2015 INSPECTION REPORT
FLY ASH DAMS I, II
AND
BOTTOM ASH COMPLEX

CARDINAL PLANT
BRILLIANT, OHIO

GERS-15-027

PREPARED BY
GEOTECHNICAL ENGINEERING
AEP SERVICE CORPORATION
ONE RIVERSIDE PLAZA
COLUMBUS, OHIO

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

GERS-15-027

REVISION 0

CARDINAL PLANT
BRILLIANT, OHIO

INSPECTION DATE **November 12& 19, 2015**

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1.0 INTRODUCTION

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 Fly Ash Dams I, II and the Bottom Ash Complex at the Cardinal plant operated by Cardinal Operating Company.

Mr. Randy Sims, P.E., at the Cardinal Plant, was the project facility contact and accompanied Mr. Mohammad Ajlouni, Geotechnical Engineering throughout the inspection. The site inspection was performed on November 12 and 19, 2015. Weather conditions were good, ranging from cloudy in the morning to partly cloudy in the afternoon. Temperatures reached a high of approximately 65° F. There was precipitation of 0.10 inch in the preceding 7 days prior to the November 19 inspection date.

This report has been prepared by Mr. Mohammad Ajlouni, under the direct supervision of Mr. Gary Zych, P.E., both of AEP's Geotechnical section. The report presents: (i) Summary of Visual Observations; (ii) Assessment of Recent Instrumentation Data; and (iii) Summary of Conclusions and Recommendations. Select photographs identifying typical conditions, problem areas, items that need correction or requiring additional monitoring, have been selected from the inspection field photographic file and provided in the Attachments A, B and C to this report. AEP's Civil Engineering Laboratory also performed a bathymetric survey of the FAR 2 reservoir on September 22, 2015 (Attachment D).

2.0 SUMMARY OF VISUAL OBSERVATIONS

The summary of the visual observations uses terms to describe the general appearance or condition of an observed item, activity or structure. Their meaning is understood as follows:

Good:	A condition or activity that is generally better or slightly better than what is minimally expected or anticipated from a design or maintenance point of view.
Fair or Satisfactory	A condition or activity that generally meets what is minimally expected or anticipated from a design or maintenance point of view.
Poor:	A condition or activity that is generally below what is minimally expected or anticipated from a design or maintenance point of view.
Minor:	A reference to an observed item (e.g., erosion, seepage, vegetation, etc.) where the current maintenance condition is below what is normal or desired, but which is not currently causing concern from a structure safety or stability point of view.
Significant:	A reference to an observed item (e.g. erosion, seepage, vegetation, etc.) where the current maintenance program has neglected to improve the condition. Usually, conditions that have been previously identified in the previous inspections, but have not yet been corrected.
Excessive:	A reference to an observed item (e.g., erosion, seepage, vegetation, etc.) where the current maintenance condition is below or worse than what is normal or desired, and which may have affected the ability of the observer to properly evaluate the structure or particular area being observed or which may be a concern from a structure safety or stability point of view.

2.1 Bottom Ash 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 Bottom Ash Complex is shown in Figure 1.

During the past year, the approximate minimum, maximum, and present depth of the impounded water was approximately 5ft, 10ft, and 7.5ft, respectively (elevation was approximately 663, 665, and 664, respectively).
The approximate minimum, maximum, and present average depth of the impounded bottom ash was approximately 8 ft, 13ft, and 10.5ft (elevation 657, 652, and 654.5).
The storage capacity of the WBAP at the time of the inspection is 324 ac-ft;
The approximate volume of the impounded water at the time of the inspection was 160 ac-ft. The approximate volume of the impounded bottom ash at the time of the inspection was 164 ac-ft.

Results of the visual inspection of the Bottom Ash Complex performed on November 12, 2015 are provided below:

1. The BAP and RCP downstream slope along the Ohio River was well protected with vegetation or riprap as typically shown in Photographs Nos. 1 to 3. The vegetation showed a good established growth and is maintained by mowing every year (Photographs Nos. 1 to 3). 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. 3 to 6.

2. The RCP overflow pipe, concrete and riprap appeared in good condition as shown in Photograph No. 4 to 5. The upstream concrete inlet structure was also in satisfactory condition. The pond water level was well below the invert of the steel weir but was seeping along its basal and side contacts with the concrete structure (Photograph No. 6).

3. The crest and interior slopes of the BAP and the Recirculation Pond were in generally good condition as shown in Photograph Nos. 7, 8, 9, and 15.

4. The BAP discharge structure concrete and steel platform were in good condition, as shown in Photograph No. 10. 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. 11 and 12 show typical exterior slope conditions. The remainder of the BAP west side slope was well protected with bottom ash and slag.

6. Photograph Nos. 10 and 13 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. 14 and 15).

8. The contractor constructed a bridge across the bottom ash pond channel to continue reclamation of the bottom ash from the pond (Photo No.16). The bottom ash sluice lines were generally clear allowing for unobstructed flow into the pond (Photo No.17).

9. Three seepage areas with minimal flow were found along the downstream of the eastern dike during quarterly inspections and persisted through this annual inspection. Piezometers are being installed to determine the source of the seeping water and to provide a fix (Photos No.52 through 56).

In general, the Bottom Ash- Recirculating Pond Complex was observed to be in good condition with no visible evidence of misalignment, significant rutting, erosion or settlement (Photo No.18).

2.2 Fly Ash Dam II

The last raising of FAD2 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 FAD2 incorporated a 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 FAD2 are provided in Figure 3A. A general cross section of FAD2 showing the final dam raising is presented in Figure 3B.

During the past year, the approximate minimum, maximum, and present depth of the impounded water was approximately 10ft, 12ft, and 11ft, respectively (water pool elevation was approximately 963).
The approximate minimum, maximum, and present average depth of the impounded fly ash was approximately 61ft, 63ft, and 62ft, respectively (elevation was approximately 953, 951, and 952, respectively).
The storage capacity of the FAR 2 at the time of the inspection is 3068 ac-ft;
The approximate volume of the impounded water at the time of the inspection was 1800 ac-ft. The approximate volume of the impounded fly ash at the time of the inspection was 9000 ac-ft.

Results of the visual inspection of FAD 2 performed on November 19, 2015 are provided below:

1. Photographs Nos. 19 & 20 shows the overall view of the FAD2 as taken from the FAD2 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. 21-25. 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. 26 and 27).

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. 28).

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. 29. 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. 30& 31. 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 in generally good condition.

9. Right abutment seepage is collected and measured from the open weir chimney/toe drain drainage blanket (Drain No. 1). Vegetation has 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 33 to 36).

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 need to be eliminated using spry chemicals (Photograph No. 37).

11. The energy dissipator structure and downstream channel appeared to be in good condition (Photograph Nos. 38).

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. Soil slumping above the dam's flume monitoring station appears stable with no additional movement. No remedial action is recommended other than to visually monitor the slip area.

14. 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. 39 and 40). The seepage rate from the spring is estimated to be less than 75 gpm shown in Photo No. 40.

15. Seepage along the right abutment at slightly higher elevation started in fall 2013 and was fixed with an installation of inverted filter (Photograph No. 32). Visually clear seepage flow rate was ~0.6 gpm.

16. Typical view of the FAR 2 pond looking towards FAR 1 dam crest (Photograph No. 41). The pond stage was 963.4 ft NGVD at the time of the inspection.

17. The discharge lines sluicing ash at their discharge point into the pond was also inspected and was observed to be in excellent condition. Note that the lines were cut at a higher elevation because of the rise of the FAR 2 water level (Photograph No. 42).

18. 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. 43).

19. Additional stop logs are available for the future raising of the water level at FAR 2 pond. (Photo No. 44).

20. Partial view of the upstream slope of the FAR 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. 45). The pump is operated by Quality Environmental Services to deliver make up water (estimated to be 700 gpm) to the coal preparation plant located in the headwaters of Blockhouse Run's western branch and operated by Ohio American Energy, Inc. The water is used by OAE to slurry their coal fines to an impoundment located in Riddles Run.

2.3 Fly Ash Dam I

Cardinal Fly Ash Dam I (FAD1) 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 FAD1 reached its maximum allowed level Cardinal Fly Ash Dam II (FAD2) was constructed and began operation in the late 1980's. Fly Ash Dam I reservoir 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 will capture sulfur dioxide emissions (Figure 2).

Results of the visual inspection of the FAD1 performed on November 19, 2015 are provided below:

1. An engineering evaluation of the former impoundment indicated that it could be utilized as a landfill for the dry disposal of synthetic gypsum produced as a by-product of the air pollution control equipment installed at the Cardinal Plant. The site was subsequently permitted for construction by the Ohio EPA on May 11, 2007 (PTI # 06-07993). As part of the landfill design, the entire surface of the former impoundment will be covered with a low permeability soil.

2. The downstream slope of FAR 1 was well protected with rockfill. Increase in vegetative growth was noticed (Photo Nos. 47 and 48). No significant erosion or slumping was observed.

3. Typical view of the FAR 1 emergency spillway showing minor vegetative growth (Photograph No. 47). 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).

3.0 ASSESSMENT OF RECENT INSTRUMENTATION DATA

3.1 Pond and Reservoir Water Levels

Pond and reservoir water levels were measured during this and previous inspections and are summarized below. The FAR 2 pool stage continues to increase incrementally (to its operating design level of 960 ft NGVD) as additional stop logs are added to provide storage for the retention and settlement of fly ash sluiced to the reservoir. In 2014, the last group of stop logs was added to reach the 1997 design elevation. In addition, the raised overflow structure base beam with top elevation of 962 caused water level elevation to reach 963.0.

Pond or Reservoir Name	Pond or Reservoir Water Elevations, Ft.					
	9/29/10	11/8/11	11/15/12	11/21/13	6/16/14	11/19/15
FAD1 Reservoir	Closed	Closed	Closed	Closed	Closed	Closed
FAD2 Reservoir	953.19	956.50	955.86	956.2	963.4	963.0
Recirculation Pond	663.90	662.60	663.84	663.9	662.8	664.5
Bottom Ash Pond	665.50	665.20	665.00	665.15	664.8	665.7

3.2 Fly Ash Dam II

Piezometers

A total of nineteen (19) pneumatic piezometers 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 F to this report.

- A composite of all the hydrographs (Figure 5a). All piezometer showed an increase in the measured porewater pressure as a result of the pond level raise took place in April 2014. 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 an increase corresponding to raise in pond stage that took place in April 2014 (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 5g, 5h & 5i). Piezometer P-3B is showing some decrease in water level despite the increase in FAR 2's pool level except for the most recent rise. Water levels in the downstream shell (P-1A) and drain (P-1BW) showed an increase corresponding to raise in pond stage took place in April 2014 (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 an increase corresponding to raise in pond stage took place in April 2014 (Figure 5j).
- 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 – a zone noted for seepage in the FAR 1 inspection reports). 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 a instant 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 dam 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 2010 (Figure 5n). It is expected that S-9 will continue to decrease because of more deposition of fly ash around the abutment area has. 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 920 ft NGVD. No measurements were taken for the S-9 monitoring wells after the 2014 Pool stage raising.
- 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 higher than the FAR II pool elevation.

In general, the Piezometric Head elevations plots indicate that the static water levels for all piezometers are showing an increase corresponding to raise in pond stage took place in April 2014. The ratio of increase in water pressure to the increase of the pond level pressure range from 5% to 19% for all piezometers except the clay core piezometer P-5A which recorded a ratio of 83% (compared to a ratio of 86% during 1998 pond raising for the same piezometer).

Vertical and Horizontal Deformation Monuments

The last AEP Civil Laboratory's Deformation Review Survey Report was prepared on May 7, 2014 for vertical and horizontal deformation monuments for FAD2. Starting October 19, a monthly basis A brief discussion of the data is provided below.

Top of dam monuments for 33 (i.e. 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 were 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. 299036 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 (Figure 6a). 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 22, 2015. These surveys show no usual 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 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	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.	0.5ft	from Aug 10 to Sept 11
October 22, 2013	908.4	-0.4 ft	from Sept 12 to Oct 13
September 3, 2014	918.4	10 ft	from Oct 13 to Sept 14
September 22, 2015	927.4	9 ft	from Sept 14 to Oct 15

Attachment D contains the most recent bathymetric survey. Fly ash deposition within the original (March 2004) mapped depression has increased over the last two years as a result of the slucing ash close to the Dam's right abutment (Figure 7). 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 been steady around 175-185 since the fall of 2009 high measurement of 343 gpm.

3.3 Fly Ash Dam I

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).

3.4 Bottom Ash Complex

Piezometers
Piezometers No. 2-N and No.3-S remain active at the Bottom Ash Complex and have been supplemented with 3 additional piezometers. Water level elevations were measured on November 11, 2015.

Piezometer No. 2-N indicated a water level elevation of 663.85 ft for a head differential of 1.85 feet with the bottom ash pond. Piezometer No.3-S indicated a water elevation of 660.59 ft for a head differential of 3.21 ft with the recirculation pond. Piezometers No. B-0902 and B-0904 indicate a water level elevation of 656.7 and 654.93 ft, respectively, and piezometer No. B-0905 indicates a water level elevation of 644.4 ft.

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

4.0 SUMMARY OF CONCLUSIONS

Based on the visual inspection, the general conditions of Fly Ash Dams I and II and the Bottom Ash Complex are good. Maintenance, inspection and monitoring activities are being performed in a timely manner and should continue on the same schedule. An item summary of the conclusions is presented below.

4.1 Bottom Ash Complex

1. The downstream slopes of the BAP and RCP appeared stable and generally in good condition.

2. The upstream slopes of the BAP and RCP were in excellent condition.

3. The crests of dike roads continue to be in excellent condition with no visible evidence of dike misalignment, significant rutting or settlement.
4. Three new locations of minimal seepage along the central part of the downstream slope of the eastern dike were observed.

4.2 Fly Ash Dam II

1. The dam generally appeared to be in good condition with no upstream or downstream slope areas containing significant erosion gullies, animal holes, cracking or areas of slope instability.

2. Observations have revealed that vegetation control and maintenance has been kept on schedule and is generally good. Cardinal Plant should continue to monitor the vegetation growth and enhance any poor growth areas with additional soil, fertilizer and seeding as needed.

3. The reservoirs decant discharge structure, downstream pipe, portal and energy dissipater all appeared in excellent condition.

4. The left and right downstream groin areas appeared in good condition.

5. The concrete decant discharge structure appeared to be in good condition with no spalling cracking or visible evidence of differential movement along the diagonal joint. The diagonal joint has been partially inundated during this year's pool raising. The diagonal crack within the RCC itself is no longer readily visible except at the crest.

6. Observations of the dam crest, MSE panels, exposed RCC cap and slopes did not reveal any significant evidence of dam misalignment or excessive settlement.

7. Seepage along the right abutment is steady in response to increasing pool stages with new seeps located in the general area of other seeps at higher elevations. Seepage measurements showed a minor increase as a result of the pond level increase.

8. Piezometer's measurements indicated an increase in the porewater pressure related to the raise in the pond water level. The ratio of the porewater pressure increase to the pond level increase is less than 1 and compares well with the previous pond raising ratios.

9. Surface monuments monitoring indicates minor downstream movement consistent with previous year's movement.

4.3 Fly Ash Dam I

1. Fly Ash Dam I reservoir has been drained and is currently inactive. Visual observations of the dam's downstream slopes and groin areas did not lead to any significant concerns.

2. Observations of the dam crest road, which is used as a hauling road, did not reveal any evidence of dam misalignment, excessive rutting or settlement.

Based on the inspection visit and review of available data, Fly Ash Dams I and II and the Bottom Ash Complex have a general good appearance and are in good condition.

6.0 RECOMMENDATIONS- GENERAL MAINTENANCE & MONITORING CONDITIONS

5.1 Overall

5.2 Bottom Ash Complex

1. The upstream slopes of the BAP and RCP were in excellent condition. Minor erosion gullies should be repaired during their normal maintenance schedule.

5.3 Fly Ash Dam II

1. Observations have revealed that vegetation control and maintenance has been kept on schedule and is generally good. Cardinal Plant should continue to monitor the vegetation growth and enhance any poor growth areas with additional soil, fertilizer and seeding as needed.

2. The left and right downstream groin areas appeared in good condition with results of recent maintenance activities noted. Woody vegetation in the groin ditch should continue to be cut regularly.

5.4 Fly Ash Dam I

1. Visual observations of the dam's downstream slopes and groin areas should continue to be performed.

6.0 RECOMMENDATIONS- REMEDIAL ACTIONS/REPAIRS

6.1 Bottom Ash Pond

1. Minor seepage along the downstream slope of the eastern dike should be monitored closely while GES and their consultant determined the cause of the seep and the proper fix design.

6.2 Fly Ash Dam I and II

None

In general, routine inspections, monitoring and maintenance by plant personnel continue with the current frequency. If you have any questions with regard to this report, please do not hesitate to contact Mohammad Ajlouni at 614-716-2939 or Gary Zych at 614-716-2917

ATTACHMENT A

PHOTOGRAPHS

BOTTOM ASH COMPLEX

November 12 and 19, 2015
Cardinal Plant
Dam and Dike Inspections

Photo # 1 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. Please see pjotos 52 through 56 for new seepage points	
Photo # 2 BAP 2009 installed 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 # 3 BAP No slumping, bulges was observed. The trees are located along the Ohio River and are being left in place to protect the riverbank.	

Photo # 4 BAP Typical view showing good condition of the rip rap and downstream outlet of the RCP discharge pipe.	
Photo # 5 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 # 6 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.	

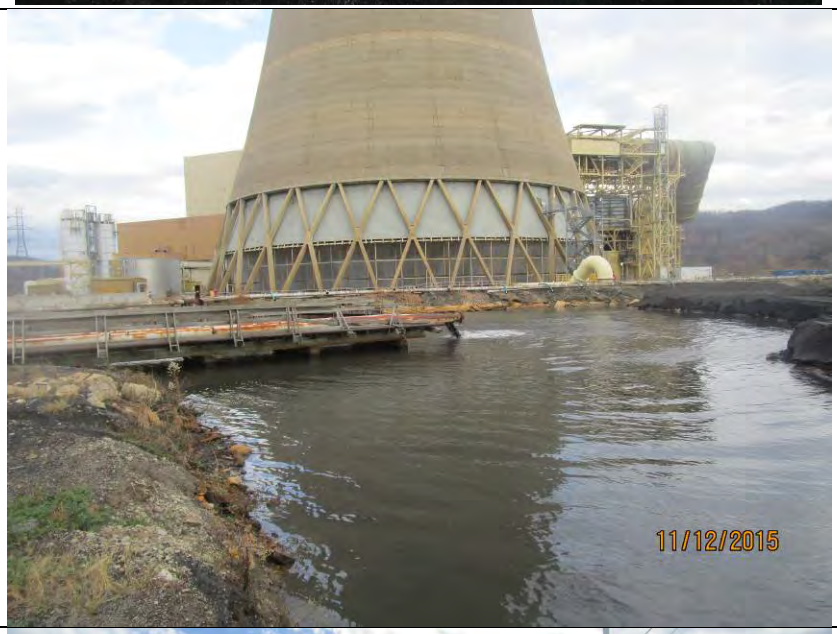
Photo # 7 BAP The road crest showed good conditions with no indications of misalignment, rutting or erosion. The piezometer in the foreground is well protected and is currently being monitored by plant personnel.	
Photo # 8 BAP Typical view showing good conditions of interior slopes and crest of the bottom ash pond.	
Photo # 9 BAP Typical view showing good conditions of interior slopes and crest of the bottom ash pond.	

Photo # 10 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 # 11 BAP Typical view showing satisfactory conditions of exterior slopes and some minor seepage/ drainage along the toe of the embankment.	
Photo # 12 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 # 13 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 # 14 BAP	
Typical view showing good conditions of the sheet piling wall that splits the RCP pond. No significant flow was observed to occur through the wall and the effluent clarity was visually less turbid on the RCP discharge side (southern most end of the pond).	

Photo # 15 BAP	
Typical view showing good conditions of the sheet piling wall that splits the RCP pond. No significant flow was observed to occur through the wall and the effluent clarity was visually less turbid on the RCP discharge side (southern most end of the pond).	

Photo # 16 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 # 17 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 # 18 BAP The road crest showed good conditions with no indications of misalignment, and minimal rutting or erosion.	

ATTACHMENT B

PHOTOGRAPHS

FLY ASH DAM II

Photo # 19 FAD 2 Typical crest view showed good conditions with no indications of misalignment, rutting or erosion.	
Photo # 20 FAD 2 Typical view showing good conditions of the crest and downstream of the dam.	
Photo # 21 FAD 2 Typical view of the upstream MSE wall on the west (left) side of the decant structure	

Photo # 22 FAD 2 Typical view of Principal spillway flow. Dam Raising Construction is underway.	
Photo # 23 FAD 2 Typical view of the upstream MSE wall on the east (right) side of the decant structure	
Photo # 24 FAD 2 Typical view of the west side of the decant structure, skimmer and stairs showing good conditions.	

Photo # 25 FAD 2 Typical view of the east side of the decant structure, skimmer and stairs showing good conditions.	
Photo # 26 FAD 2 Typical view of the upstream RRC on the east side of the decant structure. No significant wave cut erosion, erosion rills were observed.	
Photo # 27 FAD 2 Typical view of the upstream RRC on the west side of the decant structure. No significant wave cut erosion, erosion rills were observed.	

Photo # 28 FAD 2 Typical view of the emergency discharge channel showing good conditions. Vegetative control is well maintained.	
Photo # 29 FAD 2 Typical view of the Concrete and RCC discharge channel “steps.” The RCC steps have experienced a minor amount of differential erosion but appear to be in satisfactory condition.	
Photo # 30 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 # 31 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 # 32 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 # 33 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 # 34 FAD 2 Typical view showing the weirs along “Tom Dick’s Creek”. No unusual sediment accumulation was observed along the creek bottom.	
Photo # 35 FAD 2 Typical view showing good conditions for access (stairs) to measure the dam’s internal drain.	
Photo # 36 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 # 37 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 # 38 FAD 2 View of the energy dissipater showing good conditions of the concrete structure. No cracking, spalling was observed.	
Photo # 39 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 # 40 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 65 gpm. The overall measured seepage from the right abutment became constant over the last few years with increasing pool stages (See Figure 4).	
Photo # 41 FAD 2 Typical view of the FAR 2 impoundment. The pond pool stage was 963.0 ft (NGVD-29) at the time of the inspection.	
Photo # 42 FAD 2 Typical view of the ash sluice lines discharging into the FAR 2 pond. The increase in pool stage has inundated additional area and necessitate the cutting of the discharge lines.	

Photo # 43 FAD 2 Typical view of the FAR 2 ash delta downstream of the ash sluice discharge lines.	
Photo # 44 FAD 2 Additional stop logs are available for the future raising of the water level at FAR 2 pond.	
Photo # 45 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 # 46 Additional stop logs are available for the future raising of the water level at FAR 2 pond.	
Photo # 47 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 # 48 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

FLY ASH DAM I

Photo # 49 FAD 1 View of the downstream slope of the FAR 1 dam.	
Photo # 50 FAD 1 Typical view of the downstream slope of the FAR 1 dam.	
Photo # 51 FAD 1 Typical view of the emergency spillway for the FAR 1 impoundment.	

Photo # 52 BAP General View of the Location of Seep #1.	
Photo # 53 BAP Close-up of Seep #1.	
Photo # 54 BAP General View of the Location of Seep #2.	

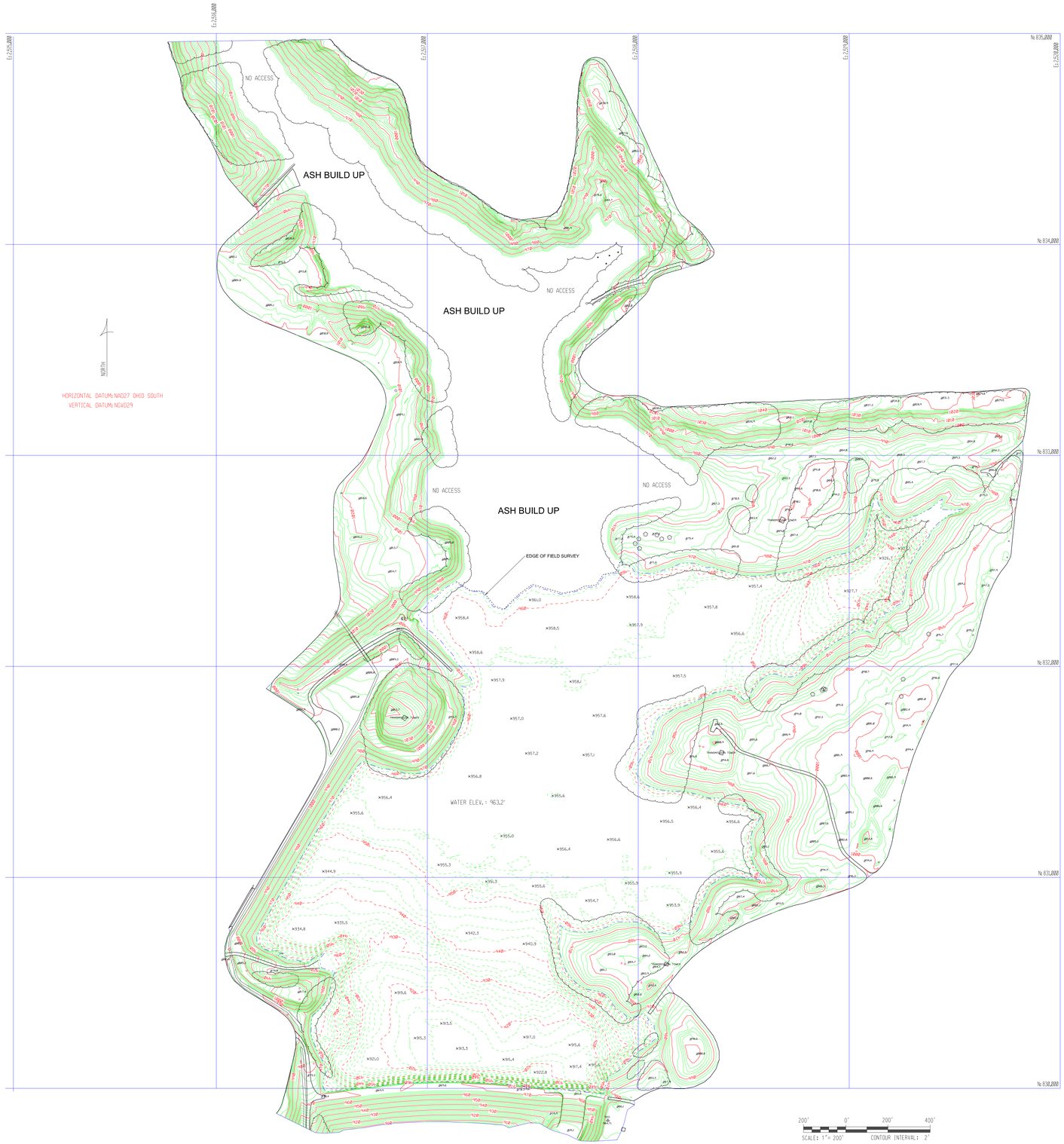
Photo # 55 BAP	
General View of the Location of Seep #3.	

Photo # 56 BAP	
Close-up of Seep #3.	

ATTACHMENT D

BATHYMETRIC SURVEY Performed Sebtember 22, 2015

DWG. NO.



Triangle Volume Report

Volume Up To Water Elevation 963.2'

Report Created: 11/10/2015
Time: 11:24am
Mode: Entire Surface
Input Grid Factor: 1.000000

Original Surface: cdFARII 9-22-15_2729SF
Description: FAR II Hydrographic Survey 9-22-15
Preference: Default
Type: Existing

Design Surface: cdFARII9-22-15_2729SF_H2O
Description: Water Elevation 963.2'
Preference: Default
Type: Existing
Cut Factor: 1.00
Fill Factor: 1.00

Cut: 174.7 cu ft
Fill: 60013109.7 cu ft
Net: -60012935.0cu ft

Cut: 6.5 cu yd
Fill: 2222707.8 cu yd
Net: -2222701.3 cu 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 CDFARII9-22-15_2729SF.DGN & .DTM

FAR II HYDROGRAPHIC SURVEY

CARDINAL PLANT

SURVEY DATE SEPTEMBER 22, 2015

DWG. NO. CD- 150922

SCALE:1" = 200'	CIVIL ENGINEERING DIVISION
DRW. W. FLYNN	
CH:	
ENGR.	
PROJ. ENGR.	
DATE: 11/06/15	

APPROVED BY

AEP AMERICAN ELECTRIC POWER
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

IGS1092

ATTACHMENT E

Water Level Measurements, Drain Discharges And Precipitation

CARDINAL FLY ASH DAM II PIEZOMETERS

DATE:	3/16,17/2015		6/24, 26/2015		9/23/15		9/30/15		11/9,11/15	
Number	Pressure (psi)	Total Head (ft)	Pressure (psi)	Total Head (ft)	Pressure (psi)	Total Head (ft)	Pressure (psi)	Total Head (ft)	Pressure (psi)	Total Head (ft)
P-1A	4.5	762.7	5.0	763.8	4.7	763.1	4.4	762.5	4.6	762.9
P-2A	4.6	781.6	4.7	781.8	4.8	782.1	4.8	782.1	4.7	781.8
P-3A	1.2	804.1	1.4	804.5	1.4	804.5	1.4	804.5	1.3	804.3
P-3B	4.9	783.6	5.1	784.1	5.1	784.1	5.1	784.1	5.0	783.8
P-1BE	0.9	730.1	1.4	731.2	1.4	731.2	1.3	731.0	1.2	730.8
P-1BW	1.3	738.9	1.2	738.7	1.3	738.9	1.4	739.1	1.3	738.9
P-2BE	13.1	760.4	13.3	760.9	13.3	760.9	13.3	760.9	13.3	760.9
P-2BW	1.1	733.6	1.2	733.9	1.2	733.9	1.2	733.9	1.2	733.9
P-2C	1.0	713.3	1.2	713.8	1.2	713.8	1.1	713.5	1.1	713.5
P-5A	53.7	898.6	53.9	899.1	53.9	899.1	54.0	899.3	53.7	898.6
P-8A	1.2	804.9	1.2	804.9	1.5	805.6	1.5	805.6	1.4	805.3
P-8B	1.3	779.0	1.4	779.2	1.6	779.7	1.6	779.7	1.6	779.7
P-9	6.3	785.7	6.4	786.0	6.6	786.4	6.6	786.4	6.5	786.2
P-10	3.0	776.0	3.6	777.4	3.7	777.6	3.2	776.5	3.3	776.7
P-11A	0.7	804.2	0.8	804.4	0.8	804.4	0.8	804.4	0.8	804.4
P-11B	3.8	797.9	4.1	798.6	4.0	798.3	4.0	798.3	4.0	798.3
MW-7	4.7	967.8	4.6	967.9	4.7	967.8	4.7	967.8	4.7	967.8
Discharge flow-MGD	15.5 MGD		11.4 MGD		8.9 MGD		18.0 MGD		7.1 MGD	
Pond Elevation	963.65		963.35		963.1		963.7		963	
Comments:	All flows normal and clear. Rainfall last 7 days =1.58"..		All flows normal and clear. Rainfall last 7 days =1.67".		All flows normal and clear. Rainfall last 7 days = 0.72"		All flows normal and clear. Rainfall last 7 days = 4.02".		All flows normal and clear. Rainfall last 7 days = 0.47"	
V Notch Weir	177 gpm		177gpm		177gpm		185gpm		177gpm	
Internal Drain Weir	23 gpm		23gpm		23gpm		23gpm		23gpm	

CARDINAL BOTTOM ASH POND PIEZOMETERS

DATE:	3/18/15		6/23/15		9/22/15		9/30/15		11/11/15	
Number	Depth	Water Level	Depth	Water Level	Depth	Water Level	Depth	Water Level	Depth	Water Level
2-N	9.30	663.19	9.70	662.79	10.50	661.99	13.51	658.98	8.64	663.85
3-S	12.20	659.46	11.50	660.16	11.35	660.31	10.82	660.84	11.07	660.59
B-0902	15.10	655.66	15.60	655.16	16.12	654.64	13.51	657.25	14.30	656.70
B-0904	15.80	655.27	17.30	653.77	16.23	654.84	15.36	655.71	16.07	654.93
B-0905	6.90	645.93	8.30	644.53	7.92	644.91	7.78	645.05	8.43	644.40
BA POND Elevation		665.00		664.00		664.00	667.30		665.70	
AWRP Elevation		664.10		662.00		662.30	665.80		664.80	
Comments:	All seepage flows normal and clear		All seepage flows normal and clear		All seepage flows normal and clear		All seepage flows normal and clear		All seepage flows normal and clear	

Cardinal Fly Ash Dam No.2 - Drains and Seepage Zones

	Date of Inspection:	11/19/2015		
Drain Number & Location	**Drain Source**	**Outlet Size**	**Amount (GPM)**	**Clarity**
1. D/S Open Weir	Chimney / toe drain system	12" Dia.	23 gpm	Clear
2. D/S Right Abutment	Right abutment valley	12" Dia.	146gpm	Clear
3. D/S Right Abutment	Slag Buttress / right abutment	12" Dia.	<1 gpm	Clear
4. D/S Right Abutment	Slag Buttress / Trench in Center	12" Dia.	<1gpm	Clear
5. Stilling Basin / Right Side	West side of stilling basin	6" dia.	4.3 gpm	Clear
6. Stilling Basin / Left Side	East side of stilling basin	6" dia.	6 gpm	Clear
7. Right Groin Ditch	West Bedrock abutment 900' elevation	12" Dia.	20 gpm	Clear
8. Left Groin Ditch	East Tributary valley abutment 905"elevation	6" dia.	10 gpm	Clear
9. Left D/S E/W	Emergency Spillway drainage blanket	12" Dia.	<1gpm	Clear
10. Left D/S E/W	E/S Left training wall	6" dia.	1.5 gpm	Clear
11. E/S 300' D/S Left	E/S Channel left 900" elevation	Seep Zone	3 gpm	Clear
12. E/S Outlet Channel	Total Seepage within Emergency Spillway	10: Dia.	10 gpm	Clear
13. Right Abutment Hillside	Right Abutment Hillside near 920' elevation	Two - 6" dia.	<1gpm	Clear
14. D/S Channel / Parshall flume	Total Flow (spillway / seepage combination)	Open Channel	8.5 MGD	Clear
15. Right Hillside Jules Verne Weir-3	Right Hillside Jules Verne near 770' elevation	V-noch	75 gpm	Clear
16. Right Groin Pipe-2	right groin 6” pipe 930' elevation	6" dia.	0.6 gpm	Clear

ATTACHMENT F

Figures & Drawings

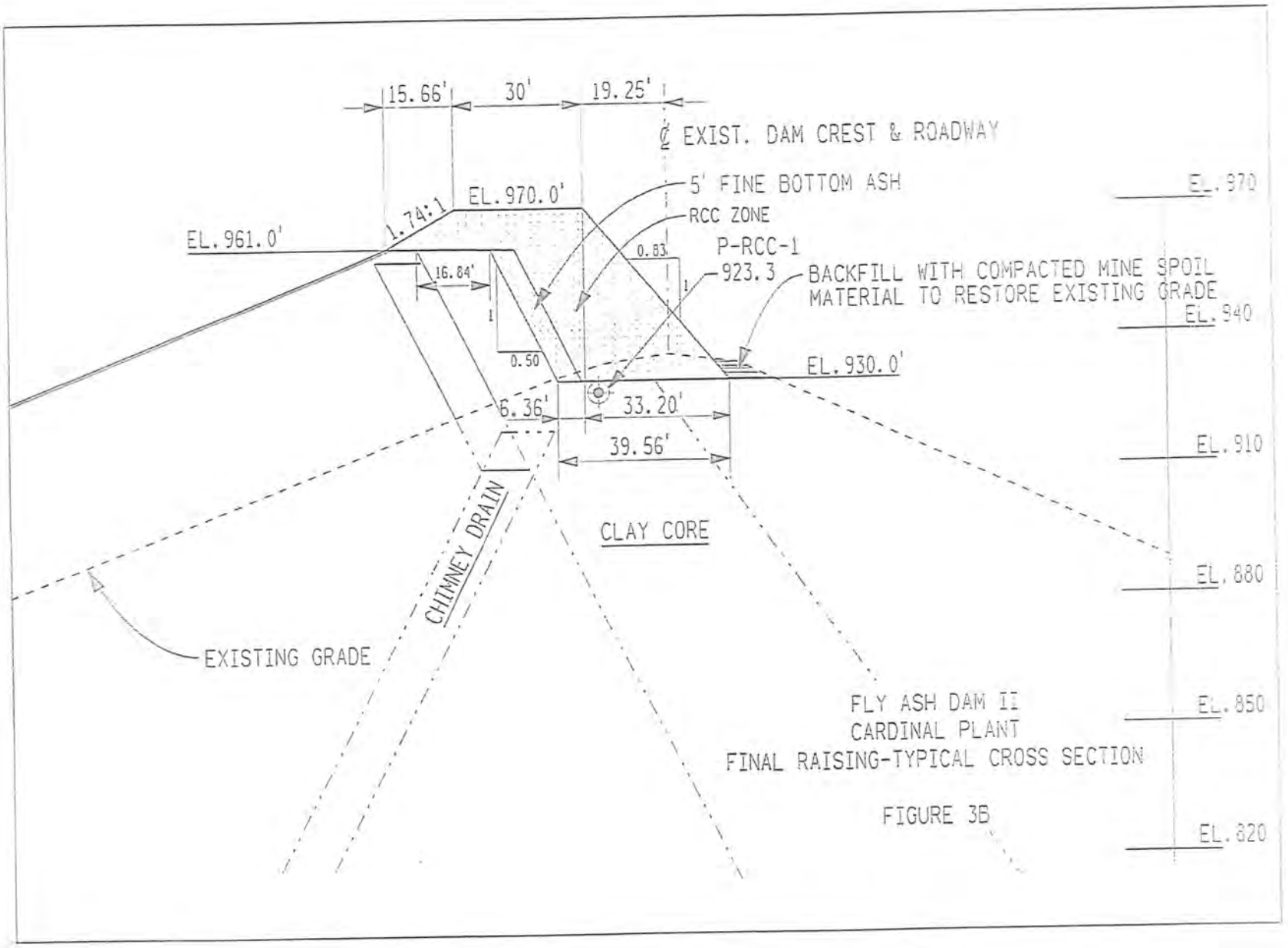
DRN BY:	CARDINAL POWER STATION	DWG NO: FIGURE **1**
DATE:		AEP AMERICAN ELECTRIC POWER / AEP SERVICE CORP. 1 RIVERSIDE PLAZA COLUMBUS, OH 43215
SCALE:	BOTTOM ASH COMPLEX	

PLOT DATE: 12/18/2013 PLOT TIME: 11:38:6 AM BY: s182642

DRN BY:	CARDINAL POWER STATION	DWG NO: FIGURE 2
DATE:		AEP AMERICAN ELECTRIC POWER / AEP SERVICE CORP. 1 RIVERSIDE PLAZA COLUMBUS, OH 43215
SCALE: 1"=	FLY ASH DAM I	

DRN BY:	CARDINAL POWER STATION	DWG NO: FIGURE 3A
DATE:	INDEX-SHEET 1 TO 10	AEP AMERICAN ELECTRIC POWER
SCALE:	FLY ASH DAM II	AEP SERVICE CORP. 1 RIVERSIDE PLAZA COLUMBUS, OH 43215

PLOT DATE: DD-MMM-YYYY PLOT TIME: HOUR:MINUTE BY: USERPLOT



FLY ASH DAM II
CARDINAL PLANT
FINAL RAISING-TYPICAL CROSS SECTION

FIGURE 3B

Figure 4
Cardinal Far 2

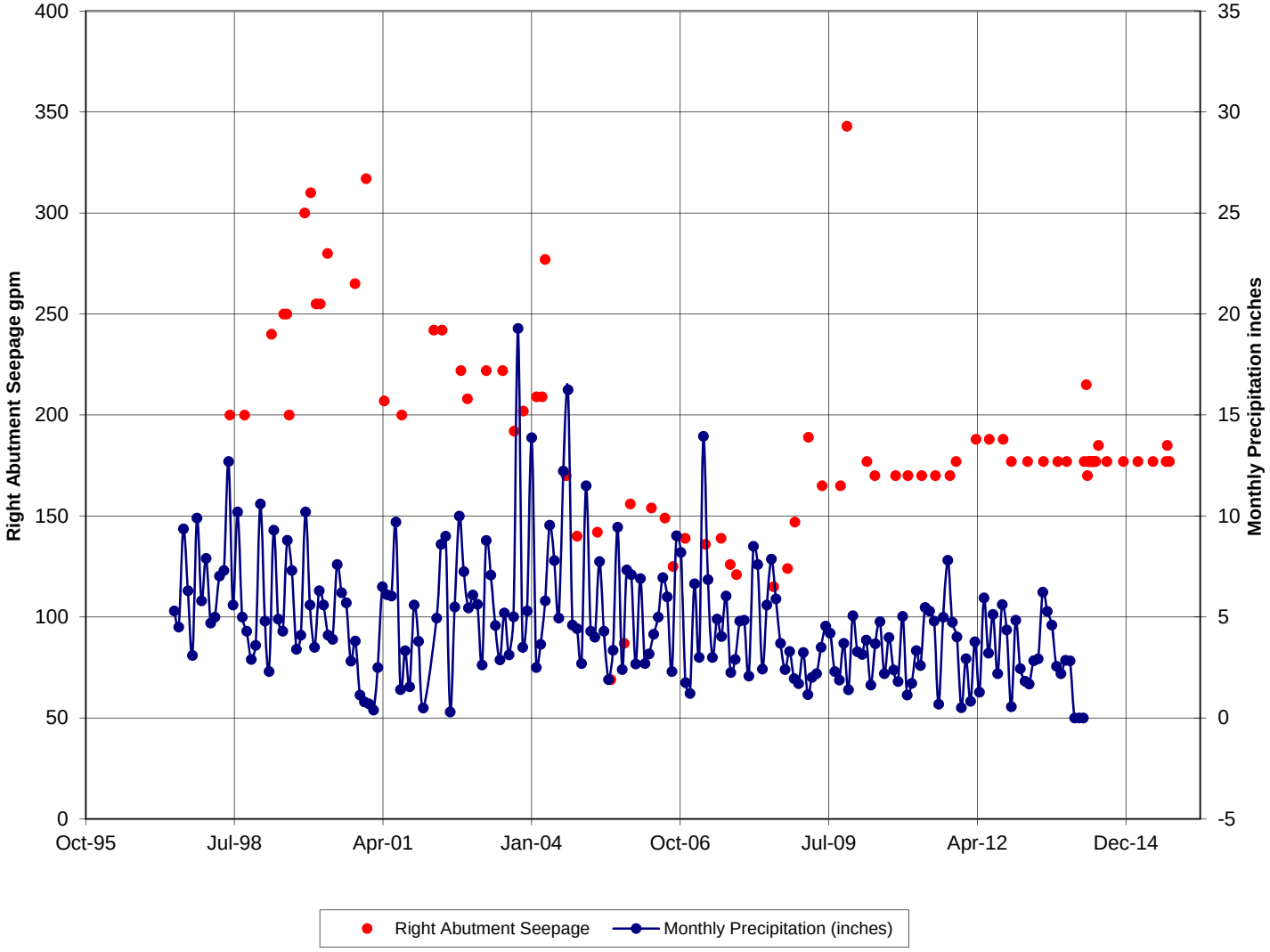


Figure 5a
Cardinal Far 2

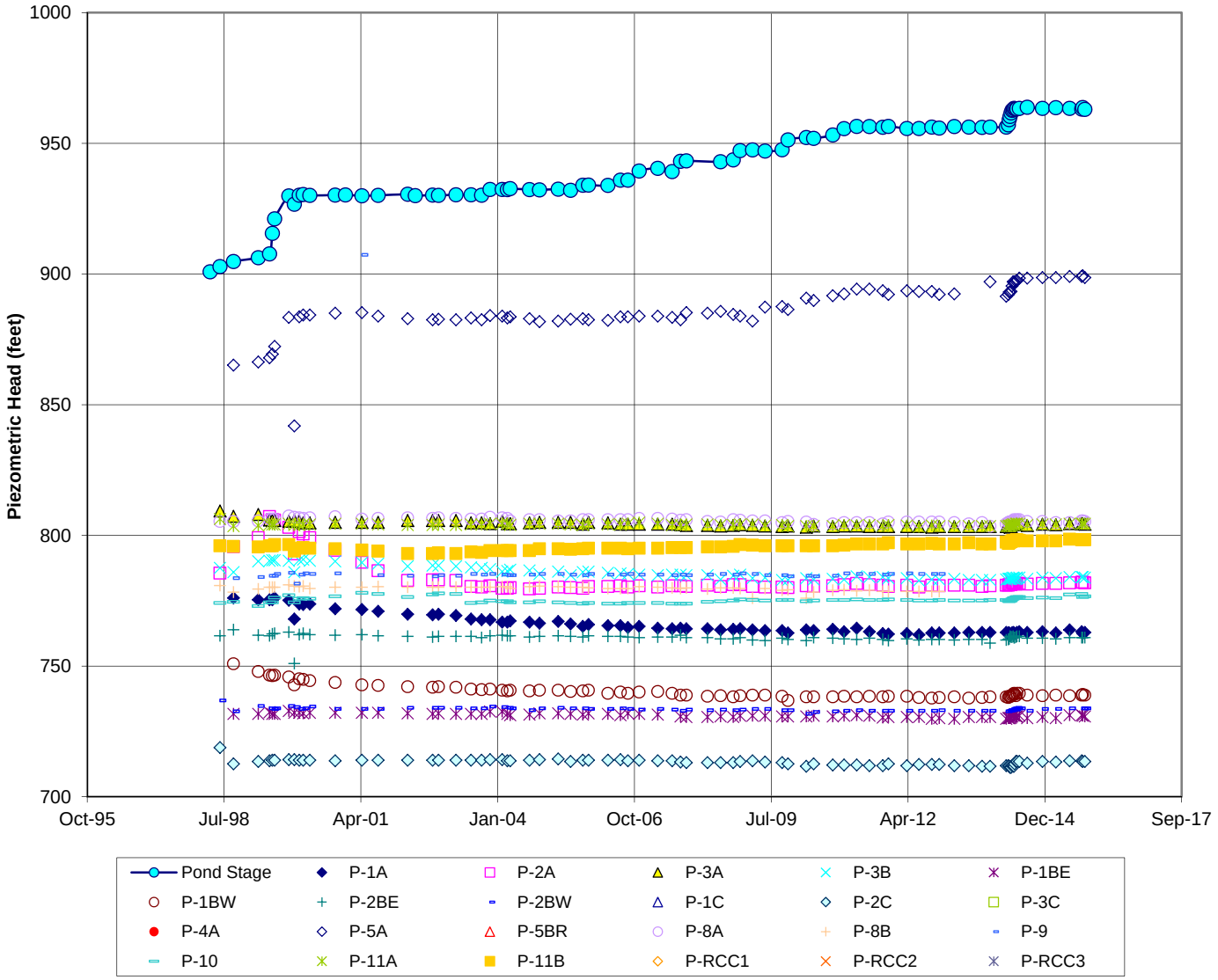


Figure 5b
Pool Stage verses Discharge
Cardinal Far 2

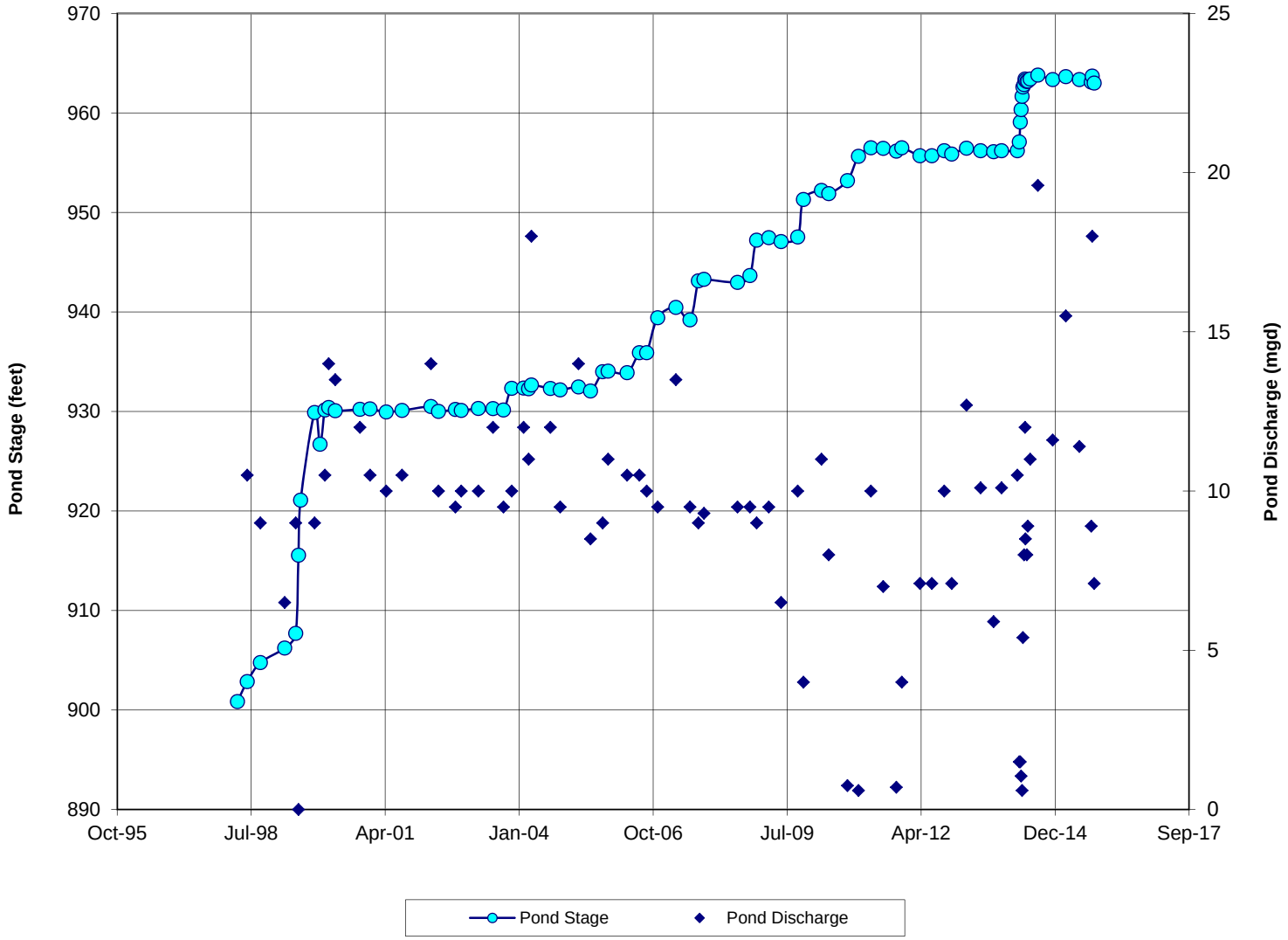


Figure 5c
Cardinal Far 2
Right of Center
Foundation Piezometers

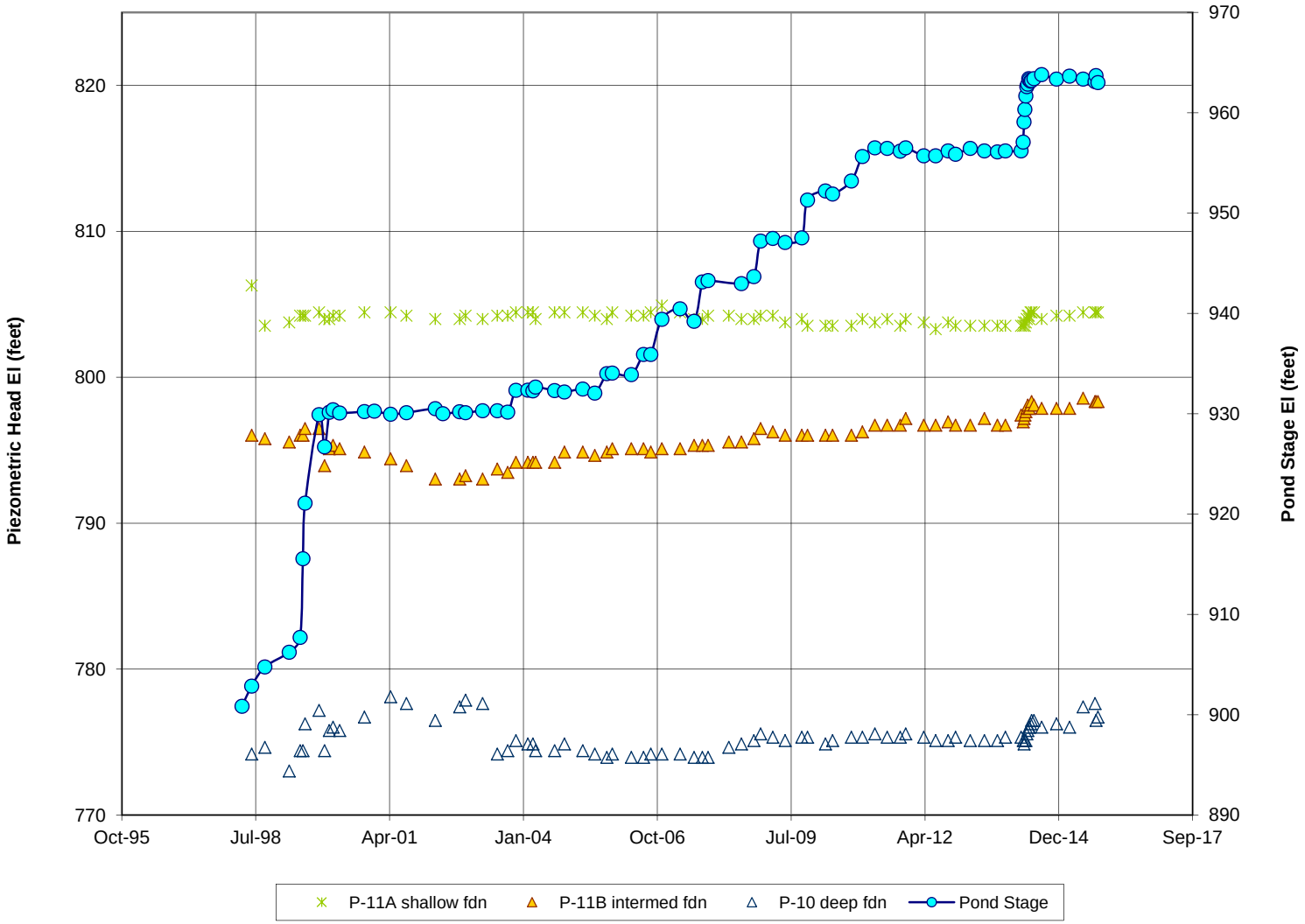


Figure 5d
Cardinal Far 2
Left of Center
Foundation Piezometers

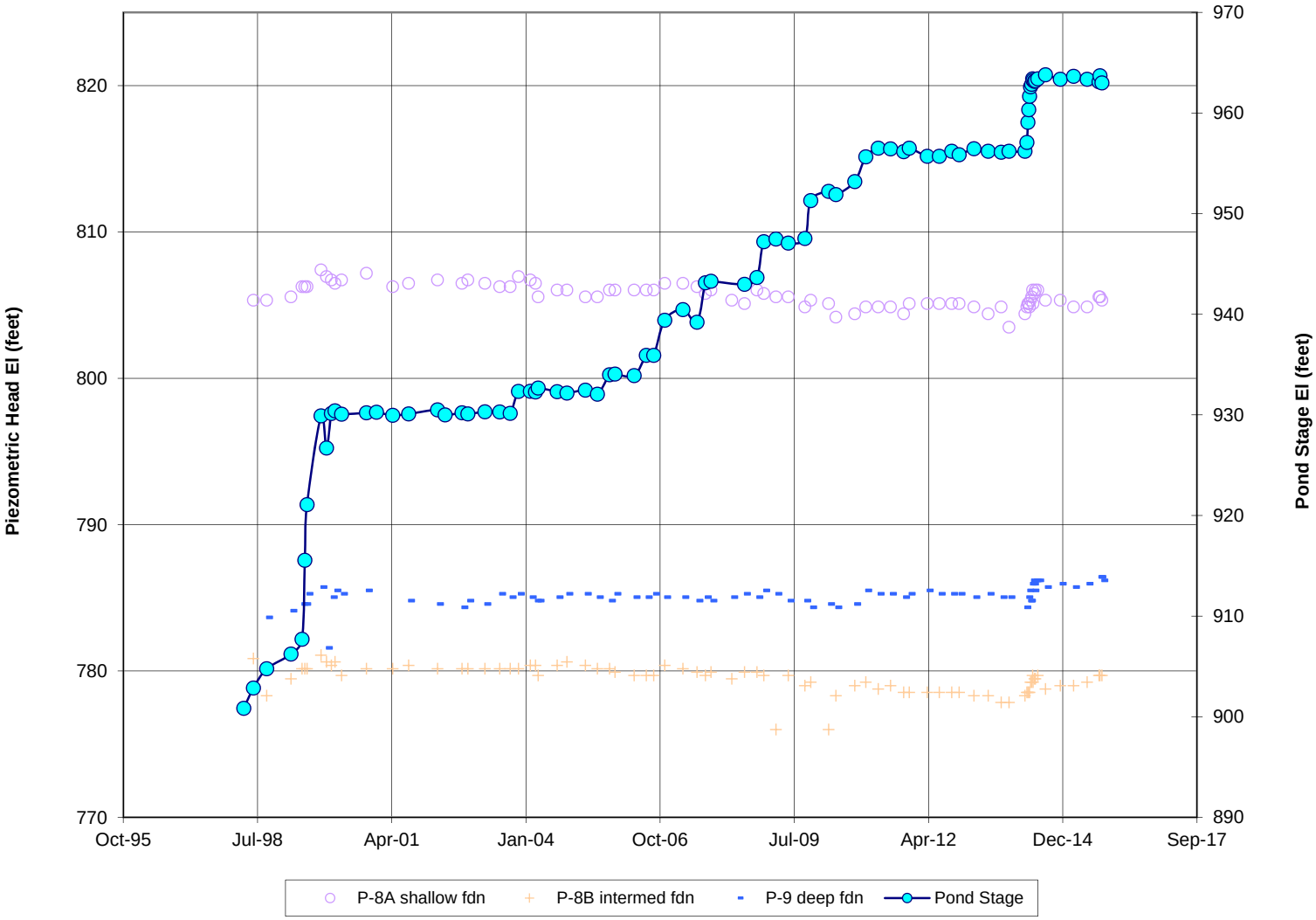


Figure 5e
Cardinal Far 2
Centerline of Dam

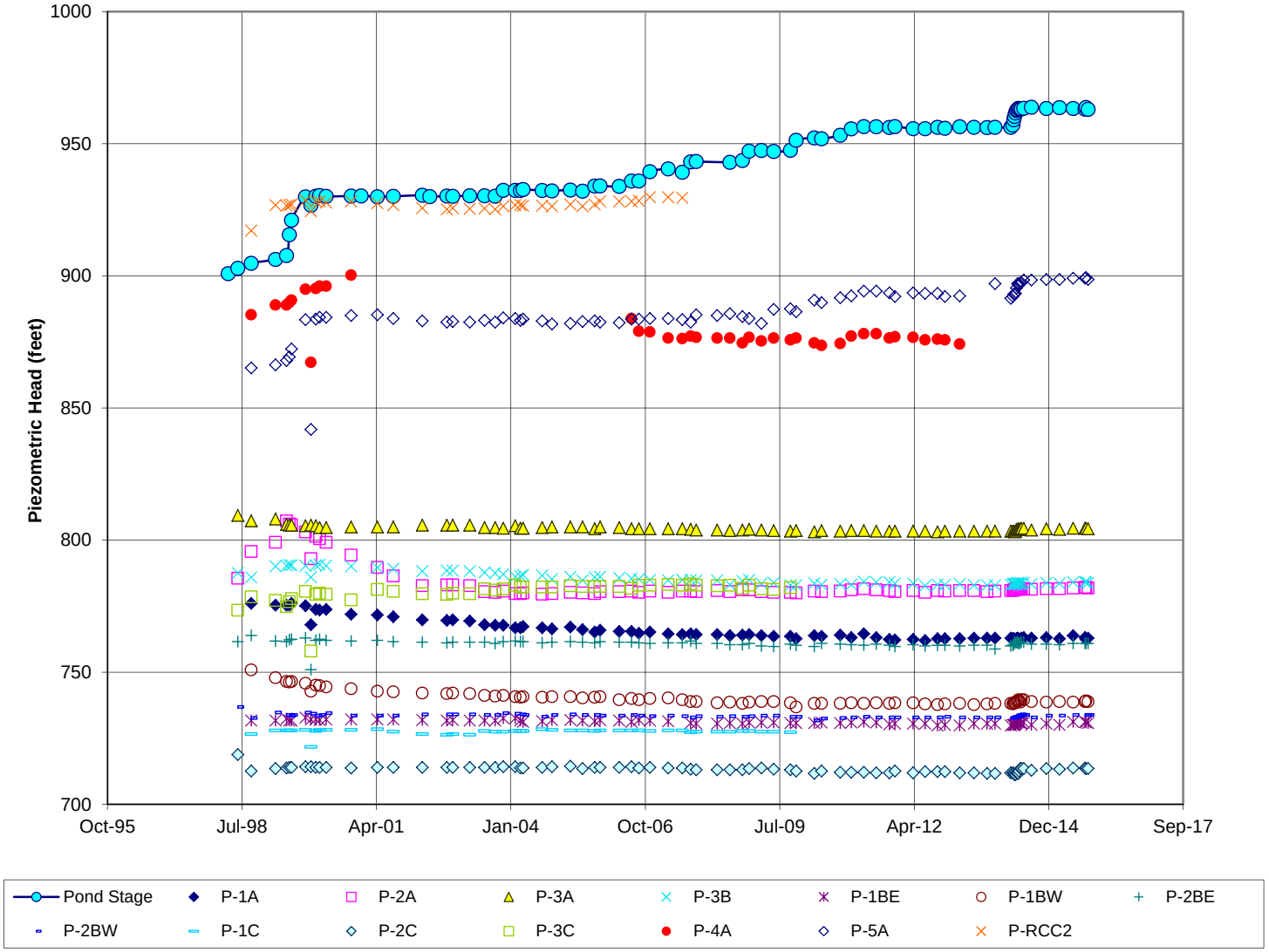


Figure 5f
Cardinal Far 2
Centerline of Dam

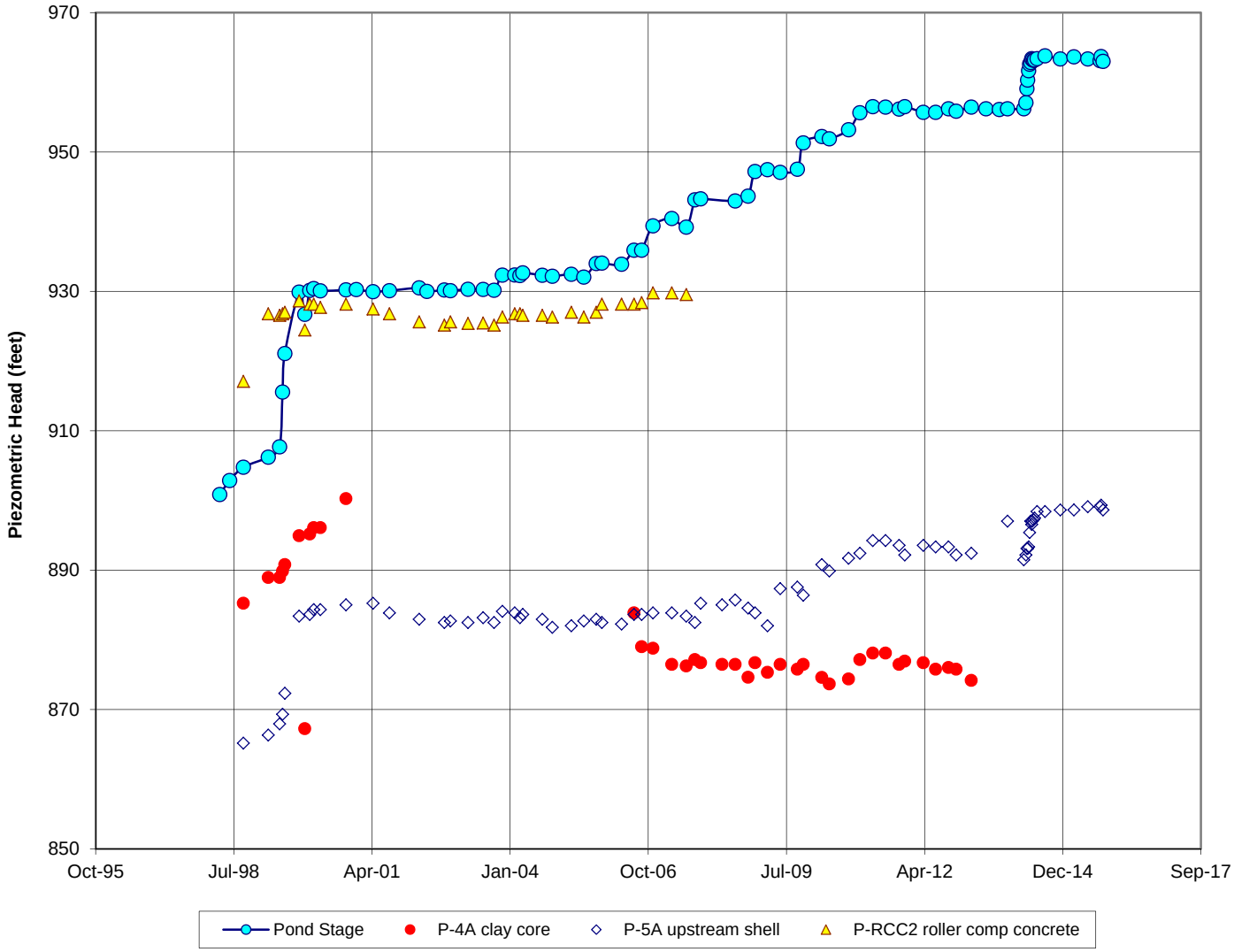


Figure 5g
Cardinal Far 2
Centerline of Dam
Clustered Piezometer Site

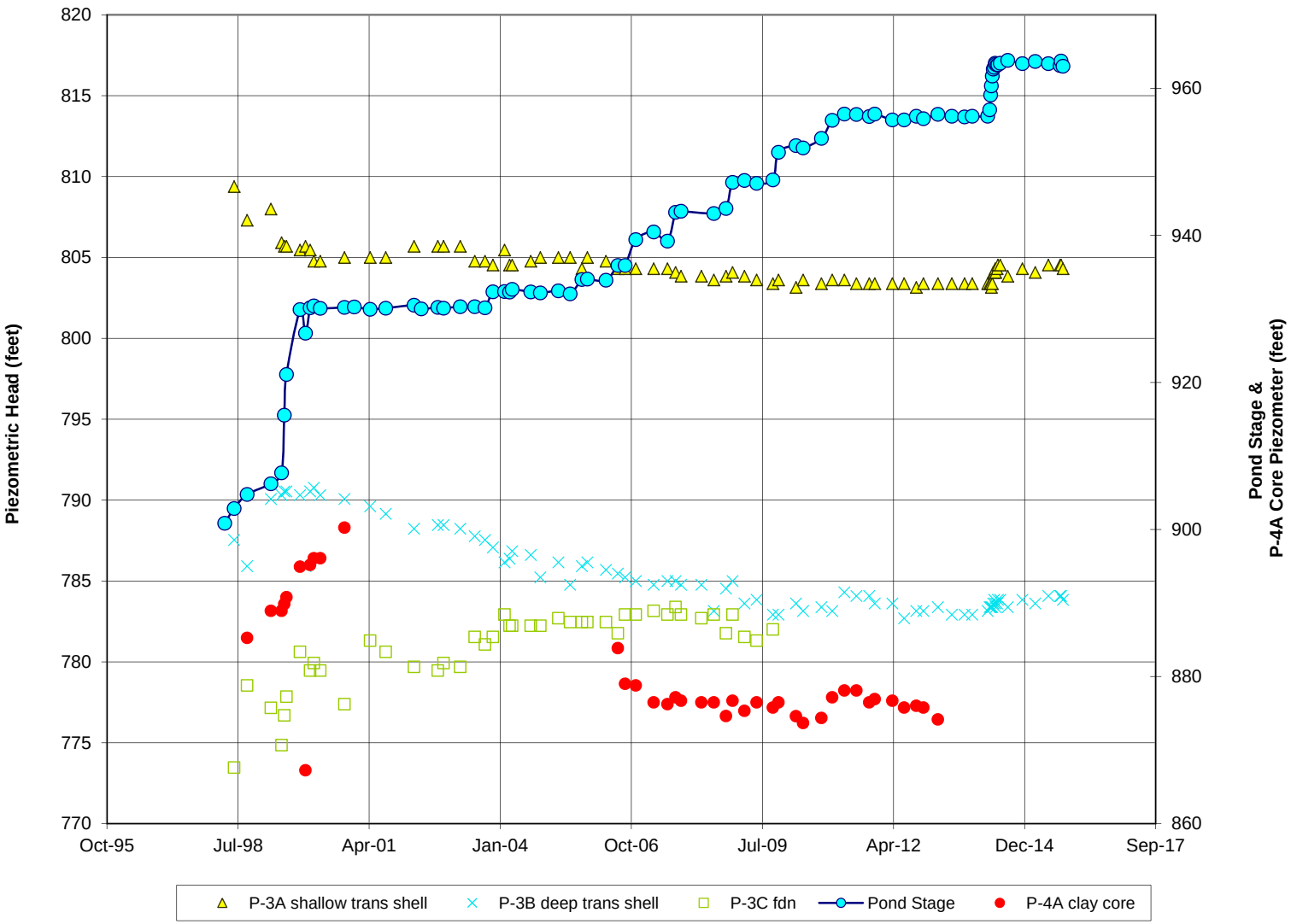


Figure 5h
Cardinal Far 2
Centerline of Dam
Clustered Piezometer Site

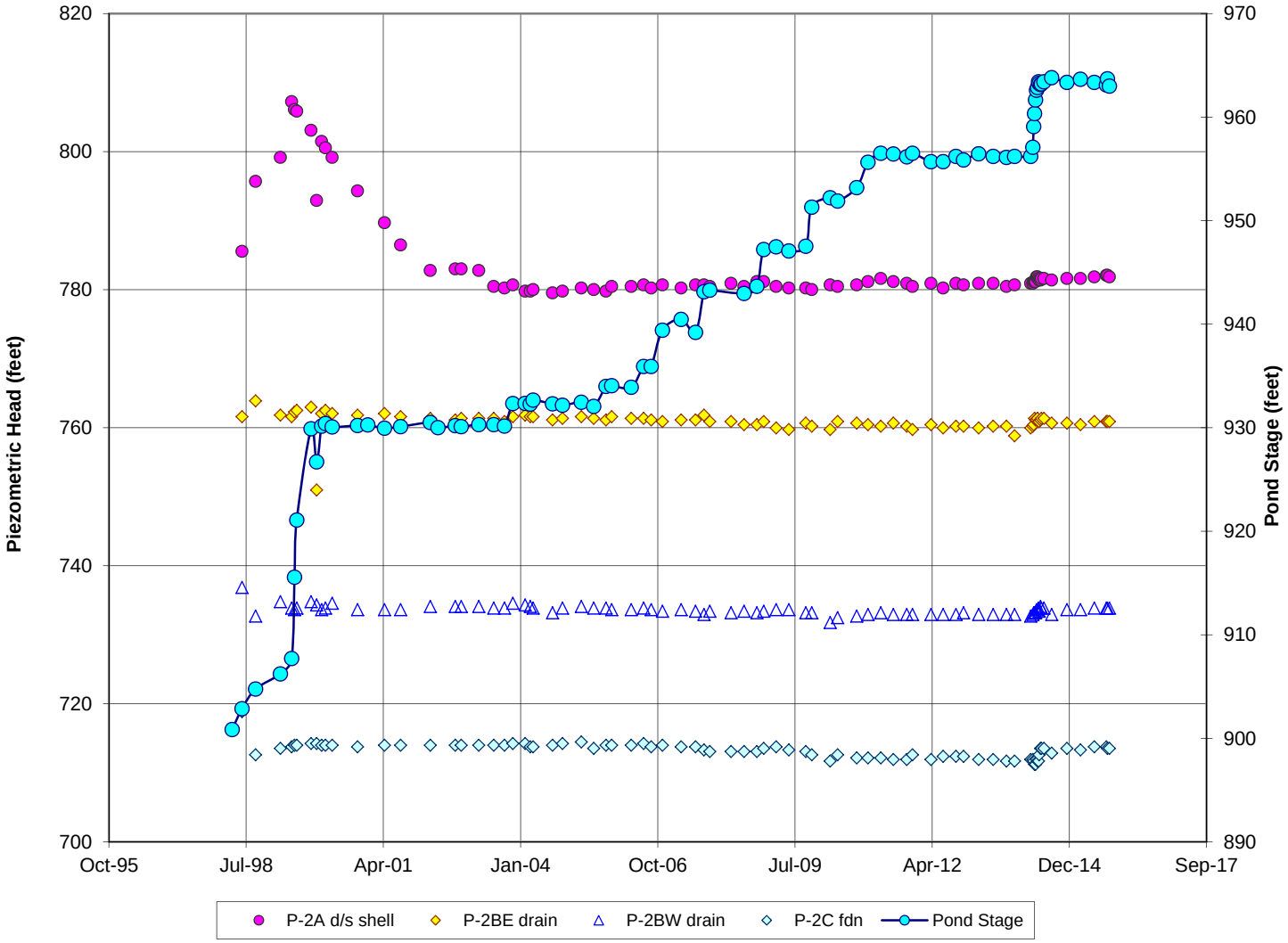


Figure 5i
Cardinal Far 2
Centerline of Dam
Cluustered Piezometer Site

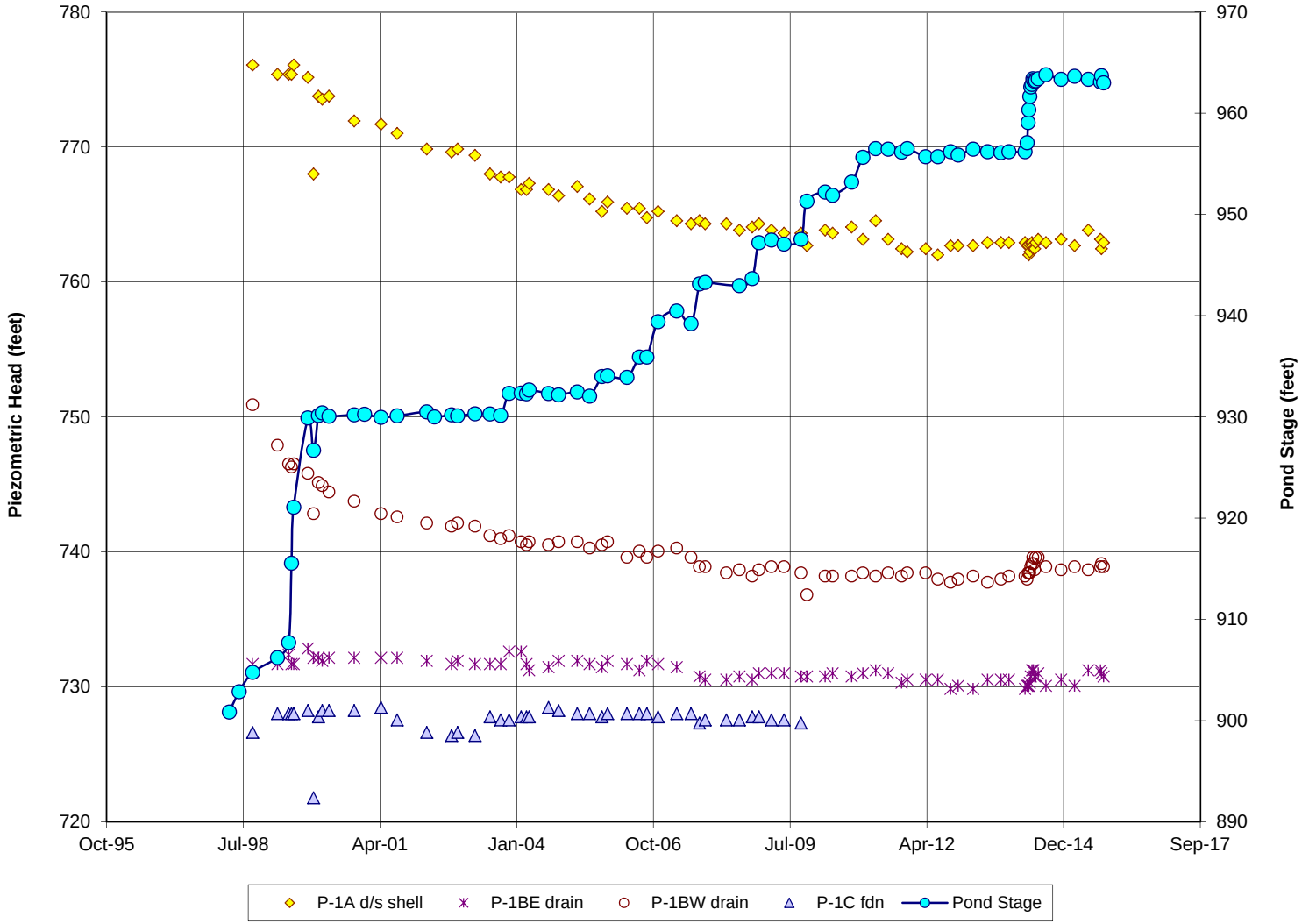


Figure 5j
Cardinal Far 2
Centerline of Dam
Drain Piezometers

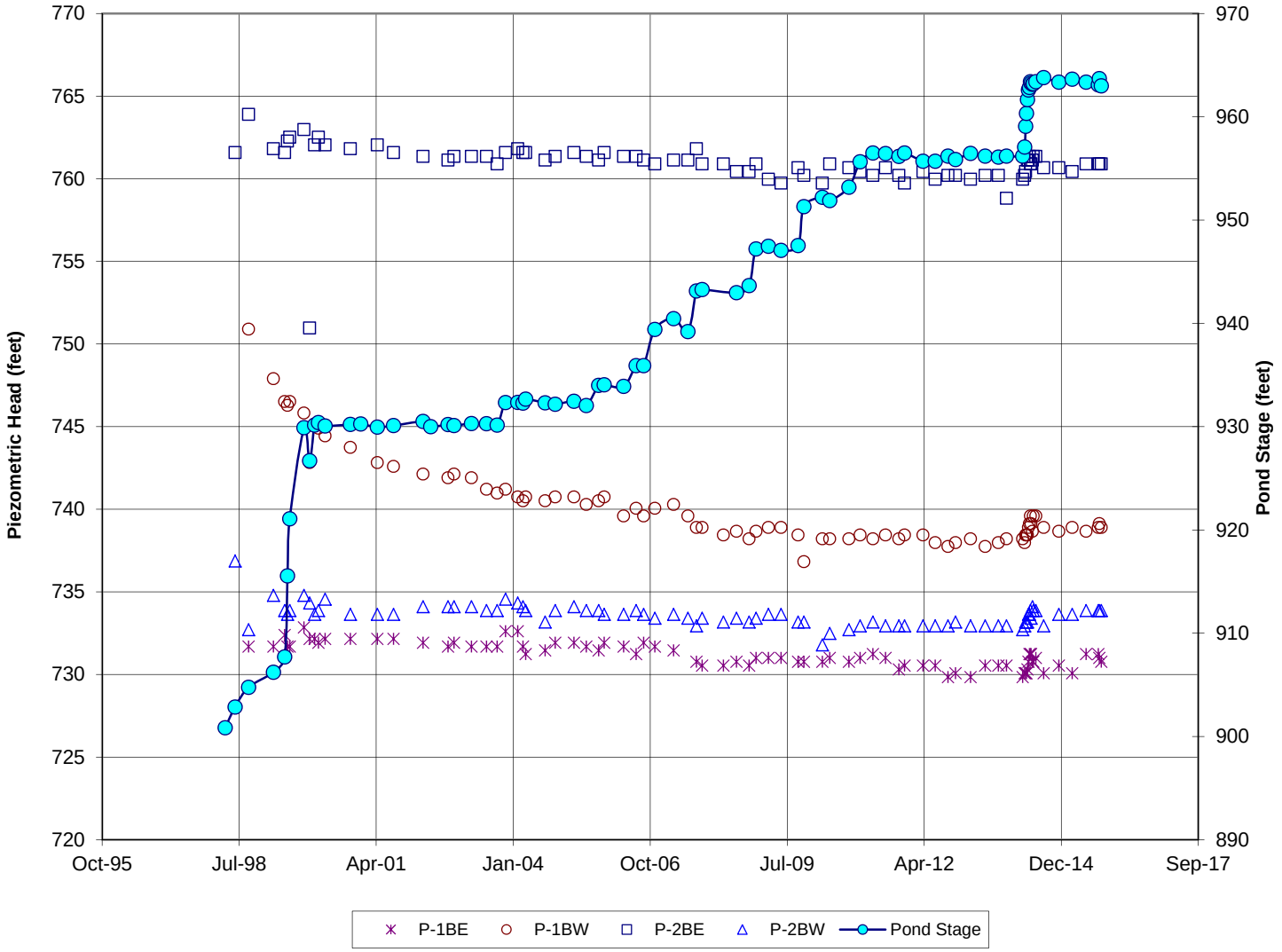


Figure 5k
Cardinal Far 2
Centerline of Dam
Foundation Piezometers

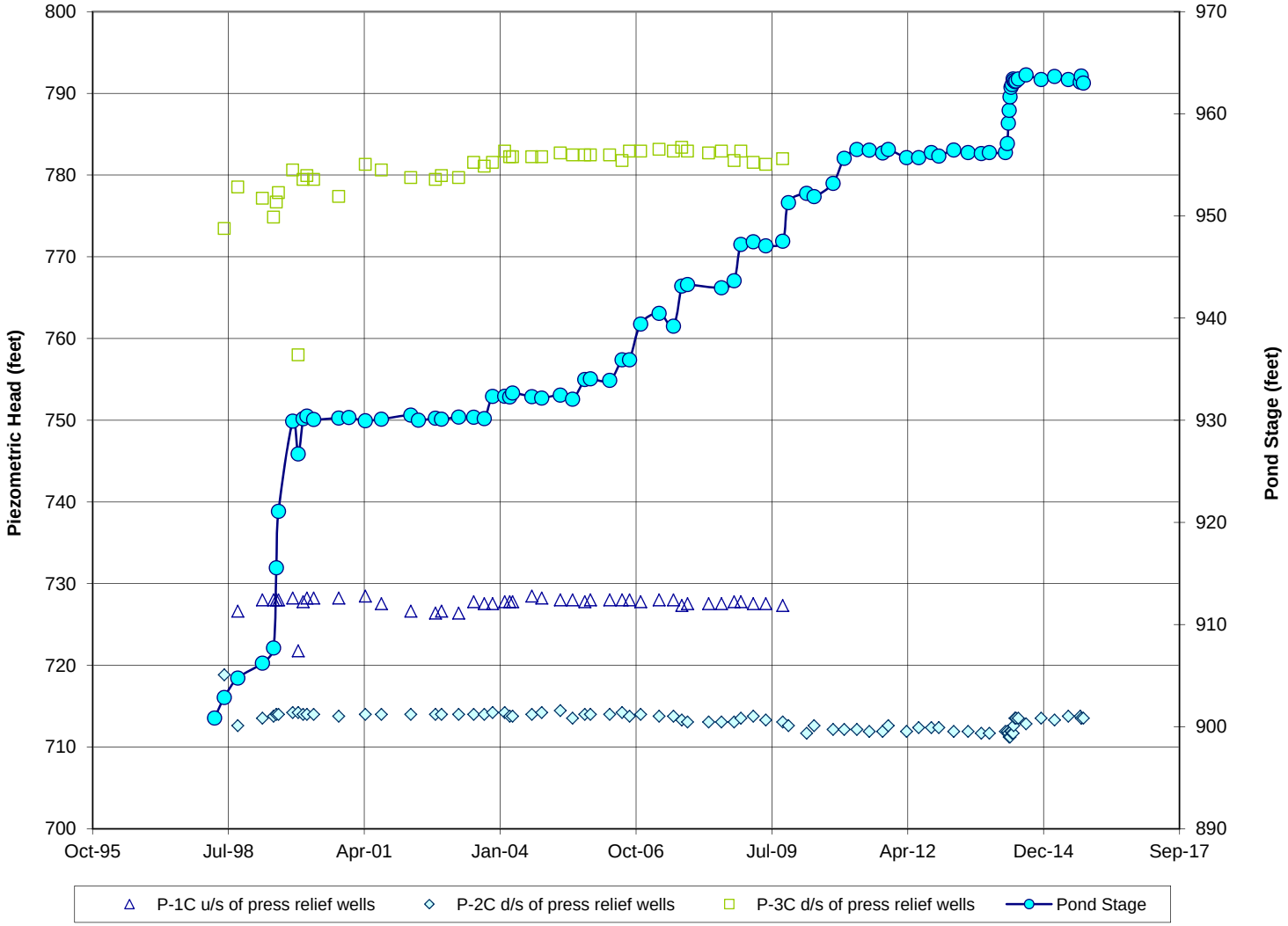


Figure 5l
Cardinal Far 2
Centerline of Dam
Drain Piezometers & Discharge

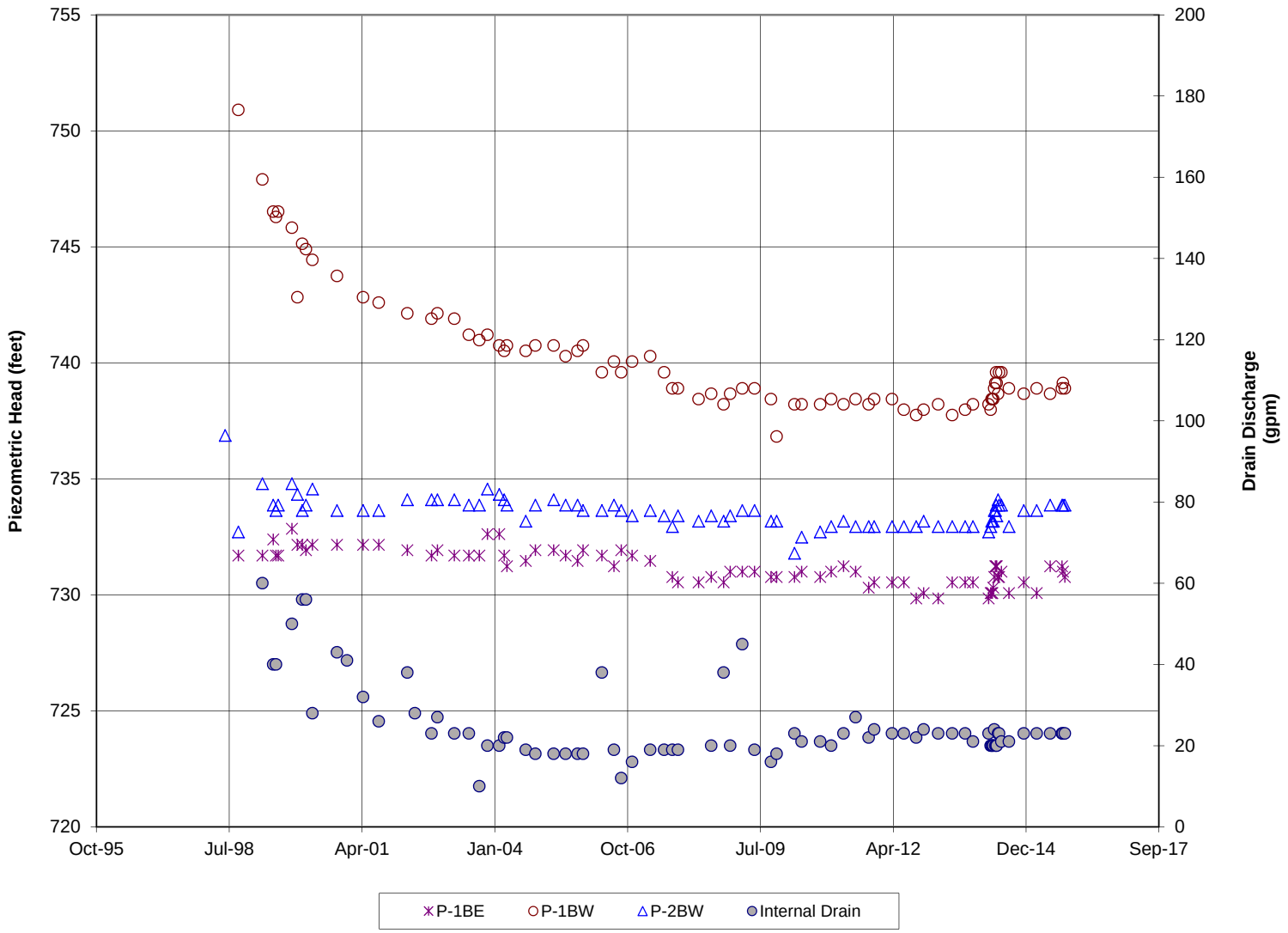


Figure 5m
Cardinal Far 2
Centerline of Dam
Drain Piezometers & V-Notched Weir Discharge

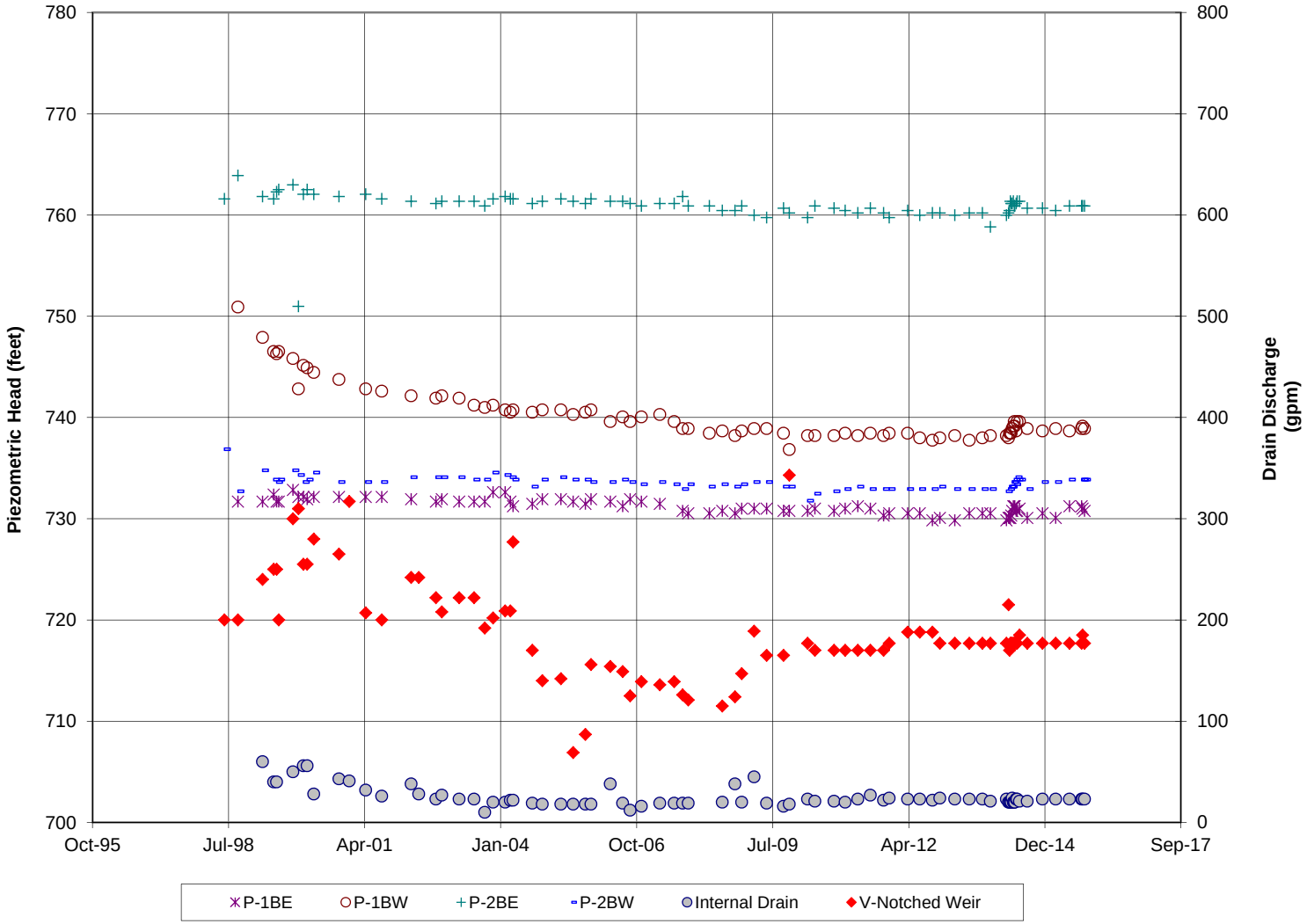


Figure 5n
Cardinal Far 2
Centerline of Dam
Drain Piezometers & Right Abutment Piezometers

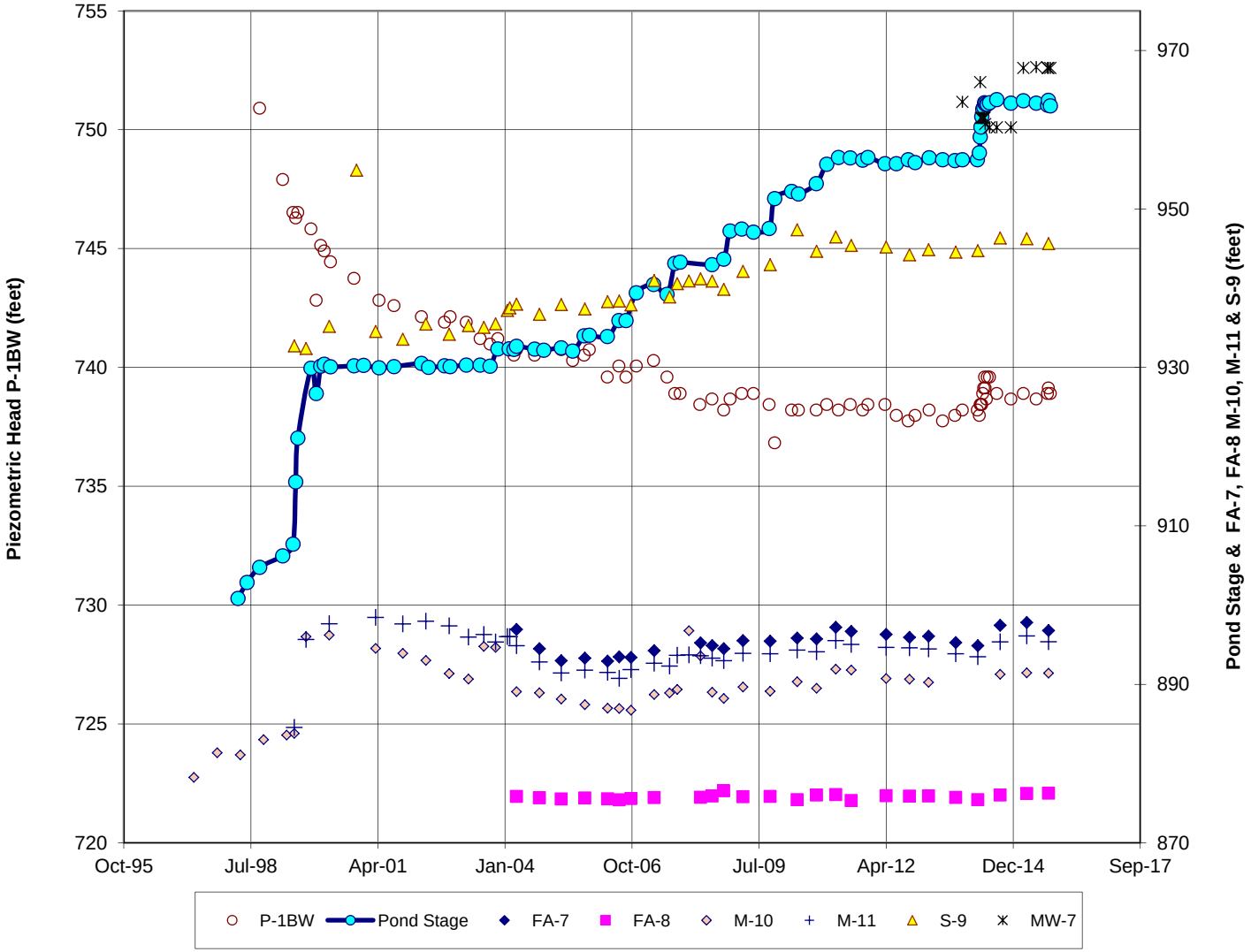


Figure 5o
Cardinal Far 2
Centerline of Dam
Tiltmeters at MSE Wall Concrete Pannels

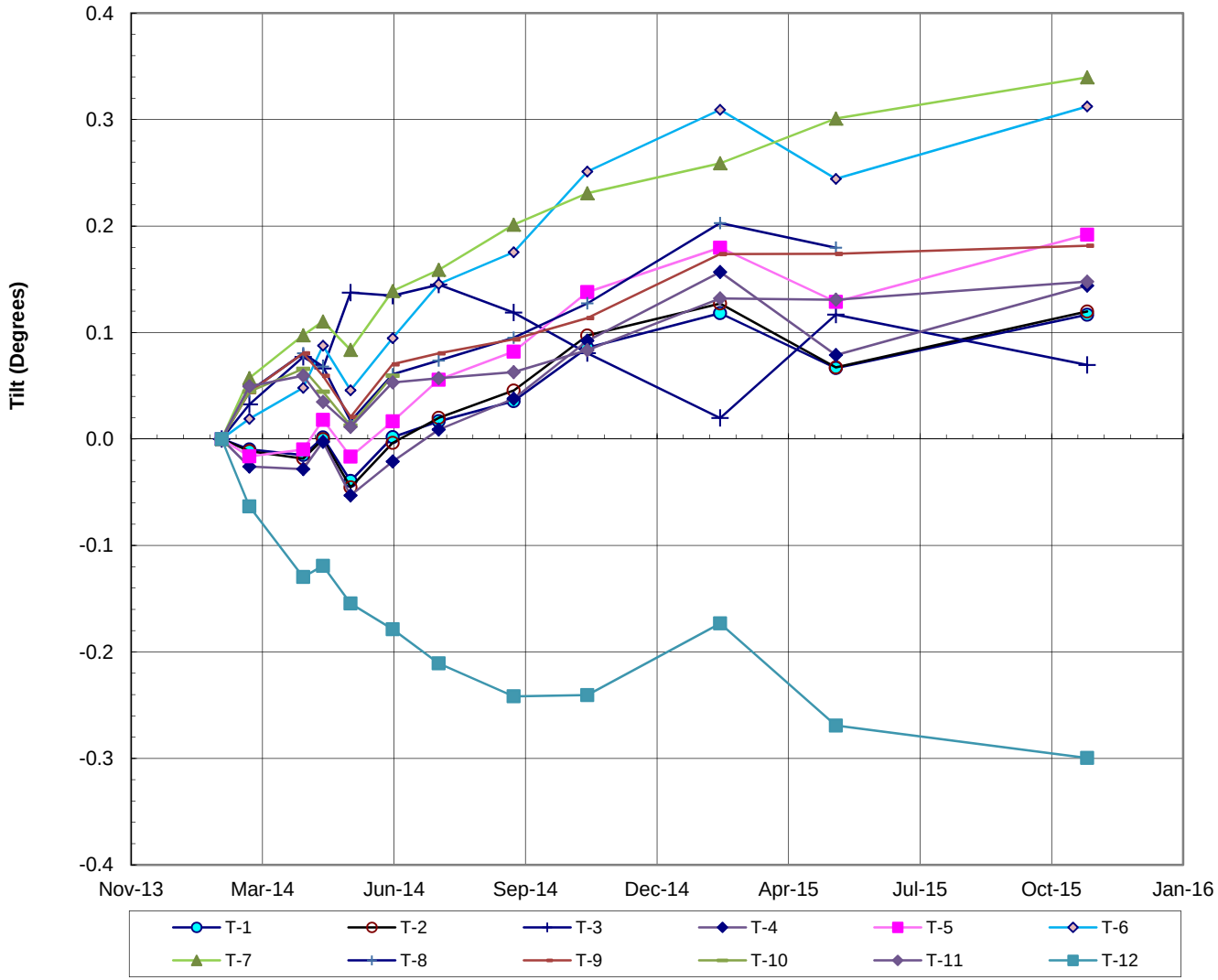


Figure 5p
Bottom Ash Complex
Piezometers & Pond Stage

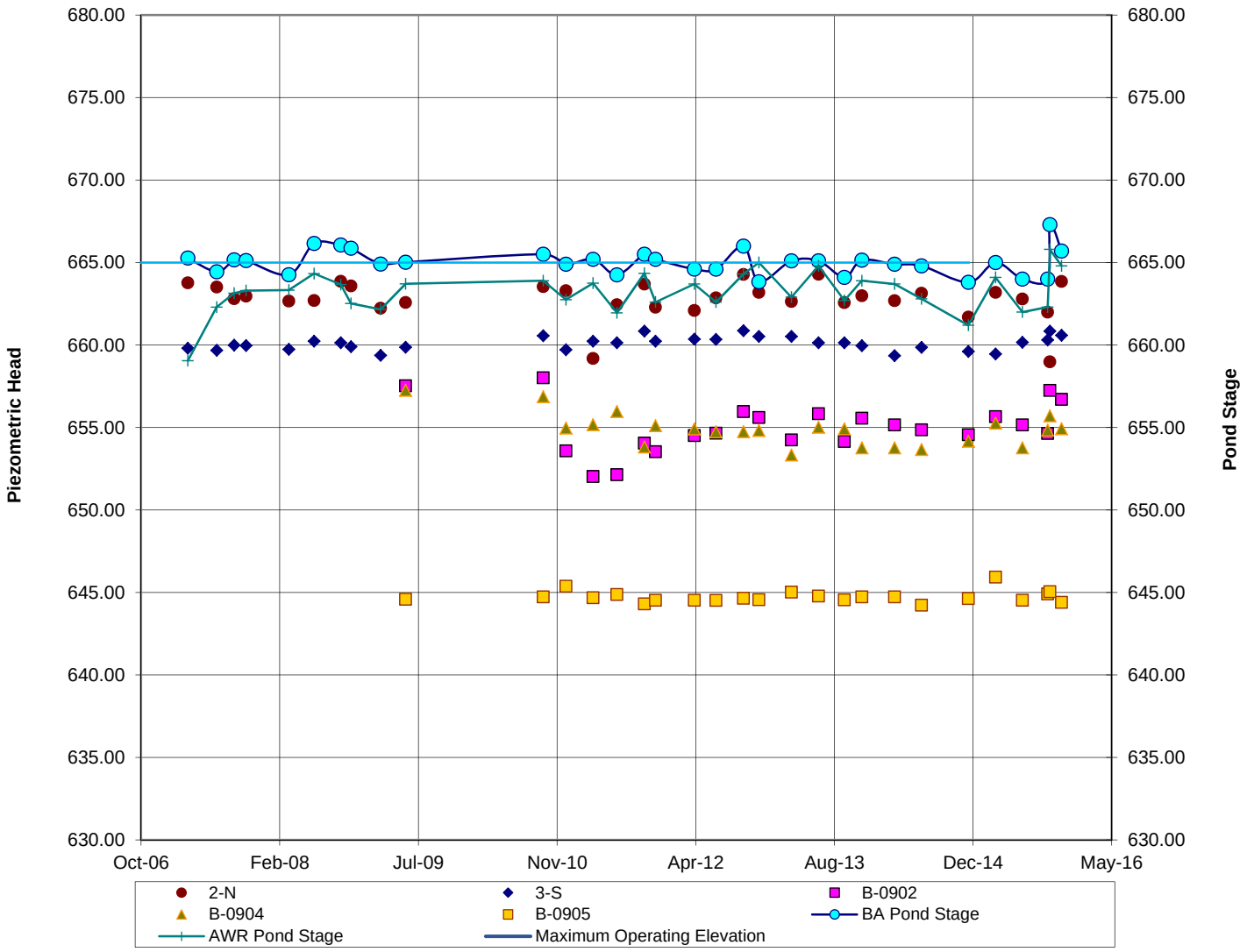
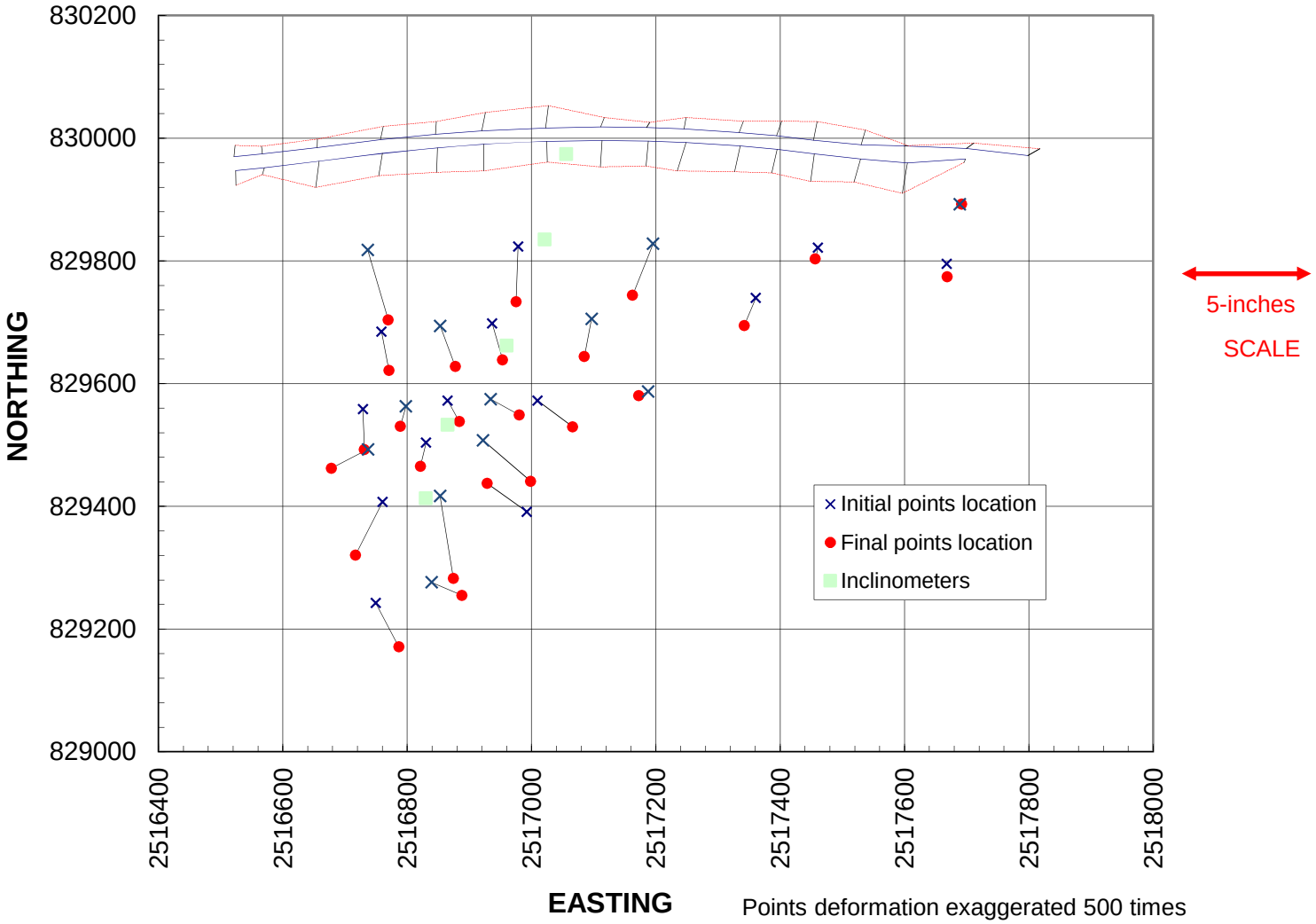


FIGURE 6A LATERAL MOVEMENT (October 2015)



DWG. NO.13-30083-C

FLY ASH RESERVOIR - II
EXIST. MAX OPERATING POOL EL. 960.0
PROPOSED MAX OPERATING POOL EL. 974.0
MARCH 2012 OPERATING POOL ~EL. 956

RIGHT ABUTMENT PLAN AND DETAILS, SEE DRAWING NO. I3-30088-1

WIDENED ACCESS ROAD

UPSTREAM AND DOWNSTREAM MSE WALL FACING PANEL

℄ SHEET PILE WALL

EXISTING SERVICE SPILLWAY, TO BE EXTENDED, SEE DRAWING NO. I3-30086-A

EXISTING TOP OF DAM EL. 970, PROPOSED TOP OF DAM EL. 983

EMERGENCY SPILLWAY AND DOWNSTREAM GRADING PLAN, SEE DRAWING NO. I3-30089-1

EXISTING ACCESS ROAD

TRANSITION MANHOLE

EXIST. TRANSMISSION TOWER

EXIST. FLY ASH SERVICE LINES

EXIST. SERVICE SPILLWAY OUTLET PIPE, SEE REFERENCE DRAWING FOR PROFILE

EXIST. TRANSMISSION TOWER

EXIST. EMERGENCY SPILLWAY

EXIST. SERVICE SPILLWAY OUTLET

N 830000
N 829500
E 2516500
E 2517000
E 2517500
E 2518000

A (DWG. I3-30087-I)
B1 (DWG. I3-30087-I)
B2 (DWG. I3-30087-I)
C (DWG. I3-30087-I)
D (DWG. I3-30087-I)
E (DWG. I3-30087-I)

LEGEND

- 900 — EXISTING CONTOUR 10FT INTERVAL
- 950 — PROPOSED GRADE CONTOUR 10FT INTERVAL
- EXISTING ACCESS ROADS
- EXISTING FLY ASH SERVICE LINES
- BENCHMARK
- EXISTING TREELINE
- SECTION NUMBER AND LOCATION

GENERAL NOTES

1. TOPOGRAPHIC MAPPING DEVELOPED FROM AERIAL SURVEY PERFORMED ON 3/5/2009

0 50 100
SCALE IN FEET

DATE	NO.	DESCRIPTION	APPD.
2/25/14	1	AS-BUILT SUBMITTAL	MGR
1/16/13	C	REVISED PER ODNR COMMENTS REC'D 12/4/2012	MGR
9/12/12	B	REVISED PER ODNR COMMENTS REC'D 7/18/12	MGR
5/23/12	A	ISSUED FOR PERMIT INITIAL SUMMITTAL	MGR

REVISIONS

CARDINAL OPERATING COMPANY

CARDINAL PLANT

BRILLIANT OHIO

DAM RAISING
FLY ASH RETENTION DAM II

DAM SITE PLAN

DWG. NO. I3-30083-I

ARCH — ELEC — MECH — STR

SCALE: AS SHOWN
DR:
CH:
QCD:
SUPV:
DATE:

APPROVED BY:

CIVIL ENGINEERING DIVISION

AMERICAN ELECTRIC POWER
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

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 — JAN 16, 2013 DATE

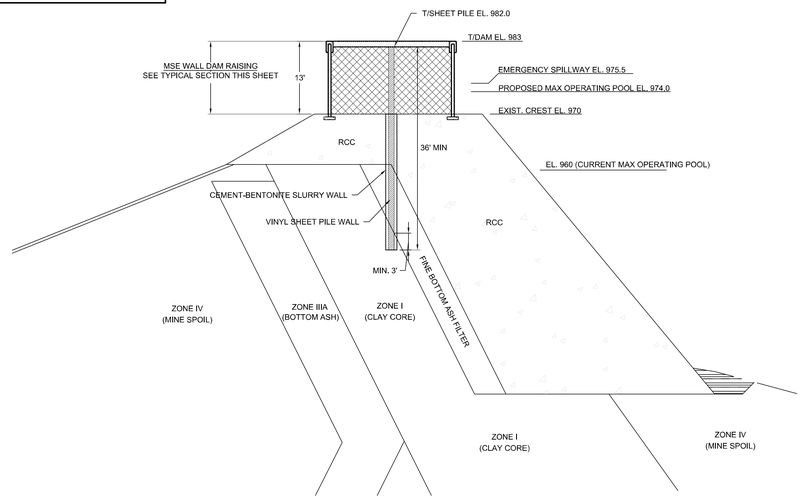
PROJECT NUMBER:	011-11497-042	DRAWN BY:	EDV
DRAWING DATE:	9/28/12	ENGINEER:	MTR
LAST UPDATED:	1/16/13	APPROVED BY:	MGR
		SCALE:	1" = 50'

S&ME

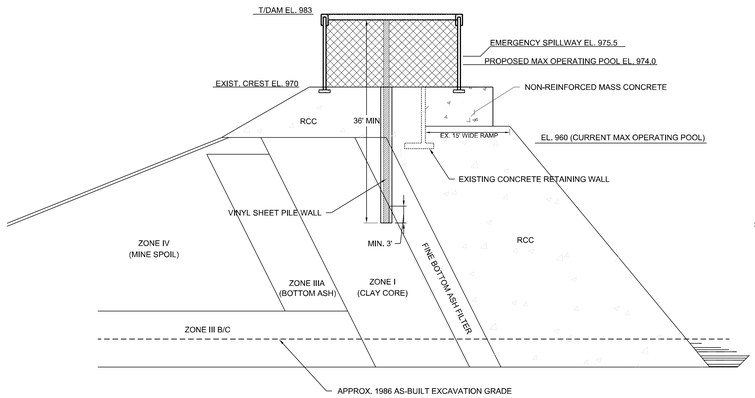
IGS1092

SYSTEM DATE= DD-MMM-YYYY
SYSTEM TIME= HOUR:MINUTE
IS4H FLR/CED

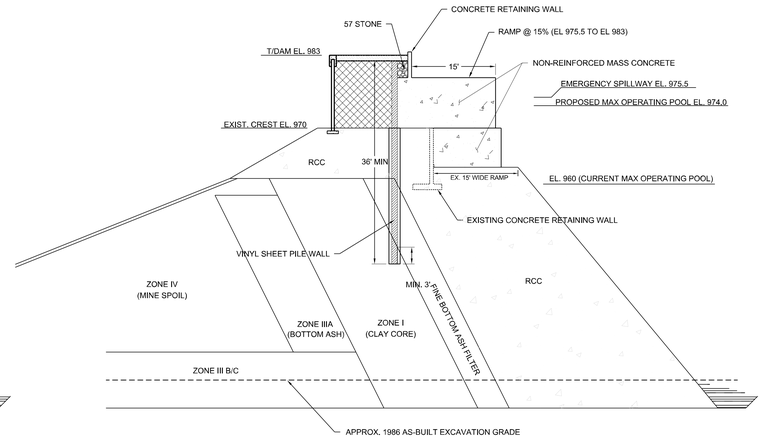
DWG. NO. 13-30087-C



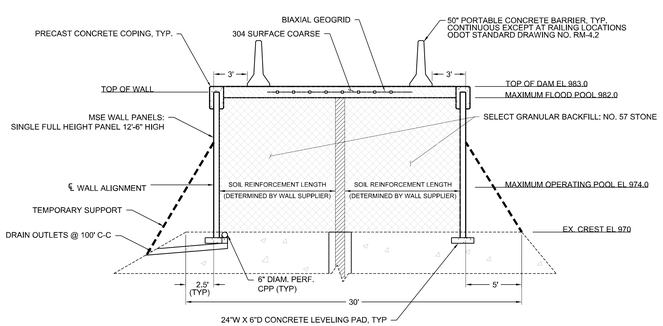
A TYPICAL SECTION - MAIN DAM
SCALE: 1" = 10'



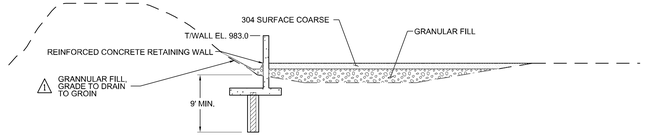
B1 SECTION THROUGH EXISTING EMERGENCY SPILLWAY RAMP
SCALE: 1" = 10'



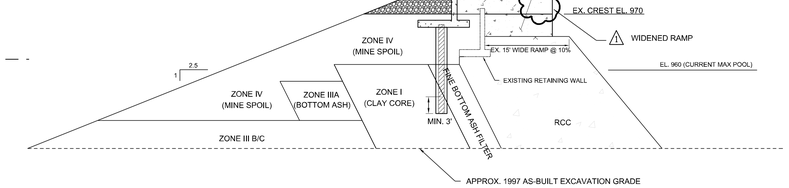
B2 SECTION THROUGH EXISTING EMERGENCY SPILLWAY RAMP
SCALE: 1" = 10'



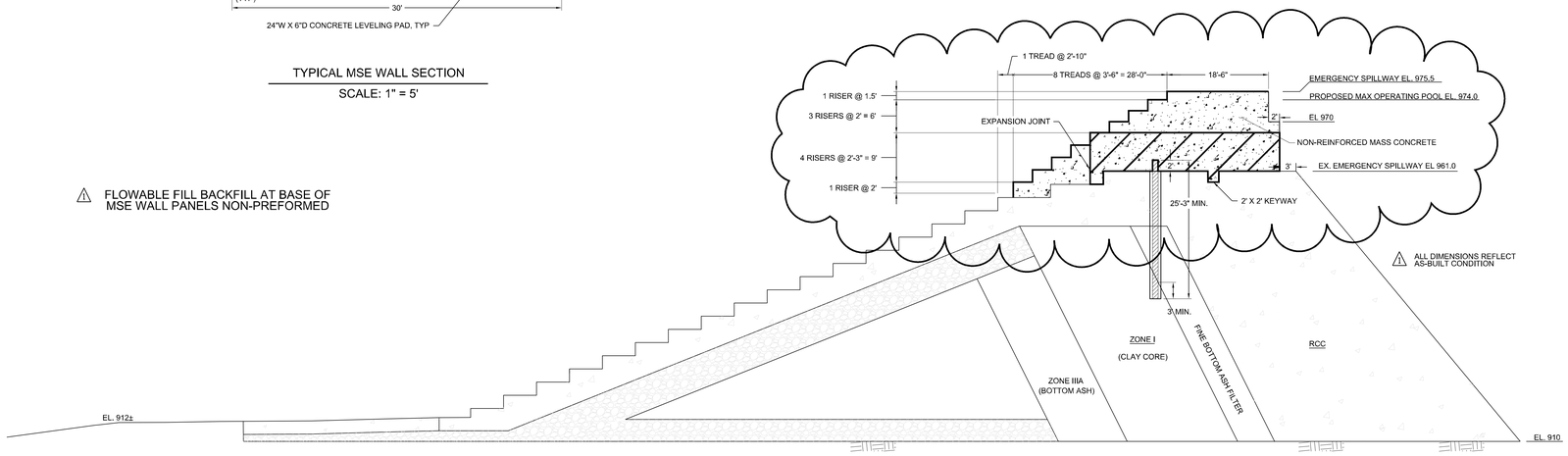
TYPICAL MSE WALL SECTION
SCALE: 1" = 5'



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



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



⚠ FLOWABLE FILL BACKFILL AT BASE OF MSE WALL PANELS NON-PREFORMED

⚠ MASS CONCRETE UP TO ELEVATION 968 UPSTREAM OF EXPANSION JOINT POURED MONOLITHICALLY AND CURED UTILIZING A THERMAL CONTROL PLAN. REMAINING NON-REINFORCED CONCRETE PLACED IN LIFTS EQUAL TO THE RISER HEIGHTS SHOWN

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

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MICHAEL GILBERT ROWLAND | E-65559 NUMBER | JAN 16, 2013 DATE

CARDINAL OPERATING COMPANY

CARDINAL PLANT

BRILLIANT OHIO

DAM RAISING
FLY ASH RETENTION DAM II
DAM RAISING
TYPICAL SECTIONS

DWG. NO. 13-30087-I

ARCH — ELEC — MECH — STR

SCALE: AS SHOWN

DR: CH: SUP'V: DATE:

APPROVED

CIVIL ENGINEERING DIVISION

AMERICAN ELECTRIC POWER

1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

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LAST UPDATED:	1/16/13	APPROVED BY:	MGR
		SCALE:	AS NOTED

S&ME

IGS\092

SYSTEM DATE: DD-MMM-YYYY
SYSTEM TIME: HOUR&MIN/E
154= FLAGED