

**REPORT ON  
GROUNDWATER MONITORING PROGRAM  
F.B CULLEY GENERATING STATION EAST ASH POND  
WARRICK COUNTY, INDIANA**

by Haley & Aldrich, Inc.  
Greenville, South Carolina

for Southern Indiana Gas and Electric Company  
Evansville, Indiana

File No. 129420-006  
October 2017





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17 October 2017  
File No. 129420-006

SIGECO Corporation  
P.O. Box 209  
Evansville, Indiana 47702-0202

Attention: Ms. Lisa C. Messinger

Subject: Groundwater Monitoring Program  
F.B. Culley Generating Station  
Warrick County, Indiana

Dear Ms. Messinger:

Haley & Aldrich, Inc. (Haley & Aldrich) is pleased to submit this Groundwater Monitoring Program (GMP) report for the F.B. Culley Generating Station East Ash Pond (Ash Pond). This GMP was developed to comply with the United States Environmental Protection Agency (USEPA) Coal Combustion Residual (CCR) Rule dated 17 April 2015 (Rule), and is based on our review of the existing data on hydrogeology and groundwater quality and considering other site conditions at the F.B. Culley Generating Station. This GMP addresses the Detection Monitoring step specified in the CCR Rule, which requires monitoring for existing CCR management facilities, or units, and includes specifications for location of the monitoring wells, sampling and chemical analysis procedures, and collection of groundwater quality data for the Appendix III and Appendix IV list of constituents for statistical analysis to determine if the next step of groundwater monitoring (Assessment Monitoring) is required.

Sincerely yours,  
HALEY & ALDRICH, INC.

A handwritten signature in blue ink that reads "Mark Miesfeldt".

Mark Miesfeldt  
Hydrogeologist

A handwritten signature in black ink that reads "Steven F. Putrich".

Steven F. Putrich, P.E.  
CCR Program Manager

Enclosures

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# 1. Introduction

Haley & Aldrich, Inc. (Haley & Aldrich) was retained by Southern Indiana Gas and Electric Company (SIGECO) to perform technical services associated with development of a groundwater monitoring program (GMP) that complies with the April 17, 2015 Coal Combustion Residuals (CCR) Rule (Rule) published by the U.S. Environmental Protection Agency (USEPA). Haley & Aldrich has prepared this GMP on behalf of SIGECO for the F.B. Culley Generating Station (Site) located in Warrick County near the communities of Yankeetown and Newburgh, Indiana. According to the CCR Rule, the first step in groundwater monitoring at existing CCR units is Detection Monitoring, which requires construction of an adequate groundwater monitoring network established in the uppermost aquifer from which a minimum of 8 rounds of representative hydrological and groundwater quality data must be obtained by October 17, 2017 as defined in the CCR Rule §257.94. This GMP was prepared in general accordance with the USEPA “Sampling and Analysis Plan Guidance and Template” (USEPA, 2000), to establish a groundwater monitoring program at the Site that complies with the groundwater monitoring requirements of the USEPA CCR Rule for existing CCR units. The groundwater monitoring requirements of the Rule are provided in Appendix A of this document, as outlined in 40 CFR §257.90 through §257.98, including the accompanying list of constituents in Appendices III and IV for the analysis of groundwater.

There are three groundwater monitoring components referenced in the CCR Rule that together describe the groundwater monitoring activities being undertaken. One component is the GMP which provides a summary of relevant background information and Site geology and hydrogeology along with a detailed description of the groundwater monitoring network and sampling program. The second component is the Groundwater Sampling and Analysis Plan (GWSAP) which is based on the CCR Rule specifications in §257.93 and describes the sampling and chemical analysis procedures and processes that are followed to obtain representative and technically defensible groundwater monitoring results. The third component describes the methods for the statistical analysis of the collected groundwater quality data as required by the Rule to determine whether a Statistically Significance Increase (SSI) of Appendix III constituents in the downgradient wells, compared to upgradient/background well(s), has occurred. The statistical methodology is provided separately and is based on the CCR Rule-specified statistical methods in §257.93 paragraphs f(1) through f(5).

## 1.1 SITE SETTING

The location of the Site is shown on Figure 1. The Site is located on the northern bank of the Ohio River approximately three miles east of the town of Newburgh. The Site varies in elevation with natural ground surface elevations varying from 430 to 359-feet above mean sea level (msl). Higher elevations are north of the Ash Pond with surface topography sloping to the west and south towards the Ohio River. Surface water runoff occurs via sheet flow into low lying areas towards the Ohio River and Little Pigeon Creek.

## 1.2 SITE HISTORY

The F.B. Culley Generating Station was constructed in 1953 with design plans prepared by Commonwealth and Associates Inc. Plant development involved excavating a portion of the hillsides to the north and placing the material as fill to the south. Little Pigeon Creek originally flowed east-to-west across the property. To facilitate construction of the generating station, Little Pigeon Creek was

diverted, joining the Ohio River near the southeastern property boundary. SIGECO currently owns and operates the Site and supplies electric power to the industrial, commercial, and residential customers in its service territory. The Site utilizes two coal-fired units to generate power utilizing steam. Coal combustion residuals are currently managed on the Site in a 9.8-acre Ash Pond. A Site Index Map is provided as Figure 2.

The Ash Pond, was constructed and commissioned in 1971 and is primarily an incised pond except for the east bank. The surface area of the impoundment is approximately 9.8 acres and is composed of several small pools with a surface area of approximately 7.26 acres. The east bank is an earthen dike constructed during the diversion of Little Pigeon Creek in 1953. Modifications to the Ash Pond occurred from 1992 to 1993 by filling an approximately 14,000 square foot area in the southwest corner to build a pad for new scrubber silos.

### **1.3 PREVIOUS INVESTIGATIONS**

Haley & Aldrich reviewed numerous historical boring logs and cross sections created prior to construction of the generating station. These subsurface explorations were relied upon by Haley & Aldrich in the development of the groundwater monitoring program.

## 2. Site Geology and Hydrogeology

### 2.1 SITE GEOLOGY

The Ohio River valley contains alluvial (river) and loess (windblown) deposits derived indirectly from continental ice sheets. The unconsolidated alluvial materials were transported down the Ohio River Valley in meltwater heavily loaded with entrained coarse-grained sediments deposited on top of the Pennsylvanian age shale, limestone and sandstone bedrock. Westerly winds simultaneously deposited fine-grained silty sediments. As a result, base levels of the valley floor increased in elevation and created natural levees and outwashes. These natural levees produced slackwater lakes which deposited thick sequences of silt and clay. When the ice sheets retreated, the sediment load in the Ohio River diminished and lowered base levels. Consequently, the river incised the slackwater lake sediments, sculpted lacustrine terraces, and deposited silty and clayey stream alluvium.

Soil borings drilled at the Site indicate that in the vicinity of the Ash Pond the uppermost geologic unit is comprised of alluvial deposits consisting of primarily silts and clays. In the upland areas to the north, the alluvial deposits are absent but instead consist of discontinuous layers of sand and consolidated shale.

The Site is located in the vicinity of the Wabash Valley and New Madrid seismic zones. The largest earthquake recorded (magnitude 5.2) proximal to the Site occurred in April 18, 2008 approximately 50 miles northwest of the facility.

### 2.2 SITE HYDROGEOLOGY

Hydrogeologic units are defined based on their ability to transmit groundwater or serve as confining units between zones of groundwater. In the vicinity of the Ash Pond, the uppermost aquifer occurs within unconsolidated Ohio River alluvial deposits consisting of silt and clay with discontinuous interbedded layers of sand. To the north of the Ash Pond the uppermost aquifer occurs in the shale and sandstone bedrock units. Recharge to the surficial aquifer occurs through direct surface infiltration.

Piezometric data recorded from the monitoring wells installed on-site shows that the configuration of the uppermost aquifer is primarily controlled by surface topography with some influence from the underlying weathered bedrock. Groundwater flow in the immediate vicinity of the Ash Pond is radial with an overall flow direction from the upland areas north of the Ash Pond to the south toward the Ohio River. Groundwater elevations vary seasonally but the groundwater flow patterns remain consistent.

Groundwater flow velocity in the uppermost aquifer beneath the Ash Pond was estimated using site-specific hydraulic conductivity, measured hydraulic gradients, and an assumed effective porosity of 25 percent. Hydraulic conductivity varied from  $1.3E-3$  cm/sec adjacent to the northern boundary of the Ash Pond to  $5.5E-5$  cm/sec in the upland area north of the Ash Pond. The hydraulic gradient north of the Ash Pond is 0.06 feet/foot. South of the Ash Pond the hydraulic gradient steepens to 0.1 feet/foot down to the Ohio River. Using the site-specific hydraulic conductivity and hydraulic gradients, and assuming an effective porosity of 25 percent the groundwater flow north of the Ash Pond is estimated to be 325 feet/year. To the south of the Ash Pond groundwater flow is estimated to be 25 feet/year.



### **3. Groundwater Monitoring Program**

Haley & Aldrich developed the groundwater monitoring program outlined below after reviewing and evaluating the existing hydrogeologic and groundwater quality data provided by SIGECO, the hydrogeological characterization results, and considering the performance standards provided in the CCR Rule §257.91. The groundwater monitoring program includes a sufficient number of wells installed at appropriate locations and depths to obtain representative groundwater samples from the uppermost aquifer. Groundwater sampling locations have been established to accurately represent background groundwater quality, not affected by the potential releases from the CCR management unit as well as the quality of groundwater passing the waste boundary of the CCR management unit.

There is one CCR facility subject to the CCR Rule-required groundwater monitoring at Site; the Ash Pond, as depicted on Figure 2. The other on-site pond, the West Ash Pond, was originally classified as inactive and is subject to modified compliance timeframes as listed in the Remand Rule dated August 2016. Details of the groundwater monitoring program for the East Ash Pond are further described below.

#### **3.1 GROUNDWATER MONITORING NETWORK FOR THE ASH POND**

The Ash Pond at the Site is located to the west of the Little Pigeon Creek. Groundwater flow in the uppermost aquifer generally follows surface topography and is influenced by weathered bedrock as shown in Figure 3. Groundwater flow in the immediate vicinity of the Ash Pond is radial. Thus, to be properly located, downgradient wells were installed along the perimeter of the unit. Haley & Aldrich concluded that the six downgradient monitoring wells (CCR-AP-2, CCR-AP-3, CCR-AP-4, CCR-AP-5, CCR-AP-6 and CCR-AP-8), located at the boundary of the unit, and screened in the uppermost aquifer, adequately monitor the potential release and migration of ash constituents from the pond, should that occur. The location of these six downgradient groundwater monitoring wells is shown on Figure 4. Well placement has been determined based on interpretations of site-specific hydrogeology including groundwater flow directions and rates of groundwater movement. The groundwater monitoring well network for the Ash Pond complies with the Rule by monitoring the uppermost aquifer at the CCR facility. Based on the groundwater flow pattern in the area of the Ash Pond, the upgradient (unaffected by the CCR unit) background monitoring wells are identified as CCR-AP-1, CCR-AP-7, and CCR-AP-9 located north of the Ash Pond as shown in Figure 4, which are also installed in the uppermost aquifer. The three upgradient wells provide spatial variability in the background groundwater quality and increases the statistical power of the data analysis. Therefore, the complete groundwater network for the CCR Rule for the Ash Pond consists of six downgradient wells and three upgradient/background wells. A summary of the monitoring network recommended for the Ash Pond along with well construction details is provided in Table 1.

#### **3.2 MONITORING WELL CONSTRUCTION AND DOCUMENTATION**

As described above, the groundwater monitoring program includes six downgradient monitoring wells located around the Ash Pond (CCR-AP-2, CCR-AP-3, CCR-AP-4, CCR-AP-5, CCR-AP-6 and CCR-AP-8), and three upgradient/background well on the north side of the facility (CCR-AP-1, CCR-AP-7 and CCR-AP-9). Boring logs and well construction diagrams for these wells are included in Appendix B.

With respect to the Ash Pond area, the monitoring wells were constructed with 2-inch Inside Diameter (ID) Schedule 40 PVC casing; a 10-foot long, 0.01-inch machine slotted PVC screen; and a locking, steel,

5-foot long protective casing or a steel, 8-inch flush mount manway covers. When possible, the well screen was placed so that the encountered water table was approximately five feet above the top of the well screen. Seasonal low water table elevations were used to determine if sufficient space was available to maintain five feet of water above the well screens and remain within the uppermost aquifer. Boring logs and construction diagrams for the monitoring wells are provided in Appendix B of this report. Groundwater samples are collected from the mid-point of the well screen approximately 5- to 10-feet below the water table depending on water table conditions at the time of sampling.

At each monitoring well, the top of the PVC well casing was surveyed by a registered Indiana surveyor to within 0.01 foot, and the ground surface was surveyed to 0.1 foot. The surveyed top of the well casing, identified on each well, was used for measuring and recording water levels. Each sample location was surveyed to North American Datum of 1988 (NAD88). A summary of the survey results for the monitoring wells, with horizontal and vertical coordinates, is added to Table 1.

All downhole drilling equipment was cleaned prior to use at the next well location. Well casing and screens were new and protected by factory packaging. Wells were installed according to the procedures described below.

Wells were installed using conventional hollow-stem auger drilling and rock coring techniques. Soil sampling was performed while advancing the borehole using standard split-spoon sampling on five-foot centers to provide samples for soil descriptions and to estimate the depth to groundwater. After the borehole was advanced approximately 15 feet below the water table, well casing and screen was placed through the augers to the bottom of the borehole. Filter sand was added by gravity to approximately 2 feet above the top of the well screen as the augers were withdrawn from the borehole. The filter pack was surged as the sand was emplaced to promote proper packing and to minimize the potential for settlement of the filter pack following placement of the bentonite seal. Approximately 2 feet of bentonite pellets was added by gravity above the sand pack to seal the well screen against surface water infiltration. A neat cement grout was emplaced by tremie pipe into the remaining annular space. The depth of the filter sand, bentonite seal, and annular space seal was carefully measured to 0.1 feet prior to the installation of the next layer. Steel protective casings or manholes were installed with a 2-foot by 2-foot square concrete pad sloping away from the casing at monitoring well CCR-AP-1, CCR-AP-7, and CCR-AP-9. A weep hole was drilled at the base of the protective casing just above the concrete pad to evacuate rainwater that may have entered the casing. In addition, with the exception of CCR-AP-7, steel bollards were installed around the monitoring wells to protect them from being damaged. To protect new wells installed in high traffic areas, the monitoring wells were completed below grade in vaults. These wells include CCR-AP-2 through CCR-AP-6 and CCR-AP-8.

The groundwater monitoring wells were developed after construction by surging and purging each well with a pump. The pump was decontaminated by submersing the pump and pumping through a soapy water solution, followed by a distilled water rinse. For wells that could not be purged dry, development was considered complete when a minimum of ten well volumes of groundwater was removed and purge water is free of turbidity. For wells that purged dry, a minimum of four well volumes of groundwater were removed.

## 4. Groundwater Sampling Program

This section includes an explanation of activities required to comply with the groundwater monitoring requirements outlined in the Rule only. Assessment Monitoring will only be implemented if one or more of the constituents listed in Appendix III of the Rule is detected at a SSI over background levels in a downgradient well located at the waste boundary of a CCR unit once the first 8 rounds of data have been collected, as specified in §257.93. Initiation of Corrective Measures in accordance with §257.96 will commence within 90 days of finding that constituents listed in Appendix IV have been detected at statistically significant levels exceeding the groundwater protection standard defined under §257.95(h) during Assessment Monitoring.

### 4.1 DETECTION MONITORING

For existing CCR landfills and existing CCR impoundments Detection Monitoring is the first step in carrying out the groundwater monitoring program at a CCR facility, as required by §257.94 in the CCR Rule. An initial Detection Monitoring program is required to collect and analyze a minimum of eight independent samples from background and downgradient wells for the constituents listed in Appendix III and IV. The timeframe for completion of this initial step is no later than October 17, 2017. Procedures for sampling and chemical analysis methods are provided in a separate GWSAP. Similarly, methods for statistical analysis of the groundwater quality data will also be presented in a separate Statistical Data Analysis Plan (SDAP) for the Site. There are six new groundwater monitoring wells in downgradient locations for the Ash Pond (CCR-AP-2, CCR-AP-3, CCR-AP-4, CCR-AP-5, CCR-AP-6, and CCR-AP-8). There are three new upgradient/background wells located on the north side of the Site property (CCR-AP-1, CCR-AP-7, and CCR-AP-9). Groundwater monitoring locations are shown on Figure 4.

#### 4.1.1 Sampling Schedule and Frequency

The CCR Rule requires that a total of eight independent samples from each upgradient/background and downgradient monitoring well for each existing CCR landfill and surface impoundment must be collected no later than October 17, 2017.

A schedule for collection of the eight independent samples is not established within the Rule. Following the installation of monitoring wells CCR-AP-1 through CCR-AP-7, SIGECO began collecting samples from background and downgradient monitoring wells in June 2016 and approximately every two months thereafter, resulting in eight independent samples being collected by October 17, 2017. In February 2017 two additional monitoring wells (CCR-AP-8 and CCR-AP-9) were installed and added to the sampling program for the East Ash Pond. To comply with the Rule and obtain eight independent samples by October 17, 2017 the sampling frequency at CCR-AP-8 and CCR-AP-9 was compressed. Groundwater samples were collected from CCR-AP-8 and CCR-AP-9 approximately once per month. Groundwater sampling methods are described in the GWSAP.

#### 4.1.2 Chemical Analysis

Groundwater samples collected for chemical analysis will be analyzed for constituents listed in Appendix III and Appendix IV of the Rule. Analytical methods are described in the GWSAP.

The Appendix III and Appendix IV constituents consist of the following:

Appendix III Constituents	Appendix IV Constituents	
Boron	Antimony	Lead
Calcium	Arsenic	Lithium
Chloride	Barium	Mercury
Fluoride	Beryllium	Molybdenum
pH	Cadmium	Selenium
Sulfate	Chromium	Thallium
Total Dissolved Solids	Cobalt	Radium 226 and 228 combined
	Fluoride	

#### 4.1.3 Sampling and Analysis Plan

The GWSAP identifies the site-specific activities and methodologies for groundwater sampling for the groundwater monitoring program as defined in §257.93 of the Rule. The GWSAP includes field data collection, sample collection, sample preservation and shipment, interpretation, laboratory analytical methods, and reporting for all groundwater sampling at each CCR unit. The administrative procedures and frequency for collection of groundwater elevation measurements, flow direction, and gradient are provided in the GWSAP.

Laboratory results from the eight initial Detection Monitoring events for each CCR unit will be statistically analyzed for each of the Appendix III constituents by selecting one of the statistical methods specified in paragraphs (f)(1) through (5) of §257.93 of the Rule. The statistical methods used for the evaluation of groundwater monitoring data are described in the SDAP. The SDAP identifies the appropriate statistical analyses to be applied to the groundwater quality data based on the sample population distribution as defined in §257.93 of the Rule, and guidance provided by USEPA in the RCRA Statistical Analysis of Groundwater Monitoring Data Unified Guidance Document (USEPA, 2009).

#### 4.1.4 Trigger for Assessment Monitoring

Assessment Monitoring is triggered for the CCR unit when statistical analysis of the groundwater quality data collected under the Detection Monitoring program for constituents in Appendix III indicates that a SSI over background levels for one or more of the Appendix III constituents has been detected at any downgradient well during Detection Monitoring at the waste boundary.

However, one may demonstrate that a source other than the CCR unit caused the SSI over the background levels for a constituent. In this case a written demonstration report, certified by a qualified professional engineer verifying the accuracy of the information, must be submitted within 90-days of the determination of an SSI. Successful demonstration of the alternative source of impact allows the CCR unit to continue with Detection Monitoring.

### 4.2 ASSESSMENT MONITORING

Pursuant to 40 CFR § 257.95(a), assessment monitoring is conducted whenever a SSI over background levels has been detected for one or more of the constituents listed in Appendix III of the Rule. Within 90 days of triggering assessment monitoring, and annually thereafter, groundwater samples will be analyzed for the constituents listed in Appendix IV of the Rule. Within 90 days of obtaining the results from the initial assessment monitoring samples, semi-annual sampling will begin for all wells installed

pursuant 40 CFR § 257.91; these samples will be analyzed for constituents listed in Appendices III and IV of the Rule. Field methods and procedures detailed in the GWSAP will be followed for the collection of the assessment monitoring groundwater samples.

If within 90 days of finding that any constituents listed in Appendix IV of the Rule have been detected at a SSL over the Groundwater Protection Standard (GWPS), which is defined as the Maximum Concentration Limit (MCL) or background for those constituents that do not have an MCL, SIGECO must initiate an assessment of corrective measures to prevent further releases and define the nature and extent of the release.

### **4.3 GROUNDWATER ELEVATION MEASUREMENT**

The depth to groundwater must be measured in each well immediately prior to purging, each time groundwater samples are collected. Groundwater measurements from monitoring wells surrounding each CCR unit should be recorded within a period short enough to avoid temporal variations in groundwater conditions. The measured groundwater levels are converted to groundwater elevations for subsequent interpretation of groundwater flow direction and rate.

#### **4.3.1 Procedures for Groundwater Elevation Measurement**

The water level in each well will be measured using an electric water level indicator. Water level measurements should be made from a surveyed fixed reference point marked on the well. The fixed reference point will usually be located on the top of the well casing or on the top of the water level access point into the well, depending on the completion of the well at the surface. If a surveyed mark is not present, the reference point is typically established and marked on the north side of the well casing. More details for groundwater measurement procedures are in the GWSAP.

#### **4.3.2 Frequency**

The depth to groundwater, in wells which monitor the same CCR unit, must be measured within a period short enough to avoid temporal variations in groundwater conditions which could preclude accurate determination of groundwater flow rate and direction.

### **4.4 GROUNDWATER FLOW DIRECTION AND GRADIENT**

The groundwater elevations will be used to construct a water table configuration map to interpret the direction of groundwater flow and calculate the hydraulic gradient each time groundwater is sampled.

#### **4.4.1 Procedures for Calculation**

Groundwater flow direction and gradient will be calculated using one of several computer programs such as Surfer, AutoCAD, or equivalent. Groundwater flow direction and gradient can also be calculated without the use of a computer program by the following steps:

- Determine the groundwater surface elevation by subtracting the water level measurement (depth to water) from the surveyed measuring point elevation at each well.
- Determine the difference in groundwater surface elevation between each of the wells by subtracting the groundwater elevation of a well with a higher elevation from the groundwater elevation of a well with a lower elevation. The elevation differences are divided up into equal

increments. Repeat this step between multiple wells. Groundwater elevation contours can be drawn at corresponding elevation increments between wells.

- Determine groundwater flow direction by drawing a line perpendicular to the groundwater contour lines from higher elevations to lower elevations.
- Determine the hydraulic gradient by dividing the groundwater elevation change in the direction of flow by the horizontal difference between measurement points.

#### 4.4.2 Frequency

The gradient and direction of groundwater flow within each CCR unit must be calculated upon completion of each groundwater sampling event.

## 5. Reporting

### 5.1 DATA MANAGEMENT

A project database that incorporates hydrogeologic and groundwater quality data has been established to allow efficient management of chemical and physical data collected in the field and received from the laboratories. Laboratories conducting groundwater analyses for this program have been supplied with specific formats for electronic data deliverables to ensure compatibility with the project database requirements. Qualified personnel will be assigned to conduct quality assurance/quality control (QA/QC) reviews for each dataset generated. The database will be integrated with a geographical information system to allow for presentation of spatial information and data, such as site features, ownership boundaries, and sample locations. Each sample location will be surveyed to North American Datum of 1988 (NAD88).

### 5.2 ANNUAL REPORTING

Per the CCR Rule, SIGECO, or a designated representative, must prepare an annual groundwater monitoring report for each CCR unit. The first annual report must be completed by 31 January 2018 and annually thereafter for existing CCR units. An annual groundwater monitoring report must be completed by January 31 of each year following the calendar year that a new CCR landfill, new CCR surface impoundment, and all lateral expansions are constructed and have received CCR. The annual groundwater monitoring report summarizes key actions completed, for the previous year; describes any problems that may have encountered, and the corresponding actions to resolve the problems. At a minimum, the annual groundwater monitoring report should include the following:

- A detailed site map showing the CCR units, including all background and downgradient monitoring wells;
- Identification of any monitoring wells installed or decommissioned during the preceding year;
- A summary of all groundwater monitoring activities, including number of samples collected, specific analysis for each groundwater sample, field procedures followed during sample collection activities, and dates of sampling events;
- Discussion of any transition between monitoring programs, including dates of transition, cause for transition, identification of constituents detected at a SSI over background levels; and
- Any other pertinent information regarding the groundwater monitoring system or groundwater monitoring program.

The annual groundwater monitoring report must comply with recordkeeping requirements specified in §257.105 and Section 6 of this Work Plan.

## 6. Documentation

### 6.1 RECORDKEEPING

Per the CCR Rule, SIGECO, or a designated representative, must maintain adequate information in a written operating record at the subject facility, as described in §257.105. The operating record must be retained for at least five years following the date of each occurrence, measurement, sampling event, maintenance activity, corrective action, or report for each CCR unit. One operating record may be kept for multi-unit facilities, provided that each CCR unit is clearly identified. The operating record may be maintained in a variety of methods, such as saved on a computer, computer storage devices, or equivalent system that ensure that adequate information is kept for the required timeframe. Documentation must be submitted to the state director or tribal authority upon request when such documentation is not available on SIGECO's maintained website, as described in Section 6.3, below. The following information pertinent to the groundwater monitoring network and the groundwater monitoring program must be placed in the operating record:

- The annual groundwater monitoring report, as required by §257.90(e);
- Documentation of the design, installation, development, and decommissioning of any monitoring well, piezometer, and other measurement or sampling device as required under §257.91(e)(1);
- The groundwater monitoring system certification, as required under §257.91(f);
- Selection of the statistical method certification (SDAP), as required under §257.93(f)(6);
- Notification of establishing an Assessment Monitoring program (within 30 days of triggering), as required under §257.94(e)(3);
- Results of Appendix III and IV constituent concentrations, as required under §257.95(d)(1);
- Notification of returning to Detection Monitoring (within 30 days), as required under §257.95(e);
- Notification of detection of one or more Appendix IV constituents at statistically significant levels above the groundwater protection standard (within 30 days), as required by §257.95(g). Note - Appendix III constituents are not assessed above the groundwater protection standards but are assessed against the upgradient/background concentrations;
- Notification of initiating the assessment of Corrective Measures (within 30 days), as required under §257.95(g)(5);
- Completed assessment of Corrective Measures, as required under §257.96(d);
- Documents prepared by owner/operator recording the public meeting for Corrective Measures assessment, as required under §257.96(e);
- The semi-annual report documenting the progress in selecting and designing the remedy and the selection of remedy report, as required under §257.97(a); and
- Notification of completing the remedy (within 30 days), as required under §257.98(e).

### 6.2 NOTIFICATION

Notifications must be provided to the relevant State Director before the close of business on the day the notification is required to be completed, as specified under §257.106. The State must be notified when information is added or placed in the operating record and on SIGECO's publicly accessible internet site. Notification must be made to the relevant authority of any design or operating criteria



modifications or actions specified under §257.106(f) and §257.106(g) of the Rule. Notification of the availability of the annual groundwater monitoring report is specified under §257.105(h)(1).

### **6.3 POSTING INFORMATION TO THE INTERNET**

A publicly accessible Internet website (CCR website) must be maintained, titled “CCR Rule Compliance Data and Information,” and must contain the information specified under §257.107 of the Rule. One CCR website may be kept for multi-unit facilities provided the name or identification number of each unit is clearly specified. All information must be made available to the public within 30 days of placing the information in the operating record and for at least five years following the date on which the information was first posted to the CCR website. Notification information provided to the relevant State Director must be posted on the CCR website as specified under §257.106.

## **7. Certification**

Pursuant to CFR Title 40 Chapter I Subchapter I Part 257 Subpart D §257.91(f), the owner or operator must obtain a certification from a qualified engineer stating that the groundwater monitoring system has been designed and constructed to meet the requirements of §257.91. The certification for the East Ash Pond is provided on the following page.

17 October 2017  
File No. 129420-006

**SUBJECT: F.B. Culley Generating Station Groundwater Monitoring System Certification for the East Ash Pond, Southern Indiana Gas and Electric Company (SIGECO)**

SIGECO operates the existing coal combustion residuals (CCR) management unit referred to as the East Ash Pond at F.B. Culley Generating Station located near the communities of Yankeetown and Newburgh, Indiana. This CCR unit is considered subject to the CCR Rule since it was active as of the effective date of the CCR Rule. This document addresses the requirements of §257.91 *Groundwater Monitoring Systems*, specifically section §257.91(f), of the US Environmental Protection Agency's (EPA's) Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities, 40 CFR Part 257 (CCR Rule) effective 19 October 2015. This document serves as certification that the East Ash Pond complies with the requirements defined in the CCR Rule and cited below. This certification has been prepared based upon information made accessible by SIGECO pursuant to §257.91(e)(1).

The groundwater monitoring system at the East Ash Pond has been designed to exceed the minimum requirement of one upgradient and three downgradient monitoring wells pursuant to §257.91(c). The actual number of wells used in the groundwater monitoring system is sufficient and appropriate to characterize the quality of groundwater flowing beneath the East Ash Pond based on site-specific conditions.

Pursuant to CFR Title 40 Chapter I Subchapter I Part 257 Subpart D §257.91(f), I certify that the groundwater monitoring system for the Ash Pond has been designed and constructed to meet the requirements of §257.91. The certification submitted is, to the best of my knowledge accurate and complete.

Signed: \_\_\_\_\_



Certified

Print Name: Steven F. Putrich, P.E.  
Indiana License No.: PE11200566  
Title: CCR Program Manager  
Company: Haley & Aldrich, Inc.

## References

1. United States Environmental Protection Agency (USEPA), 2000. Sampling and Analysis Plan Guidance and Template, R9QA/002.1. April 2000.
2. United States Environmental Protection Agency (USEPA), 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities Unified Guidance, EPA 530/R-09-007. March 2009.

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## Tables

**TABLE 1**  
**GROUNDWATER MONITORING WELL LOCATION AND CONSTRUCTION DETAILS**  
**F.B. CULLEY GENERATING STATION - EAST ASH POND**  
**NEWBURGH, INDIANA**

Well	CCR Unit	Date Installed	Easting	Northing	Top of Pad Elevation (ft msl)	Top of Riser Elevation (ft msl)	Surface Grout (ft bgs)	Bentonite (ft bgs)	Sand Pack (ft bgs)	Screen Zone (ft bgs)	Screen Length (ft)	Well Radius (in)
CCR-AP-1R	East Ash Pond	March 2016	2883429.69	969939.69	438.50	441.64	1.0-51.0	51.0-53.0	53.0-65.0	55.0-65.0	10	2
CCR-AP-2	East Ash Pond	December 2015	2884168.67	969117.52	394.40	393.97	1.0-30.5	30.5-32.5	32.5-45.0	36.0-46.0	10	2
CCR-AP-3	East Ash Pond	December 2015	2883542.09	969007.98	395.10	394.54	1.0-31.0	31.0-32.8	32.8-45.0	35.0-45.0	10	2
CCR-AP-4	East Ash Pond	December 2015	2883281.93	969641.70	395.40	394.91	1.0-19.7	19.7-22.5	23.0-35.5	25.5-35.5	10	2
CCR-AP-5	East Ash Pond	December 2015	2884016.66	969379.68	394.80	394.32	1.0-28.6	28.6-30.6	30.6-44.0	34.0-44.0	10	2
CCR-AP-6	East Ash Pond	March 2016	2883285.03	969122.16	397.00	396.71	1.0-31.5	31.5-33.0	33.5-45.5	35.5-45.5	10	2
CCR-AP-7	East Ash Pond	March 2016	2883090.34	970774.64	429.50	434.11	1.0-16.0	16.0-18.0	18.0-30.0	20.0-30.0	10	2
CCR-AP-8	East Ash Pond	February 2017	2883846.87	969046.03	394.15	393.83	1.0-31.5	31.5-33.0	33.5-45.5	35.5-45.5	10	2
CCR-AP-9	East Ash Pond	February 2017	2883998.96	969768.61	445.58	448.69	1.0-56.0	56.0-58.0	58.0-70.0	60.0-70.0	10	2
CCR-PZ-1	East Ash Pond	December 2015	2883970.48	968930.29	360.50	363.40	--	--	--	2.0-3.0	1	1
CCR-PZ-2	East Ash Pond	December 2015	2883341.85	968930.78	360.50	361.17	--	--	--	4.0-5.0	1	1
CCR-SG-1	East Ash Pond	December 2015	2883971.86	968914.32	--	*359.40	--	--	--	--	--	--
CCR-SG-2	East Ash Pond	December 2015	2883327.43	968918.84	--	*359.23	--	--	--	--	--	--

**NOTES:**

\*Elevation of Staff Guages is based on the 3.0' mark of the vertical staff guage. Piezometers/staff guages for water level guaging only.

bgs = below ground surface

ft = feet

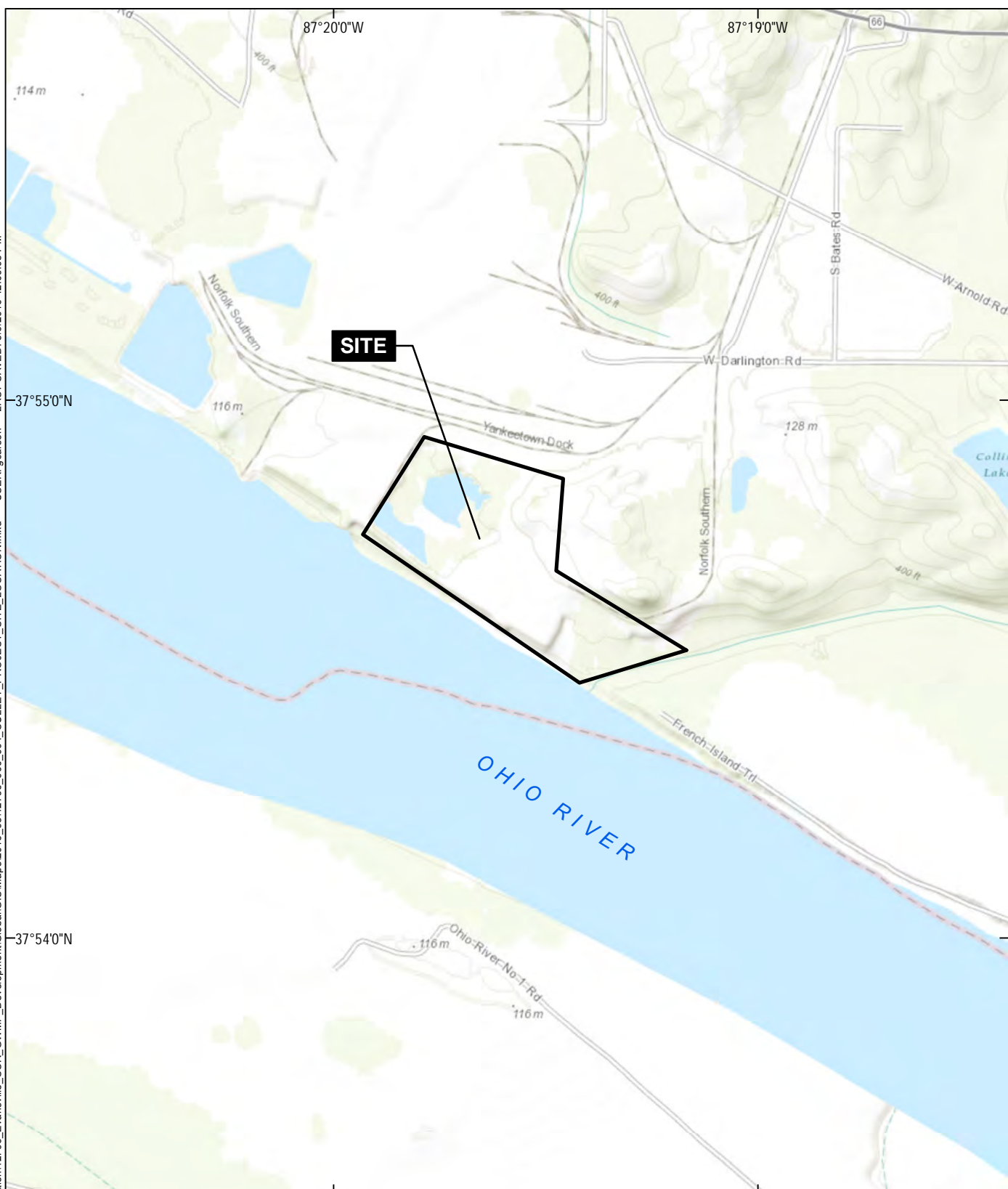
in = inches

msl = mean sea level

Datum of Elevations in NAVD 88

## Figures

GIS FILE PATH: G:\Projects\Vectren\_Corporation\42796\_Evansville\_CCR\_GWMP\_Development\Global\GIS\Maps\2016\_05\42796\_000\_001\_CULLEY\_PROJECT\_SITE\_LOCATION.mxd — USER: gcarson — LAST SAVED: 5/6/2016 12:09:08 PM



MAP SOURCE: ESRI



VECTREN CORPORATION  
F.B. CULLEY GENERATING STATION  
3711 DARLINGTON ROAD  
NEWBURGH, IN 47630

### SITE LOCATION MAP

APPROXIMATE SCALE: 1 IN = 2000 FT  
MAY 2016

FIGURE 1



GIS FILE PATH: G:\Projects\Vectren\_Corporation\42796\_Evansville\_CCR\_GWMP\_Development\GlobalGISMaps\2017\_04\42796\_000\_002\_CULLEY\_EAP\_GW\_MONITORING\_LOCS.mxd — USER: gearson — LAST SAVED: 4/18/2017 7:16:47 PM



**NOTE**

1. AERIAL IMAGERY SOURCE: DIGITAL GLOBE 3/14/2014



0 300 600  
SCALE IN FEET

**HALEY  
ALDRICH**

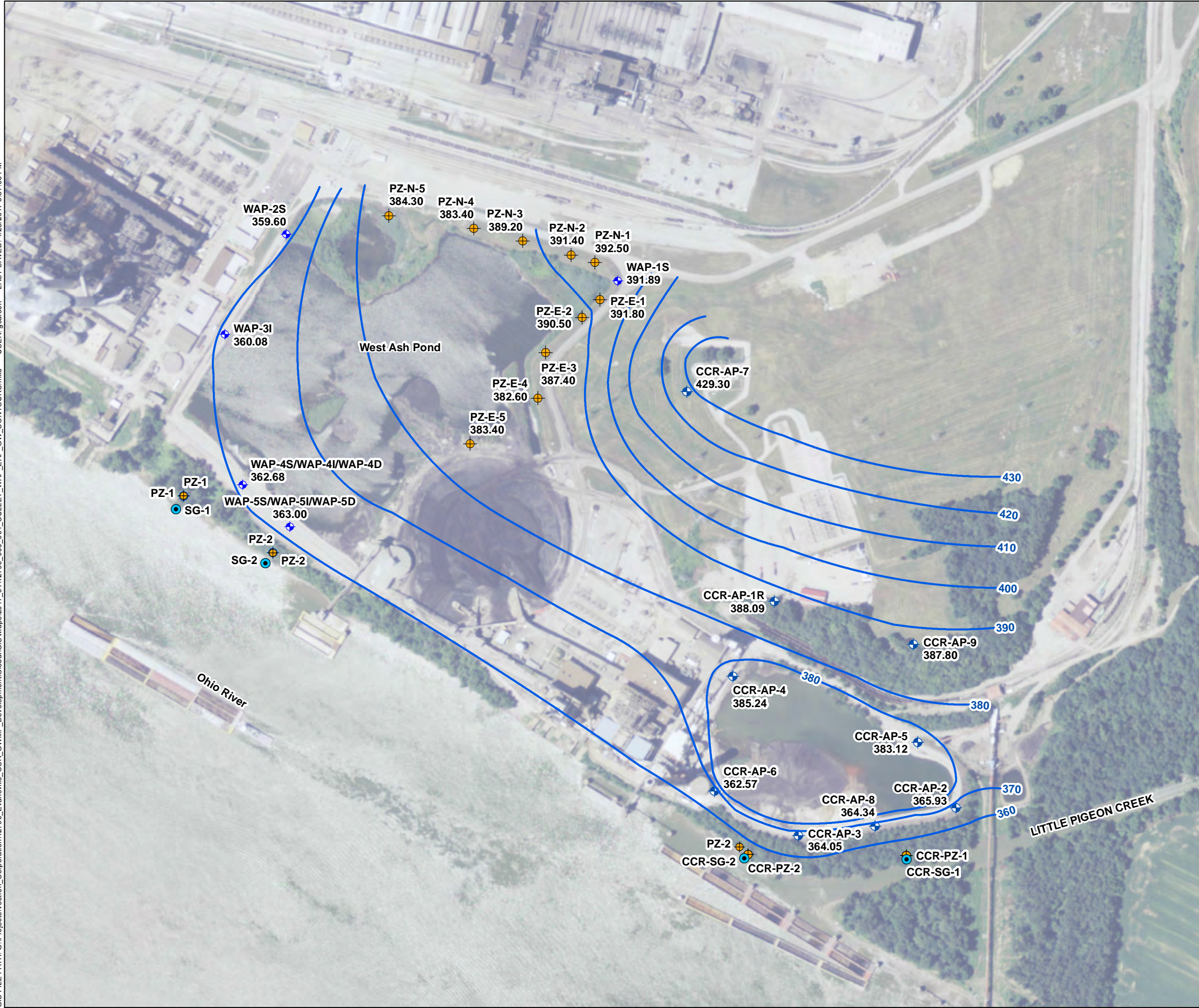
VECTREN CORPORATION  
F.B. CULLEY GENERATING STATION  
3711 DARLINGTON ROAD  
NEWBURGH, IN 47630

SITE INDEX MAP

APRIL 2017

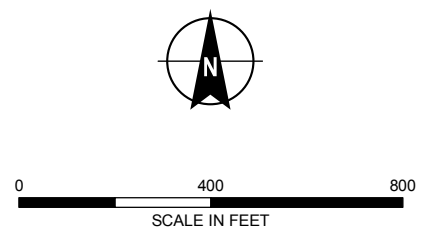
FIGURE 2

GIS FILE PATH: G:\Projects\Vectren\_Corporation\42796\_Evansville\_CCR\_GWMP\_Development\Global\GIS\Maps\2017\_04\42796\_000\_001\_CULLEY\_WAP\_EAP\_GW\_CONTOURS.mxd — USER: gcarson — LAST SAVED: 4/25/2017 8:57:08 PM



**LEGEND**  
 WAP-1S  
 EXISTING MONITORING WELL  
 PZ-1  
 EXISTING PIEZOMETER  
 SG-1  
 EXISTING STAFF GAUGE

**NOTES**  
 1. AERIAL IMAGERY SOURCE: DIGITAL GLOBE 3/14/2014  
 2. MONITORING WELLS WITH AN "S" DESIGNATION ARE SCREENED IN THE UPPERMOST AQUIFER. THE "D" DESIGNATION REPRESENTS WELLS SCREENED AT THE TOP OF BEDROCK, AND THE "I" DESIGNATION IS FOR WELLS SCREENED AT AN INTERMEDIATE DEPTH BETWEEN THE TWO.  
 3. ELEVATIONS ARE FEET ABOVE MEAN SEA LEVEL.



**HALEY ALDRICH**  
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 NEWBURGH, IN 47630

**GROUNDWATER ELEVATION CONTOURS - APRIL 2017**




APRIL 2017

FIGURE 3

GIS FILE PATH: G:\Projects\Vectren\_Corporation\42796\_Evansville\_CCR\_GWMP\_Development\GlobalGIS\Maps\2017\_04\42796\_000\_002\_CULLEY\_EAP\_GW\_MONITORING\_LOCS.mxd — USER: gearson — LAST SAVED: 4/18/2017 7:16:47 PM



**LEGEND**

- CCR-AP-2  
 EXISTING MONITORING WELL
- CCR-PZ-1  
 EXISTING PIEZOMETER
- CCR-SG-1  
 EXISTING STAFF GAUGE

**NOTE**

1.AERIAL IMAGERY SOURCE: DIGITAL GLOBE 3/14/2014



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**GROUNDWATER MONITORING  
WELL LOCATIONS FOR  
COMPLIANCE WITH FEDERAL  
CCR RULE**

APRIL 2017

FIGURE 4

**APPENDIX A**

**40 CFR §257.90 through §257.98 and Appendices III and IV**

following the date of initial receipt of CCR in the CCR unit.

(4) *Frequency of inspections.* (i) Except as provided for in paragraph (b)(4)(ii) of this section, the owner or operator of the CCR unit must conduct the inspection required by paragraphs (b)(1) and (2) of this section on an annual basis. The date of completing the initial inspection report is the basis for establishing the deadline to complete the first subsequent inspection. Any required inspection may be conducted prior to the required deadline provided the owner or operator places the completed inspection report into the facility's operating record within a reasonable amount of time. In all cases, the deadline for completing subsequent inspection reports is based on the date of completing the previous inspection report. For purposes of this section, the owner or operator has completed an inspection when the inspection report has been placed in the facility's operating record as required by § 257.105(g)(6).

(ii) In any calendar year in which both the periodic inspection by a qualified professional engineer and the quinquennial (occurring every five years) structural stability assessment by a qualified professional engineer required by §§ 257.73(d) and 257.74(d) are required to be completed, the annual inspection is not required, provided the structural stability assessment is completed during the calendar year. If the annual inspection is not conducted in a year as provided by this paragraph (b)(4)(ii), the deadline for completing the next annual inspection is one year from the date of completing the quinquennial structural stability assessment.

(5) If a deficiency or release is identified during an inspection, the owner or operator must remedy the deficiency or release as soon as feasible and prepare documentation detailing the corrective measures taken.

(c) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(g), the notification requirements specified in § 257.106(g), and the internet requirements specified in § 257.107(g).

#### **§ 257.84 Inspection requirements for CCR landfills.**

(a) *Inspections by a qualified person.* (1) All CCR landfills and any lateral expansion of a CCR landfill must be examined by a qualified person as follows:

(i) At intervals not exceeding seven days, inspect for any appearances of actual or potential structural weakness

and other conditions which are disrupting or have the potential to disrupt the operation or safety of the CCR unit; and

(ii) The results of the inspection by a qualified person must be recorded in the facility's operating record as required by § 257.105(g)(8).

(2) *Timeframes for inspections by a qualified person—(i) Existing CCR landfills.* The owner or operator of the CCR unit must initiate the inspections required under paragraph (a) of this section no later than October 19, 2015.

(ii) *New CCR landfills and any lateral expansion of a CCR landfill.* The owner or operator of the CCR unit must initiate the inspections required under paragraph (a) of this section upon initial receipt of CCR by the CCR unit.

(b) *Annual inspections by a qualified professional engineer.* (1) Existing and new CCR landfills and any lateral expansion of a CCR landfill must be inspected on a periodic basis by a qualified professional engineer to ensure that the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering standards. The inspection must, at a minimum, include:

(i) A review of available information regarding the status and condition of the CCR unit, including, but not limited to, files available in the operating record (e.g., the results of inspections by a qualified person, and results of previous annual inspections); and

(ii) A visual inspection of the CCR unit to identify signs of distress or malfunction of the CCR unit.

(2) *Inspection report.* The qualified professional engineer must prepare a report following each inspection that addresses the following:

(i) Any changes in geometry of the structure since the previous annual inspection;

(ii) The approximate volume of CCR contained in the unit at the time of the inspection;

(iii) Any appearances of an actual or potential structural weakness of the CCR unit, in addition to any existing conditions that are disrupting or have the potential to disrupt the operation and safety of the CCR unit; and

(iv) Any other change(s) which may have affected the stability or operation of the CCR unit since the previous annual inspection.

(3) *Timeframes for conducting the initial inspection—(i) Existing CCR landfills.* The owner or operator of the CCR unit must complete the initial inspection required by paragraphs (b)(1) and (2) of this section no later than January 18, 2016.

(ii) *New CCR landfills and any lateral expansion of a CCR landfill.* The owner or operator of the CCR unit must complete the initial annual inspection required by paragraphs (b)(1) and (2) of this section no later than 14 months following the date of initial receipt of CCR in the CCR unit.

(4) *Frequency of inspections.* The owner or operator of the CCR unit must conduct the inspection required by paragraphs (b)(1) and (2) of this section on an annual basis. The date of completing the initial inspection report is the basis for establishing the deadline to complete the first subsequent inspection. Any required inspection may be conducted prior to the required deadline provided the owner or operator places the completed inspection report into the facility's operating record within a reasonable amount of time. In all cases, the deadline for completing subsequent inspection reports is based on the date of completing the previous inspection report. For purposes of this section, the owner or operator has completed an inspection when the inspection report has been placed in the facility's operating record as required by § 257.105(g)(9).

(5) If a deficiency or release is identified during an inspection, the owner or operator must remedy the deficiency or release as soon as feasible and prepare documentation detailing the corrective measures taken.

(c) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(g), the notification requirements specified in § 257.106(g), and the internet requirements specified in § 257.107(g).

#### **Groundwater Monitoring and Corrective Action**

##### **§ 257.90 Applicability.**

(a) Except as provided for in § 257.100 for inactive CCR surface impoundments, all CCR landfills, CCR surface impoundments, and lateral expansions of CCR units are subject to the groundwater monitoring and corrective action requirements under §§ 257.90 through 257.98.

(b) *Initial timeframes—(1) Existing CCR landfills and existing CCR surface impoundments.* No later than October 17, 2017, the owner or operator of the CCR unit must be in compliance with the following groundwater monitoring requirements:

(i) Install the groundwater monitoring system as required by § 257.91;

(ii) Develop the groundwater sampling and analysis program to include selection of the statistical

procedures to be used for evaluating groundwater monitoring data as required by § 257.93;

(iii) Initiate the detection monitoring program to include obtaining a minimum of eight independent samples for each background and downgradient well as required by § 257.94(b); and

(iv) Begin evaluating the groundwater monitoring data for statistically significant increases over background levels for the constituents listed in appendix III of this part as required by § 257.94.

(2) *New CCR landfills, new CCR surface impoundments, and all lateral expansions of CCR units.* Prior to initial receipt of CCR by the CCR unit, the owner or operator must be in compliance with the groundwater monitoring requirements specified in paragraph (b)(1)(i) and (ii) of this section. In addition, the owner or operator of the CCR unit must initiate the detection monitoring program to include obtaining a minimum of eight independent samples for each background well as required by § 257.94(b).

(c) Once a groundwater monitoring system and groundwater monitoring program has been established at the CCR unit as required by this subpart, the owner or operator must conduct groundwater monitoring and, if necessary, corrective action throughout the active life and post-closure care period of the CCR unit.

(d) In the event of a release from a CCR unit, the owner or operator must immediately take all necessary measures to control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of contaminants into the environment. The owner or operator of the CCR unit must comply with all applicable requirements in §§ 257.96, 257.97, and 257.98.

(e) *Annual groundwater monitoring and corrective action report.* For existing CCR landfills and existing CCR surface impoundments, no later than January 31, 2018, and annually thereafter, the owner or operator must prepare an annual groundwater monitoring and corrective action report. For new CCR landfills, new CCR surface impoundments, and all lateral expansions of CCR units, the owner or operator must prepare the initial annual groundwater monitoring and corrective action report no later than January 31 of the year following the calendar year a groundwater monitoring system has been established for such CCR unit as required by this subpart, and annually thereafter. For the preceding calendar year, the annual report must document the status of the groundwater

monitoring and corrective action program for the CCR unit, summarize key actions completed, describe any problems encountered, discuss actions to resolve the problems, and project key activities for the upcoming year. For purposes of this section, the owner or operator has prepared the annual report when the report is placed in the facility's operating record as required by § 257.105(h)(1). At a minimum, the annual groundwater monitoring and corrective action report must contain the following information, to the extent available:

(1) A map, aerial image, or diagram showing the CCR unit and all background (or upgradient) and downgradient monitoring wells, to include the well identification numbers, that are part of the groundwater monitoring program for the CCR unit;

(2) Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a narrative description of why those actions were taken;

(3) In addition to all the monitoring data obtained under §§ 257.90 through 257.98, a summary including the number of groundwater samples that were collected for analysis for each background and downgradient well, the dates the samples were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs;

(4) A narrative discussion of any transition between monitoring programs (e.g., the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels); and

(5) Other information required to be included in the annual report as specified in §§ 257.90 through 257.98.

(f) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the internet requirements specified in § 257.107(h).

#### **§ 257.91 Groundwater monitoring systems.**

(a) *Performance standard.* The owner or operator of a CCR unit must install a groundwater monitoring system that consists of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer that:

(1) Accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit. A determination of background

quality may include sampling of wells that are not hydraulically upgradient of the CCR management area where:

(i) Hydrogeologic conditions do not allow the owner or operator of the CCR unit to determine what wells are hydraulically upgradient; or

(ii) Sampling at other wells will provide an indication of background groundwater quality that is as representative or more representative than that provided by the upgradient wells; and

(2) Accurately represent the quality of groundwater passing the waste boundary of the CCR unit. The downgradient monitoring system must be installed at the waste boundary that ensures detection of groundwater contamination in the uppermost aquifer. All potential contaminant pathways must be monitored.

(b) The number, spacing, and depths of monitoring systems shall be determined based upon site-specific technical information that must include thorough characterization of:

(1) Aquifer thickness, groundwater flow rate, groundwater flow direction including seasonal and temporal fluctuations in groundwater flow; and

(2) Saturated and unsaturated geologic units and fill materials overlying the uppermost aquifer, materials comprising the uppermost aquifer, and materials comprising the confining unit defining the lower boundary of the uppermost aquifer, including, but not limited to, thicknesses, stratigraphy, lithology, hydraulic conductivities, porosities and effective porosities.

(c) The groundwater monitoring system must include the minimum number of monitoring wells necessary to meet the performance standards specified in paragraph (a) of this section, based on the site-specific information specified in paragraph (b) of this section. The groundwater monitoring system must contain:

(1) A minimum of one upgradient and three downgradient monitoring wells; and

(2) Additional monitoring wells as necessary to accurately represent the quality of background groundwater that has not been affected by leakage from the CCR unit and the quality of groundwater passing the waste boundary of the CCR unit.

(d) The owner or operator of multiple CCR units may install a multiunit groundwater monitoring system instead of separate groundwater monitoring systems for each CCR unit.

(1) The multiunit groundwater monitoring system must be equally as capable of detecting monitored constituents at the waste boundary of

the CCR unit as the individual groundwater monitoring system specified in paragraphs (a) through (c) of this section for each CCR unit based on the following factors:

- (i) Number, spacing, and orientation of each CCR unit;
- (ii) Hydrogeologic setting;
- (iii) Site history; and
- (iv) Engineering design of the CCR unit.

(2) If the owner or operator elects to install a multiunit groundwater monitoring system, and if the multiunit system includes at least one existing unlined CCR surface impoundment as determined by § 257.71(a), and if at any time after October 19, 2015 the owner or operator determines in any sampling event that the concentrations of one or more constituents listed in appendix IV to this part are detected at statistically significant levels above the groundwater protection standard established under § 257.95(h) for the multiunit system, then all unlined CCR surface impoundments comprising the multiunit groundwater monitoring system are subject to the closure requirements under § 257.101(a) to retrofit or close.

(e) Monitoring wells must be cased in a manner that maintains the integrity of the monitoring well borehole. This casing must be screened or perforated and packed with gravel or sand, where necessary, to enable collection of groundwater samples. The annular space (*i.e.*, the space between the borehole and well casing) above the sampling depth must be sealed to prevent contamination of samples and the groundwater.

(1) The owner or operator of the CCR unit must document and include in the operating record the design, installation, development, and decommissioning of any monitoring wells, piezometers and other measurement, sampling, and analytical devices. The qualified professional engineer must be given access to this documentation when completing the groundwater monitoring system certification required under paragraph (f) of this section.

(2) The monitoring wells, piezometers, and other measurement, sampling, and analytical devices must be operated and maintained so that they perform to the design specifications throughout the life of the monitoring program.

(f) The owner or operator must obtain a certification from a qualified professional engineer stating that the groundwater monitoring system has been designed and constructed to meet the requirements of this section. If the groundwater monitoring system

includes the minimum number of monitoring wells specified in paragraph (c)(1) of this section, the certification must document the basis supporting this determination.

(g) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the internet requirements specified in § 257.107(h).

#### § 257.92 [Reserved]

#### § 257.93 Groundwater sampling and analysis requirements.

(a) The groundwater monitoring program must include consistent sampling and analysis procedures that are designed to ensure monitoring results that provide an accurate representation of groundwater quality at the background and downgradient wells required by § 257.91. The owner or operator of the CCR unit must develop a sampling and analysis program that includes procedures and techniques for:

- (1) Sample collection;
- (2) Sample preservation and shipment;
- (3) Analytical procedures;
- (4) Chain of custody control; and
- (5) Quality assurance and quality control.

(b) The groundwater monitoring program must include sampling and analytical methods that are appropriate for groundwater sampling and that accurately measure hazardous constituents and other monitoring parameters in groundwater samples. For purposes of §§ 257.90 through 257.98, the term *constituent* refers to both hazardous constituents and other monitoring parameters listed in either appendix III or IV of this part.

(c) Groundwater elevations must be measured in each well immediately prior to purging, each time groundwater is sampled. The owner or operator of the CCR unit must determine the rate and direction of groundwater flow each time groundwater is sampled. Groundwater elevations in wells which monitor the same CCR management area must be measured within a period of time short enough to avoid temporal variations in groundwater flow which could preclude accurate determination of groundwater flow rate and direction.

(d) The owner or operator of the CCR unit must establish background groundwater quality in a hydraulically upgradient or background well(s) for each of the constituents required in the particular groundwater monitoring program that applies to the CCR unit as determined under § 257.94(a) or

§ 257.95(a). Background groundwater quality may be established at wells that are not located hydraulically upgradient from the CCR unit if it meets the requirements of § 257.91(a)(1).

(e) The number of samples collected when conducting detection monitoring and assessment monitoring (for both downgradient and background wells) must be consistent with the statistical procedures chosen under paragraph (f) of this section and the performance standards under paragraph (g) of this section. The sampling procedures shall be those specified under § 257.94(b) through (d) for detection monitoring, § 257.95(b) through (d) for assessment monitoring, and § 257.96(b) for corrective action.

(f) The owner or operator of the CCR unit must select one of the statistical methods specified in paragraphs (f)(1) through (5) of this section to be used in evaluating groundwater monitoring data for each specified constituent. The statistical test chosen shall be conducted separately for each constituent in each monitoring well.

(1) A parametric analysis of variance followed by multiple comparison procedures to identify statistically significant evidence of contamination. The method must include estimation and testing of the contrasts between each compliance well's mean and the background mean levels for each constituent.

(2) An analysis of variance based on ranks followed by multiple comparison procedures to identify statistically significant evidence of contamination. The method must include estimation and testing of the contrasts between each compliance well's median and the background median levels for each constituent.

(3) A tolerance or prediction interval procedure, in which an interval for each constituent is established from the distribution of the background data and the level of each constituent in each compliance well is compared to the upper tolerance or prediction limit.

(4) A control chart approach that gives control limits for each constituent.

(5) Another statistical test method that meets the performance standards of paragraph (g) of this section.

(6) The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer stating that the selected statistical method is appropriate for evaluating the groundwater monitoring data for the CCR management area. The certification must include a narrative description of the statistical method selected to evaluate the groundwater monitoring data.

(g) Any statistical method chosen under paragraph (f) of this section shall comply with the following performance standards, as appropriate, based on the statistical test method used:

(1) The statistical method used to evaluate groundwater monitoring data shall be appropriate for the distribution of constituents. Normal distributions of data values shall use parametric methods. Non-normal distributions shall use non-parametric methods. If the distribution of the constituents is shown by the owner or operator of the CCR unit to be inappropriate for a normal theory test, then the data must be transformed or a distribution-free (non-parametric) theory test must be used. If the distributions for the constituents differ, more than one statistical method may be needed.

(2) If an individual well comparison procedure is used to compare an individual compliance well constituent concentration with background constituent concentrations or a groundwater protection standard, the test shall be done at a Type I error level no less than 0.01 for each testing period. If a multiple comparison procedure is used, the Type I experiment wise error rate for each testing period shall be no less than 0.05; however, the Type I error of no less than 0.01 for individual well comparisons must be maintained. This performance standard does not apply to tolerance intervals, prediction intervals, or control charts.

(3) If a control chart approach is used to evaluate groundwater monitoring data, the specific type of control chart and its associated parameter values shall be such that this approach is at least as effective as any other approach in this section for evaluating groundwater data. The parameter values shall be determined after considering the number of samples in the background data base, the data distribution, and the range of the concentration values for each constituent of concern.

(4) If a tolerance interval or a prediction interval is used to evaluate groundwater monitoring data, the levels of confidence and, for tolerance intervals, the percentage of the population that the interval must contain, shall be such that this approach is at least as effective as any other approach in this section for evaluating groundwater data. These parameters shall be determined after considering the number of samples in the background data base, the data distribution, and the range of the concentration values for each constituent of concern.

(5) The statistical method must account for data below the limit of detection with one or more statistical procedures that shall at least as effective as any other approach in this section for evaluating groundwater data. Any practical quantitation limit that is used in the statistical method shall be the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions that are available to the facility.

(6) If necessary, the statistical method must include procedures to control or correct for seasonal and spatial variability as well as temporal correlation in the data.

(h) The owner or operator of the CCR unit must determine whether or not there is a statistically significant increase over background values for each constituent required in the particular groundwater monitoring program that applies to the CCR unit, as determined under § 257.94(a) or § 257.95(a).

(1) In determining whether a statistically significant increase has occurred, the owner or operator must compare the groundwater quality of each constituent at each monitoring well designated pursuant to § 257.91(a)(2) or (d)(1) to the background value of that constituent, according to the statistical procedures and performance standards specified under paragraphs (f) and (g) of this section.

(2) Within 90 days after completing sampling and analysis, the owner or operator must determine whether there has been a statistically significant increase over background for any constituent at each monitoring well.

(i) The owner or operator must measure "total recoverable metals" concentrations in measuring groundwater quality. Measurement of total recoverable metals captures both the particulate fraction and dissolved fraction of metals in natural waters. Groundwater samples shall not be field-filtered prior to analysis.

(j) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the Internet requirements specified in § 257.107(h).

#### **§ 257.94 Detection monitoring program.**

(a) The owner or operator of a CCR unit must conduct detection monitoring at all groundwater monitoring wells consistent with this section. At a minimum, a detection monitoring program must include groundwater

monitoring for all constituents listed in appendix III to this part.

(b) Except as provided in paragraph (d) of this section, the monitoring frequency for the constituents listed in appendix III to this part shall be at least semiannual during the active life of the CCR unit and the post-closure period. For existing CCR landfills and existing CCR surface impoundments, a minimum of eight independent samples from each background and downgradient well must be collected and analyzed for the constituents listed in appendix III and IV to this part no later than October 17, 2017. For new CCR landfills, new CCR surface impoundments, and all lateral expansions of CCR units, a minimum of eight independent samples for each background well must be collected and analyzed for the constituents listed in appendices III and IV to this part during the first six months of sampling.

(c) The number of samples collected and analyzed for each background well and downgradient well during subsequent semiannual sampling events must be consistent with § 257.93(e), and must account for any unique characteristics of the site, but must be at least one sample from each background and downgradient well.

(d) The owner or operator of a CCR unit may demonstrate the need for an alternative monitoring frequency for repeated sampling and analysis for constituents listed in appendix III to this part during the active life and the post-closure care period based on the availability of groundwater. If there is not adequate groundwater flow to sample wells semiannually, the alternative frequency shall be no less than annual. The need to vary monitoring frequency must be evaluated on a site-specific basis. The demonstration must be supported by, at a minimum, the information specified in paragraphs (d)(1) and (2) of this section.

(1) Information documenting that the need for less frequent sampling. The alternative frequency must be based on consideration of the following factors:

- (i) Lithology of the aquifer and unsaturated zone;
- (ii) Hydraulic conductivity of the aquifer and unsaturated zone; and
- (iii) Groundwater flow rates.

(2) Information documenting that the alternative frequency will be no less effective in ensuring that any leakage from the CCR unit will be discovered within a timeframe that will not materially delay establishment of an assessment monitoring program.

(3) The owner or operator must obtain a certification from a qualified



professional engineer stating that the demonstration for an alternative groundwater sampling and analysis frequency meets the requirements of this section. The owner or operator must include the demonstration providing the basis for the alternative monitoring frequency and the certification by a qualified professional engineer in the annual groundwater monitoring and corrective action report required by § 257.90(e).

(e) If the owner or operator of the CCR unit determines, pursuant to § 257.93(h) that there is a statistically significant increase over background levels for one or more of the constituents listed in appendix III to this part at any monitoring well at the waste boundary specified under § 257.91(a)(2), the owner or operator must:

(1) Except as provided for in paragraph (e)(2) of this section, within 90 days of detecting a statistically significant increase over background levels for any constituent, establish an assessment monitoring program meeting the requirements of § 257.95.

(2) The owner or operator may demonstrate that a source other than the CCR unit caused the statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The owner or operator must complete the written demonstration within 90 days of detecting a statistically significant increase over background levels to include obtaining a certification from a qualified professional engineer verifying the accuracy of the information in the report. If a successful demonstration is completed within the 90-day period, the owner or operator of the CCR unit may continue with a detection monitoring program under this section. If a successful demonstration is not completed within the 90-day period, the owner or operator of the CCR unit must initiate an assessment monitoring program as required under § 257.95. The owner or operator must also include the demonstration in the annual groundwater monitoring and corrective action report required by § 257.90(e), in addition to the certification by a qualified professional engineer.

(3) The owner or operator of a CCR unit must prepare a notification stating that an assessment monitoring program has been established. The owner or operator has completed the notification when the notification is placed in the facility's operating record as required by § 257.105(h)(5).

(f) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the Internet requirements specified in § 257.107(h).

**§ 257.95 Assessment monitoring program.**

(a) Assessment monitoring is required whenever a statistically significant increase over background levels has been detected for one or more of the constituents listed in appendix III to this part.

(b) Within 90 days of triggering an assessment monitoring program, and annually thereafter, the owner or operator of the CCR unit must sample and analyze the groundwater for all constituents listed in appendix IV to this part. The number of samples collected and analyzed for each well during each sampling event must be consistent with § 257.93(e), and must account for any unique characteristics of the site, but must be at least one sample from each well.

(c) The owner or operator of a CCR unit may demonstrate the need for an alternative monitoring frequency for repeated sampling and analysis for constituents listed in appendix IV to this part during the active life and the post-closure care period based on the availability of groundwater. If there is not adequate groundwater flow to sample wells semiannually, the alternative frequency shall be no less than annual. The need to vary monitoring frequency must be evaluated on a site-specific basis. The demonstration must be supported by, at a minimum, the information specified in paragraphs (c)(1) and (2) of this section.

(1) Information documenting that the need for less frequent sampling. The alternative frequency must be based on consideration of the following factors:

- (i) Lithology of the aquifer and unsaturated zone;
- (ii) Hydraulic conductivity of the aquifer and unsaturated zone; and
- (iii) Groundwater flow rates.

(2) Information documenting that the alternative frequency will be no less effective in ensuring that any leakage from the CCR unit will be discovered within a timeframe that will not materially delay the initiation of any necessary remediation measures.

(3) The owner or operator must obtain a certification from a qualified professional engineer stating that the demonstration for an alternative groundwater sampling and analysis frequency meets the requirements of this section. The owner or operator must

include the demonstration providing the basis for the alternative monitoring frequency and the certification by a qualified professional engineer in the annual groundwater monitoring and corrective action report required by § 257.90(e).

(d) After obtaining the results from the initial and subsequent sampling events required in paragraph (b) of this section, the owner or operator must:

(1) Within 90 days of obtaining the results, and on at least a semiannual basis thereafter, resample all wells that were installed pursuant to the requirements of § 257.91, conduct analyses for all parameters in appendix III to this part and for those constituents in appendix IV to this part that are detected in response to paragraph (b) of this section, and record their concentrations in the facility operating record. The number of samples collected and analyzed for each background well and downgradient well during subsequent semiannual sampling events must be consistent with § 257.93(e), and must account for any unique characteristics of the site, but must be at least one sample from each background and downgradient well;

(2) Establish groundwater protection standards for all constituents detected pursuant to paragraph (b) or (d) of this section. The groundwater protection standards must be established in accordance with paragraph (h) of this section; and

(3) Include the recorded concentrations required by paragraph (d)(1) of this section, identify the background concentrations established under § 257.94(b), and identify the groundwater protection standards established under paragraph (d)(2) of this section in the annual groundwater monitoring and corrective action report required by § 257.90(e).

(e) If the concentrations of all constituents listed in appendices III and IV to this part are shown to be at or below background values, using the statistical procedures in § 257.93(g), for two consecutive sampling events, the owner or operator may return to detection monitoring of the CCR unit. The owner or operator must prepare a notification stating that detection monitoring is resuming for the CCR unit. The owner or operator has completed the notification when the notification is placed in the facility's operating record as required by § 257.105(h)(7).

(f) If the concentrations of any constituent in appendices III and IV to this part are above background values, but all concentrations are below the groundwater protection standard

established under paragraph (h) of this section, using the statistical procedures in § 257.93(g), the owner or operator must continue assessment monitoring in accordance with this section.

(g) If one or more constituents in appendix IV to this part are detected at statistically significant levels above the groundwater protection standard established under paragraph (h) of this section in any sampling event, the owner or operator must prepare a notification identifying the constituents in appendix IV to this part that have exceeded the groundwater protection standard. The owner or operator has completed the notification when the notification is placed in the facility's operating record as required by § 257.105(h)(8). The owner or operator of the CCR unit also must:

(1) Characterize the nature and extent of the release and any relevant site conditions that may affect the remedy ultimately selected. The characterization must be sufficient to support a complete and accurate assessment of the corrective measures necessary to effectively clean up all releases from the CCR unit pursuant to § 257.96. Characterization of the release includes the following minimum measures:

(i) Install additional monitoring wells necessary to define the contaminant plume(s);

(ii) Collect data on the nature and estimated quantity of material released including specific information on the constituents listed in appendix IV of this part and the levels at which they are present in the material released;

(iii) Install at least one additional monitoring well at the facility boundary in the direction of contaminant migration and sample this well in accordance with paragraph (d)(1) of this section; and

(iv) Sample all wells in accordance with paragraph (d)(1) of this section to characterize the nature and extent of the release.

(2) Notify all persons who own the land or reside on the land that directly overlies any part of the plume of contamination if contaminants have migrated off-site if indicated by sampling of wells in accordance with paragraph (g)(1) of this section. The owner or operator has completed the notifications when they are placed in the facility's operating record as required by § 257.105(h)(8).

(3) Within 90 days of finding that any of the constituents listed in appendix IV to this part have been detected at a statistically significant level exceeding the groundwater protection standards the owner or operator must either:

(i) Initiate an assessment of corrective measures as required by § 257.96; or

(ii) Demonstrate that a source other than the CCR unit caused the contamination, or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. Any such demonstration must be supported by a report that includes the factual or evidentiary basis for any conclusions and must be certified to be accurate by a qualified professional engineer. If a successful demonstration is made, the owner or operator must continue monitoring in accordance with the assessment monitoring program pursuant to this section, and may return to detection monitoring if the constituents in appendices III and IV to this part are at or below background as specified in paragraph (e) of this section. The owner or operator must also include the demonstration in the annual groundwater monitoring and corrective action report required by § 257.90(e), in addition to the certification by a qualified professional engineer.

(4) If a successful demonstration has not been made at the end of the 90 day period provided by paragraph (g)(3)(ii) of this section, the owner or operator of the CCR unit must initiate the assessment of corrective measures requirements under § 257.96.

(5) If an assessment of corrective measures is required under § 257.96 by either paragraph (g)(3)(i) or (g)(4) of this section, and if the CCR unit is an existing unlined CCR surface impoundment as determined by § 257.71(a), then the CCR unit is subject to the closure requirements under § 257.101(a) to retrofit or close. In addition, the owner or operator must prepare a notification stating that an assessment of corrective measures has been initiated.

(h) The owner or operator of the CCR unit must establish a groundwater protection standard for each constituent in appendix IV to this part detected in the groundwater. The groundwater protection standard shall be:

(1) For constituents for which a maximum contaminant level (MCL) has been established under §§ 141.62 and 141.66 of this title, the MCL for that constituent;

(2) For constituents for which an MCL has not been established, the background concentration for the constituent established from wells in accordance with § 257.91; or

(3) For constituents for which the background level is higher than the MCL identified under paragraph (h)(1)

of this section, the background concentration.

(i) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the Internet requirements specified in § 257.107(h).

#### **§ 257.96 Assessment of corrective measures.**

(a) Within 90 days of finding that any constituent listed in appendix IV to this part has been detected at a statistically significant level exceeding the groundwater protection standard defined under § 257.95(h), or immediately upon detection of a release from a CCR unit, the owner or operator must initiate an assessment of corrective measures to prevent further releases, to remediate any releases and to restore affected area to original conditions. The assessment of corrective measures must be completed within 90 days, unless the owner or operator demonstrates the need for additional time to complete the assessment of corrective measures due to site-specific conditions or circumstances. The owner or operator must obtain a certification from a qualified professional engineer attesting that the demonstration is accurate. The 90-day deadline to complete the assessment of corrective measures may be extended for no longer than 60 days. The owner or operator must also include the demonstration in the annual groundwater monitoring and corrective action report required by § 257.90(e), in addition to the certification by a qualified professional engineer.

(b) The owner or operator of the CCR unit must continue to monitor groundwater in accordance with the assessment monitoring program as specified in § 257.95.

(c) The assessment under paragraph (a) of this section must include an analysis of the effectiveness of potential corrective measures in meeting all of the requirements and objectives of the remedy as described under § 257.97 addressing at least the following:

(1) The performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to any residual contamination;

(2) The time required to begin and complete the remedy;

(3) The institutional requirements, such as state or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the remedy(s).

(d) The owner or operator must place the completed assessment of corrective measures in the facility's operating record. The assessment has been completed when it is placed in the facility's operating record as required by § 257.105(h)(10).

(e) The owner or operator must discuss the results of the corrective measures assessment at least 30 days prior to the selection of remedy, in a public meeting with interested and affected parties.

(f) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the Internet requirements specified in § 257.107(h).

#### § 257.97 Selection of remedy.

(a) Based on the results of the corrective measures assessment conducted under § 257.96, the owner or operator must, as soon as feasible, select a remedy that, at a minimum, meets the standards listed in paragraph (b) of this section. This requirement applies to not in place of, any applicable standards under the Occupational Safety and Health Act. The owner or operator must prepare a semiannual report describing the progress in selecting and designing the remedy. Upon selection of a remedy, the owner or operator must prepare a final report describing the selected remedy and how it meets the standards specified in paragraph (b) of this section. The owner or operator must obtain a certification from a qualified professional engineer that the remedy selected meets the requirements of this section. The report has been completed when it is placed in the operating record as required by § 257.105(h)(12).

(b) Remedies must:

(1) Be protective of human health and the environment;

(2) Attain the groundwater protection standard as specified pursuant to § 257.95(h);

(3) Control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in appendix IV to this part into the environment;

(4) Remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, taking into account factors such as avoiding inappropriate disturbance of sensitive ecosystems;

(5) Comply with standards for management of wastes as specified in § 257.98(d).

(c) In selecting a remedy that meets the standards of paragraph (b) of this section, the owner or operator of the

CCR unit shall consider the following evaluation factors:

(1) The long- and short-term effectiveness and protectiveness of the potential remedy(s), along with the degree of certainty that the remedy will prove successful based on consideration of the following:

(i) Magnitude of reduction of existing risks;

(ii) Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy;

(iii) The type and degree of long-term management required, including monitoring, operation, and maintenance;

(iv) Short-term risks that might be posed to the community or the environment during implementation of such a remedy, including potential threats to human health and the environment associated with excavation, transportation, and re-disposal of contaminant;

(v) Time until full protection is achieved;

(vi) Potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment;

(vii) Long-term reliability of the engineering and institutional controls; and

(viii) Potential need for replacement of the remedy.

(2) The effectiveness of the remedy in controlling the source to reduce further releases based on consideration of the following factors:

(i) The extent to which containment practices will reduce further releases; and

(ii) The extent to which treatment technologies may be used.

(3) The ease or difficulty of implementing a potential remedy(s) based on consideration of the following types of factors:

(i) Degree of difficulty associated with constructing the technology;

(ii) Expected operational reliability of the technologies;

(iii) Need to coordinate with and obtain necessary approvals and permits from other agencies;

(iv) Availability of necessary equipment and specialists; and

(v) Available capacity and location of needed treatment, storage, and disposal services.

(4) The degree to which community concerns are addressed by a potential remedy(s).

(d) The owner or operator must specify as part of the selected remedy a

schedule(s) for implementing and completing remedial activities. Such a schedule must require the completion of remedial activities within a reasonable period of time taking into consideration the factors set forth in paragraphs (d)(1) through (6) of this section. The owner or operator of the CCR unit must consider the following factors in determining the schedule of remedial activities:

(1) Extent and nature of contamination, as determined by the characterization required under § 257.95(g);

(2) Reasonable probabilities of remedial technologies in achieving compliance with the groundwater protection standards established under § 257.95(h) and other objectives of the remedy;

(3) Availability of treatment or disposal capacity for CCR managed during implementation of the remedy;

(4) Potential risks to human health and the environment from exposure to contamination prior to completion of the remedy;

(5) Resource value of the aquifer including:

(i) Current and future uses;

(ii) Proximity and withdrawal rate of users;

(iii) Groundwater quantity and quality;

(iv) The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to CCR constituents;

(v) The hydrogeologic characteristic of the facility and surrounding land; and

(vi) The availability of alternative water supplies; and

(6) Other relevant factors.

(e) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the Internet requirements specified in § 257.107(h).

#### § 257.98 Implementation of the corrective action program.

(a) Within 90 days of selecting a remedy under § 257.97, the owner or operator must initiate remedial activities. Based on the schedule established under § 257.97(d) for implementation and completion of remedial activities the owner or operator must:

(1) Establish and implement a corrective action groundwater monitoring program that:

(i) At a minimum, meets the requirements of an assessment monitoring program under § 257.95;

(ii) Documents the effectiveness of the corrective action remedy; and

(iii) Demonstrates compliance with the groundwater protection standard pursuant to paragraph (c) of this section.

(2) Implement the corrective action remedy selected under § 257.97; and

(3) Take any interim measures necessary to reduce the contaminants leaching from the CCR unit, and/or potential exposures to human or ecological receptors. Interim measures must, to the greatest extent feasible, be consistent with the objectives of and contribute to the performance of any remedy that may be required pursuant to § 257.97. The following factors must be considered by an owner or operator in determining whether interim measures are necessary:

(i) Time required to develop and implement a final remedy;

(ii) Actual or potential exposure of nearby populations or environmental receptors to any of the constituents listed in appendix IV of this part;

(iii) Actual or potential contamination of drinking water supplies or sensitive ecosystems;

(iv) Further degradation of the groundwater that may occur if remedial action is not initiated expeditiously;

(v) Weather conditions that may cause any of the constituents listed in appendix IV to this part to migrate or be released;

(vi) Potential for exposure to any of the constituents listed in appendix IV to this part as a result of an accident or failure of a container or handling system; and

(vii) Other situations that may pose threats to human health and the environment.

(b) If an owner or operator of the CCR unit, determines, at any time, that compliance with the requirements of § 257.97(b) is not being achieved through the remedy selected, the owner or operator must implement other methods or techniques that could feasibly achieve compliance with the requirements.

(c) Remedies selected pursuant to § 257.97 shall be considered complete when:

(1) The owner or operator of the CCR unit demonstrates compliance with the groundwater protection standards established under § 257.95(h) has been achieved at all points within the plume of contamination that lie beyond the groundwater monitoring well system established under § 257.91.

(2) Compliance with the groundwater protection standards established under § 257.95(h) has been achieved by demonstrating that concentrations of constituents listed in appendix IV to this part have not exceeded the groundwater protection standard(s) for a

period of three consecutive years using the statistical procedures and performance standards in § 257.93(f) and (g).

(3) All actions required to complete the remedy have been satisfied.

(d) All CCR that are managed pursuant to a remedy required under § 257.97, or an interim measure required under paragraph (a)(3) of this section, shall be managed in a manner that complies with all applicable RCRA requirements.

(e) Upon completion of the remedy, the owner or operator must prepare a notification stating that the remedy has been completed. The owner or operator must obtain a certification from a qualified professional engineer attesting that the remedy has been completed in compliance with the requirements of paragraph (c) of this section. The report has been completed when it is placed in the operating record as required by § 257.105(h)(13).

(f) The owner or operator of the CCR unit must comply with the recordkeeping requirements specified in § 257.105(h), the notification requirements specified in § 257.106(h), and the internet requirements specified in § 257.107(h).

#### Closure and Post-Closure Care

##### § 257.100 Inactive CCR surface impoundments.

(a) Except as provided by paragraph (b) of this section, inactive CCR surface impoundments are subject to all of the requirements of this subpart applicable to existing CCR surface impoundments.

(b) An owner or operator of an inactive CCR surface impoundment that completes closure of such CCR unit, and meets all of the requirements of either paragraphs (b)(1) through (4) of this section or paragraph (b)(5) of this section no later than April 17, 2018, is exempt from all other requirements of this subpart.

(1) *Closure by leaving CCR in place.* If the owner or operator of the inactive CCR surface impoundment elects to close the CCR surface impoundment by leaving CCR in place, the owner or operator must ensure that, at a minimum, the CCR unit is closed in a manner that will:

(i) Control, minimize or eliminate, to the maximum extent feasible, post-closure infiltration of liquids into the waste and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere;

(ii) Preclude the probability of future impoundment of water, sediment, or slurry;

(iii) Include measures that provide for major slope stability to prevent the

sloughing or movement of the final cover system; and

(iv) Minimize the need for further maintenance of the CCR unit.

(2) The owner or operator of the inactive CCR surface impoundment must meet the requirements of paragraphs (b)(2)(i) and (ii) of this section prior to installing the final cover system required under paragraph (b)(3) of this section.

(i) Free liquids must be eliminated by removing liquid wastes or solidifying the remaining wastes and waste residues.

(ii) Remaining wastes must be stabilized sufficient to support the final cover system.

(3) The owner or operator must install a final cover system that is designed to minimize infiltration and erosion, and at a minimum, meets the requirements of paragraph (b)(3)(i) of this section, or the requirements of an alternative final cover system specified in paragraph (b)(3)(ii) of this section.

(i) The final cover system must be designed and constructed to meet the criteria specified in paragraphs (b)(3)(i)(A) through (D) of this section.

(A) The permeability of the final cover system must be less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than  $1 \times 10^{-5}$  centimeters/second, whichever is less.

(B) The infiltration of liquids through the CCR unit must be minimized by the use of an infiltration layer that contains a minimum of 18 inches of earthen material.

(C) The erosion of the final cover system must be minimized by the use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.

(D) The disruption of the integrity of the final cover system must be minimized through a design that accommodates settling and subsidence.

(ii) The owner or operator may select an alternative final cover system design, provided the alternative final cover system is designed and constructed to meet the criteria in paragraphs (b)(3)(ii)(A) through (C) of this section.

(A) The design of the final cover system must include an infiltration layer that achieves an equivalent reduction in infiltration as the infiltration layer specified in paragraphs (b)(3)(i)(A) and (B) of this section.

(B) The design of the final cover system must include an erosion layer that provides equivalent protection from wind or water erosion as the erosion layer specified in paragraph (b)(3)(i)(C) of this section.

deficiency or release specified under § 257.105(f)(11).

(11) The initial and periodic safety factor assessments specified under § 257.105(f)(12).

(12) The design and construction plans, and any revisions of them, specified under § 257.105(f)(13).

(g) *Operating criteria.* The owner or operator of a CCR unit subject to this subpart must place the following information on the owner or operator's CCR Web site:

(1) The CCR fugitive dust control plan, or any subsequent amendment of the plan, specified under § 257.105(g)(1) except that only the most recent plan must be maintained on the CCR Web site irrespective of the time requirement specified in paragraph (c) of this section.

(2) The annual CCR fugitive dust control report specified under § 257.105(g)(2).

(3) The initial and periodic run-on and run-off control system plans specified under § 257.105(g)(3).

(4) The initial and periodic inflow design flood control system plans specified under § 257.105(g)(4).

(5) The periodic inspection reports specified under § 257.105(g)(6).

(6) The documentation detailing the corrective measures taken to remedy the deficiency or release specified under § 257.105(g)(7).

(7) The periodic inspection reports specified under § 257.105(g)(9).

(h) *Groundwater monitoring and corrective action.* The owner or operator of a CCR unit subject to this subpart must place the following information on the owner or operator's CCR Web site:

(1) The annual groundwater monitoring and corrective action report specified under § 257.105(h)(1).

(2) The groundwater monitoring system certification specified under § 257.105(h)(3).

(3) The selection of a statistical method certification specified under § 257.105(h)(4).

(4) The notification that an assessment monitoring programs has been established specified under § 257.105(h)(5).

(5) The notification that the CCR unit is returning to a detection monitoring program specified under § 257.105(h)(7).

(6) The notification that one or more constituents in appendix IV to this part have been detected at statistically significant levels above the groundwater protection standard and the notifications to land owners specified under § 257.105(h)(8).

(7) The notification that an assessment of corrective measures has been initiated specified under § 257.105(h)(9).

(8) The assessment of corrective measures specified under § 257.105(h)(10).

(9) The semiannual reports describing the progress in selecting and designing remedy and the selection of remedy report specified under § 257.105(h)(12), except that the selection of the remedy report must be maintained until the remedy has been completed.

(10) The notification that the remedy has been completed specified under § 257.105(h)(13).

(i) *Closure and post-closure care.* The owner or operator of a CCR unit subject to this subpart must place the following information on the owner or operator's CCR Web site:

(1) The notification of intent to initiate closure of the CCR unit specified under § 257.105(i)(1).

(2) The annual progress reports of closure implementation specified under § 257.105(i)(2).

(3) The notification of closure completion specified under § 257.105(i)(3).

(4) The written closure plan, and any amendment of the plan, specified under § 257.105(i)(4).

(5) The demonstration(s) for a time extension for initiating closure specified under § 257.105(i)(5).

(6) The demonstration(s) for a time extension for completing closure specified under § 257.105(i)(6).

(7) The notification of intent to close a CCR unit specified under § 257.105(i)(7).

(8) The notification of completion of closure of a CCR unit specified under § 257.105(i)(8).

(9) The notification recording a notation on the deed as required by § 257.105(i)(9).

(10) The notification of intent to comply with the alternative closure requirements as required by § 257.105(i)(10).

(11) The annual progress reports under the alternative closure requirements as required by § 257.105(i)(11).

(12) The written post-closure plan, and any amendment of the plan, specified under § 257.105(i)(12).

(13) The notification of completion of post-closure care specified under § 257.105(i)(13).

(j) *Retrofit criteria.* The owner or operator of a CCR unit subject to this subpart must place the following information on the owner or operator's CCR Web site:

(1) The written retrofit plan, and any amendment of the plan, specified under § 257.105(j)(1).

(2) The notification of intent to comply with the alternative retrofit

requirements as required by § 257.105(j)(2).

(3) The annual progress reports under the alternative retrofit requirements as required by § 257.105(j)(3).

(4) The demonstration(s) for a time extension for completing retrofit activities specified under § 257.105(j)(4).

(5) The notification of intent to retrofit a CCR unit specified under § 257.105(j)(5).

(6) The notification of completion of retrofit activities specified under § 257.105(j)(6).

■ 5. Amend part 257 by adding "Appendix III to Part 257" and "Appendix IV to Part 257" to read as follows:

#### Appendix III to Part 257—Constituents for Detection Monitoring

Common name <sup>1</sup>
Boron
Calcium Chloride
Fluoride
pH
Sulfate
Total Dissolved Solids (TDS)

<sup>1</sup> Common names are those widely used in government regulations, scientific publications, and commerce; synonyms exist for many chemicals.

#### Appendix IV to Part 257—Constituents for Assessment Monitoring

Common name <sup>1</sup>
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Fluoride
Lead
Lithium
Mercury
Molybdenum
Selenium
Thallium
Radium 226 and 228 combined

<sup>1</sup> Common names are those widely used in government regulations, scientific publications, and commerce; synonyms exist for many chemicals.

#### PART 261—IDENTIFICATION AND LISTING OF HAZARDOUS WASTE

■ 6. The authority citation for part 261 continues to read as follows:

**Authority:** 42 U.S.C. 6905, 6912(a), 6921, 6922, 6924(y) and 6938.

■ 7. Section 261.4 is amended by revising paragraph (b)(4) to read as follows:

## **APPENDIX B**

### **Boring Logs and Construction Diagrams**



# TEST BORING REPORT

**Boring No. CCR-AP-1R**

Project CCR Hydrogeologic Characterization, F.B. Culley Generating Station  
 Client Southern Indiana Gas & Electric Company  
 Contractor Stearns Drilling

File No. 42796-001  
 Sheet No. 1 of 3  
 Start 15 December 2015  
 Finish 08 March 2016  
 Driller J. Gryska  
 H&A Rep. J. Yonts

Type	S	S	-	Rig Make & Model: Track
Inside Diameter (in.)	4.25	1 3/8	-	Bit Type:
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)	-	30	-	Casing: Auger
				Hoist/Hammer: Winch Automatic Hammer
				PID Make & Model:

Elevation 438.5 (est.)  
 Datum  
 Location  
 N 969,940  
 E 2,883,430

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel			Sand			Field Test					
								% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength		
0	5	S1	0.0		438.0	--	Top soil with gravel parking lot base	-	-	-	-	-	-	-	-	-	-	-	
5	5	16/24	2.0		438.0	0.5	MH	Soft yellow-brown mottled tan elastic SILT, mps = 11 mm, no odor, moist	-	10	5	-	-	85	N	L	M	M	
								-ALLUVIUM-											
5	6	S2	4.0		434.5	4.0	ML	Medium stiff light brown SILT, mps = 3 mm, no odor, moist	-	-	-	10	90	R	L	N	L		
	9	18/24	6.0					-ALLUVIUM-											
10	2	S3	9.0		429.5	9.0	CL	Medium stiff yellow-brown lean CLAY, mps = 10 mm, no odor, moist	-	10	10	-	-	80	N	M	M	H	
	4	14/24	11.0				-ALLUVIUM-												
15	4	S4	14.0		423.5	15.0	CL	Medium stiff light brown lean CLAY, mps = 5 mm, no odor, moist	-	-	-	10	90	N	M	M	H		
	6	16/24	16.0				Moderately hard slightly weathered light brown to yellow-brown to red fine-grained SANDSTONE, dry	-	-	-	-	-	-	-	-	-	-	-	
	50/4	-	-				Moderately hard moderately weathered yellow-brown to red fine-grained SANDSTONE, laminar bedding, dry	-	-	-	-	-	-	-	-	-	-	-	
20	-	S5	18.0				Medium hard, highly weathered, light brown SANDSTONE,	-	-	-	-	-	-	-	-	-	-	-	
	-	5/5	21.0																

Water Level Data				Sample ID		Well Diagram		Summary	
Date	Time	Elapsed Time (hr.)	Depth (ft) to:	O - Open End Rod T - Thin Wall Tube U - Undisturbed Sample S - Split Spoon Sample		Riser Pipe Screen Filter Sand Cuttings Grout Concrete Bentonite Seal	Overburden (ft)	15.0	<b>Boring No. CCR-AP-1R</b>
12/20/15	14:08		Bottom of Casing Bottom of Hole Water				52.78	Rock Cored (ft)	

**Field Tests:** Dilatancy: R - Rapid S - Slow N - None Plasticity: N - Nonplastic L - Low M - Medium H - High  
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High V - Very High

**\*Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**  
**Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.**

HA-TEST BORING-07-1 HA-LIB09-REV.GLB HA-TB+CORE+WELL-07-1.GDT \\GRNCOM\MON\42796 - VECTRENF B CULLEY\GINT\F.B. CULLEY LOGS.GPJ Apr 20, 17



# TEST BORING REPORT

Boring No. CCR-AP-1R

File No. 42796-001  
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Test						
								% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength		
20					414.5 24.0		extremely thin bedding, dry												
25	50/2 - -	S6 2/2	24.0 26.0					Medium hard highly weathered gray-brown SHALE, friable, dry	-	-	-	-	-	-	-	-	-	-	-
30	50/5 - -	S7 5/5	29.0 31.0					Similar as above  Similar as above	-	-	-	-	-	-	-	-	-	-	-
35	50/3 - -	S8 3/3	35.0 37.0					Medium hard moderately weathered gray SHALE, friable, dry to moist	-	-	-	-	-	-	-	-	-	-	-
40	50/4 - -	S9 4/4	40.0 42.0					Medium hard moderately weathered gray SHALE, friable, moist	-	-	-	-	-	-	-	-	-	-	-
45	50/3 - -	S10 3/3	45.0 47.0					Similar as above	-	-	-	-	-	-	-	-	-	-	-

H&A-TEST BORING-07-1 HA-LIB09-REV.GLB HA-TB+CORE+WELL-07-1.GDT \\GRNCOM\MON\42796 - VECTRENF B CULLEY\GINT\F.B. CULLEY LOGS.GPJ Apr 20, 17

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-1R





# TEST BORING REPORT

Boring No. CCR-AP-1R

File No. 42796-001  
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Test				
								% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
50	- - - - -	S11 5/5	50.0 55.0		388.5 50.0		Gray SANDSTONE composed of medium to fine sand. No apparent fractures.	-	-	-	-	-	-	-	-	-	-
					385.1 53.4		Black organic rich layers, coal possible, breaks along laminae with mica and plants (fossil). Gray SILTSTONE with trace SHALE laminae.	-	-	-	-	-	-	-	-	-	-
55	- - -	S12 5/5	55.0 60.0				Similar to above except 55.2 ft to 55.4 ft black and gray turbidite layer. Gray SHALE with layers of siltstone, plant (fossil) stems and mica breaks.	-	-	-	-	-	-	-	-	-	-
60	- - -	S13 5/5	60.0 65.0				Gray SILTSTONE with laminae of SHALE but mostly SHALE.  Gray black SHALE with a few thin beds of gray (lighter) siltstone, pyrite rich SHALE layer from approximately 61.0 ft to 61.3 ft. SHALE/SILTSTONE slight variation throughout except coarser silty layers.	-	-	-	-	-	-	-	-	-	-
65					373.5 65.0		BOTTOM OF EXPLORTION 65.0 FT										

H&A-TEST BORING-07-1 HA-LIB09-REV.GLB HA-TB+CORE+WELL-07-1.GDT \\GRNCOM\MON\42796 - VECTRENF B. CULLEY LOGS.GPJ Apr 20, 17

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-1R



# TEST BORING REPORT

**Boring No. CCR-AP-2**

Project CCR Hydrogeologic Characterization, F.B. Culley Generating Station  
 Client Southern Indiana Gas & Electric Company  
 Contractor Stearns Drilling

File No. 42796-001  
 Sheet No. 1 of 2  
 Start 16 December 2015  
 Finish 16 December 2015  
 Driller J. Gryska  
 H&A Rep. E. Shirley

Type	S	S	-	Rig Make & Model: Track
Inside Diameter (in.)	4.25	1 3/8	-	Bit Type:
Hammer Weight (lb)	-	140	-	Drill Mud: None
Hammer Fall (in.)	-	30	-	Casing: Auger
				Hoist/Hammer: Winch Automatic Hammer
				PID Make & Model:

Elevation 394.4 (est.)  
 Datum  
 Location  
 N 969,118  
 E 2,884,169

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Test						
								% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength		
0	3	S1	0.0		393.9	ML	6-inch gravel base	-	-	-	-	-	-	-	-	-	-	-	
5	5	21/24	2.0		0.5	ML	Medium stiff light brown SILT, mps = 1 mm, no odor, moist	-	-	-	5	95	S	L	N	M			
	8							-FILL-											
5	3	S2	3.5				ML	Similar to S1 above	-	-	-	5	95	S	L	N	M		
	5	16/24	5.5																
10	0	S3	8.5			ML	Similar to S2 above except organic material observed and soft	-	-	-	5	95	S	L	N	M			
	2	18/24	10.5																
15	0	S4	13.5		380.4	CL	Soft light brown lean CLAY, mps = 3 mm, no odor, moist	-	-	-	5	95	N	M	M	H			
	2	21/24	15.5		14.0														
	3						-FILL-												
20	1	S5	18.5			CL	Soft dark brown lean CLAY, no odor, moist, organic material observed and wood fibers approximately 19.5 feet	-	-	-	-	100	S	L	M	M			
	3	24/24	20.5																

Water Level Data				Sample ID		Well Diagram		Summary	
Date	Time	Elapsed Time (hr.)	Depth (ft) to:	O - Open End Rod T - Thin Wall Tube U - Undisturbed Sample S - Split Spoon Sample		Riser Pipe Screen Filter Sand Cuttings Grout Concrete Bentonite Seal	Overburden (ft)	46.0	<b>Boring No. CCR-AP-2</b>
12/20/15	14:00		Bottom of Casing Bottom of Hole Water				Rock Cored (ft)	-	

**Field Tests:** Dilatancy: R - Rapid S - Slow N - None Plasticity: N - Nonplastic L - Low M - Medium H - High  
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High V - Very High

**\*Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**  
**Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.**

H&A-TEST BORING-07-1 HA-LIB09-REV.GLB HA-TB+CORE+WELL-07-1.GDT \\GRNCOM\MON\42796 - VECTRENF\B.CULLEY\LOGS.GPJ Apr 20, 17



# TEST BORING REPORT

Boring No. CCR-AP-2

File No. 42796-001  
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Test						
								% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength		
20	6						- FILL												
23.5	2	S6	23.5				CL	Similar as above	-	-	-	-	-	100	S	L	M	M	
25.5	3	22/24	25.5																
25.5	6																		
25.5	7						CL	Similar as above except organic wood fibers observed	-	-	-	-	-	100	S	L	M	M	
28.0	1	S7	28.0																
30.0	3	25/24	30.0																
30.0	4																		
30.0	6						CL	Similar as above	-	-	-	-	-	100	S	L	M	M	
32.0	2	S8	32.0																
32.0	3	23/24	32.0																
32.0	4																		
32.0	4																		
32.0	1	S9	32.0					Similar as above	-	-	-	-	-	100	S	L	M	M	
34.0	3	23/24	34.0																
34.0	4																		
34.0	4	S10	34.0		359.4	MH	Soft, brown, elastic SILT, no odor, moist	-	-	-	-	-	100	S	M	M	M		
35.0	4	21/24	36.0		35.0		- ALLUVIUM -												
36.0	1	S11	36.0																
38.0	3	23/24	38.0			MH	Similar as above	-	-	-	-	-	100	S	M	M	M		
38.0	5																		
38.0	6					MH	Similar as above	-	-	-	-	-	100	S	M	M	M		
38.0	0	S12	38.0																
40.0	2	22/24	40.0																
40.0	3																		
40.0	4					MH	Similar as above	-	-	-	-	-	100	S	M	M	M		
40.0	1	S13	40.0		352.9	ML	Soft brown sandy SILT, mps = 1 mm, no odor, wet	-	-	-	-	30	70	R	L	N	L		
42.0	2	24/24	42.0		41.5														
42.0	3				352.4														
42.0	4				42.0	MH	Soft brown elastic SILT, no odor, wet	-	-	-	-	-	100	S	M	M	M		
42.0	1	S14	42.0																
44.0	2	24/24	44.0																
44.0	2						1-inch sandy SILT at 43.5 feet	-	-	-	-	30	70	S	M	M	M		
44.0	2																		
44.0	0	S15	44.0																
46.0	1	24/24	46.0			MH	Similar as above except more sand	-	-	-	-	40	60	S	M	M	M		
46.0	2																		
46.0	2				348.4														
46.0					46.0		- BOTTOM OF EXPLORATION 46.0 FT -												

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-2



# TEST BORING REPORT

**Boring No. CCR-AP-3**

Project CCR Hydrogeologic Characterization, F.B. Culley Generating Station  
 Client Southern Indiana Gas & Electric Company  
 Contractor Stearns Drilling

File No. 42796-001  
 Sheet No. 1 of 2  
 Start 15 December 2015  
 Finish 15 December 2015  
 Driller J. Gryska  
 H&A Rep. E. Shirley

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	S	S	-	Rig Make & Model: Track Bit Type:
Inside Diameter (in.)	4.25	1 3/8	-	Drill Mud: None
Hammer Weight (lb)	-	140	-	Casing: Auger
Hammer Fall (in.)	-	30	-	Hoist/Hammer: Winch Automatic Hammer PID Make & Model:

Elevation 395.1 (est.)  
 Datum  
 Location  
 N 969,008  
 E 2,883,542

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel			Sand			Field Test				
								% Coarse	% Fine	% Fines	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
0	12 24 24 16	S1 24/24	0.0 2.0	[Well Diagram: Solid black bar]	394.1 1.0	ML	Gravel and sand road base material	-	-	-	-	-	-	-	-	-	-	-
								Stiff dark brown SILT, mps = 20 mm, no odor, moist. Grades brown at 1.75 feet	5	5	10	-	-	80	S	L	L	L
							-FILL-											
5	5 7 8 7	S2 17/24	4.0 6.0	[Well Diagram: Solid black bar]	390.1 5.0	CL	Stiff dark brown lean CLAY, mps = 10 mm, no odor, moist, organic material observed	-	5	5	-	-	90	N	M	M	H	
								-FILL-										
10	1 1 1 1	S3 16/24	9.0 11.0	[Well Diagram: Solid black bar]	385.1 10.0	MH	Soft brown elastic SILT, mps = 5 mm, no odor, moist	-	-	-	-	15	85	S	L	L	M	
								-FILL-										
15	1 1 2 4	S4 11/24	14.0 16.0	[Well Diagram: Solid black bar]	380.1 15.0	CL	Soft brown lean CLAY, mps = 12 mm, no odor, moist	-	5	-	-	-	95	N	M	M	H	
								-FILL-										
20	2 2	S5 19/24	19.0 21.0	[Well Diagram: Solid black bar]														

Water Level Data					Sample ID	Well Diagram	Summary
Date	Time	Elapsed Time (hr.)	Depth (ft) to:		O - Open End Rod T - Thin Wall Tube U - Undisturbed Sample S - Split Spoon Sample		Overburden (ft) 45.0
12/20/15	13:40		Bottom of Casing	Bottom of Hole			Water 43.00
							Samples 15S
							<b>Boring No. CCR-AP-3</b>

**Field Tests:** Dilatancy: R - Rapid S - Slow N - None Plasticity: N - Nonplastic L - Low M - Medium H - High  
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High V - Very High

**\*Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**  
**Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.**

H&A-TEST BORING-07-1 HA-LIB09-REV.GLB HA-TB+CORE+WELL-07-1.GDT \\GRNCOM\MON\42796 - VECTREN\FB CULLEY\GINT\F.B. CULLEY LOGS.GPJ Apr 20, 17



# TEST BORING REPORT

Boring No. CCR-AP-3

File No. 42796-001  
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Test					
								% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength	
20	3 4					CL	Medium stiff brown lean CLAY, mps = 25 mm, no odor, moist	5	5	5	-	-	85	N	M	M	H	
25	1 1 3 4	S6 18/24	24.0 26.0			CL	Soft dark brown lean CLAY, mps = 5 mm, no odor, moist	-	-	-	5	5	90	N	M	M	H	
	0 0 1 3	S7 24/24	28.0 30.0			CL	Soft dark brown lean CLAY, mps = 3 mm, no odor, moist	-	-	-	-	5	95	N	M	M	H	
30	0 2 3 5	S8 21/24	30.0 32.0			CL	Similar as above	-	-	-	-	5	95	N	M	M	H	
	0 0 3 4	S9 24/24	32.0 34.0			CL	Similar as above	-	-	-	-	5	95	N	M	M	H	
35	3 5 6 7	S10 20/24	34.0 36.0			CL	Similar as above except wood in shoe at 36 feet	-	-	-	-	5	95	N	M	M	H	
	2 5 5 9	S11 22/24	36.0 38.0			CL	Similar as above	-	-	-	-	5	95	N	M	M	H	
	3 5 6 6	S12 22/24	38.0 40.0			CL	Similar as above	-	-	-	-	5	95	N	M	M	H	
40	2 3 4 5	S13 24/24	40.0 42.0			355.1 40.0	CL	Similar as above except organic material and interbedded 1- to 2- inch sand layers	-	-	-	-	5	95	N	M	M	H
	0 1 2 3	S14 24/24	42.0 44.0				CL	Similar as above	-	-	-	-	5	95	N	M	M	H
	0 0	S15 12/12	44.0 45.0			350.6 44.5 350.1 45.0	CL	Similar as above	-	-	-	-	5	95	N	M	M	H
45	-						MH	Dark brown SILT, moist to wet at 44.5 feet	-	-	-	-	5	95	S	L	L	L
								-BOTTOM OF EXPLORATION 45 FT-										

H&A-TEST BORING-07-1 HA-LIB09-REV.GLB HA-TB+CORE+WELL-07-1.GDT \\GRNCOMMON\42796 - VECTRENFB CULLEY\GINT\F.B. CULLEY LOGS.GPJ Apr 20, 17

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-3



# TEST BORING REPORT

**Boring No. CCR-AP-4**

Project CCR Hydrogeologic Characterization, F.B. Culley Generating Station  
 Client Southern Indiana Gas & Electric Company  
 Contractor Stearns Drilling

File No. 42796-001  
 Sheet No. 1 of 2  
 Start 16 December 2015  
 Finish 16 December 2015  
 Driller J. Gryska  
 H&A Rep. E. Shirley

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	S	S	-	Rig Make & Model: Track Bit Type:
Inside Diameter (in.)	4.25	1 3/8	-	Drill Mud: None
Hammer Weight (lb)	-	140	-	Casing: Auger
Hammer Fall (in.)	-	30	-	Hoist/Hammer: Winch Automatic Hammer PID Make & Model:

Elevation 395.4 (est.)  
 Datum  
 Location  
 N 969,642  
 E 2,883,282

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel			Sand			Field Test					
								% Coarse	% Fine	% Fines	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength	
0	6	S1	0.0		394.4	CL	Gravel base	-	-	-	-	-	-	-	-	-	-	-	
6	6	19/24	2.0				1.0	CL	Stiff brown lean CLAY, mps = 10 mm, no odor, moist	5	-	-	-	-	95	N	M	M	H
4	4							-FILL-											
5	6	S2	4.0		391.4	4.0	SW	Loose brown well-graded SAND, mps = 8 mm, no odor, moist	-	5	25	35	30	5	-	-	-	-	
6	10	15/24	6.0					-FILL-											
10	1	S3	9.0			SW	Very loose brown well-graded SAND, mps = 9 mm, no odor, wet	-	5	30	35	25	5	-	-	-	-		
11	2	12/24	11.0				-FILL-												
15	3	S4	14.0		381.4	MH	Medium stiff brown elastic SILT, no odor, moist	-	-	-	-	-	100	S	L	L	M		
16	5	10/24	16.0		14.0		-ALLUVIUM-												
20	2	S5	19.0			MH	Soft, brown, elastic SILT, no odor, moist	-	-	-	-	-	100	S	L	L	M		
21	3	15/24	21.0																

Water Level Data					Sample ID		Well Diagram		Summary	
Date	Time	Elapsed Time (hr.)	Depth (ft) to:		O - Open End Rod T - Thin Wall Tube U - Undisturbed Sample S - Split Spoon Sample		Riser Pipe Screen Filter Sand Cuttings Grout Concrete Bentonite Seal	Overburden (ft)	Rock Cored (ft)	Samples
			Bottom of Casing	Bottom of Hole				Water		
12/20/15	13:33				7.11			35.5	-	10S

**Boring No. CCR-AP-4**

**Field Tests:** Dilatancy: R - Rapid S - Slow N - None Plasticity: N - Nonplastic L - Low M - Medium H - High  
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High V - Very High

\*Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.  
 Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-07-1 HA-LIB09-REV.GLB HA-TB+CORE+WELL-07-1.GDT \\GRNCOM\MON\42796 - VECTREN\FB CULLEY\GINT\F.B. CULLEY LOGS.GPJ Apr 20, 17



# TEST BORING REPORT

Boring No. CCR-AP-4

File No. 42796-001  
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Test						
								% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength		
20	4 5																		
25	3 3 2 3	S6 19/24	24.0 26.0		371.4 24.0	CL	Soft dark brown lean CLAY, mps = 2 mm, no odor, moist  -ALLUVIUM-	-	-	-	-	5	95	N	M	M	H		
	1 2 4 3	S7 24/24	28.0 30.0			CL	Similar as above	-	-	-	-	-	-	-	-	-	-	-	-
30	0 3 2 3	S8 21/24	30.0 32.0			CL	Similar as above  2-inch pocket of brown SILT at 31.5 feet	-	-	-	-	-	-	-	-	-	-	-	-
	1 2 4 7	S9 22/24	32.0 34.0			CL	Similar as above	-	-	-	-	-	-	-	-	-	-	-	-
	2 4 50/1	S10 13/24	34.0 36.0			CL	Medium stiff gray mottled brown lean CLAY, mps = 12 mm, no odor, moist	-	5	5	5	-	85	N	M	M	H		
35					360.4 359.0 359.9 35.5		Highly weathered gray SHALE, friable  -REFUSAL AT 35.5 FT-	-	-	-	-	-	-	-	-	-	-	-	-

H&A-TEST BORING-07-1 HA-LIB09-REV.GLB HA-TB+CORE+WELL-07-1.GDT \\GRNCOM\MON\42796 - VECTRENF B CULLEY\GINT\F.B. CULLEY LOGS.GPJ Apr 20, 17

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-4



# TEST BORING REPORT

**Boring No. CCR-AP-5**

Project CCR Hydrogeologic Characterization, F.B. Culley Generating Station  
 Client Southern Indiana Gas & Electric Company  
 Contractor Stearns Drilling

File No. 42796-001  
 Sheet No. 1 of 2  
 Start 18 December 2015  
 Finish 18 December 2015  
 Driller J. Gryska  
 H&A Rep. E. Shirley

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	S	S	-	Rig Make & Model: Track Bit Type:
Inside Diameter (in.)	4.25	1 3/8	-	Drill Mud: None
Hammer Weight (lb)	-	140	-	Casing: Auger
Hammer Fall (in.)	-	30	-	Hoist/Hammer: Winch Automatic Hammer PID Make & Model:

Elevation 394.8 (est.)  
 Datum  
 Location  
 N 969,380  
 E 2,884,017

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Test					
								% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength	
0	5	S1	0.0		394.3		Gravel base	-	-	-	-	-	-	-	-	-	-	-
5	7	21/24	2.0		0.5	CL	Medium stiff brown gravelly lean CLAY, mps = 33 mm, no odor, moist  -FILL-	25	5	-	-	-	70	N	M	M	H	
5	4	S2	4.0				CL	Medium stiff brown gravelly lean CLAY, mps = 25 mm, no odor, moist	25	15	-	-	-	65	N	M	M	H
5	7	24/24	6.0															
10	2	S3	9.0		385.3		CL	Soft gray lean CLAY with weathered shale, mps = 40 mm, no odor, wet	40	-	-	-	-	60	N	M	M	H
10	4	14/24	11.0		9.5			Moderately hard moderately weathered gray SHALE, friable, wet	-	-	-	-	-	-	-	-	-	-
15	4	S4	14.0					Medium hard highly weathered gray SHALE, friable, moist	-	-	-	-	-	-	-	-	-	-
15	2	14/24	16.0															
20	8	S5	19.0				Medium hard highly weathered gray SHALE, friable, moist	-	-	-	-	-	-	-	-	-	-	
20	19	14/24	21.0															

Water Level Data				Sample ID		Well Diagram		Summary	
Date	Time	Elapsed Time (hr.)	Depth (ft) to:	O - Open End Rod		Riser Pipe	Overburden (ft)	9.5	
			Bottom of Casing	T - Thin Wall Tube		Screen	Rock Cored (ft)	35.5	
			Bottom of Hole	U - Undisturbed Sample		Filter Sand	Samples	14S	
12/20/15	14:04		9.92	S - Split Spoon Sample		Cuttings	<b>Boring No. CCR-AP-5</b>		
						Grout			
						Concrete			
						Bentonite Seal			

**Field Tests:** Dilatancy: R - Rapid S - Slow N - None Plasticity: N - Nonplastic L - Low M - Medium H - High  
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High V - Very High

**\*Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**  
**Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.**





# TEST BORING REPORT

Boring No. CCR-AP-5

File No. 42796-001  
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Test								
								% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength				
20	6 12				369.3 25.5             351.3 43.8 350.8 44.0																
									Medium hard highly weathered gray SHALE, friable, moist	-	-	-	-	-	-	-	-	-	-	-	-
25	5 6 7 9	S6 15/24	24.0 26.0						Moderately hard highly weathered brown SANDSTONE, friable, moist	-	-	-	-	-	-	-	-	-	-	-	-
									Similar as above except moderately weathered at 28 feet	-	-	-	-	-	-	-	-	-	-	-	-
									Similar as above except highly weathered and brown to gray at 29 feet	-	-	-	-	-	-	-	-	-	-	-	-
30	2 4 4 4	S8 17/24	30.0 32.0																		
									Similar as above	-	-	-	-	-	-	-	-	-	-	-	-
									Similar as above	-	-	-	-	-	-	-	-	-	-	-	-
									Soft highly weathered brown SANDSTONE, wet	-	-	-	-	-	-	-	-	-	-	-	-
35	3 2 2 2	S10 19/24	34.0 36.0																		
									Medium hard highly weathered brown SANDSTONE, friable, moist	-	-	-	-	-	-	-	-	-	-	-	-
							Similar as above	-	-	-	-	-	-	-	-	-	-	-	-		
40	9 33 22 16	S13 21/24	40.0 42.0																		
							Similar as above	-	-	-	-	-	-	-	-	-	-	-	-		
							Similar as above	-	-	-	-	-	-	-	-	-	-	-	-		
							Soft, black COAL, friable, moist	-	-	-	-	-	-	-	-	-	-	-	-		
							BOTTOM OF EXPLORTION 44.0 FT-														

H&A-TEST BORING-07-1 HA-LIB09-REV.GLB HA-TB+CORE+WELL-07-1.GDT \\GRNCOMMON\42796 - VECTRENFB CULLEY\GINT\F.B. CULLEY LOGS.GPJ Apr 20, 17

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-5



# TEST BORING REPORT

**Boring No. CCR-AP-6**

Project CCR Hydrogeologic Characterization, F.B. Culley Generating Station  
 Client Southern Indiana Gas & Electric Company  
 Contractor Stearns Drilling

File No. 42796-001  
 Sheet No. 1 of 2  
 Start 08 March 2016  
 Finish 09 March 2016  
 Driller J. Gryska  
 H&A Rep. S. Lewis

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	-	S	-	Rig Make & Model: CME 850 XR Air Track Bit Type:
Inside Diameter (in.)	-	1 3/8	-	Drill Mud: None
Hammer Weight (lb)	-	140	-	Casing: Auger
Hammer Fall (in.)	-	30	-	Hoist/Hammer: Winch Automatic Hammer PID Make & Model:

Elevation 397.0 (est.)  
 Datum  
 Location  
 N 969,122  
 E 2,883,285

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Test				
								% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength
0						ML	Brown/dark brown SILT  -FILL-	-	-	-	-	-	-	-	-	-	-
2.7	7	S1 18/24	3.5 5.5			ML	Very stiff brown SILT (ML), mps 19.0 mm, no odor, dry	-	5	-	-	10	85	-	-	-	-
8.9	12	S2 20/24	8.5 10.5			ML	Very stiff olive brown SILT (ML), mps 2.0 mm, no odor, dry, wood fragments present	-	-	-	5	5	90	-	-	-	-
13.3	4	S3 18/24	13.5 15.5		383.5 13.5	CL	Medium stiff olive gray lean CLAY with sand (CL), mps 2.0 mm, no odor, moist, rounded sand, black wood fragments present  -FILL-	-	-	-	15	5	80	-	-	-	-
18.1	3	S4 22/24	18.5 20.5			CL	Soft olive gray lean CLAY with sand (CL), mps 2.0 mm, no odor, wet, black wood fragments present, rounded sand	-	-	-	10	5	85	-	-	-	-

Water Level Data					Sample ID		Well Diagram		Summary	
Date	Time	Elapsed Time (hr.)	Depth (ft) to:		O - Open End Rod T - Thin Wall Tube U - Undisturbed Sample S - Split Spoon Sample			Overburden (ft)	Rock Cored (ft)	Samples
			Bottom of Casing	Bottom of Hole						
								45.5	-	155

**Boring No. CCR-AP-6**

**Field Tests:** Dilatancy: R - Rapid S - Slow N - None Plasticity: N - Nonplastic L - Low M - Medium H - High  
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High V - Very High  
 \*Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.  
 Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HA-TEST BORING-07-1 HA-LIB09-REV.GLB HA-TB+CORE+WELL-07-1.GDT \\GRNCOM\MON\42796 - VECTRENF\B.CULLEY\LOGS.GPJ Apr 20, 17



# TEST BORING REPORT

Boring No. CCR-AP-6

File No. 42796-001  
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Test								
								% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength				
20	6																				
23.5	2	S5	23.5				CL	Medium stiff olive gray lean CLAY with sand (CL), mps 2.0 mm, no odor, moist, black wood fragments present, rounded sand	-	-	10	5	85	-	-	-	-	-	-	-	
25.5	2	22/24	25.5																		
	4																				
	4																				
	4	S6	28.5			368.5	SW-SC	Medium dense olive gray well graded SAND with clay and gravel (SW-SC), mps 19.0 mm, no odor, wet	15	15	20	20	10	20	-	-	-	-	-	-	-
	5	18/24	30.5			367.5	SC	Medium dense olive gray clayey SAND (SC), no odor, wet, wood fragments present	-	-	-	10	60	30	-	-	-	-	-	-	
	6					29.5		-ALLUVIUM-													
	3	S7	33.5			363.0	CL	*Drove with 3.0 in. spoon due to no recovery.	-	-	-	-	-	-	-	-	-	-	-	-	
	4	12/24	35.5			34.0	CL	Stiff olive gray lean CLAY with sand (CL), mps 2.0 mm, no odor, wet, wood fragments present	-	-	-	15	5	80	-	-	-	-	-	-	
	7						-ALLUVIUM-														
	8																				
	2	S8	38.5			CL	Soft gray lean CLAY (CL), no odor, wet, wood fragments present	-	-	-	5	5	90	-	-	-	-	-	-		
	2	24/24	40.5																		
	2																				
	3																				
	1	S9	43.5			CL	Medium stiff gray sandy lean CLAY (CL), no odor, wet, wood fragments present	-	-	-	40	60	-	-	-	-	-	-	-		
	2	24/24	45.5		351.5																
	3				45.5		BOTTOM OF EXPLORATION 45.5 FT														

H&A-TEST BORING-07-1 HA-LIB09-REV.GLB HA-TB+CORE+WELL-07-1.GDT \\GRNCOM\MON\42796 - VECTREN\FB CULLEY\GINT\F.B. CULLEY LOGS.GPJ Apr 20, 17

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-6



# TEST BORING REPORT

**Boring No. CCR-AP-7**

Project CCR Hydrogeologic Characterization, F.B. Culley Generating Station  
 Client Southern Indiana Gas & Electric Company  
 Contractor Stearns Drilling

File No. 42796-001  
 Sheet No. 1 of 2  
 Start 09 March 2016  
 Finish 09 March 2016  
 Driller J. Gryska  
 H&A Rep. S. Lewis

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	-	S	-	Rig Make & Model: CME 850 XR Air Track Bit Type:
Inside Diameter (in.)	-	1 3/8	-	Drill Mud: None
Hammer Weight (lb)	-	140	-	Casing: Auger
Hammer Fall (in.)	-	30	-	Hoist/Hammer: Winch Automatic Hammer PID Make & Model:

Elevation 429.5 (est.)  
 Datum  
 Location  
 N 970,775  
 E 2,883,090

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel			Sand			Field Test				
								% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength	
0						ML	Brown SILT (ML), trace coarse gravel  -FILL-	-	-	-	-	-	-	-	-	-	-	-
1	1	S1	3.0		421.5 8.0	ML	Soft brown SILT with sand (ML), no odor, moist, mottle with gray and red colors	-	-	-	-	15	85	-	-	-	-	
2	2	16/24	5.0			ML	Very stiff olive brown SILT (ML), mps 2.0 mm, no odor, dry, wood fragments present  -ALLUVIUM-	-	-	-	-	15	85	-	-	-	-	
3	3					ML	Medium stiff gray SILT with sand (CL), no odor, moist, wood fragments present	-	-	-	-	15	85	-	-	-	-	
5						ML	Medium stiff gray SILT with sand (ML), no odor, wet	-	-	-	-	15	85	-	-	-	-	
7	2	S2	8.0					ML	Very stiff olive brown SILT (ML), mps 2.0 mm, no odor, dry, wood fragments present	-	-	-	-	15	85	-	-	-
8	2	17/24	10.0					ML	Medium stiff gray SILT with sand (CL), no odor, moist, wood fragments present	-	-	-	-	15	85	-	-	-
10	2							ML	Medium stiff gray SILT with sand (ML), no odor, wet	-	-	-	-	15	85	-	-	-
12	2	S3	13.0					ML	Medium stiff gray SILT with sand (CL), no odor, moist, wood fragments present	-	-	-	-	15	85	-	-	-
13	2	19/24	15.0					ML	Medium stiff gray SILT with sand (ML), no odor, wet	-	-	-	-	15	85	-	-	-
15	2							ML	Medium stiff gray SILT with sand (ML), no odor, wet	-	-	-	-	15	85	-	-	-
17	1	S4	18.0			ML	Medium stiff gray SILT with sand (ML), no odor, wet	-	-	-	-	15	85	-	-	-		
18	2	20/24	20.0			ML	Medium stiff gray SILT with sand (ML), no odor, wet	-	-	-	-	15	85	-	-	-		
20	3					ML	Medium stiff gray SILT with sand (ML), no odor, wet	-	-	-	-	15	85	-	-	-		

Water Level Data						Sample ID		Well Diagram		Summary	
Date	Time	Elapsed Time (hr.)	Depth (ft) to:			O - Open End Rod	T - Thin Wall Tube	U - Undisturbed Sample	S - Split Spoon Sample	Overburden (ft)	Rock Cored (ft)
			Bottom of Casing	Bottom of Hole	Water						
										35.0	-
											5S
										<b>Boring No. CCR-AP-7</b>	

**Field Tests:** Dilatancy: R - Rapid S - Slow N - None Plasticity: N - Nonplastic L - Low M - Medium H - High  
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High V - Very High

**\*Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**  
**Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.**

HA-TEST BORING-07-1 HA-LIB09-REV.GLB HA-TB+CORE+WELL-07-1.GDT \\GRNCOM\MON\42796 - VECTRENF B CULLEY\GINT\F.B. CULLEY LOGS.GPJ Apr 20, 17



# TEST BORING REPORT

**Boring No.** CCR-AP-7

File No. 42796-001  
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Test						
								% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength		
20																			
	1 1 2 1	S5 24/24	23.0 25.0			ML	Soft gray sandy SILT (ML), no odor, wet	-	-	-	-	30	70	-	-	-	-	-	-
25																			
	1 1 1 2	S6 24/24	28.0 30.0			CL	Soft gray lean CLAY (CL), no odor, wet, mottled with black colors, possibly organic matter	-	-	-	-	10	90	-	-	-	-	-	-
30																			
	1 2 3 3	S7 24/24	33.0 35.0			CL	Medium stiff gray lean CLAY (CL), no odor, wet	-	-	-	-	10	90	-	-	-	-	-	-
35					394.5 35.0		<p style="text-align: center;">BOTTOM OF EXPLORATION 35.5 FT</p> <p>Notes: Well set at 30.0 ft. 35.0 ft o 34.0 ft backfilled with bedtonite. 30.0 ft to 34.0 ft backfilled with sand.</p>												

H&A-TEST BORING-07-1 HA-LIB09-REV.GLB HA-TB+CORE+WELL-07-1.GDT \\GRNCOM\MON\42796 - VECTRENF B CULLEY\GINT\F.B. CULLEY LOGS.GPJ Apr 20, 17

**NOTE:** Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

**Boring No.** CCR-AP-7



# TEST BORING REPORT

**Boring No. CCR-AP-8**

Project CCR Hydrogeologic Characterization, F.B. Culley Generating Station  
 Client Southern Indiana Gas & Electric Company  
 Contractor Stearns Drilling

File No. 42796-001  
 Sheet No. 1 of 2  
 Start 15 February 2017  
 Finish 15 February 2017  
 Driller W. Bates  
 H&A Rep. S.Lewis

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	S	S	--	Rig Make & Model: Track Bit Type:
Inside Diameter (in.)	4.25	1 3/8	--	Drill Mud: None
Hammer Weight (lb)	-	140	-	Casing: Auger
Hammer Fall (in.)	-	30	-	Hoist/Hammer: Winch Automatic Hammer PID Make & Model:

Elevation 394.1 (est.)  
 Datum  
 Location  
 N 969,046  
 E 2,883,847

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel			Sand			Field Test						
								% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength			
0																				
6	7	S1	3.5		389.6	ML	Very stiff, brown, SILT(ML), MPS = 19 mm, no structure, no odor, dry	-	10	-	-	5	85	-	-	L	-			
7	9	18	5.5			4.5		ML	-FILL-	-	-	-	-	5	95	-	-	L	-	
9	10					385.6		Very stiff, brown, SILT(ML), MPS = 4 mm, no structure, no odor, dry												
						8.5	CL	Stiff, grayish brown, lean CLAY (CL), MPS = < 0.08 mm, no structure, no odor, dry, rootlets present	-	-	-	-	-	100	-	-	M-H	-		
10	3	S2	8.5		380.6															
	2	16	10.5			13.5	CL	Medium stiff, gray, lean CLAY (CL), MPS = < 0.08mm, no structure, no odor, moist	-	-	-	-	-	100	-	-	M-H	-		
	3					375.6														
	3	S3	13.5		15.5	18.5	CL	Medium stiff, dark gray, lean CLAY (CL), MPS = < 0.08mm, no structure, no odor, moist, black wood fragments present	-	-	-	-	-	100	-	-	M-H	-		
15	2																			
	3	S4	18.5		20.5															
	3																			
	3																			
20	4																			

Water Level Data					Sample ID		Well Diagram		Summary	
Date	Time	Elapsed Time (hr.)	Depth (ft) to:		O - Open End Rod T - Thin Wall Tube U - Undisturbed Sample S - Split Spoon Sample		Riser Pipe Screen Filter Sand Cuttings Grout Concrete Bentonite Seal	Overburden (ft)	Rock Cored (ft)	Samples
			Bottom of Casing	Bottom of Hole						
2/16/17	16:00				Dry			45.5	-	95

**Boring No. CCR-AP-8**

**Field Tests:** Dilatancy: R - Rapid S - Slow N - None Plasticity: N - Nonplastic L - Low M - Medium H - High  
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High V - Very High

**\*Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.**  
**Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.**

HA-TEST BORING-07-1 HA-LIB09-REV.GLB HA-TB+CORE+WELL-07-1.GDT \\GRNCOM\MON\42796 - VECTRENF B CULLEY\GINT\F.B. CULLEY LOGS.GPJ Apr 20, 17



# TEST BORING REPORT

Boring No. CCR-AP-8

File No. 42796-001  
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Test						
								% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength		
20	5																		
23.5	2	S5	23.5		370.6 23.5	CL	Similar to S4, rootlets present	-	-	-	-	-	100	-	-	M-H	-		
25	2 2 3 4	20	25.5																
28.5	1	S6	28.5		365.6 28.5	CL	Similar to S4	-	-	-	-	-	100	-	-	M-H	-		
30	2 2 3 3	23	30.5																
33.5	2	S7	33.5		360.6 33.5	CL	Similar to S4	-	-	-	-	-	100	-	-	M-H	-		
35	2 2 3 5	24	35.5																
36.3					358.1 36.0 357.9 36.3	CL	Medium Stiff, dark gray, sandy lean CLAY (CL), MPS = 0.43 mm, interbedded, no odor, wet	-	-	-	-	-	30	70	-	M	-		
38.5	2	S8	38.5		355.6 38.5	CL	Medium stiff, gray, lean CLAY (CL), MPS = < 0.08mm, no structure, no odor, moist, black wood fragments present	-	-	-	-	-	100	-	-	M-H	-		
40	2 4 6	24	40.5				Similar to S7												
45	1	S9	43.5		348.9 45.3 348.6 45.5	CL	Medium Stiff, gray, sandy lean CLAY (CL), MPS = 0.43, interbedded, no odor, wet	-	-	-	-	-	30	70	-	M	-		
							END OF BORING AT 45.5 FT												

H&A-TEST BORING-07-1 HA-LIB09-REV.GLB HA-TB+CORE+WELL-07-1.GDT \\GRNCOM\MON\42796 - VECTREN\FB CULLEY\GINT\F.B. CULLEY LOGS.GPJ Apr 20, 17

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CCR-AP-8



# TEST BORING REPORT

**Boring No. CRR-AP-9**

Project CCR Hydrogeologic Characterization, F.B. Culley Generating Station  
 Client Southern Indiana Gas & Electric Company  
 Contractor Stearns Drilling

File No. 42796-001  
 Sheet No. 1 of 3  
 Start 14 February 2017  
 Finish 15 February 2017  
 Driller W.Bates  
 H&A Rep. S.Lewis

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	S	S	--	Rig Make & Model: Track Bit Type:
Inside Diameter (in.)	4.25	1 3/8	--	Drill Mud: None
Hammer Weight (lb)	-	140	-	Casing: Auger/Steel
Hammer Fall (in.)	-	30	-	Hoist/Hammer: Winch Automatic Hammer PID Make & Model:

Elevation 445.6 (est.)  
 Datum  
 Location  
 N 969,769  
 E 2,883,999

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Test						
								% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength		
0																			
5	5 6 7 8	S1 17	3.5 5.5			ML	Stiff, brownish gray, SILT (ML), MPS = 0.08, laminated with interbedded layers of clay, no odor, dry  -ALLUVIUM-	-	-	-	-	-	100	-	-	L-M	-		
10	4 7 9 11	S2 21	8.5 10.5		437.1 8.5	CL	Very stiff, grayish brown CLAY (CL), MPS = 0.08, laminated with interbedded layers of silt, no odor, dry, orange and black mottling	-	-	-	-	-	100	-	-	M	-		
15	5 8 20 50/2	S3 15	13.5 15.5		431.1 14.5		Gray, soft weathered SHALE, no structure, clayey, brown mottling, dry	-	-	-	-	-	-	-	-	-	-		
	-	S4 53	15.1 20.1		430.5 15.1		Switched to rock coring at 15.5 ft Gray, LIMESTONE, no structure, fracture at 16.5 feet	-	-	-	-	-	-	-	-	-	-		
20																			

Water Level Data						Sample ID		Well Diagram			Summary								
Date	Time	Elapsed Time (hr.)	Depth (ft) to:			O - Open End Rod	T - Thin Wall Tube	U - Undisturbed Sample	S - Split Spoon Sample	Riser Pipe	Screen	Filter Sand	Cuttings	Grout	Concrete	Bentonite Seal	Overburden (ft)	Rock Cored (ft)	Samples
			Bottom of Casing	Bottom of Hole	Water														

**Field Tests:** Dilatancy: R - Rapid S - Slow N - None  
 Toughness: L - Low M - Medium H - High  
 Plasticity: N - Nonplastic L - Low M - Medium H - High  
 Dry Strength: N - None L - Low M - Medium H - High V - Very High

\*Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.  
 Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

HA-TEST BORING-07-1 HA-LIB09-REV.GLB HA-TB+CORE+WELL-07-1.GDT \\GRNCOM\MON\42796 - VECTRENF\B.CULLEY\LOGS.GPJ Apr 20, 17





# TEST BORING REPORT

Boring No. CRR-AP-9

File No. 42796-001  
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Test					
								% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength	
20	- - - -	S5 60	19.8 24.8		425.6 20.0		Gray, weathered SHALE, no structure, organic fragments 20.5-21.0 feet	-	-	-	-	-	-	-	-	-	-	-
25	- - - -	S6 58	24.8 29.8		421.1 24.5		Light gray, weathered SHALE, no structure	-	-	-	-	-	-	-	-	-	-	-
					420.6 25.0		Gray, fine grained SANDSTONE	-	-	-	-	-	-	-	-	-	-	-
30	- - - -	S7 60	29.8 34.8		416.6 29.0		Gray, fine grained SANDSTONE, interbedded layers of soft weathered SHALE	-	-	-	-	-	-	-	-	-	-	-
					414.6 31.0		Gray, fine to medium grained SANDSTONE	-	-	-	-	-	-	-	-	-	-	-
35	- - - -	S8 60	34.8 39.8		412.1 33.5		Gray, fine grained, SANDSTONE, interbedded layers of soft weathered SHALE	-	-	-	-	-	-	-	-	-	-	-
					410.8 34.8		Gray, SHALE, very fine layering, interbedded layers of competent fine grained SANDSTONE	-	-	-	-	-	-	-	-	-	-	-
40	- - - -	S9 22	39.8 44.8		405.8 39.8		Gray, fine grained, SANDSTONE, interbedded layers of soft weathered SHALE	-	-	-	-	-	-	-	-	-	-	-
					400.8 44.8		Gray, SHALE, interbedded very fine layers of organics	-	-	-	-	-	-	-	-	-	-	-
45	- - - -	S10 60	44.8 49.8		398.1 47.5		*brown/dark brown organic matter surfacing with drilling water, floats on water	-	-	-	-	-	-	-	-	-	-	-
							Dark gray, SHALE, thinly laminated	-	-	-	-	-	-	-	-	-	-	-

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. CRR-AP-9



# TEST BORING REPORT

**Boring No.** CRR-AP-9

File No. 42796-001  
Sheet No. 3 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size*, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel		Sand			Field Test									
								% Coarse	% Fine	% Coarse	% Medium	% Fine	% Fines	Dilatancy	Toughness	Plasticity	Strength					
50	-	S11 60	49.8 54.8		390.8 54.8		Dark gray, very fine grained, SANDSTONE, frequent very fine interbedded layers of organics,	-	-	-	-	-	-	-	-	-	-	-				
55	-	S12 60	54.8 59.8																			
60	-	S13 60	59.8 64.8																			
65	-	S14 60	64.8 69.8																			
END OF BORING AT 69.8 FT																						

375.8  
69.8  
375.6  
70.0

H&A-TEST BORING-07-1 HA-LIB09-REV.GLB HA-TB+CORE+WELL-07-1.GDT \\GRNCOM\MON\42796 - VECTRENF B CULLEY\GINT\F.B. CULLEY LOGS.GPJ Apr 20, 17

**NOTE:** Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

**Boring No.** CRR-AP-9

# GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

**Well No.**  
**Boring No. CCR-AP-1R**

Project CCR Hydrogeologic Characterization  
 Location F.B. Culley Generating Station  
 Client Southern Indiana Gas & Electric Company  
 Contractor Stearns Drilling  
 Driller J. Gryska

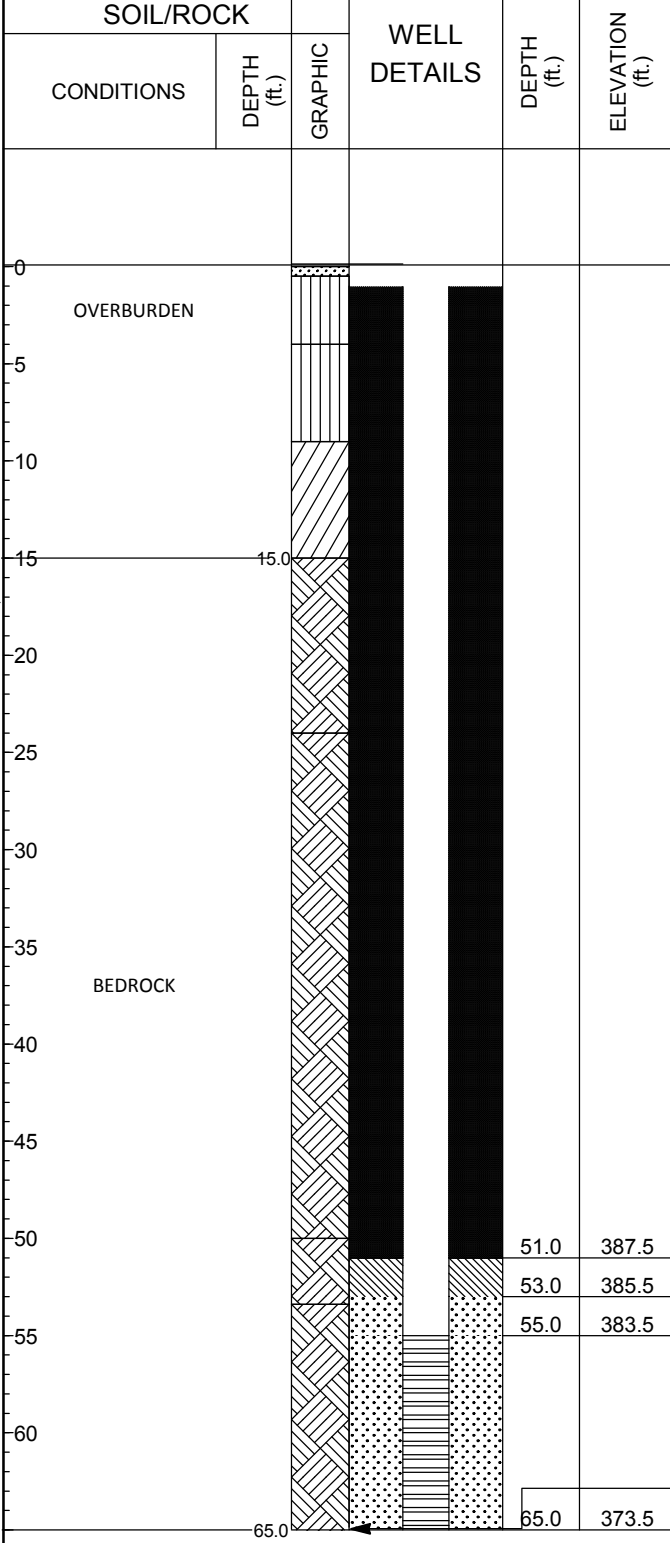
**Well Diagram**

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 42796-001  
 Date Installed 08 Mar 2016  
 H&A Rep. J.Yonts  
 Location N 969939.88  
 E 2883429.69

Ground El. 438.5 (est.)  
 Datum

Initial Water Level (depth bgs) ft



## WELL CONSTRUCTION DETAILS

- Type of protective cover Stick Up Guard Pipe
  - Height of Steel above ground surface 3.5 ft
  - Height of top of riser above ground surface 3.3 ft
  - Type of protective casing Steel
  - Length 6.0 ft
  - Inside diameter 4.0 in.
  - Depth of bottom of Steel 2.5 ft
  - Type of riser pipe Schedule 40 PVC
  - Inside diameter of riser pipe 2.0 in.
  - Depth of bottom of riser pipe 54.7 ft
- | Type of Seals | Top of Seal (ft) | Thickness (ft) |
|---------------|------------------|----------------|
| Concrete      | 1.0              | 50.0           |
| Bentonite     | 51.0             | 2.0            |
| Sand          | 53.0             | 12.0           |
|               | -                | -              |
- Diameter of borehole 6.0 in.
  - Depth to top of well screen 54.7 ft
  - Type of screen Machine slotted Sch 40 PVC
  - Screen gauge or size of openings 0.010 in.
  - Diameter of screen 2.0 in.
  - Type of backfill around screen Quartz Sand
  - Depth to bottom of well screen 64.7 ft
  - Bottom of silt trap 65.0 ft
  - Depth of bottom of borehole 65.0 ft

HA-LIB09-REV.GLB GW INSTALLATION REPORT-07-1 \\GRNCOMMON\42796 - VECTREN\FB\CULLEY\GINT\F.B. CULLEY LOGS - OW LOGS.GPJ Apr 20, 17








**COMMENTS:**

**GROUNDWATER OBSERVATION WELL  
INSTALLATION REPORT**

**Well No.**  
**Boring No. CCR-AP-2**

Project CCR Hydrogeologic Characterization  
 Location F.B. Culley Generating Station  
 Client Southern Indiana Gas & Electric Company  
 Contractor Stearns Drilling  
 Driller J. Gryska

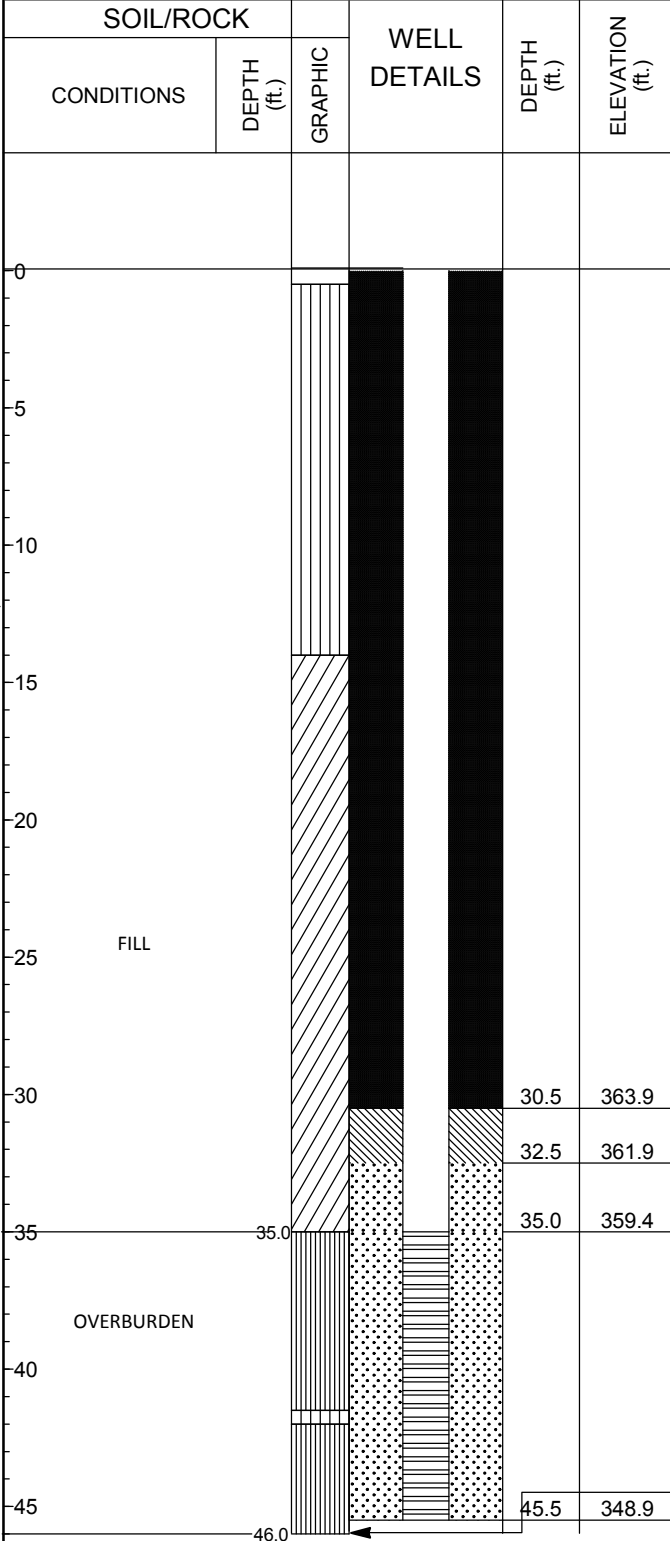
**Well Diagram**

-  Riser Pipe
-  Screen
-  Filter Sand
-  Cuttings
-  Grout
-  Concrete
-  Bentonite Seal

File No. 42796-001  
 Date Installed 16 Dec 2015  
 H&A Rep. E. Shirley  
 Location N 969117.52  
 E 2884168.67

Ground El. 394.4 (est.)  
 Datum

Initial Water Level (depth bgs) ft



**WELL CONSTRUCTION DETAILS**

Type of protective cover	Flush Mount	
Depth of Steel below ground surface	0.0 ft	
Depth of top of riser below ground surface	0.3 ft	
Type of protective casing	Steel	
Length	1.0 ft	
Inside diameter	-	
Depth of bottom of Steel	1.0 ft	
Type of riser pipe	Schedule 40 PVC	
Inside diameter of riser pipe	2.0 in.	
Depth of bottom of riser pipe	35.7 ft	
<u>Type of Seals</u>	<u>Top of Seal (ft)</u>	<u>Thickness (ft)</u>
Grout	1.0	29.5
Bentonite	30.5	2.0
Sand	32.5	13.0
	-	-
Diameter of borehole	8.0 in.	
Depth to top of well screen	35.7 ft	
Type of screen	Machine slotted Sch 40 PVC	
Screen gauge or size of openings	0.010 in.	
Diameter of screen	2.0 in.	
Type of backfill around screen	Quartz Sand	
Depth to bottom of well screen	45.7 ft	
Bottom of silt trap	46.0 ft	
Depth of bottom of borehole	46.0 ft	

HA-LIB09-REV.GLB GW INSTALLATION REPORT-07-1 \\\GRRM\COMMON\42796 - VECTREN\FB CULLEY\GINT\F.B. CULLEY LOGS - OW LOGS.GPJ Apr 20, 17

**COMMENTS:**

# GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

**Well No.**  
**Boring No. CCR-AP-3**

Project CCR Hydrogeologic Characterization  
 Location F.B. Culley Generating Station  
 Client Southern Indiana Gas & Electric Company  
 Contractor Stearns Drilling  
 Driller J. Gryska

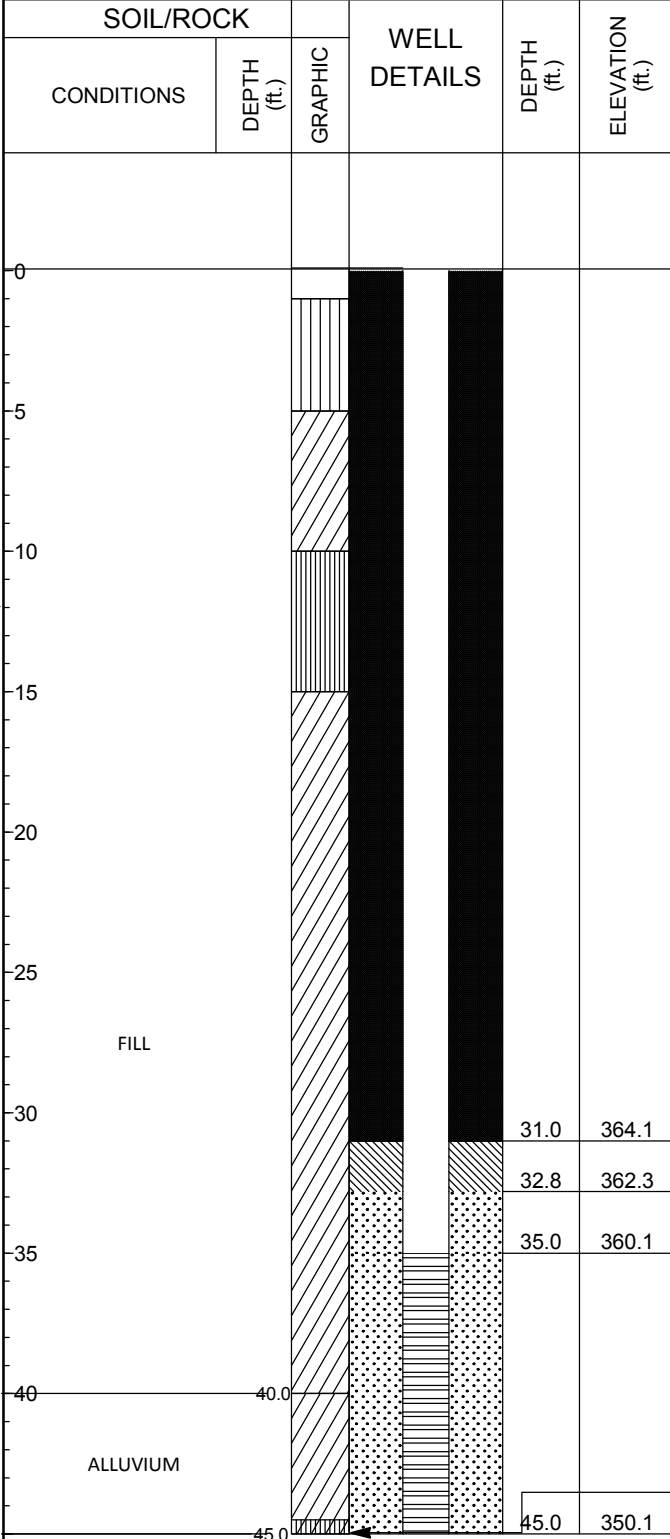
**Well Diagram**

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 42796-001  
 Date Installed 15 Dec 2015  
 H&A Rep. E. Shirley  
 Location N 969007.98  
 E 2883542.09

Ground El. 395.1 (est.)  
 Datum

Initial Water Level (depth bgs) ft



## WELL CONSTRUCTION DETAILS

Type of protective cover	Flush Mount	
Depth of Steel below ground surface	0.0 ft	
Depth of top of riser below ground surface	0.3 ft	
Type of protective casing	Steel	
Length	1.0 ft	
Inside diameter	-	
Depth of bottom of Steel	1.0 ft	
Type of riser pipe	Schedule 40 PVC	
Inside diameter of riser pipe	2.0 in.	
Depth of bottom of riser pipe	34.7 ft	
<u>Type of Seals</u>	<u>Top of Seal (ft)</u>	<u>Thickness (ft)</u>
Grout	1.0	30.0
Bentonite	31.0	1.8
Sand	32.8	12.7
-	-	-
Diameter of borehole	8.0 in.	
Depth to top of well screen	34.7 ft	
Type of screen	Machine slotted Sch 40 PVC	
Screen gauge or size of openings	0.010 in.	
Diameter of screen	2.0 in.	
Type of backfill around screen	Quartz Sand	
Depth to bottom of well screen	44.7 ft	
Bottom of silt trap	45.0 ft	
Depth of bottom of borehole	45.0 ft	

HA-LIB09-REV.GLB GW INSTALLATION REPORT-07-1 \\GSRM\COMMON\42796 - VECTREN\FB\CULLEY\GINT\F.B. CULLEY LOGS - OW LOGS.GPJ Apr 20, 17

**COMMENTS:**

# GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

**Well No.**  
**Boring No. CCR-AP-4**

Project CCR Hydrogeologic Characterization  
 Location F.B. Culley Generating Station  
 Client Southern Indiana Gas & Electric Company  
 Contractor Stearns Drilling  
 Driller J. Gryska

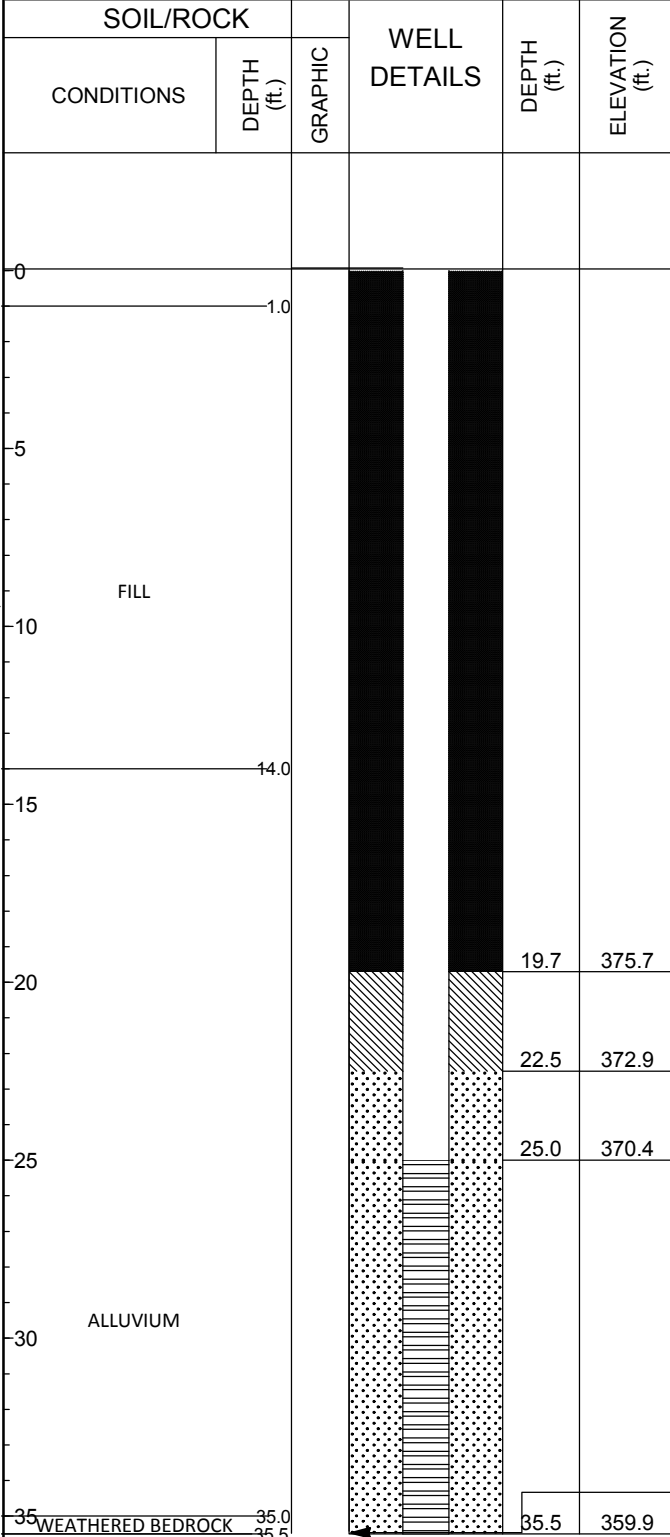
**Well Diagram**

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 42796-001  
 Date Installed 16 Dec 2015  
 H&A Rep. E. Shirley  
 Location N 969641.7  
 E 2883281.93

Ground El. 395.4 (est.)  
 Datum

Initial Water Level (depth bgs) ft



## WELL CONSTRUCTION DETAILS

Type of protective cover	Flush Mount	
Depth of Steel below ground surface	0.0 ft	
Depth of top of riser below ground surface	0.3 ft	
Type of protective casing	Steel	
Length	1.0 ft	
Inside diameter	-	
Depth of bottom of Steel	1.0 ft	
Type of riser pipe	Schedule 40 PVC	
Inside diameter of riser pipe	2.0 in.	
Depth of bottom of riser pipe	25.2 ft	
<u>Type of Seals</u>	<u>Top of Seal (ft)</u>	<u>Thickness (ft)</u>
Grout	1.0	18.7
Bentonite	19.7	2.8
Sand	22.5	13.0
-	-	-
Diameter of borehole	8.0 in.	
Depth to top of well screen	25.2 ft	
Type of screen	Machine slotted Sch 40 PVC	
Screen gauge or size of openings	0.010 in.	
Diameter of screen	2.0 in.	
Type of backfill around screen	Quartz Sand	
Depth to bottom of well screen	35.2 ft	
Bottom of silt trap	35.5 ft	
Depth of bottom of borehole	35.5 ft	

HA-11809-REV.GLB GW INSTALLATION REPORT-07-1 I:\GRN\COMMON\42796 - VECTREN\FB CULLEY\GINT\F.B. CULLEY LOGS - OW LOGS.GPJ Apr 20, 17

**COMMENTS:**

# GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

**Well No.**  
**Boring No. CCR-AP-5**

Project CCR Hydrogeologic Characterization  
 Location F.B. Culley Generating Station  
 Client Southern Indiana Gas & Electric Company  
 Contractor Stearns Drilling  
 Driller J. Gryska

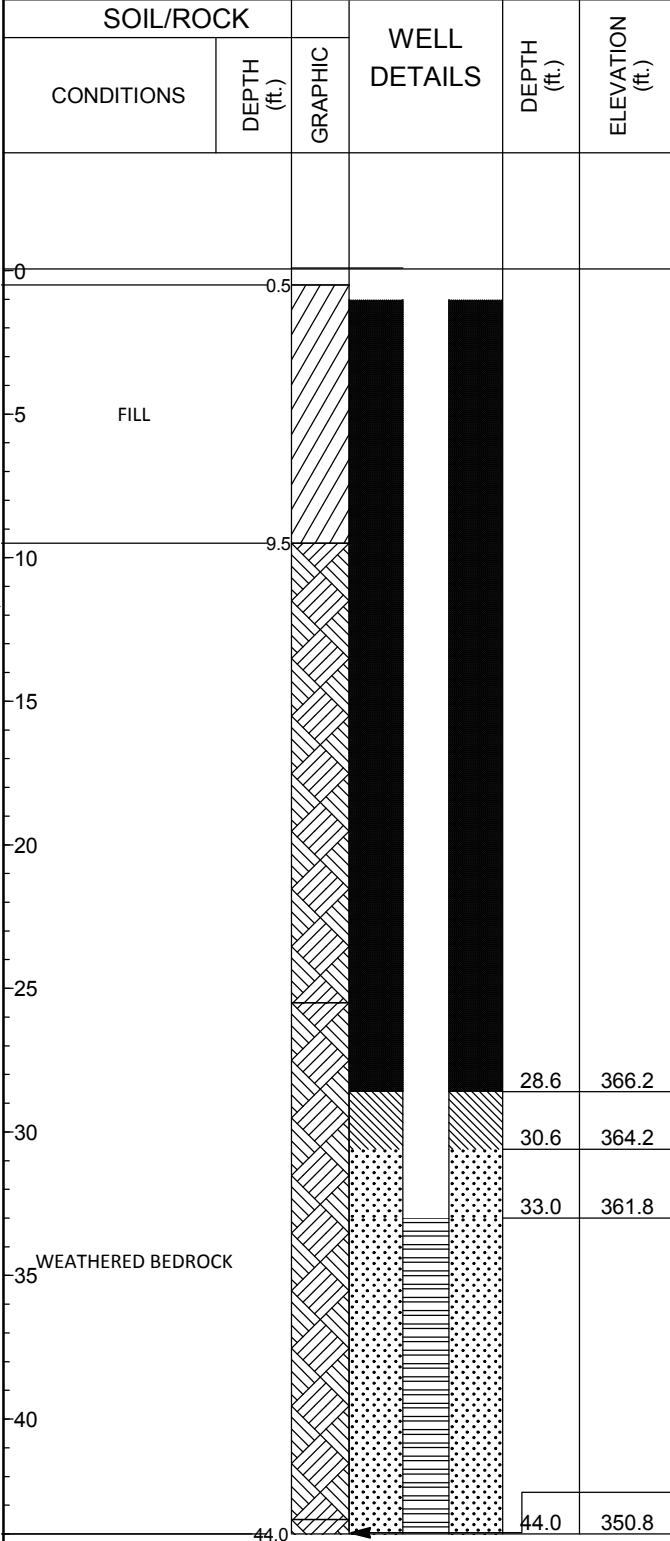
**Well Diagram**

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 42796-001  
 Date Installed 18 Dec 2015  
 H&A Rep. E. Shirley  
 Location N 969379.68  
 E 2884016.66

Ground El. 394.8 (est.)  
 Datum

Initial Water Level (depth bgs) ft



## WELL CONSTRUCTION DETAILS

Type of protective cover	Flush Mount	
Depth of Steel below ground surface	0.0 ft	
Depth of top of riser below ground surface	0.3 ft	
Type of protective casing	Steel	
Length	1.0 ft	
Inside diameter	-	
Depth of bottom of Steel	1.0 ft	
Type of riser pipe	Schedule 40 PVC	
Inside diameter of riser pipe	2.0 in.	
Depth of bottom of riser pipe	33.7 ft	
<u>Type of Seals</u>	<u>Top of Seal (ft)</u>	<u>Thickness (ft)</u>
Grout	1.0	27.6
Bentonite	28.6	2.0
Sand	30.6	13.4
-	-	-
Diameter of borehole	8.0 in.	
Depth to top of well screen	33.7 ft	
Type of screen	Machine slotted Sch 40 PVC	
Screen gauge or size of openings	0.010 in.	
Diameter of screen	2.0 in.	
Type of backfill around screen	Quartz Sand	
Depth to bottom of well screen	43.7 ft	
Bottom of silt trap	44.0 ft	
Depth of bottom of borehole	44.0 ft	

HA-LIB09-REV.GLB GW INSTALLATION REPORT-07-1 \GRRM\COMMON\42796 - VECTREN\FB CULLEY\GINT\F.B. CULLEY LOGS - OW LOGS.GPJ Apr 20, 17

**COMMENTS:**



# GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

**Well No.**  
**Boring No. CCR-AP-6**

Project CCR Hydrogeologic Characterization  
 Location F.B. Culley Generating Station  
 Client Southern Indiana Gas & Electric Company  
 Contractor Stearns Drilling  
 Driller J. Gryska

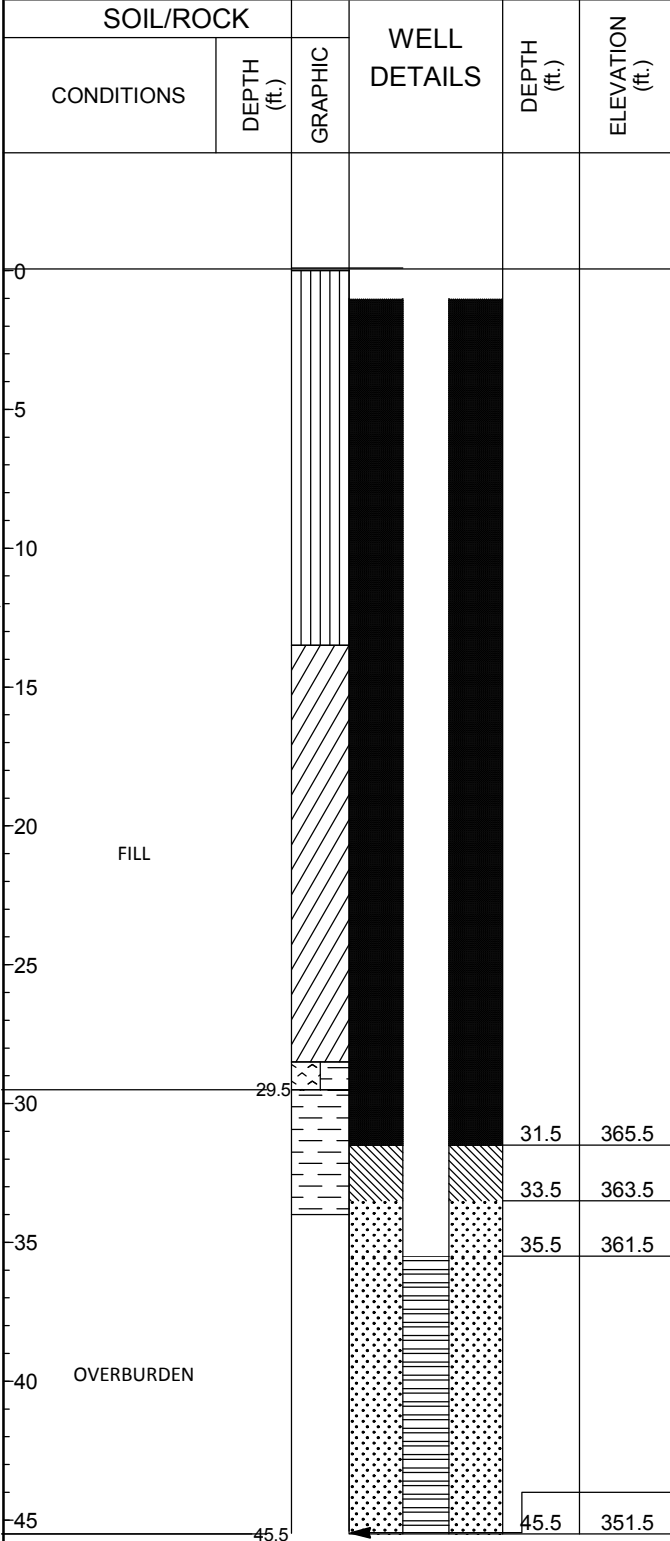
**Well Diagram**

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 42796-001  
 Date Installed 09 Mar 2016  
 H&A Rep. S. Lewis  
 Location N 969122.16  
 E 2883285.03

Ground El. 397.0 (est.)  
 Datum

Initial Water Level (depth bgs) ft



## WELL CONSTRUCTION DETAILS

- Type of protective cover Flush Mount
  - Depth of Morrison Flush Mount below ground surface 0.0 ft
  - Depth of top of riser below ground surface 0.4 ft
  - Type of protective casing Morrison Flush Mount
  - Length 1.0 ft
  - Inside diameter 9.0 in.
  - Depth of bottom of Morrison Flush Mount 1.0 ft
  - Type of riser pipe Schedule 40 PVC
  - Inside diameter of riser pipe 2.0 in.
  - Depth of bottom of riser pipe 35.2 ft
- | Type of Seals | Top of Seal (ft) | Thickness (ft) |
|---------------|------------------|----------------|
| Grout         | 1.0              | 30.5           |
| Bentonite     | 31.5             | 2.0            |
| Sand          | 33.5             | 12.0           |
|               | -                | -              |
- Diameter of borehole 8.0 in.
  - Depth to top of well screen 35.2 ft
  - Type of screen Machine slotted Sch 40 PVC
  - Screen gauge or size of openings 0.010 in.
  - Diameter of screen 2.0 in.
  - Type of backfill around screen Quartz Sand
  - Depth to bottom of well screen 45.2 ft
  - Bottom of silt trap 45.5 ft
  - Depth of bottom of borehole 45.5 ft

HA-LIB09-REV.GLB GW INSTALLATION REPORT-07-1 \GPRN\COMMON\42796 - VECTREN\FB CULLEY\INT\F.B. CULLEY LOGS - OW LOGS.GPJ Apr 20, 17

**COMMENTS:**



# GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

**Well No.**  
**Boring No. CCR-AP-7**

Project CCR Hydrogeologic Characterization  
 Location F.B. Culley Generating Station  
 Client Southern Indiana Gas & Electric Company  
 Contractor Stearns Drilling  
 Driller J. Gryska

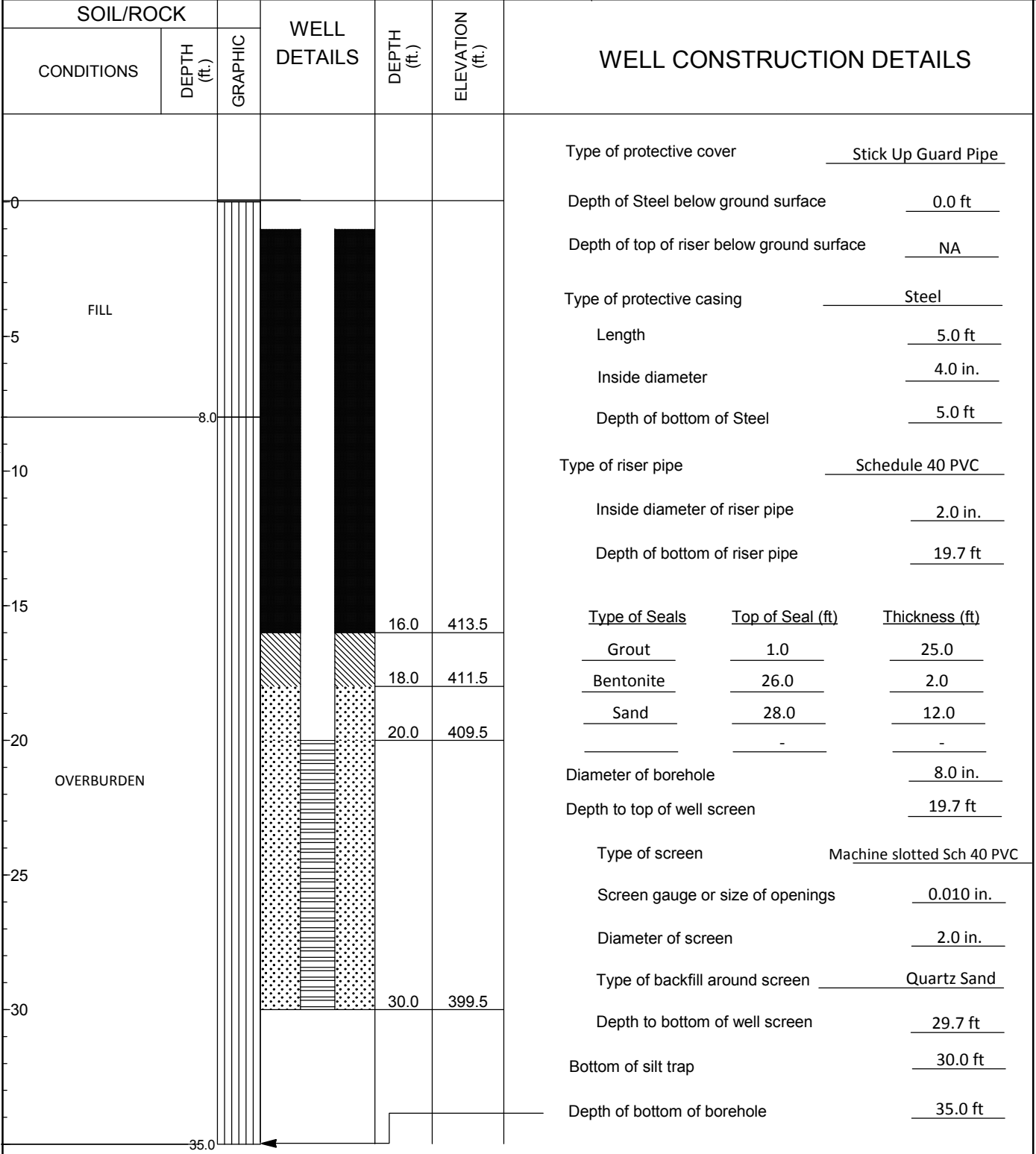
**Well Diagram**

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 42796-001  
 Date Installed 09 Mar 2016  
 H&A Rep. S. Lewis  
 Location N 970774.64  
 E 2883090.34

Ground El. 429.5 (est.)  
 Datum

Initial Water Level (depth bgs) ft



HA-11809-REV.GLB GW INSTALLATION REPORT-07-1 \\\GRRM\COMMON\42796 - VECTREN\FB CULLEY\GINT\F.B. CULLEY LOGS - OW LOGS.GPJ Apr 20, 17








**COMMENTS:**

**GROUNDWATER OBSERVATION WELL  
INSTALLATION REPORT**

**Well No.**  
**Boring No. CCR-AP-8**

Project CCR Hydrogeologic Characterization  
 Location F.B. Culley Generating Station  
 Client Southern Indiana Gas & Electric Company  
 Contractor Stearns Drilling  
 Driller W. Bates

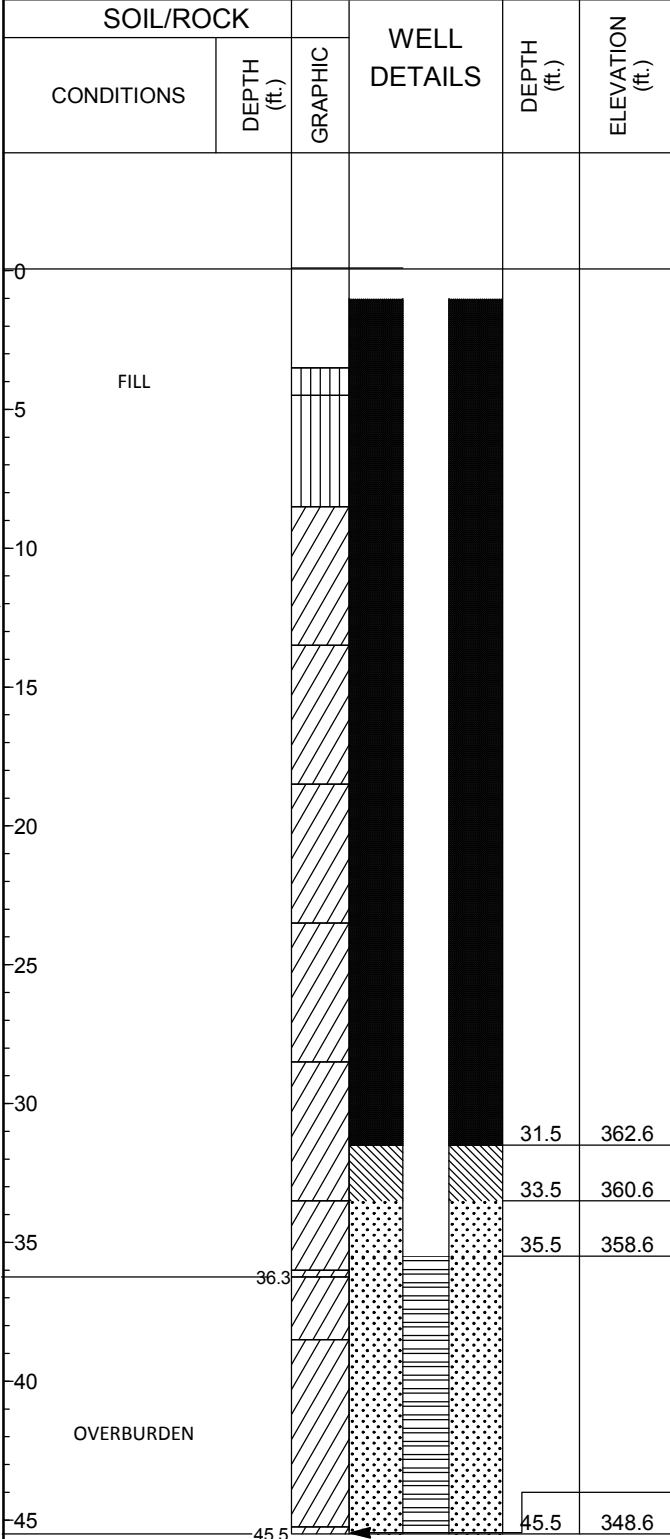
**Well Diagram**

-  Riser Pipe
-  Screen
-  Filter Sand
-  Cuttings
-  Grout
-  Concrete
-  Bentonite Seal

File No. 42796-001  
 Date Installed 15 Feb 2017  
 H&A Rep. S.Lewis  
 Location N 969046  
 E 2883846.9

Ground El. 394.1 (est.)  
 Datum

Initial Water Level (depth bgs) ft



**WELL CONSTRUCTION DETAILS**

Type of protective cover Flush Mount

Depth of Steel below ground surface 0.0 ft

Depth of top of riser below ground surface 0.3 ft

Type of protective casing Steel

Length 1.0 ft

Inside diameter -

Depth of bottom of Steel 1.0 ft

Type of riser pipe Schedule 40 PVC

Inside diameter of riser pipe 2.0 in.

Depth of bottom of riser pipe 35.5 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	1.0	31.5
Bentonite	31.5	2.0
Sand	33.5	12.0
	-	-

Diameter of borehole 8.0 in.

Depth to top of well screen 35.5 ft

Type of screen Machine slotted Sch 40 PVC

Screen gauge or size of openings 0.010 in.

Diameter of screen 2.0 in.

Type of backfill around screen Quartz Sand

Depth to bottom of well screen 45.5 ft

Bottom of silt trap 45.8 ft

Depth of bottom of borehole 45.5 ft

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**COMMENTS:**

# GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

**Well No.**  
**Boring No. CRR-AP-9**

Project CCR Hydrogeologic Characterization  
 Location F.B. Culley Generating Station  
 Client Southern Indiana Gas & Electric Company  
 Contractor Stearns Drilling  
 Driller W.Bates

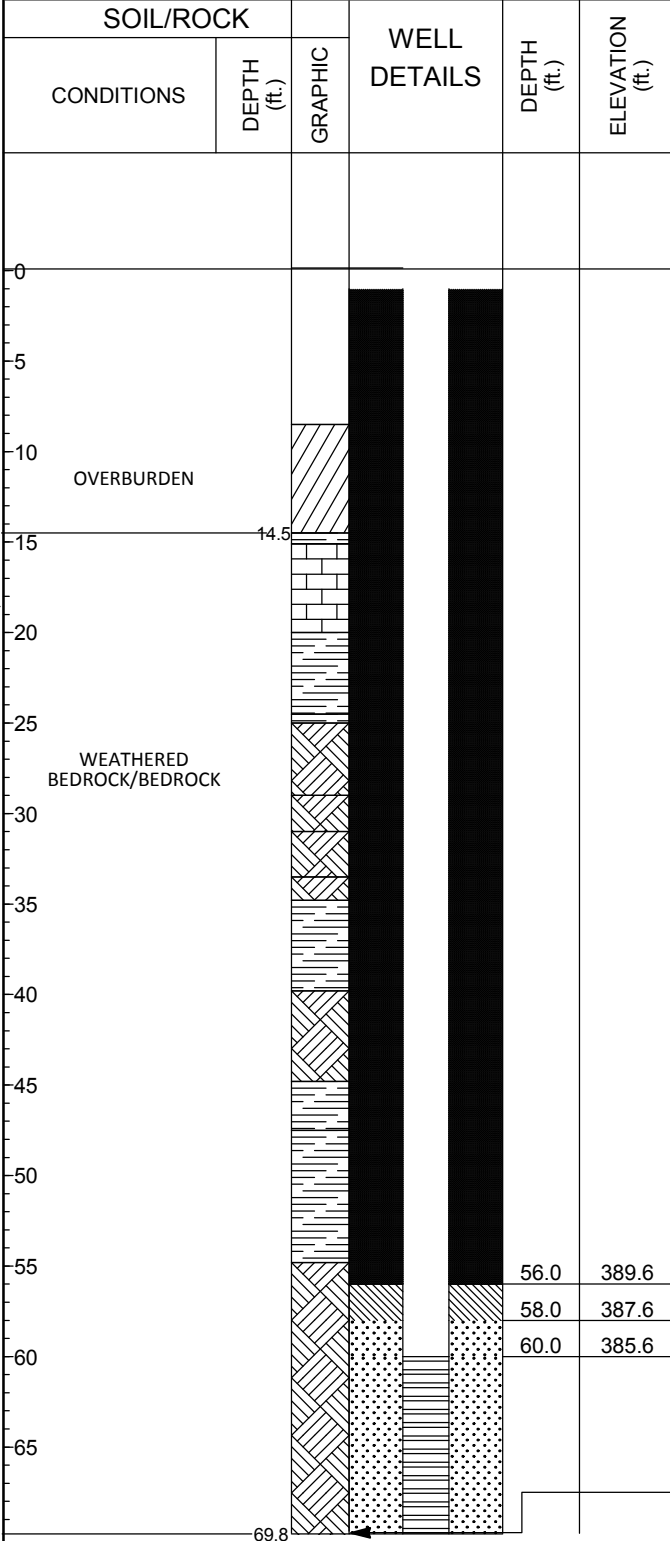
**Well Diagram**

- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 42796-001  
 Date Installed 15 Feb 2017  
 H&A Rep. S.Lewis  
 Location N 969768.6  
 E 2883999

Ground El. 445.6 (est.)  
 Datum

Initial Water Level (depth bgs) ft



## WELL CONSTRUCTION DETAILS

Type of protective cover Stick Up Guard Pipe

Height of Steel above ground surface 3.5 ft

Height of top of riser above ground surface 3.3 ft

Type of protective casing Steel

Length 6.0 ft

Inside diameter 6.0 in.

Depth of bottom of Steel 2.5 ft

Type of riser pipe Schedule 40 PVC

Inside diameter of riser pipe 2.0 in.

Depth of bottom of riser pipe 59.5 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Grout	1.0	55.5
Bentonite	57.5	2.0
Sand	57.5	12.0
	-	-

Grout 1.0 55.5

Bentonite 57.5 2.0

Sand 57.5 12.0

- - -

Diameter of borehole 8.0 in.

Depth to top of well screen 59.5 ft

Type of screen Machine slotted Sch 40 PVC

Screen gauge or size of openings 0.010 in.

Diameter of screen 2.0 in.

Type of backfill around screen Quartz Sand

Depth to bottom of well screen 69.5 ft

Bottom of silt trap 69.8 ft

Depth of bottom of borehole 69.8 ft

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**COMMENTS:**