2016 ANNUAL DAM AND DIKE INSPECTION REPORT

Fly Ash Dams 1, 2
&
Bottom Ash Pond Complex

Cardinal PLANT

BRILLIANT, OHIO

December, 2016

Prepared for: Cardinal Operating Company
Brilliant, Ohio

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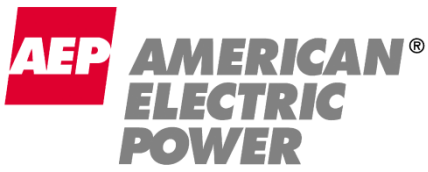

GERS-16-165

Dam & Dike Inspection Report
Fly Ash Dams I, II, and
Bottom Ash Complex

GERS-16-165
Revision 0

CARDINAL PLANT

BRILLIANT, OHIO

INSPECTION DATE **November 17, 2016**

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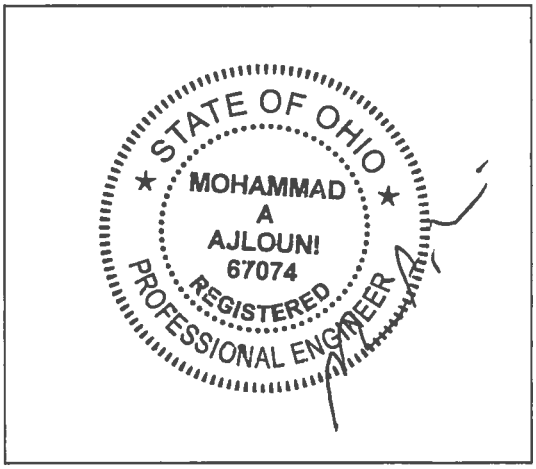

PROFESSIONAL ENGINEER SEAL & SIGNATURE

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1.0 INTRODUCTION

This report was prepared by AEP- Geotechnical Engineering Services (GES) section, in part, to fulfill requirements of 40 CFR 257.83 and the Ohio Department of Natural Resource (ODNR), Division of Water and to provide Cardinal Operating Company and Cardinal plant with an evaluation of the facility.

The Cardinal Power Plant is located at 306 County Road 7 East, Brilliant, OH, 43913 County, near the town of Brilliant, Jefferson County, Ohio. It is owned by Buckeye Power and AEP Generation Resources (GENCO) and operated by Cardinal Operating Company. The facility operates the Fly Ash Dam 1 (FAD 1, ODNR# 0205-009, the Fly Ash Dam 2 (FAD 2), ODNR# 0205-010 and the Bottom Ash Pond (BAP) Complex dam, ODNR# 0105-004.

American Electric Power Service Corporation's Civil Engineering Division administers the Cardinal Plant's Dam Inspection and Maintenance Program (DIMP). As part of the DIMP, staff from the Geotechnical Engineering Services Section annually conducts dam and dike inspections. This report contains the inspection findings, observations, photographic descriptions, conclusions, and maintenance recommendations. This inspection report addresses the FAD 1, FAD 2, and the BAP Complex at the Cardinal plant.

Mr. Randy Sims, P.E., at the Cardinal Plant, was the project facility contact and accompanied Mr. Mohammad Ajlouni of GES throughout the inspection. The site inspection was performed on November 17, 2016. Weather conditions were cool, ranging from cloudy in the morning to partly cloudy in the afternoon. Temperatures reached a high of approximately 55°F. There was precipitation of 0.17 inch in the preceding 7 days prior to the November 17 inspection date.
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2.0 DESCRIPTIONS OF IMPOUNDMENTS

2.1 FLY ASH DAM 1

FAD 1 is the plant's original fly ash retention dam constructed in the early 1970's. The dam is an earth and rockfill dam having a final design crest elevation of 1001.5 ft. The dam has upstream (u/s) and downstream (d/s) slopes of approximately 2.5 Horizontal to 1 Vertical (2.5 H to 1 V). As ash placement behind FAD 1 reached its maximum allowed level, Cardinal FAD 2 was constructed and began operation in the late 1980's. FAD 1 is still listed with the ODNR as an active dam, however, its reservoir area has been repermitted by the Ohio EPA as a solid waste landfill (PTI permit # 06-07993, dated May 11, 2007) for the disposal of synthetic gypsum generated by the air pollution control equipment constructed at the Cardinal Plant that captures sulfur dioxide emissions (Figure 1).

2.2 FLY ASH DAM 2

The last raising of FAD 2 was completed in 2013 with a design crest elevation of 983 ft, a maximum reservoir operating elevation of 974 ft, and a dam height of approximately 250-ft. This raising of FAD 2 incorporated back to back Mechanically Stabilized Earth (MSE) walls with a cut off system consisting of a PVC sheetpile inserted into a trenched cement bentonite cutoff wall connected to the existing clay core. The emergency overflow spillway was raised using mass concrete to minimum elevation of 974.5. The MSE wall was supported by the existing RCC crest placed during the 1997 dam raising. Inspection location plans for FAD 2 are provided in Figure 2A. A general cross section of FAD 2 showing the final dam raising is presented in Figure 2B.

2.3 BOTTOM ASH POND COMPLEX

The Bottom Ash Complex at the Cardinal Plant consists of a Bottom Ash Pond (BAP) and a Recirculation Pond (RCP) located along the Ohio River. Flow from the Bottom Ash Pond is directed to the RCP. The exterior dike crest elevation is approximately 670 ft and an overflow conduit with an inlet elevation of approximately 665.5 ft. controls the maximum Recirculation Pond water level. The arrangement of BAP Complex is shown in Figure 3.

3.0 REVIEW OF AVAILABLE INFORMATION (257.83(b)(1)(i))

A review of available information regarding the status and condition of the FAD 1, FAD 2, and the BAP Complex, which include files available in the operating record, such as design and construction information, previous periodic structural stability assessments, previous 7 day inspection reports, and previous annual inspections has been conducted. Based on the review of the data there were no signs of actual or potential structural weakness or adverse conditions.

4.0 INSPECTION (257.83(b)(1)(ii))

4.1 FLY ASH DAM 1

4.1.1 CHANGES IN GEOMETRY SINCE LAST INSPECTION (257.83(b)(2)(i))

No modifications have been made to the geometry of the FAD 1 since the 2015 annual inspection. The geometry of the impoundment has remained essentially unchanged.

4.1.2 CHANGES THAT EFFECT STABILITY OR OPERATION (257.83(b)(2)(vii))

Based on interviews with plant personnel and field observations there were no changes to the FAD 1 since the last annual inspection that would affect the stability or operation of the impounding structure.

4.1.3 INSTRUMENTATION (257.83(b)(2)(ii))

No instrumentation data is provided for Fly Ash Dam I since the reservoir has been drained and the site is now under construction to receive synthetic gypsum. The permit application submitted to the Ohio EPA to license this area as a residual waste landfill was approved on May 11, 2007 (Ohio EPA PTI # 06-07993).

4.1.4 IMPOUNDMENT CHARACTERISTICS (257.83(b)(2)(iii, iv, v))

As ash placement behind FAD 1 reached its maximum allowed level in the late 1980's, FAD 2 was constructed and began operation soon thereafter. FAD 1 and its impoundment are not subject to CCR rules since they were close well before the CCR rules were promulgated.

4.1.5 VISUAL INSPECTION (257.83(b)(2)(i))

A visual inspection of the FAD 1 was conducted to identify any signs of distress or malfunction of the impoundment and appurtenant structures. Specific items inspected included all structural elements of the dam such as inboard and outboard slopes, crest, and toe.

Results of the visual inspection of the FAD 1 performed on November 17, 2016 are provided below (photos are presented in Attachment A):

1. The downstream slope of FAD 1 was well protected with rockfill. Increase in vegetative growth was noticed (Photo Nos. 1 and 2). No significant erosion or slumping was observed.

2. Typical view of the FAD 1 emergency spillway showing minor vegetative growth (Photograph No. 3). No significant erosion was observed along the spillway (Note that the spillway conveys contact water from the FGD landfill and noncontact water from the upper reaches of the west branch of Blockhouse Hollow).

3. Surface water collection pipe installed at the right groin of FAD 1 is partially damaged and needs fix (Photograph No. 4).

Overall the facility is in good condition. The impoundment is functioning as intended with no signs of potential structural weakness or conditions which are disrupting to the safe operation of the impoundment.

4.2 FLY ASH DAM 2

4.2.1 CHANGES IN GEOMETRY SINCE LAST INSPECTION (257.83(b)(2)(i))

No modifications have been made to the geometry of the FAD 2 since the 2015 annual inspection. The geometry of the impoundment has remained essentially unchanged.

4.2.2 CHANGES THAT EFFECT STABILITY OR OPERATION (257.83(b)(2)(vii))

Based on interviews with plant personnel and field observations there were no changes to the FAD 2 since the last annual inspection that would affect the stability or operation of the impounding structure. The pond's water level was raised on October 5, 2016 by adding 5 ft of stoplogs to the riser structure.

4.2.3 INSTRUMENTATION (257.83(b)(2)(ii))

The location and type of instrumentation is shown on Figure 2A. The results of the measurements of various piezometers are shown in Figure 5b through 5n. The maximum recorded readings of each instrument since the previous annual inspection is shown in Table 1.

Table 1 FAD 2 Maximum recorded instruments reading since the previous annual inspection

INSTRUMENTATION DATA Fly Ash Dam 2			
Instrument	**Type**	**Maximum Reading since last annual inspection**	**Date of Reading**
P-1A	Piezometer	763.15	10/28/16
P-2A	Piezometer	782.31	3/23/16
P-3A	Piezometer	804.8	1/26/16
P-3B	Piezometer	784.30	3/23/16
P-1BE	Piezometer	731.23	6/13/16
P-1BW	Piezometer	739.13	11/15/15
P-2BE	Piezometer	761.36	10/28/16
P-2BW	Piezometer	733.90	1/26/16
P-2C	Piezometer	713.77	10/28/16
P-5A	Piezometer	899.33	10/28/16
P-8A	Piezometer	805.79	5/17/16
P-8B	Piezometer	779.70	1/26/16
P-9	Piezometer	786.66	4/19/16
P-10	Piezometer	776.72	11/15/15
P-11A	Piezometer	804.45	2/24/16
P-11B	Piezometer	798.56	10/28/16
MW-7	Piezometer	968.80	1/26/16

PIEZOMETERS

A total of Sixteen (16) pneumatic piezometers and one monitoring well were installed in the foundation and various zones of the dam to monitor total hydraulic head. The piezometers' locations are shown in plan view Figure 3A (Drawing No. 13-30040) and in cross-sections (Drawing Nos. 13-30041 and 13-30042). Precipitation is measured at the plant and also continues to be slightly below normal (Figure 4). Historical records of the piezometer and observation borehole water elevations are presented in a graphical form in Figure 5, Attachment E to this report.

- A composite of all the hydrographs (Figure 5a). All piezometer showed none or a minor increase in the measured porewater pressure as a result of the raising the pond level in October 5, 2016. Figure 5b provides a record of pond discharge as measured at its Parshall flume (Drain No.14) versus the pond stage.
- Water levels in the shallow, intermediate and deep foundation showed none or a minor increase corresponding to raising the pond stage that took place in October 2016 (Figures 5c &5d).
- Water levels along the centerline of the dam are shown in Figure 5e and are segregated into hydrographs for each clustered location (Figures 5f through 5i). Piezometer P-3B is showing some decrease in water level despite the increase in FAR 2's pool level. Water levels in the downstream shell (P-1A) and drain (P-1BW) showed none or a minor increase corresponding to raising the pond stage (Figure 5i).
- Piezometer P-2BE, installed within the drain, reflects a higher-pressure head (about 27ft) in comparison to the western (right) P-2BW. Most piezometers show no increase corresponding to raising the pond stage (Figure 5j and 5l).

- Piezometer P-2C, installed within the foundations of the dam show no increase corresponding to raising the pond stage (Figure 5k).
- Two standpipe type piezometers were installed in 2004 into the right bedrock abutment to monitor seepage (FA-7 & FA-8). Both of these piezometers are installed into the Morgantown Sandstone member, a well fractured and jointed, medium to coarse grained sandstone. Piezometer FA-7 also forms a clustered well site with M-11 (also screened within the Morgantown Sandstone) and S-9 (screened in the Connellsville Sandstone). M-10 is located away from the dam site but is also screened within the Morgantown Sandstone and is used to help illustrate the following trends (Figure 5n).
- Monitoring wells M-10 & M-11 showed an increase in static water levels coincident with the raising of the FAR 2 (2013) dam followed by slow decrease. Piezometer FA-7 monitors a 1 inch wide open joint (observed by a borehole camera survey prior to well installation) and reflects a steady decline that closely correlates with the declines observed in the drain piezometer P-1BW, M-10 and M-11 (Figure 5n). The long-term decline before the current pond stage raising is believed to result from the progradation of the fly ash delta forming a blanket deposit and acting as a hydraulic barrier that reduces seepage from the reservoir.
- The shallow monitoring well, S-9, is becoming more constant or slightly decreasing after raising that coincides with the FAR 2 Pool stage rising in 2004 through 2013 (Figure 5n). It is expected that S-9 will continue to decrease due to the deposition of fly ash around the abutment area. Monitoring well S-9 is screened from elevation 914 to 923 ft and the fly ash has been deposited to elevations ranging from 909 to 924 ft NGVD.
- One standpipe type piezometer (MW-7) was installed in 2014 into the left abutment to monitor potential seepage through the PVC sheet pile (Figure 5n). It appear that MW-7 readings are reflective of the water pressure in the rock at the left abutment and is currently at similar level of FAR II pool.

In general, the piezometric head elevations plots indicate that the static water levels for all piezometers are showing minor or no increase corresponding to 2016 pond stage raising.

VERTICAL AND HORIZONTAL DEFORMATION MONUMENTS

The last AEP Civil Laboratory's Deformation Review Survey Report was prepared on August 22, 2016 for vertical and horizontal deformation monuments for FAD2. Starting October 2015, a monthly basis Survey Report is being prepared by DLZ. A brief discussion of the data is provided below.

33 top of dam monuments (29901 thru 29933) were covered due to the 2014 dam raising. Replacement top of dam deformation monuments (1401 thru 1433) were installed and a base measurement was established. In addition, 12 tiltmeters were installed at the MSW wall concrete panels with less than 0.5º tilt recorded to date (Figure 5o).

Vertical and horizontal deformation measurements for 33 top of dam monuments (i.e. 1401 thru 1433), 23 downstream dam face and berm monuments (i.e. 29936 thru 29958), 2 additional monuments located at the emergency spillway (i.e. 29934 and 29935) and 9 additional deformation monuments (i.e. 29959 to 29966 were made.

In general, all horizontal movement is towards a downstream direction. Review of top of dam horizontal movement plots provided in the report indicates small movements in a southerly direction (downslope), -southeast at the center of the dam; and southeast to east along the left abutment. Downstream face monuments show small movements generally in the downstream (south) direction. The least amount of movement is observed along the east end where the RCC is more fully supported by bedrock.

SLOPE INCLINOMETERS

Three slope inclinometers, SI-1, SI-2 and SI-3, were installed at the dam site as part of the 1998 dam raising project. The slope indicators are located near the alignment of the creek valley. SI-1 was installed in November 1997, and it is believed SI-2 and SI-3 were installed at a later date (date not reported in logs). Two additional slope indicators, SI-4 and SI-5, were installed in 2006 further down slope from SI-1. Copies of the SI plots are provided in the Deformation Review Survey Report. Slope indicators measurements indicate movement generally towards the southwest with a good correlation with the surface deformation monuments.

BATHYMETRIC SURVEYS

AEP's Civil Engineering Lab performed the most recent bathymetric survey on September 20, 2016. These surveys show no unusual morphological features in the vicinity of the right abutment upstream of the dam. The ash delta is prograding into this area in a uniform manner. The depressions noted in previous surveys are no longer present. The deposition of fly ash within this portion of the reservoir has increased greatly due to the sluicing to the ash at the right abutment side of the pond that started in early 2014:

Survey Date	Ash Elev.	Thickness Increase	Comment
March 3, 2004	873.7		
December 9, 2004	889.3	15.6ft	from Mar 04 to Dec 04
March 29, 2005	891.8	2.5ft	from Dec. 04 to Mar. 05
October 19, 2005	898.1	6.3ft	from Mar. 05 to Oct. 05
October 3, 2006	906.0	7.9ft	from Oct 05 to Oct 06
September 13, 2007	907.5	1.5ft	from Oct 06 to Sept 07
September 3, 2008	907.4	-0.1ft	from Sept 07 to Sept 08
August 31, 2009	909.0	1.6ft	from Sept 08 to Aug 09
August 30, 2010	908.5	-0.5ft	from Aug 09 to Aug 10
September 6, 2011	909.0	0.5ft	from Aug 10 to Sept 11
October 22, 2013	908.4	-0.6 ft	from Sept 12 to Oct 13
September 3, 2014	918.2	9.8 ft	from Oct 13 to Sept 14
September 22, 2015	924.0	5.8 ft	from Sept 14 to Sept 15
September 20, 2016	923.8	-0.2 ft	from Sept. 2015 to Sept. 2016

Attachment D contains the most recent bathymetric survey. Fly ash deposition within the original (March 2004) mapped depression has increased over the last few years as a result of the sluicing ash close to the Dam's right abutment (Figure 6). Over this same time period, the hydraulic gradient has remained practically constant between the Pond's pool stage and ground water levels observed in M-11. Also, the direction of ground water flow in the upper portion of the bedrock has been reversed as noted by the gradient reversal between the pond stage and S-9 and M-11.

The discharge from the right abutment seepage as measured at the V– notched weir has fall to around 149 gpm.

A review of the data contained on the FAD 2 static water elevation plot showed that all piezometers exhibit consistent water elevations.

4.2.4 IMPOUNDMENT CHARACTERISTICS (257.83(b)(2)(iii, iv, v))

Table 2 is a summary of the minimum, maximum, and present depth and elevation of the impounded water & CCR since the previous annual inspection; the storage capacity of the impounding structure at the time of the inspection; and the approximate volume of the impounded water and CCR at the time of the inspection.

Table 2 Summary of Relevant Storage Information FAR 2

IMPOUNDMENT CHARACTERISTICS **Fly Ash Reservoir 2** (water pool elevation was approximately 968)	
Approximate **Minimum** depth (Elevation) of impounded water since last annual inspection	9 ft. (963) ft.
Approximate **Maximum** depth (Elevation) of impounded water since last annual inspection	13 ft. (968) ft.
Approximate **Present** depth (Elevation) of impounded water since last annual inspection	12 ft. (968) ft.
Approximate **Minimum** depth (Elevation) of CCR since last annual inspection	63 ft. (953) ft.
Approximate **Maximum** depth (Elevation) of CCR since last annual inspection (ft.)	65 ft. (955 ft.)
Approximate **Present** depth (Elevation) of CCR since last annual inspection	65 ft. (955 ft.)
Storage Capacity of impounding structure at the time of the inspection	2468 ac-ft
Approximate volume of impounded water at the time of the inspection	2000 ac-ft.
Approximate volume of CCR at the time of the inspection	9400 ac-ft

4.2.5 VISUAL INSPECTION (257.83(b)(2)(i))

A visual inspection of the FAD 2 was conducted to identify any signs of distress or malfunction of the impoundment and appurtenant structures. The inspection also included hydraulic structures underlying the base of the dike. Specific items inspected included all structural elements of the dam such as inboard and outboard slopes, crest, and toe; as well as appurtenances such as the outlet structure at the FAD 2 and pipe discharge structure.

Results of the visual inspection of FAD 2 performed on November 17, 2016 are provided below (photos are presented in Attachment B):

1. Photographs Nos. 5 & 6 shows the overall view of the FAD 2 as taken from the FAD 2 access road.

2. The discharge structure was inspected closely at the locations of the diagonal joint and diagonal crack in the RCC face, as shown in Photographs Nos. 7-11. There was no visual evidence of significant differential movement of the structure chute or steps. Visual portions of the structure's concrete, diagonal joint and steps appeared to be in good condition. The diagonal crack in the underlying RCC has weathered and infilled and is no longer visible. The overlying diagonal construction joint in the skimmer chute continues to exhibit no differential movement and was caulked and sealed in anticipation of it being inundated during the next pool raising.

3. The upstream RCC slope appeared to be stable with no significant wave cut erosion, slumping or cracking (Photos Nos. 12 and 13).

4. The RCC crest surface is mostly covered by the new MSE Wall construction. The top surface of the gravel road appears to be in good conditions with no signs of major rutting or settlement

5. The emergency spillway channel is cut through natural high ground. The channel's left slope continues to have bank seepage that is conveyed to a shallow ditch along the toe of the slope with subsequent discharge through Drain No. 12 at the mouth of the emergency spillway channel. The channel abutment slopes appeared stable with no visible signs of slumping or significant erosion (Photograph No. 14).

6. The emergency spillway has a downstream slope channel constructed of RCC steps and berms between the concrete retaining walls as shown in Photograph No. 15. The concrete walls and concrete steps appeared to be in good condition while the spillway's 2-ft high RCC steps continue to weather.

7. The downstream slope of the dam appeared to be in good condition with good vegetative growth as shown in Photograph Nos. 16& 17. No significant erosion was observed and the slopes appeared to be uniform with no slumping or bulges.

8. The right downstream groin ditch was in good condition. The discharge from Drain No. 7 is clear and no sediment deposits were observed. The groin appeared to be generally in good conditions.

9. Right abutment seepage is collected and measured from the open weir chimney/toe drain drainage blanket (Drain No. 1). Vegetation was removed along the slopes and adjacent to the stairwell and the downstream channel below the weir discharge point. The discharge was approximately the same as the previous inspection and was visually clear (Photographs 19 to 22).

10. The left groin ditches and discharge pipe were observed to be in good conditions. The vegetation was cut back to the left of the pipeline allowing excellent visual observation of the abutment. No significant uncontrolled seepage along this portion of the abutment or as the discharge pipe enters into the ground prior to its connection to the energy dissipater structure was observed. No significant erosion, slumping or bulges were observed. Minor vegetation growth within the groin ditch needs to be eliminated using spry chemicals (Photograph No. 23).

11. The energy dissipator structure and downstream channel appeared to be in good condition (Photograph Nos. 24).

12. The dam's concrete flume (identified as Drain 14 (NPDES Permit Outfall # 000)) was observed to be in excellent condition and flow was unobstructed.

13. Seepage along the right abutment is collected and measured from the open weir installed in 2013. The water remains visually clear. No additional ash laden seepage has occurred since April 2004 (Photographs Nos. 25 and 26). The seepage rate from the spring is estimated to be less than 75 gpm shown in Photo No. 26.

14. Seepage along the right abutment at slightly higher elevations started in the fall of 2013 and was fixed with an installation of inverted filter (Photograph No. 18). A visually clear seepage was observed at an estimated flow rate of 0.6 gpm.

15. Typical view of the FAR 2 pond looking towards FAR 1 dam crest (Photograph No. 27). The pond stage was 968 ft NGVD at the time of the inspection.

16. The discharge lines sluicing ash at their discharge point into the pond were partially inundated because of the rise of the FAR 2 water level (Photograph No. 28). The lines needs be cut at a higher elevation.

17. The ash delta is prograding away from its discharge point and generally follows the apex of the valley towards the decant structure located along the face of the dam (Photo No. 29).

18. Additional stop logs are available for the future raising of the water level at FAR 2 pond. (Photo No. 30).

19. Partial view of the upstream slope of the FAD 2 showing the ash sluicing to the right corner of the upstream slope, in the background, the pumping platform installed within the FAR 2 impoundment is shown (Photo No. 31). The pump is operated by Quality Environmental Services to deliver make up water to the coal preparation plant located in the headwaters of Blockhouse Run's western branch and operated by Ohio American Energy, Inc.

Overall the facility is in good condition. The impoundment is functioning as intended with no signs of potential structural weakness or conditions which are disrupting to the safe operation of the impoundment. Additional pictures taken during the inspection can be made available upon request.

4.3 BOTTOM ASH POND COMPLEX

4.3.1 CHANGES IN GEOMETRY SINCE LAST INSPECTION (257.83(b)(2)(i))

No modifications have been made to the geometry of the BAP Complex since the 2015 annual inspection. The geometry of the impoundment has remained essentially unchanged. A security fencing was added to the riverside of the pond at the outer edge of the crest in order to comply with AEP's security requirements.

4.3.2 CHANGES THAT EFFECT STABILITY OR OPERATION (257.83(b)(2)(vii))

Based on interviews with plant personnel and field observations there were no changes to the BAP Complex since the last annual inspection that would affect the stability or operation of the impounding structure.

4.3.3 INSTRUMENTATION (257.83(b)(2)(ii))

The location and type of instrumentation is shown on Figure 3. The results of the measurements of various piezometers since November 2015 are shown in Figure 5p. The maximum recorded readings of each instrument since the previous annual inspection is shown in Table 3.

Figure 5p presents the historical piezometric head elevations of all the piezometers along with the two pond's stages. The fluctuation of a few of the instruments could be directly correlated to the fluctuation in the pond stage.

A review of the data contained on the BAP Complex static water elevation plot showed that all piezometers exhibit consistent water elevations.

Table 3 BAP Complex Maximum recorded instruments reading since the previous annual inspection

INSTRUMENTATION DATA **Bottom Ash Pond Complex**			
Instrument	**Type**	**Maximum Reading since last annual inspection**	**Date of Reading**
2-N	Piezometer	664.79	10/4/16
3-S	Piezometer	660.78	10/4/16
B-0902	Piezometer	657.08	10/4/16
B-0904	Piezometer	655.60	7/12/16
B-0905	Piezometer	645.65	7/12/16

4.3.4 IMPOUNDMENT CHARACTERISTICS (257.83(b)(2)(iii, iv, v))

Table 4 is a summary of the minimum, maximum, and present depth and elevation of the impounded water & CCR since the previous annual inspection; the storage capacity of the impounding structure at the time of the inspection; and the approximate volume of the impounded water and CCR at the time of the inspection.

Table 4 Summary of Relevant Storage Information BAP Complex

IMPOUNDMENT CHARACTERISTICS **Bottom Ash Pond Complex**	
Approximate **Minimum** depth (Elevation) of impounded water since last annual inspection	5 ft. (663) ft.
Approximate **Maximum** depth (Elevation) of impounded water since last annual inspection	10 ft. (665) ft.
Approximate **Present** depth (Elevation) of impounded water since last annual inspection	7.5 ft. (664) ft.
Approximate **Minimum** depth (Elevation) of CCR since last annual inspection	8 ft. (657) ft.
Approximate **Maximum** depth (Elevation) of CCR since last annual inspection (ft.)	13 ft. (652 ft.)
Approximate **Present** depth (Elevation) of CCR since last annual inspection	10.5 ft. (654.5 ft.)
Storage Capacity of impounding structure at the time of the inspection	324 ac-ft
Approximate volume of impounded water at the time of the inspection	160 ac-ft.
Approximate volume of CCR at the time of the inspection	164 ac-ft.

4.3.5 VISUAL INSPECTION (257.83(b)(2)(i))

A visual inspection of the BAP Complex was conducted to identify any signs of distress or malfunction of the impoundment and appurtenant structures. The inspection also included hydraulic structures underlying the base of the dike. Specific items inspected included all structural elements of the dam such as inboard and outboard slopes, crest, and toe; as well as appurtenances such as the outlet structure at the BAP Complex, and pipe discharge structure.

Results of the visual inspection of the BAP Complex performed on November 17, 2016 are provided below (photos are presented in Attachment C):

1. The BAP and RCP downstream slope along the Ohio River was well protected with vegetation or riprap as typically shown in Photographs Nos. 34 to 38. The vegetation showed a good established growth and is maintained by mowing every year (Photographs Nos. 34 to 36). The trees shown in the photographs along the riverbank are generally located below the toe of the slope and serve to protect the river bank from erosion. Oversized rock at the very southern end of the recirculation pond was replaced with an inverted filter drain to control seepage emanating from the impoundment as shown in Photograph Nos. 37 to 38.
2. The RCP overflow pipe, concrete and riprap appeared in good condition as shown in Photograph No. 37 and 39. The upstream concrete inlet structure was also in satisfactory condition. The pond water level was well below the invert of the steel weir (Photograph No. 39).
3. The crest and interior slopes of the BAP and the Recirculation Pond were in generally good condition as shown in Photograph Nos. 40, to 42, 44 and 52.
4. The BAP discharge structure concrete and steel platform were in good condition, as shown in Photograph No. 43. The railings are showing minor rust and the steel support members to the walkway are showing fair conditions with minor corrosion.
5. The BAP downstream slope on the west side has two old seepage areas that have been repaired with an inverted riprap filter. These seepage areas appeared stable with grass growing in the immediate vicinity of the seepage. Photograph Nos. 44 and 45 show typical exterior slope conditions. The remainder of the BAP west side slope was well protected with bottom ash and slag.
6. Photograph Nos. 46 and 47 show the upstream, crest and downstream of the splitter dike conditions. Minor erosion was noticed at the corners of the dike.
7. The PVC sheet piling installed across the width of the recirculation pond appears to be stable with no change noted along the slight bulge in the sheet pile alignment previously noted at the time of installation (Photo Nos. 48 and 49).
8. The contractor constructed a bridge across the bottom ash pond channel to continue reclamation of the bottom ash from the pond (Photo No.51). The bottom ash sluice lines were generally clear allowing for unobstructed flow into the pond (Photo No.52).
9. Three seepage areas with minimal flow were found along the downstream slope of the eastern dike during quarterly inspections and persisted through this annual inspection. Seep areas are to be monitored on weekly basis (Photos No.53 through 56).

Overall the facility is in good condition. The impoundment is functioning as intended with no signs of potential structural weakness or conditions which are disrupting to the safe operation of the impoundment.

5.0 SUMMARY OF FINDINGS

5.1 MAINTENANCE ITEMS

The following maintenance items were identified during the visual inspection:

Fly Ash Dam 1

- Vegetation control on the outboard slopes is to be kept under control by mowing or spraying.
- Damaged pipes at the right groin are to be fixed and/or backfilled.

Fly Ash Dam 2

- Ash sluicing pipes needs to be cut at elevation 5 ft higher than the pond water level (968.0) to prevent the submergence of the pipes.

Bottom Ash Pond Complex

- There are no items to be addressed.

5.2 ITEMS TO MONITOR

Fly Ash Dam 1

- There are no items to monitor.

Fly Ash Dam 2

- Seepage in the rock in the left abutment should be monitored on weekly basis. Changes in the rate or the clarity of the seep should be reported to GES on the day of the inspection.

Bottom Ash Pond Complex

- Minor seepage along the downstream slope of the eastern dike should be monitored on weekly basis. Changes in the rate or the clarity of the seep should be reported to GES on the day of the inspection.

5.3 DEFICIENCIES (257.83(b)(2)(vi))

There were no deficiencies or signs of structural weakness or disruptive conditions that were observed at the time of the inspection that would require additional investigation or remedial action. There were no deficiencies noted during any of the periodic 7-day or 30-day inspections. If any of these conditions occur before the next annual inspection contact AEP Geotechnical Engineering immediately.

If you have any questions with regard to this report, please contact Mohammad Ajlouni at Audinet: 200-2939 or Gary Zych at Audinet: 200-2917.

ATTACHMENT A:
Photographs – Fly Ash Dam 1

Photo # 1 FAD 1	
View of the downstream slope of the FAR 1 dam.	
Photo # 2 FAD 1	
Typical view of the downstream slope of the FAR 1 dam.	
Photo # 3 FAD 1	
Typical view of the emergency spillway for the FAR 1 impoundment.	

November 17, 2016
Cardinal Plant
Dam and Dike Inspections

Photo # 4 FAD 1	
Right Groin of FAD 1 showing a damaged surface water pipe.	

ATTACHMENT B:
Photographs – Fly Ash Dam 2

Photo # 5 FAD 2 Typical crest view showed good conditions with no indications of misalignment, rutting or erosion.	
Photo # 6 FAD 2 Typical view showing good conditions of the crest and downstream of the dam.	
Photo # 7 FAD 2 Typical view of the upstream MSE wall on the west (left) side of the decant structure	

Photo # 8 FAD 2 Typical view of Principal spillway flow.	
Photo # 9 FAD 2 Typical view of the upstream MSE wall on the east (right) side of the decant structure	
Photo # 10 FAD 2 Typical view of the west side of the decant structure, skimmer and stairs showing good conditions.	

Photo # 11 FAD 2 Typical view of the east side of the decant structure, skimmer and stairs showing good conditions.	
Photo # 12 FAD 2 Typical view of the upstream RCC on the east side of the decant structure. No significant wave cut erosion, erosion rills were observed.	
Photo # 13 FAD 2 Typical view of the upstream RCC on the west side of the decant structure. No significant wave cut erosion, erosion rills were observed.	

Photo # 14 FAD 2 Typical view of the emergency discharge channel showing good conditions. Vegetative control is well maintained. Historic seep from the rock slope at the left abutment has slightly increase in rate as a result of the increased upstream gradient as a result of rising the pool elevation by approximately 5 ft.	
Photo # 15 FAD 2 Typical view of the Concrete and RCC discharge channel "steps." The RCC steps have experienced a moderate amount of differential erosion but appear to be in fair condition.	
Photo # 16 FAD 2 Typical view of the downstream slope showing good conditions. Vegetative cover is well established and no significant erosion rills or gullies were observed.	

Photo # 17 FAD 2 Typical view of the downstream slope showing good conditions. No significant erosion was observed along the contact between the RRC and the vegetative cover. No bulging or slumping was observed. The slopes appeared to be uniform.	
Photo # 18 FAD 2 Typical view of the right groin ditch. The woody shrub/small tree growth has been removed from the ditch per previous recommendations. The rip rap is a hard limestone and showed no significant weathering or deterioration. Flow measurements was taken of the drain recently installed to monitor seep fix area at the upper right groin (See newly placed Riprap)	
Photo # 19 FAD 2 Typical view of Drain No. 2 that discharges from the right abutment drainage blanket. The discharge was visually clear but has increased.	

Photo # 20 FAD 2 Typical view showing the weirs along “Tom Dick’s Creek”. No unusual sediment accumulation was observed along the creek bottom.	
Photo # 21 FAD 2 Typical view showing good conditions for access (stairs) to measure the dam’s internal drain.	
Photo # 22 FAD 2 Typical view of the discharge from the dam’s internal drain showing a visually clear discharge. Flow was unobstructed and the concrete weir box is in good condition. The discharge was measured to be 21 gpm and is consistent with previous measurements.	

Photo # 23 FAD 2 Typical view showing good conditions of the left groin ditch and discharge pipe. No leakage was observed along the pipe and access to the pipe was good. The left ditch was unobstructed and the rip rap was in sound condition.	
Photo # 24 FAD 2 View of the energy dissipater showing good conditions of the concrete structure. No cracking, spalling was observed.	
Photo # 25 FAD 2 View of the location along the right abutment where historical seepage is occurring– The exposed bedrock is part of the Morgantown sandstone. A new 90º v-notch open weir was installed in 2013	

Photo # 26 FAD 2 Close up view of the seepage shown in Photo # 40. The discharge appeared to be visually clear and the flow is measured to be 75 gpm. The overall measured seepage from the right slightly increased with increasing pool stage (See Figure 4).	
Photo # 27 FAD 2 Typical view of the FAR 2 impoundment. The pond pool stage was 968.0 ft (NGVD-29) at the time of the inspection.	
Photo # 28 FAD 2 Typical view of the ash sluice lines discharging into the FAR 2 pond. The increase in pool stage has inundated additional area including the discharge lines ends.	

Photo # 29 FAD 2 Typical view of the FAR 2 ash delta downstream of the ash sluice discharge lines.	
Photo # 30 FAD 2 Additional stop logs are available for the future raising of the water level at FAR 2 pond.	
Photo # 31 FAD 2 Ash Sluicing to the right corner of the upstream slope. The location of the pumping platform installed within the FAR 2 impoundment is shown in the background.	

Photo # 32 FAD 2 Ash Dredging to the right corner of the upstream slope. The location of the pumping platform installed within the FAR 2 impoundment is shown in the background.	
Photo # 33 FAD 2 Two aerators are operating in the FAR 2 pond and are used to keep the impoundment from stratifying and direct the cenospheres to move towards the shoreline allowing greater penetration of sunlight into the pond and promote the growth of algae.	

ATTACHMENT C:
Photographs –Bottom Ash Pond Complex

Photo # 34 BAP	
The embankment along the Ohio River showed a good growth of vegetative cover and is regularly controlled by mowing. No slumping, or bulges was observed. The trees are located along the Ohio River and are being left in place to protect the riverbank.	
Photo # 35 BAP	
The embankment along the Ohio showing piezometer along the toe of the embankment. The trees are located along the Ohio River and are being left in place to protect the riverbank.	
Photo # 36 BAP	
No slumping, bulges or seepage was observed. The trees are located along the Ohio River and are being left in place to protect the riverbank.	

Photo # 37 BAP Typical view showing good condition of the rip rap and downstream outlet of the RCP discharge pipe.	
Photo # 38 BAP Typical view showing good condition of the rip rap. An inverted filter drain was extended in late 2009 through this area to control seepage emanating from the pond.	
Photo # 39 BAP The RCP overflow structure's concrete was observed to be in good condition. No spalling or cracking of the concrete was observed. The RCP overflow structure has been retrofitted with a steel weir.	

Photo # 40 BAP	
The road crest showed good conditions with no indications of misalignment, rutting or erosion. The piezometer in the foreground is well protected and is currently being monitored by plant personnel.	
Photo # 41 BAP	
Typical view showing good conditions of interior slopes and crest of the bottom ash pond.	
Photo # 42 BAP	
Typical view showing good conditions of interior slopes and crest of the bottom ash pond west dike. One rut was noticed at the dike crest	

Photo # 43 BAP	
Typical view of the BAP discharge structure. The concrete drop inlet structure was observed to be in good condition. New Staff Gage and Max Operating Level Mark were installed Recently.	

Photo # 44 BAP	
Typical view showing satisfactory conditions of exterior slopes and some minor seepage/ drainage along the toe of the embankment.	

Photo # 45 BAP	
Typical view showing satisfactory conditions of exterior slopes and some minor seepage/ drainage along the toe of the embankment. No significant erosion gullies, slumping or bulges were observed.	

Photo # 46 BAP Typical view showing good conditions of the splitter dike between the bottom ash pond and the RCP pond with minor erosion at the corners.	
Photo # 47 BAP Typical view showing good conditions of the splitter dike between the bottom ash pond and the RCP pond with minor erosion at the corners.	
Photo # 48 BAP Typical view showing good conditions of the sheet piling wall that splits the RCP pond.	

Photo # 49 BAP Typical view showing good conditions of the sheet piling wall that splits the RCP pond.	
Photo # 50 BAP Typical view of the bridge across the bottom ash pond discharge channel into the pond. The channel appeared to be in good condition and flow was unobstructed.	
Photo # 51 BAP Typical view showing good conditions of the bottom ash discharge pipes. Access to the discharge lines is being maintained, Discharge into the channel and flow through the channel was unobstructed.	

Photo # 52 BAP	
The road crest showed good conditions with no indications of misalignment, and minimal rutting or erosion.	

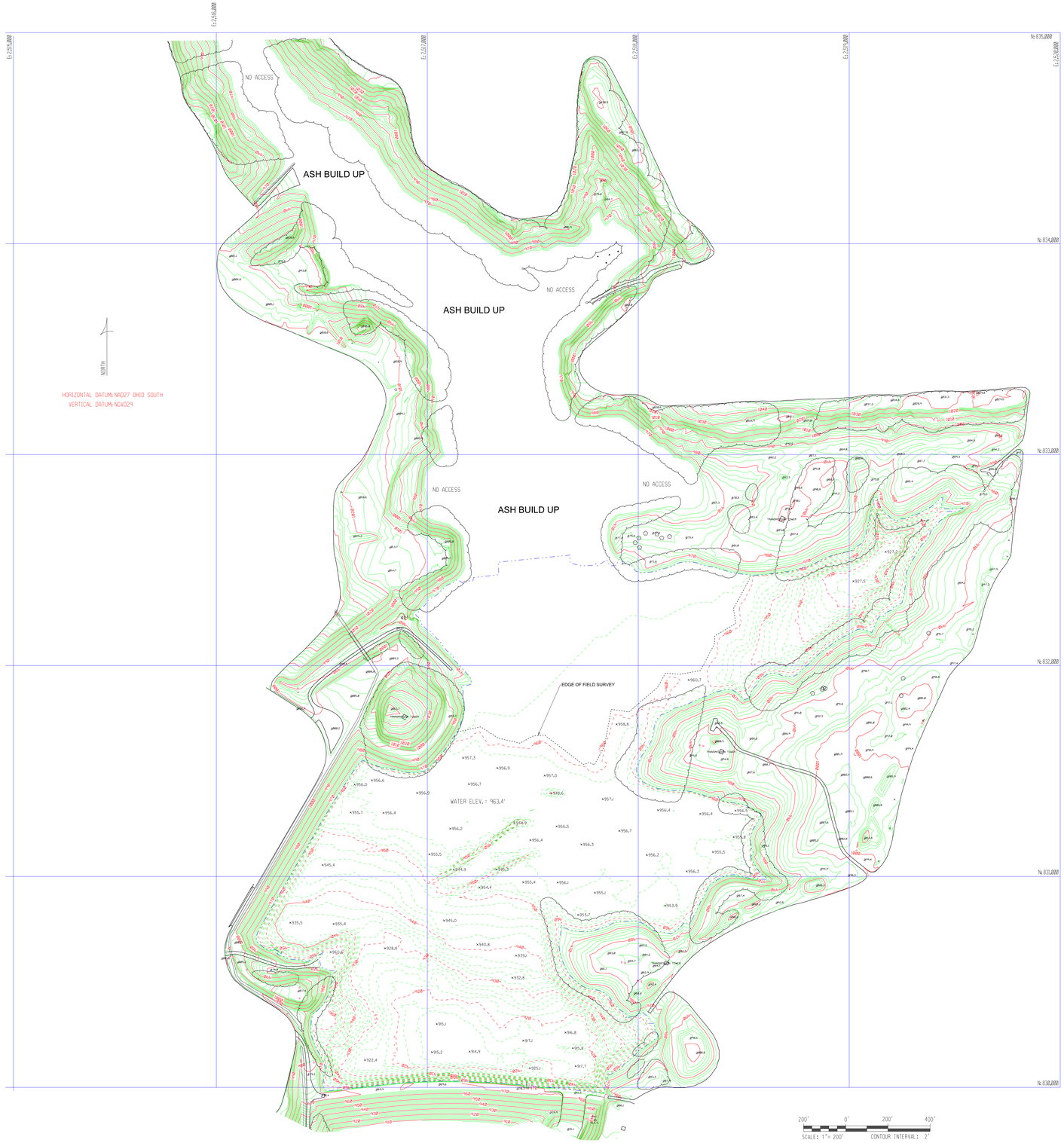
Photo # 53 BAP	
General View of the Location of Seep #1.	

Photo # 54 BAP	
Close-up of Seep #1.	

Photo # 55 BAP General View of the Location of Seep #2.	
Photo # 56 BAP General View of the Location of Seep #3.	

ATTACHMENT D:
Bathymetric Surveys (September 20, 2016)

DWG. NO.



Triangle Volume Report

Volume Up To Water Elevation 963.4'

Report Created: 11/4/2016
Time: 1:37pm
Mode: Entire Surface
Input Grid Factor: 1.000000

Original Surface: cdFARII 9-20-16_2729SF_H2O
Description: Fly Ash Reservoir II 9-20-16 Waters Edge
Preference: Default
Type: Existing

Design Surface: cdFARII 9-20-16_2729SF
Description: Fly Ash Reservoir II 9-20-16 Complete
Preference: Default
Type: Existing

Cut Factor: 1.00
Fill Factor: 1.00

Cut: 56816898.2cu ft
Fill: 4.5cu ft
Net: 56816893.8cu ft

Cut: 2104329.6cu yd
Fill: 0.2cu yd
Net: 2104329.4cu yd

•NOTE: CONTOURS AND DTM DATA ABOVE THE WATER LEVEL ARE FROM AERIAL PHOTOS DATED 3/05-09.

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

DIGITAL MAP FILES CDFARII 9-20-16_2729SF.DGN & .DTM

FAR II HYDROGRAPHIC SURVEY

CARDINAL PLANT

SURVEY DATE SEPTEMBER 20, 2016

DWG. NO. CD- 160920

SCALE: 1" = 200'	CIVIL ENGINEERING DIVISION
DRM. W. FLYNN	
CH:	
ENGR.	
PROJ. ENGR.	
DATE: 11/04/16	

APPROVED BY

AEP AMERICAN ELECTRIC POWER
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

IGS1092

ATTACHMENT E:
Figures & Drawings 13-30040, 13-30041 & 13-30042

DRN BY:	CARDINAL POWER STATION	DWG NO: FIGURE 1
DATE:		AEP AMERICAN ELECTRIC POWER / AEP SERVICE CORP. 1 RIVERSIDE PLAZA COLUMBUS, OH 43215
SCALE: 1"=	FLY ASH DAM I	

DWG. NO. 13-30040

GENERAL NOTES

1. - EXCAVATE ROCK SURFACE TO ACHIEVE A RIGHT ANGLE CONTACT WITH THE RCC.
2. - THE SOIL OVERBURDEN ON BOTH THE RIGHT & LEFT ABUTMENTS SHALL BE STRIPPED. A 2' BOTTOM ASH DRAINAGE BLANKET SHALL BE PROVIDED OVER THE ENTIRE STRIPPED AREA. ANY SEEPAGE ZONES FOUND DURING STRIPPING SHALL BE DRAINED AS NECESSARY BY A FRENCH DRAIN DAYLIGHTING INTO GROIN DITCH.
3. - ADJUST LOCATION OF GROIN DITCH AS REQUIRED TO CLEAR PIPE SUPPORTS.

LEGEND - EXISTING

- SPOT ELEVATION
- INTERMEDIATE CONTOUR
- INDEX CONTOUR
- DEPRESSION CONTOUR
- TREES AND TREELINE
- STRUCTURE AND BUILDING
- FENCE
- POLE
- ROADS
- EDGE OF WATER
- MANHOLES / CATCH BASIN
- POWER POLE
- PIPES
- TOWER

LEGEND - PROPOSED

- +(970.0') FIN. GRADE SPOT ELEV.
- 920 FIN. GRADE CONTOUR
- DRAINAGE DITCH
- INCLINED BORE HOLES
- VERTICAL BORE HOLES
- PIEZOMETER

REFERENCE DRAWINGS

13-30041 - FLY ASH DAM II RAISING PROFILE & SECTION.

13-30042 - FLY ASH DAM II RAISING SECTIONS & DETAILS SHT.1.

13-30043 - FLY ASH DAM II RAISING SECTIONS & DETAILS SHT.2.

DATE	NO.	DESCRIPTION	APPD.
3/30/00	5	REVISED TO REFLECT AS-BUILT CONDITIONS. FINAL SUBMITTAL TO STATE	GTM/LK
5/24/99	4	AS-BUILT: REVISED TOPO, DRAIN PIPES , ADDED TABLES, PIEZOMETERS AND OPEN BORE HOLES. REMOVED MONITORING WELLS 4,3, 2D & 2S	LMH/ JC
8/22/98	3	REMOVED INTERMEDIATE CONTOURS. INDICATED CONCRETE TRAINING WALL & GEOTEXTILE FABRIC.	LMH/ RCD
5/20/98	2	DELETED DROP MANHOLE & REV. PIPE ALIGNMENT.	LMH/ RCD
8/25/97	1	REV. TOE OF DAM TO REFLECT SLIDE REPAIR. RELOCATED DROP MANHOLE & REV. PIPE BEND, 6°30' WAS 6°. ADDED UNDERDRAIN SYSTEM.	LMH/ RCD
4/2/97	0	ISSUED FOR CONSTRUCTION.	LMH/

REVISIONS

s:/cd/13/geo_hydro_site/30040.dgn

CARDINAL OPERATING COMPANY

CARDINAL PLANT

BRILLIANT OHIO

FLY ASH DAM II RAISING GRADING & DRAINAGE PLAN

DWG. NO. 13-30040-5

SCALE: 1"=50'

CIVIL ENGINEERING DIVISION

DRN: RCD
CHK: GTC
ENGR.: LMH
PROJ. ENGR.:
APPROVED BY: H. Joseph Bubac
DATE: 4/2/97

AEP AMERICAN ELECTRIC POWER — 1 RIVERSIDE PLAZA COLUMBUS, OH 43215

PTS No. 55689

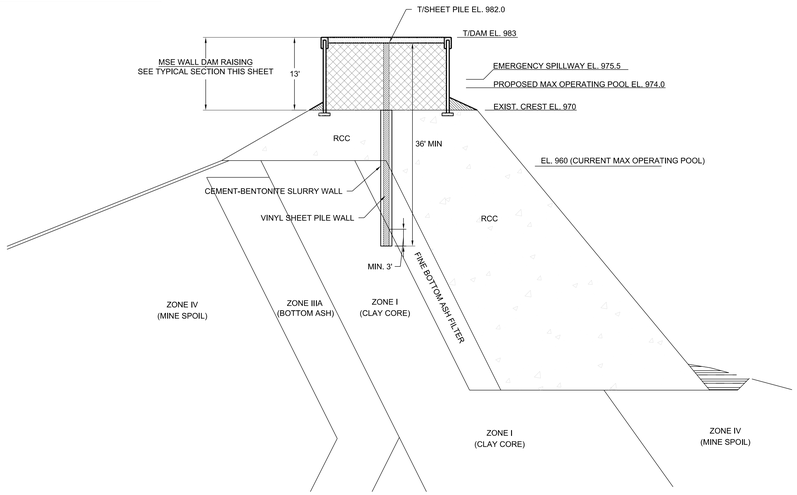
MONITORING WELLS	NORTH	EAST	TIP ELEV.
MW-1D	830,048.740	2,518081.850	654.5
MW-1S	830,048.780	2,518081.930	806.1
MW-5	830,072.415	2,516465.055	782.2
MW-6	830,072.415	2,516465.990	915.6
MW-7	829,942.57	2,517,824.47	972.50
PIEZOMETER No.	NORTH	EAST	TIP ELEV.
P8B	829,880.385	2,517,198.101	776.0
P8A	829,880.185	2,517,191.730	802.1
P2BE nested	829,893.405	2,517,001.135	730.0
P2C nested	829,893.405	2,517,001.135	711.0
P3B nested	829,965.095	2,516,994.335	772.3
P3A nested	829,965.095	2,516,994.335	802.3
P3C	829,947.865	2,516,994.545	712.3
P2BW	829,892.685	2,516,941.390	731.1
P2A	829,910.895	2,516,891.870	771.0
P11	829,874.275	2,516,805.610	802.6
P11B	829,887.670	2,516,773.430	789.1
P10	829,815.120	2,516,776.440	769.1
P9	829,757.800	2,517,221.000	771.2
P8E	829,687.855	2,516,999.390	728.0
P1A	829,692.010	2,516,965.335	752.3
P1C	829,692.010	2,516,965.335	714.4
PSBR-Orig.	829,851.135	2,517,269.030	725.0
PSBR-sl. doylite	829,705.160	2,517,222.820	CONNECTOR EL.807.0
P1BW	829,701.320	2,516,925.760	735.9
PRCC3	830,018.040	2,517,445.700	913.3
PRCC2	830,034.680	2,517,185.460	913.4
PRCC1	830,008.870	2,516,765.950	923.3
P4A	830,078.650	2,517,007.900	801.7
P5A	830,079.170	2,517,013.940	774.7

OPEN BOREHOLES	NORTH	EAST	GR. ELEV.	BOTT. ELEV.
OB-1	829,963.475	2,516,484.110	970.205	920.000
OB-2	829,976.090	2,516,583.770	970.015	920.000
OB-3	829,988.100	2,516,683.385	969.950	920.000
OB-4	830,000.125	2,516,781.285	969.915	920.000
OB-5	830,009.680	2,516,880.480	969.890	920.000
OB-6	830,016.215	2,516,980.785	969.885	920.000
OB-7	830,019.285	2,517,080.595	969.865	920.000
OB-8	830,017.820	2,517,180.080	969.880	920.000
OB-9	830,013.940	2,517,279.295	969.935	920.000
OB-10	830,006.100	2,517,378.760	970.015	920.000
OB-11	829,998.195	2,517,452.330	970.035	920.000
OB-12	829,987.550	2,517,642.140	961.965	910.000
OB-13	829,979.315	2,517,739.690	961.240	910.000

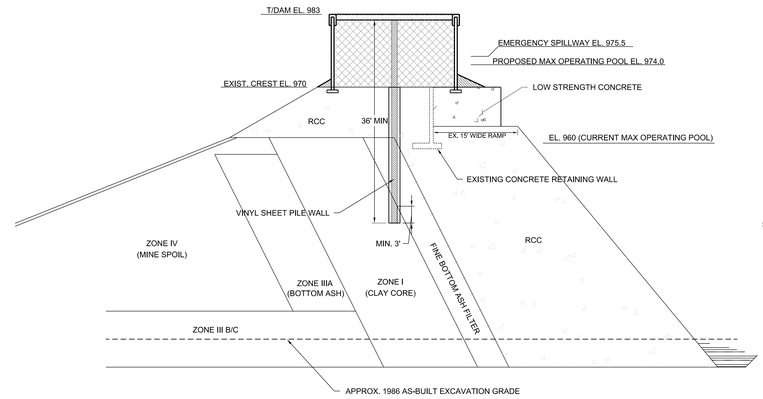
NOTE: ALL OB. HOLES ARE INCLINED 15° FROM VERTICAL

FIGURE 2A

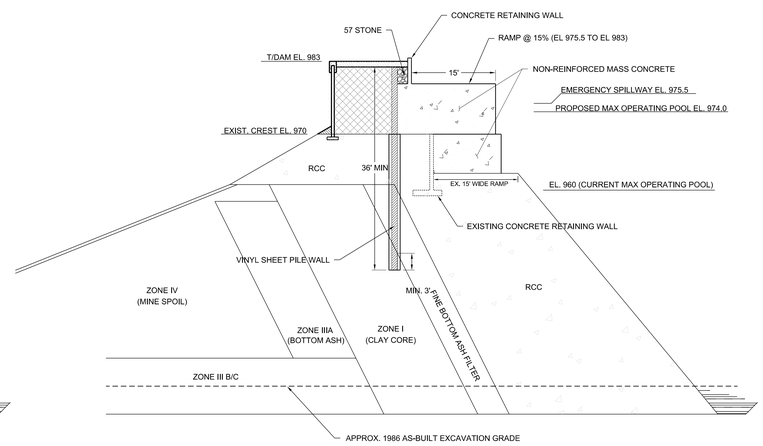
DWG. NO. 13-30087-A



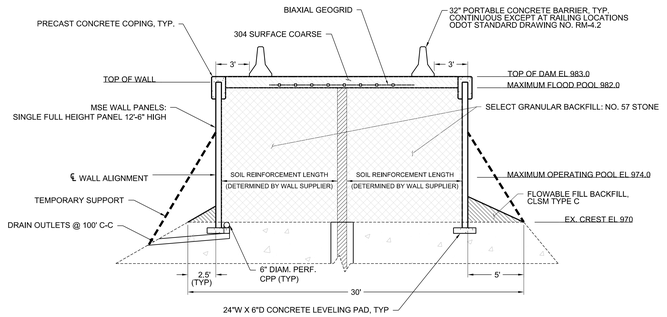
A TYPICAL SECTION - MAIN DAM
SCALE: 1" = 10'



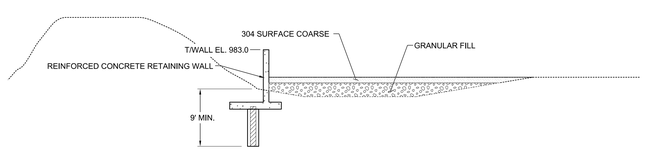
B1 SECTION THROUGH EXISTING EMERGENCY SPILLWAY RAMP
SCALE: 1" = 10'



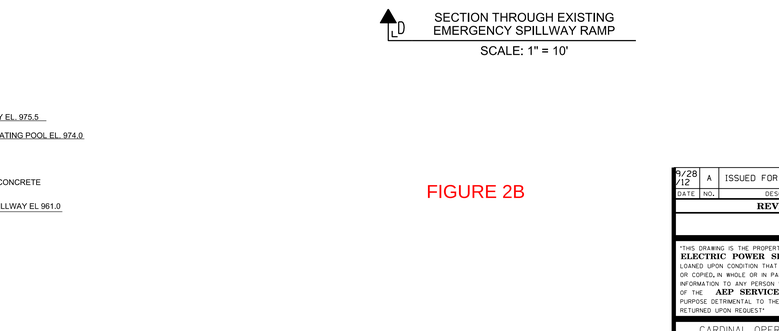
B2 SECTION THROUGH EXISTING EMERGENCY SPILLWAY RAMP
SCALE: 1" = 10'



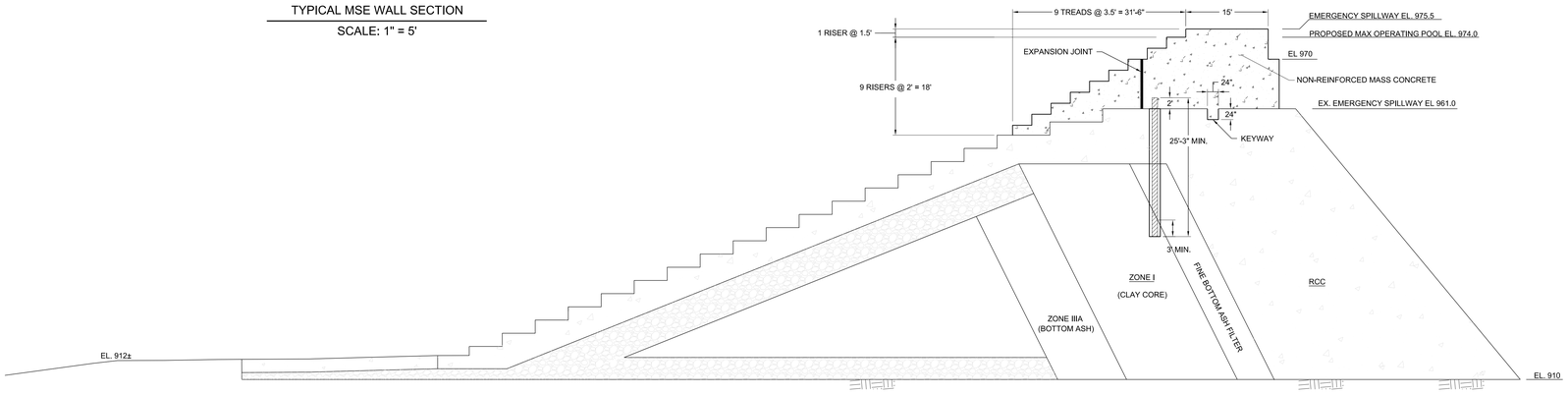
TYPICAL MSE WALL SECTION
SCALE: 1" = 5'



E SECTION E-E
SCALE: 1" = 10'



D SECTION THROUGH EXISTING EMERGENCY SPILLWAY RAMP
SCALE: 1" = 10'



C SECTION THROUGH EXISTING EMERGENCY SPILLWAY
SCALE: 1" = 10'

FIGURE 2B

S&ME, INC.
6190 ENTERPRISE COURT
DUBLIN, OH 43016
PHONE: 614-793-2226
FAX: 614-793-2410
www.smeinc.com

STATE OF OHIO · MICHAEL GILBERT ROWLAND · E-65559 · REGISTERED PROFESSIONAL ENGINEER

MICHAEL GILBERT ROWLAND | E-65559 NUMBER | SEPT 28, 2012 DATE

PROJECT NUMBER:	011-11497-042	DRAWN BY:	EDV
DRAWING DATE:	9/28/12	ENGINEER:	MTR
LAST UPDATED:	9/28/12	APPROVED BY:	MGR
		SCALE:	AS NOTED

S&ME

DATE	NO.	DESCRIPTION	APPD.
9/28/12	A	ISSUED FOR BID	SSB MGR

REVISIONS

CARDINAL OPERATING COMPANY

CARDINAL PLANT

BRILLIANT OHIO

DAM RAISING
FLY ASH RETENTION DAM II
DAM RAISING
TYPICAL SECTIONS

DWG. NO. 13-30087-A

ARCH — ELEC — MECH — STR

SCALE: AS SHOWN

DR:

CH:

QC:

DATE:

APPROVED BY:

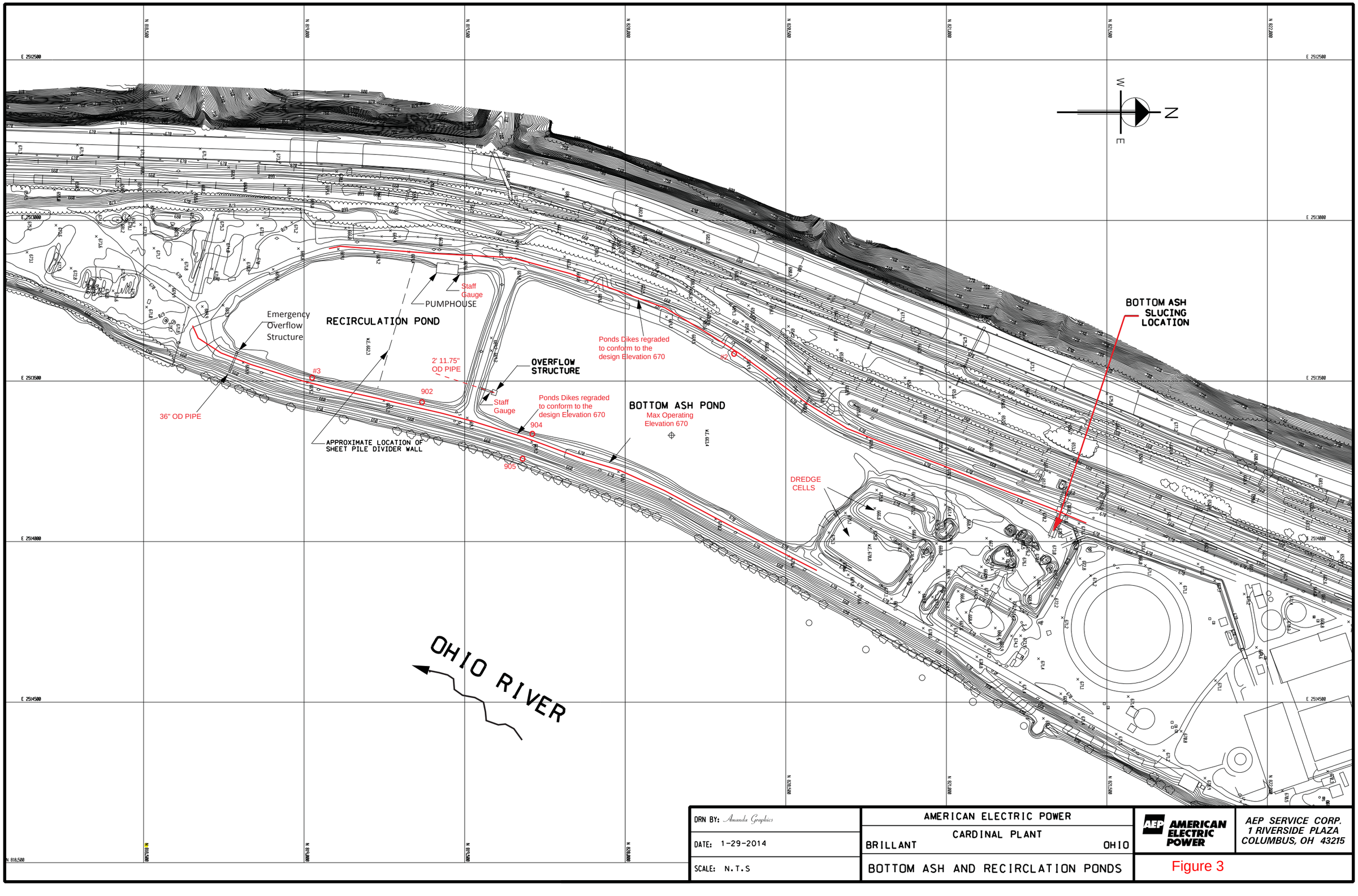
CIVIL ENGINEERING DIVISION

AMERICAN ELECTRIC POWER

1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

IGSI092

SYSTEM DATE: DD-MMM-YYYY
SYSTEM TIME: HOURMINUTE
I54M FLR/CED



DRN BY: Amanda Graphics	AMERICAN ELECTRIC POWER CARDINAL PLANT BRILLANT OHIO	AEP AMERICAN ELECTRIC POWER AEP SERVICE CORP. 1 RIVERSIDE PLAZA COLUMBUS, OH 43215
DATE: 1-29-2014		
SCALE: N.T.S	BOTTOM ASH AND RECIRCLATION PONDS	Figure 3

Figure 4
Cardinal FAD 2

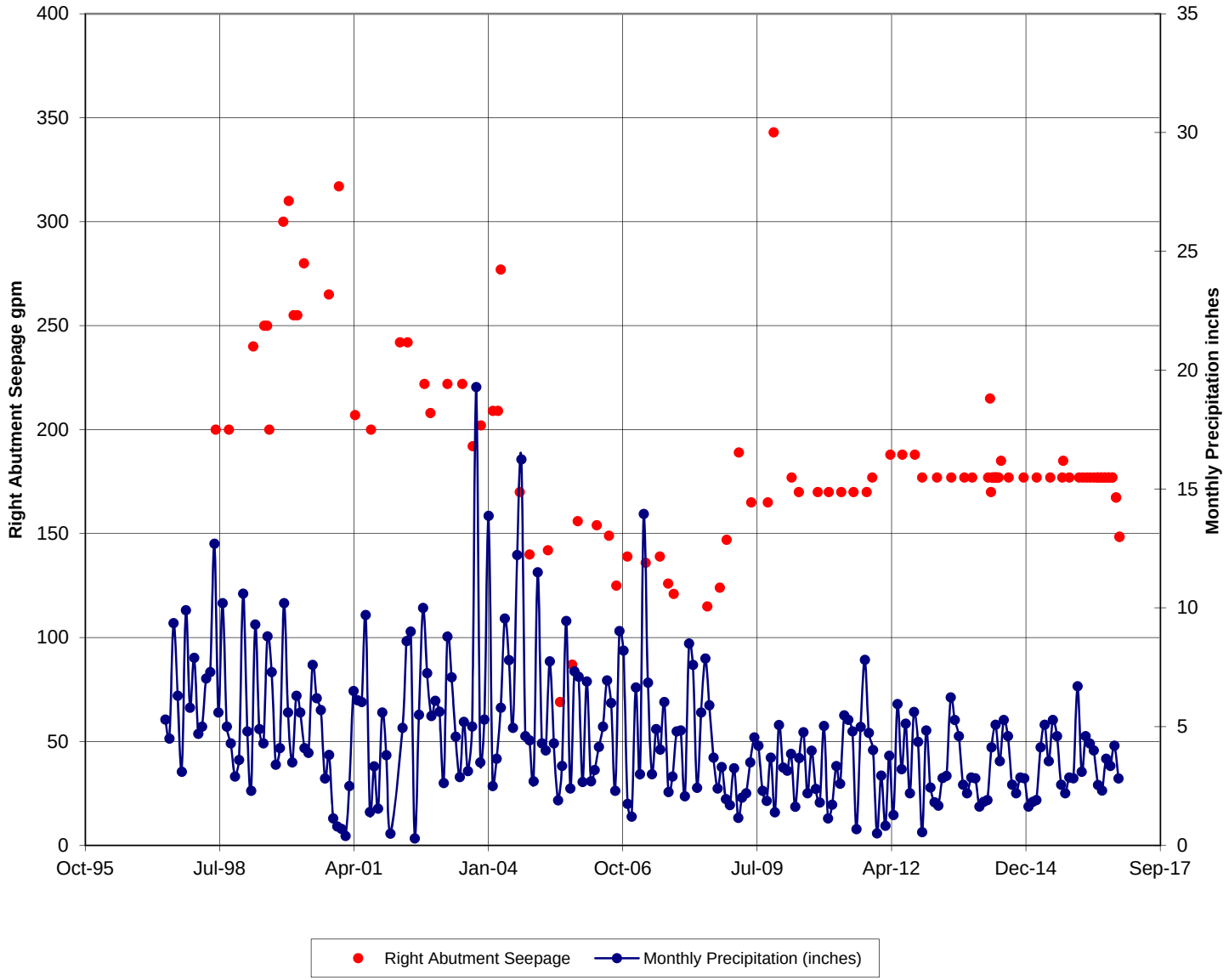


Figure 5a
Cardinal FAD 2

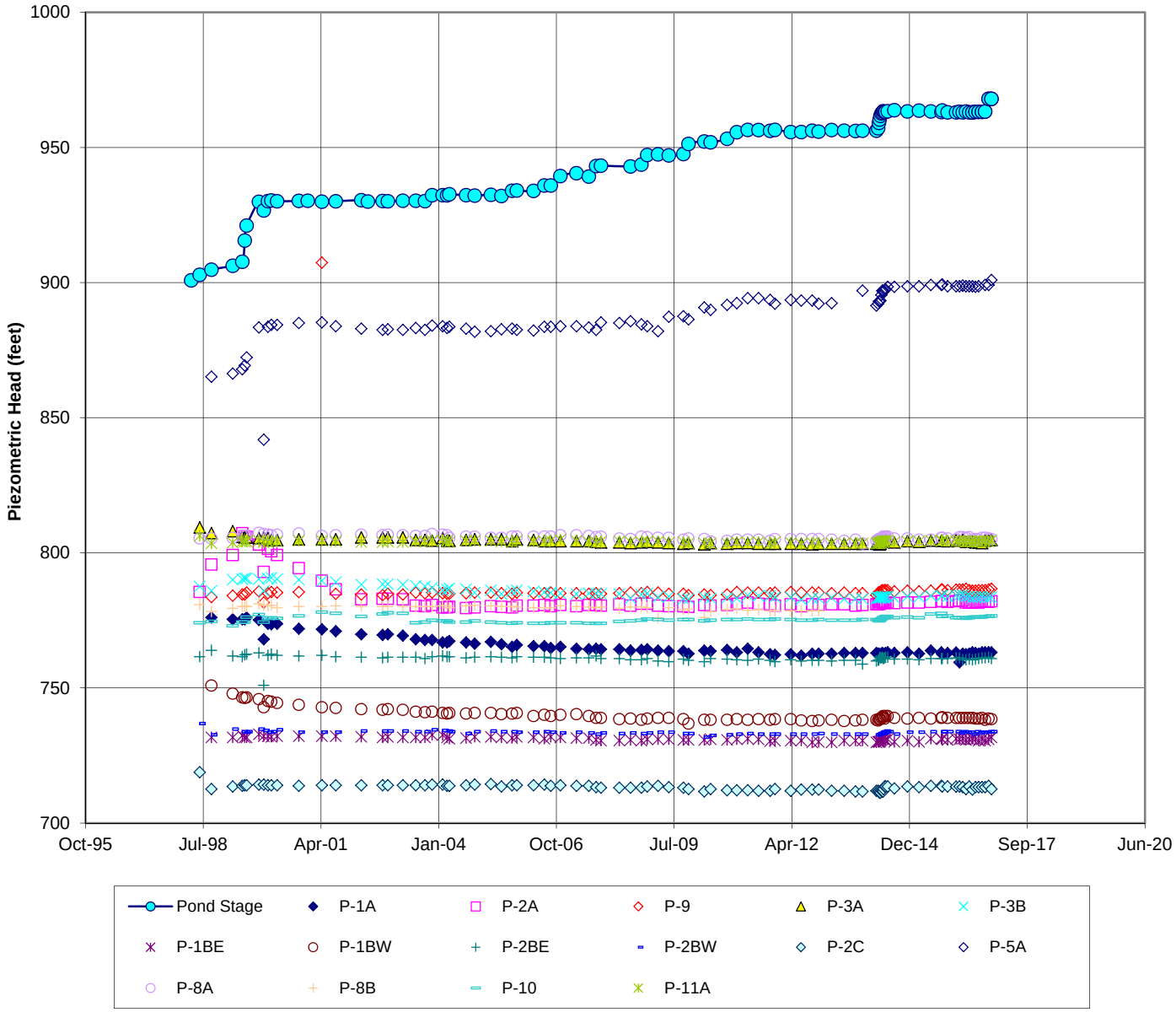


Figure 5b
Pool Stage verses Discharge
Cardinal FAD 2

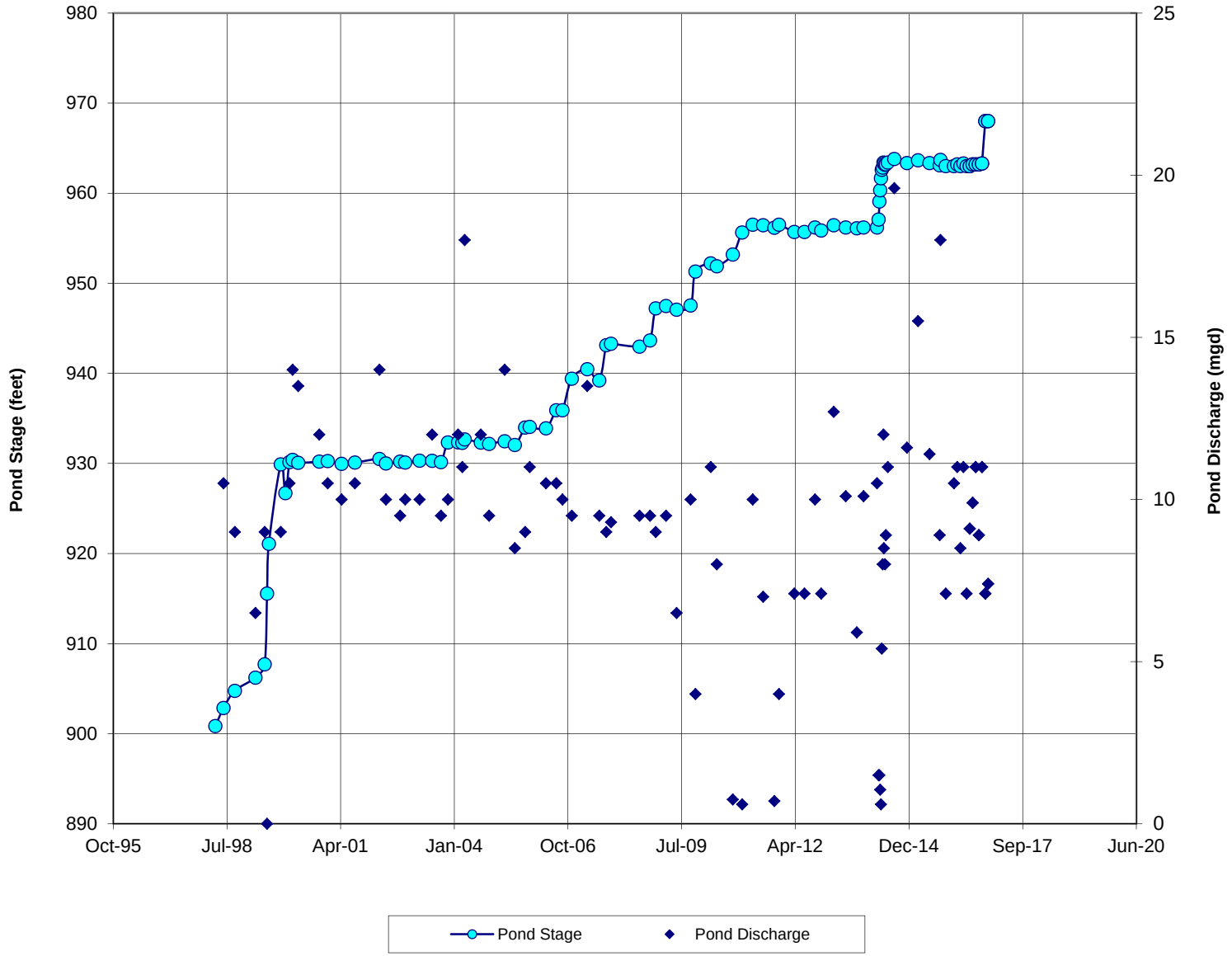


Figure 5c
Cardinal FAD 2
Right of Center
Foundation Piezometers

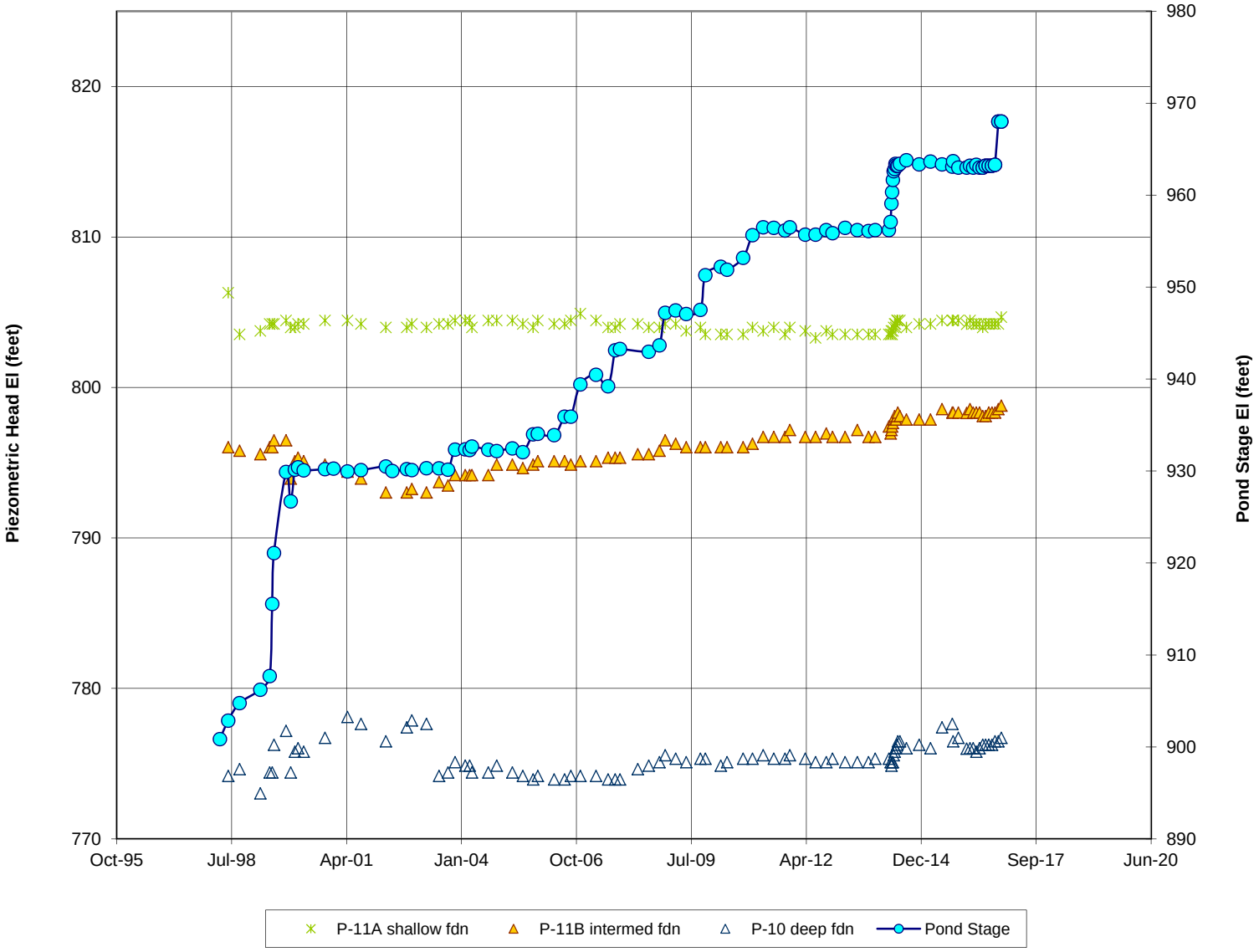


Figure 5d
Cardinal FAD 2
Left of Center
Foundation Piezometers

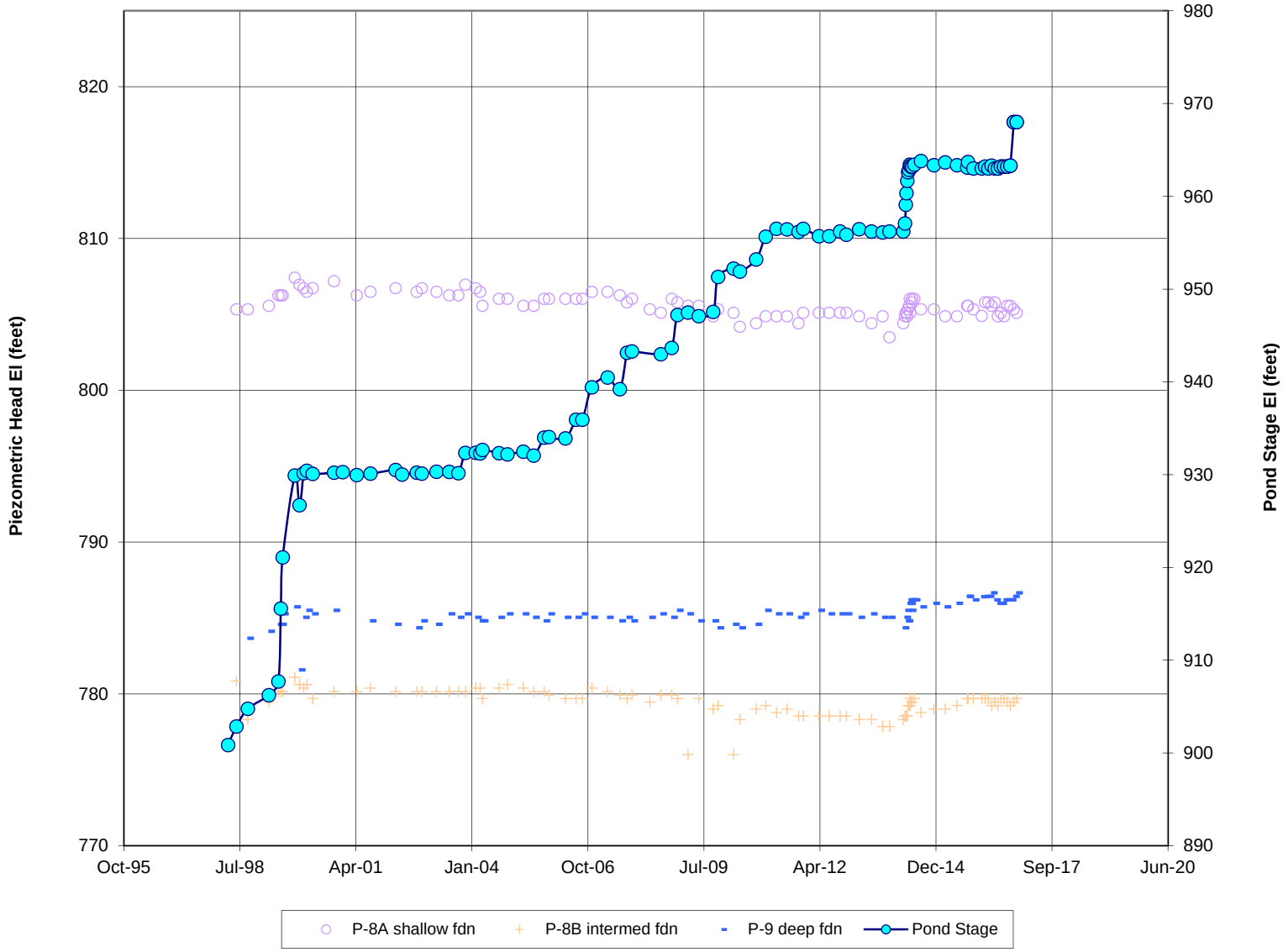


Figure 5e
Cardinal FAD 2
Centerline of Dam

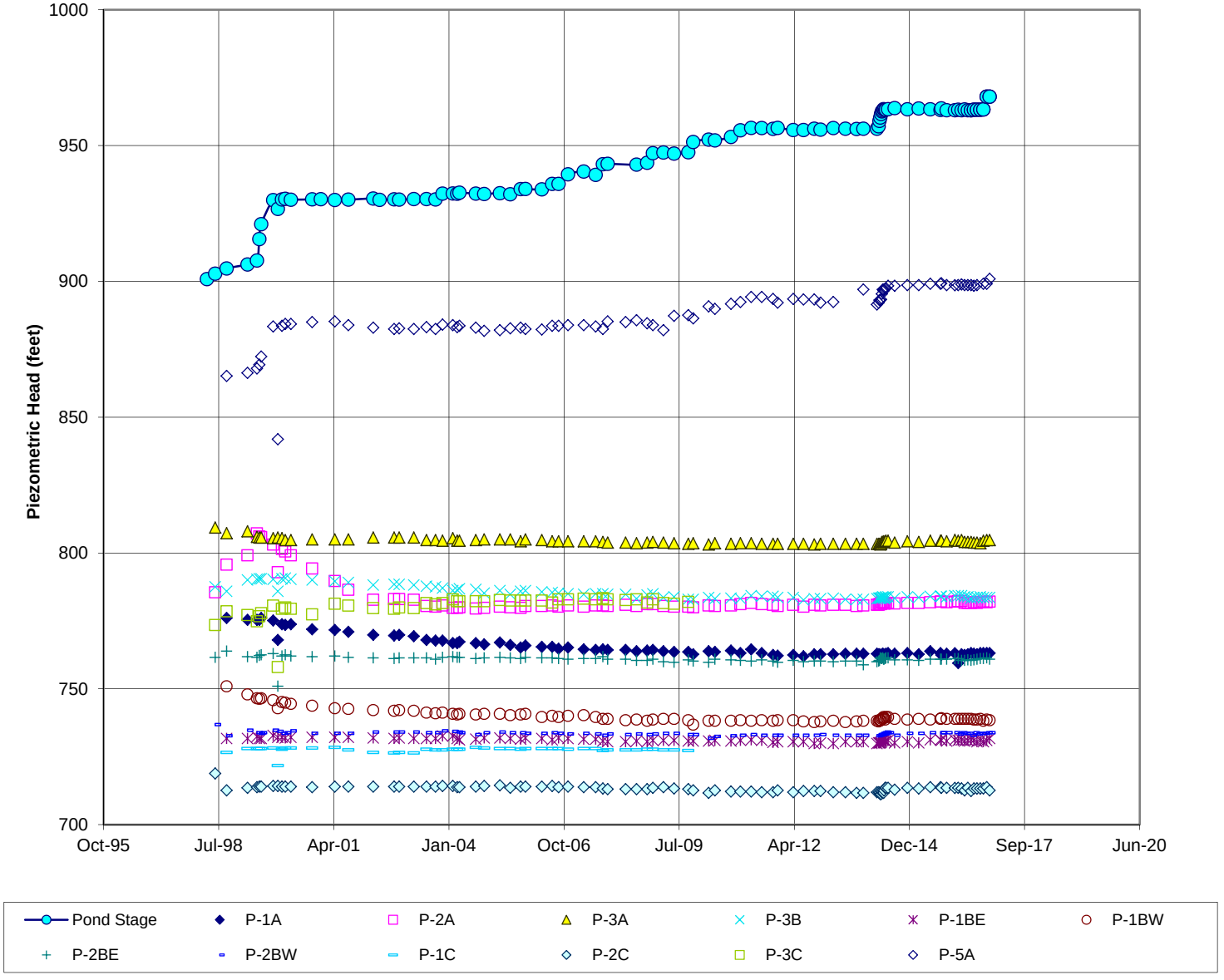


Figure 5f
Cardinal FAD 2
Centerline of Dam

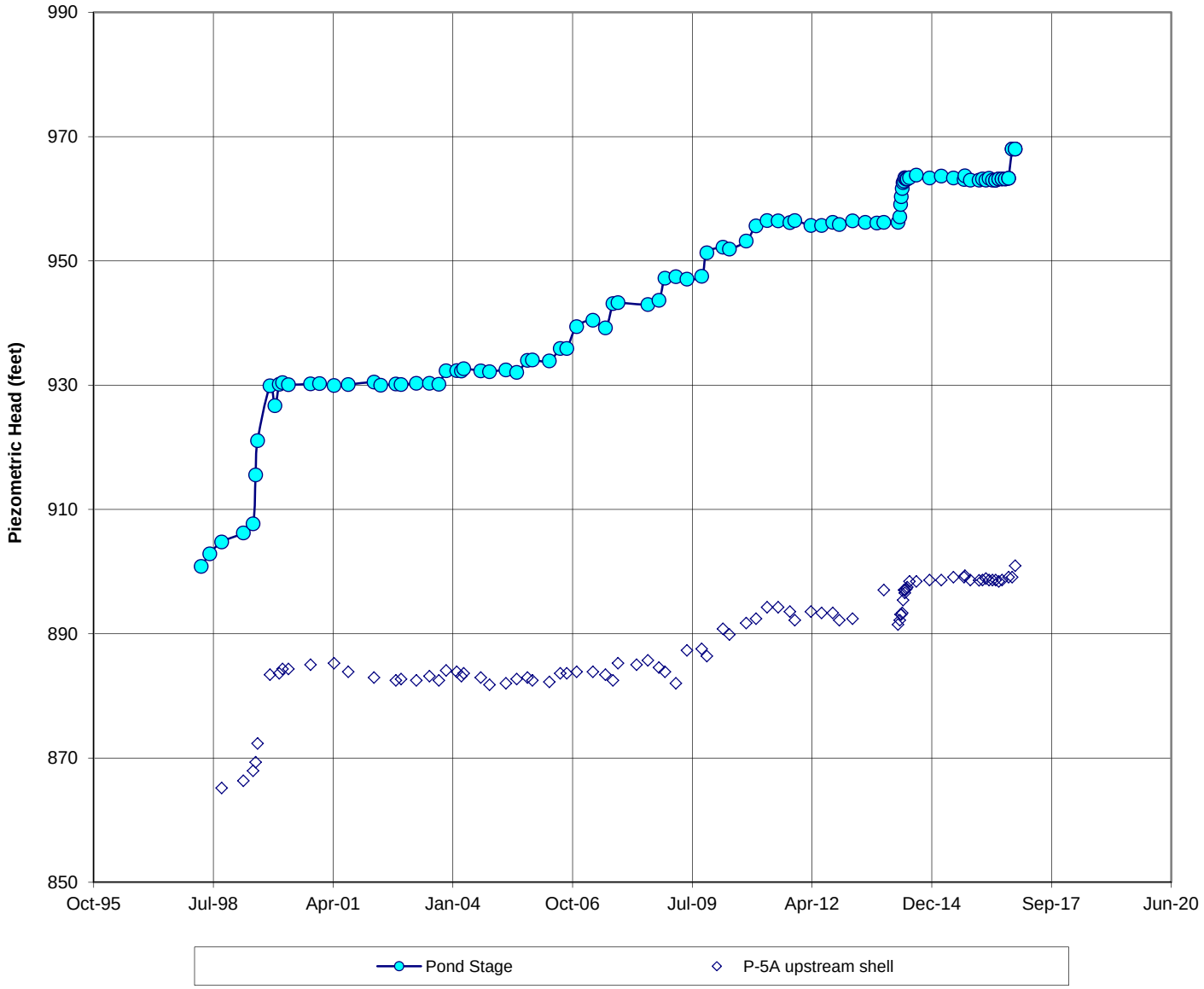


Figure 5g
Cardinal FAD 2
Centerline of Dam
Clustered Piezometer Site

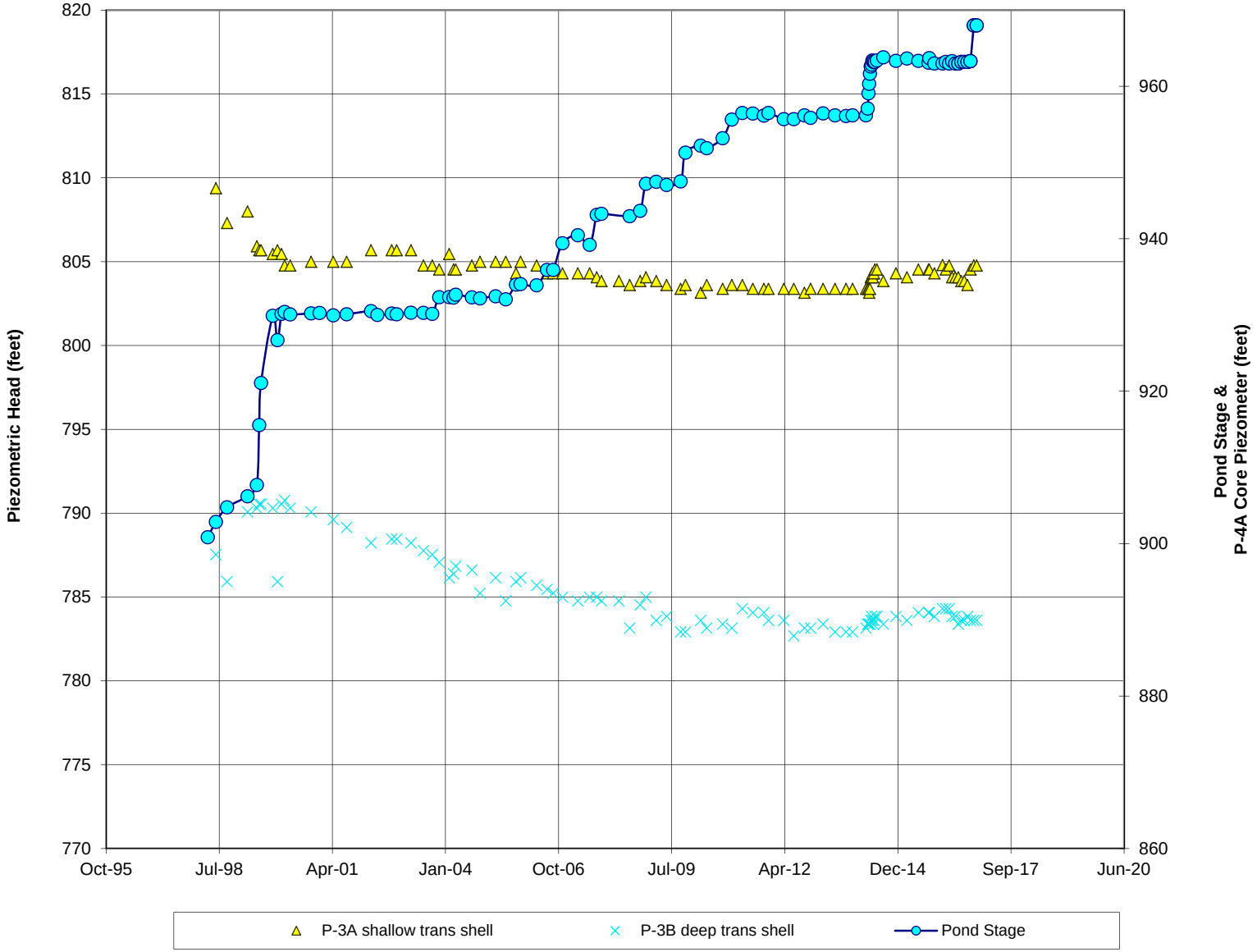


Figure 5h
Cardinal FAD 2
Centerline of Dam
Clustered Piezometer Site

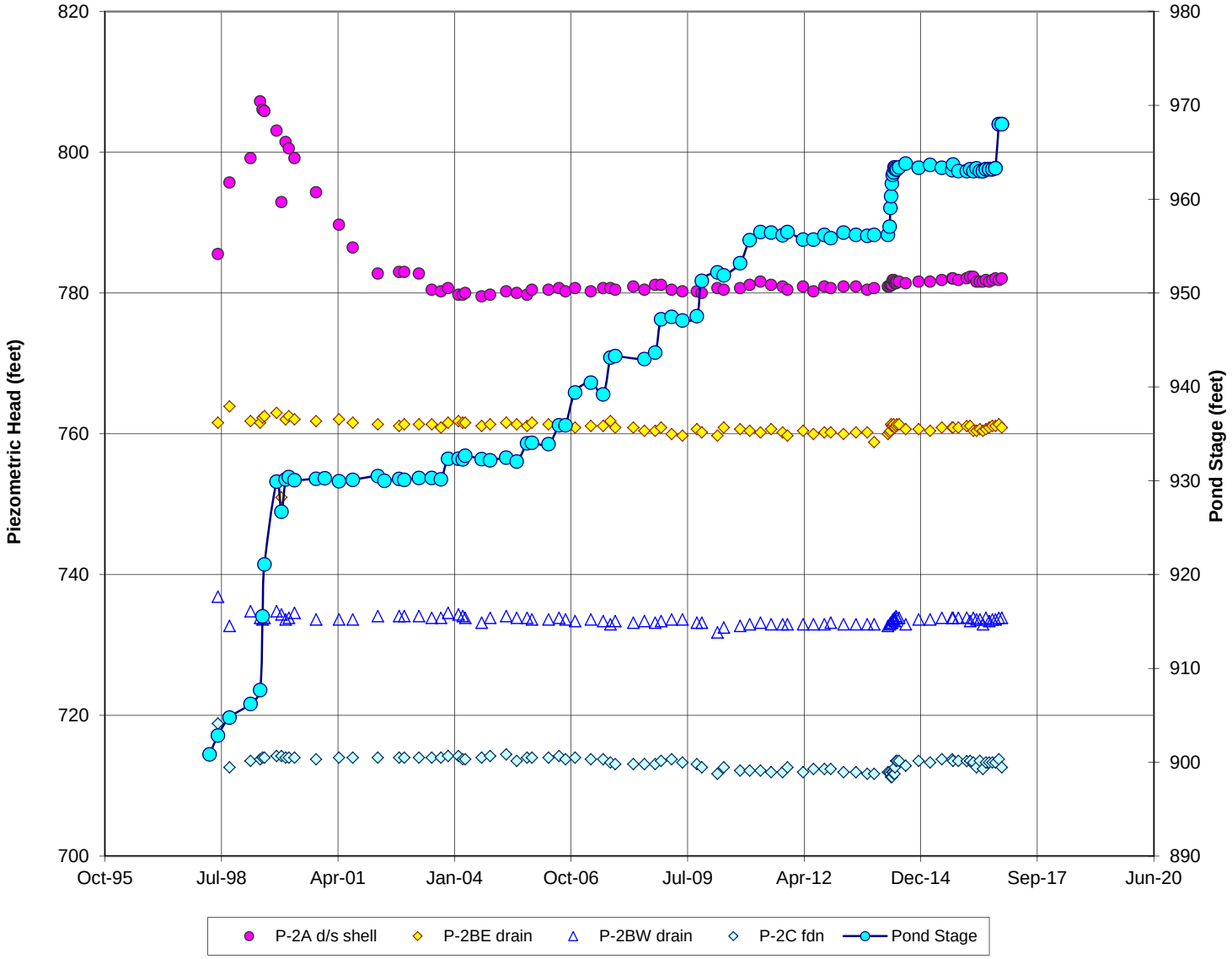


Figure 5i
Cardinal FAD 2
Centerline of Dam
Cluustered Piezometer Site

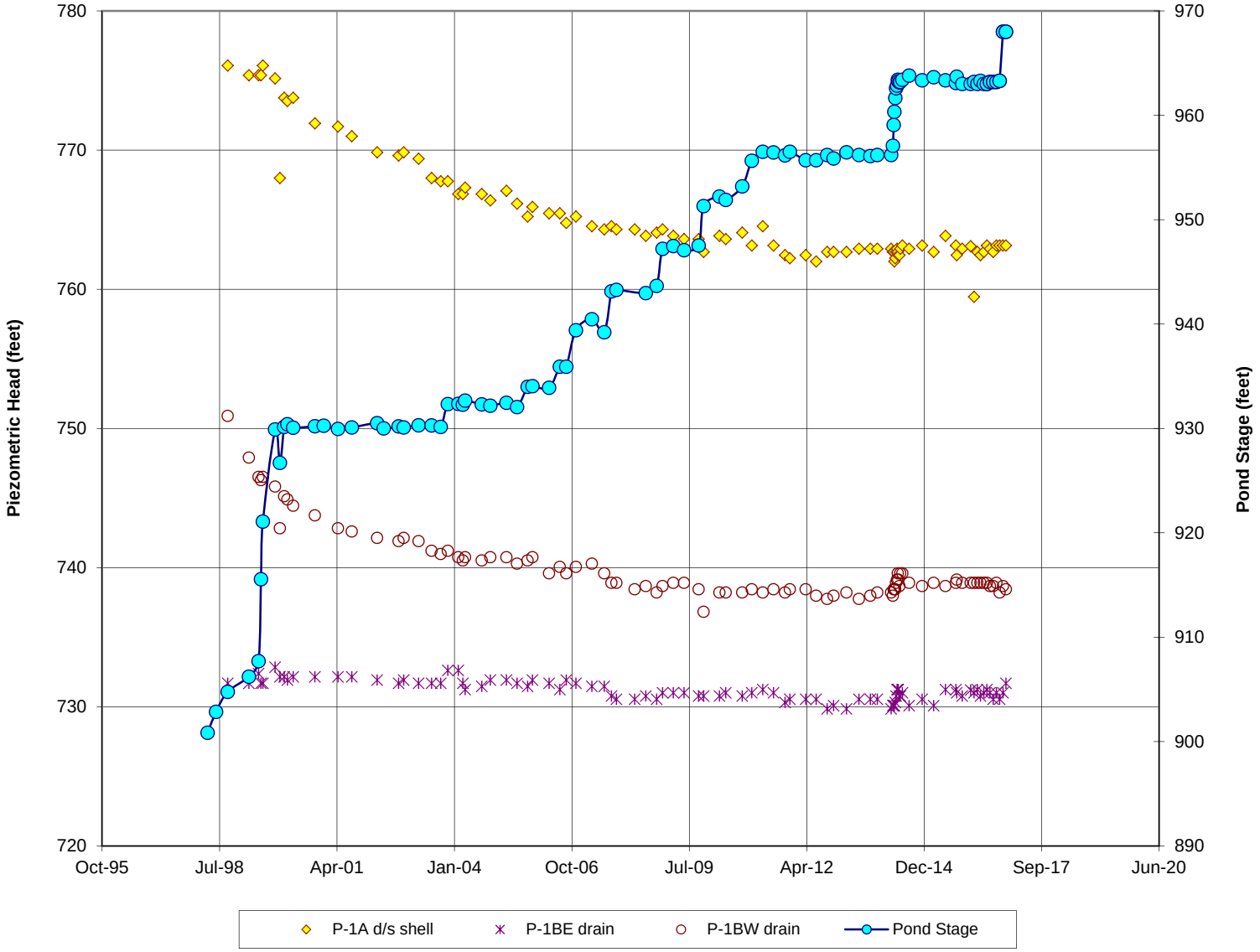


Figure 5j
Cardinal FAD 2
Centerline of Dam
Drain Piezometers

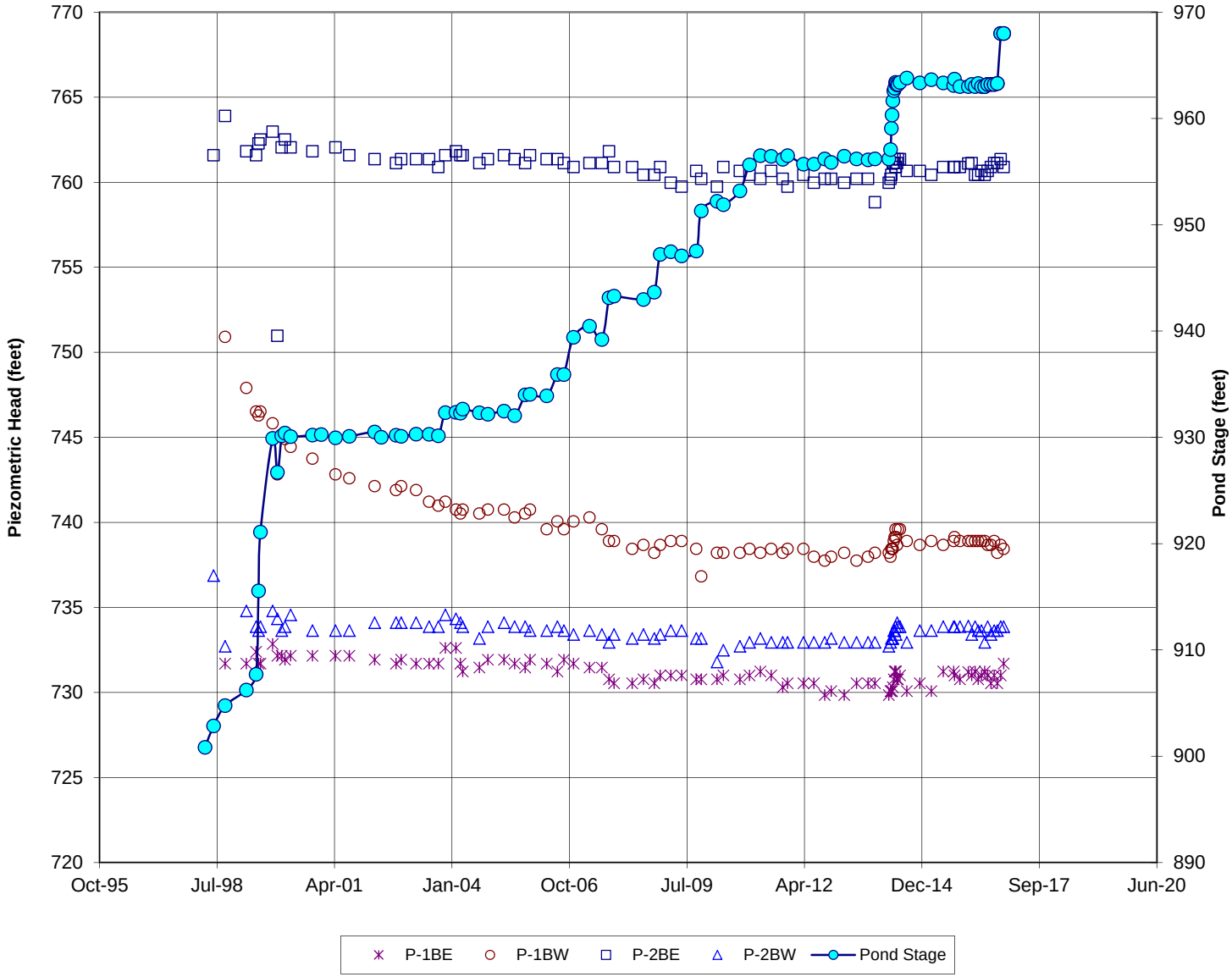


Figure 5k
Cardinal FAD 2
Centerline of Dam
Foundation Piezometers

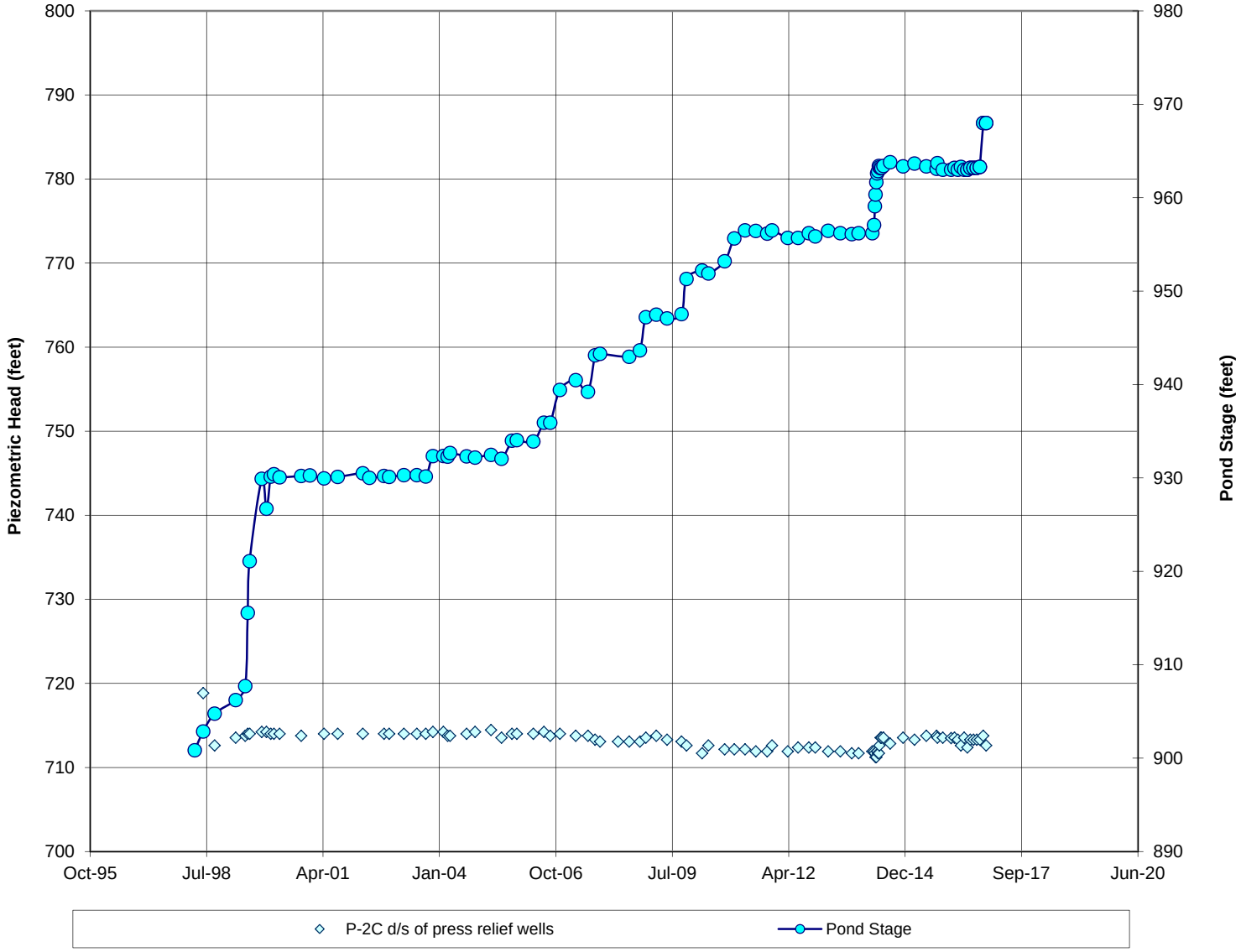


Figure 5l
Cardinal FAD 2
Centerline of Dam
Drain Piezometers & Discharge

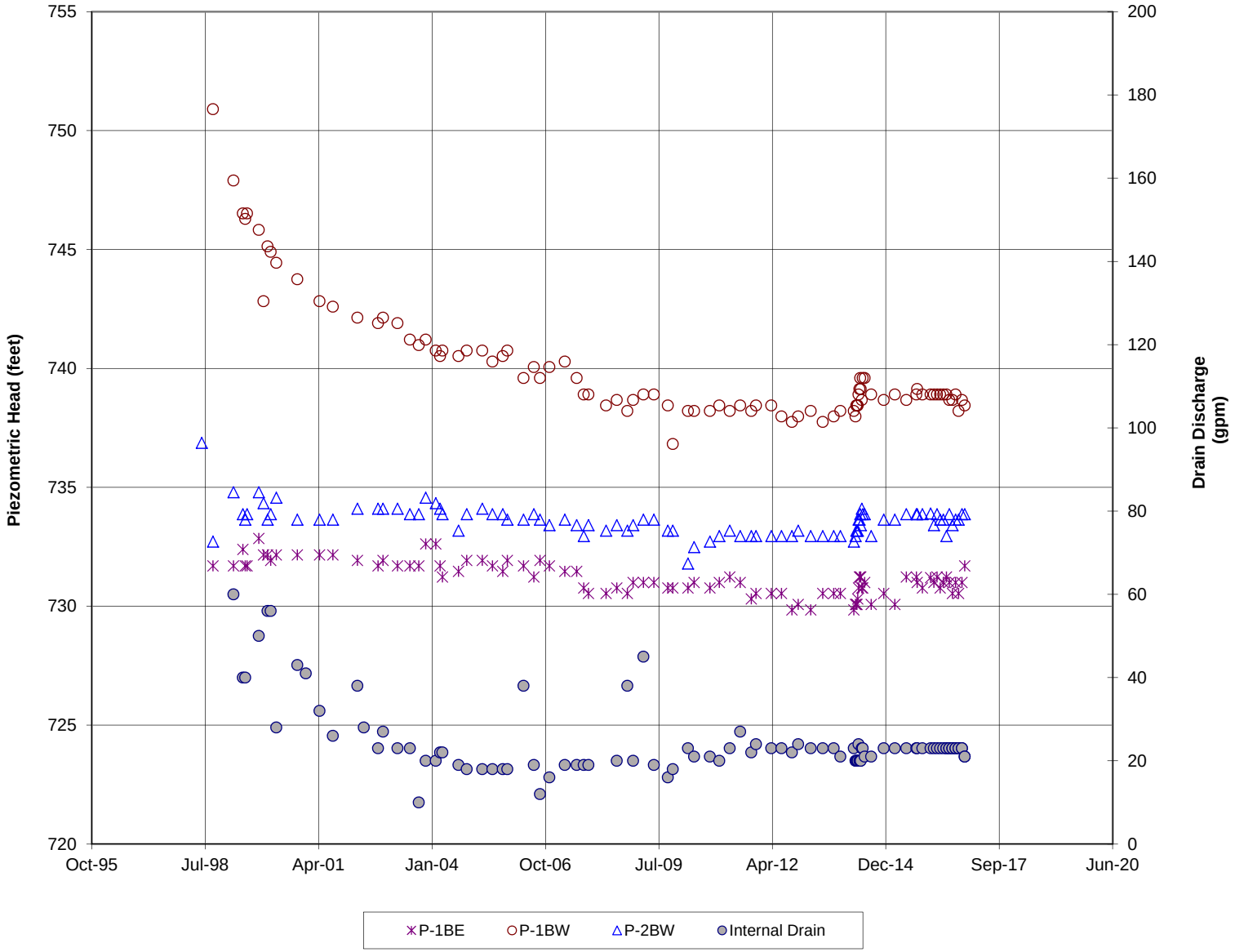


Figure 5m
Cardinal FAD 2
Centerline of Dam
Drain Piezometers & V-Notched Weir Discharge

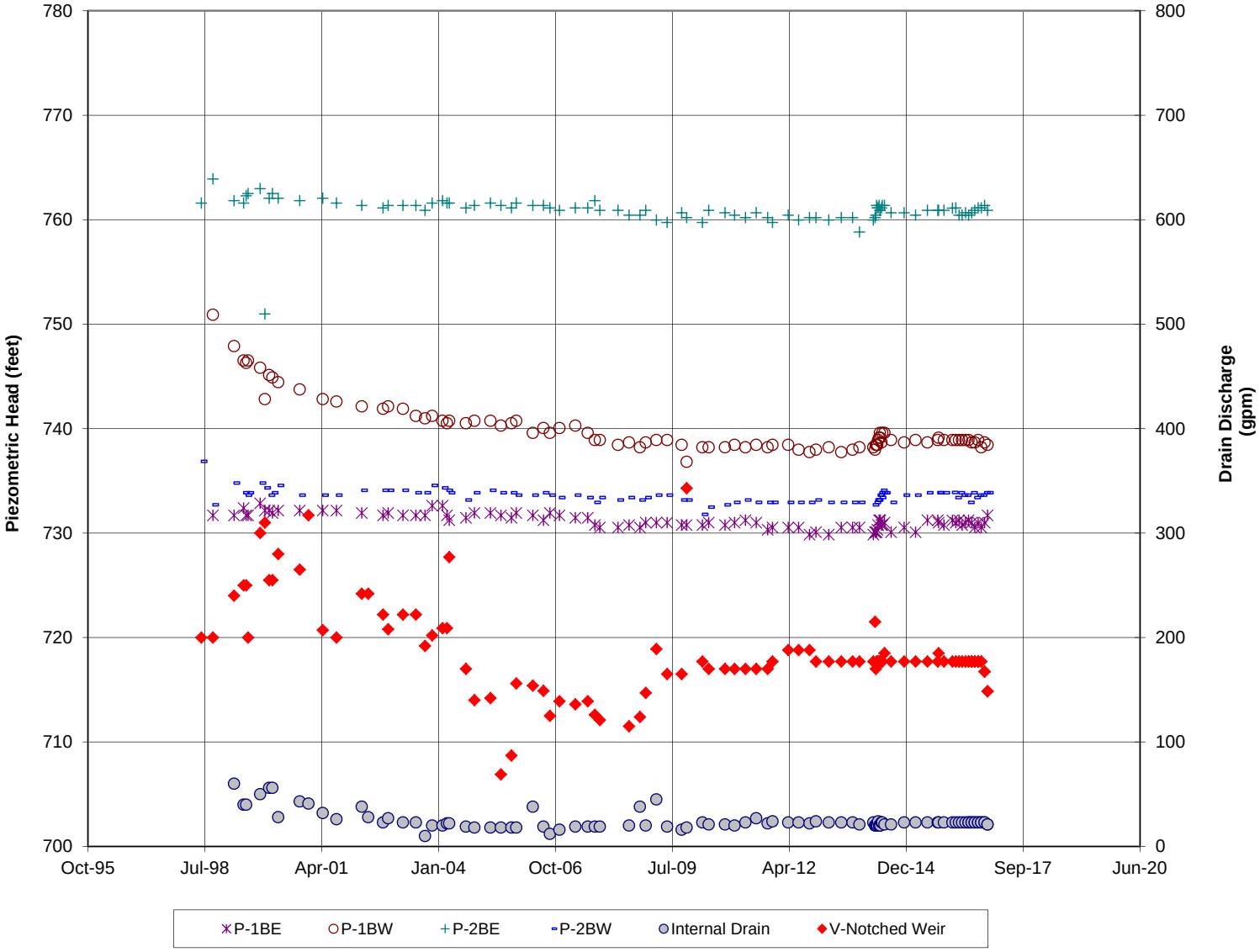


Figure 5n
Cardinal FAD 2
Centerline of Dam
Drain Piezometers & Right Abutment Piezometers

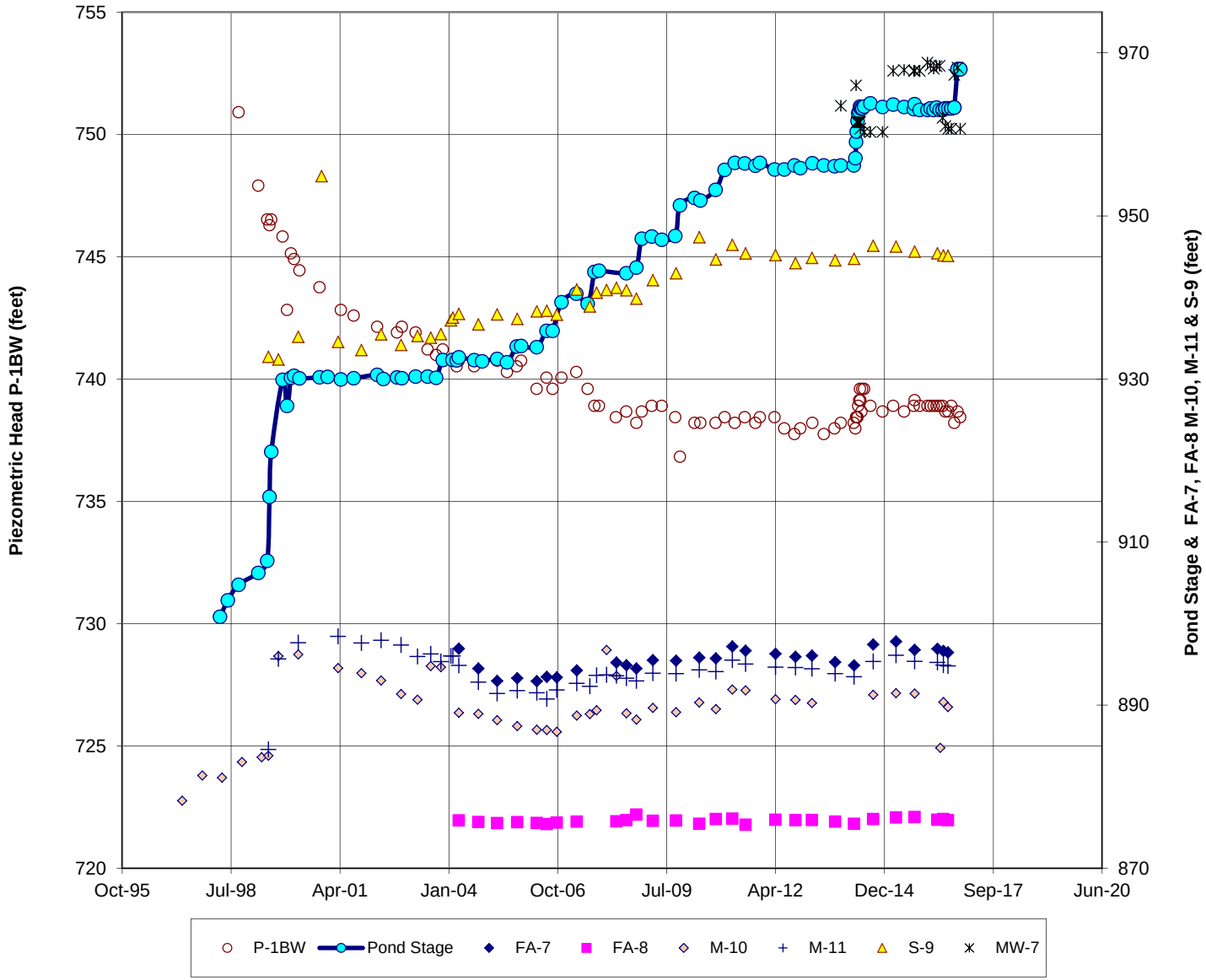


Figure 5o
Cardinal FAD 2
Centerline of Dam
Tiltmeters at MSE Wall Concrete Pannels

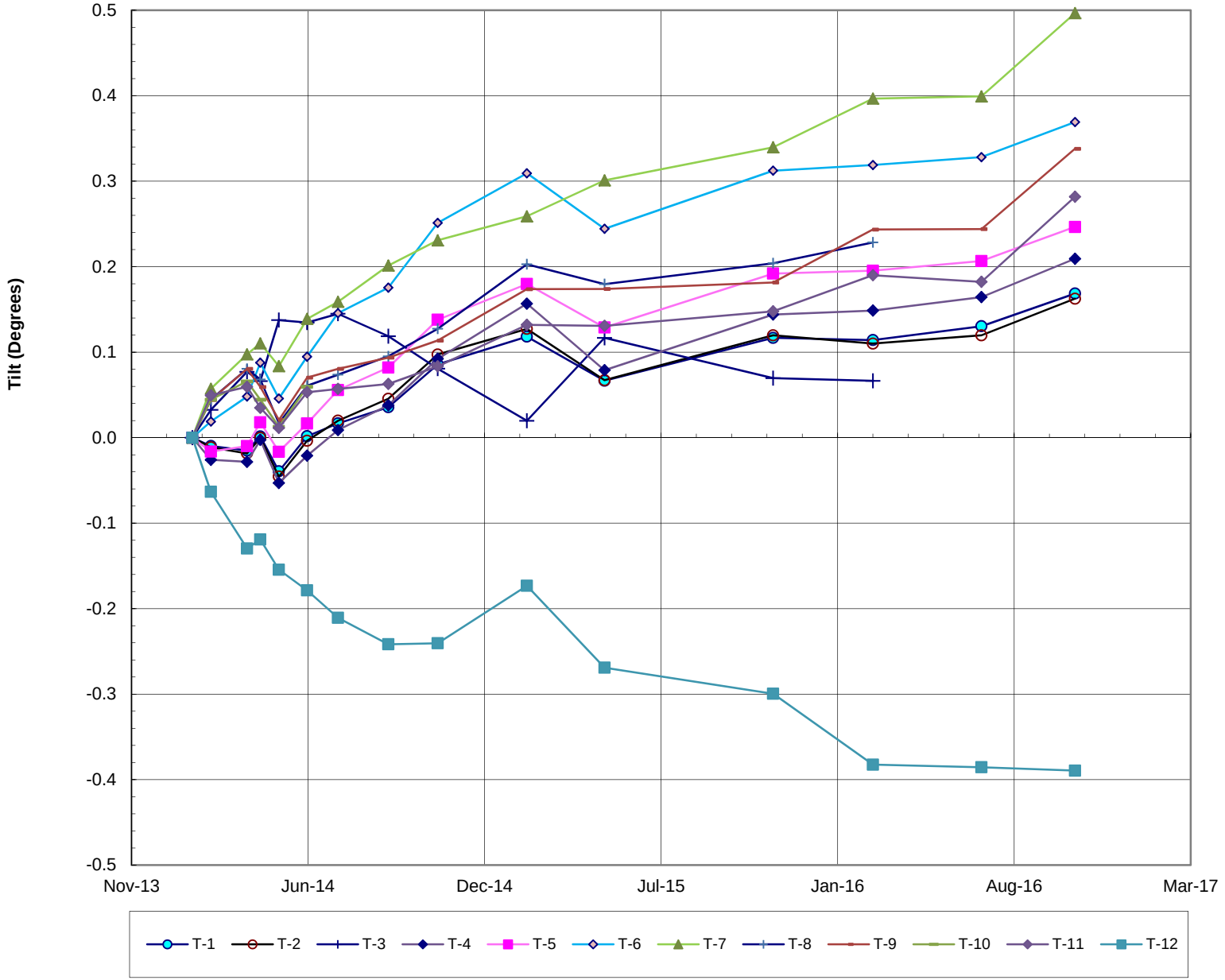
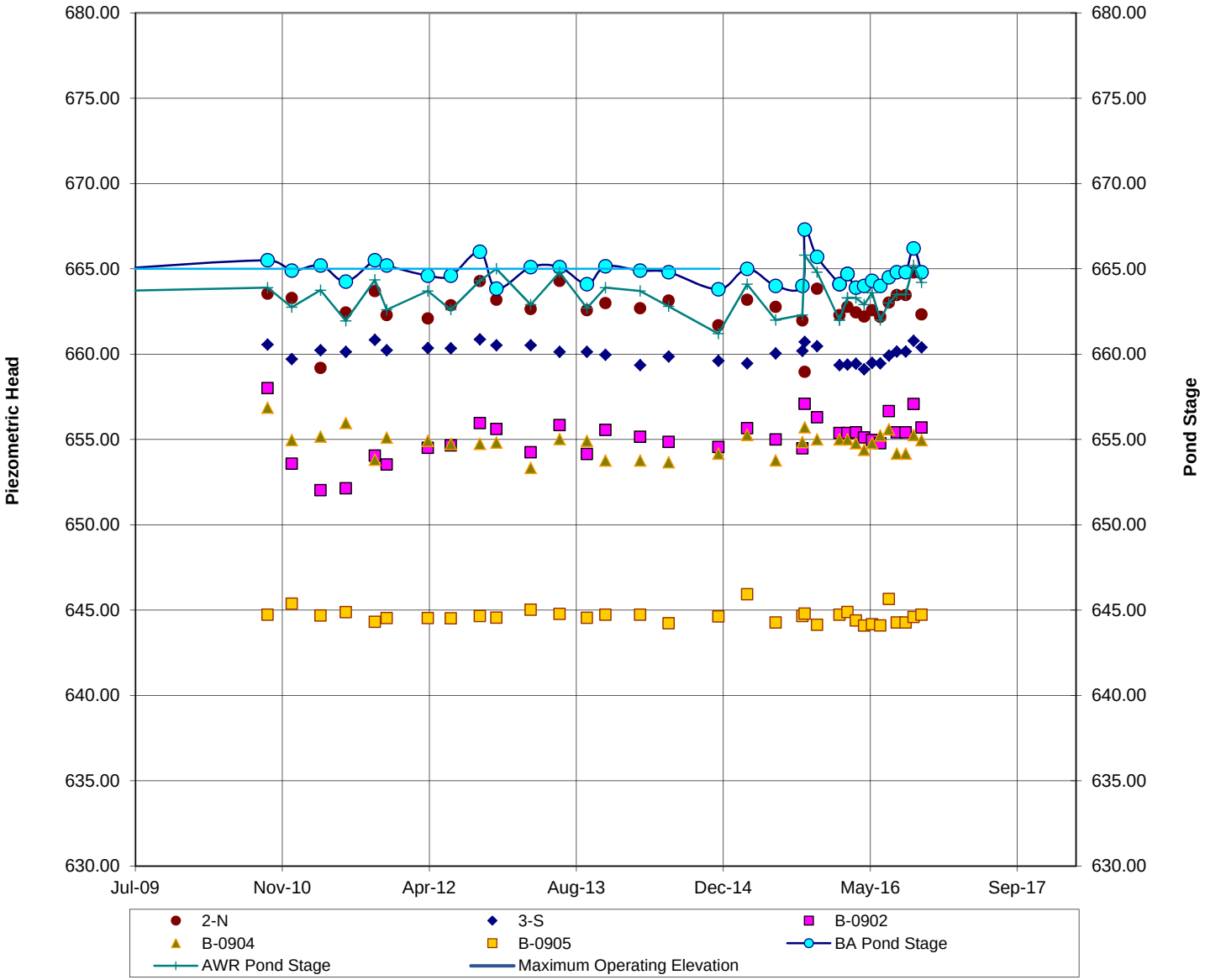
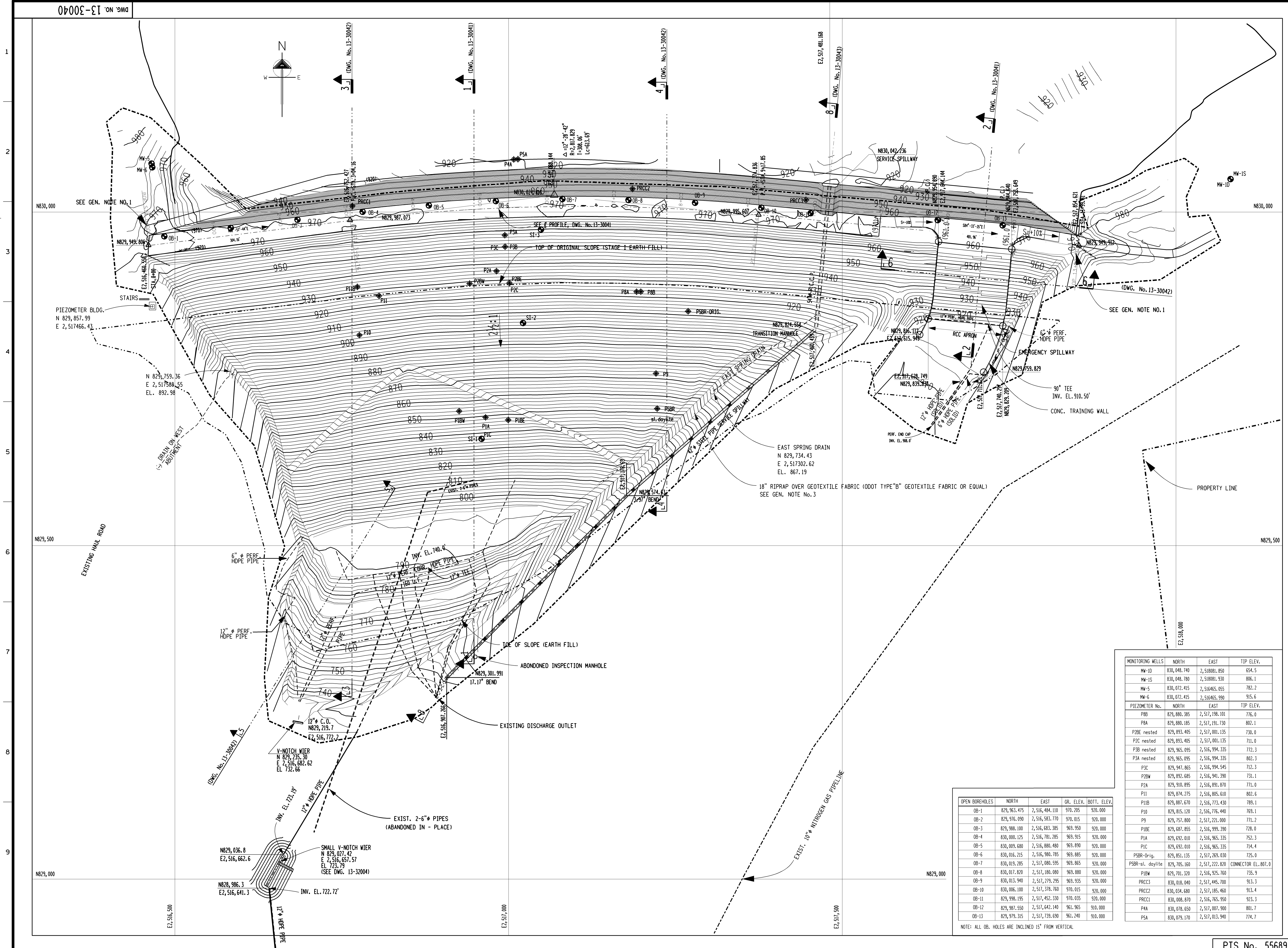


Figure 5p
Bottom Ash Pond Complex
Piezometers & Ponds Stages





MONITORING WELLS	NORTH	EAST	TIP ELEV.
MW-1D	830,048.740	2,518081.850	654.5
MW-1S	830,048.780	2,518081.930	806.1
MW-5	830,072.415	2,516465.055	782.2
MW-6	830,072.415	2,516465.990	915.6
PIEZOMETER No.	**NORTH**	**EAST**	**TIP ELEV.**
P8B	829,880.385	2,517,198.101	776.0
P8A	829,880.185	2,517,191.730	802.1
P2BE nested	829,893.405	2,517,001.135	730.0
P2C nested	829,893.405	2,517,001.135	711.0
P3B nested	829,965.095	2,516,994.335	772.3
P3A nested	829,965.095	2,516,994.335	802.3
P3C	829,947.865	2,516,994.545	712.3
P2BW	829,892.685	2,516,941.390	731.1
P2A	829,910.895	2,516,891.870	771.0
P11	829,874.275	2,516,805.610	802.6
P11B	829,887.670	2,516,773.430	789.1
P10	829,815.120	2,516,776.440	769.1
P9	829,757.800	2,517,221.000	771.2
P1BE	829,687.855	2,516,999.390	728.0
P1A	829,692.010	2,516,965.335	752.3
P1C	829,692.010	2,516,965.335	714.4
P5BR-Orig.	829,851.135	2,517,269.030	725.0
P5BR-sl. daylite	829,705.160	2,517,222.820	CONNECTOR EL.807.0
P1BW	829,701.320	2,516,925.760	735.9
PRCC3	830,018.040	2,517,445.700	913.3
PRCC2	830,034.680	2,517,185.460	913.4
PRCC1	830,008.870	2,516,765.950	923.3
P4A	830,078.650	2,517,007.900	801.7
P5A	830,079.170	2,517,013.940	774.7

OPEN BOREHOLES	NORTH	EAST	GR. ELEV.	BOTT. ELEV.
OB-1	829,963.475	2,516,484.110	970.205	920.000
OB-2	829,976.090	2,516,583.770	970.015	920.000
OB-3	829,988.100	2,516,683.385	969.950	920.000
OB-4	830,000.125	2,516,781.285	969.915	920.000
OB-5	830,009.680	2,516,880.480	969.890	920.000
OB-6	830,016.215	2,516,980.785	969.885	920.000
OB-7	830,019.285	2,517,080.595	969.865	920.000
OB-8	830,017.820	2,517,180.080	969.880	920.000
OB-9	830,013.940	2,517,279.295	969.935	920.000
OB-10	830,006.100	2,517,378.760	970.015	920.000
OB-11	829,998.195	2,517,452.330	970.035	920.000
OB-12	829,987.550	2,517,642.140	961.965	910.000
OB-13	829,979.315	2,517,739.690	961.240	910.000

NOTE: ALL OB. HOLES ARE INCLINED 15° FROM VERTICAL

PTS No. 55689

GENERAL NOTES

1.- EXCAVATE ROCK SURFACE TO ACHIEVE A RIGHT ANGLE CONTACT WITH THE RCC.
2.- THE SOIL OVERBURDEN ON BOTH THE RIGHT & LEFT ABUTMENTS SHALL BE STRIPPED. A 2' BOTTOM ASH DRAINAGE BLANKET SHALL BE PROVIDED OVER THE ENTIRE STRIPPED AREA. ANY SEEPAGE ZONES FOUND DURING STRIPPING SHALL BE DRAINED AS NECESSARY BY A FRENCH DRAIN DAYLIGHTING INTO GROIN DITCH.
3.- ADJUST LOCATION OF GROIN DITCH AS REQUIRED TO CLEAR PIPE SUPPORTS.

LEGEND - EXISTING

- SPOT ELEVATION
- INTERMEDIATE CONTOUR
- INDEX CONTOUR
- DEPRESSION CONTOUR
- TREES AND TREELINE
- STRUCTURE AND BUILDING
- FENCE
- POLE
- ROADS
- EDGE OF WATER
- MANHOLES / CATCH BASIN
- POWER POLE
- PIPES
- TOWER

LEGEND - PROPOSED

- +(970.0') FIN. GRADE SPOT ELEV.
- 920 FIN. GRADE CONTOUR
- DRAINAGE DITCH
- INCLINED BORE HOLES
- VERTICAL BORE HOLES
- PIEZOMETER

REFERENCE DRAWINGS

13-30041 - FLY ASH DAM II RAISING PROFILE & SECTION.
13-30042 - FLY ASH DAM II RAISING SECTIONS & DETAILS SHT.1.
13-30043 - FLY ASH DAM II RAISING SECTIONS & DETAILS SHT.2.

DATE	NO.	DESCRIPTION	APPD.
3/31/00	5	REVISED TO REFLECT AS_BUILT CONDITIONS. FINAL SUBMITTAL TO STATE (Amanda Graphics)	BMK
5/21/99	4	AS_BUILT: REVISED TOPO, DRAIN PIPES, ADDED TABLES, PIEZOMETERS AND OPEN BORE HOLES. REMOVED MONITORING WELLS 4,3, 2D & 2S (AG)	HJB
6/22/98	3	REMOVED INTERMEDIATE CONTOURS. INDICATED CONCRETE TRAINING WALL & GEOTEXTILE FABRIC. (RGD)	HJB
5/20/98	2	DELETED DROP MANHOLE & REV. PIPE ALIGNMENT. (RGD)	HJB
4/23/98	1	REV. TOE OF DAM TO REFLECT SLIDE REPAIR. RELOCATED DROP MANHOLE & REV. PIPE BEND, 6°30' WAS 6°. ADDED UNDERDRAIN SYSTEM. (RGD)	HJB
4/21/97	0	ISSUED FOR CONSTRUCTION.	HJB

REVISIONS

s:/cd/13/geo_hydro_site/30040.dgn

CARDINAL OPERATING COMPANY
CARDINAL PLANT
BRILLIANT OHIO

FLY ASH DAM II RAISING GRADING & DRAINAGE PLAN

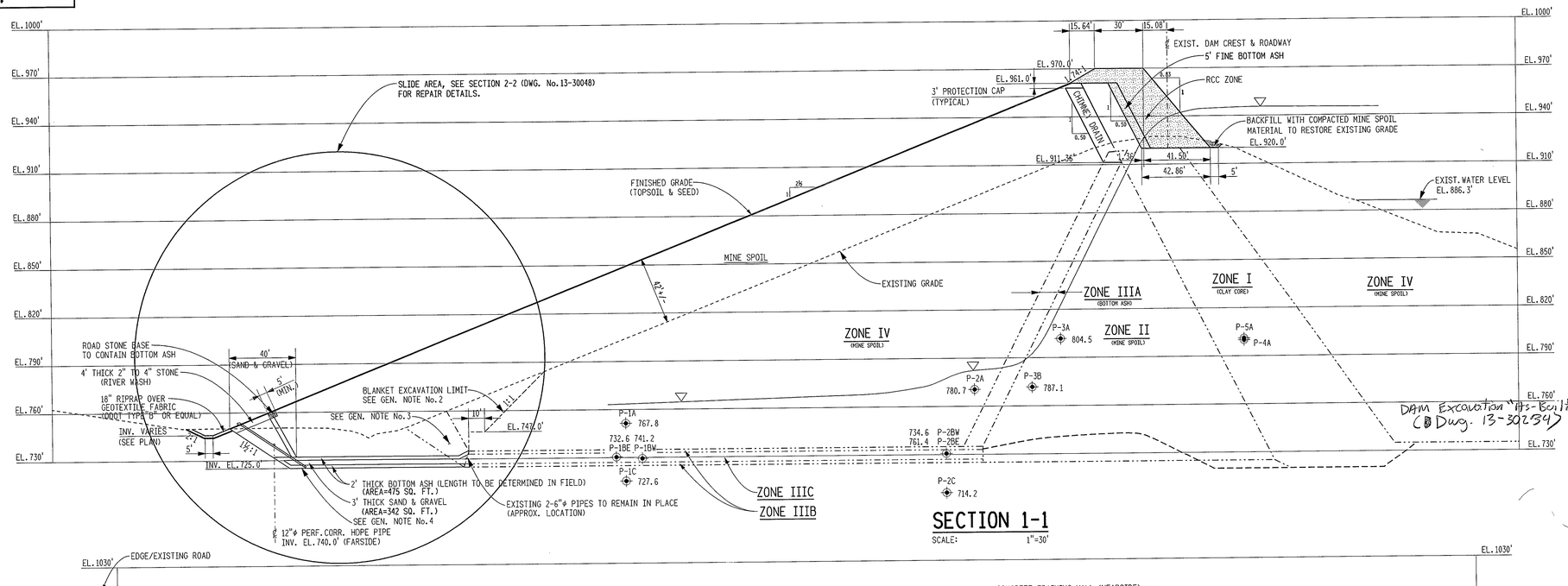
DWG. NO. 13-30040-5

SCALE: 1"=50'
CIVIL ENGINEERING DIVISION
DR: RGD
CH: GJZ
ENGR. HJB
PROJ. ENGR.
DATE: 4/21/97
APPROVED BY H. Joseph Buhac

AMERICAN ELECTRIC POWER
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

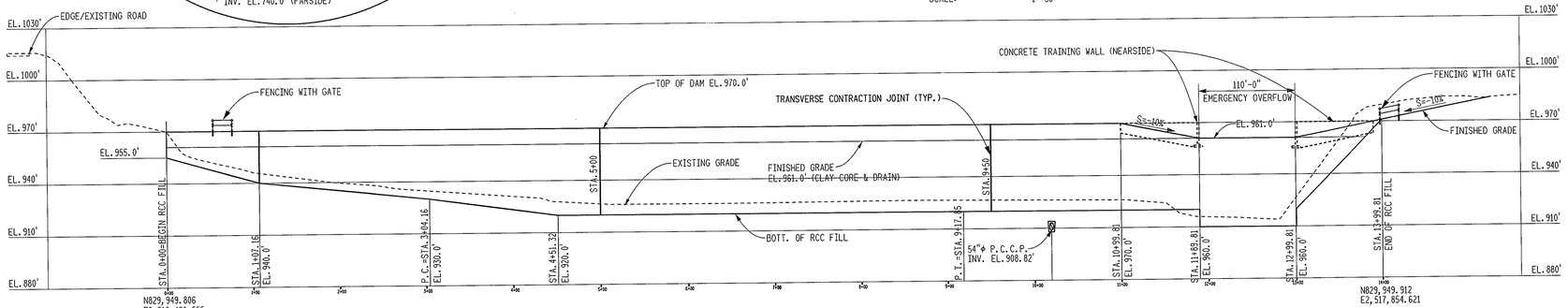
SYSTEM DATE-26 JAN 2005
SYSTEM TIME-14:08:29
15th FLR 0465

DWG. NO. 13-30041



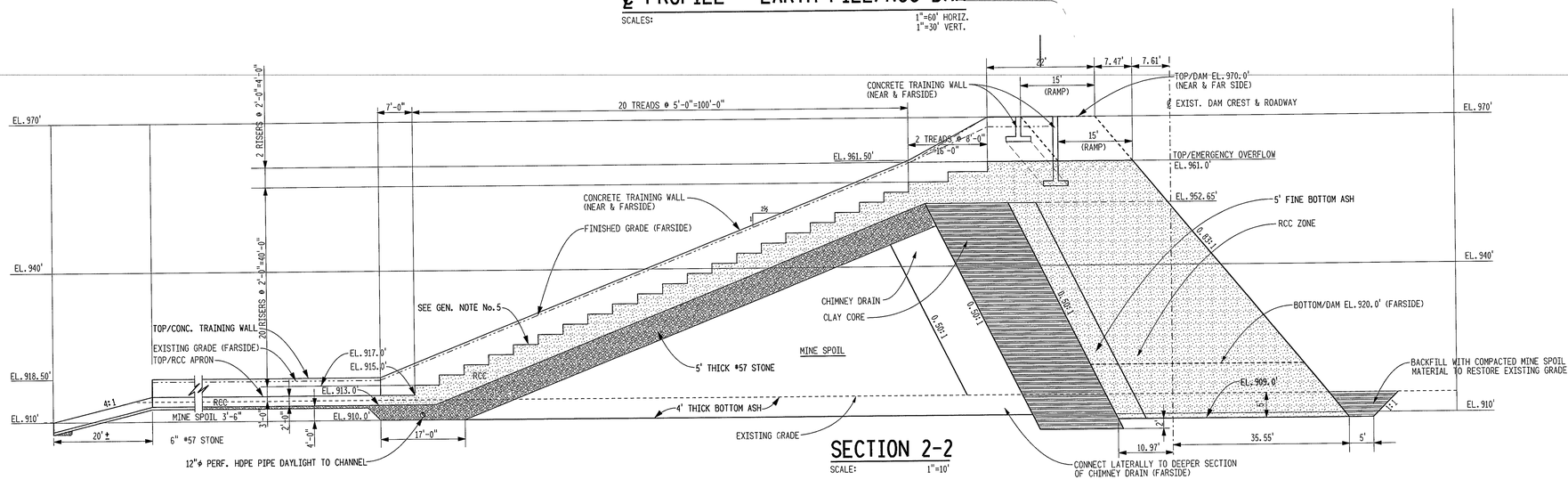
SECTION 1-1

SCALE: 1"=30'



℄ PROFILE - EARTH FILL/RCC DAM

SCALES: 1"=60' HORIZ. 1"=30' VERT.



SECTION 2-2

SCALE: 1"=10'

GENERAL NOTES

1. - FOR SECTIONS LOCATION, SEE DWG. No.13-30040.
2. - LIMIT WIDTH OF EXCAVATION SECTIONS ALONG THE TOE OF THE DAM TO 20 FEET. PROVIDE SOIL SUPPORT AS REQUIRED.
3. - REMOVE EXISTING 12"ϕ PIPE. STOCKPILE REMOVED SAND & GRAVEL MATERIAL AND RE-USE ONLY A CLEAN PORTION OF MATERIAL TO EXTEND DRAINAGE BLANKET.
4. - REMOVE SOIL OVERBURDEN & CLEAN THE SURFACE OF THE ROCK.
5. - SEAL JOINTS BETWEEN RCC AND TRAINING WALL WITH JOINT FILLER.

REFERENCE DRAWINGS

13-30040 - FLY ASH DAM II RAISING GRADING & DRAINAGE PLAN.

DATE	NO.	DESCRIPTION	APPD.
	6	REVISED TO SHOW INSTALLATION DEPTH OF PNEUMATIC PIEZOMETER. AND DAM "AS-BUILT" EXCAVATION GRADES.	
3/2000	5	REVISED TO REFLECT AS-BUILT CONDITIONS. FINAL SUBMITTAL TO STATE	AMK
5/1999	4	AS-BUILT: REVISED TOE AREA OF SECTION 2-2	AMK
6/23/98	3	EXTENDED CONC. TRAINING WALL REMOVED HIGHER & LOWER RCC STRENGTH FACING & ZONE, ADDED GEN. NOTE No.5. 2' DIM ON SECT."2-2" WAS 5'.	AMK
5/20/98	2	REV. SECT.2-2. INDICATED RCC APRON & BOTTOM ASH BLANKET DRAIN THICKNESS.	AMK
4/23/98	1	REV. SECT.1-1, SECT.2-2 & ℄ PROFILE.	AMK
4/2/97	0	ISSUED FOR CONSTRUCTION.	AMK

REVISIONS

s:/cd/13/geo_hydro_site/30041.dgn

CARDINAL OPERATING COMPANY

CARDINAL PLANT

BRILLIANT OHIO

FLY ASH DAM II RAISING PROFILE & SECTIONS

DWG. NO. 13-30041-6

SCALE: AS NOTED

DR: Amanda Gephart

CHI:

ENGR.

PROJ. ENGR.

DATE:

APPROVED BY

CIVIL ENGINEERING DIVISION

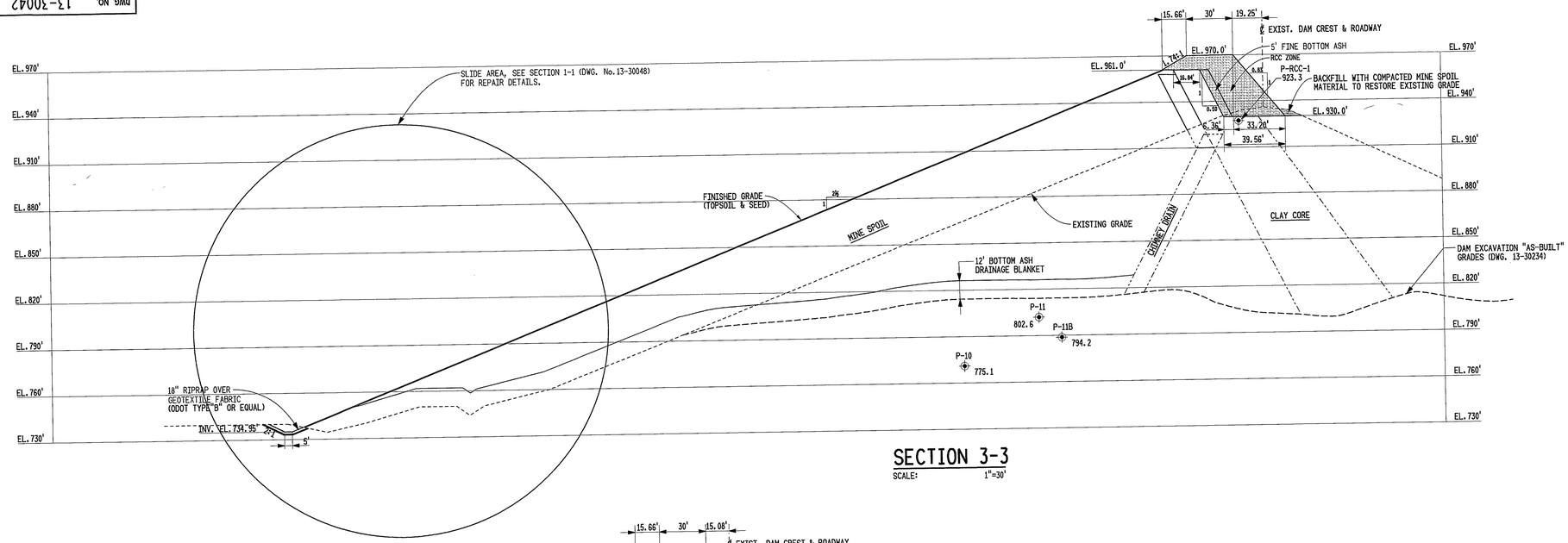
AEP AMERICAN ELECTRIC POWER

1 RIVERSIDE PLAZA COLUMBUS, OH 43215

PTS No. 55689

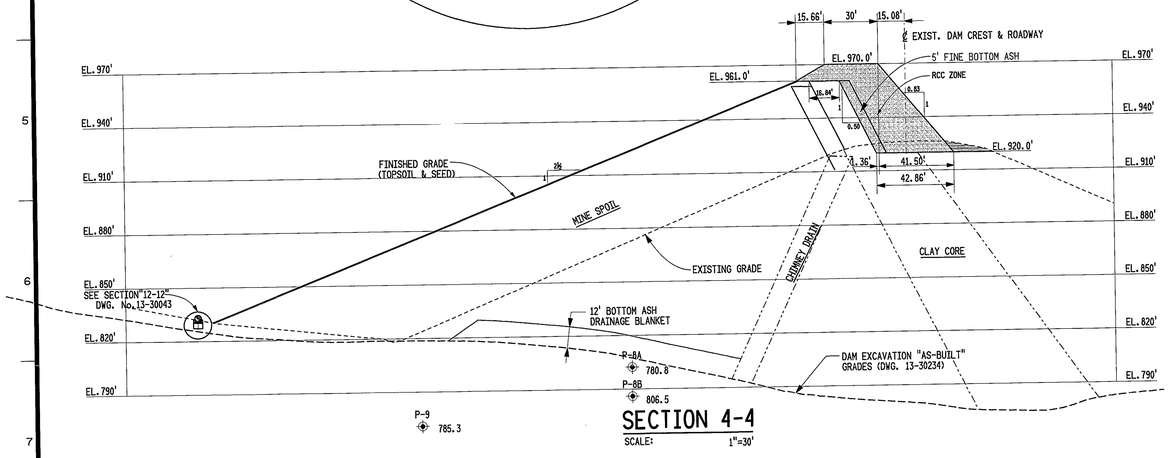
SYSTEM DATE-17 MAY 2004
SYSTEM TIME-09:40:56
15th FLR.-CED

DWG. NO. 13-30042



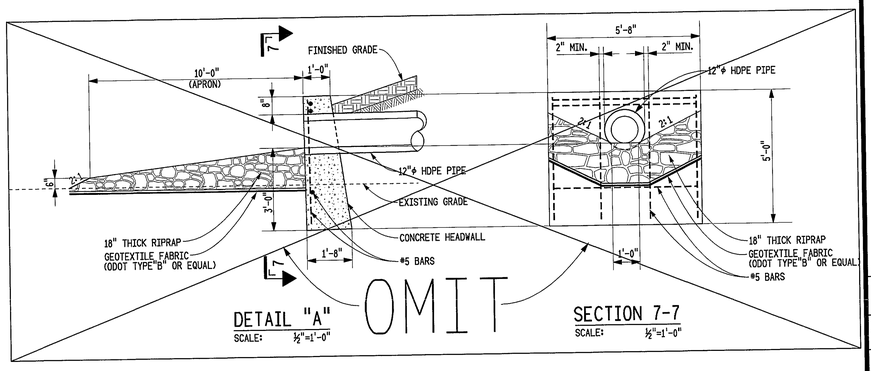
SECTION 3-3

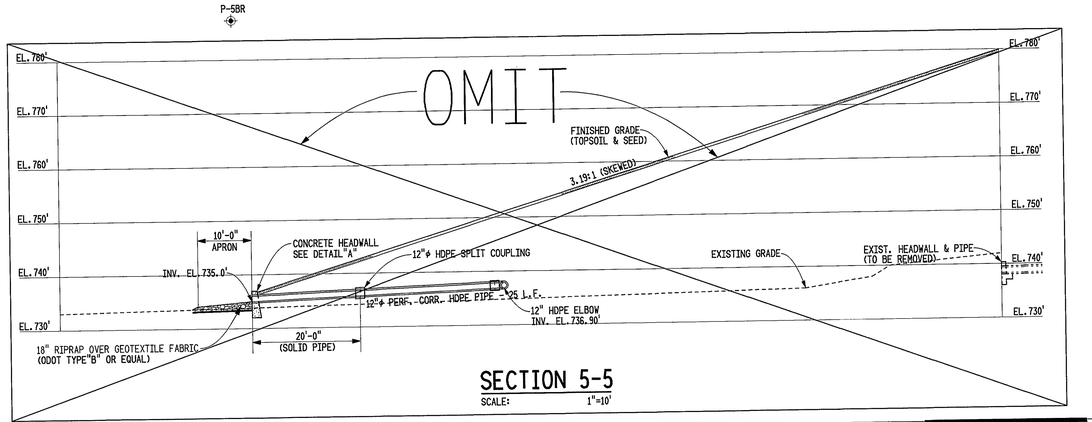
SCALE: 1"=30'



SECTION 4-4

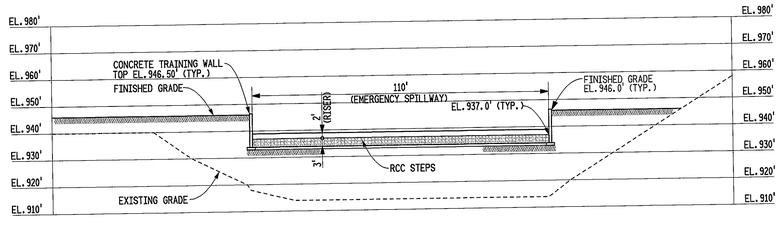
SCALE: 1"=30'





SECTION 5-5

SCALE: 1"=10'



SECTION 6-6

SCALE: 1"=20'

GENERAL NOTES

1.- FOR SECTIONS LOCATION, SEE DWG. No. 13-30040.

REFERENCE DRAWINGS

13-30040 - FLY ASH DAM II RAISING GRADING & DRAINAGE PLAN.

DATE	NO.	DESCRIPTION	APP'D
4/23/98	4	REVISED TO SHOW INSTALLATION DEPTH OF PNEUMATIC PIEZOMETER, AND DAM "AS-BUILT" EXCAVATION GRADES.	
3/2000	3	REVISED TO REFLECT AS-BUILT CONDITIONS. FINAL SUBMITTAL TO STATE.	BMK
4/22/98	2	REMOVED HIGHER & LOWER RCC FACING & ZONE.	MJB
4/23/98	1	REV. SECTS. "3-3" & "4-4" OMITTED SECT. "5-5", "7-7" AND DETAIL "A".	MJB
4/2/97	0	ISSUED FOR CONSTRUCTION.	MJB

REVISIONS

s:/cd/13/geo_hydro_site/30042.dgn

CARDINAL OPERATING COMPANY

CARDINAL PLANT

BRILLIANT OHIO

FLY ASH DAM II RAISING SECTIONS & DETAILS SHT.1

DWG. NO. 13-30042-4

SCALE: AS NOTED | CIVIL ENGINEERING DIVISION

ORI: Arnold Gryboski
CHI:
ENGR.:
PROJ. ENGR.:
DATE:
APPROVED BY:

AEP AMERICAN ELECTRIC POWER — 1 RIVERSIDE PLAZA COLUMBUS, OH 43215

PTS No. 55689

IGS1092

SYSTEM DATE: 18 MAY 2004
SYSTEM TIME: 09:34:21
ISM: P:\0465