amended on 20 July, 1984, and current dam safety regulations of the State of North Carolina.

1.2 Purpose and Scope of Services

According to FERC regulations, the purpose of the five-year independent consultant inspection is "...to identify any actual or potential deficiencies, whether in the condition of those project works or in the quality or adequacy of project maintenance, surveillance, or methods of operation, that might endanger public safety." In our proposal dated November 28, 2007, S&ME, Inc. prepared a scope of services to address these issues and fulfill the requirements of the NCUC. These services included the following activities:

- Review of previous inspection reports, engineering analyses made available by Duke Energy.
- Review of surveillance measurements made available by Duke Energy.
- Review of engineering drawings for the dikes including plans, cross sections, and construction details.
- Site observation visit with documentation of existing conditions.
- Preparation of this report.

2 Project Information

2.1 Incorporation by Reference

To the extent that conditions, assumptions, and available information have not changed since the most recent report by an independent consultant under the current regulations, the analyses provided or referenced in that report are hereby incorporated by reference in this report. The most recent five-year independent consultant report is dated January 15, 2003.

2.2 Description

The Allen Steam Station is located on the west side of the Catawba River approximately 4.5 miles south of the town of Belmont, Gaston County, North Carolina (Figure 1). The Active Ash Basin facility lies approximately 1 mile south of the power generating facility and immediately south of the Retired Ash Basin.

The Active Ash Basin is formed by two earthen dikes each with a crest elevation of 645 feet, above mean sea level (MSL) (Figure 2, 3, and 4). The main or East Dike forms the entire eastern rim of the ash basin. The axis of the East Dike runs north-south except at its southern end where the dike abuts the natural topography by making a turn to the west. At its northern end the East Dike abuts a second dike originally constructed to form the southern rim of the retired ash basin. The East Dike was completed in 1973. A berm was added against the downstream slope in 1982.

The axis of this second dike or North Dike runs generally east-west and forms the northern rim of the Active Ash Basin. The axis of the North Dike makes a bend southward for approximately 170 feet near its western end. The dike axis re-aligns east-west before terminating into natural topography. A transmission tower stands in the bend on the downstream side of the dike. According to drawing number A3350-1A provided by Duke, the North Dike was constructed in three stages. Successive crest elevations were 610 feet MSL in 1965, 625 feet MSL in 1968, and 645 feet MSL in 1973 (Figure 4).

The Active Ash Basin has a total impounding water surface area of approximately 160 acres at the crest elevation of 645 feet MSL (measured from the USGS Belmont, NC Quadrangle map shown in Figure 2). The Active Ash Basin is divided into multiple cells by embankments presumably constructed of ash. Ash from the power plant is sluiced to one of these cells while the others are in various stages of operations. Excess water is channeled from the initial discharge cell to a larger, final treatment cell. The water surface elevation in the final treatment cell is controlled by stop logs in the Ash Basin Discharge Tower. Overflows are released to the Catawba River through the associated spillway conduit.

Parameter	East Dike	North Dike
Crest Elevation	645.0 feet MSL	645.0 feet MSL
Water Surface Elevation	642.0 feet MSL (design)	642.0 feet MSL (design)
Crest Width	15 feet	15 feet (design)
Downstream Slope	2.5 horiz.:1 vert.(berm slope)	3 horiz.:1 vert. (berm slope)
Upstream Slope	2 horiz.:1 vert.	2 horiz.:1 vert.
Height	75 feet	65 feet

2.3 Size Classification

According to record drawing number A3350-1A provided by Duke Energy, the outlet invert elevation of the Active Ash Basin spillway conduit is 570 feet MSL. Assuming this is the lowest elevation along the toe of the East Dike, the height of the dike would be 75 feet. Likewise, the lowest recorded elevation along the toe of the North Dike is approximately elevation 580 feet MSL on drawing number A-3350. The Height of the North Dike would therefore be 65 feet. According to North Carolina Dam Safety Regulations both dikes would be classified as “Large” dam. According to US Army Corps of Engineers (USACOE) criteria, the dikes would be classified as “Intermediate” structures.

2.3.1 Hazard Classification

Past reports indicate that the dike system is currently classified by the State of North Carolina as a High Hazard structure due to environmental impact considerations associated with a potential breach. We also note that development near the shoreline of Lake Wylie, opposite the East Dike may be impacted by a flood wave in a breach or slope failure event.

2.3.2 Geology and Seismicity

Reference is made to the previous independent consultant five-year inspection reports. These reports identify the location of the dikes within the Piedmont Physiographic Province and Seismic Zone 2 according to the Seismic Zone Map of Contiguous States in *Recommended Guidelines for Safety Inspection of Dams* by the USACOE. The USACOE recommends seismic evaluations for projects in Zone 2 where materials exist that are suspected to be susceptible to liquefaction or excessive deformation. Past inspection reports indicate that these materials may exist in the form of sluiced ash or alluvial sands in the foundations of the North Dike – Stages II and III; and in the foundation of the East Dike near the shores of Lake Wylie.

3 Engineering and Operational Information

3.1 Engineering Information

S&ME, Inc. reviewed the engineering analyses contained in past independent consultant five-year inspections. In general, the information presented demonstrates adequate factors of safety for slope stability and adequate freeboard for hydraulic capacity where operating conditions are within original design parameters.

3.1.1 Slope Stability

Slope stability analyses were performed in 1982 and 1994 for the East Dike and the North Dike. These analyses were developed using soil strength parameters obtained by Duke Energy through drilling, sampling, and laboratory testing of embankment materials. The Ordinary Method of Slices and the Modified Bishop Method were the analyses techniques used in 1982 and 1994 respectively. Generally, lower factors of safety were associated with shallow failures (less than 10 feet deep). It is understood that Duke accepts these conditions as maintenance items that would be addressed as they occur.

An ash landfill has been proposed over the Retired Ash Basin on the north side of the North Dike. In 2007, Duke Energy contracted with S&ME, Inc. to analyze the static slope stability of the North Dike under varying hydrostatic conditions in consideration of the proposed landfill. The analyses followed the Spencer's Method and used data from more recent geotechnical investigations. The analyses demonstrated acceptable factors of safety for a range of anticipated water surface elevations against the North Dike under static loading conditions.

Seismic loading conditions were not evaluated in the 2007 report by S&ME, Inc. The 2002, five-year independent consultant report makes reference to USACOE guidelines advising seismic analyses where embankment and foundation materials could be considered susceptible to deformation under seismic loading conditions. These material types include poorly consolidated materials deposited by hydraulic in-filling. Alluvial sands of the Catawba River floodplain and sluiced ash in the retired ash basin pose potential concern in this regard. Seismic analyses have not been performed for the East dike and the North Dike. We recommend investigation and slope stability analyses consistent with the USACOE guidelines for slope stability in seismic events.

3.1.2 Hydraulic Capacity

Hydraulic capacity of project spillway systems has not been altered since past analyses. The outlet works consist of a rectangular reinforced concrete riser with two sharp-crested weirs approximately three feet, nine inches in length according to record drawings (Figure 5). The weir crests are formed by concrete stop logs which maintain the normal

pool at the desired operating level (Figure 6). A 42-inch diameter reinforced concrete pipe serves as the outlet conduit (Figure 7). No emergency overflow spillway section was observed.

Previous hydrologic analyses for the Active Ash Basin watershed are summarized in the 2002 five-year independent consultant report. The past analyses were based on the assumption that all rainfall in the watershed is converted directly to runoff. The analyses indicated that adequate freeboard is available to pass the 6-hour, $\frac{3}{4}$ probable maximum precipitation (PMP) storm event.

Operations procedures may affect the storage volume of the ash basin. Portions of the ash basin have been allowed to fill with sluiced ash at or above the design operating water surface elevation of 642 feet MSL (Figure 8). In this condition, stormwater storage volume is reduced. The reduced storage volume results in higher water surface elevations during storm events. Therefore, overfilling the ash basin with sluiced ash results in greater risk of embankment overtopping during storm events. We recommend installation of monitoring devices to indicate water surface elevations relative to the design operating normal pool elevation.

Site drainage from the Retired Ash Basin and associated upslope areas are controlled in a channel that runs along the downstream toe of the North Dike. The outlet structure is similar in design to the Active Ash Basin outlet structure (Figure 9). Only one weir on the structure was activating at the time of our site visit, and the interior vertical intake conduit has been displaced (Figure 10). No hydrologic or hydraulic calculations were reviewed for this structure. We understand that issues related to the Retired Ash Basin overflow structure will be addressed with future development of a proposed landfill within the area of the Retired Ash Basin.

3.2 Project Operations

Currently, all sluiced ash and plant yard drainage is routed directly into the Active Ash Basin (Figure 11). Water levels vary across sections of the Active Ash Basin as ash is periodically excavated and removed on a section by section basis. Recent ash excavation was reported at the western end of the North Dike. Excavation work reportedly encroached within the immediate vicinity of the upstream slope of the North Dike near the area of the southern jog in the dike axis near its western end (Figure 12). Increased seepage rates and embankment movements were noted in this area and are discussed further in Section 4 of this report. We also noted the crest elevation in this area appeared slightly lower (Figure 13).

Safety related operations include routine observations, surveillance measurements of piezometer water levels, and routine maintenance of embankment slopes and dam appurtenant works. Observations are made by Duke Energy personnel and by outside consultants. Reports of routine inspections by Duke personnel were not available at the time of this report. Inspections by independent consultants are performed at five-year intervals in accordance with NCUC regulations.

3.3 Monitoring

Review of recent water level data from observation wells and piezometer readings indicates phreatic surface behavior typical of historical activity. We note fluctuation in water surface readings in OW-15 at station 21+00 on the North Dike from 2004 to 2006. The piezometer is reportedly broken and no current readings are available. The last current readings indicated a return to historical water levels prior to being broken.

Monitoring of embankment movements using such devices as settlement plates, inclinometers, or monitoring pins is not currently in place. No change in embankment movement monitoring is anticipated in the future. See section 6 for additional monitoring discussion.

4 Field Observations

S&ME, Inc. performed the field observations on December 19, 2007. John Garner, P.E. of S&ME, Inc. was accompanied by Mr. Gary Blevins, P.E. of Duke during the visit. Weather conditions during the site visit were clear and cool. The site had received a trace of rain prior to the visit. The water level in the Active Ash Basin at the time of the visit is estimated to be approximately 637 feet MSL based on the water surface elevation relative to the average top elevation of the North Dike. Sluiced ash levels exceeded this elevation in portions of the Active Ash Basin. Photographs of items described are located in Appendix A.

4.1 North Dike – Active Ash Basin

The North Dike supports a stand of grass that is generally well-maintained. The crest of the dike was originally designed to be 15 feet wide. The crest has been widened significantly by the addition of ash on the upstream slope of the dike to facilitate construction traffic. An access road broaches the crest of the North Dike from the downstream toe, just east of the southward bend in the dike axis near its western end.

The downstream embankment was rehabilitated in 1982 following a major slope failure near the location of the current access road. As such, the access road generally delineates the western extents of the embankment remediation. Therefore, east of the access road, the downstream embankment is buttressed by two stabilization berms, underlain by a washed stone blanket drain. West of the access road, the dike is not buttressed by any stabilization berm.

Ash sluice lines were discharging into the Active Ash Basin in the section located just east of the transmission tower peninsula (Figure 14). The sluice lines follow the access road which broaches the crest of the dike just east of the bend in the dike axis near its western end. Areas of sparse vegetation were noted just west of the access road previously described (Figure 15). The dike crest east of the access road supports constant construction traffic and the roadway is under continuous maintenance. The crest appears to have been widened significantly to the upstream side to accommodate additional equipment access (Figure 16).

For this report, no piezometer location maps were reviewed. Mr. Blevins reported destruction of at least two piezometers which appear to be listed as “BROKEN” in the piezometer reading data table provided. These piezometers are listed as OW-15 and OW-17. Based on review of past reports and analyses, it appears that OW-15 is in an area of significance relative to past dike failure and recent slope stability analyses.

A significant leak was noted in the sluice pipes at the location where the access road crests the North Dike embankment, just east of the southward bend in the dike axis (Figure 17). The leak had resulted in minor, localized erosion on the downstream slope.

We noted transverse (perpendicular to the dike axis) cracks in the crest of the dike embankment between the access road and the southward bend in the dike axis to the west of the access road. These cracks were generally a few inches to a foot deep (Figure 18). In some locations, these cracks transected longitudinal cracks near the downstream edge of the crest. The upstream pool area along this portion of the North Dike was filled with saturated ash approximately two to three feet below the dike crest (Figure 19). Similar cracks were less prevalent to the west beyond the bend in the dike axis.

We noted saturated soils and seepage at the downstream embankment toe beginning at the location of a road cut into the toe, just west of the access road and extending around the southward bend in the embankment axis. Seepage appeared more concentrated in the section of the bend where the downstream slope is in a concave configuration (Figure 20). Seepage in this area was noted in the 2002 five-year inspection report. Mr. Blevins noted that the seepage appear greater in flow than in his past observations. We noted that a 15-inch HDPE roadway culvert intended to pass flow from the toe area of the dike at the location of the access roadway cut appeared partially clogged, resulting in standing water along the downstream toe. Also, seepage through the embankment appears to be causing minor erosion near the toe of the embankment, at the location where the downstream toe has been cut to accommodate a roadway drainage ditch (Figure 21). The seepage appeared clear and we noted no boils along the downstream embankment.

We noted a localized area of saturation along the downstream toe of the North Dike in the vicinity of OW-16 (Figure 22). Mr. Blevins reported that this area of saturation was not always evident in past observations. We observed no other areas of seepage or saturation along the North Dike downstream embankment during the site visit.

We noted an inconsistency in the downstream embankment geometry approximately 90 feet east of the transmission tower peninsula. The apparent scarp is at or near the elevation of the downstream crest of the dike (Figures 23, 24). This inconsistency in the embankment surface may also be partially attributable to wheel rutting by mowing equipment. We noted no other scarps, slumps or major geometry inconsistencies on the downstream slope of the North Dike.

The downstream toe of the North Dike was relatively free of heavy vegetation due to recent clearing activities. The clearing work was extended beyond the toe several feet in accordance with past recommendations (Figure 25). The washed stone drainage blanket was exposed and observed to be generally consistent in condition and placement. We noted some localized areas of inconsistent rip rap cover over the drainage stone. We noted the vegetation was not well established in some surface drainage channels which run perpendicular to the downstream slope (Figure 26).

The upstream slope of the North Dike was covered by vegetation, earth fill materials, or ash fill materials and could not be observed. The rock rip rap wave protection noted in past reports was not documented during the site observation visit. We note that constant construction work along the crest may have impacted the crest geometry (Figure 27).

4.2 East Dike – Active Ash Basin

We observed East Dike operating conditions to be generally consistent with past observations. The crest accommodates a gravel road bed. We observed no major discontinuities in the crest elevation or geometry and no signs of significant settlement, sags or tension cracking.

The exposed portion of the upstream slope is covered by rip rap. Dense vegetation along some portions of the upstream slope obscures observation, primarily along the northern half of the East Dike. We observed not signs of upstream slope discontinuity, wave erosion, slides, or sloughing.

The downstream slopes are generally covered by a well-maintained stand of grasses (Figure 28). A stabilization berm abuts the downstream slope approximately 25 feet below the crest. A zoned toe drain exits the toe of the stabilizing berm, according to the record drawings.

We noted two apparent scarps on the downstream embankment 40 feet north of OW-11 (Figure 29). The irregularities appear limited to an area just lower than the dike crest and extend laterally several feet. Vegetation is less dense relative to the surrounding embankment. No significant erosion problems were noted within the areas of exposed soil. The area should be monitored visually for signs of movement and erosion.

There is also exposed soil on the downstream embankment approximately 5 feet above the elevation of the crest of the stabilizing berm (Figure 30). These exposed areas could be due to rutting from mowing equipment. We noted no other signs of slope instability, scarps, slumps, or excessive surface erosion on the downstream slope of the East Dike.

We noted seepage and standing water in the drainage ditches along the toe of the East Dike from the vicinity of observation well OW-6 extending southward approximately 180 feet (Figure 31). The seepage appeared clear and of a relatively slight volume. We noted no boils or surface erosion associated with the seepage. We noted that culverts intended to convey surface water to Lake Wylie may be partially clogged by debris and vegetation. It also appears that ditch slopes combined with heavy vegetation are not allowing free drainage to the culverts. These conditions appear to contribute to the saturated conditions at the toe. We recommend further monitoring of this area

Vegetation cover appeared to be less dense at the southern end of the East Dike, particularly along the bend in the embankment section (Figure 32). Surface drainage ditches extending down the slope in this area were also sparsely vegetated and exposed to erosion (Figure 33).

Previous reports noted seepage through foundation soils at the southern end in the vicinity of the southeastern corner bend. Seepage has also been previously noted through embankment soils at the maximum height embankment section located in the vicinity of

observation well OW-12. We did not observe these areas of seepage during the site visit. However, these areas should continue to be monitored during routine inspections.

4.3 Inlet and Outlet Structures - Active Ash Basin

The ash sluice lines have been previously described. We documented a leak in one of the discharge lines which could lead to erosion problems on the downstream embankment of the North Dike. Ash sluice lines should be continually monitored for additional leaks.

Two yard drainage lines discharge into the Active Ash Basin at the northern end of the East Dike. The lines are routed below ground surface until they emerge from the stabilizing berm on the downstream slope of the East Dike (Figure 34). We noted no areas of instability related to the dike embankment in this location.

The outlet structure for the Active Ash Basin appears to function as designed (Figure 5). We noted no deficiencies in the ash tower structure. However, the condition of the stop logs could not be observed. Repairs to the walkway were noted. We noted no signs of seepage around the spillway conduit or internal erosion through the conduit in our observations at the outlet end of the conduit. Previously documented damage to the end of the spillway conduit is still evident (Figure 7).

4.4 Retired Ash Basin

Existing dikes at a lower crest elevation form the perimeter of the Retired Ash Basin, which lies just north of the Active Ash Basin. The Retired Ash Basin dikes are covered with mature pine trees on both the upstream and downstream slopes (Figure 35). The outlet structure tower requires some maintenance for any use beyond maintaining surface water at a low elevation (Figure 9). The outlet conduit discharges surface water flows to Lake Wylie. We observed no signs of seepage around the pipe or joint deterioration (Figure 36).

Just south of the Retired Ash Basin outlet conduit, we observed flow discharging from a deteriorating 8-inch corrugated metal pipe (Figure 37). The flow appeared clear but steady. We were not able to identify the source of the flow while on the site. Record drawings indicate that the 8-inch pipe is the outfall for catch basins in the rail yard and serves as the outlet for the track drain system. We noted a sinkhole in the railroad track embankment slope, upslope of the CMP outlet (Figure 38).

5 Previous Inspections and Pertinent Reports

S&ME, Inc. reviewed previous inspection reports and reports of analyses performed for the Active Ash Basin and associated dikes and outlet works. We incorporated pertinent information in our report as they relate to operational safety of the project. We relied on available data from Duke Energy and our own internal information and observations for this report. Additional data should be incorporated in future reviews as it becomes available.

6 Monitoring Information

Previous reports document four piezometers and 14 observation wells were installed in the East and North Dikes. Current readings are available for all but two of these instruments. Observation wells OW-15 and OW-17 located on the North Dike have been broken and are no longer serviceable. The four piezometers are installed in the East Dike – two each at stations 54+00 and 62+00. Approximate locations are shown on sheet A3350-1A of the record drawings.

We recommend that damaged observation wells be replaced and the monitoring program continued for the North Dike. Replacement observation wells should be installed to the same depths and in the same approximate locations as the broken observation wells.

We noted areas of apparent embankment movement during our site visit. These areas have been mentioned in the previous five-year inspection report. Routine visual monitoring of slope and embankment movements in these areas should be part of each annual inspection going forward. We recommend that evaluation of additional movement monitoring be made in conjunction with the annual inspection report.

7 Conclusions and Recommendations

S&ME, Inc. performed the Five-year Independent Consultant Inspection to fulfill the safety requirements of the NCUC for non-hydropower dams used in power production. Our services included field observation made at the site, review of historical documents and reports, interviews with Duke personnel, and review of state and federal dam safety regulations. Based on our findings, we conclude that the East Dike and the North Dike, which form the Active Ash Basin at the Allen Steam Station are currently operating in a satisfactory condition relative to immediate site and public safety.

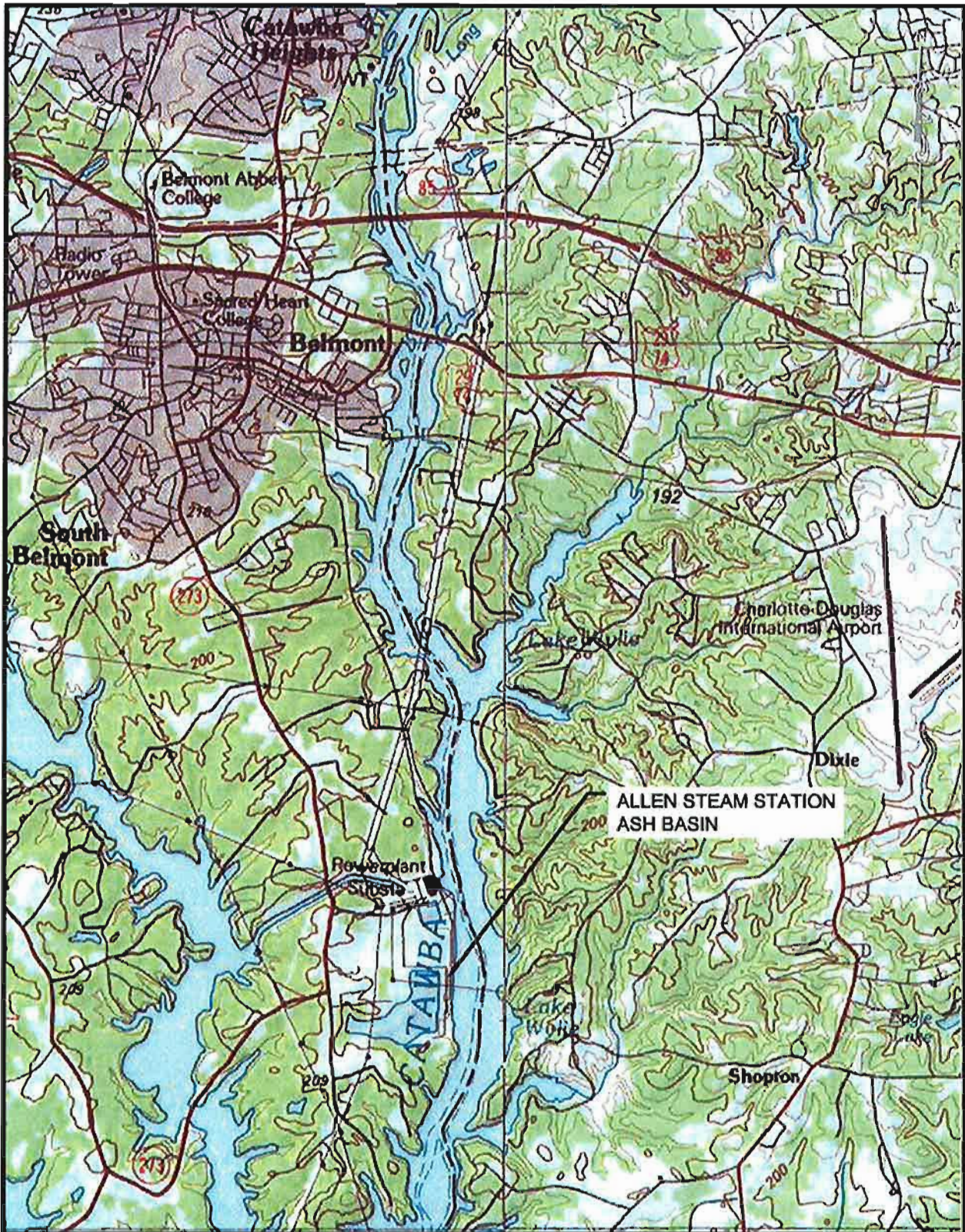
We note that issues related to maintenance and long term safety of the Active Ash Basin were discovered during our work on the project. We have developed a set of recommendations based on these issues. These issues and our recommendations are presented in the following list:

Item No.	Dike Condition Issue	Recommendation
1.	Observation Wells OW-15, OW-17 broken	Re-install observation wells near the original location.
2.	Leak in ash sluice pipe near the downstream crest of the North Dike along the access road.	Repair the leak.
3.	Seepage in North Dike west of access road along southward bend in dike axis (See Section 4.1)	Conduct an engineering study to evaluate options for addressing this seepage issue.
4.	Standing water at toe of North Dike near bend in the dike axis west of the access road	Clear drainage culvert and provide positive drainage away from the toe of the dike embankment.
5.	Ash level elevation above design normal pool operating elevation and diminishing stormwater storage.	Install a freeboard indicator that provides an indication of ash/water levels relative to maximum normal pool elevation 640.0 MSL
6.	Cracking in North Dike embankment crest between access road and axis bend.	Establish a monthly routine of embankment observation noting changes in crack size and geometry.
7.	Slope movements near the crest of the North Dike approximately 90 feet east of the transmission tower peninsula	Document the area photographically and incorporate ongoing documentation into routine annual inspection to monitor progressive movement. Evaluate movement monitoring program annually.
8.	Slope movement near the crest of the East Dike approximately 40 feet north of OW-11.	Document the area photographically and incorporate ongoing documentation into routine inspection to monitor progressive movement.
9.	Standing water along toe of East Dike from OW-6 extending southward approximately 180 feet.	Clear drainage culverts and ditch lines and provide positive drainage to culverts.
10.	Rutting by mowing equipment on downstream embankment slopes.	Mow slopes in a diagonal pattern running transverse to existing rut lines.
11.	Embankment geometry changes throughout operations	Monitor excavation, fill placement, and embankment conditions as ash cells are emptied and ash is being excavated and removed.
12.	Sparse embankment vegetation at the North Dike, west of the access road; the North Dike surface water drainage ditches; and the East Dike, southern end and surface drainage ditches	Re-seed and cover with straw and tack.
13.	Rip rap cover of toe drain materials on the North Dike	Supplement with additional rip rap as needed.
14.	Seepage at the toe of the East Dike near the southern end collected in corrugated metal pipes.	Continue to monitor visually during routine inspections.
15.	Monitoring dike operating conditions	Continue with annual documented inspections of the dikes
16.	Slope stability and liquefaction potential of embankment and foundation materials in seismic events	Conduct engineering explorations and analyses to evaluate liquefaction potential and slope stability in seismic events in accordance with USACOE guidelines

APPENDIX I

FIGURES

- **Site Maps**
- **As-built Cross Sections**
- **Site Photographs**

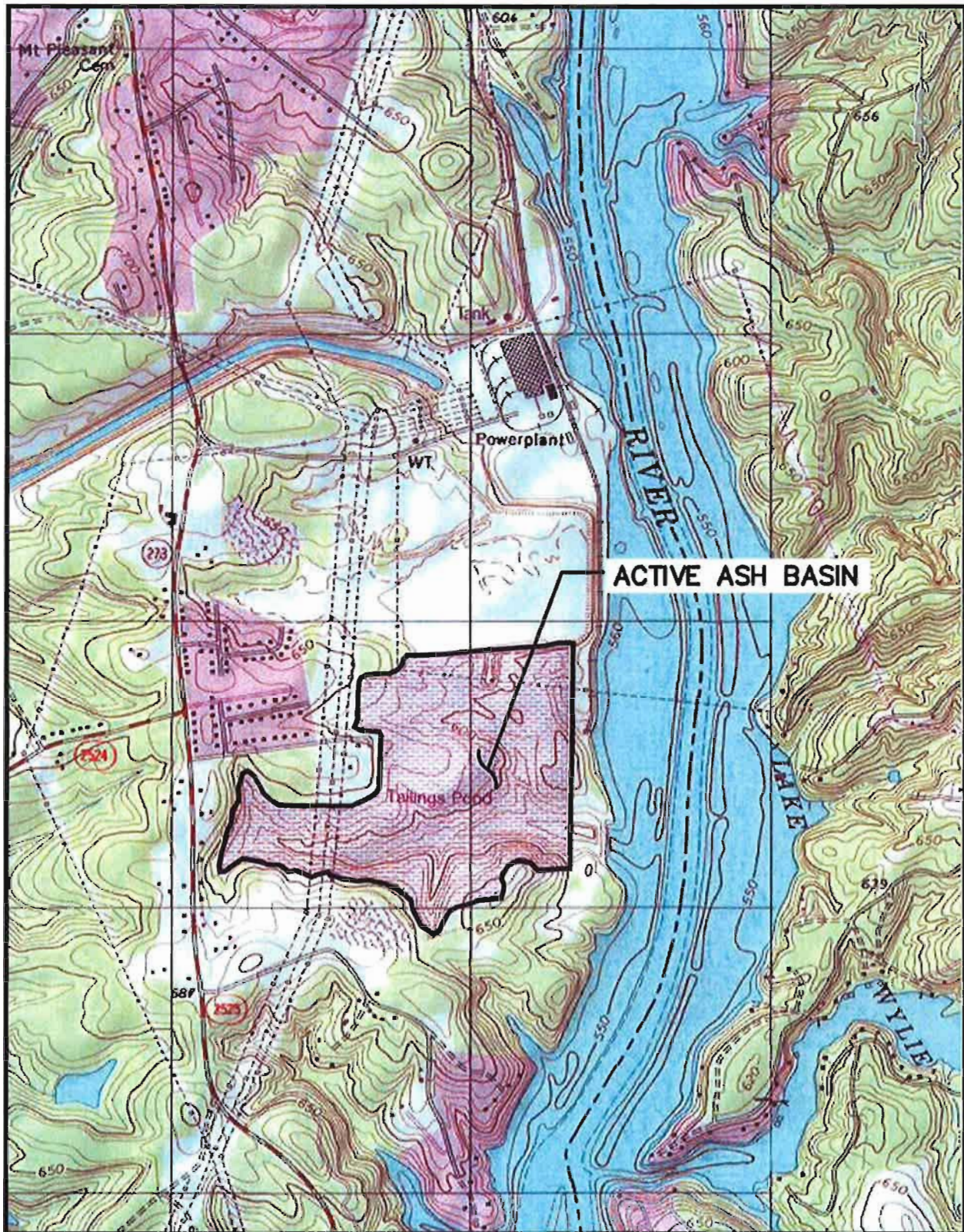


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ASH BASIN DIKES LOCATION PLAN Allen Steam Station
JOB NO: 1411-02-152

FIGURE NO: 1



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ASH BASIN DIKES
 AREA PLAN
 Allen Steam Station

JOB NO: 1411-08-152

FIGURE NO:

2

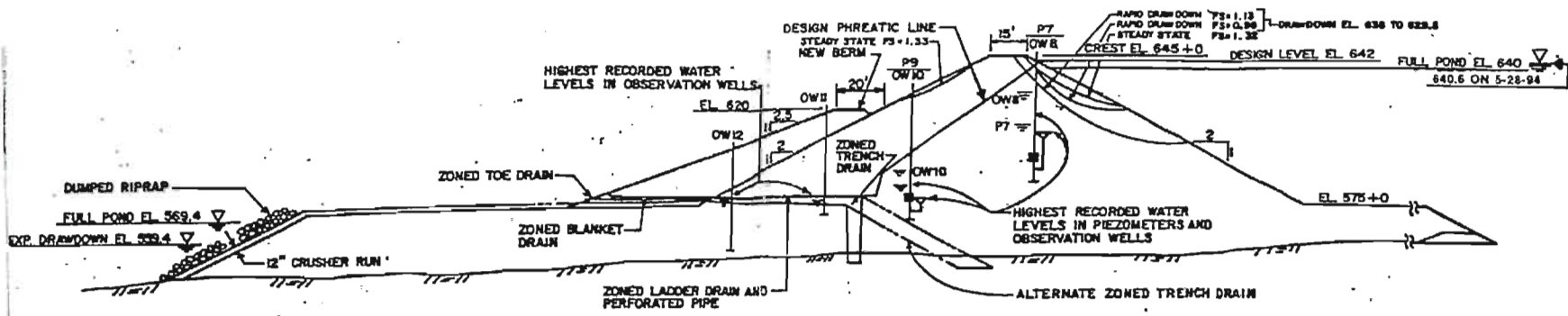


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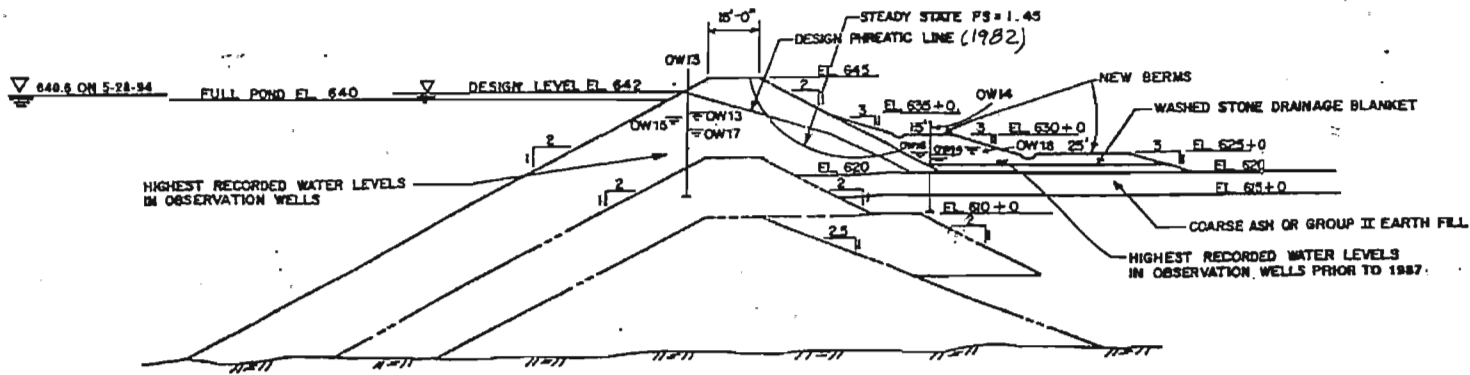


ASH BASIN DIKES ARIAL PHOTO Allen Steam Station
JOB NO: 1411-07-152

FIGURE NO: 3



SECTION A-A
EAST DIKE



SECTION B-B
NORTH DIKE

DRAWING PROVIDED BY DUKE ENERGY

SCALE:	DATE:
NOT TO SCALE	09-12-2008
PROJECT NO.	DRAWN BY:
1411-07-152	JFG
	CHECKED BY:



44 BUCK SHOALS ROAD, SUITE C-3
ARROW, NC 28704
PH. (828) 687-0080
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NORTH DIKE and EAST DIKE AS-BUILT CROSS SECTIONS
ACTIVE ASH BASIN, ALLEN STEAM STATION
DUKE ENERGY, 5-YEAR INDEPENDENT CONSULTANT INSPECTION
BELMONT, NC

FIGURE NO.

4



SCALE:	NTS
CHECKED BY:	
DRAWN BY:	JFG
DATE:	5/15/2008

Location: East Dike - southern end

Description: Ash Tower outlet structure



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JOB NO. 1411-07-152

FIGURE NO.
5



SCALE:	NTS	Location: East Dike - Ash Tower	Active Ash Basin Dikes	FIGURE NO.
CHECKED BY:	JFG			
DRAWN BY:	JFG	Description: Stop log weir	Five-year Indep. Consultant Inspection	6
DATE:	5/15/2008		JOB NO. 1411-07-152	



SCALE:	NTS
CHECKED BY:	
DRAWN BY:	JFG
DATE:	5/15/2008

Location: East Dike - southern end
Description: 42-inch RCP conduit outlet



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FIGURE NO.
7



SCALE: NTS
 CHECKED BY:
 DRAWN BY: JFG
 DATE: 5/15/2008



Location: North Dike crest west of access road
Description: Sluiced ash above normal operating pool level.

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 JOB NO. 1411-07-152

FIGURE NO. **8**



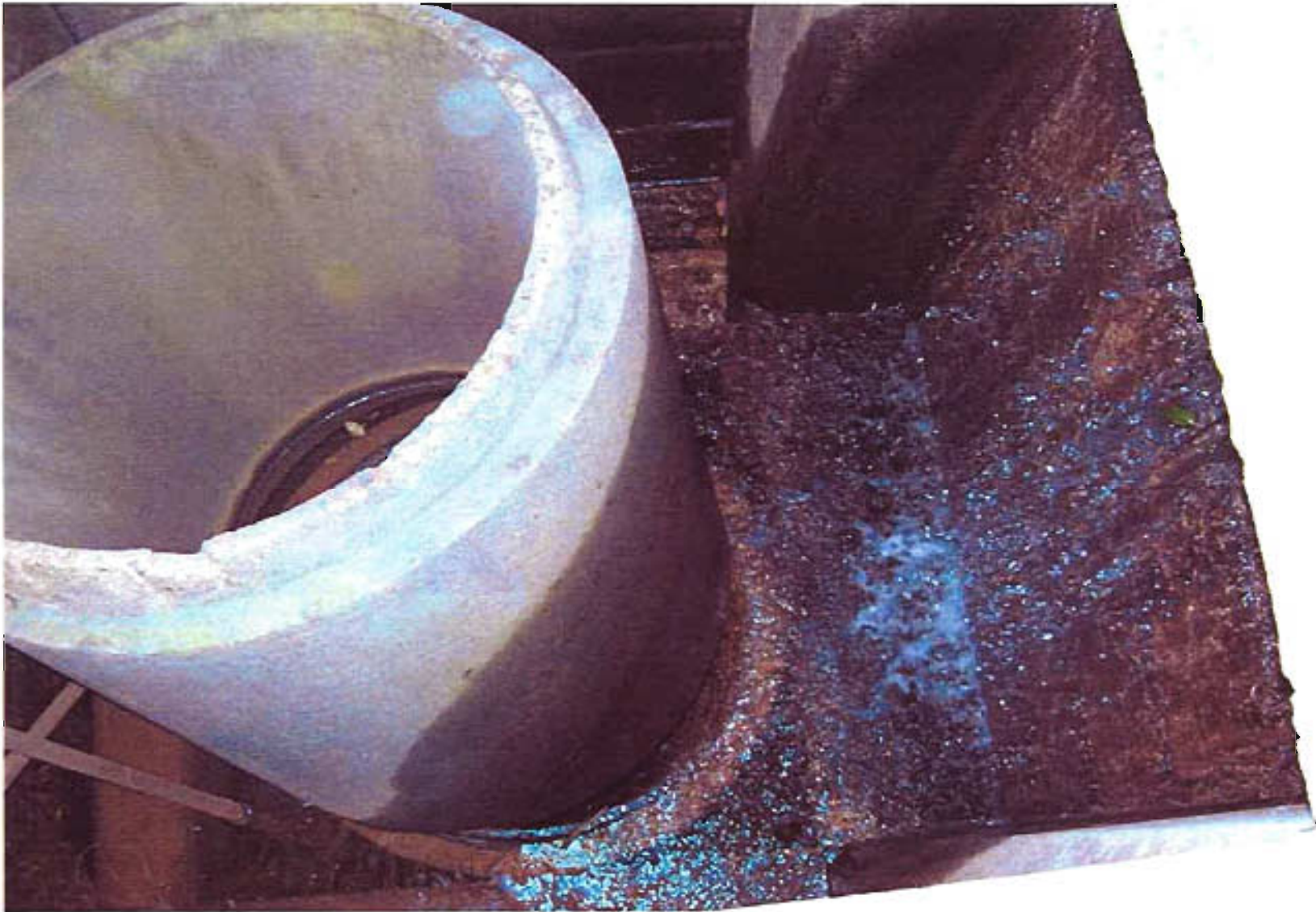
SCALE:	NTS
CHECKED BY:	
DRAWN BY:	JFG
DATE:	5/15/2008

Location: North Dike
Description: Retired Ash Basin outlet structure



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JOB NO. 1411-07-152

FIGURE NO.
9



SCALE:	NTS
CHECKED BY:	
DRAWN BY:	JFG
DATE:	5/15/2008

Location: North Dike
Description: Retired Ash Basin outlet structure - interior



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FIGURE NO.
10



SCALE:	NTS
CHECKED BY:	
DRAWN BY:	JFG
DATE:	5/15/2008

Location: East Dike looking north

Description: Yard Drainage Discharge
(picture from 2006)



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FIGURE NO.
11



SCALE:	NTS
CHECKED BY:	
DRAWN BY:	JFG
DATE:	5/15/2008

Location: North Dike looking west from access road
Description: Area of past excavation work near dike crest



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FIGURE NO.

12



SCALE:	NTS
CHECKED BY:	
DRAWN BY:	JFG
DATE:	5/15/2008

Location: North Dike looking east toward access road
Description: Irregular crest elevation



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JOB NO. 1411-07-152

FIGURE NO.
13



SCALE:

NTS

CHECKED BY:

DRAWN BY: JFG

DATE:

5/15/2008

Location: North Dike crest looking east

from access road

Description: Ash sluice lines



Active Ash Basin Dikes

Five-year Indep. Consultant Inspection

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LOG NO.

1411-07-152

FIGURE NO.

14



SCALE: NTS CHECKED BY: DRAWN BY: JFG DATE: 5/15/2008		Location: North Dike Crest - looking east from axis bend to access road Description: Area of sparse vegetation		Active Ash Basin Dikes Five-year Indep. Consultant Inspection ALLEN STEAM STATION JOB NO. 1411-07-152		FIGURE NO. <h1>15</h1>
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SCALE:	NTS
CHECKED BY:	
DRAWN BY:	JFG
DATE:	5/15/2008

Location:	North Dike looking east from access road
Description:	Crest widened for construction traffic



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JOB NO. 1411-07-152

FIGURE NO.
16



SCALE:	NTS
CHECKED BY:	
DRAWN BY:	JFG
DATE:	5/15/2008

Location: North Dike near crest along west access road

Description: Leak in ash sluice line

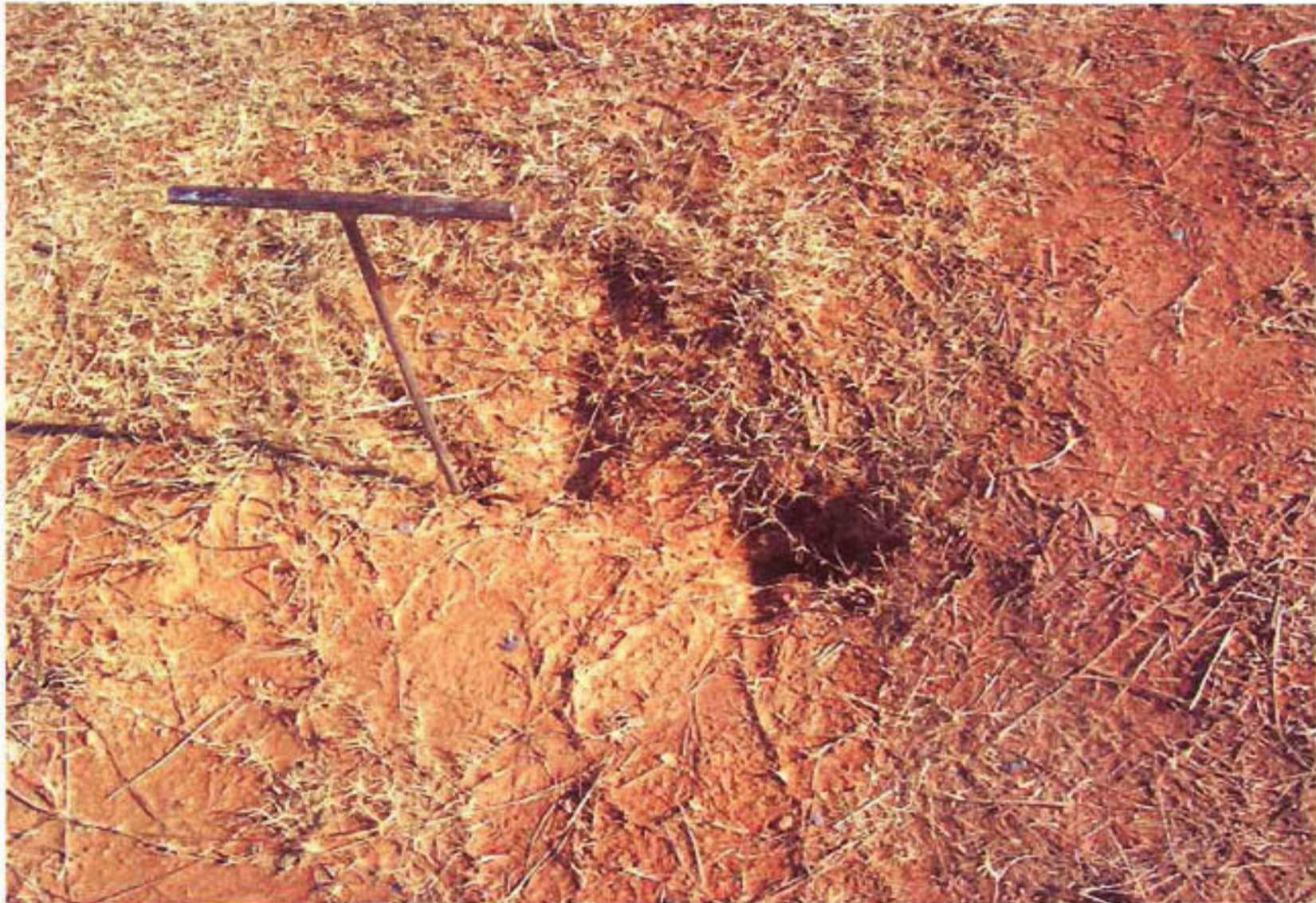


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JOB NO. 1411-07-152

FIGURE NO.

17



SCALE:	NTS
CHECKED BY:	
DRAWN BY:	JFG
DATE:	5/15/2008

Location:	North Dike crest near bend in dike axis
Description:	Transverse cracking in embankment materials



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Five-year Indep. Consultant Inspection
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JOB NO. 1411-07-152

FIGURE NO.
18



SCALE:	NTS
CHECKED BY:	
DRAWN BY:	JFG
DATE:	5/15/2008

Location: North Dike toe along bend in dike axis

Description: Sluiced ash level



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JOB NO. 1411-07-152

FIGURE NO.

19



SCALE:	NTS
CHECKED BY:	
DRAWN BY:	JFG
DATE:	5/15/2008

Location: North Dike toe along bend in dike axis
Description: Seepage from dike toe (Note wet area between pipes)



Active Ash Basin Dikes
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JOB NO. 1411-07-152

FIGURE NO.
20



SCALE:	NTS
CHECKED BY:	
DRAWN BY:	JFG
DATE:	5/15/2008

Location: North Dike toe west of access road @ ditch bank
Description: Seepage from dike toe (Note embankment sloughing)



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Five-year Indep. Consultant Inspection
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JOB NO. 1411-07-152

FIGURE NO.

21



SCALE:	NTS
CHECKED BY:	
DRAWN BY:	JFG
DATE:	5/15/2008

Location: North Dike toe looking west toward access road

Description: Localized area of saturation



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 JOB NO. 1411-07-152

FIGURE NO.
22



SCALE:	NTS
CHECKED BY:	
DRAWN BY:	JFG
DATE:	5/15/2008

Location: North Dike downstream slope
Description: Geometry irregularity



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JOB NO. 1411-07-152

FIGURE NO.
23



apparent scarp

SCALE:	NTS
CHECKED BY:	
DRAWN BY:	JFG
DATE:	5/15/2008

Location: North Dike downstream slope
looking west

Description: Geometry irregularity



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JOB NO. 1411-07-152

FIGURE NO.

24



SCALE:	NTS
CHECKED BY:	
DRAWN BY:	JFG
DATE:	5/15/2008

Location: North Dike toe looking west
Description: Rip Rap at toe drain outlet and clearing around toe.



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JOB NO. 1411-07-152

FIGURE NO.
25



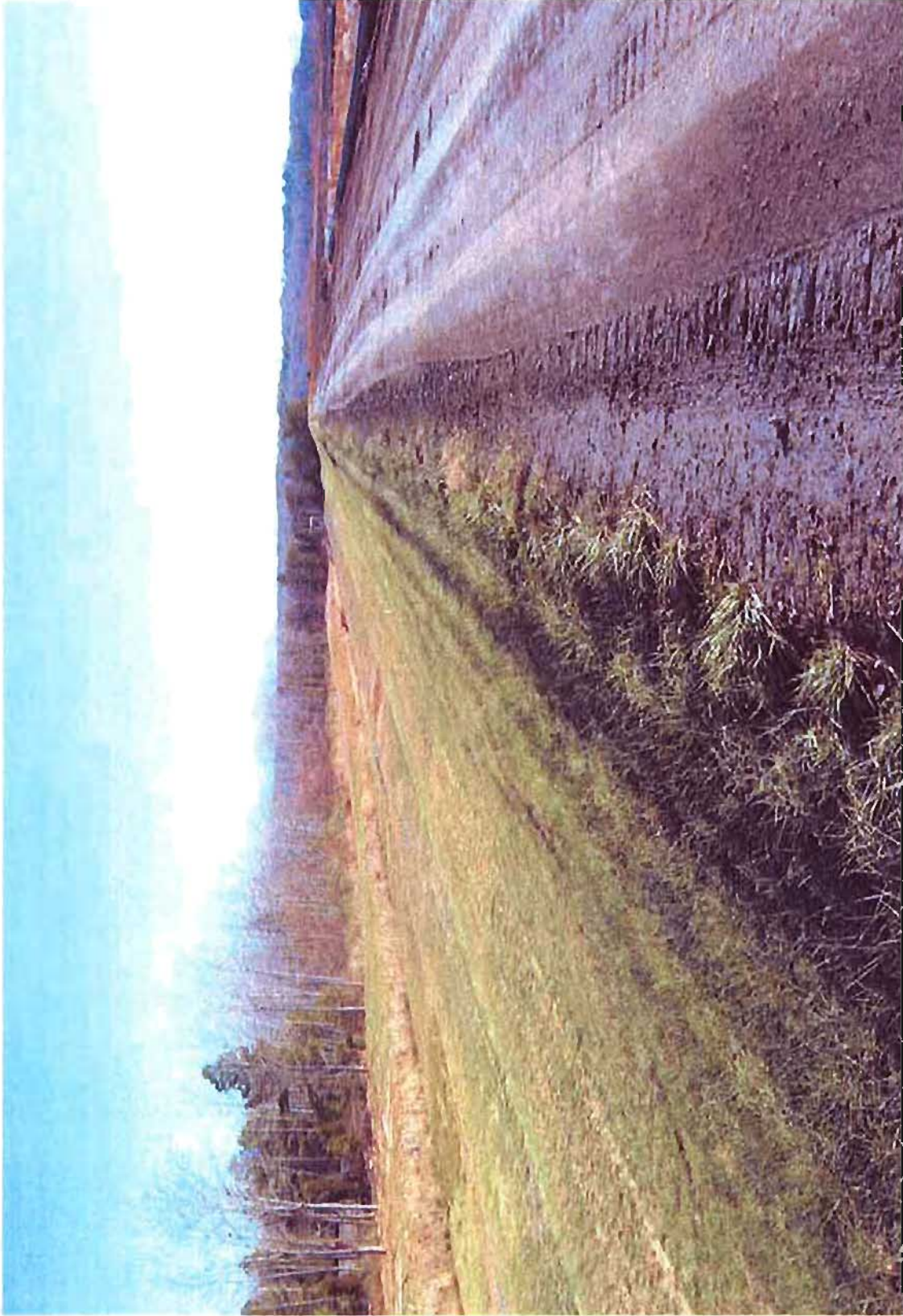
SCALE: NTS
 CHECKED BY:
 DRAWN BY: JFG
 DATE: 5/15/2008

Location: North Dike toe
 Description: Lack of vegetation in drainage ditch outlet



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 JOB NO. 1411-07-152

FIGURE NO.
26



SCALE: NTS
 CHECKED BY:
 DRAWN BY: JFG
 DATE: 5/15/2008

Location: North Dike crest looking east
 Description: Crest geometry - embankment steepness near crest



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 JOB NO. 1411-07-152

FIGURE NO. **27**



SCALE:	NTS
CHECKED BY:	
DRAWN BY:	JFG
DATE:	5/15/2008

Location: East Dike downstream embankment looking south

Description: Typical vegetation



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FIGURE NO.

28



SCALE:	NTS
CHECKED BY:	
DRAWN BY:	JFG
DATE:	5/15/2008

Location: East Dike looking south 40 feet north of OW-11
Description: Area of potential movement and sparse vegetation



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JOB NO. 1411-07-152

FIGURE NO.
29



SCALE:

NTS

CHECKED BY:

DRAWN BY: JFG

DATE: 5/15/2008

Location: East Dike looking north

40 feet north of OW-11

Description: Exposed soil above

stabilization berm



Active Ash Basin Dikes

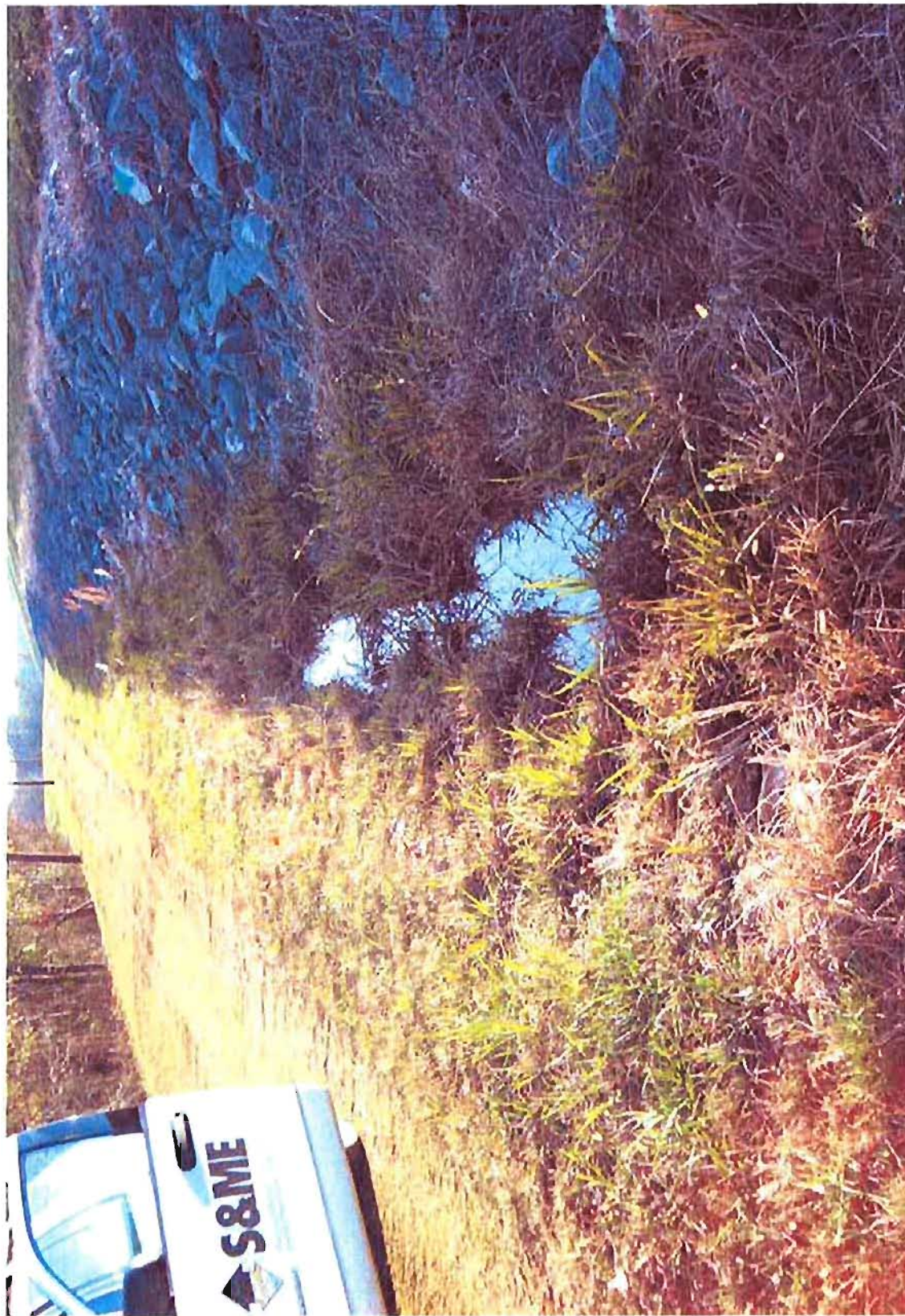
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ALLEN STEAM STATION

JOB NO. 1411-07-152

FIGURE NO.

30



SCALE: NTS
 CHECKED BY:
 DRAWN BY: JFG
 DATE: 5/15/2008

Location: East Dike toe @ OW-6
 Description: Seepage at toe



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 JOB NO. 1411-07-152

FIGURE NO. **31**

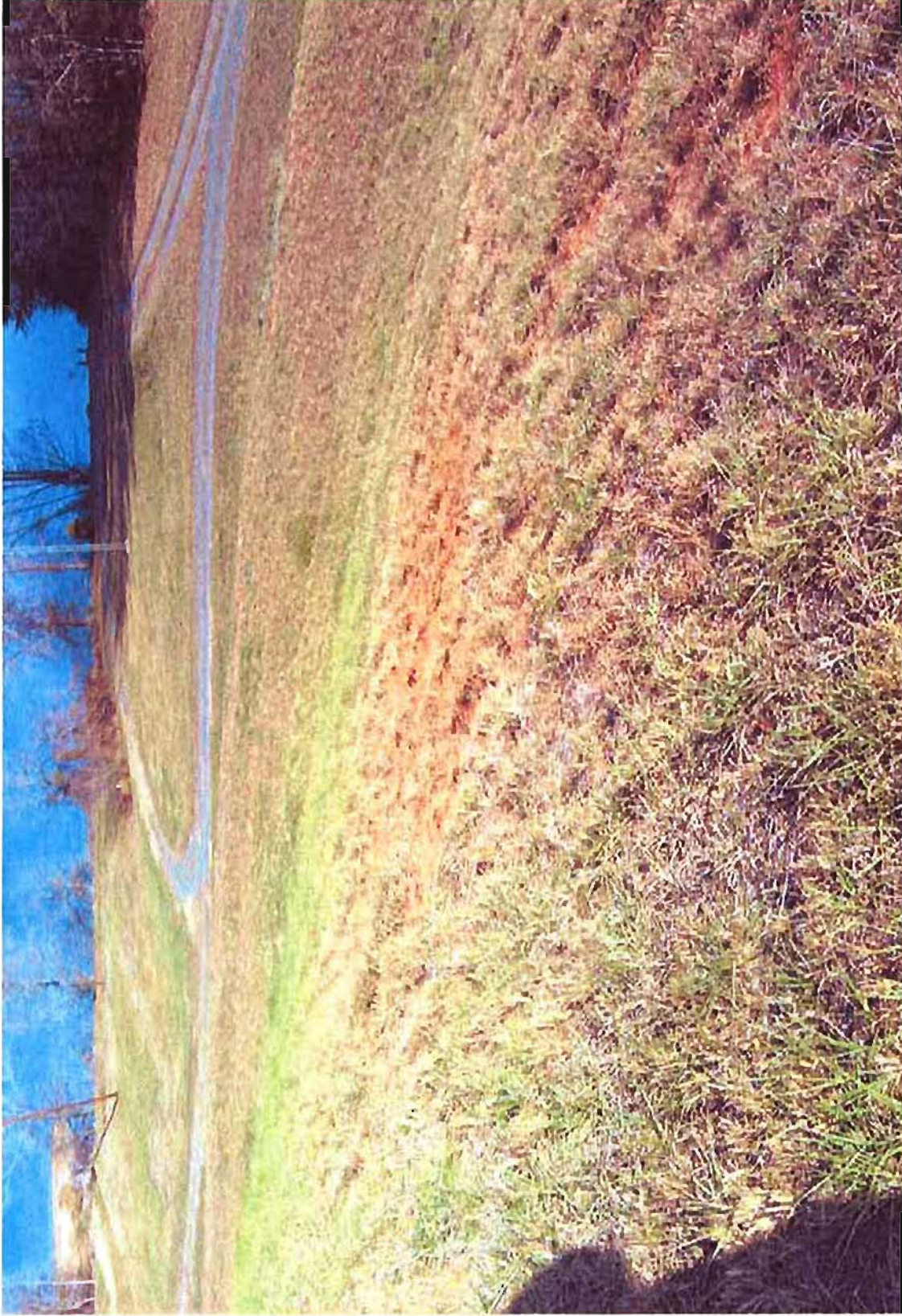


FIGURE NO. **32**

Active Ash Basin Dikes
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 JOB NO. 1411-07-152



Location: East Dike at the southern bend
Description: Sparse vegetation

SCALE: NTS
 CHECKED BY:
 DRAWN BY: JFG
 DATE: 5/15/2008



SCALE: NTS
 CHECKED BY:
 DRAWN BY: JFG
 DATE: 5/15/2008

Location: East Dike at southern bend
 Description: Sparse vegetation in drainage ditch.



Active Ash Basin Dikes
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 JOB NO. 1411-07-152

FIGURE NO. **33**



SCALE:	NTS
CHECKED BY:	
DRAWN BY:	JFG
DATE:	5/15/2008

Location:	East Dike looking north at northern end
Description:	Yard drainage discharge pipes on downstream slope



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JOB NO. 1411-07-152

FIGURE NO.
34



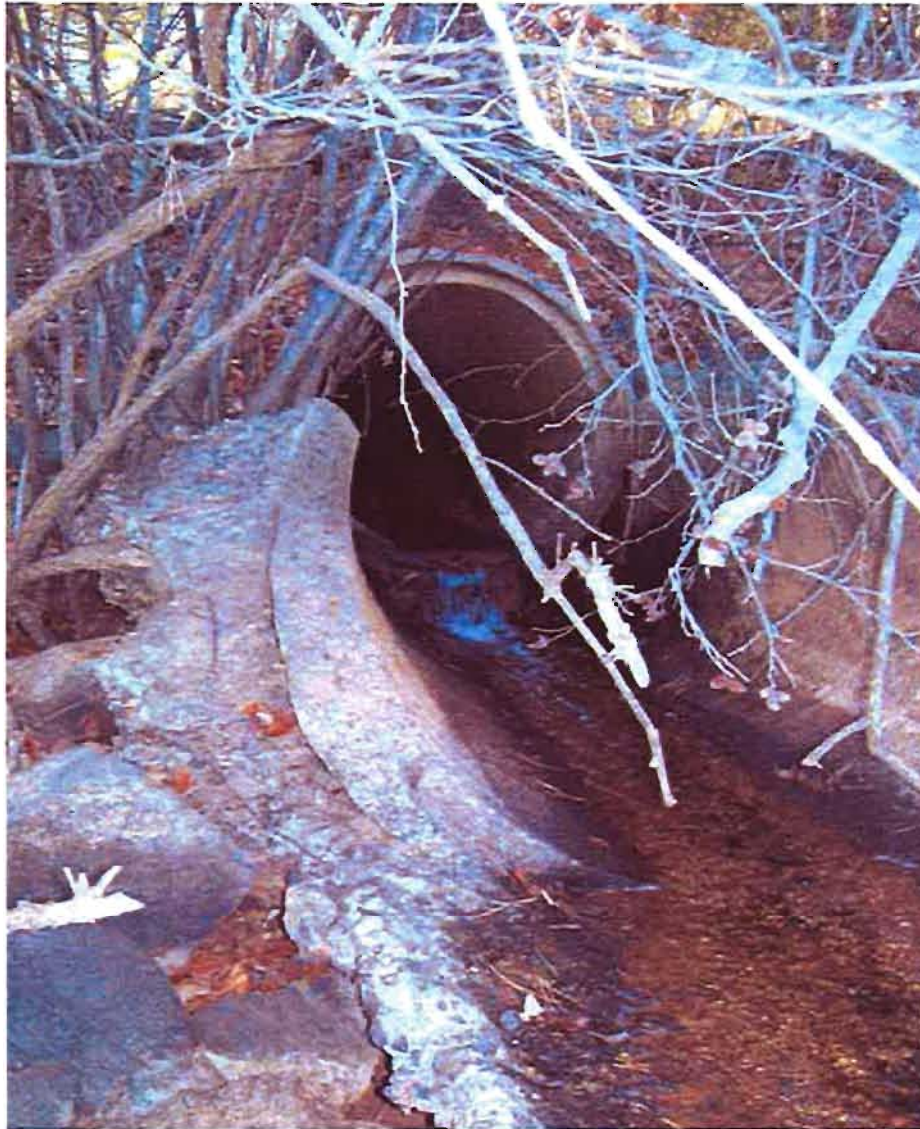
SCALE:	NTS
CHECKED BY:	
DRAWN BY:	JFG
DATE:	5/15/2008

Location: Retired Ash Basin Dike
Description: Typical embankment cover



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JOB NO. 1411-07-152

FIGURE NO.
35



SCALE:	NTS
CHECKED BY:	
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DATE:	5/15/2008

Location: Retired Ash Basin Tower Outlet on Lake Shoreline
Description: Outfall conditions



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JOB NO. 1411-07-152

FIGURE NO.
36



SCALE:	NTS
CHECKED BY:	
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DATE:	5/15/2008

Location: Track Drain Outlet on Lake Shoreline

Description: Deteriorating outlet pipe and sediment from internal erosion



Active Ash Basin Dikes
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JOB NO. 1411-07-152

FIGURE NO.
37



SCALE:	NTS
CHECKED BY:	
DRAWN BY:	JFG
DATE:	5/15/2008

Location: Upslope from Track Drain
Outlet

Description: Sinkhole



Active Ash Basin Dikes
Five-year Indep. Consultant Inspection
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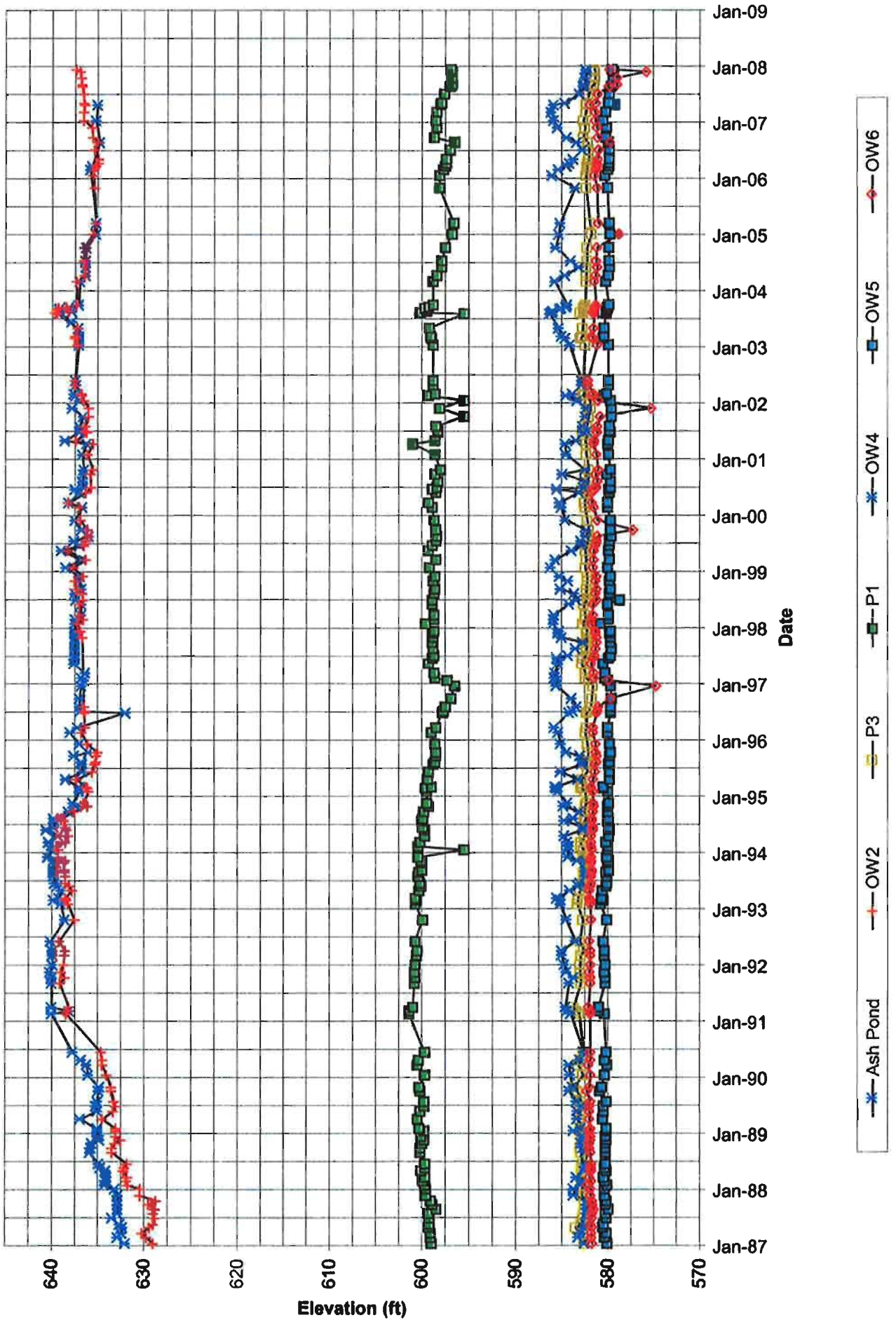
FIGURE NO.

38

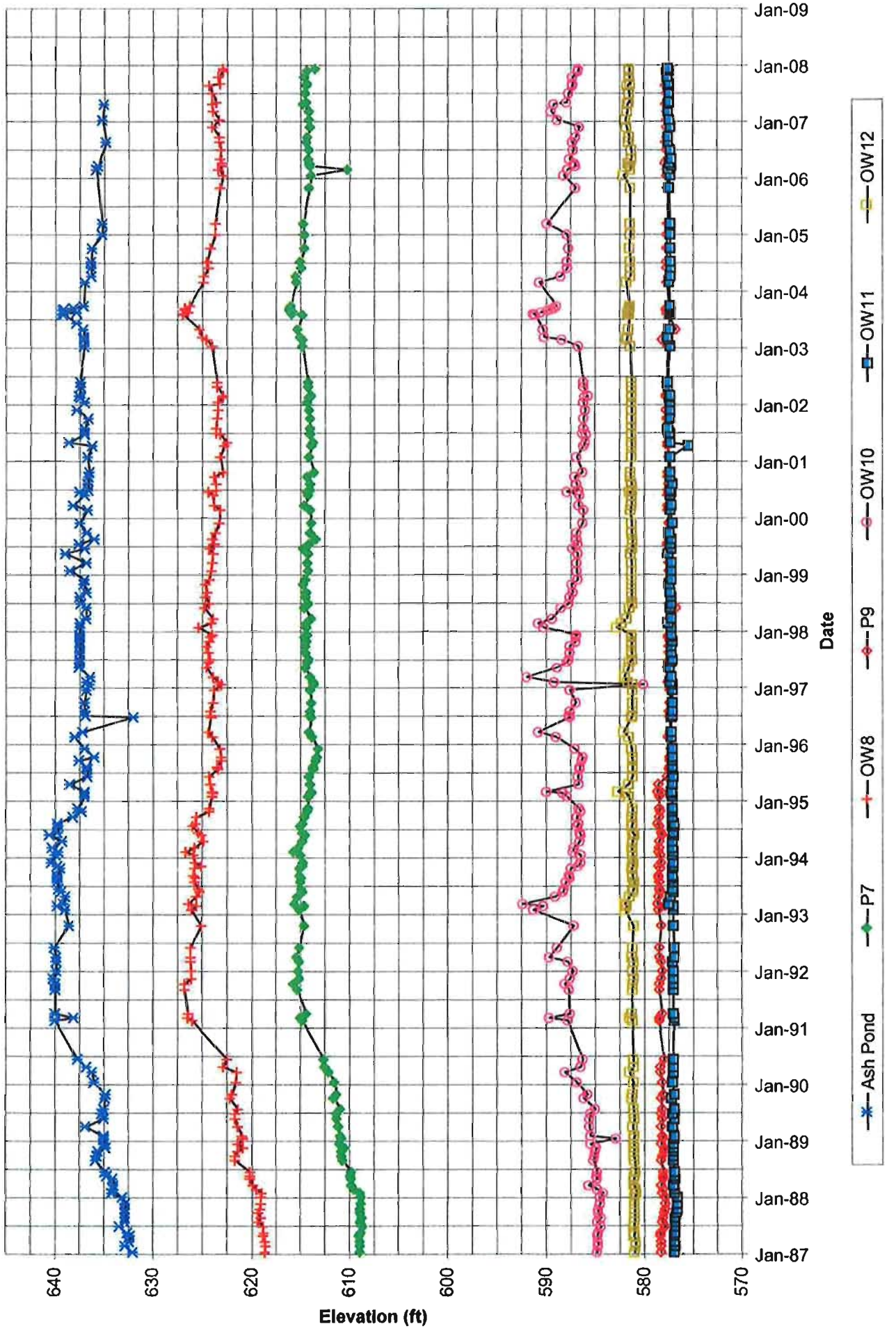
APPENDIX II

OBSERVATION WELL AND PIEZOMETER READINGS

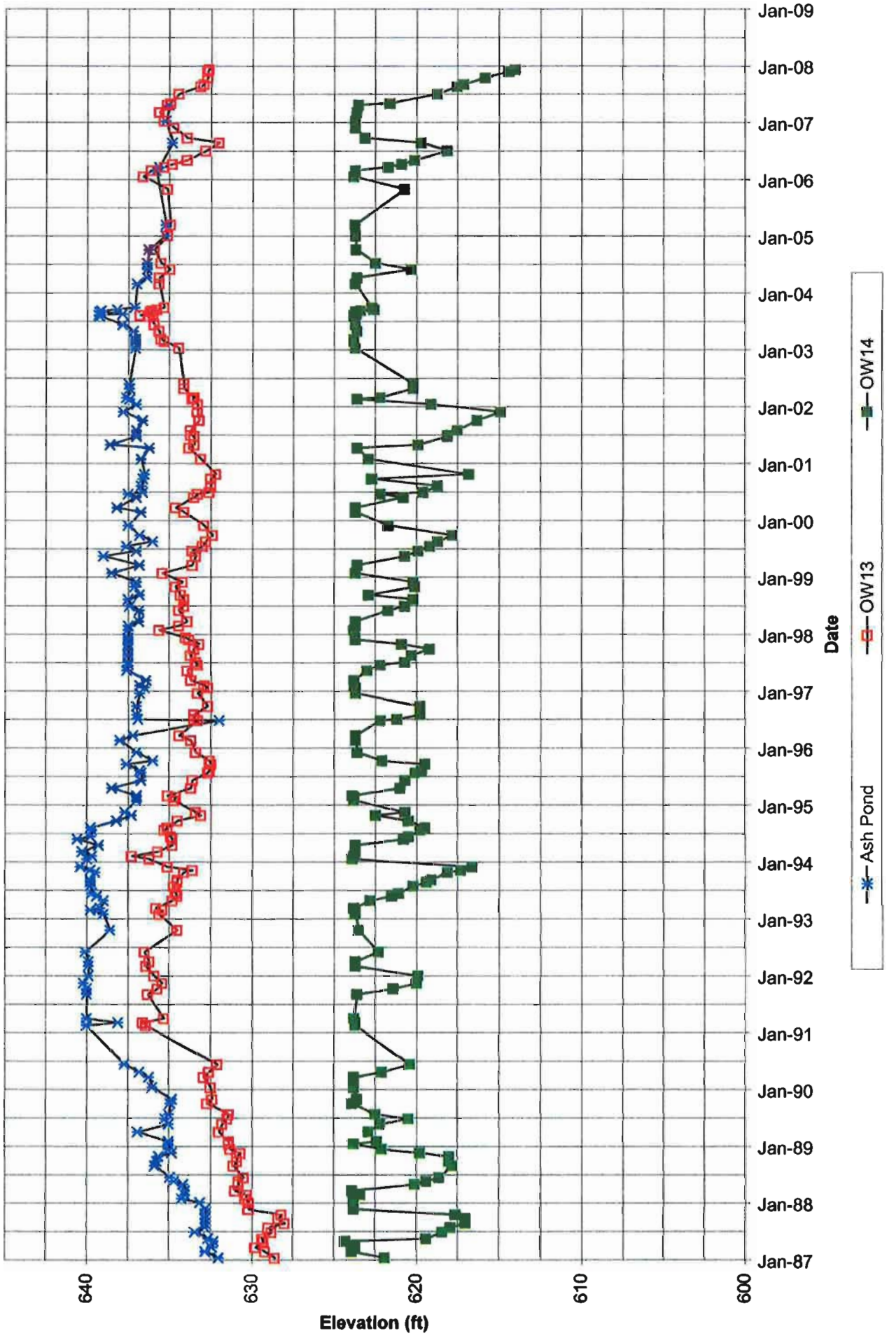
Allen East Dike @ STA 51+00



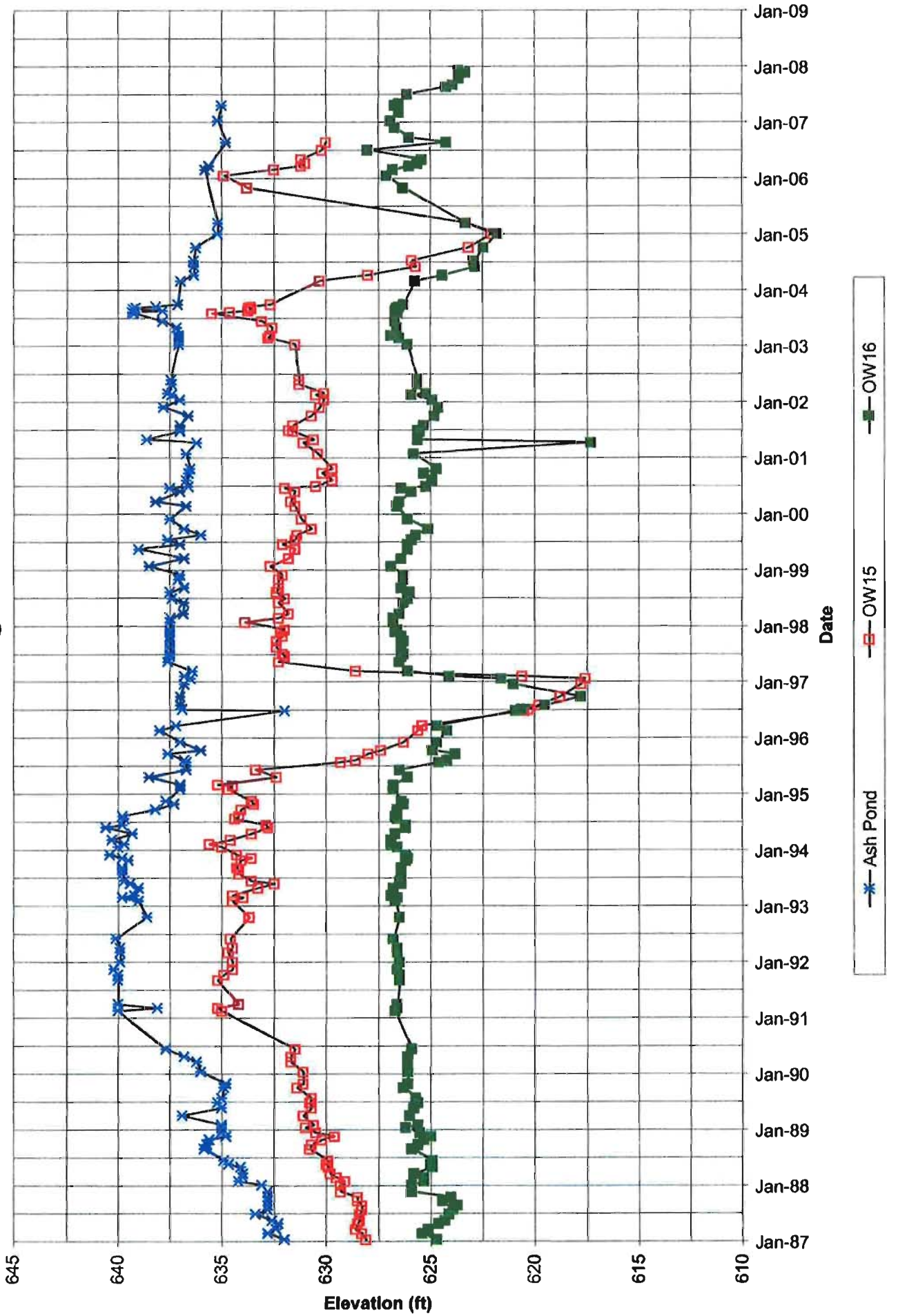
Allen East Dike @ STA 62+00



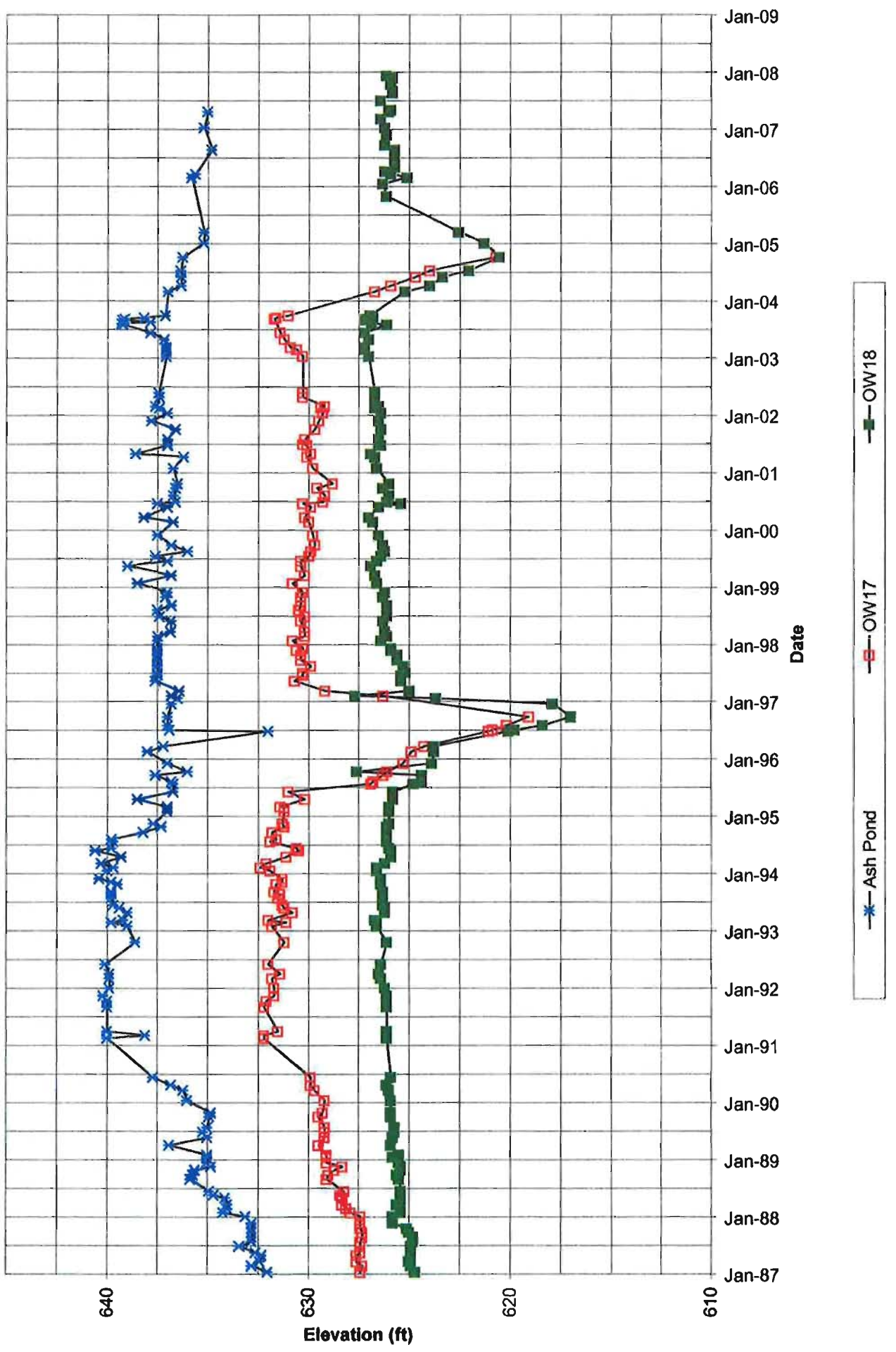
Allen North Dike @ STA 12+00



Allen North Dike @ STA 21+00



Allen North Dike @ STA 23+50



Allen Ash Pond Elevations

