J.M. Stuart Station
937-549-2641

April 22, 2013

Mr. Stephen Hoffman
U.S. Environmental Protection Agency (5304P)
1200 Pennsylvania Avenue, NW
Washington, DC 20460

RE: Action Plan Request for Dayton Power & Light's Killen Electric Generating Station

Dear Mr. Hoffman:

On March 14, 2013, Dayton Power and Light (DP&L) received the final report and recommendations regarding the June 2011 inspection of the coal combustion residual impoundments, which were performed by GZA GeoEnvironmental, Inc (GZA). Please note that the cover letter accompanying the final report was directed to our Hutchings Station rather than Killen Station. Future correspondence regarding Killen Station should be sent to:

Mr. David Orme, VP Power Production
Dayton Power & Light Company, PO Box 468; Aberdeen, Ohio 45101

We have reviewed the recommendations and are providing comments. Many of these items were taken from the DP&L inspection report provided by GZA and have already been completed. The following contains details of actions completed, as well as actions proposed by DP&L.

RECOMMENDATIONS from GZA - Studies and Analyses:

1. Survey of the crest of both ponds by a licensed Professional Surveyor to evaluate the current elevation profile of the crest and confirm that survey monuments are not moving horizontally. STATUS: *Killen Station's Ash Pond is equipped with settlement monuments which are surveyed every 5 years. GZA was provided the results of the February 23, 2009 survey. Survey results indicated that no significant changes had occurred in regard to settlement or horizontal movement. DP&L anticipates having another survey completed this year.*

2. Install piezometers/observation wells in the noted wet areas (between Stations 36+00 to 39+00 and in the vicinity of Stations 80+00 and 88+00) to evaluate water levels, and possibly water chemistry, in these areas. This activity may require consultation and/or design by a licensed Professional Engineer. STATUS: *The perimeter of the pond has 7 piezometers installed that are monitored on a monthly basis. DP&L does*

not believe additional piezometers will provide further significant information as to the stability of the structure. DP&L will continue to monitor the seepage in accordance with Best Management Practice as documented in ODNR Fact Sheet 94-31 which is provided for your convenience. We believe monitoring seepage water flow and clarity will provide more valuable information on changes in the dam's condition than additional piezometers.

3. Based on data from piezometers/observation wells, perform a seepage analysis and assess need for subsurface toe drainage in wet locations and make improvements as needed. STATUS: *The wet area from station 36+00 to 39+00 was caused by original surface grades sloping toward the toe of the dam. This area will be regraded in 2013 to prevent trapping of water at the toe of the dam. The area at station 80+00 was regraded in late 2012 and will be monitored to determine if further action is needed. In addition, drainage was improved at station 88+00 in early 2012 and has remained dry through the remainder of the year. This area will also be monitored on a regular basis.*
4. Resolve pending variance with ODNR regarding reducing the minimum freeboard requirement from five feet to three feet. STATUS: *ODNR approved the design freeboard of 3.50' as part of their original approval.*
5. Provide or perform spillway analysis to demonstrate capacity of discharge structures to accommodate the regulatory Spillway Design Flood with the proposed normal pool freeboard. STATUS: *Killen Station has an upland reservoir and receives no run on flow from storm events - only direct rainfall. As such, we feel the recommended study is not applicable.*
6. Provide or perform a slope stability analysis for the embankments. Analysis should include assessment of upstream slope stability in light of observed movement of riprap. Analysis may require a subsurface exploration program to develop appropriate input data. Most recent inspection should be provided to the EPA for review. STATUS: *We have attached a Slope Stability Analysis as well as the most recent inspection report for your review. The beaching noted in the GZA inspection was a result of wave action. Fabric below the stone is still intact indicating no displacement in structural material. Stone in this area has been replaced with larger stone to prevent future displacement.*

RECOMMENDATIONS from GZA - Operation & Maintenance Activities:

1. Clear vegetation from the interior embankment slopes of both ponds. STATUS: *This work was completed in 2011. Maintenance efforts have increased to ensure this vegetation is controlled.*
2. Remove stumps that are 4-inches or more in diameter resulting from the removal of trees and brush on the outer embankment near Station 3+00. STATUS: *DP&L has removed all stumps (4"and greater) from the pond dam.*

3. Install a staff gauge on or near the pump station inlet structure in order to take periodic measurements of the Bottom Ash Pond water surface elevation. STATUS: *In 2013, DP&L will install a staff gauge in the bottom ash portion of the pond as recommended.*
4. Inspect each of the piezometers around the toe of the pond embankments and ensure each piezometers *[sic]* has a cap, lockable protective cover/casing and is visible during mowing operations. STATUS: *DP&L will install steel casings with locks. All wells have been inspected and are in good condition.*
5. Ensure each survey monument is protected and is visible during mowing operations. STATUS: *DP&L will ensure each survey monument is protected and clearly visible. Damaged bollards will be replaced.*
6. If DP&L has the opportunity to stop discharging from the Bottom Ash Pond for a limited time period, inspect the discharge pipes from the pump station inlet structure to the ash water pumps to verify that they are operating correctly and are in good condition. This may be performed by video photography. STATUS: *Due to fugitive dust concerns, DP&L was unable to lower the water level in the bottom ash portion of the pond to perform an internal inspection. The horizontal portion of the pipe is encased in another pipe. Based on a visual inspection, this pipe appears to be in good condition and is not leaking.*
7. If DP&L has the opportunity to stop discharging from the Fly Ash Pond for a limited time period, inspect the discharge pipes from the decant structure to the outfall structure to verify that they are operating correctly and are in good condition. This may be performed by video photography. STATUS: *DP&L completed a portion of this inspection during the 2013 Spring outage. The water level in the pond was lowered so that flow could be stopped. Due to fugitive dust issues that occurred, this will only be attempted in emergency situations.*

RECOMMENDATIONS from GZA - Repairs:

1. Clear the area of established vegetation near the lower portion and toe of the outer embankment slopes near the outfall structure. STATUS: *Clearing work was completed in 2012. Maintenance and mowing activities have increased to control vegetation in these areas.*
2. Restore riprap in sections where displacement has occurred. STATUS: *Riprap repairs were completed in 2011 and 2012. DP&L continues to monitor and will perform repairs as needed.*

If you have questions, please contact John Hendrix at 937.549.2641, Ext. 5835, or john.hendrix@aes.com.

Sincerely,

David Orme
Vice President, Power Production
Stuart and Killen Stations

Ohio Department of Natural Resources

Division of Soil and Water Resources

Fact Sheet

Fact Sheet 94–31

Dam Safety: Seepage Through Earthen Dams

Contrary to popular opinion, wet areas down stream from dams are not usually natural springs, but seepage areas. Even if natural springs exist, they should be treated with suspicion and carefully observed. Flows from ground-water springs in existence prior to the reservoir would probably increase due to the pressure caused by the pool of water behind the dam.

All dams have some seepage as the impounded water seeks paths of least resistance through the dam and its foundation. Seepage must, however, be controlled to prevent erosion of the embankment or foundation or damage to concrete structures.

Detection

Seepage can emerge anywhere on the downstream face, beyond the toe, or on the downstream abutments at elevations below normal pool. Seepage may vary in appearance from a "soft," wet area to a flowing "spring." It may show up first as an area where the vegetation is lush and darker green. Cattails, reeds, mosses, and other marsh vegetation often become established in a seepage area. Another indication of seepage is the presence of rust-colored iron bacteria. Due to their nature, the bacteria are found more often where water is discharging from the ground than in surface water. Seepage can make inspection and maintenance difficult. It can also saturate and weaken portions of the embankment and foundation, making the embankment susceptible to earth slides.

If the seepage forces are large enough, soil will be eroded from the foundation and be deposited in the shape of a cone around the outlet. If these "boils" appear, professional advice should be sought immediately. Seepage flow which is muddy and carrying sediment (soil particles) is evidence of "piping," and will cause failure of the dam. Piping can occur along a spillway and other conduits through the embankment, and these areas should be closely inspected. Sinkholes may develop on the surface of the embankment as internal erosion takes place. A whirlpool in the lake surface may follow and then likely a rapid and complete failure of the dam. Emergency procedures, including downstream evacuation, should be implemented if this condition is noted.

Seepage can also develop behind or beneath concrete structures such as chute spillways or headwalls. If the concrete structure does not have a means such as weep holes or relief drains to relieve the water pressure, the concrete structure may heave, rotate, or crack. The effects of the freezing and thawing can amplify these problems. It should be noted that the water pressure behind or beneath structures may also be due to infiltration of surface water or spillway discharge.

A continuous or sudden drop in the normal lake level is another indication that seepage is occurring. In this case, one or more locations of flowing water are usually noted downstream from the dam. This condition, in itself, may not be a serious problem, but will require frequent and close monitoring and professional assistance.

Control

The need for seepage control will depend on the quantity, content, and location of the seepage. Reducing the quantity of seepage that occurs after construction is difficult and expensive. It is not usually attempted unless the seepage has lowered the pool level or is endangering the embankment or appurtenant structures. Typical methods used to control the quantity of seepage are grouting or installation of an upstream blanket. Of these methods, grouting is probably the least effective and is most applicable to leakage zones in bedrock, abutments, and foundations. These methods must be designed and constructed under the supervision of a professional engineer experienced with dams.

Continued on back!

Controlling the content of the seepage or preventing seepage flow from removing soil particles is extremely important. Modern design practice incorporates this control into the embankment through the use of cut-offs, internal filters, and adequate drainage provisions. Control at points of seepage exit can be accomplished after construction by installation of toe drains, relief wells, or inverted filters.

Weep holes and relief drains can be installed to relieve water pressure or drain seepage from behind or beneath concrete structures. These systems must be designed to prevent migration of soil particles but still allow the seepage to drain freely. The owner must retain a professional engineer to design toe drains, relief wells, inverted filters, weep holes, or relief holes.

Monitoring

Regular monitoring is essential to detect seepage and prevent dam failure. Knowledge of the dam's history is important to determine whether the seepage condition is in a steady or changing state. It is important to keep written records of points of seepage exit, quantity and content of flow, size of wet area, and type of vegetation for later comparison. Photographs provide invaluable records of seepage.

All records should be kept in the operation, maintenance, and inspection manual for the dam. The inspector should always look for increases in flow and evidence of flow carrying soil particles, which would indicate that a more serious problem is developing. Instrumentation can also be used to monitor seepage. V-notch weirs can be used to measure flow rates, and piezometers may be used to determine the saturation level (phreatic surface) within the embankment.

Regular surveillance and maintenance of internal embankment and foundation drainage outlets is also required. The rate and content of flow from each pipe outlet for toe drains, relief wells, weep holes, and relief drains should be monitored and documented regularly. Normal maintenance consists of removing all obstructions from the pipe to allow for free drainage of water from the pipe. Typical obstructions include debris, gravel, sediment, and rodent nests. Water should not be permitted to submerge the pipe outlets for extended periods of time. This will inhibit inspection and maintenance of the drains and may cause them to clog.

Any other questions, comments concerns, or fact sheet requests, should be directed to:

Ohio Department of Natural Resources
Division of Soil and Water Resources
Dam Safety Engineering Program
2045 Morse Road
Columbus, Ohio 43229-6693
Voice: (614) 265-6731 Fax: (614) 447-9503
E-mail: dswc@dnr.state.oh.us
Website: http://ohiodnr.gov/soilandwater
Emergency 24hr hotline: 614-799-9538

VI. DETAILED ANALYSES AND CONCLUSIONS

A. SETTLEMENT ANALYSES

Detailed static settlement analyses have been performed to determine the settlement due to consolidation within the dike fill materials and in the foundation materials beneath the dikes. The analyses were performed using the Terzaghi one-dimensional consolidation theory and the results of consolidation tests performed on the dike fill and foundation materials. Influence values for vertical stresses under embankment loads were obtained from the U.S. Navy Design Manual for Soil Mechanics, Foundations, and Earth Structures (NAVDOCK DM-7, Reference 2).

The estimated total settlement for perimeter and interior dikes is shown on Figure 11. The maximum expected settlement is on the order of 12 inches. Any settlement in the deep granular foundation will occur rapidly with the application of the load, and no appreciable settlement will occur in this stratum upon completion of the dikes. Approximately 50 percent of the estimated settlement in the dike and upper foundation materials will occur during construction. Thus, the maximum amount of settlement that could be expected in the post-construction period is on the order of 6 inches at the crest of the dike. Post-construction settlement is only of major concern for the higher portions of the dike (over 60 feet high). To compensate for this post-construction settlement, all sections of the dike over 60 feet high will be overbuilt 6 inches to Elevation 573.5.

B. SLOPE STABILITY ANALYSES

1. General

Typical and critical cross-sections (Figure 12) were selected for analyses from the results of the detailed subsurface investigation. The location and description of different soil strata were determined by the use of boring records and standard penetration tests, field descriptions, and laboratory test results.

Two (2) cross-sections of the perimeter dike and one (1) cross-section of the interior dike were selected for analysis. A typical cross-section of the perimeter dike is 53 feet high and consists of an impervious core with random fill zones in the upstream and downstream slopes. The most critical cross-section of the perimeter dike occurs at its maximum height of 87 feet, where the dike crosses Spring Run in the southwest corner of the ash pond. This section was conservatively analyzed by assuming that continuous horizontal strata exist at the maximum height, neglecting the effects of the sloping creek banks which are 25 to 30 feet high (a three-dimensional analysis would give a higher factor of safety). A typical section of the interior dike is 45 feet in height and consists entirely of random fill materials.

B. SLOPE STABILITY ANALYSES (Continued)

Two (2) sets of shear strength data were used in each analysis. Drained (effective) soil strength parameters were used to model long-term static conditions in which any build-up of pore pressure in the soil due to construction is considered to be dissipated. Undrained (total) strength parameters were used to model conditions where pore pressures have been built up due to relatively quick load appliation, as occurs during construction or during dynamic loading. Average soil strength parameters were considered for these analyses. The basis for selection of these strength properties is discussed in Section IV.B.2.

Two (2) methods of analyses, the U.S. Army Corps of Engineers sliding wedge method and the M.I.T.ICES-LEASE I slip-circle computer program, were used to investigate the stability of the slopes.

The criteria for the minimum acceptable factors of safety for the ash pond dikes were established, as follows:

Minimum Factor of Safety	Type Of Analysis	Model Conditions
1.50	Static	Long-Term
1.30	Static	Construction
1.20	Dynamic	Long-Term

These minimum factors of safety are based on normally accepted state and federal standards and good engineering judgement.

The perimeter dikes were also analyzed for high water conditions in the Ohio River (up to Elevation 526.0). The interior dike was analyzed for differential head which occurs during initial filling of the pond.

2. Slip-Circle Analyses

The M.I.T. ICES-LEASE I computer program employs the simplified Bishop approach in which a circular failure surface is assumed to form about its center of rotation. The circle through the slope is then divided into vertical slices and the tangential resisting and driving forces along the circular surface are computed for each slice. The factor of safety against sliding is computed as the ratio of the sum of the resisting moments taken about the center of rotation to the sum of the driving moments taken about the center of rotation.

Use of the program requires that slope geometry be fully defined on a coordinate grid system including changes in soil layers. All soils encountered on and beneath the slope being analyzed must be fully defined with respect to saturated unit weight and shear strength. Water level along the slope must also be defined, i.e., whether it is free standing water, groundwater or pore pressure built up within the soil. Finally, the horizontal and vertical components of seismic acceleration are input into the program.

The program utilizes a search routine to find the radius and center of rotation yielding the circle with the lowest factor of safety. A trial center is selected and different radii investigated, computing the factor of safety for each radius. The center of rotation is moved in prescribed increments in both the vertical and horizontal directions and the above process repeated until the lowest safety factor is found.

The simplified Bishop method yields conservative results in that shear resistance between slices which would tend to raise the factor of safety against sliding is neglected. Additional conservatism is built into the program for computing safety factors under dynamic loading by assuming the components of the seismic acceleration act only in one direction, neglecting any back and forth motion, and the magnitude of the acceleration is constant over the entire slope for an infinite period of time.

3. Sliding Wedge Method

The sliding wedge method of slope stability analysis, originally developed by the U.S. Army Corps of Engineers, assumes failure by sliding on an inclined and/or horizontal plane located within the slope. An Ebasco in-house computer program, WEDGE, was used to perform the analyses on the ash pond dikes.

The method utilized an active soil wedge which is mobilized against a neutral horizontal block and a passive resisting wedge. The factor of safety is calculated as the ratio of the sum of the resisting forces in the horizontal directon to the sum of driving forces in the horizontal direction. In applying the sliding wedge method to the site conditions, the possible failure planes to be analyzed were selected initially in such a manner as to have no passive wedge. This would yield more conservative results than if a passive resisting wedge were considered. The width of the neutral block was then varied in increments to find the lowest factor of safety.

B. <u>SLOPE STABILITY ANALYSES</u> (Continued)

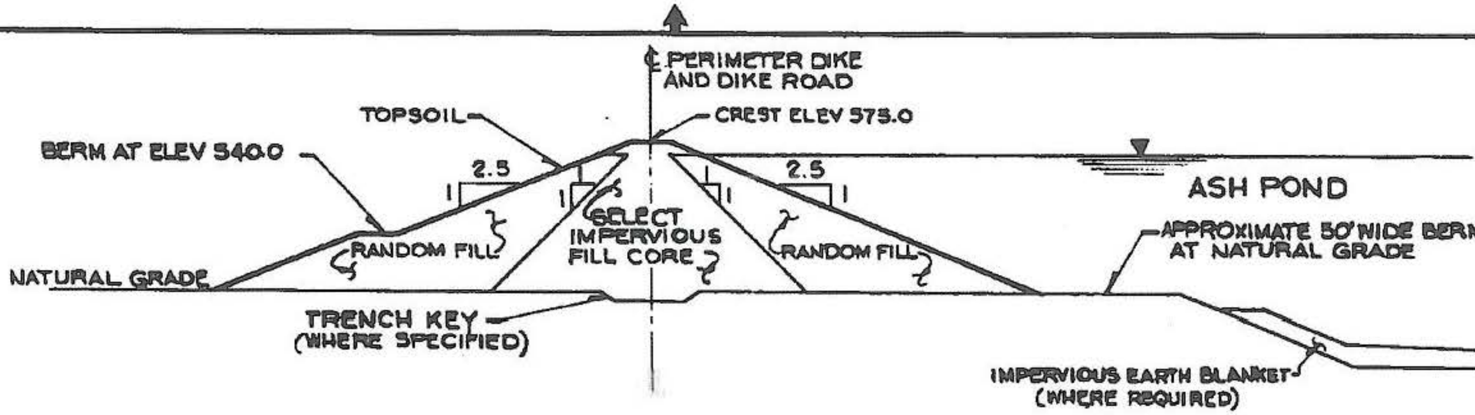
Factors of safety calculated using the sliding wedge method are comparable to those obtained using the slip-circle method.

4. <u>Conclusions of Slope Stability Analyses</u>

Analyses of the perimeter and interior dike slopes indicate all slopes are stable at 2.5 horizontal to 1.0 vertical with respect to large scale movements under static and dynamic loading conditions. There were two (2) controlling cases considered for analyses. The long-term condition is of primary concern, in that the ash pond will be initially filled with water and will be operated full for the life of the ash pond. In the long-term case, pore pressures are considered to be negligible and effective soil strengths were used. The construction case was analyzed to determine the effect of excess pore pressures, particularly in the impervious core. Pore pressures in the random zones of the perimeter dike and in the interior dikes are expected to dissipate quickly, due to the granular nature of the materials in the fill. Sudden drawdown was not a design consideration as there is no provision to allow rapid drainage of the pond.

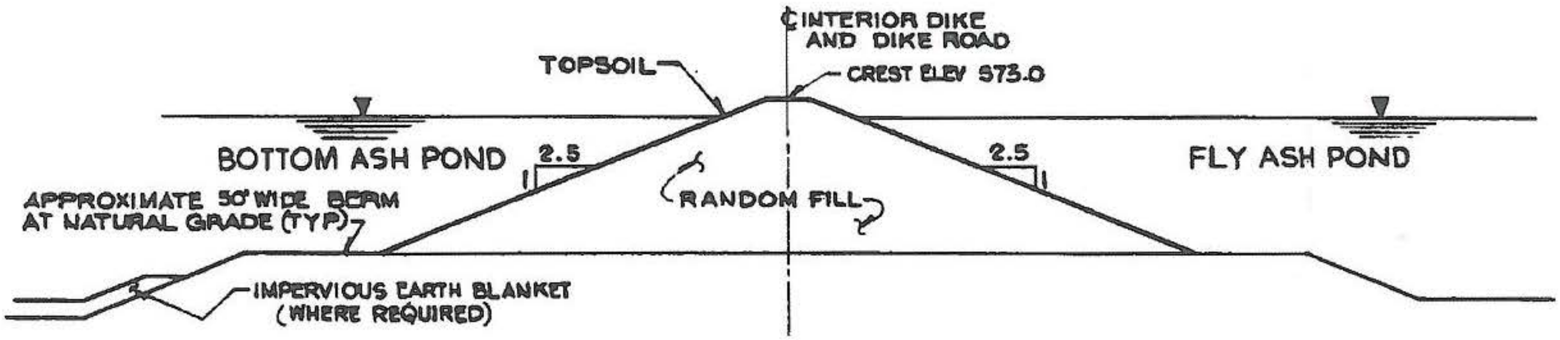
The free water surface in the perimeter dike and the river level elevation were varied for the various cases considered. The most critical case occurs, when the river level is at normal pool elevation. When the river level is at maximum elevation, the stability is slightly improved due to a reduction in driving forces within the critical sliding mass. The random fill shell permits rapid dissipation of pore pressures in the core without endangering the stability of the dike.

Factors of safety obtained for the long-term conditions using the slip-circle method were 1.90 or greater for static analysis and 1.20 or greater for dynamic analyses. Factors of safety obtained from the construction case using the slip-circle method were 1.30 or greater. The factors of safety for the most critical cases are shown on Figure 12. Factors of safety obtained using the sliding wedge analysis were generally somewhat higher than those obtained using the slip-circle method.



TYPICAL SECTION - PERIMETER DIKE

SCALE 1" = 40'



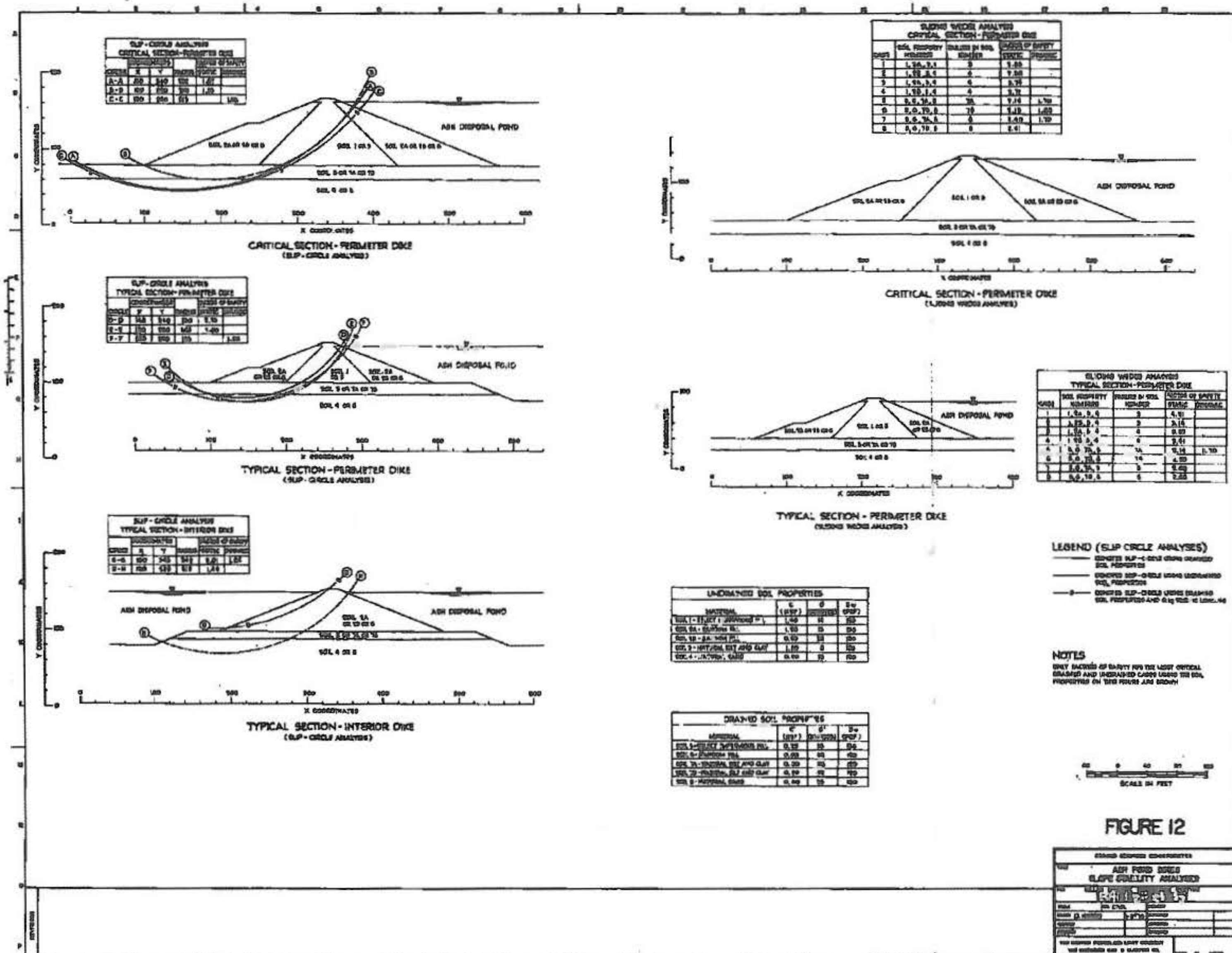
TYPICAL SECTION - INTERIOR DIKE

SCALE 1" = 40'

KILLEN STATION

TYPICAL SECTIONS
ASH POND DIKES

FIG 4


CRITICAL SECTION - PERIMETER DIKE
(SLIP-CIRCLE ANALYSIS)
TYPICAL SECTION - PERIMETER DIKE
(SLIP-CIRCLE ANALYSIS)
TYPICAL SECTION - INTERIOR DIKE
(SLIP-CIRCLE ANALYSIS)
CRITICAL SECTION - PERIMETER DIKE
(SLIDING WEDGE ANALYSIS)
TYPICAL SECTION - PERIMETER DIKE
(SLIDING WEDGE ANALYSIS)
ASH DISPOSAL POND
X COORDINATES
Y COORDINATES
UNDRAINED SOIL PROPERTIES
DRAINED SOIL PROPERTIES
LEGEND (SLIP CIRCLE ANALYSES)
NOTES
SCALE IN FEET
ASH POND DIKES
SLOPE STABILITY ANALYSES
FIGURE 12