2.3.3 Water Quality

2.3.3.1 Surface Water

The proposed small modular reactors (SMRs) withdraw cooling water from the Clinch River arm of the Watts Bar Reservoir through an intake structure located near Clinch River Mile (CRM) 17.9. Heated water from the plant is to be returned to the Clinch River arm of the Watts Bar Reservoir by a discharge structure located near CRM 15.5.

2.3.3.1.1 Upper Tennessee River Basin

The water quality data in the Upper Tennessee River Basin from 1994 to 1998 was summarized by the U.S. Geological Survey (USGS) in 2000. The report evaluated concentrations and distribution of bacteria, nutrients, pesticides, and volatile organic compounds (VOCs) in surface water and sediment, the influence of industry and mining on water quality, and the effects of toxic spills and releases. The study was performed as part of the USGS National Water-Quality Assessment Program, which, as of 2000, had evaluated 36 study areas throughout the United States. The report compared water quality data from the Upper Tennessee River to data from the other study areas, as well as to national water quality benchmarks, such as those for drinking water quality and protection of aquatic organisms.

In general, the report concluded that surface water in the Upper Tennessee River Basin usually meets existing guidelines for drinking water, recreation, and the protection of aquatic life. Specific findings included:

- Bacteria levels frequently exceeded state standards in agricultural and urban areas. In agricultural areas, this was attributed to runoff from pasture land. In urban areas, this was attributed to wastewater infrastructure.
- Nutrients, including nitrogen and phosphorus, were found at elevated levels in some streams.
- Herbicides were detected in 98 percent of the stream samples collected, and insecticides were detected in 12 percent of samples. Concentrations were within drinking water standards, but exceeded aquatic life guidelines for some chemicals.
- Contamination from past industrial and mining activities was still present in many areas. Contamination had resulted in fish consumption advisories for polychlorinated biphenyls (PCBs), dioxin, and mercury. Semivolatile organic compounds (SVOCs) were found in sediment at concentrations that exceeded aquatic life guidelines, and were attributed to coal mining.
- Spills and releases had resulted in fish and mussel kills in many parts of the basin (Reference 2.3.3-1)

Specific findings were discussed for the Lower Clinch River Watershed, Watts Bar Reservoir, and Melton Hill Reservoir. Mercury was found to be a major contaminant in the drainages downstream from the Oak Ridge Reservation (ORR), including Whiteoak Creek watershed, and the lower Clinch River - Watts Bar Reservoir. Mercury, polychlorinated compounds (PCBs), and cesium-137 are known to have migrated to areas downstream of ORR. The State of Tennessee has posted a fish-consumption advisory for ORR drainages as well as Watts Bar Reservoir as a result of bioaccumulation of mercury and PCBs in some fish species. A fish-consumption advisory was also in place for Melton Hill reservoir due to the presence of PCBs and chlordane. (Reference 2.3.3-1)

2.3.3.1.2 State Monitoring and 303(d) List

The TDEC conducts monitoring of more than 7000 stations throughout the state, with 600 stations scheduled for sampling in fiscal year 2014-2015 (Reference 2.3.3-2). Water quality monitoring includes biological, chemical, and bacteriological analyses in wetlands, rivers, streams, reservoirs, and lakes.

There are 12 monitoring stations located on the Clinch River arm of the Watts Bar Reservoir, including four monitoring stations between Melton Hill Dam and the Clinch River Nuclear (CRN) Site, and eight stations between the CRN Site and the confluence of the Clinch River arm with the Tennessee River arm of the reservoir. The closest station is located directly adjacent to the CRN Site, on the eastern side of the peninsula near CRM 18. Another station is located directly adjacent to the Barge/Traffic Area. (Reference 2.3.3-3)

Section 303(d) of the federal Clean Water Act requires that states develop a list of surface water bodies that are “water quality limited” or are expected to exceed water quality standards in the next two years. Streams that are water quality limited have one or more characteristics that violate water quality standards. These streams are considered to be impaired by pollution, and cannot fully meet their designated uses. (Reference 2.3.3-4)

In 2014, TDEC issued its 303(d) list for the year 2012. Table 2.3.3-1 lists the water bodies near the CRN Site which are listed as impaired.

2.3.3.1.3 River and Reservoir Compliance Monitoring Program

TVA initiated a reservoir monitoring program, formerly called the Vital Signs Monitoring Program, in 1990 to provide information on the ecological health or integrity of major reservoirs in the Valley. Through the current Reservoir Ecological Health Program, TVA monitors ecological conditions at 69 sites on 31 reservoirs. Each site is sampled every other year unless a substantial change in the ecological health score occurs during a 2-year (yr) cycle. If that occurs, the site is sampled the next year to confirm that the change was not temporary. Roughly half the sites are sampled each year on an alternating basis. The program includes five ecological indicators (chlorophyll-a, dissolved oxygen (DO), sediment quality, benthic macroinvertebrates, and fish assemblage), which are monitored at up to four locations in each reservoir. To complete the ecological health scoring process, the 20 to 100 percent scoring range is divided into categories representing good, fair, and poor ecological health conditions relative to what is expected given the hydrogeomorphology of the reservoir. (Reference 2.3.3-5)

2.3.3.1.3.1 Melton Hill Reservoir

TVA monitors three locations on Melton Hill Reservoir: the deep, still water near the dam, called the forebay; the middle part of the reservoir; and the riverine area at the upper end of the reservoir, called the inflow. Monitoring is usually done on a two year cycle. The overall ecological condition of Melton Hill rated fair in 2012. Melton Hill received a good rating in 2006 and 2010 but rated fair in all other years monitored. The higher ecological health scores were primarily due to two indicators (chlorophyll and bottom life) rating near the upper end of their historic ranges. (Reference 2.3.3-6)

The following paragraphs summarize the result for the Melton Hill Reservoir Monitoring Program for 2012.

Dissolved Oxygen

In 2012, DO rated poor at the forebay and good at the mid-reservoir location. A large portion of the lower water column at the forebay had low DO concentrations in June, resulting in a poor rating. DO has rated good at the mid-reservoir location all years monitored and typically has rated good in the forebay unless there was an extended period with low flow. Low flow conditions can allow water to sit long enough that oxygen in the lower water column becomes depleted as it is used in the natural process of decomposition. This was the case in 2012 and in 2000, 2001, and 2008 when DO rated fair at the forebay location. (Reference 2.3.3-6)

Chlorophyll

In 2012, chlorophyll rated fair at the forebay and good at the mid-reservoir monitoring location. Annual average chlorophyll concentrations have fluctuated through time at the mid-reservoir, with no specific trend of increasing or decreasing. Chlorophyll concentrations have shown an overall trend of increasing at the forebay since monitoring began in 1991. Chlorophyll rated good at the forebay during the 1991 to 1996 time period. Since 1998, chlorophyll ratings have fluctuated between fair and poor at this location. Reservoir flows have played a part in the year-to-year fluctuations as low-flow conditions tend to allow more time for algal populations to become established. (Reference 2.3.3-6)

Fish

In 2012, the fish community rated good at the forebay, fair at the mid-reservoir, and poor at the inflow. Consistent with previous years, the fish assemblage at each monitoring location was characterized by lower numbers of fish and higher proportions of tolerant individuals than expected. As in most years, improved diversity at the mid-reservoir and forebay, respectively, resulted in higher ratings at these locations. (Reference 2.3.3-6)

Bottom life

In 2012, bottom life rated fair at the forebay and mid-reservoir locations and poor at the inflow. Over the period of the monitoring program from 1994 to 2012, scores for bottom life have fluctuated within the "low fair" to poor range at the forebay and within the poor range at the inflow location. Scores have improved, however, at the mid-reservoir location since 1994 with scores shifting from the low end of the fair range to the middle of the fair range and even rating good in 2006. The improved ratings were primarily due to an increase in the number of organisms less tolerant of poor conditions. (Reference 2.3.3-6)

Sediment

In 2012, sediment quality rated fair at the forebay because samples contained slightly more arsenic than would be expected to occur naturally. The mid-reservoir location rated good because no PCBs or pesticides were detected, and no metals had elevated concentrations. Arsenic, chlordane, copper, and PCBs have exceeded suggested limits in some previous years. (Reference 2.3.3-6)

2.3.3.1.3.2 Fort Loudoun Reservoir

TVA monitors three locations on Fort Loudoun Reservoir: the forebay; the middle part of the reservoir; and the inflow. Fort Loudoun Reservoir was monitored annually from 1994 through 2007. In 2008, TVA began monitoring Fort Loudoun every other year. The ecological health condition of Fort Loudoun Reservoir rated fair in 2011. Conditions were similar to most previous years. Low ratings for three indicators (chlorophyll, bottom life, and sediment quality) typically reduce the reservoir's overall health score. In addition, DO has rated poor in some years. (Reference 2.3.3-7)

The following paragraphs summarize the result for the Fort Loudoun Reservoir Monitoring Program for 2011.

Dissolved Oxygen

In 2011, DO rated fair at the forebay and good at the mid-reservoir monitoring location. This indicator usually rates good at the mid-reservoir location, but ratings have varied between good, fair, and poor at the forebay, generally in response to reservoir flow conditions. TVA has installed aeration equipment to add oxygen to the deep water above Fort Loudoun Dam and to improve conditions immediately downstream. (Reference 2.3.3-7)

Chlorophyll

In 2011, average summer chlorophyll concentrations were high at both monitoring locations, resulting in poor ratings. High chlorophyll concentrations are a consistent issue on Fort Loudoun, rating poor at both sites in most previous years. (Reference 2.3.3-7)

Fish

In 2011, the fish assemblage rated “high fair” at all three monitoring locations. The variety of fish collected at each location was good, but catch rates were slightly lower than desired and composition was dominated by a few species such as gizzard shad, bluegill, and/or largemouth bass. The fish community typically scores good or at the upper end of the fair range at the forebay and mid-reservoir, while scores at the inflow have generally fluctuated within the fair range. (Reference 2.3.3-7)

Bottom life

In 2011, similar to previous years, bottom life rated poor at the forebay and inflow monitoring locations and fair at the mid-reservoir location. Relatively few organisms are usually collected from the forebay and inflow locations, and those collected are primarily species capable of tolerating poor conditions. Bottom life at the mid-reservoir location typically rates fair due to greater diversity, which includes a better representation of intolerant species such as mayflies. (Reference 2.3.3-7)

Sediment

In 2011, sediment quality rated fair at both the forebay and mid-reservoir monitoring locations because PCBs were detected. Sediment quality typically rates fair at both locations due to chlordane, PCBs, and/or zinc exceeding suggested limits. (Reference 2.3.3-7)

2.3.3.1.3.3 Watts Bar Reservoir

TVA monitors four locations on Watts Bar Reservoir: the forebay; the middle part of the reservoir; and the Tennessee and Clinch River inflow locations. Samples are usually collected on a two-year cycle. The overall ecological health condition for Watts Bar Reservoir rated fair in 2012. Ecological health scores for Watts Bar have fluctuated between a “high fair” and poor and have generally followed reservoir flow conditions. Flow conditions in 2012 were low during most of the summer months in response to the generally dry weather pattern. The indicator most responsive to flow is DO, which rated poor at the forebay in 2012. In addition, common problems are elevated chlorophyll concentrations, poor bottom life, and the presence of metals and/or organic contaminants in the sediments. (Reference 2.3.3-5)

The following paragraphs summarize the result for the Watts Bar Reservoir Monitoring Program for 2012.

Dissolved Oxygen

DO rated poor at the forebay and good at the mid-reservoir location. DO has rated good at the mid-reservoir location all years monitored except 2008 and 2010, when it rated fair and poor, respectively. Low DO levels (<2 milligrams per liter [mg/L]) have occurred in the lower water column at the mid-reservoir in several years, including 2012. However, the area affected was larger in 2010 than in other years, resulting in the only poor rating for this indicator at this location. Ratings have varied between good, fair, and poor at the forebay, primarily due to differences in reservoir flows. Poorer DO conditions typically occur as a result of reduced flows through the reservoir during dry conditions. TVA has installed aeration equipment to add oxygen to the deep water above Watts Bar Dam and to improve conditions immediately downstream. (Reference 2.3.3-5)

Chlorophyll

Chlorophyll rated poor at both locations monitored because of elevated concentrations. Annual average chlorophyll concentrations have fluctuated through time at the forebay, with no specific trend of increasing or decreasing. Chlorophyll concentrations have shown an overall trend of increasing at the mid-reservoir location since monitoring began in 1990. (Reference 2.3.3-5)

Fish

The fish assemblage rated good at the Tennessee inflow location and at the upper end of the fair range at other monitoring locations. At all locations, the percent composition of tolerant individuals was higher than expected and catch rates were lower than expected. Better fish diversity at the Tennessee inflow location contributed to the higher (good) rating. (Reference 2.3.3-5)

Bottom life

Bottom life rated good at the mid-reservoir, fair at the forebay and Clinch inflow locations, and poor at the Tennessee inflow location. Scores for bottom life in 2012 were similar to those of previous years at each monitoring location except the Clinch inflow location. Bottom life rated poor at the Clinch inflow location until 2004 when it received its first fair rating. Since 2004, bottom life at Clinch inflow location has scored within the fair to low-good range. Improvements in ratings at the Clinch inflow location are attributable to increases in the density and diversity of organisms in the samples collected from the reservoir bottom. (Reference 2.3.3-5)

Sediment

Sediment quality rated fair at the forebay and mid-reservoir locations because concentrations of arsenic exceeded suggested background levels. Sediment quality commonly rates fair at both locations due to one or more contaminants: PCBs, chlordane, and/or arsenic. Additionally, the concentration of copper was elevated in the sample collected at the mid-reservoir location in 2009, and lindane was detected in the sample collected at the forebay in 2006. (Reference 2.3.3-5)

2.3.3.1.4 Preapplication Monitoring Program

To support the evaluation of the suitability of the CRN Site and Barge/Traffic Area, TVA monitored the surface water on and in the immediate vicinity. This program consisted of characterization of surface water in the Clinch River arm of the Watts Bar Reservoir, as well as characterization of stormwater runoff on both the CRN Site and Barge/Traffic Area. The resulting data provides information to determine existing conditions for surface water. The parameters measured or analyzed include temperature, total metals, nutrients, acids/base/neutral compounds, PCBs, gross alpha, gross beta, radium 228, radium 226, oil and grease (O&G), pH, cyanide, phenols, biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), color, bromide, surfactants, total organic carbon (TOC), sulfide, sulfate, ammonia-N, fluoride, TOC, and hardness. Pesticide monitoring was included in the July 2013 sampling. (Reference 2.3.3-8) The locations of the samples are provided in Figure 2.3.3-1, and the results are provided in Tables 2.3.3-2 and 2.3.3-3. Tables 2.3.3-2 and 2.3.3-3 provide the maximum concentrations for quarterly stormwater and surface water samples, respectively, collected in July 2013; March, May, and November 2014; and February, April, and June, 2015. All sample results for the Clinch River arm of the Watts Bar Reservoir upstream and downstream of the CRN Site indicate that TDEC's most stringent numeric criteria are being met and that site runoff (should it occur) would not have a significant impact to water quality (Reference 2.3.3-8).

2.3.3.1.5 Biological Monitoring Program

As part of the biological monitoring to characterize the aquatic community near the CRN Site, TVA collected and analyzed surface water and sediment samples at selected locations on the Clinch River arm of the Watts Bar Reservoir between CRM 15.5 and 22.0. The locations of the samples are shown in Figure 2.3.3-1.

The biological monitoring program data were collected to characterize baseline conditions of the aquatic habitats and communities in the reservoir immediately upstream and downstream of the CRN Site. This program focused on ecological health, but included collection of surface water quality and sediment chemistry data, as indicators of ecological health. Surface water samples were collected at four mid-channel locations, including three upstream locations at CRM 18.5, 19.7, and 22.0, and one downstream location at CRM 15.5. The surface water samples were collected monthly from March to December 2011. The samples from each month (a total of 10 months) were analyzed for nutrients (Kjeldahl nitrogen, nitrate plus nitrite-nitrogen, ammonia-nitrogen, total phosphorus, and orthophosphate), TOC, alkalinity, hardness, water clarity (turbidity and TSS), and total dissolved solids (TDS). The samples from every second month (April, June, August, October, and December) were analyzed for total and dissolved metals. In June, 2011, sediment samples were collected at three of the locations, including CRM 15.5, 18.5, and 22.0. Sediment samples were also collected from one location in Melton Hill Reservoir in June, 2011, and from two locations in the Tennessee River arm of Watts Bar Reservoir in June, 2010, and June, 2011. The sediment samples were analyzed for metals and organochloride pesticides and PCBs. (Reference 2.3.3-9)

The results from the biological monitoring program samples collected between March 2011 and December 2011 are provided in Tables 2.3.3-4 through 2.3.3-8, and are discussed in the following paragraphs (Reference 2.3.3-8).

Nutrient concentrations typically were relatively high for nitrogen and moderate to low for phosphorus. Phosphorus concentrations were often low enough to be a limiting factor to phytoplankton, while nitrogen appeared to be underutilized. Chlorophyll a concentrations were low (<1.0–5.0 micrograms per liter [μg/L]). Concentrations were below detectable levels (1 μg/L) in approximately 53 percent of the samples, and only three of the 68 samples had concentrations greater than 2 μg/L. Secchi-disk transparency ranged from 1.5 to 6.2 meters (m). The average transparency was greater than 3 m (3.1m to 3.6 m) at each CRN Site sampling location (CRMs 15.5, 18.5, 19.7, and 22.0) in 2011, which is higher than typically observed in mainstream Tennessee River reservoirs. Turbidity ranged from 0.6 to 12 nephelometric turbidity units (NTU), with 68 percent of the values less than 4 NTUs. TSS ranged from 1 to 11 mg/L, with 85 percent of the values less than 4 mg/L. Phytoplankton populations were characterized by low abundance and appeared to be mainly the result of phytoplankton populations generated within Melton Hill Reservoir and transported downstream. Based on chlorophyll results, phytoplankton productivity in the sampled reach was very limited and phytoplankton populations were essentially in a senescent phase. Productivity was likely light-limited due to turbulence within the water column. Zooplankton assemblages were characterized by low abundance and diversity throughout the 10-month sampling period. As with phytoplankton, high turbulence and advection within the sampled reach likely limited zooplankton populations and affected their distribution. (Reference 2.3.3-8)

The typical pH was 7.5–7.9. All pH values were within the bounds of the State of Tennessee aquatic life criteria (6.5 to 9.0). The maximum water temperature was 79.6°F, well below the State of Tennessee criteria (86.9°F). Concentrations of metals in water were found to be below concentrations established by the State of Tennessee for protection of aquatic life. Ammonia concentrations were below the quantification limit (0.10 mg/L) in approximately 45 percent of the samples, while some samples had higher ammonia concentrations (0.16–0.19 mg/L) than generally expected. Ammonia concentrations typically are low (<0.15 mg/L) in aerated surface waters of TVA reservoirs; values greater than 0.15 mg/L are infrequent. PCBs and pesticides were not detected in the sediment samples collected near the CRN Site and metals concentrations were below EPA Region 4 ecological screening values for sediments. (Reference 2.3.3-8)

As discussed in Subsection 2.3.1.1.2.7, daily thermal gradients were documented to occur in the reservoir during summer due to surficial warming during the hottest time of the day. However, the warmer surface water was then either flushed out by daily dam releases from Melton Hill Dam, or its heat dissipated with nighttime atmospheric cooling. However, appreciable vertical gradients in DO concentrations existed at some locations during the July survey. Likewise, the slight deviation (4.87 mg/l) below the state water quality criterion for DO at CRM 15.5 in June 2011 may have resulted from periodic increases in flow mixing oxygenated water in the upper strata with oxygen-deficient water in the lower strata. (Reference 2.3.3-8)

Hourly hydro water releases from Melton Hill Dam typically range from no discharge to the maximum turbine capacity of approximately 20,000 cfs. However, intervals of 12 to 22 hr with no releases are common. Average hourly releases from Melton Hill Dam for April through

September of 2011 and 2013 were above average, but there were no hourly releases from Melton Hill Dam for about 42 percent of the time. By comparison, the percentage of hours with no releases is often in the range 60 to 70 percent. Therefore, data collected in 2011 and 2013 are likely more representative of conditions that exist during normal to above average flow conditions. During low flow years, the potential exists for greater spatial difference in temperatures and for increases in the magnitude and duration of stratification and resultant oxygen deficiencies. (Reference 2.3.3-8)

2.3.3.2 Groundwater

This subsection describes the quality characteristics of groundwater aquifers that could affect plant water use and effluent discharge or be impacted by construction and operation of the SMRs to be built at the CRN Site.

The CRN plant design does not require groundwater as a source for cooling water, potable water, or other plant needs. Circulating cooling water is sourced from the Clinch River arm of Watts Bar Reservoir, while potable and other water comes from the Oak Ridge Department of Public Works. Temporary dewatering is required to maintain a dry excavation for the construction of the required foundations for the CRN plant structures.

2.3.3.2.1 Hydrogeochemical Characteristics

2.3.3.2.1.1 Regional Hydrogeochemical Characteristics

As discussed in Subsection 2.3.1.2.1.2, the principal aquifers in the Valley and Ridge Province consist of carbonate rocks that are generally in communication with surface water features such as rivers or lakes. Other types of rocks in the province can yield water to wells where they are fractured or contain solution openings or are directly hydraulically connected to sources of recharge. Groundwater can also be present in the alluvium along streams and the residuum of weathered material that overlies most of the rocks in the area.

The chemical quality of water in the freshwater parts of the Valley and Ridge aquifers is similar for shallow wells and springs. The water is hard, a calcium-magnesium-bicarbonate type, and typically has a dissolved-solids concentration of 170 parts per million (ppm) or less. The ranges of concentrations are thought to be indicators of the depth and rate at which groundwater flows through the carbonate-rock aquifers. In general, the smaller values for a constituent represent water that is moving rapidly along shallow, short flow paths from recharge areas to points of discharge. This water has been in the aquifers for a short time and has accordingly dissolved only small quantities of aquifer material. Conversely, the larger values represent water that is moving more slowly along deep, long flow paths. Such water has been in contact with aquifer minerals for a longer time and thus has had greater opportunity to dissolve the minerals. Also, water that moves into deeper parts of the aquifers can mix with saltwater (brine) that might be present at depth (Reference 2.3.3-10).

The chemical characteristics of the groundwater in the ORR aquitards range from a mixed-cation-bicarbonate water type at shallow depths to a sodium-bicarbonate water type at deeper depths, to sodium-calcium-chloride water type as evidenced from very deep wells. These chloride-rich waters appear to be a zone of dilution on top of deeper saline sodium-calcium-chloride brines, similar to those encountered within the Conasauga Group at depths greater than 1000 ft in Melton Valley (Reference 2.3.3-11). The Knox aquifer is characterized by a calcium-magnesium-bicarbonate water type. The hydrogeologic conditions at the CRN Site are similar to those observed at the ORR with the exception of land disturbance areas resulting from earlier site work performed for the CRBRP where excavations and fill material are present.

2.3.3.2.1.2 Local Hydrogeochemical Characteristics

The hydrogeochemical characteristics of the groundwater are summarized on Figure 2.3.1-23. The shallow groundwater is characterized by mixed cation-bicarbonate type water, intermediate depth sodium-bicarbonate water, and deep sodium-chloride type water (Reference 2.3.3-12). The transition to sodium-chloride type water occurs below approximately 300 ft and thus is not intercepted by onsite monitoring wells. A study of groundwater circulation in the deep system was conducted on the ORR, which included one well adjacent to the site (GW-214) (Reference 2.3.3-13). This well appears to be at the top of the saline zone (sodium-chloride type water) at a depth of 393 ft with a total dissolved solids measurement of 1693 ppm. The results of this study indicated that some active exchange of water from the shallower groundwater is occurring. This exchange was characterized as highly variable as a result of the paucity of vertically interconnecting fractures. A more recent study performed as part of the Melton Valley exit pathway monitoring program indicated a similar depth to saline groundwater (385 ft for monitoring well OMW1c) (Reference 2.3.3-14).

2.3.3.2.1.3 Site Hydrogeochemical Characteristics

Site-specific groundwater chemistry data were collected from selected onsite observation wells (Reference 2.3.3-15). Table 2.3.3-9 summarizes the field parameter measurements for the selected wells. Table 2.3.3-10 summarizes the analytical results. Regional groundwater chemistry information was obtained from the USGS National Water-Quality Assessment Program (NAWQA) website for groundwater analyses from Roane, Anderson, and Knox counties to compare with the site-specific data. The results of these analyses are presented on a Piper trilinear diagram shown on Figure 2.3.3-2 (Reference 2.3.3-16). The site groundwater ranges mostly from calcium-bicarbonate to magnesium-bicarbonate type. The water is generally near neutral pH with a total dissolved solids concentration of less than 500 ppm. Examination of the figure indicates that, in general, the site groundwater chemistry is similar to the regional information from NAWQA. A notable exception is OW-202L, which is based on water chemistry, appears to be associated with the intermediate depth groundwater zone as defined on the ORR with a sodium-bicarbonate water type, alkaline pH, and higher total dissolved solids concentration. OW-202L was purged dry during sampling and had the highest field turbidity and pH measurement of the wells sampled (Table 2.3.3-9).

2.3.3.2.2 Groundwater Quality

2.3.3.2.2.1 Local Groundwater Quality

The CRN Site is located adjacent to the ORR which includes three DOE facilities: the Oak Ridge National Laboratory (ORNL), the Y-12 National Security Complex (Y-12), and the East Tennessee Technology Park (ETTP). The ORNL is composed of subareas including Melton Valley, Bethel Valley, and White Oak Creek. The Y-12 facility includes Bear Creek Valley, Upper East Fork Poplar Creek, and Chestnut Ridge. These facilities were constructed as part of the Manhattan Project during World War II and were involved with nuclear weapons production and research. A variety of chemicals and radionuclides are present at the sites. The primary classes of contaminants present include VOCs and radionuclides (primarily uranium, tritium, and strontium-90). Figure 2.3.3-3 presents a map showing the major groundwater plumes associated with the facilities (Reference 2.3.3-17). Examination of the map with respect to the location of the CRN Site indicates that none of the major groundwater plumes are impacting the site area.

2.3.3.2.2.2 Site Groundwater Quality

To support the evaluation of the suitability of the proposed SMR site, the CRN Site field investigation includes monitoring groundwater at the CRN Site. As discussed in Subsection 2.3.1.2.1.4.2 and shown in Figure 2.3.1-18, observation wells were installed across the CRN Site to characterize the groundwater. Analytical results of quarterly sampling provide information on baseline groundwater conditions for the site.

<u>Legacy Contaminants</u>

Current groundwater conditions at the CRN Site are influenced through proximity to ORR. As mentioned in Subsection 2.3.3.2.2.1, legacy contaminants from historic ORR operations include VOCs and radionuclides associated with the facilities. Contaminant plumes on ORR include volatile organic compounds along with cesium-137, strontium-90, and tritium at ORNL. Contaminant plumes at Y-12 include uranium, nitrate, and mercury. Plumes at ETTP also include chromium-6 and technetium-99. (Reference 2.3.3-18) In addition, the regularly maintained, fenced White Oak Dam complex continues to settle legacy ORNL contaminants into the sediment of its 25-ac lake and, potentially, groundwater in the region. Groundwater monitoring, assessment, and corrective action are ongoing at the ORR sites.

Legacy groundwater contaminant plumes also include the former American Nuclear Corporation, located 15 mi southwest of the CRN Site on Braden Branch Creek near CRM 50.5. From 1962 until 1970, American Nuclear Corporation produced radioactive sources and detectors. In 1970, contamination entering the Clinch River was traced to the American Nuclear Corporation, the operational license was revoked, and the plant closed. The plant was cleaned and fenced to allow the radioactive materials to decay in place. Contaminants include cobalt-60 and cesium-137. (Reference 2.3.3-19)

Monitoring Network Baseline

Observation wells were sampled on a quarterly basis by TVA from December 2013 through November 2014 to help characterize seasonal variations throughout the annual cycle to baseline current groundwater conditions (Reference 2.3.3-18). Sampling events were performed in December 2013 to January 2014, in April 2014, in August 2014, and in November 2014 to characterize groundwater conditions in winter, spring, summer, and fall, respectively. Groundwater samples were collected using a submersible bladder pump. Each well was evacuated until field parameters stabilized; field parameters included sample depth, temperature, pH, oxidation-reduction potential, specific conductance, dissolved oxygen, and turbidity. Once stabilized, analytical samples were collected. Sample analysis included volatile organic compounds, semivolatile organic compounds, pesticides, PCBs, total petroleum hydrocarbons, metals, cyanide, radionuclides, and polycyclic aromatic compounds. (Reference 2.3.3-18)

The baseline range of field parameters for groundwater is summarized in Table 2.3.3-11. A more detailed summary, detailing data by sample depth and season is shown in Table 2.3.3-12.

Unlike most of the other field parameters, the minimum and maximum groundwater sample temperatures overlap during the annual cycle as shown in Table 2.3.3-13. Minimum temperatures range from 8.36 to 20.74 degrees Celsius (°C; 47.05 to 69.33 degrees Fahrenheit [°F]) and maximum temperatures range from 13.7 to 24.44°C (56.66 to 75.99°F). The effect of well depth on the seasonal variance in temperatures is not apparent due to the wide range in depths for each well designation (i.e., upper, lower, and deep). Wells designated as upper had depths ranging from 8.76 to 31.5 m, while lower wells ranged from 35.97 to 50.3 m and deep wells ranged from 57.3 to 80 m; thus making the depth ranges rather continuous and less discrete.

As presented in TVA's Groundwater Quality Monitoring Report, analytical results of the 2013/2014 baseline sampling summarized in Table 2.3.3-14, were examined for legacy contaminants and for detections exceeding drinking water maximum contaminant levels (MCLs). A detailed summary of sampling results is presented in Appendix 2.3.3-2-A. Only two detected analytes exceeded their MCL. Five fluoride results exceeded the MCL of 4 µg/L; ranging from 6.9 to 14.2 µg/L with the smallest exceedance from the OW422D well and the other four from the OW415L well. Lead had three detections, 5.5, 10.6, and 120 µg/L, with the maximum detection from the fall sampling of OW419U exceeding lead's action level of 15 µg/L. (Reference 2.3.3-18)

A summary of legacy contaminant detections is presented in Table 2.3.3-15. Of the regional legacy contaminants, none of the wells had detections of mercury or uranium. Similarly, none of the wells had detections of trichloroethylene or 1,1-dichloroethane. Detected legacy volatile organic compounds were limited to a solitary detection of tetrachloroethylene, along with twenty-two low level chloroform detections. Additionally, some wells exhibited nitrate detections; all low level. Detected legacy metals include a solitary arsenic detection, along with two detections of cadmium. Barium was detected at low levels in several wells and chromium had five detections. The legacy radionuclides tritium, strontium 90, and technetium 99 were detected a few times.

Table 2.3.3-16 presents a summary of detected analytes.

Well Cluster 422

During the CRN Site subsurface investigation, a three-well cluster was installed east of the OW-101 well cluster, at boring location MP-422 (OW-422 U, L, and D). Following drilling, wells were scheduled to be completed by casing, screening, filtering, sealing, and packing to produce a viable groundwater monitoring well. During well completion, groundwater contamination was observed in OW-422L. TDEC was notified and was provided with the results of well sampling. The contamination was determined to be non-radiological, petroleum products (gasoline range organics). Due to the contamination in OW-422L, this well cluster (OW-422 U, L, and D) was not developed; however, the well cluster remains in place, locked and under TVA control. TVA has no plans to perform any additional work in the location, and TDEC will make a determination regarding the disposition of the well cluster. Because the wells were not developed and monitoring of water levels in these wells was not performed, the OW-422 well series is not included in the discussion of site observation wells. Well clusters OW-428 and OW-429 (installed north and south of the OW-422 cluster) were installed to provide replacement geological/groundwater data. (Reference 2.3.3-18)

Some permanent observation well clusters (OW-428 and OW429), located in the area around OW-422, were sampled after well development and no evidence of petroleum products (gasoline range organics) was observed in January 2014. The contamination seems to be restricted to the immediate area around well OW-422. No evidence of petroleum products (gasoline range organics) was observed before or after the 72-hour (hr) pumping test conducted near the OW-428 U,L, and D well cluster (up dip [higher in the geologic unit] of OW-422L). Water quality sampling in discharge water from the 72-hr pumping test also showed no detection of volatile organic compounds. Finally, gross alpha and beta radionuclides were below minimum detectable concentration levels in the discharge water from the pumping test. Therefore, the contamination seems to be a localized issue around well OW-422.

2.3.3.3 References

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Reference 2.3.3-16. U.S. Geological Survey, National Water-Quality Assessment Program, NAWQA Data Export, Website: http://water.usgs.gov/nawqa/data, 2014.

Reference 2.3.3-17. Science Applications International Corporation, "Third Reservation-wide CERCLA Five-Year Review for the U.S. Department of Energy Oak Ridge Reservation, Oak Ridge, Tennessee," DOE/OR/01-2516&D2, U.S. Department of Energy Office of Environmental Management under subcontract 23900-BA-KK665, July, 2012.

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Reference 2.3.3-20. Hem, J., "Study and Interpretation of the Chemical Characteristics of Natural Water, Water-Supply Paper 2254," U.S. Geological Survey (Third Edition): 1-272, 1985.

Table 2.3.3-1
Surface Water Bodies near CRN Site listed in 2012 303(d)

Water Body	Acres	Characteristics that Violate Water Quality Standards
Watts Bar Reservoir	34,075	PCBs in sediment
Fort Loudoun Reservoir	14,066	PCBs in sediment
	534	Atmospheric deposition of mercury
Tellico Reservoir	16,500	PCBs in sediment and atmospheric deposition of mercury
Norris Reservoir	23,198	Atmospheric deposition of mercury
Upper Clinch River	16.88 (river miles)	Loss of native mussel species
Poplar Creek Embayment of Watts Bar Reservoir	141	PCBs from an industrial point source, mercury in contaminated sediments
Clinch River arm of Watts Bar Reservoir	2682	PCBs from industrial point source, chlordane in contaminated sediment, and atmospheric deposition of mercury
Melton Hill Reservoir	5960	PCBs and chlordane in contaminated sediment
Whiteoak Creek	5.3 (river miles)	Cesium, strontium, and loss of biological integrity
Emory River Arm of Watts Bar Reservoir	283.36	Mercury, PCBs, and chlordane from an industrial point source, atmospheric deposition, and contaminated sediments
	454.98	Arsenic, coal ash, aluminum, mercury, PCBs, and chlordane from various sources (including the 2008 Kinston coal ash spill)
	362.64	Mercury, PCBs, and chlordane from atmospheric deposition and contaminated sediments

Source: (Reference 2.3.3-4)

Table 2.3.3-2 (Sheet 1 of 2)
Maximum Concentrations for Quarterly Surface Water Samples at the CRN Site
(July 2013; March, May, November 2014; and February, April, and June, 2015)

Parameter	CRS8 Maximum	CRS9 Maximum	CRS10 Maximum	CRS12 Maximum	Most Stringent TDEC Numeric Criterion	Comments
Temperature, °C (°F)	24.5 (76.1)	22.3 (72.1)	24.5 (76.1)	26.8 (80.2)	30.5 (86.9)	
pH (SU)	6.4-7.7	6.6 - 7.7	6.1-7.0	6.3-7.3	6.0 - 9.0	
Oil and Grease (mg/L)	< 5.3	< 5.3	< 5.0	< 5.0	NANA	
Cyanide (mg/L)	< 0.005	< 0.005	< 0.005	< 0.005	0.0052	
T. Phenols (mg/L)	0.059	0.14	< 0.010	< 0.010	10	
BOD (mg/L)	< 5.0	< 5.0	< 2.0	8.85	NA	
TSS (mg/L)	< 5.0	4.6	13.4	4.4	NA	
Color (PC Units)	5.0	20	50	5.0	NA	
Bromide (mg/L)	< 1.0	< 1.0	0.10	0.10	NA	
Surfactants (mg/L)	< 0.20	0.20	< 0.20	< 0.20	NA	
TOC (mg/L)	13.1	13.0	13.2	18.1	NA	
Sulfide (mg/L)	< 0.10	< 0.10	< 0.10	< 0.10	NA	
Ammonia-N (mg/L)	0.21	< 0.10	< 0.10	< 0.10	1.24	Calculated for pH 8 and 25°C
Nitrate/Nitrite (mg/L)	1.5	1.1	0.47	0.49	10	
T. Organic Nitrogen (mg/L)	< 0.50	< 0.50	< 0.50	< 0.50	NA	
Total Kjeldahl Nitrogen (mg/L)	< 0.50	< 0.50	< 0.50	< 0.50	NA	
T. Phosphorus (mg/L)	< 0.10	< 0.10	< 0.050	< 0.050	NA	
COD (mg/L)	< 25	< 25	< 25	< 25	NA	
T. Fluoride (mg/L)	< 0.50	< 0.50	< 0.50	< 0.50	NA	
Sulfate (mg/L)	22.3	22.3	24.3	22.30	NA	
Metals (mg/L)						
T. Aluminum	0.121	0.172	0.747	0.0873	NA	
T. Magnesium	11.4	11.0	11.1	11.2	NA	
T. Calcium	39.1	38.9	37.7	38.8	NA	
T. Iron	0.191	0.232	0.149	0.164	NA	
T. Copper	< 0.0010	0.0010	0.0015	0.0011	0.009	Based on 100 mg/L TH
T. Zinc	< 0.010	0.010	< 0.0050	0.005	0.120	Based on 100 mg/L TH

Table 2.3.3-2 (Sheet 2 of 2)
Maximum Concentrations for Quarterly Surface Water Samples at the CRN Site
(July 2013; March, May, and November 2014; and February, April, and June, 2015)

Parameter	CRS8 Maximum	CRS9 Maximum	CRS10 Maximum	CRS12 Maximum	Most Stringent TDEC Numeric Criterion	Comments
T. Barium	0.0375	0.0372	0.0366	0.0384	2.0	
T. Boron	< 0.20	< 0.20	0.05	0.050	NA	
T. Cobalt	< 0.0010	0.0010	0.0010	0.0010	NA	
T. Manganese	0.0594	0.0436	0.895	0.060	NA	
T. Molybdenum	0.0010	< 0.0020	0.0010	0.0010	NA	
T. Tin	< 0.050	0.050	0.050	0.050	NA	
T. Titanium	< 0.010	< 0.010	< 0.010	< 0.010	NA	
T. Antimony	< 0.0010	0.0010	0.0010	0.0010	0.006	
T. Arsenic	< 0.0010	< 0.0010	< 0.0010	< 0.0010	0.010	
T. Beryllium	< 0.0010	0.0010	0.00010	0.00010	0.004	
T. Cadmium	< 0.00050	< 0.00050	0.00010	0.00010	0.00025	See note below
T. Chromium	0.0014	0.0010	0.0012	0.0010	0.011	Criterion for Cr_{+6}
T. Lead	0.0010	0.0010	0.0021	0.0010	0.003	
T. Mercury						
LL Mercury (ng/L)	0.934	0.5420	5.08	5.33	50	Based on 100 mg/L TH
T. Nickel	0.0010	0.0010	0.0010	0.0010	0.052	Based on 100 mg/L TH
T. Selenium	0.0010	0.0010	0.0010	0.0010	0.005	
T. Silver	< 0.00050	< 0.00050	0.00010	0.00010	0.0032	Based on 100 mg/L TH
T. Thallium	0.0010	0.0010	0.0010	0.0010	0.00024	Criterion is below RL
T. Hardness	143	143	140	143	NA	
Radioactivity						
Gross Alpha (ρCi/L)	<MDC	<MDC	<MDC	<MDC	NA	
Gross Beta (ρCi/L)	2.85 ± 1.05	<MDC	2.31 ± 1.11	<MDC	NA	
Total Alpha Radium (ρCi/L)	<MDC	<MDC			NA	
Radium 226 (ρCi/L)	<MDC	<MDC	<MDC	0.719 ± 0.217	NA	
Radium 228 (ρCi/L)	<MDC	<MDC	<MDC	<MDC	NA	

Source: (Reference 2.3.3-8)

Table 2.3.3-3 (Sheet 1 of 2)
Maximum Concentrations for Quarterly Stormwater Samples at the CRN Site
(July 2013, and March, May, and November 2014)

Parameter	CRS1 Maximum	CRS2 Maximum	CRS3 Maximum	CRS6 Maximum	CRS11 Maximum	Most Stringent TDEC Numeric Criterion	Comments
Temperature, °C (°F)	24.7 (76.5)	31.3 (88.3)	23.9 (75.0)	21.1 (70.0)	12.0 (53.6)	30.5 (86.9)	WQC apply in-stream
pH (SU)	6.8 - 7.3	6.7 - 8.1	6.7 - 7.6	6.8 - 7.3	6.7	6.0 - 9.0	
Oil and Grease (mg/L)	< 5.3	< 5.6	< 5.3	< 5.3	< 5.0	NA	
Cyanide (mg/L)	< 0.0050	< 0.0050	< 0.0050	< 0.0050	< 0.0050	0.0052	
T. Phenols (mg/L)	0.071	0.054	0.083	0.064	< 0.010	10	
BOD (mg/L)	< 5	< 5	< 5	< 5	< 2.0	NA	
TSS (mg/L)	26.2	69.8	114	77.1	5.7	NA	
Color (PC Units)	80	40	45	50	5.0	NA	
Bromide (mg/L)	< 1.0	< 1.0	< 1.0	2.0	0.10	NA	
Surfactants (mg/L)	0.14	< 2.0	0.13	0.16	< 0.20	NA	
TOC (mg/L)	26.5	37.0	21.9	24.2	11.0	NA	
Sulfide (mg/L)	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	NA	
Ammonia-N (mg/L)	0.12	0.13	< 0.10	< 0.10	< 0.10	1.24	For pH 8 and 25°C
Nitrate/Nitrite (mg/L)	0.48	0.95	0.24	0.25	0.027	10	
T. Organic Nitrogen (mg/L)	1.1	< 0.50	0.62	0.65	< 0.50	NA	
Total Kjeldahl Nitrogen (mg/L)	1.1	< 0.50	0.62	0.65	< 0.50	NA	
T. Phosphorus (mg/L)	0.11	0.11	0.23	0.13	< 0.050	NA	
COD (mg/L)	43.0	61.0	42.0	62.0	< 25.0	NA	
T. Fluoride (mg/L)	< 0.50	0.25	< 0.50	0.17	< 0.50	NA	
Sulfate (mg/L)	22.8	130	128	16.0	9.10	NA	
Metals (mg/L)							
T. Aluminum	0.531	1.37	2.18	1.77	0.0658	NA	
T. Magnesium	16.4	31	33.1	10.4	6.99	NA	
T. Calcium	59.2	52.2	87.3	76.5	23.2	NA	
T. Iron	0.702	1.8	2.88	1.84	1.98	NA	
T. Copper	0.0016	0.0024	0.0050	0.0021	0.0010	0.009	Based on 100 mg/L TH
T. Zinc	0.0075	0.0078	0.025	0.0115	0.0062	0.120	Based on 100 mg/L TH

Table 2.3.3-3 (Sheet 2 of 2)
Maximum Concentrations for Quarterly Stormwater Samples at the CRN Site
(July 2013, and March, May, and November 2014)

Parameter	CRS1 Maximum	CRS2 Maximum	CRS3 Maximum	CRS6 Maximum	CRS11 Maximum	Most Stringent TDEC Numeric Criterion	Comments
T. Barium	0.046	0.051	0.041	0.0815	0.0446	2.0	
T. Boron	< 0.20	< 0.20	< 0.20	< 0.20	0.050	NA	
T. Cobalt	0.0010	0.0010	0.005	0.0010	0.0019	NA	
T. Manganese	0.136	0.040	0.175	0.0655	0.884	NA	
T. Molybdenum	< 0.0020	< 0.0020	< 0.0020	0.0012	0.0010	NA	
T. Tin	0.050	0.050	0.050	0.050	0.050	NA	
T. Titanium	0.0197	0.0353	0.0369	0.0332	< 0.010	NA	
T. Antimony	0.0010	0.0010	0.0010	0.0010	0.0010	0.006	
T. Arsenic	0.0010	0.0010	0.0050	0.0015	< 0.0010	0.010	
T. Beryllium	< 0.0010	< 0.0010	0.00018	< 0.0010	0.00010	0.004	
T. Cadmium	< 0.00050	< 0.00050	< 0.00050	< 0.00050	0.00010	0.00025	
T. Chromium	0.0010	0.0019	0.005	0.0023	0.0010	0.011	Criterion for Cr+6
T. Lead	0.0010	0.0010	0.0030	0.0017	0.0010	0.0025	Based on 100 mg/L TH
T. Mercury					1.22		
LL Mercury (ng/L)	4.17	3.96	5.64	2.83	1.22	50	
T. Nickel	0.0010	0.0021	0.0050	0.0024	0.0012	0.052	Based on 100 mg/L TH
T. Selenium	0.0018	0.0010	0.0050	0.0033	0.0010	0.005	
T. Silver	< 0.00050	< 0.00050	0.00050	< 0.00050	0.00010	0.0032	Based on 100 mg/L TH
T. Thallium	0.0010	0.0010	0.0010	0.0010	0.001	0.00024	Criterion is below RL
T. Hardness	201	186	324	216	86.8	NA	
Radioactivity							
Gross Alpha (ρCi/L)	<MDC	<MDC	2.39 ± 1.21	1.50 ± 0.890	<MDC	NA	
Gross Beta (ρCi/L)	3.12 ± 1.41	2.18 ± 1.10	2.69 ± 1.20	2.85 ± 1.28	<MDC	NA	
Total Alpha Radium (ρCi/L)	<MDC	<MDC	<MDC	<MDC		NA	
Radium 226 (ρCi/L)	<MDC	<MDC	<MDC	<MDC	<MDC	NA	
Radium 228 (ρCi/L)	<MDC	<MDC	<MDC	<MDC	<MDC	NA	

Notes:
NA = Not applicable
Source: (Reference 2.3.3-8)

Table 2.3.3-4 (Sheet 1 of 3)
Analytical Results for Standard Water Quality Parameters and Chlorophyll a in Samples Collected Monthly March through December 2011 at CRM 15.5, 18.5, 19.7 and 22.0

Parameter			Alkalinity	Ammonia Nitrogen	Dissolved Solids	Hardness, Total (as CaCO3)	Kjeldahl Nitrogen, TKN	Nitrate-Nitrite	Phosphate,Ortho	Phosphorus,Total	Suspended Solids	Total Organic Carbon	Turbidity	Apparent Chlorophyll a	Corrected Chlorophyll a	Corrected Phaeo a
Units			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	µg/L	µg/L	µg/L
Reporting Limit			20	0.1	10	30	0.1	0.1	0.025	0.003	1.0	1.0	0.1	1.0	1.0	1.0
Location	**QC**	**Date**														
CRM 15.5		03/24/2011	120	<0.10	170	NM	<0.10	0.48	<0.025	0.005	2.8	1.4	4.9	1	<1.0	<1.0
		4/26/2011	120	<0.10	170	140	0.14	0.52	<0.025	0.01	6.5	3.6	7.5	2	1	1.4
		5/24/2011	110	---	170	140	0.41	0.6	<0.025	0.006	2.9	1.4	2.7	2	1	<1.0
		6/21/2011	110	0.17	160	140	0.33	0.47	<0.025	0.029	3	2.6	4.9	<1.0	<1.0	2
		7/18/2011	100	0.13	200	140	0.44	0.51	<0.025	0.015	3.4	1.3	4	2	1	<1.0
	T1	8/22/2011	100	0.11	200	140	0.49	0.58	<0.025	0.018	1.9	1.2	1.8	1	<1.0	<1.0
	T2	8/22/2011	110	<0.10	190	140	0.36	0.58	<0.025	0.016	2	1.2	1.9	2	<1.0	1.3
	T3	8/22/2011	110	<0.10	190	140	0.36	0.59	<0.025	0.016	2.4	1.2	2.1	2	1	1.2
		9/19/2011	95	0.11	160	140	0.37	0.49	<0.025	0.022	2	2.5	0.7	2	1	<1.0
		10/11/2011	110	0.16	160	150	0.38	0.35	<0.025	0.005	1.5	3.5	1.5	1	<1.0	<1.0
		11/10/2011	110	---	160	160	0.79	0.36	<0.025	0.01	2.2	3.2	3.5	1	1	<1.0
		12/13/2011	110	0.11	170	150	<0.10	0.56	<0.025	0.01	4	2.8	6.4	1	<1.0	<1.0
CRM 18.5		3/24/2011	130	0.15	170	NM	0.18	0.48	<0.025	0.012	8.4	1.5	12	2.0	1.0	1.4
		4/26/2011	120	<0.10	170	140	0.14	0.53	<0.025	0.006	11.0	3.3	8.0	2.0	2.0	<1.0
	T1	05/24/2011	110	<0.10	170	140	0.13	0.61	<0.025	0.005	1.8	1.4	1.6	1.0	1.0	<1.0
	T2	05/24/2011	110	0.11	150	140	0.13	0.61	<0.025	0.005	1.5	1.3	1.3	1.0	<1.0	<1.0
	T3	05/24/2011	110	<0.10	160	140	0.20	0.61	<0.025	<0.003	1.6	1.4	1.6	1.0	<1.0	<1.0
		6/21/2011	110	0.11	170	140	0.31	0.44	<0.025	0.018	2.5	1.4	3.4	1.0	<1.0	<1.0
		7/18/2011	100	---	200	140	0.71	0.53	<0.025	0.048	2.5	1.6	2.1	2.0	1.0	<1.0
		8/22/2011	110	0.14	190	140	0.42	0.61	<0.025	0.02	2.8	1.2	2.2	2.0	1.0	1.2

Table 2.3.3-4 (Sheet 2 of 3)
Analytical Results for Standard Water Quality Parameters and Chlorophyll a in Samples Collected Monthly March through December 2011 at CRM 15.5, 18.5, 19.7 and 22.0

Parameter			Alkalinity	Ammonia Nitrogen	Dissolved Solids	Hardness, Total (as CaCO3)	Kjeldahl Nitrogen, TKN	Nitrate-Nitrite	Phosphate,Ortho	Phosphorus,Total	Suspended Solids	Total Organic Carbon	Turbidity	Apparent Chlorophyll a	Corrected Chlorophyll a	Corrected Phaeo a
Units			**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**NTU**	**µg/L**	**µg/L**	**µg/L**
Reporting Limit			**20**	**0.1**	**10**	**30**	**0.1**	**0.1**	**0.025**	**0.003**	**1.0**	**1.0**	**0.1**	**1.0**	**1.0**	**1.0**
Location	**QC**	**Date**														
CRM 18.5 (cont'd)		9/19/2011	97	<0.10	160	130	0.34	0.54	<0.025	0.027	1.5	2.6	0.6	1.0	<1.0	<1.0
		10/11/2011	110	<0.10	160	150	0.31	0.34	<0.025	0.005	1.5	1.8	1.6	2.0	1.0	<1.0
		11/10/2011	120	0.12	160	150	0.25	0.35	<0.025	0.008	1.1	3.1	2.6	1.0	<1.0	<1.0
		12/13/2011	110	<0.10	180	140	<0.10	0.54	<0.025	0.010	3.5	2.2	9.8	<1.0	<1.0	<1.0
CRM 19.7		3/25/2011	130	<0.10	170	NM	<0.10	0.7	<0.025	<0.003	2.5	1.3	2.9	<1.0	<1.0	<1.0
		4/26/2011	120	<0.10	180	140	0.31	0.52	<0.025	<0.003	2.8	3.1	2.9	2.0	2.0	<1.0
		5/23/2011	110	---	170	140	0.12	0.5	<0.025	0.006	3.0	1.4	3.3	3.0	<1.0	6.5
		6/20/2011	100	0.17	160	140	<0.10	0.5	<0.025	0.010	3.4	1.8	2.9	2.0	2.0	<1.0
		7/19/2011	100	0.14	180	140	0.27	0.54	<0.025	0.021	1.2	1.4	1.7	1.0	1.0	<1.0
		8/22/2011	110	0.19	200	140	0.38	0.6	<0.025	0.03	4.5	1.2	5.6	3.0	2.0	2.3
		9/19/2011	97	<0.10	160	130	0.37	0.51	<0.025	0.024	1.7	2.7	0.7	2.0	1.0	<1.0
		10/11/2011	110	<0.10	170	150	0.35	0.36	<0.025	0.007	1.1	1.8	1.1	1.0	2.0	<1.0
		11/10/2011	110	0.11	160	150	0.28	0.34	<0.025	0.012	1.1	3.0	3.6	<1.0	<1.0	<1.0
		12/13/2011	110	<0.10	160	140	0.11	0.53	<0.025	0.011	3.1	2.0	7.5	1.0	<1.0	1.2
CRM 22.0		3/25/2011	130	<0.10	170	NM	0.11	0.66	<0.025	0.004	3.1	1.4	3.8	1.0	<1.0	<1.0
		4/26/2011	120	<0.10	170	140	0.38	0.53	<0.025	<0.003	2.2	2.9	2.8	2.0	2.0	<1.0
		5/23/2011	110	<0.10	170	130	0.15	0.49	<0.025	0.010	3.2	1.4	5.0	4.0	3.0	1.3
		6/20/2011	100	0.12	170	140	0.19	0.49	<0.025	0.010	2.0	2.1	2.1	2.0	2.0	<1.0
		7/19/2011	110	0.12	190	140	0.25	0.58	<0.025	0.015	1.9	1.3	2.1	2.0	1.0	<1.0
		8/22/2011	110	<0.10	200	150	0.34	0.57	<0.025	0.027	4.3	1.2	4.9	5.0	5.0	1.3

Table 2.3.3-4 (Sheet 3 of 3)
Analytical results for Standard Water Quality Parameters and Chlorophyll a in Samples Collected Monthly March through December 2011 at CRM 15.5, 18.5, 19.7 and 22.0

Parameter			Alkalinity	Ammonia Nitrogen	Dissolved Solids	Hardness, Total (as CaCO3)	Kjeldahl Nitrogen, TKN	Nitrate-Nitrite	Phosphate,Ortho	Phosphorus,Total	Suspended Solids	Total Organic Carbon	Turbidity	Apparent Chlorophyll a	Corrected Chlorophyll a	Corrected Phaeo a
Units			**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**NTU**	**µg/L**	**µg/L**	**µg/L**
Reporting Limit			**20**	**0.1**	**10**	**30**	**0.1**	**0.1**	**0.025**	**0.003**	**1.0**	**1.0**	**0.1**	**1.0**	**1.0**	**1.0**
Location	**QC**	**Date**														
CRM 22.0 (cont'd)		9/19/2011	96	0.11	160	130	0.41	0.52	<0.025	0.032	1.8	2.8	2.1	<1.0	<1.0	<1.0
		10/11/2011	110	<0.10	170	150	0.40	0.39	<0.025	0.014	1.2	2.4	1.1	1.0	1.0	<1.0
		11/10/2011	110	0.11	160	150	0.22	0.35	<0.025	0.018	1.2	2.6	1.9	1.0	1.0	<1.0
		12/13/2011	110	<0.10	170	150	0.14	0.52	<0.025	0.008	3.6	2.8	7.8	1.0	1.0	<1.0
Container Blank		5/25/2011	<20	<0.10	<10	<30	<0.10	<0.10	<0.025	<0.003	<1.0	<1.0	<0.1	NM	NM	NM
Container Blank		8/23/2011	<20	<0.10	<10	<30	<0.10	<0.10	<0.025	<0.003	<1.0	<1.0	0.2	NM	NM	NM

Notes:
T1, T2, and T3 are Triplicate Samples that are three distinct samples, each collected separately and in the same manner.
Container Blanks are sample containers filled with deionized (DI) water directly from the DI system.
NM = Not Measured.
Symbol (---) = Non-reportable results.

Source: (Reference 2.3.3-8)

Table 2.3.3-5 (Sheet 1 of 2)
Concentrations of Total and Dissolved Metals in Water Samples Collected Bi-Monthly April through December 2011 at CRM 15.5, 18.5, 19.7 and 22.0[1]

Metals, Total and Dissolved (µg/IL)			Aluminum	Aluminum, Dissolved	Arsenic	Arsenic, Dissolved	Cadmium	Cadmium, Dissolved	Calcium	Chromium	Chromium, Dissolved	Copper	Copper, Dissolved	Iron	Iron, Dissolved
Method Reporting Limit			100	100	1.0	1.0	0.5	0.5	500	2.0	2.0	2.0	1.0/ 2.0	100	100
Location	QC	Date													
CRM 15.5		4/26/2011	800	<100	<1.0	<1.0	<0.5	<0.5	33000	<2.0	<2.0	<2.0	<1.0	610	<100
		6/21/2011	290	<100	<1.0	<1.0	<0.5	<0.5	33000	<2.0	<2.0	<2.0	2.2 DT	170	<100
	T1	8/22/2011	<100	<100	<1.0	<1.0	<0.5	<0.5	36000	<2.0	<2.0	<2.0	<2.0	<100	<100
	T2	8/22/2011	<100	<100	1.1	<1.0	<0.5	<0.5	37000	<2.0	<2.0	<2.0	<2.0	<100	<100
	T3	8/22/2011	<100	<100	1.0	<1.0	<0.5	<0.5	36000	<2.0	<2.0	<2.0	<2.0	<100	<100
		10/11/2011	<100	<100	<1.0	<1.0	<0.5	<0.5	38000	<2.0	<2.0	<2.0	---	<100	<100
		12/13/2011	170	<100	<1.0	<1.0	<0.5	<0.5	36000	<2.0	<2.0	<2.0	<2.0	230	<100
CRM 18.5		4/26/2011	680	<100	<1.0	<1.0	<0.5	<0.5	33000	<2.0	<2.0	<2.0	<1.0	480	<100
		6/21/2011	170	<100	<1.0	<1.0	<0.5	<0.5	33000	<2.0	<2.0	<2.0	<2.0	<100	<100
		8/22/2011	<100	<100	1.1	<1.0	<0.5	<0.5	35000	<2.0	<2.0	<2.0	<2.0	<100	<100
		10/11/2011	<100	150 DT	<1.0	<1.0	<0.5	<0.5	37000	<2.0	<2.0	<2.0	---	<100	<100
		12/13/2011	180	<100	<1.0	<1.0	<0.5	<0.5	36000	<2.0	<2.0	<2.0	<2.0	200	<100
CRM 19.7		4/26/2011	<100	<100	<1.0	<1.0	<0.5	<0.5	33000	<2.0	<2.0	<2.0	<1.0	120	<100
		6/20/2011	120	<100	<1.0	<1.0	<0.5	<0.5	34000	<2.0	<2.0	<2.0	<2.0	110	<100
		8/22/2011	150	<100	1.1	<1.0	<0.5	<0.5	36000	<2.0	<2.0	<2.0	<2.0	150	<100
		10/11/2011	<100	<100	<1.0	<1.0	<0.5	<0.5	37000	<2.0	<2.0	<2.0	---	<100	<100
		12/13/2011	170	<100	<1.0	<1.0	<0.5	<0.5	35000	<2.0	<2.0	<2.0	<2.0	130	<100
CRM 22.0		4/26/2011	140	<100	<1.0	<1.0	<0.5	<0.5	33000	<2.0	<2.0	<2.0	<1.0	130	<100
		6/20/2011	110	<100	<1.0	<1.0	<0.5	<0.5	34000	<2.0	<2.0	<2.0	<2.0	<100	<100
		8/22/2011	110	<100	<1.0	<1.0	<0.5	<0.5	37000	<2.0	<2.0	<2.0	<2.0	100	<100
		10/11/2011	<100	<100	<1.0	<1.0	<0.5	<0.5	37000	<2.0	<2.0	<2.0	---	<100	<100
		12/13/2011	180	<100	<1.0	<1.0	<0.5	<0.5	36000	<2.0	<2.0	<2.0	<2.0	140	<100
Container Blank		08/23/2011	<100	<100	<1.0	<1.0	<0.5	<0.5	<500	<2.0	<2.0	<2.0	<2.0	<100	<100

Table 2.3.3-5 (Sheet 2 of 2)
Concentrations of Total and Dissolved Metals in Water Samples Collected Bi-Monthly April through December 2011 at CRM 15.5, 18.5, 19.7 and 22.0[1]

Metals, Total and Dissolved (µg/IL)			Lead	Lead, Dissolved	Magnesium	Magnesium, Dissolved	Manganese	Manganese, Dissolved	Nickel	Nickel, Dissolved	Selenium	Selenium, Dissolved	Zinc	Zinc, Dissolved
Method Reporting Limit			**1.0**	**1.0**	**100**	**100**	**10**	**10**	**1.0**	**1.0**	**1.0**	**1.0**	**10**	**10.0**
Location	**QC**	**Date**												
CRM 15.5		4/26/2011	<1.0	<1.0	11000	9900	58	<10	1.3	2.5 DT	<1.0	<1.0	<10	<10
		6/21/2011	8.6	<1.0	10000	11000	29	10	1.0	<1.0	<1.0	<1.0	<10	<10
	T1	8/22/2011	<1.0	<1.0	10000	10000	33	<10	3.1	<1.0	<1.0	<1.0	<10	<10
	T2	8/22/2011	<1.0	<1.0	11000	11000	20	<10	1.1	<1.0	<1.0	<1.0	<10	<10
	T3	8/22/2011	<1.0	<1.0	11000	11000	21	<10	1.4	1.0	<1.0	<1.0	<10	<10
		10/11/2011	<1.0	<1.0	10000	11000	15	42 DT	<1.0	<1.0	<1.0	<1.0	<10	<10
		12/13/2011	<1.0	<1.0	11000	11000	48	<10	<1.0	<1.0	<1.0	<1.0	<10	<10
CRM 18.5		4/26/2011	<1.0	<1.0	10000	10000	42	<10	1.1	1.9 DT	<1.0	<1.0	<10	<10
		6/21/2011	1.4	<1.0	10000	11000	20	<10	1.1	1.1	<1.0	<1.0	<10	<10
		8/22/2011	<1.0	<1.0	10000	10000	31	<10	<1.0	<1.0	<1.0	<1.0	<10	<10
		10/11/2011	<1.0	<1.0	10000	12000	14	<10	<1.0	<1.0	<1.0	<1.0	<10	<10
		12/13/2011	<1.0	<1.0	11000	11000	47	<10	<1.0	<1.0	<1.0	<1.0	<10	<10
CRM 19.7		4/26/2011	<1.0	<1.0	10000	10000	12	<10	<1.0	1.8 DT	<1.0	<1.0	<10	<10
		6/20/2011	<1.0	<1.0	11000	11000	29	<10	<1.0	<1.0	<1.0	<1.0	<10	<10
		8/22/2011	<1.0	1.3 DT	11000	11000	52	<10	1.3	<1.0	<1.0	<1.0	<10	<10
		10/11/2011	<1.0	<1.0	10000	11000	12	<10	<1.0	<1.0	<1.0	<1.0	<10	<10
		12/13/2011	<1.0	<1.0	11000	11000	40	<10	<1.0	<1.0	<1.0	<1.0	<10	<10
CRM 22.0		4/26/2011	<1.0	<1.0	10000	10000	14	<10	1.3	1.9 DT	<1.0	<1.0	<10	<10
		6/20/2011	<1.0	<1.0	11000	11000	24	<10	<1.0	<1.0	<1.0	<1.0	<10	<10
		8/22/2011	<1.0	1.5 DT	10000	11000	46	<10	2.3	<1.0	<1.0	<1.0	<10	<10
		10/11/2011	<1.0	<1.0	11000	12000	17	<10	<1.0	<1.0	<1.0	<1.0	<10	<10
		12/13/2011	<1.0	<1.0	11000	11000	47	<10	<1.0	<1.0	<1.0	<1.0	<10	<10
Container Blank		08/23/2011	<1.0	1.3 DT	<100	<100	**0**	<10	<1.0	<1.0	<1.0	<1.0	<10	<10

[1] Metals samples were not collected during November 2012 to September 2013

Notes: DT= Dissolved fraction exceeded the total recoverable metal concentration. Symbol (---) = Non-reportable results

Source: (Reference 2.3.3-8)

Table 2.3.3-6
Maximum Concentrations of Selected Metals in Water Samples Collected at CRM 15.5, 18.5, 19.7, and 22.0 and Respective Water Quality Criteria for the Protection of Fish and Aquatic Life

State Criteria[1]	Metal	Water Quality Criteria		Maximum Concentration (µg/l)			
		Acute[2] (µg/l)	Chronic[3] (µg/l)	CRM 15.5	CRM 18.5	CRM 19.7	CRM 22.0
West Virginia	Aluminum[4]	750	750	<100	150 DT	<100	<100
Tennessee	Arsenic (III)[4]	340	150	<1.0	<1.0	<1.0	<1.0
	Cadmium[5]	2.60	0.30	<0.5	<0.5	<0.5	<0.5
	Chromium (III)[5]	706	92	<2.0	<2.0	<2.0	<2.0
	Copper[5]	17	11.2	2.2 DT	<2.0	<2.0	<2.0
	Lead[5]	86	3.3	<1.0	<1.0	1.3 DT	1.5 DT
	Nickel[5]	585	65	2.5 DT	1.9 DT	1.8 DT	1.9 DT
	Selenium[6]	20	5	<1.0	<1.0	<1.0	<1.0
	Zinc[5]	146	140	<10	<10	<10	<10

1 The State of West Virginia’s criteria for aluminum was used for comparison. The State of Tennessee has not promulgated criteria for aluminum.
2 The acute exposure limit is a one hour average concentration which is not to be exceeded more than once every three years on the average.
3 The chronic exposure limit is a four day average concentration which is not to be exceeded more than once every three years on the average.
4 Criteria for these metals are expressed as dissolved.
5 Criteria for these metals are expressed as dissolved and are a function of total hardness (130 mg/L).
6 Criteria are expressed in terms of total recoverable metal.

Note:
DT = Dissolved fraction exceeded the total recoverable metal concentration in the sample.

Source: (Reference 2.3.3-8)

Table 2.3.3-7 (Sheet 1 of 2)
Pesticide and PCB Concentrations in Sediments Collected at CRM's 15.5, 18.5, and 22.0 in 2011 and at Far-Field Locations (CRM 24.5, TRM 560.8, and TRM 532.5) in 2010 and 2011

					Organochlorine Pesticides and PCB's (ug/kg dry weight)											
					(EPA 8081A)				(EPA Method 8082)							
									Polychlorinated Biphenyls (PCB's)							
			METHOD													
	Reservoir	Mile No.	Replicate	Collection Date	ENDRIN ALDEHYDE	HEPTACHLOR	HEPTACHLOR EPOXIDE	METHOXYCHLOR	1016	1221	1232	1242	1248	1254	1260	TOTAL
Clinch SMR	Watts Bar	CRM 15.5	1	06/21/2011	< 10	< 10	< 10	< 10	< 25	< 25	< 25	< 25	< 25	< 25	< 25	< 25
	Watts Bar	CRM 15.5	2	6/21/2011	< 10	< 10	< 10	< 10	< 25	< 25	< 25	< 25	< 25	< 25	< 25	< 25
	Watts Bar	CRM 18.5	1	6/21/2011	< 10	< 10	< 10	< 10	< 25	< 25	< 25	< 25	< 25	< 25	< 25	< 25
	Watts Bar	CRM 22.0	1	6/21/2011	< 10	< 10	< 10	< 10	< 25	< 25	< 25	< 25	< 25	< 25	< 25	< 25
Far-field	Melton Hill	CRM 24.0	1	6/21/2011	< 10	< 10	< 10	< 10	< 25	< 25	< 25	310	< 25	< 25	< 25	310
	Melton Hill	CRM 24.0	1	6/8/2011	< 10	< 10	< 10	< 10	< 25	< 25	< 25	72	< 25	< 25	< 25	72
	Watts Bar	TRM 532.5	1	6/15/2010	< 10	< 10	< 10	< 10	< 25	< 25	< 25	160	< 25	< 25	< 25	160
	Watts Bar	TRM 532.5	2	6/15/2010	< 10	< 10	< 10	< 10	< 25	< 25	< 25	150	< 25	< 25	< 25	150
	Watts Bar	TRM 532.5	1	6/16/2010	< 10	< 10	< 10	< 10	< 25	< 25	< 25	77	< 25	< 25	< 25	77
	Watts Bar	TRM 560.8	1	6/15/2010	< 10	< 10	< 10	< 10	< 25	< 25	< 25	110	< 25	< 25	< 25	110
	Watts Bar	TRM 560.8	2	6/15/2010	< 10	< 10	< 10	< 10	< 25	< 25	< 25	140	< 25	< 25	< 25	140
	Watts Bar	TRM 560.8	1	6/16/2011	< 10	< 10	< 10	< 10	< 25	< 25	< 25	57	< 25	< 25	< 25	57

Table 2.3.3-7 (Sheet 2 of 2)
Pesticide and PCB Concentrations in Sediments Collected at CRM's 15.5, 18.5, and 22.0 in 2011 and at Far-Field Locations (CRM 24.5, TRM 560.8, and TRM 532.5) in 2010 and 2011

	METHOD				Organochlorine Pesticides and PCB's (ug/kg dry weight) (EPA Method 8081A)														
							Benzene Hexachloride (BHC)						DDT's			Endosulfan			
	Reservoir	Mile No.	Replicate	Collection Date	TOXAPHENE	ALDRIN	ALPHA	BETA	DELTA	GAMMA	CHLORDANE	DIELDRIN	P,P DDD	P,P DDE	P,P DDT	ALPHA	BETA	SULPHATE	ENDRIN
Clinch SMR	Watts Bar	CRM 15.5	1	06/21/2011	< 500	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
	Watts Bar	CRM 15.5	2	6/21/2011	< 500	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
	Watts Bar	CRM 18.5	1	6/21/2011	< 500	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
	Watts Bar	CRM 22.0	1	6/21/2011	< 500	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Far-field	Melton Hill	CRM 24.0	1	6/21/2011	< 500	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
	Melton Hill	CRM 24.0	1	6/8/2011	< 500	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
	Watts Bar	TRM 532.5	1	6/15/2010	< 500	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
	Watts Bar	TRM 532.5	2	6/15/2010	< 500	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
	Watts Bar	TRM 532.5	1	6/16/2010	< 500	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
	Watts Bar	TRM 560.8	1	6/15/2010	< 500	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
	Watts Bar	TRM 560.8	2	6/15/2010	< 500	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
	Watts Bar	TRM 560.8	1	6/16/2011	< 500	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10

Source: (Reference 2.3.3-8)

Table 2.3.3-8
Metals Concentrations in Sediments Collected at CRM's 15.5, 18.5, and 22.0 in 2011 and at Far-Field Locations (CRM 24.5, TRM 560.8, and TRM 532.5) in 2010 and 2011

					Metals (mg/kg, dry weight)												
		METHOD			(EPA 6010)	(EPA 7060)	(EPA 6010)								(EPA 7471)	(EPA 7060)	
	Reservoir	River Mile No.	Replicate	Collection Date	ALUMINUM	ARSENIC	CADMIUM	CALCIUM	CHROMIUM	COPPER	IRON	LEAD	MAGNESIUM	MANGANESE	MERCURY	NICKEL	ZINC
Clinch SMR	Watts Bar	CRM 15.5	1	06/21/2011	4300	1.5	< 0.50	810	7.6	3.1	6500	5.9	650	430	< 0.10	5.7	22
Clinch SMR	Watts Bar	CRM 15.5	2	6/21/2011	4800	1.6	< 0.50	1100	12	3.8	7400	6.2	720	480	< 0.10	7.8	24
Clinch SMR	Watts Bar	CRM 18.5	1	6/21/2011	10000	6.2	< 0.50	2900	18	8.7	14000	16	1400	1500	< 0.10	14	51
Clinch SMR	Watts Bar	CRM 22.0	1	6/21/2011	11000	4.7	< 0.50	2200	14	8.1	15000	16	1400	1100	< 0.10	12	50
Far-field	Melton Hill	CRM 24.0	1	6/21/2011	31000	15	< 0.50	24000	32	41	35000	29	4500	3742	0.1	31	110
Far-field	Melton Hill	CRM 24.0	1	6/8/2011	35000	20	< 0.50	20000	31	38	39000	27	3100	3600	0.11	29	120
Far-field	Watts Bar	TRM 532.5	1	6/15/2010	43000	18	< 0.50	3500	41	41	45000	28	4100	3100	0.43	33	160
Far-field	Watts Bar	TRM 532.5	2	6/15/2010	44000	18	< 0.50	3600	41	41	46000	28	4100	3100	0.42	32	160
Far-field	Watts Bar	TRM 532.5	1	6/16/2011	43000	20	0.58	3500	49	51	46000	35	3600	2900	0.31	42	160
Far-field	Watts Bar	TRM 560.8	1	6/15/2010	37000	23	< 0.50	4200	38	46	37000	28	3800	2600	0.47	34	150
Far-field	Watts Bar	TRM 560.8	2	6/15/2010	38000	24	< 0.50	4000	38	47	37000	28	3700	2700	0.49	34	150
Far-field	Watts Bar	TRM 560.8	1	6/16/2011	37000	22	0.71	3800	39	56	41000	34	3500	2900	0.42	39	160
EPA Region 4 Ecological Screening Values (ESV) for Sediment (2001)[1]					NA	7.24	1	NA	52.3	18.7	NA	30.2	NA	NA	0.13	15.9	124

[1] EPA ecological screening values for metals in sediments are provided as a reference only. Since these numbers are based on conservative endpoints and sensitive ecological effects data, they represent a preliminary screening of site contaminant levels. Concentrations that exceed these values are not necessarily above expected background levels for a given region or area.

Source: (Reference 2.3.3-8)

Table 2.3.3-9
Field Geochemical Results

Well Number	Date	Geologic Unit Formation	pH (standard units)	Specific Conductance (µS/cm)1	Turbidity (NTU)	Dissolved Oxygen (ppm)	Temperature, °C (°F)[2]	REDOX (□mv)	Purge Water Appearance
OW-101L	11/19/2013	Chickamauga Rockdell	7.17	620	3.86	0.05	16.5 (61.7)	-152.5	Clear, faint sulfur odor
OW-202L[3]	11/19/2013	Chickamauga Fleanor Member	9.58	978	193.00	5.16	17.0 (62.6)	-116.9	Red, purged dry
OW-401L	11/21/2013	Knox Newala	7.78	340	14.30	4.21	19.5 (67.1)	9.7	Clear
OW-409U	11/19/2013	Chickamauga Rockdell	7.10	672	49.70	45.30[4]	17.2 (63.0)	186.2	Clear
OW-409L	11/18/2013	Chickamauga Rockdell	7.80	849	25.20	3.31	16.0 (60.8)	30.5	Clear
OW-415U	11/20/2013	Chickamauga Bowen/Benbolt	7.24	598	122.00	3.61	17.3 (63.1)	75.7	Clear to slightly cloudy
OW-416L	11/21/2013	Chickamauga Rockdell	7.04	694	1.07	0.25	17.4 (63.3)	-188.1	Clear, sulfur odor
OW-417L	11/21/2013	Chickamauga Fleanor Member	7.21	609	2.55	1.51	16.3 (61.3)	53.4	Clear
OW-418U	11/19/2013	Chickamauga Eidson Member	7.47	517	2.84	1.18	18.8 (65.8)	119.8	Clear
OW-419U	11/20/2013	Knox Newala	6.97	532	1.27	1.15	16.3 (61.3)	63.0	Clear
OW-420L	11/22/2013	Knox Newala	7.56	472	69.90	9.21	17.7 (63.9)	57.5	Clear
OW-421L	11/22/2013	Chickamauga/Knox Blackford/Newala	8.00	400	17.50	8.53	17.0 (62.6)	44.3	Clear
OW-423U	11/19/2013	Chickamauga Eidson Member	6.99	599	5.82	4.70	16.7 (62.1)	90.6	Clear

1 Specific Conductance in mS/cm converted to Specific Conductance in µS/cm by multiplying by 1000
2 Values rounded to the nearest 0.1°C and the nearest 0.1°F
3 Well purged dry; insufficient water for field parameter testing at time of sampling. Values are last before purged dry.
4 Suspect results – concentration in excess of maximum oxygen saturation value.

Notes: Adapted from (Reference 2.3.3-15) Table 3.2

Table 2.3.3-10 (Sheet 1 of 5)
Laboratory Geochemical Results

Well Number	Date	Geologic Unit Formation	Water Type	Analytical Error[1] %	Nitrate as N ppm	Qualifier[2]	Nitrite as N ppm	Qualifier[2]	Fluoride ppm	Qualifier[2]	Chloride ppm	Qualifier[2]	Bromide ppm	Qualifier[2]
OW-101L	11/19/2013	Chickamauga Rockdell	Calcium-Bicarbonate	12	0.0054	JQ	<0.020	U	0.22		2.1		0.038	JQ
OW-101L Dup	11/19/2013	Chickamauga Rockdell	Calcium-Bicarbonate	3	0.0099	JQ	<0.020	U	0.19		2.1		0.04	JQ
OW-202L	11/22/2013	Chickamauga Fleanor Member	Sodium-Bicarbonate	-3.2	0.028		<0.020	UL	7.4		24		0.17	JQ
OW-401L	11/21/2013	Knox Newala	Calcium-Bicarbonate	1.4	0.15		<0.020	UL	0.20	JH	1.4		<0.25	U
OW-409U	11/19/2013	Chickamauga Rockdell	Calcium-Bicarbonate	12	0.88		<0.020	UL	0.25		1.8		<0.25	U
OW-409L	11/19/2013	Chickamauga Rockdell	Sodium-Bicarbonate	1.1	0.12		0.0052	JQ	0.37		2.2		<0.25	U
OW-415U	11/20/2013	Chickamauga Bowen/Benbolt	Calcium-Bicarbonate	16	0.90		<0.020	UL	0.13		8.8		0.053	JQ
OW-416L	11/21/2013	Chickamauga Rockdell	Calcium-Bicarbonate	-1.7	0.20		<0.020	U	0.39		7.6		0.071	JQ
OW-417L	11/21/2013	Chickamauga Fleanor Member	Calcium-Bicarbonate	-0.76	<0.020	U	<0.020	U	0.18		2.8		0.048	JQ
OW-418U	11/20/2013	Chickamauga Eidson Member	Calcium-Bicarbonate	0.019	0.68		<0.020	U	0.3		2.7		<0.25	U
OW-419U	11/20/2013	Knox Newala	Calcium-Bicarbonate	2.0	0.43		<0.020	U	0.16		1.3		<0.25	U
OW-420L	11/22/2013	Knox Newala	Calcium-Bicarbonate	2.1	0.36	J	<0.020	UL	0.31	JH	2.1	J	<0.25	U
OW-420L Dup	11/22/2013	Knox Newala	Calcium-Bicarbonate	-0.019	0.25	J	<0.020	UL	0.35		2.6	J	<0.25	U
OW-421L	11/22/2013	Chickamauga/Knox Blackford/Newala	Magnesium-Bicarbonate	3.9	1.6		<0.020	UL	0.58		2.6		<0.25	U
OW-423U	11/19/2013	Chickamauga Eidson Member	Calcium-Bicarbonate	4.1	0.14		<0.020	U	0.090	JQ	2.7		<0.25	U

Table 2.3.3-10 (Sheet 2 of 5)
Laboratory Geochemical Results

Well Number	Date	Geologic Unit Formation	Water Type	Analytical Error[1] %	Sulfate ppm	Bicarbonate ppm[3]	Total Alkalinity ppm as $CaCO_3$	Bicarbonate Alkalinity ppm as $CaCO_3$	Carbonate Alkalinity ppm as $CaCO_3$	Qualifier[2]
OW-101L	11/19/2013	Chickamauga Rockdell	Calcium-Bicarbonate	12	42	366	300	300	<5.0	U
OW-101L Dup	11/19/2013	Chickamauga Rockdell	Calcium-Bicarbonate	3	43	354	290	290	<5.0	U
OW-202L	11/22/2013	Chickamauga Fleanor Member	Sodium-Bicarbonate	-3.2	93	732[(4)]	680	600	78	
OW-401L	11/21/2013	Knox Newala	Calcium-Bicarbonate	1.4	6.9	219	180	180	<5.0	U
OW-409U	11/19/2013	Chickamauga Rockdell	Calcium-Bicarbonate	12	83	329	270	270	<5.0	U
OW-409L	11/19/2013	Chickamauga Rockdell	Sodium-Bicarbonate	1.1	150	366	300	300	<5.0	U
OW-415U	11/20/2013	Chickamauga Bowen/Benbolt	Calcium-Bicarbonate	16	36	329	270	270	<5.0	U
OW-416L	11/21/2013	Chickamauga Rockdell	Calcium-Bicarbonate	-1.7	63	366	300	300	<5.0	U
OW-417L	11/21/2013	Chickamauga Fleanor Member	Calcium-Bicarbonate	-0.76	13	390	320	320	<5.0	U
OW-418U	11/20/2013	Chickamauga Eidson Member	Calcium-Bicarbonate	0.019	20	329	270	270	<5.0	U
OW-419U	11/20/2013	Knox Newala	Calcium-Bicarbonate	2.0	17	329	270	270	<5.0	U
OW-420L	11/22/2013	Knox Newala	Calcium-Bicarbonate	2.1	14	280	230	230	<5.0	U
OW-420L Dup	11/22/2013	Knox Newala	Calcium-Bicarbonate	-0.019	15	293	240	240	<5.0	U
OW-421L	11/22/2013	Chickamauga/Knox Blackford/Newala	Magnesium-Bicarbonate	3.9	8.3	256	210	210	<5.0	U
OW-423U	11/19/2013	Chickamauga Eidson Member	Calcium-Bicarbonate	4.1	24	354	290	290	<5.0	U

Table 2.3.3-10 (Sheet 3 of 5)
Laboratory Geochemical Results

Well Number	Date	Geologic Unit Formation	Water Type	Analytical Error[1] %	Ammonia ppm	Qualifier[2]	Total Dissolved Solids ppm	Calcium ppm	Qualifier[2]	Iron ppm	Qualifier[2]
OW-101L	11/19/2013	Chickamauga Rockdell	Calcium-Bicarbonate	12	0.31	J	370	130	J	0.33	
OW-101L Dup	11/19/2013	Chickamauga Rockdell	Calcium-Bicarbonate	3	0.35	J	370	99	J	0.31	
OW-202L	11/22/2013	Chickamauga Fleanor Member	Sodium-Bicarbonate	-3.2	0.58	J	1100	23		19	
OW-401L	11/21/2013	Knox Newala	Calcium-Bicarbonate	1.4	0.140	J	190	40		0.14	
OW-409U	11/19/2013	Chickamauga Rockdell	Calcium-Bicarbonate	12	0.099	J	410	140		0.22	
OW-409L	11/19/2013	Chickamauga Rockdell	Sodium-Bicarbonate	1.1	0.710	J	520	46		0.068	
OW-415U	11/20/2013	Chickamauga Bowen/Benbolt	Calcium-Bicarbonate	16	0.140	J	370	150		0.39	
OW-416L	11/21/2013	Chickamauga Rockdell	Calcium-Bicarbonate	-1.7	0.120	J	420	99		0.072	
OW-417L	11/21/2013	Chickamauga Fleanor Member	Calcium-Bicarbonate	-0.76	0.140	J	340	61		0.041	JQ
OW-418U	11/20/2013	Chickamauga Eidson Member	Calcium-Bicarbonate	0.019	0.059	J	300	52		0.055	
OW-419U	11/20/2013	Knox Newala	Calcium-Bicarbonate	2.0	0.140	J	290	72		0.023	JQ
OW-420L	11/22/2013	Knox Newala	Calcium-Bicarbonate	2.1	0.110	J	270	59		0.25	
OW-420L Dup	11/22/2013	Knox Newala	Calcium-Bicarbonate	-0.019	0.140	J	280	59		0.29	
OW-421L	11/22/2013	Chickamauga/Knox Blackford/Newala	Magnesium-Bicarbonate	3.9	<0.050	UL	230	38		0.23	
OW-423U	11/19/2013	Chickamauga Eidson Member	Calcium-Bicarbonate	4.1	0.083	J	340	99		0.076	

Table 2.3.3-10 (Sheet 4 of 5)
Laboratory Geochemical Results

Well Number	Date	Geologic Unit Formation	Water Type	Analytical Error[1] %	Potassium ppm	Magnesium ppm	Manganese ppm	Sodium ppm	Silicon ppm	Silica ppm
OW-101L	11/19/2013	Chickamauga Rockdell	Calcium-Bicarbonate	12	2.1	23	0.05	7.8	3.9	8.3
OW-101L Dup	11/19/2013	Chickamauga Rockdell	Calcium-Bicarbonate	3	2.1	22	0.048	7.6	4.2	9
OW-202L	11/22/2013	Chickamauga Fleanor Member	Sodium-Bicarbonate	-3.2	14	9.9	0.16	280	82	170
OW-401L	11/21/2013	Knox Newala	Calcium-Bicarbonate	1.4	1.8	22	0.008	0.91	4.7	10
OW-409U	11/19/2013	Chickamauga Rockdell	Calcium-Bicarbonate	12	1.2	23	0.011	4.8	7.6	16
OW-409L	11/19/2013	Chickamauga Rockdell	Sodium-Bicarbonate	1.1	8.1	31	0.017	99	4.6	9.9
OW-415U	11/20/2013	Chickamauga Bowen/Benbolt	Calcium-Bicarbonate	16	2.4	13	0.046	5.2	7.6	16
OW-416L	11/21/2013	Chickamauga Rockdell	Calcium-Bicarbonate	-1.7	0.77	13	0.020	29	5	11
OW-417L	11/21/2013	Chickamauga Fleanor Member	Calcium-Bicarbonate	-0.76	3.4	31	0.021	22	6.1	13
OW-418U	11/20/2013	Chickamauga Eidson Member	Calcium-Bicarbonate	0.019	2.7	19	0.0037	40	8.7	19
OW-419U	11/20/2013	Knox Newala	Calcium-Bicarbonate	2.0	1.5	29	0.0023	0.91	3.2	6.8
OW-420L	11/22/2013	Knox Newala	Calcium-Bicarbonate	2.1	1.8	26	0.033	1.2	4.2	9
OW-420L Dup	11/22/2013	Knox Newala	Calcium-Bicarbonate	-0.019	1.9	26	0.032	1.3	4.4	9.4
OW-421L	11/22/2013	Chickamauga/Knox Blackford/Newala	Magnesium-Bicarbonate	3.9	12	27	0.01	12	6	13
OW-423U	11/19/2013	Chickamauga Eidson Member	Calcium-Bicarbonate	4.1	1.3	19	0.051	8.7	7.2	15

Table 2.3.3-10 (Sheet 5 of 5)
Laboratory Geochemical Results

[1] Analytical error is the difference between the sum of the cations and the sum of the anions divided by the sum of the anions and cations and multiplied by 100% (the anion and cation concentrations are in milliequivalents per liter). The analytical error represents the charge balance error of the analysis.

[2] Data Qualifier Definitions:

- J = Estimated quantitation based on associated QC data
- JQ = Estimated quantitation; value is between the reporting limit and the detection limit
- JH = Estimated quantitation; possibly biased high based on QC data
- U = Undetected
- UL = Undetected; data biased low: the reporting detection limit is higher than indicated

[3] Bicarbonate concentration determined by dividing the Bicarbonate Alkalinity by 0.8202 (Reference 2.3.3-20)

[4] Bicarbonate concentration is suspect due to high sample pH (pH = 9.58)

Notes:
Dup = Duplicate sample
Data adapted from (Reference 2.3.3-15) Table 5.13

Table 2.3.3-11
Baseline Range of Field Parameters for Groundwater

Baseline Groundwater Conditions	Minimum	Maximum
Temperature, degrees C (degrees F)	8.36 (47.05)	24.44 (75.99)
Oxidation reduction potential (mV)	-19	478
Specific Conductance, Field (umhos/cm)	72.36	4723.2
Oxygen, dissolved (mg/L)	0	13
pH, Field (pH)	5.3	9.7
Turbidity, Field (NTU)	0.9	114

Source: (Reference 2.3.3-18)

Table 2.3.3-12 (Sheet 1 of 2)
Detailed Summary - Baseline Range of Field Parameters for Groundwater

Baseline Groundwater Conditions	Minimum of Temperature, °C (°F)	Maximum of Temperature, °C (°F)	Minimum of Oxidation reduction potential (mV)	Maximum of Oxidation reduction potential (mV)	Minimum of Specific Conductance, Field (umhos/cm)	Maximum of Specific Conductance, Field (umhos/cm)
Winter 2013						
Upper	8.79 (47.82)	16.23 (61.21)	166	478	341.9	938.1
Lower	8.36 (47.05)	13.7 (56.66)	-19	471	72.36	4425
Deep	11.34 (52.41)	24.1 (75.38)	55	331	414.1	808.3
Spring 2014						
Upper	12.03 (53.65)	17 (62.60)	75	414	363	890
Lower	13.19 (55.74)	18.2 (64.76)	47	364	406.1	4338
Deep	15.16 (59.29)	22.37 (72.27)	11	294	408	866.2
Summer 2014						
Upper	16.4 (61.52)	24.1 (75.38)	158	469	369	897.7
Lower	17.48 (63.46)	24.44 (75.99)	67	441	109.3	4723.2
Deep	20.74 (69.33)	22 (71.60)	105	255	446	830
Fall 2014						
Upper	11.7 (53.06)	17.52 (63.54)	138	418	356	870.9
Lower	14 (57.20)	18.3 (64.94)	36	433	392	4651
Deep	12.64 (54.75)	16.45 (61.61)	9	391	405	731.6
All Samples	8.36 (47.05)	24.44 (75.99)	-19	478	72.36	4723.2

Table 2.3.3-12 (Sheet 2 of 2)
Detailed Summary - Baseline Range of Field Parameters for Groundwater

Baseline Groundwater Conditions	Minimum of Oxygen, dissolved (mg/L)	Maximum of Oxygen, dissolved (mg/L)	Minimum of pH, Field (pH)	Maximum of pH, Field (pH)	Minimum of Turbidity, Field (NTU)	Maximum of Turbidity, Field (NTU)
Winter 2013						
Upper	0.4	8.6	6.1	7.2	0.9	46.2
Lower	1.1	8.4	6.4	8.8	5.8	69.7
Deep	0.4	13	5.6	7.3	7.8	55.9
Spring 2014						
Upper	0.1	7.4	6.4	7.3	2.7	68.6
Lower	0.1	7.9	5.3	9.6	9.9	114
Deep	1.7	8.1	6.1	7.4	11.9	20.3
Summer 2014						
Upper	0.5	6.3	6.5	7.1	2.2	46.4
Lower	0.9	8.1	6.8	9.7	6.6	56.2
Deep	0	1.4	6.4	6.9	34	87.1
Fall 2014						
Upper	0.1	6.1	5.4	7.1	1.9	71
Lower	1.5	6.6	5.9	7.3	8.4	38.1
Deep	1.3	4.5	6	7.3	8.6	18.2
All Samples	0	13	5.3	9.7	0.9	114

Source: (Reference 2.3.3-18)

Table 2.3.3-13
Baseline Groundwater Temperatures and Sample Depths

Baseline	Minimum Temperature, °C (°F)	Maximum Temperature, °C (°F)	Average Temperature °C (°F)	Minimum Sample Depth (m)	Maximum Sample Depth (m)	Average Sample Depth (m)
Winter 2013						
Upper	8.79 (47.82)	16.23 (61.21)	11.90 (53.43)	8.76	31.5	18.88315789
Lower	8.36 (47.05)	13.7 (56.66)	11.26 52.27)	35.97	50.3	41.0625
Deep	11.34 (52.41)	24.1 (75.38)	15.65 (60.16)	57.3	80	66.91333333
Spring 2014						
Upper	12.03 (53.65)	17.00 (62.60)	14.12 (57.42)	8.76	31.5	18.358
Lower	13.19 (55.74)	18.20 (64.76)	15.24 (59.42)	35.97	50.3	41.188125
Deep	15.16 (59.29)	22.37 (72.27)	18.47 (65.25)	57.3	70.03	64.296
Summer 2014						
Upper	16.40 (61.52)	24.1 (75.38)	19.80 (67.64)	8.76	31.5	18.11214286
Lower	17.48 (63.46)	24.44 (75.99)	20.21 (68.37)	35.97	50.3	41.63071429
Deep	20.74 (69.33)	22.00 (71.60)	21.25 (70.24)	57.3	70.03	63.07333333
Fall 2014						
Upper	11.70 (53.06)	17.52 (63.54)	15.54 (59.98)	11.8	31.5	19.44
Lower	14.00 (57.20)	18.30 (64.94)	15.72 (60.29)	36	50.3	42.06615385
Deep	12.64 (54.75)	16.45 (61.61)	14.54 (58.17)	57.3	70	64.8

Source: (Reference 2.3.3-18)

Table 2.3.3-14 (Sheet 1 of 6)
Baseline Groundwater Summary

Analyte	MCL	Minimum Detect	Maximum Detect
Temperature, degrees C (degrees F)	NE	8.36 (47.05)	24.44 (75.99)
Oxidation reduction potential (mV)	NE	-19	478
Specific Conductance, Field (umhos/cm)	NE	72.36	4723.2
Oxygen, dissolved (mg/L)	NE	0	13
pH, Field (pH)	NE	5.3	9.7
GW Elevation (m above s/l) (m)	NE	223.81	247.85
Sample Depth (m)	NE	8.8	103.3
Well Depth (m)	NE	5.75	76.28
Water Level Depth (m)	NE	1.18	22.49
Turbidity, Field (NTU)	NE	0.9	114
Anions			
Bromide (mg/L)	NE	0.079	6.46
Chloride, total (mg/L)	NE	0.811	614
Sulfate, total (mg/L)	NE	3.33	2240
Fluoride, total (mg/L)	4	0.085	14.2
General Chemistry			
Color (Pt-Co units)	NE	5	50
Chlorine, Total Residual (mg/L)	NE	0.201	0.307
Biological Oxygen Demand (mg/L)	NE	2	291
COD, Low Level (mg/L)	NE	24.1	58.5
pH, Lab (pH)	NE	5.87	9.94
Phenols, total (ug/L)	NE	74	74
Alkalinity, Lab (mg/L)	NE	158	653
TSS (mg/L)	NE	0.8	1570
Oil & Grease (mg/L)	NE	10.7	10.7
Nitrogen, Ammonia (mg/L)	NE	0.076	12
Nitrite + Nitrate (mg/L)	NE	0.035	2.62
Phosphorus, total (mg/L)	NE	0.106	1.68
Carbon, total organic (mg/L)	NE	0.566	6.78
Cyanide, total (mg/L)	0.2	0.004	0.115
Sulfide, total (mg/L)	NE	ND	ND
Methylene Blue Active Sub	NE	0	0.205

Table 2.3.3-14 (Sheet 2 of 6)
Baseline Groundwater Summary

Analyte	MCL	Minimum Detect	Maximum Detect
Metals (total)			
Aluminum (mg/L)	NE	0.112	10.4
Antimony (ug/L)	6	ND	ND
Arsenic, (ug/L)	10	7	7
Barium (ug/L)	2000	12	582
Beryllium (ug/L)	4	1.4	1.4
Boron (ug/L)	NE	25.9	2170
Cadmium (ug/L)	5	0.3	1.2
Calcium (mg/L)	NE	1.2	187
Chromium (ug/L)	100	5.4	11.6
Cobalt (ug/L)	NE	7.4	7.4
Copper (ug/L)	130	14.8	21.7
Iron (ug/L)	NE	33.5	11900
Lead (ug/L)	15	5.5	120
Magnesium (mg/L)	NE	1.72	65.1
Manganese (ug/L)	NE	7.5	902
Molybdenum (ug/L)	NE	0.9	0.9
Nickel (ug/L)	100	4.9	18.8
Potassium (mg/L)	NE	0.873	33.3
Selenium (ug/L)	50	ND	ND
Silver (ug/L)	100	ND	ND
Sodium (mg/L)	NE	0.812	1650
Thallium (ug/L)	2	ND	ND
Tin (ug/L)	NE	ND	ND
Titanium (ug/L)	NE	36.9	36.9
Zinc (ug/L)	NE	33.8	72.9
Gross Alpha and Gross Beta Radioactivity			
Alpha, total (pCi/L)	NE	2.93	13
Beta, total (pCi/L)	NE	1.13	30.2
Tritium (pCi/L)	NE	284	847
Radium 226, total (pCi/L)	NE	0.108	1.31
Radium 228, total (pCi/L)	NE	0.295	1.06
Strontium 90, total (pCi/L)	NE	0.317	0.428
Technetium 99 (pCi/L)	NE	2.02	8.16

Table 2.3.3-14 (Sheet 3 of 6)
Baseline Groundwater Summary

Analyte	MCL	Minimum Detect	Maximum Detect
Semivolatile Organic Compounds (ug/L)			
1,2,4-Trichlorobenzene	70	ND	ND
1,2,5,6-Dibenzanthracene	NE	ND	ND
1,2-Dichlorobenzene	NE	ND	ND
1,2-Diphenylhydrazine	NE	ND	ND
1,3-Dichlorobenzene	NE	ND	ND
1,4-Dichlorobenzene	NE	ND	ND
2,4,6-Trichlorophenol	NE	ND	ND
2,4-Dichlorophenol	NE	ND	ND
2,4-Dimethylphenol	NE	ND	ND
2,4-Dinitrophenol	NE	ND	ND
2,4-Dinitrotoluene	NE	ND	ND
2,6-Dinitrotoluene	NE	ND	ND
2-Chloronaphthalene	NE	ND	ND
2-Chlorophenol	NE	ND	ND
2-Nitrophenol	NE	ND	ND
3,3'-Dichlorobenzidine	NE	ND	ND
4-Bromophenyl Phenyl Ether	NE	ND	ND
4-Chlorophenyl Phenyl Ether	NE	ND	ND
4-Nitrophenol	NE	ND	ND
Acenaphthene	NE	ND	ND
Acenaphthylene	NE	ND	ND
Anthracene	NE	ND	ND
Benzidine	NE	ND	ND
Benzo(a)anthracene	NE	ND	ND
Benzo(B)fluoranthene	NE	ND	ND
Benzo(ghi)perylene	NE	ND	ND
Benzo(K)fluoranthene	NE	ND	ND
Benzo-a-pyrene	0.2	ND	ND
Bis (2-Chloroethoxy) Methylene	NE	ND	ND
Bis (2-Chloroisopropyl) Ethylene	NE	ND	ND
Bis(2-Ethylhexyl) Phthalate	NE	6.27	99
Bis(chloromethyl)ether	NE	ND	ND
Chrysene	NE	ND	ND
Diethyl Phthalate	NE	ND	ND
Dimethyl Phthalate	NE	ND	ND

Table 2.3.3-14 (Sheet 4 of 6)
Baseline Groundwater Summary

Analyte	MCL	Minimum Detect	Maximum Detect
Di-n-Butyl Phthalate	NE	ND	ND
Di-n-Octyl Phthalate	NE	ND	ND
DNOC (4,6-Dinitro-Ortho-Cresol)	NE	ND	ND
Fluoranthene	NE	ND	ND
Fluorene	NE	ND	ND
Hexachlorobenzene	1	ND	ND
Hexachlorobutadiene	NE	ND	ND
Hexachlorocyclopentadiene	50	ND	ND
Hexachloroethane	NE	ND	ND
Indeno (1,2,3-cd)Pyrene	NE	ND	ND
Isophorone	NE	ND	ND
Naphthalene	NE	4	41
N-Butyl Benzyl Phthalate	NE	ND	ND
Nitrobenzene	NE	ND	ND
Nitrosodimethylamine, n-	NE	ND	ND
N-nitrosodi-n-propylamine	NE	ND	ND
N-nitrosodiphenylamine	NE	ND	ND
Parachlorometa Cresol	NE	ND	ND
PCP (Pentachlorophenol)	NE	ND	ND
Phenanthrene	NE	ND	ND
Phenol(C6H5OH)-Single Com	NE	ND	ND
Pyrene	NE	ND	ND
Volatile Organic Compounds (ug/L)			
1,1,1-Trichloroethane	200	ND	ND
1,1,2,2-TetrachloroEthane	NE	ND	ND
1,1,2-TrichloroEthane	5	ND	ND
1,1-Dichloroethane	NE	ND	ND
1,2-Dichloroethane	5	ND	ND
1,2-Dichloroethylene	NE	ND	ND
1,2-DichloroPropane	5	ND	ND
2-ChloroEthyl Vinyl Ether	NE	ND	ND
Acrolein	NE	ND	ND
Acrylonitrile	NE	ND	ND
Benzene, total	NE	0.131	5.49
Bromoform	NE	ND	ND
Bromomethane	NE	ND	ND

Table 2.3.3-14 (Sheet 5 of 6)
Baseline Groundwater Summary

Analyte	MCL	Minimum Detect	Maximum Detect
Carbon Tetrachloride	5	ND	ND
ChloroBenzene	100	ND	ND
Chlorodibromomethane	NE	ND	ND
ChloroEthane	NE	ND	ND
Chloroform	80	0.291	4.02
Chloromethane	NE	ND	ND
Cis-1,3-DichloroPropene	NE	ND	ND
Dichlorobromomethane (mg/L)	700	ND	ND
Ethylbenzene	1000	1.46	1.7
Hexane, n-	NE	1.81	14
Methylene Chloride	NE	0.484	0.484
Tetrachloroethylene	NE	0.499	0.499
Toluene	NE	0.132	12.6
Trans-1,3-DichloroPropene	NE	ND	ND
Trichloroethylene	5	ND	ND
Polychlorinated Biphenyl Compounds (PCBs) (ug/L)			
PCB-1016	NE	ND	ND
PCB-1221	NE	ND	ND
PCB-1232	NE	ND	ND
PCB-1242	NE	0.591	3.88
PCB-1248	NE	ND	ND
PCB-1254	NE	ND	ND
PCB-1260	NE	ND	ND
Organochlorine Pesticides (ug/L)			
4,4'-DDD	NE	ND	ND
4,4'-DDE	NE	ND	ND
Aldrin	NE	ND	ND
alpha-BHC	NE	ND	ND
alpha-Chlordane	NE	ND	ND
beta-BHC	NE	0.0225	0.0225
Chlordane, gamma	NE	ND	ND
DDT	NE	ND	ND
delta-BHC	NE	ND	ND
Dieldrin	2	ND	ND
Endosulfan I	NE	ND	ND
Endosulfan II	NE	ND	ND

Table 2.3.3-14 (Sheet 6 of 6)
Baseline Groundwater Summary

Analyte	MCL	Minimum Detect	Maximum Detect
Endosulfan Sulfate	NE	ND	ND
Endrin	2	ND	ND
Endrin Aldehyde	NE	ND	ND
Endrin Ketone	NE	ND	ND
gamma-BHC (Lindane)	0.2	ND	ND
Heptachlor	0.4	0.058	0.058
Heptachlor Epoxide	0.2	ND	ND
Toxaphene	3	ND	ND
Mercury (ug/L)			
Mercury, total	2	ND	ND

Note:
NE = not established
ND = not detected

Source: (Reference 2.3.3-18)

Table 2.3.3-15
Baseline Groundwater Summary Legacy Contaminants

Analyte	MCL	Number Detects	Number Samples	Minimum Detect	Maximum Detect	Maximum Location	Maximum Date
Nitrite + Nitrate (mg/L)	NE	54	80	0.035	2.62	OW421U	December 2013
Arsenic, (ug/L)	10	1	81	7	7	OW42OU	April 2014
Barium (ug/L)	2000	73	81	12	582	OW420L	December 2013
Cadmium (ug/L)	5	2	81	0.3	1.2	OW42OU	April 2014
Chromium (ug/L)	100	5	81	5.4	11.6	OW42OU	April 2014
Tritium (pCi/L)	NE	4	81	284	847	OW428D	December 2013
Strontium 90, total (pCi/L)	NE	5	81	0.317	0.428	OW416L	August 2014
Technetium 99 (pCi/L)	NE	3	80	2.02	8.16	OW401D	August 2014
1,1-Dichloroethane (ug/L)	NE	0	81	ND	ND	ND	ND
Chloroform (ug/L)	80	22	81	0.291	4.02	OW429L	April 2014
Tetrachloroethylene (ug/L)	NE	1	81	0.499	0.499	OW42OU	April 2014
Trichloroethylene (ug/L)	5	0	81	ND	ND	ND	ND
Mercury, total (ug/L)	2	0	81	ND	ND	ND	ND

Notes:
NE = Not established
ND = not detectable

Source: (Reference 2.3.3-18)

Table 2.3.3-16 (Sheet 1 of 3)
Baseline Groundwater Summary of Detected Analytes

Analyte	MCL	Minimum Detect	Maximum Detect	Number Detects
Temperature, Celsius (degrees C)	NE	8.36	24.44	NA
Oxidation reduction potential (mV)	NE	-19	478	NA
Specific Conductance, Field (umhos/cm)	NE	72.36	4723.2	NA
Oxygen, dissolved (mg/L)	NE	0	13	NA
pH, Field (pH)	NE	5.3	9.7	NA
GW Elevation (m above s/l) (m)	NE	223.81	247.85	NA
Sample Depth (m)	NE	8.8	103.3	NA
Well Depth (m)	NE	5.75	76.28	NA
Water Level Depth (m)	NE	1.18	22.49	NA
Turbidity, Field (NTU)	NE	0.9	114	NA
Anions				
Bromide (mg/L)	NE	0.079	6.46	13
Chloride, total (mg/L)	NE	0.811	614	62
Sulfate, total (mg/L)	NE	3.33	2240	77
Fluoride, total (mg/L)	4	0.085	14.2	77
General Chemistry				
Color (Pt-Co units)	NE	5	50	63
Chlorine, Total Residual (mg/L)	NE	0.201	0.307	2
Biological Oxygen Demand (mg/L)	NE	2	291	32
COD, Low Level (mg/L)	NE	24.1	58.5	9
pH, Lab (pH)	NE	5.87	9.94	78
Phenols, total (ug/L)	NE	74	74	1
Alkalinity, Lab (mg/L)	NE	158	653	81
TSS (mg/L)	NE	0.8	1570	76
Oil & Grease (mg/L)	NE	10.7	10.7	1
Nitrogen, Ammonia (mg/L)	NE	0.076	12	56
Nitrite + Nitrate (mg/L)	NE	0.035	2.62	54
Phosphorus, total (mg/L)	NE	0.106	1.68	22
Carbon, total organic (mg/L)	NE	0.566	6.78	57
Cyanide, total (mg/L)	0.2	0.004	0.115	8
Methylene Blue Active Sub	NE	0	0.205	21

Table 2.3.3-16 (Sheet 2 of 3)
Baseline Groundwater Summary of Detected Analytes

Analyte	MCL	Minimum Detect	Maximum Detect	Number Detects
Metals (total)				
Aluminum (mg/L)	NE	0.112	10.4	45
Arsenic, (ug/L)	10	7	7	1
Barium (ug/L)	2000	12	582	73
Beryllium (ug/L)	4	1.4	1.4	1
Boron (ug/L)	NE	25.9	2170	38
Cadmium (ug/L)	5	0.3	1.2	2
Calcium (mg/L)	NE	1.2	187	81
Chromium (ug/L)	100	5.4	11.6	5
Cobalt (ug/L)	NE	7.4	7.4	1
Copper (ug/L)	130	14.8	21.7	2
Iron (ug/L)	NE	33.5	11900	43
Lead (ug/L)	15	5.5	120	3
Magnesium (mg/L)	NE	1.72	65.1	76
Manganese (ug/L)	NE	7.5	902	30
Molybdenum (ug/L)	NE	0.9	0.9	1
Nickel (ug/L)	100	4.9	18.8	2
Potassium (mg/L)	NE	0.873	33.3	71
Sodium (mg/L)	NE	0.812	1650	71
Titanium (ug/L)	NE	36.9	36.9	1
Zinc (ug/L)	NE	33.8	72.9	2
Gross Alpha and Gross Beta Radioactivity				
Alpha, total (pCi/L)	NE	2.93	13	22
Beta, total (pCi/L)	NE	1.13	30.2	45
Tritium (pCi/L)	NE	284	847	4
Radium 226, total (pCi/L)	NE	0.108	1.31	41
Radium 228, total (pCi/L)	NE	0.295	1.06	11
Strontium 90, total (pCi/L)	NE	0.317	0.428	5
Technetium 99 (pCi/L)	NE	2.02	8.16	3
Semivolatile Organic Compounds (ug/L)				
Bis(2-Ethylhexyl) Phthalate	NE	6.27	99	21
Naphthalene	NE	4	41	4

Table 2.3.3-16 (Sheet 3 of 3)
Baseline Groundwater Summary of Detected Analytes

Analyte	MCL	Minimum Detect	Maximum Detect	Number Detects
Volatile Organic Compounds (ug/L)				
Benzene, total	NE	0.131	5.49	7
Chloroform	80	0.291	4.02	22
Ethylbenzene	1000	1.46	1.7	2
Hexane, n-	NE	1.81	14	3
Methylene Chloride	NE	0.484	0.484	1
Tetrachloroethylene	NE	0.499	0.499	1
Toluene	NE	0.132	12.6	10
Polychlorinated Biphenyl Compounds (PCBs) (ug/L)				
PCB-1242	NE	0.591	3.88	4
Organochlorine Pesticides (ug/L)				
beta-BHC	NE	0.0225	0.0225	1
Heptachlor	0.4	0.058	0.058	1

Notes:
NE = Not established
NA = Not available

Source: (Reference 2.3.3-18)

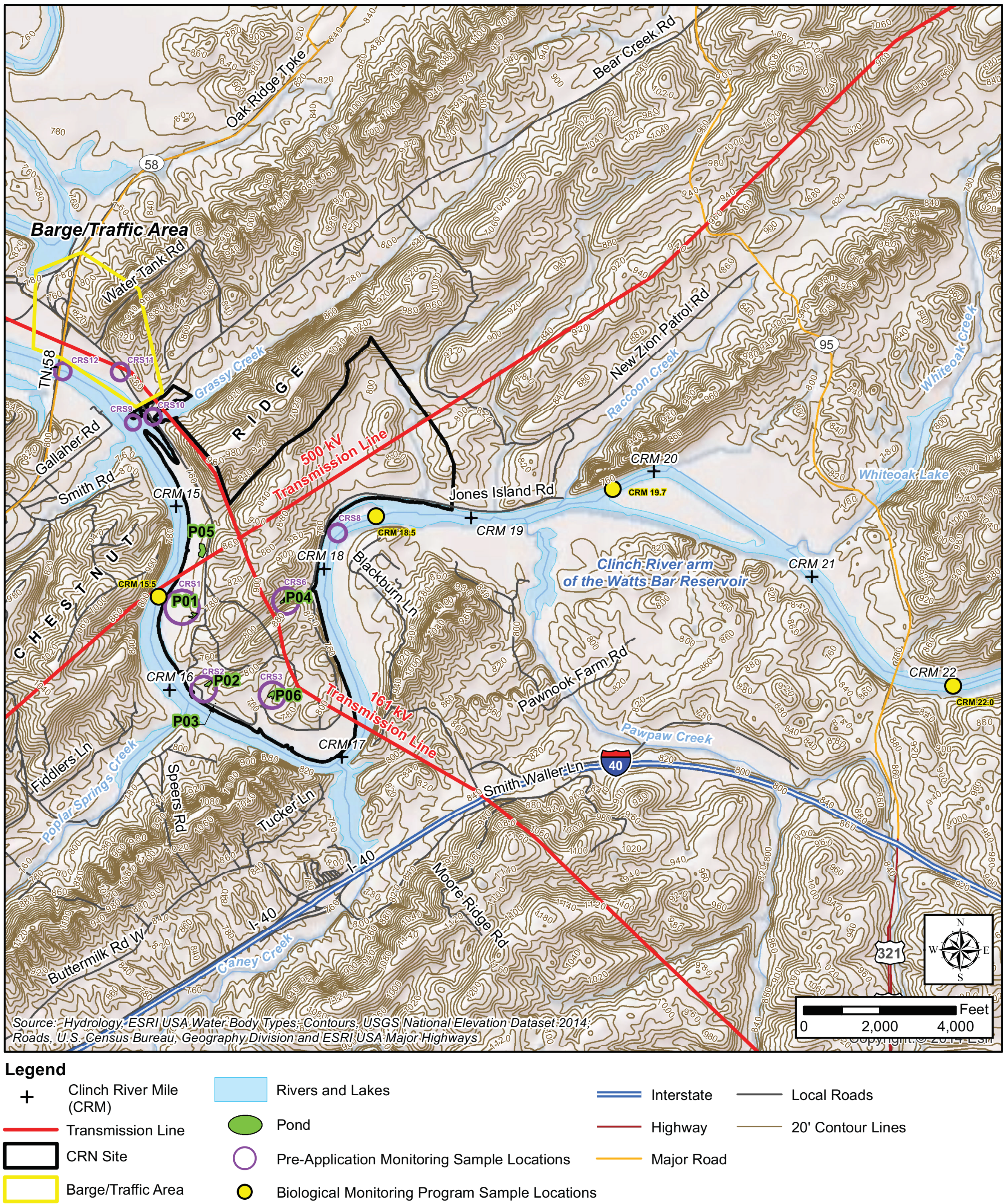
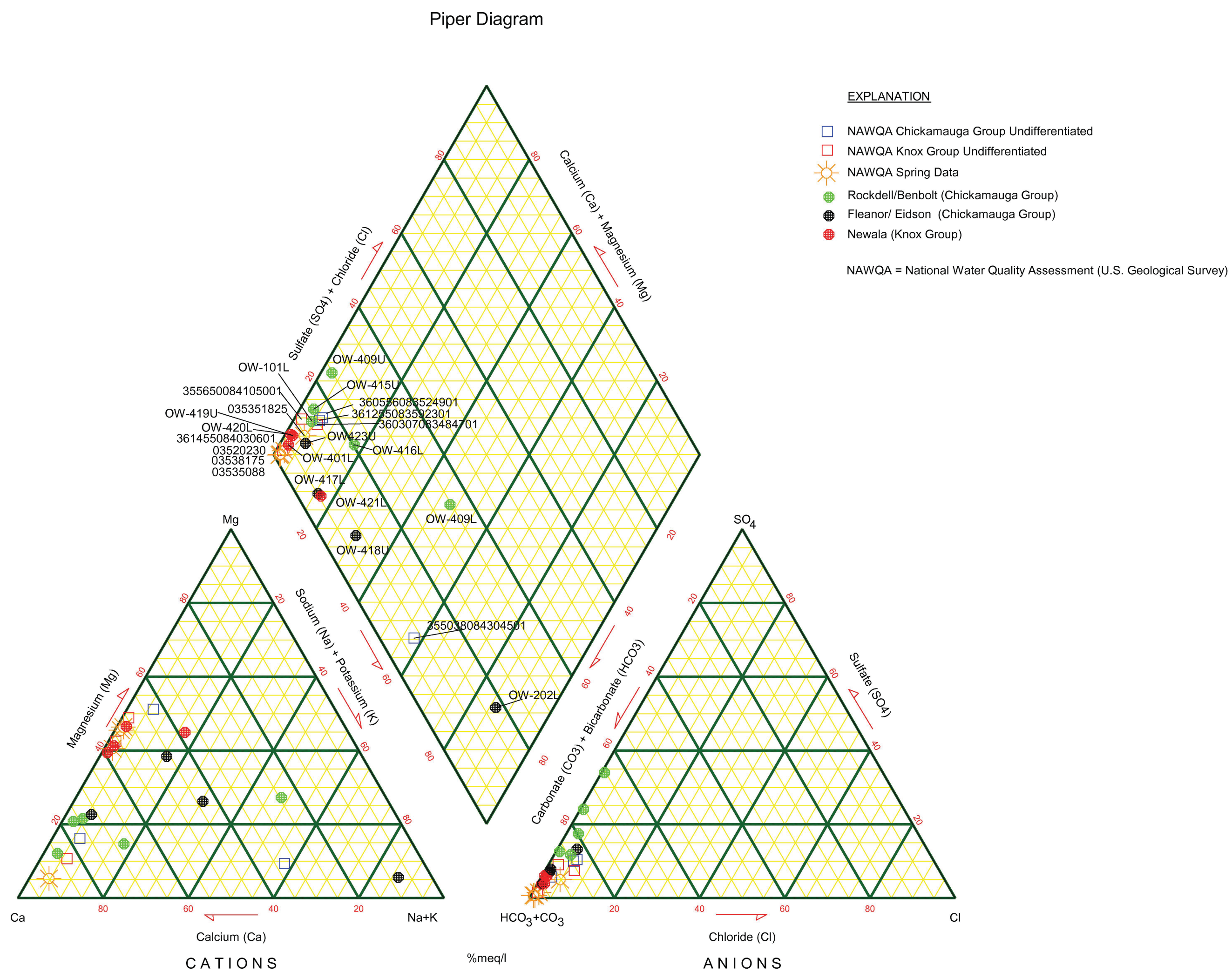
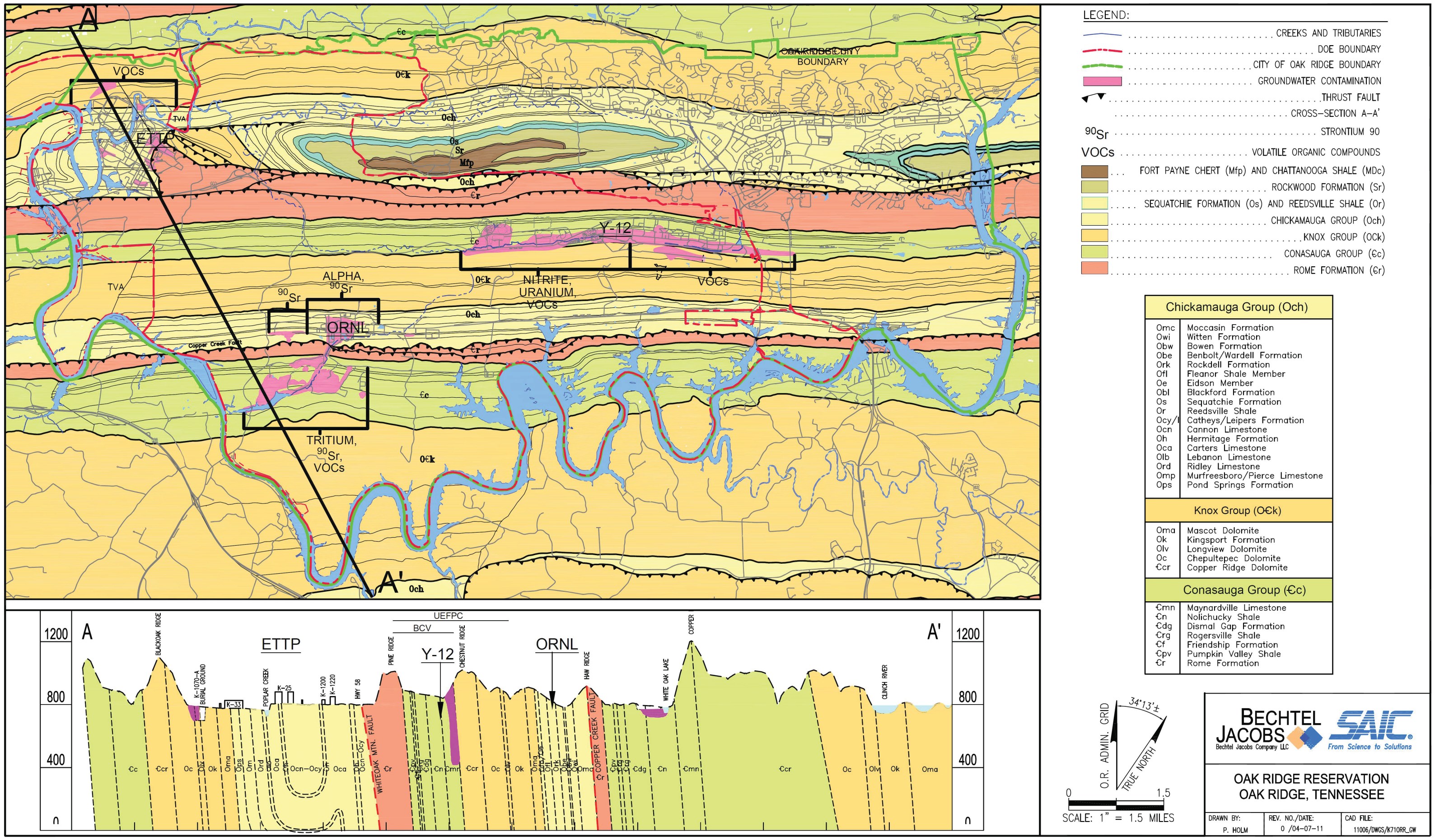


Figure 2.3.3-1. CRN Site Surface Water Monitoring Locations



Sources: (Reference 2.3.2-15; Reference 2.3.2-16)

Figure 2.3.3-2. Piper Trilinear Diagram



Adapted from: (Reference 2.3.2-17)

Figure 2.3.3-3. ORR Groundwater Contamination Map