COAL COMBUSTION RESIDUALS (CCR) GROUNDWATER MONITORING PLAN

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Record of Revisions

Groundwater Monitoring Plan

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8/11/2016	Developed Groundwater Monitoring Plan to comply with CCR requirements	Entire document (initial development)	J. Bookout (ECS) B. Ketchum, PE (ECS)
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1.0 INTRODUCTION

1.1 SITE DESCRIPTION AND REGULATORY APPLICABILITY

The Choctaw Generation Limited Partnership, LLLP – Red Hills Operations (Red Hills) is located near the City of Ackerman in Choctaw County, Mississippi. Red Hills is in north central Mississippi on a 170-acre site. Red Hills is bounded on the south by Pensacola Road, and is about ½ mile west of US Highway 9. Figure 1 shows the location of the site. Red Hills operates a single unit electrical generation facility designed to generate electricity for dispatch to the Tennessee Valley Authority (TVA) electrical system. The primary boiler fuel is lignite coal. As a result of combusting lignite coal, ash is created and must be disposed for re-purposed. Red Hills owns and operates an existing Ash Management Unit (AMU) for the placement and disposal of ash. The AMU (or CCR unit) is located in the northeastern portion of the property and consists of three (3) cells, as shown on Figure 2. The CCR unit encompasses approximately 90 acres of Red Hills' site.

The site is currently regulated by the Mississippi Department of Environmental Quality (MDEQ) Solid Waste Regulations and Solid Waste Permit No. SW0100040462. The site is now also required to comply with the Groundwater Monitoring and Corrective Action requirements of 40 CFR Part 257, Subpart D – Standards for the Disposal of Coal Combustion Residuals (CCR) in Landfills and Surface Impoundments (§257.90-98). As an existing CCR unit, the site must be in compliance with the following groundwater monitoring requirements by October 17, 2017:

- Install a groundwater monitoring system as required by §257.91;
- Develop a 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;
- Initiate the detection monitoring program to include obtaining a minimum of eight (8) independent samples for each background and downgradient well as required by §257.94(b); and
- Begin evaluating the groundwater monitoring data for statistically significant increases over background levels for the constituents listed in Appendix III of Subpart D as required by §257.94.

Once the CCR unit groundwater monitoring system and groundwater monitoring program at Red Hills has been established, groundwater monitoring and, if necessary, corrective action must be conducted throughout the active life and post-closure care period of the CCR unit. In the event of a release from a CCR unit, all necessary measures must be taken 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.

1.2 PROFESSIONAL ENGINEER CERTIFICATION

Groundwater Monitoring System

After a review of the boring logs and the existing groundwater monitoring system, it is believed that the system and wells have been designed and constructed to meet the requirements of 40 CFR 257, Subpart

D. 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. The system should accurately represent the quality of background groundwater (i.e., upgradient wells) that has not been affected by leakage from a CCR unit. In addition, the system should accurately represent the quality of groundwater passing the waste boundary of the CCR unit (i.e., downgradient wells). The system must contain a minimum of at least one (1) upgradient and three (3) downgradient monitoring wells. Due to the size and other contributing factors, several additional groundwater monitoring wells were installed in order to accurately and completely represent the quality of background groundwater and the quality of groundwater passing through the waste site and boundary. The initial Red Hills CCR unit groundwater monitoring system included three (3) background or up-gradient wells and eight (8) down-gradient wells to ensure complete coverage of the CCR unit, which consists of three (3) ash disposal cells covering approximately 90 acres. An additional downgradient well was added in August 2018. The well, identified as CCR-5, was installed downgradient from the CCR unit at the facility boundary in the direction of contaminant migration to meet the requirements of 40 CFR 257.95(g)(1)(iii). The addition of CCR-5 will help assess the nature and extent of groundwater contamination as a result of concentrations of cobalt and lithium exceeding the groundwater protection standards in some downgradient wells. Based on a review of the boring logs for each well, it appears that the wells and well screen is positioned to collect representative groundwater samples from the uppermost aquifer that will accurately depict the quality of background groundwater and detect potential unit leakage. A map showing the monitoring well locations is included as Figure 2.

Statistical Method

The Red Hills site has evaluated multiple statistical software packages and has decided to use DUMPStat® (*by Discerning Systems, Inc.*) to statistically evaluate the groundwater monitoring results in accordance with EPA approved statistical methodology. A review of the proposed statistical software (i.e., DUMPStat®) for evaluating the monitored data shows that the software is designed to meet the requirements of 40 CFR 257, Subpart D. Red Hills will utilize the DUMPStat® software to perform the statistical analyses and to provide predictions and a graphical representation of the collected groundwater monitoring data. This software offers complete consistency with EPA Subtitle C and D regulations, American Society for Testing and Materials (ASTM) Standard D6312-98 requirements for landfill detection monitoring, and methods described in the USEPA Unified Guidance. DUMPStat® provides results from the statistical comparisons performed on each sampling point and the overall monitoring event. Information about the algorithms and statistical methodologies used in DUMPStat® are detailed in the software manual and the developer's book – *Statistical Methods for Groundwater Monitoring* (Gibbons, 1994). DUMPStat® will screen for outliers, test distributional assumptions, detect historical trends, compute detection frequency, and select the optimal form of prediction limit. The DUMPStat® analysis will be used to develop and project findings along with the actual analytical results, the physical sampling methodology, and other factors. DUMPStat® is a powerful statistical software package designed for facilities performing ongoing groundwater detection monitoring, and it is commonly used by landfill owners and operators.

DUMPStat® performs upgradient versus downgradient or intra-well comparisons and provides results in both graphical and tabular formats showing all intermediate calculations. Appropriate prediction limits, distribution testing, treatment of non-detects, trend analysis and outlier detection are automatically generated by the program. An older version of DUMPStat® is currently used by Red Hills to analyze data associated with the wells installed and monitored in accordance with the Mississippi Department of Environmental Quality (MDEQ) regulations and as required by the Solid Waste Permit.

Certification

I hereby certify that I am familiar with the provisions of the final rule to regulate the disposal of Coal Combustion Residuals (CCR) as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA). I also attest that I, or an agent under my supervision, have reviewed the following:

- ❑ Groundwater Monitoring System requirements (§257.91), the groundwater monitoring well locations, and the boring logs, so that the design of the system will obtain representative background and down-gradient samples and that it meets or exceeds the minimal requirements of the regulations; and

- ❑ Statistical Method requirements (§257.93), and the statistical software package (DUMPStat®) so it is appropriate for the evaluating groundwater monitoring data and meets the minimal requirements of the regulations.

1/29/19

Brian Ketchum, PE   Date
Principal, Senior Engineer
Environmental Compliance & Safety, Inc.
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(Seal)

2.0 GROUNDWATER MONITORING SYSTEM

2.1 SITE GEOLOGY AND HYDROGEOLOGY

The CCR unit is underlain by mixtures of clays, silts, silty sands, and lignite of the Tuscahoma Formation. The clays are typically thicker and more continuous than the silts and sands. The lignite seams are also very correlative. The clays encountered under the CCR unit are light gray in color and are stiff-to-blocky in texture. Some minor sands occur, and these generally have a considerable portion of fines and are tan-to-gray in color.

Data indicates that there are two groundwater zones; the shallow or upper zone is a non-continuous perched water table zone, and the deeper water zone well below the base of the AMU. Hydrographs and potentiometric maps from previous monitoring events associated with existing groundwater monitoring wells compliant with the Nonhazardous Waste Regulations and MDEQ Solid Waste Permit illustrate that the groundwater flow direction is to the northwest, which correlates with the regional groundwater flow direction. A description of the full site geology/hydrogeology has been detailed in the Solid Waste Permit application.

2.2 MONITORING WELL SYSTEM

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. The system should accurately represent the quality of background groundwater (i.e., upgradient wells) that has not been affected by leakage from a CCR unit. In addition, the system should accurately represent the quality of groundwater passing the waste boundary of the CCR unit (i.e., downgradient wells). The downgradient wells should be installed at the waste boundary to ensure detection of groundwater contamination in the uppermost aquifer. The number, spacing, and depths of groundwater monitoring wells within the system were determined based upon site-specific technical information that included an assessment of items such as:

- ❑ Aquifer thickness and groundwater flow direction; and
- ❑ 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.

The groundwater monitoring system must include a minimum number of monitoring wells necessary to meet the performance standards and information specified above. The direction of groundwater flow through the CCR unit is to the northwest, which has been consistently determined through ongoing solid waste permit groundwater monitoring events and historically from previous piezometer and water level data.

The locations for the monitoring wells were based upon the known direction of groundwater movement. The monitoring wells screen the uppermost laterally continuous aquifer below the base of ash fill. The base of ash fill is at an approximate elevation of 480 feet mean sea level (msl). The zone that will be screened and monitored is at an approximate elevation of 470 feet msl but varies through the unit.

The system must contain a minimum of at least one (1) upgradient and three (3) downgradient monitoring wells. However, in order to accurately and completely represent the quality of background groundwater and the quality of groundwater passing through the waste site and boundary, additional monitoring wells were believed necessary. The initial Red Hills CCR unit groundwater monitoring system consists of three (3) background or up-gradient wells and eight (8) down-gradient wells to ensure complete coverage of the CCR unit, which consists of three (3) ash disposal cells covering approximately 90 acres. An additional downgradient well was added in August 2018, identified as CCR-5. A map showing the monitoring well locations is included as Figure 2.

2.3 CONSTRUCTION, INSTALLATION, AND DEVELOPMENT OF MONITORING WELLS

Monitoring wells were installed according to the guidelines established in the 1994 USEPA Region IV RCRA Subtitle D Training Manual (SDTM, 1994), or other generally accepted guidelines, and the requirements of 40 CFR Part 257, Subpart D. The monitoring wells were developed after construction and before the initial sampling to remove accumulated silt and to make sure that representative samples could be collected. Development water was discharged down-gradient of each monitoring well.

The groundwater monitoring wells are constructed of 4-inch Schedule 40 PVC flush-joint casings with a PVC well screen of sufficient length to intersect the monitoring interval. The screen and casings were placed in the borehole and the filter pack material was tremied into the hole. The filter pack material filled the annulus to a point approximately five feet (5') above the screen. Two feet (2') of bentonite pellets were placed (by tremie pipe) in the borehole and allowed to hydrate for at least eight hours, before tremieing the grout to the surface with a four percent cement-bentonite grout mixture. A locking, protective cover and a three foot by three foot, six-inch thick level concrete pad was installed at each well a minimum of 24 hours after the bentonite grout mixture had settled. The monitoring wells have been surveyed to provide elevations. The monitoring well documentation, including the design, installation, and development (soil boring logs and well reports) are maintained on site and were available for review during development of the CCR Groundwater Monitoring Plan.

3.0 GROUNDWATER SAMPLING AND ANALYSIS REQUIREMENTS

This groundwater monitoring program includes consistent sampling and analysis procedures that are designed to ensure monitoring results that provide an accurate representation of groundwater quality at the background and down-gradient wells. The sampling and analytical methods used are appropriate for groundwater sampling at this site and for the constituents being analyzed. The sampling and analysis program has been developed to include procedures and techniques for:

- ❑ Sample collection and analytical procedures;
- ❑ Sample preservation and shipment;
- ❑ Chain of custody control; and
- ❑ Quality assurance and quality control (QA/QC).

3.1 SAMPLE COLLECTION AND ANALYTICAL PROCEDURES

The purpose of groundwater monitoring is to ensure that laboratory results provide an accurate representation of groundwater quality at the site. Since metals are of primary concern, the US EPA approved low flow/low volume sampling technique or "low stress approach" will be used for collecting samples. Low flow sampling involves the use of variable speed peristaltic, bladder, or submersible pumps set at low purge rates (less than 0.5 L/min). An important note is that peristaltic pumps can only be used when the elevation of the top of the water column is no greater than 25 feet below the pump head elevation. The low flow/low volume technique results in very little draw down of the water table, reduces sample turbidity, minimizes chemical reactions that can occur due to atmospheric exposure and agitation, and reduces waste. Low sample turbidity is important, when the major constituents of concern are inorganics (i.e., metals), as they readily adsorb to the surface of clay particles.

3.1.1 Sampling Equipment

An equipment inventory will be conducted prior to initiating the sampling event. The following equipment may be used when collecting groundwater samples:

- ❑ Field logbook
- ❑ Monitoring Plan
- ❑ Well locks and keys
- ❑ Water level indicator with measuring tape marked with 0.01 ft increments
- ❑ pH, conductivity, temperature, and turbidity meter(s)
- ❑ Low phosphate detergent
- ❑ Decontamination brushes
- ❑ Tap water, Deionized water, Isopropyl alcohol, and Wash/Dispensing bottles
- ❑ Five (5) gallon buckets

- ❑ Low-flow pump (i.e., peristaltic, bladder, and submersible) and appropriate tubing
- ❑ PVC bailers and nylon twine
- ❑ Sample containers and necessary preservatives (corresponding to constituents being analyzed)
- ❑ Sampling labels
- ❑ Permanent markers
- ❑ Coolers and ice
- ❑ Packing material
- ❑ Chain-of-Custody Forms and Groundwater Sampling Forms
- ❑ Latex gloves
- ❑ Shipping tape and Duct tape
- ❑ Paper towels
- ❑ Plastic sheeting
- ❑ Clipboard
- ❑ Garbage bags
- ❑ Containers for contaminated purge water and equipment contamination, if necessary
- ❑ Re-sealable plastic bags
- ❑ Basic tool kit

3.1.2 Sampling Procedures

The following groundwater sampling procedures will be performed:

1) Review the groundwater monitoring plan, determine constituents required to be sampled, and order sample containers from the laboratory in advance of the event.

2) Ensure a key(s) to the well locks have been provided.

3) Conduct sampling equipment inventory check, and conduct equipment calibrations, where and when required.

4) Wear appropriate safety equipment and take precautions as necessary depending upon the type and location of sample collection. Check with the site contact to verify all needed safety equipment for working on the site.

5) Unlock the protective well casing and remove the well cap from each well to be monitored.

6) Measure the groundwater elevation to the nearest 0.01 feet using the water level indicator (prior to purging). Reference the depth to groundwater from the same location at the top of the well casing (i.e., small notch inscribed on top of the well casing). Measure the water level before purging the well to ensure static water levels are obtained. Collect water levels from all monitoring wells within the same day. Compare the total depth of each well during subsequent monitoring events to verify well construction integrity (i.e., identifies siltation problems, etc.).

7) Place plastic sheeting around the well to prevent equipment from being potentially contaminated.

8) Record well number, sample number, date, time, sampling personnel, weather conditions and all other information required on the groundwater sampling form.

9) Decontaminate non-dedicated sampling equipment (i.e., pump, tubing, and other associated equipment) that contact groundwater using the cleaning procedures in this document.

10) Use the appropriate pump (considering well depth and well setup) to withdraw water from the well. Dedicated tubing will be permanently installed in each well or new tubing will be used during each event. Ensure tubing is positioned near the middle of the screened area so that purging and sampling occurs within the screened area.

11) Collect purge water in a five (5) gallon bucket.

12) Purge water at a rate that prevents significant drawdown. Monitor water levels frequently during purging. If drawdown exceeds ten percent (10%) of the water column height, stop flow and allow the well to recover.

13) Measure pH, conductivity, temperature, and turbidity periodically and note in the field logbook or the groundwater sampling form.

14) Continue to purge and containerize groundwater until field water quality parameters stabilize for three (3) consecutive readings. Water quality is considered stable when:

    - ❑ pH is within 0.1 standard units;
    - ❑ Conductivity is within three percent (3%);
    - ❑ Temperature is within 0.1-0.2°C; and
    - ❑ Turbidity is less than 10 NTUs or variance within ten percent (10%).

15) Record the total purged water volume prior to collecting samples.

16) Collect samples from the pump discharge line. Sample containers are provided by the laboratory.

17) Ensure samples are properly preserved for shipment and analysis. Properly label the sample container, and ensure container is wrapped with packaging material to prevent breaking during shipment and placed in a cooler containing ice or ice packs to ensure sample quality. Preservation, labeling, and packaging is further detailed within this plan.

18) Dispose of purge water down-gradient of the well.

19) Move to the next well and go back to number 4) above and follow these procedures until each well has been sampled.

For existing CCR landfills like at Red Hills, a minimum of eight (8) independent samples from each background and downgradient well must be collected and analyzed for the constituents listed in Appendix III and IV of 40 CFR 257, Subpart D by no later than October 17, 2017. These constituents are listed in the tables provided in the following subsection. After the eight (8) initial sample events are completed to develop background data, the monitoring wells shall perform detection monitoring on a semi-annual basis during the active life of the CCR unit and the post-closure period unless assessment monitoring is triggered.

3.1.3 Field Records

Field logs will be kept by sampling personnel to record pertinent information about the groundwater monitoring event. The field logbook (or Groundwater Sampling Form) will include at a minimum the following information:

- Date, time, and weather conditions
- Sampling personnel identification
- Well and sample identification
- Static water level and total well depth
- Purging method and equipment used
- Purge rate and total purged volume
- Preservatives used in sample containers
- Types of sample containers used
- Analysis to be performed
- Results of field measurements (i.e., pH, conductivity, temperature, and turbidity)
- Field observations

If a field book is used, an “X” will be marked through any incomplete portion of unused pages in the field logbook at the conclusion of each day. In addition, the personnel maintaining the logbook will sign the last page used at the completion of each day. Any errors or mistakes will be struck through with a single line and initialed, not erased. Indelible ink will be used for the logbook. A copy of an example Groundwater Monitoring Form is provided in Appendix A.

3.1.4 Sample Analysis and Methods

The owner or operator of a CCR unit must conduct detection monitoring at all groundwater monitoring wells consistent with requirements of 40 CF 257, Subpart D. At a minimum, a detection monitoring program must include groundwater monitoring for all constituents listed in Appendix III of Subpart D. The monitoring frequency for these constituents shall be at least on a semi-annual basis during the active life of the CCR unit and the post-closure period. For existing CCR landfills, a minimum of eight (8) independent samples from each background and downgradient well must be collected and analyzed for the constituents listed in Appendix III and IV by no later than October 17, 2017.

The table below is a list of the wells included in the CCR groundwater monitoring system that are required to be sampled during each event. In addition, this table provides the additional QA/QC samples required during the sampling events.

List of Monitoring Wells for Sampling				
Well No.	Background or Down-gradient	Elevation (ft)	Well Depth (ft)	Well Dia. (inches)
MW-9	Down-gradient	480.96	21.74	4
MW-16	Down-gradient	489.05	21.74	4
OW-2	Down-gradient	489.10	27.05	4

List of Monitoring Wells for Sampling				
Well No.	Background or Down-gradient	Elevation (ft)	Well Depth (ft)	Well Dia. (inches)
MW-15	Down-gradient	487.61	22.74	4
MW-12	Down-gradient	475.00	19.09	4
MW-13	Background	563.00	106.00	4
MW-7	Background	572.62	56.92	4
MW-14	Background	595.00	60.97	4
CCR-2	Down-gradient	539.90	84.50	4
CCR-3	Down-gradient	502.60	53.00	4
CCR-4	Down-gradient	504.00	52.90	4
CCR-5	Down-gradient	467.81	32.0	4
Duplicate				
Equip. Blank				
Trip Blank				
Field Blank				

The tables below provide the groundwater constituents to be monitored, analytical method, container type and volume, preservative, and holding time. ***Appendix III and IV constituents are required to be sampled during the initial eight (8) events, and during the following Detection Monitoring only the Appendix III constituents are required to be sampled.***

40 CFR 257, Subpart D, Appendix III – Constituents for Background and Subsequent Detection Monitoring					
Parameter	Analytical Method	Container		Preservative	Holding Time
Chloride	4500-Cl-B	P	1000mL	NA	28 days
Fluoride	4500-F-D	P	1000mL	NA	28 days
Sulfate	4110B	P	1000mL	NA	28 days
TDS	2540C	P	1000mL	NA	7 days
Boron	200.7	P	500mL	NA	6 months
Calcium	200.7	P	500mL	NA	6 months
Duplicate	Varies	P	Varies	NA	Varies
Equip. Blank	N/A due to dedicated or new equipment and materials				
Trip Blank	N/A since no VOC samples are collected				
Field Blank	Varies	P	Varies	NA	Varies
pH	Measured and monitored in the field.				
Temperature					
Conductivity					
Turbidity					

T = Teflon, P = Plastic, G = Glass, NA = Not Applicable

40 CFR 257, Subpart D, Appendix IV – Constituents for Background (and Assessment) Monitoring					
Parameter	Analytical Method	Container		Preservative	Holding Time
Antimony	200.8	P	500mL	NA	6 months
Arsenic	200.8	P	500mL	NA	6 months
Barium	200.8	P	500mL	NA	6 months
Beryllium	200.8	P	500mL	NA	6 months
Cadmium	200.8	P	500mL	NA	6 months
Chromium	200.8	P	500mL	NA	6 months
Cobalt	200.8	P	500mL	NA	6 months
Fluoride	4500-F-C	P	1000mL	NA	28 days
Lead	200.8	P	500mL	NA	6 months
Lithium	200.7	P	500mL	NA	6 months
Mercury	245.1	P	500mL	NA	28 days
Molybdenum	200.8	P	500mL	NA	6 months
Selenium	200.8	P	500mL	NA	6 months
Thallium	200.8	P	500mL	NA	6 months
Radium 226/228	901.1	P	1000mL	NA	NA
pH	Measured and monitored in the field.				
Temperature					
Conductivity					
Turbidity					

T = Teflon, P = Plastic, G = Glass, NA = Not Applicable

For the metals listed above, the analytical must measure "total recoverable metals" concentrations in measuring groundwater quality. The measurement of total recoverable metals captures both the particulate fraction and dissolved fraction of metals in natural waters. In addition, the groundwater samples must not be field-filtered prior to analysis.

3.1.5 Sample Labels

All samples will be identified with a label, along with an entry on a chain-of-custody form. Labels will be cross-referenced to the chain-of-custody record, and any inconsistencies will be noted. Sample labels will include the following information on each sample container:

- ❑ Sample identification number
- ❑ Sample location
- ❑ Preservative

- ❑ Analysis requested
- ❑ Date
- ❑ Time
- ❑ Name or initials of sampler

3.2 SAMPLE PRESERVATION AND SHIPMENT

The sample containers will be properly labeled, wrapped with packaging material to prevent breaking during shipment, and placed in a cooler containing ice or ice packs at or less than 6°C to ensure sample quality. The ice used to cool the cooler is contained in a plastic bag to prevent leaking. Prior to sealing the cooler with packaging tape, the chain-of-custody form will be completed and stored in a sealable plastic bag and the cooler will be filled with additional packaging material to protect the sample containers during overnight shipping and handling. An overnight shipping label, usually provided by the laboratory, will be affixed to the top of the cooler and the cooler will be transported to an overnight delivery service.

All samples are packaged on the same day that they are collected. Samples not shipped the same day are stored on ice in coolers and kept in a secure area until shipped.

3.3 CHAIN-OF-CUSTODY CONTROL

A chain-of-custody will be completed by the lead sampler in order to establish the documentation necessary to trace sample possession from the time of collection to the time of analysis. The chain-of-custody procedures provide a method of completing and transferring custody of the samples. Chain-of-custody guidelines are presented below to create an accurate written record that can be used to transfer the possession and handling of a sample from the moment of its collection through analysis, which can be used or introduced as legal evidence, if necessary. The form will be completed in indelible ink with legible handwriting and will accompany the samples to the laboratory. The sampler will transfer custody of the samples by completing the chain-of-custody form, which includes sampler's signature and the date and time under the "Relinquished by" section at the bottom of the form. The information recorded on a chain-of-custody includes:

- ❑ Site name and location
- ❑ Name of sampler
- ❑ Sample number
- ❑ Sample location/description
- ❑ Date
- ❑ Time
- ❑ Matrix (i.e., soil, groundwater)
- ❑ Number of containers for each sample number
- ❑ Analysis requested

- ❑ Preservatives
- ❑ Other remarks
- ❑ Sampler's Signature

The sampler will transfer custody of the samples to the shipper and on to the designated laboratory as follows:

- ❑ Sign, date, and enter time on the chain-of-custody under "Relinquished by" entry.
- ❑ Common carriers will usually not accept responsibility for handling chain-of-custody forms; therefore, place the original chain-of-custody form in the appropriate sample shipping package, and retain a copy with the field records.
- ❑ Seal the cooler with clear packaging tape.
- ❑ Complete other carrier-required shipping papers.

Custody of samples must be maintained through the shipment of samples to the laboratories. Samples will be packaged and shipped via overnight delivery service or hand delivery to the laboratory. Custody forms for the samples will be signed by the sampling team member who is relinquishing custody. The custody form will include the bill of lading or air bill number, method of shipment, and time and date of the transfer of custody. Custody forms will be placed in a plastic bag and enclosed in the shipping cooler. A shipping label with return address and the bill of lading or air bill will be applied. Samples will be shipped to an approved laboratory for chemical analysis. Once the samples arrive at the laboratory, custody of the samples will be maintained by laboratory personnel. The receiving laboratory will sign "Received for Laboratory by" on lower line of the chain-of-custody and enter the date and time. Approved laboratories are required to develop written Standard Operating Procedures (SOPs) for maintaining security of samples and tracking the work performed on samples through the entire analytical process. These SOPs generally require the process stages be documented by the laboratory including, sample receipt, sample extraction/preparation, sample analysis, data reduction, and data reporting. In addition, the laboratory SOPs address organization and assembly of documents including control of sample tags, custody records, sample tracking records, analysts log book pages, bench sheets, read-out records, and document inventory.

3.4 QUALITY ASSESSMENT/QUALITY CONTROL (QA/QC)

The quality assurance and quality control (QA/QC) objectives are formulated to maintain the accuracy, precision, representativeness, and completeness of the data generating and sampling activities. Analytical data will be reviewed for sample holding times, equipment calibration requirements, sample labels, chain-of-custody, and other recording requirements. QA/QC procedures are in place to prevent cross-contamination using proper purging, sampling, shipping, and decontamination procedures. The purpose of the quality assurance objectives of each activity is summarized in the table below:

Activity	General Tasks	Purpose of QA Objectives
Sampling	Groundwater Sampling	Prevention of cross-contamination with proper sample collection, decontamination, and shipping procedures. These procedures make sure representative samples are collected.
Laboratory	Water Analysis	Maintain high data quality through approved methodologies, accuracy protocols, precision protocols, sensitivity goals, comparability and overall data completeness.

The precision, accuracy, representativeness, and completeness of the sampling programs will be determined using these quality assurance objectives as verified through the following procedures and methods:

Representativeness

Data representativeness is a qualitative element. Representativeness refers to a sample or a group of samples that reflects the characteristics of the medium at the sampling point. It also includes how well the sampling point represents the actual parameter variations that are under study. Sample representativeness will be determined by the sampling techniques employed during the investigation. Sampling personnel will follow the procedures described in this plan. Details of, and reasons for, any deviations from the protocols in this plan will be fully described in the field notes and subsequent sampling report.

Completeness

Completeness is the amount of valid data obtained from a measurement system compared with the amount expected and needed to be obtained in keeping with project data goals. The determination of data completeness is the responsibility of the appropriate field team leader and will be judged on the percentage of valid data generated during monitoring. A goal of 95% or higher has been set for the completeness criteria.

Comparability

Comparability is a qualitative characteristic considered during preparation of the plan. The objective of comparability is to make sure that results of similar investigative activities conducted by different parties are comparable. This can be reinforced by employing, and following, widely accepted investigative procedures that are logically developed and clearly documented. All sampling personnel will follow the protocols described in this plan.

Sample Blanks

Another QA/QC method is to ensure data and analyses are accurate and that samples are not contaminated. During each monitoring event, a duplicate sample and an equipment, trip, and field blank will be collected and analyzed.

Duplicate Samples

Duplicate samples will be submitted to the laboratory at a rate of one (1) monitoring well per sampling event. Duplicate well results will be compared to evaluate sampling precision. Field duplicates will be assigned a unique identification. A typical semi-annual groundwater monitoring event will result in one (1) duplicate sample being collected.

Equipment Blank

An equipment blank is when a sampling container of deionized, organic free water is opened in the field and poured into or over equipment used for sampling, such as a clean water bailer, then poured back into its original sampling container. The container is then shipped back to the laboratory to undergo the full analysis with the actual samples. Equipment blanks are required where non-dedicated sampling equipment is used. A typical semi-annual groundwater monitoring event should result in no equipment blanks taken, since all equipment used is dedicated or new.

Trip Blank

A trip blank is when a sampling container of deionized, organic free water received from the laboratory is not opened but accompanies the volatile samples for which it is serving as the trip blank. After samples are collected, the trip blank is returned to the respective laboratory, along with the samples, to undergo VOC analysis. A typical semi-annual groundwater monitoring event should result in no trip blanks taken, since VOC analyses are not being performed.

Field Blank

A field blank is taken by pouring deionized water into a sample container in the field at a sampling location. The purpose of the field blank is to evaluate the contribution of dust or other ambient sampling conditions in the field, which may impact sample results. The field blank will be analyzed for the same constituents as the groundwater samples collected for analysis. One (1) field blank will be collected per sampling event.

Laboratory QA/QC

Analytical data will be reviewed for compliance with QA/QC goals. This review will use an abbreviated checklist based on selected portions of the EPA CLP Data Validation Protocol or similar procedure. The purpose of reviewing laboratory data is to prevent and eliminate problems in interpretations resulting from systemic errors in the laboratory analyses, which may include such things as holding times, calibration (initial and continuing), units, method blanks, spikes, and tuning.

A qualified laboratory with the appropriate level of licenses, certifications and QA/QC procedures will be used. A copy of the lab's QA/QC procedures can be made available upon request. It is reviewed as necessary due to methodology updates.

4.0 DECONTAMINATION PROCEDURES

To prevent cross contamination between samples, all tools, sampling devices, instruments and other items that are not dedicated equipment in a well and that contact samples (i.e., groundwater) will be cleaned prior to use or reuse as follows:

- Wash with low phosphate detergent and tap water using a brush if necessary.
- Rinse thoroughly with water.
- Rinse thoroughly with deionized water.
- Rinse with isopropyl alcohol. ***Do not solvent rinse PVC or plastic items***.
- Rinse with deionized water.
- Air dry (if practical).

Non-dedicated sampling equipment will be decontaminated before use at each sampling location as described above. Sample collection containers or glassware will be provided by a certified laboratory as clean and non-contaminated.

5.0 DATA EVALUATION AND STATISTICAL ANALYSIS

One of the five (5) statistical methods specified below must 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 provided below.

Any statistical method chosen above 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 a 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 predictional 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.

The owner or operator of a 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. In determining whether a statistically significant increase has occurred, the groundwater quality of each constituent at each monitoring well shall be compared to the background value of that constituent, according to the statistical procedures and performance standards previously specified. Within ninety (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.

The Red Hills site has evaluated multiple statistical software packages and has decided to use DUMPStat® (*by Discerning Systems, Inc.*) to statistically evaluate the groundwater monitoring results in accordance with EPA approved statistical methodology. A review of the proposed statistical software (i.e., DUMPStat®) for evaluating the monitored data shows that the software is designed to meet the requirements of 40 CFR 257, Subpart D. Red Hills will utilize the DUMPStat® software to perform the statistical analyses and to provide predictions and a graphical representation of the collected groundwater monitoring data. This software offers complete consistency with EPA Subtitle C and D regulations, American Society for Testing and Materials (ASTM) Standard D6312-98 requirements for landfill detection monitoring, and methods described in the USEPA Unified Guidance. DUMPStat® provides results from the statistical comparisons performed on each sampling point and the overall monitoring event. Information about the algorithms and statistical methodologies used in DUMPStat® are detailed in the software manual and the developer's book – *Statistical Methods for Groundwater Monitoring* (Gibbons, 1994). DUMPStat® will screen for outliers, test distributional assumptions, detect historical trends, compute detection frequency, and select the optimal form of prediction limit. The DUMPStat® analysis will be used to develop and project findings along with the actual analytical results, the physical sampling methodology, and other factors. DUMPStat® is a powerful statistical software package designed for facilities performing ongoing groundwater detection monitoring, and it is commonly used by landfill owners and operators.

DUMPStat® performs upgradient versus downgradient or intra-well comparisons and provides results in both graphical and tabular formats showing all intermediate calculations. Appropriate prediction limits, distribution testing, treatment of non-detects, trend analysis and outlier detection are automatically generated by the program. An older version of DUMPStat® is currently used by Red Hills to analyze data associated with the wells installed and monitored in accordance with the Mississippi Department of Environmental Quality (MDEQ) regulations and as required by the Solid Waste Permit.

DUMPStat® merges structured ASCII (text) files into its environmental database. Once the data are merged, select the monitoring network and contaminants for analysis and specify statistical options so that each type of analysis can be custom tailored as required. These selections persist as new data are added, so that subsequent analyses can be performed easily. The program selects the most appropriate methods to use within the parameters of the statistical analysis settings, which guide the processing automatically so that large quantities of environmental data can be analyzed quickly and correctly. DUMPStat® provides separate viewers for the graphical and tabular results and worksheets, which show the individual statistical calculations in detail. The viewers allow for the customization of display and printing with options for colors, scaling and page layout, and filtering options to highlight statistically interesting results such as exceedances or those containing trends. DUMPStat® includes a complete simulation module that can be used to compute site-wide false positive and false negative rates (statistical power) based on any combination of statistical methods available.

6.0 MONITORING PROGRAM

6.1 DETECTION MONITORING

For existing CCR landfills similar to the Red Hills AMU, a minimum of eight (8) independent samples from each background and downgradient well must be collected and analyzed for the constituents listed in Appendix III and IV of 40 CFR 257, Subpart D by no later than October 17, 2017. These constituents are listed in the tables provided in this plan. After the eight (8) initial sample events are completed to develop background data, the monitoring wells shall perform detection monitoring on a semi-annual basis during the active life of the CCR unit and the post-closure period.

Detection monitoring will be conducted in accordance with the sample collection procedures outlined earlier in this plan and consistent with §257.94(b). At a minimum, a detection monitoring program must include groundwater monitoring for all constituents listed in Appendix III to the subpart. Unless otherwise required, one (1) sample from each background and down-gradient well will be collected and analyzed consistent with §257.93(e). The detection monitoring samples will be collected during the calendar year between January – June and July – December, with the analytical results provided by the 31st of the month following the semi-annual period (i.e., January 31st and July 31st).

6.2 ASSESSMENT MONITORING

If the owner or operator of the CCR unit determines during detection monitoring analysis that there is a statistically significant increase over background levels for one (1) or more of the constituents listed in Appendix III at any monitoring well at the waste boundary, the owner or operator must:

- Establish an Assessment Monitoring Program in accordance with §257.95 within ninety (90) days of detection.
- If the statistically significant increase over background resulted from another source or an error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality, provide a written demonstration within 90 days of detection. This demonstration requires a certification from a qualified professional engineer verifying the accuracy of the information. If a successful demonstration is completed within the 90-day period, the CCR unit owner or operator may continue with the Detection Monitoring Program.
- Prepare a notification stating that an Assessment Monitoring Program has been established and place the notification in the facility's operating record (as required by §257.105(h)(5)).

A statistically significant increase over background is determined when comparing the detection monitoring results of each constituent at each monitoring well to the background value of that constituent using the appropriate statistical procedures and performance standards specified in the regulations and this plan (i.e., DUMPStat®).

The Assessment Monitoring Program is required to be implemented within 90 days of triggering the program, and groundwater monitoring conducted semi-annually thereafter. Assessment monitoring includes the sampling and analysis of the groundwater for all constituents listed in Appendix IV from each well. New wells may be required to be installed as a result of implementing an Assessment Monitoring Program. If so, these wells would be required to be sampled and analyzed for all parameters in Appendix III and Appendix IV on a semi-annual basis.

Groundwater protection standards must be established as part of the assessment monitoring program for all constituents in Appendix IV detected in the groundwater, and the protection standards shall be:

- The maximum contaminant level (MCL) for constituents that have one;
- If no MCL has been established, use the background concentration for the constituent; or
- If the background level is higher than the MCL, use the background concentration.

If the concentrations of all constituents listed in Appendices III and IV are shown to be at or below background values using the statistical procedures, for two (2) consecutive sampling events, the owner or operator may return to the previous Detection Monitoring Program; otherwise, Assessment Monitoring must continue. A notification stating that detection monitoring is resuming for the CCR unit must be prepared, and the notification must be placed in the facility's operating record as required by §257.105(h)(7).

If one or more constituents in Appendix IV are detected at statistically significant levels above the established groundwater protection standard in any sampling event, the owner or operator must prepare a notification identifying the constituents in Appendix IV that have exceeded the protection standard, and the notification must be placed in the facility's operating record as required by §257.105(h)(8).

The CCR Groundwater Monitoring Program will be revised as necessary if Assessment Monitoring and Corrective Actions are required per §257.95 – 98 to include the site-specific scenarios, findings, recommendations, and corrective actions.

Red Hills is currently in the Assessment Monitoring Program and has implemented the requirements specified in §257.95.

7.0 RECORDKEEPING, NOTIFICATIONS, AND REPORTING

7.1 RECORDKEEPING AND NOTIFICATIONS

The facility must comply with the recordkeeping requirements specified in §257.105(h), which requires the following information, as it becomes available, to be placed in the facility's operating record:

1) The annual groundwater monitoring and corrective action report.
2) Documentation of the design, installation, development, and decommissioning of any monitoring wells, piezometers and other measurement, sampling, and analytical devices.
3) The groundwater monitoring system certification.
4) The selection of a statistical method certification.
5) The results of constituent concentrations listed in Appendices III and IV.

In addition to the above recordkeeping requirements, the following are required only if needed:

6) The notification required for establishing an assessment monitoring program (within 30 days).
7) The notification of returning to a detection monitoring program (within 30 days).
8) The notification of detecting one or more constituents in Appendix IV at statistically significant levels above the groundwater protection standard (within 30 days).
9) The notification of initiating the assessment of corrective measures requirements (within 30 days).
10) The completed assessment of corrective measures.
11) The public meeting recording documentation for the corrective measures assessment.
12) The semi-annual report describing the progress in selecting and designing the remedy and the selection of remedy, except that the selection of remedy report must be maintained until the remedy has been completed.
13) The notification of completing the remedy (within 30 days).

With regards to the CCR unit on site, Red Hills is also required to ***notify the MDEQ*** of availability of the following records and documents when information has been placed in the site's operating record and on their publicly accessible internet site:

1) Annual groundwater monitoring and corrective action report;
2) Groundwater monitoring system certification;
3) Selection of a statistical method certification;
4) Assessment monitoring program establishment;
5) CCR unit is returning to a detection monitoring program;

6) Constituents in Appendix IV detected at statistically significant levels above the groundwater protection standard and the required notifications to land owners;
7) Initiation of assessment of corrective measures;
8) Assessment of corrective measures;
9) Semi-annual report describing the progress in selecting and designing the remedy; and
10) Completion of the remedy.

7.2 REPORTING

Semi-annual groundwater monitoring results will be provided following each detection or assessment monitoring event. The events will generally be scheduled during the January-June and July-December periods, or as otherwise required by the CCR regulations, with the results provided no later than the end of the month following the semi-annual period (i.e., January 31 and July 31).

In accordance with 40 CFR 257, Subpart D (§257.90(e)), the site is required to prepare an Annual Groundwater Monitoring and Corrective Action Report. For an existing CCR landfill, like Red Hills operates, the initial report shall be prepared by no later than January 31, 2018, and annually thereafter. 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, and discuss actions to resolve the problems for the preceding calendar year, and project key activities for the upcoming year or next calendar year. The annual report is not considered complete until it is placed in the facility's operating record and on the publicly accessible internet site. 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 up-gradient) and down-gradient monitoring wells, to include the well identification numbers, that are part of the groundwater monitoring program;

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 - 98.

8.0 OPERATION AND MAINTENANCE OF THE MONITORING SYSTEM

8.1 ROUTINE INSPECTIONS

During each sampling event, the sampling team will inspect the wells for damage, and other signs of tampering or vandalism. Problems such as sediment accumulation or obstructions in the well will be recorded in the field logbook or on the groundwater sampling form. All wells will be capped and locked using keyed-alike locks.

8.2 REPAIRS

Well repairs may include any of the following:

- Retrieval of sampling equipment;
- Pumping/removal of excess sediment;
- Additional development; and
- Replacement.

The decision as to the appropriate repair will be made as needed by the project engineer, Red Hills, and other qualified representation. Repaired wells will not be sampled for 30 days after the repair, and all repairs will be placed in the operating record.

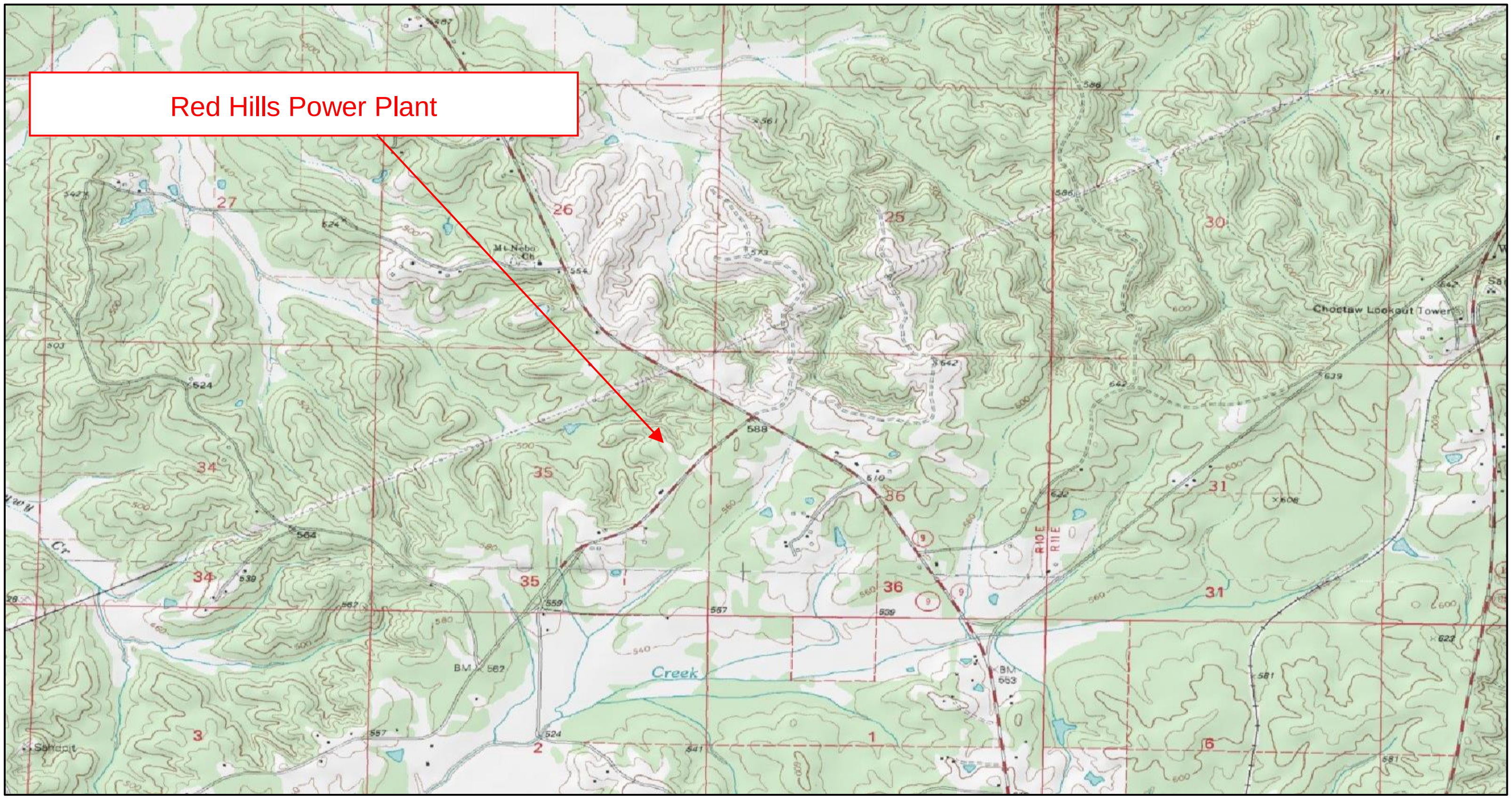
8.3 WELL ABANDONMENT

Within thirty (30) days from the conclusion of the monitoring program, all monitoring wells will be abandoned. Wells damaged beyond repair during the program will be abandoned and a replacement well will be installed. The procedure for abandoning monitoring wells will be as specified by the MDEQ, Office of Land and Water Resources.

A well abandonment report, including the well abandonment records, will be submitted following notification and approval. The well will be sealed in general accordance with the MDEQ Regulations and appropriate guidance documents.

FIGURE 1

SITE LOCATION MAP



Legend:	Drawn By: JTB	Checked By: BSK
	Date: 8/11/2016	Scale: 1:24,000
	Project No.:	Drawing No: N/A

N W E S

Source: Digital-Topo-maps.com

Red Hills Power Plant
2391 Pensacola Road
Ackerman, Mississippi

ECS
ENVIRONMENTAL COMPLIANCE & SAFETY, INC.

P.O. Box 356
Sherman, Mississippi 38869
(662) 840-5945

Figure 1: Site Location Map

FIGURE 2

FACILITY DIAGRAM

ECS
ENVIRONMENTAL COMPLIANCE & SAFETY, INC.
P.O. Box 356
Sherman, MS 38869
(662) 840-5945

Red Hills Power Plant
2391 Pensacola Road
Ackerman, Mississippi

Facility Diagram

Figure 2 | Project No.:

Legend:
Monitoring Well MW-14 E=591.34

Scale: Not Determined
Drawn By: JTB | Revised By: JTB
Date: 8/27/2018 | Date: 1/28/2019

APPENDIX A

GROUNDWATER MONITORING FORM

RED HILLS AMU MONITOR WELLS

Monitor Well: MW-7

Date: ____________

Sampling Method: Pumped

Measured Well Depth: 56.92 ft

Static Water Level: ______ ft
(Depth to Water)

Maximum Drawdown Depth ______ ft
(10% of WCH + SWL)

Well Diameter: 4 inches

Water Column Height: ______ ft
(Measured Well Depth - Static Water Level)

TOC Elevation: 572.62 ft

GW Elevation: ______ ft
(TOC Elevation - Static Water Level)

Well Volume: ______ gal
(Water Column Height x Well Casing Volume Factor)

	Date	Volume Purged (L)	Time	Elapsed Time (min)	Water Level (ft)	Turbidity (NTU)	Temp (C)	pH	Conductivity (uS/cm)
Start Pump									

Sample Time: ____________

Sample Analyzed for: Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chloride, Chromium, Cobalt, Fluoride, Lead, Lithium, Mercury, Molybdenum, Selenium, Sulfate, Thallium, TDS, Radium 226, & Radium 228

Total Drawdown (ft): ____________

Drawdown/Water Column (%): ____________

Sampler Signature: ____________

If possible, total drawdown will not exceed 0.33 ft.

If drawdown exceeds 10% of water column height , flow will be stopped and well allowed to recover.

Well Stabilization	
pH:	0.1 standard units
conductivity:	within 3%
temperature:	0.1 deg. C
turbidity:	<5 NTU or 10%

Well Casing Volumes (gal/ft)			
1" = 0.041	1 1/2 " = 0.10	2" = 0.16	2 1/2" = 0.24
3" = 0.37	3 1/2" = 0.50	4" = 0.65	6" = 1.46
8" = 2.61	10" = 4.08	12" = 5.87	