# EXHIBIT F

# WHITE RIVER USE ATTAINABILITY ANALYSIS – FAYETTEVILLE, ARKANSAS

# White River Use Attainability Analysis—Fayetteville, Arkansas

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# Executive Summary

## Introduction

The City of Fayetteville, Arkansas, is authorized under the National Pollutant Discharge Elimination System (NPDES) to discharge wastewater from the Paul R. Noland Wastewater Treatment Plant (Noland WWTP) to the White River (NPDES Permit No. AR0020010). The Noland WWTP discharges through a single outfall, upstream of Beaver Lake, within the Arkansas Department of Environmental Quality (ADEQ) Reach 23 of Planning Segment 4K. This segment of the White River is listed on the Arkansas draft 2010 303(d) list of impaired waterbodies for exceedances of siltation/turbidity, total dissolved solids (TDS), chloride, and sulfate water quality criteria (WQC).

Minerals concentrations measured in the White River both above and below the Noland WWTP discharge have historically exceeded the site-specific WQC for Reach 23. The City of Fayetteville believes that minerals concentrations in this reach are not preventing the attainment of an existing or designated use and that continued discharge of minerals from the Noland WWTP will have no adverse impacts on downstream designated uses. The City has therefore conducted a Use Attainability Analysis (UAA) pursuant to Arkansas Pollution Control and Ecology Commission (APCEC) Regulation 2.303 to evaluate existing and attainable uses and to recommend modified site-specific WQC for dissolved minerals that would protect existing and attainable designated uses in the White River and downstream affected waters.

Noland's WWTP NPDES permit (No. AR0020010), issued in 2006, authorizes the discharge of treated municipal wastewater from the cities of Fayetteville, Farmington, Elkins, Greenland, and Johnson, as well as industrial and commercial enterprises, although the flow from Farmington and Johnson is normally treated in the City's West Side WWTP. The Noland WWTP has a daily average design capacity of 12.6 million gallons per day (mgd) and is permitted to discharge 11.21 mgd of treated effluent to the White River near Fayetteville.

The study area for this report includes Beaver Lake and portions of the Upper White River watershed upstream of the reservoir. The affected waters include waterbodies that could be influenced by the Noland WWTP effluent, to the downstream end of Beaver Lake. This includes Reach 23 of the White River and Beaver Lake.

A draft UAA Study Plan was submitted to ADEQ and the U.S. Environmental Protection Agency (USEPA) in April 2011. The final UAA Study Plan, which addressed comments provided by ADEQ and USEPA, was approved by ADEQ on June 22, 2011. The final UAA approach (as detailed in the UAA Study Plan, provided in Appendix A) included:

- An evaluation of historical watershed data
- Field data collection and analysis, including water quality monitoring, physical habitat assessments, and fish and benthic macroinvertebrate community assessments
- Whole effluent toxicity (WET) testing of Noland WWTP effluent samples
- An analysis of water quality in Beaver Lake and a mass balance model for the study area
- A review of existing and attainable designated uses in the study area
- A technical evaluation of alternatives to reduce chloride, sulfate, and TDS concentrations in the Noland WWTP effluent
- A recommendation for changes to Regulation No. 2 (APCEC, 2011), based on results of the items listed above that would be protective of the designated uses

## Physical, Chemical, and Biological Conditions in the Study Area

The Noland WWTP discharges to the White River through Outfall 001, which is located in Reach 23 of Planning Segment 4K. This 6.2-mile (mi) reach of the White River, from Lake Sequoyah to Beaver Lake, has the following

designated uses, per APCEC Regulation No. 2: primary and secondary contact recreation; domestic, industrial, and agricultural water supply; and perennial Ozark Highlands fisheries (2011). Beaver Lake and Lake Sequoyah are designated as primary and secondary contact recreation; domestic, industrial, and agricultural water supply; and lake fisheries. All portions of the study area in the Boston Mountains Ecoregion are designated as primary and secondary contact recreation; domestic, industrial, and agricultural water supply; and perennial/seasonal Boston Mountain fisheries, with the exception of a portion of the White River, which is designated as an extraordinary resource water (APCEC, 2011).

Historically, water quality data have been collected from over 40 locations in the Upper White River watershed, including, and upstream of, Beaver Lake. As part of this UAA, an inventory and analysis of historical chloride, sulfate, and TDS data was completed. A detailed summary of historical minerals concentrations (chloride, sulfate, and TDS) is provided in Appendix B. Physical and biological data have been collected in the White River watershed by various groups. These included stations on streams sampled for the UAA Field Data Collection and Analysis (i.e., White River, West Fork White River, and Richland Creek). A summary of the historical study results is provided in Appendix B.

A summary of the designated uses that are not supported (i.e., the attainment status) for all waterbodies in Arkansas' Planning Segment 4K is provided in Table ES-1. The White River, from Lake Sequoyah to Beaver Lake, is listed as not meeting its fisheries designated use due to siltation/turbidity (category 4a). The reach is also listed for violating WQC for TDS, chloride, and sulfate (category 5); though a specific designated use impairment is not identified for these exceedances. At this time, ADEQ does not believe that the magnitude of the minerals is impairing the aquatic life of the stream reach (Wise, 2011, personal communication). The potential source of elevated siltation/turbidity is cited as surface runoff, while the source of the elevated TDS, chloride, and sulfate is listed as unknown. A Total Maximum Daily Load (TMDL) for siltation/turbidity in this stream reach was developed in 2006 (USEPA, 2006); there has not been a TMDL developed for TDS, chloride, or sulfate (ADEQ, 2010).

Upper Beaver Lake (i.e., the upper 1,500 acres of the reservoir) is included on Arkansas' draft 2010 303(d) List as not meeting its designated use of fisheries (formerly "aquatic life"), due to excessive siltation/turbidity, and designated use of primary contact recreation, due to pathogen indicators (bacteria). The source of water quality impairment is cited as surface erosion (includes erosion from agriculture activities, construction activities, unpaved road surfaces, and in-stream erosion, mainly from unstable stream banks).

TABLE ES-1
**Summary of Waterbodies in Planning Segment 4K on Arkansas' Draft 2010 List of Impaired Waterbodies**

| Waterbody Name | Reach | Extent | Category [a] | Designated Use Not Supported | Cause of Impairment | Source | Priority |
|---|---|---|---|---|---|---|---|
| White River | 23 | 6.2 mi | 4a | Fisheries | Siltation/ Turbidity | Surface Erosion | N/A |
| White River | 23 | 6.2 mi | 5 | N/A | Chlorides, Sulfates, TDS | Unknown | Medium |
| West Fork White River | 24 | 27.2 mi | 4a | Fisheries | Siltation/ Turbidity | Surface Erosion | N/A |
| West Fork White River | 24 | 27.2 mi | 5 | Fisheries | Sulfates, TDS | Unknown | Medium |
| Kings River | 37 | 19.1 mi | 5 | N/A | TDS | Unknown | Low |
| Kings River | 42 | 39.5 mi | 5 | Fisheries | Dissolved Oxygen (DO), TDS | Unknown | Low |
| Holman Creek | 59 | 9.1 mi | 4a | Fisheries | Siltation/ Turbidity | Surface Erosion | N/A |
| Holman Creek | 59 | 9.1 mi | 5 | Drinking Water | Chloride, TDS | Municipal Point Source | Low |
| Leatherwood Creek | 916 | 7.6 mi | 5 | Fisheries | DO | Unknown | Low |
| Beaver Lake – Upper | A | 1,500 acres | 5 | Fisheries, Primary Contact Recreation | Siltation/ Turbidity, Bacteria | Surface Erosion | Low |

Source: (ADEQ, 2010)

Note: At the time of development of the draft UAA Report, ADEQ suggested using the draft 2010 List of Impaired Waterbodies, instead of the list included in the final 2008 Integrated Water Quality Monitoring and Assessment Report (Wise, 2011, personal communication). Since this time, the draft 2012 List of Impaired Waterbodies has been released and is currently under review.

[a] 4a = impaired, TMDL has been developed for parameter violated; 5 = impaired, TMDL has not been developed.

# Data Collection and Analysis

This UAA study involved collecting the following water quality and biological data specific to this study (see Table ES-2):

- Collection of minerals data for the Noland WWTP effluent and at various river and stream locations on a monthly basis beginning in March 2011 and continuing through May 2012
- Characterization of physical and biological habitat at river and stream stations in fall 2011 and spring 2012
- Collection of benthic macroinvertebrate community samples and diurnal DO measurements at river and stream stations in fall 2011 and spring 2012; benthic macroinvertebrates are generally defined as bottom-dwelling organisms that can be seen with the naked eye, such as aquatic insects, worms, and snails
- Collection of fish community samples at river and stream stations in fall 2011
- WET testing with Noland WWTP effluent spiked with minerals to estimate lethal and sublethal toxic thresholds for an aquatic organism (the water flea, *Ceriodaphnia dubia*) known to be very sensitive to minerals

TABLE ES-2
**Field Data Collection Station Locations and Type**

| Station ID | Location | Drainage Area | Associated Established Station | Method Used to Estimate Stream Discharge | Water Quality | Fish, Benthic, Habitat |
|---|---|---|---|---|---|---|
| 001[a] | Noland WWTP Outfall | N/A | 001 | N/A | X | |
| WR-01 [a] | White River at Wyman Rd. (u/s of Noland WWTP, downstream (d/s) of Lake Sequoyah) | 400 $mi^2$ | USGS 7048600 | Real-time data from USGS 7048600 | X | X |
| WR-02 [a] | White River, 0.4 mi d/s of Noland WWTP | 403 $mi^2$ | N/A | Real-time data from USGS 7048600 & Noland WWTP continuous effluent flow data | X | X |
| WR-2.5 [b] | White River, 2.7 mi d/s of Noland WWTP | 405 $mi^2$ | N/A | Instream flow measurements during biological monitoring events | X | X |
| WR-03 [a] | White River just u/s of confluence with Richland Creek, at State Hwy 45; 5.5 mi d/s of Noland WWTP | 412 $mi^2$ | ADEQ WHI0052/ USGS 7048700 | Real-time data from USGS 7048700 | X | |
| WF-01 [a] | West Fork White River u/s of West Fork WWTP, at Highway 170 | 62 $mi^2$ | N/A (1 mi upstream of ADEQ WHI0098) | Instream flow measurements during all sampling events | X | |
| WF-02 [a] | West Fork White River at Mally Wagon Road | 123 $mi^2$ | USGS 7048550 | Real-time data from USGS 7048550 | X | |
| RC-01 [a] | Richland Creek at State Hwy 45 | 138 $mi^2$ | USGS 7048800 | Real-time data from USGS 7048800 | X | X |
| RC-02 [c] | Richland Creek at County Road 79 | 119 $mi^2$ | N/A | Instream flow measurements during biological monitoring events | X | X |

[a] Monthly water quality samples collected May 2011-May 2012
[b] Monthly water quality samples collected September 2011-May 2012
[c] Monthly water quality samples collected October 2011-May 2012
USGS = U.S. Geological Survey

Table 3-8 is a summary table of selected parameters from each of the UAA's field and laboratory data collection components. This summary is intended to provide a weight of evidence for interpretation of the data, and therefore only those stations where all data were collected are included in the table. Applying comparable significance to each monitoring component and parameter, the overall weight of evidence analysis demonstrates that minerals concentrations in the White River downstream of the Noland WWTP are not adversely affecting aquatic biological communities in the river. The following key observations are made to reach this conclusion:

1. The percent dominant taxa and HBI metric are generally higher at Station WR-02 than at the other sampling stations and generally indicate less diverse communities at Station WR-02.Taxa richness, number of EPT taxa, percent dominant taxa, and HBI values indicate the benthic macroinvertebrate community at Station WR-2.5 (approximately 2.7 mi downstream of the Noland WWTP outfall) is comparable to communities upstream of the Noland WWTP and to those in Richland Creek. Therefore, lower diversity of the benthic macroinvertebrate communities is isolated to directly downstream (as evidenced 0.4 mi downstream) of the Noland WWTP outfall.
2. Mineral concentrations are relatively high and similar at Stations WR-02 and WR-2.5 (see Table 3-8); however, benthic macroinvertebrate communities at these stations are not comparable. Therefore, the differences observed immediately downstream of the outfall are not attributable to minerals but to other water quality conditions, food sources, and/or hydraulic characteristics, since other measures of physical habitat between the stations are comparable (i.e., the physical habitat at each White River station is suboptimal).
3. The fish communities downstream of the Noland WWTP outfall at Stations WR-02 and WR-2.5 are rated "generally similar," as defined by ADEQ for the ecoregion. The fish communities at WR-02 and WR-2.5 were rated higher than the community upstream of the outfall (at WR-01), based on the ADEQ thresholds for the Index of Biotic Integrity (IBI) score. However, there was a noticeable difference in the community at Station WR-02, specifically a decrease in sensitive individuals and a higher proportion of members of the Ictaluridae family (catfishes) and primary feeders. These species are indicative of organic loading and their presence is not expected to be related to mineral concentrations at Station WR-02. This is supported by a return to fish community structure at Station WR-2.5 similar to that upstream of the Noland WWTP. Since mineral concentrations are similar at Stations WR-02 and WR-2.5, the altered fish community structure observed at WR-02 is not due to mineral levels. The IBI score for fish at Station WR-02 reveals the fish community is supporting the fisheries designated use. This is particularly meaningful given that White River flows during fish sampling were less than the Q7-10 (the lowest mean discharge during 7 consecutive days, occurring once every 10 years on average).
4. The predominance of benthic algae and the associated increase in community metabolism at Station WR-02 compared to WR-01 is influencing biological communities downstream of the Noland WWTP (such as lower diversity of macroinvertebrates and higher proportion of benthic herbivore fish species). Although the Noland WWTP permit requires substantial removal of phosphorus from the effluent (to less than 1.0 milligram per liter [mg/L]), it is expected that phosphorus concentrations would still be somewhat higher downstream than upstream. That said, the levels of nutrients and algae downstream of the Noland WWTP did not result in levels of DO below the applicable criteria during continuous DO monitoring, even during extreme low flows during the fall sampling period.
5. The estimated 25 percent inhibition concentration (IC25) values of 1,643 mg/L TDS, 371 mg/L sulfate and 327 mg/L chloride determined in the WET testing represent the best estimates of the sublethal toxic thresholds for these minerals at this site. These values are much greater than instream minerals concentrations and greater than the highest TDS, sulfate and chloride concentrations measured in the Noland WWTP effluent to date (680 mg/L, 104 mg/L, and 76 mg/L, respectively). This reinforces the results of the biological field data which indicated that minerals concentrations are not having an adverse impact on biological communities.

# Effluent Mineral Characterization and Watershed Mass Balance Model

Effluent mineral concentration data are available for the Noland WWTP from January 2006 through May 2012. There are 84 chloride concentrations, 98 sulfate concentrations, and 98 TDS concentrations. The period of record average concentrations are 42 mg/L chloride, 59 mg/L sulfate, and 354 mg/L TDS. The 95$^{th}$ percentile concentrations are 55 mg/L chloride, 86 mg/L sulfate, and 425 mg/L TDS. Average mineral loads in the effluent during this period are 2,444 lb/day chloride, 3,092 lb/day sulfate, and 18,675 lb/day TDS. Mineral concentrations in the effluent are generally highest during the month of July; however, the maximum chloride concentration was measured in February.

A mass balance spreadsheet model that includes the Middle Fork White River, Lake Sequoyah, West Fork White River, Richland Creek, and the mainstem White River to Beaver Lake was developed to predict mineral concentrations in the White River under various loading scenarios from both the Noland WWTP effluent and the surrounding watershed. The highest instream mineral concentrations are predicted for Q7-10 flows and 95$^{th}$ percentile (June through November) mineral concentrations in the watershed, coupled with design capacity flow and 95$^{th}$ percentile (June through November) concentrations in the Noland WWTP effluent.

Based on the results of the mass balance model, the proposed site-specific WQC that would account for the Q7-10 flows in the White River, coupled with either permitted or design capacity effluent discharge from the Noland WWTP Outfall 001, and 95$^{th}$ percentile mineral concentrations in the WWTP effluent and watershed are: 60 mg/L chloride; 100 mg/L sulfate; and, 440 mg/L TDS. These concentrations are well below the toxic thresholds determined in Section 3.8; therefore, they are recommended as the proposed, modified site-specific WQC for the White River reach from the Noland WWTP outfall to immediately downstream of Richland Creek.

The proposed site-specific WQC were evaluated with respect to Beaver Lake water quality using the results of the USGS two-dimensional, laterally averaged, hydrodynamic and water quality model for Beaver Lake (Galloway and Green, 2006 and 2007). The USGS has recently updated the model to include simulations of chloride, sulfate, and TDS (Green, 2013). The hydrologic simulation period of the updated model is January 1, 2006, through December 31, 2010, a period that includes dry, typical, and wet years.

A review of the USGS model results indicates that the proposed, site-specific WQC concentrations of 60 mg/L chloride, 100 mg/L sulfate, and 440 mg/L TDS would be protective of currently designated uses and associated minerals criteria for Beaver Lake. Although a modification of the site-specific WQC for minerals is being proposed for the White River from the Noland WWTP effluent discharge point to immediately downstream of Richland Creek, no changes to the WWTP are proposed or anticipated that would increase mineral concentrations in the effluent.

# Review of Existing and Attainable Uses

A UAA is conducted to define reach-specific existing and attainable uses, and, as appropriate, use the results to modify water quality standards or designated uses. The following section evaluates the designated uses (those established through rule-making process) of the affected waters (i.e., Reach 23 of the White River and Beaver Lake), with respect to existing uses (those present any time after November 28, 1975) and attainable uses (i.e., existing uses and those uses that do not exist but can be attained with additional management measures).

All streams within ADEQ's Planning Segment 4K have the following designated uses: fisheries, primary and secondary contact recreation, and domestic, agricultural, and industrial water supplies. Any proposed modification to surface water quality standards must be protective of downstream surface water quality standards. Therefore, the following evaluation includes Segment 23 of the White River and Beaver Lake (the only downstream waterbody expected to be influenced by discharges from the Noland WWTP).

Reach 23 of the White River is listed as not supporting the fisheries designated use, with the cause of impairment cited as siltation/turbidity. At this time, ADEQ does not believe that the magnitude of TDS, chloride, and sulfate in

Reach 23 is impairing the aquatic life of the stream reach (Wise, 2011, personal communication). A TMDL to address the fisheries impairment was completed in 2006, with total suspended solids evaluated as a surrogate for siltation/turbidity (USEPA, 2006). The TMDL attributed all total suspended solids (TSS) loadings to the White River to nonpoint source runoff, and ADEQ cites the cause of runoff as surface erosion (ADEQ, 2010).

In the 2011-2016 Nonpoint Source Pollution Management Plan, the Arkansas Natural Resources Commission (ANRC) designated the Upper White River watershed (USGS HUC-11010001), including Reach 23, as a priority watershed (2011). Implementation of this plan, or the Priority Watershed Program, is focused on implementing best management practices (BMPs) to address four primary pollutants of concern, including TSS, siltation/ turbidity, DO, and nutrients. The BMPs are scheduled to be implemented by ANRC, the Arkansas Forestry Commission, ADEQ, and the Arkansas Department of Health during the period 2011 through 2016. The long-term goal of the program is to restore all designated uses in the Upper White River watershed within 15 years. If the fisheries use is currently impaired, or partially impaired, it is anticipated that the BMPs outlined by the Priority Watershed Program will restore this designated use within the next 15 years.

Arkansas lakes and reservoirs that support the fisheries use provide “water which is suitable for the protection and propagation of fish and other forms of aquatic life adapted to impounded waters” (APCEC, 2010). Upper Beaver Lake (i.e., the upper 1,500 acres of the reservoir) is listed on Arkansas’ draft 2010 List of Impaired Waterbodies as not meeting the fisheries use, with siltation/turbidity cited as the impairment. A TMDL has not been developed for siltation/turbidity in Upper Beaver Lake. However, implementation of the 2011-2016 Nonpoint Source Pollution Management Plan (see Section 5.2.3.1) includes measures to reduce nonpoint source runoff, and associated TSS and siltation/turbidity, in Beaver Lake. Therefore, if the fisheries use is currently impaired, it is expected that the nonpoint source BMPs outlined in the 2011-2016 Nonpoint Source Pollution Management Plan will fully restore this use in the reservoir, within the next 15 years.

# Alternatives Evaluation

Chloride, sulfate, and TDS concentrations were measured in influent and effluent between November 2010 and November 2011. Table ES-3 summarizes the influent and effluent concentrations of chloride, sulfate, and TDS measured during this time period. Levels of the three constituents in the influent and effluent water are below USEPA secondary drinking water criteria. The influent concentrations suggest there are no dischargers within the collection area that would contribute to elevated concentrations. According to the typical composition of untreated domestic wastewater, the influent wastewater exhibits medium strength characteristics (Metcalf and Eddy, 2003). The addition of alum for phosphorus removal, and sodium hypochlorite and caustic for odor control, to the WWTP are possible contributors to increased concentrations of chloride and sulfate. The average influent and effluent values of the three constituents are all above the existing instream criteria concentrations for minerals applicable to the White River (see Table ES-3).

TABLE ES-3
**Summary of Mineral Concentrations (November 2010—November 2011)**

| | Chloride (mg/L) | Sulfate (mg/L) | TDS (mg/L) |
|---|---|---|---|
| **Influent** | | | |
| Average | 35 | 48 | 378 |
| Minimum | 23 | 28 | 263 |
| Maximum | 43 | 57 | 488 |
| Number of Samples | 5 | 15 | 9 |
| **Effluent** | | | |
| Average | 40 | 59 | 352 |
| Minimum | 17 | 37 | 140 |
| Maximum | 76 | 100 | 470 |
| Number of Samples | 49 | 80 | 74 |
| **USEPA Secondary Drinking Water Criteria** | 250 | 250 | 500 |
| **Instream Criteria** | 20 | 20 | 160 |

Mass balances were calculated to determine if chemical additions in the treatment processes contribute significantly to elevating concentrations of chloride, sulfate, and TDS through the WWTP. Based on the calculations, it was determined that changes to the chemical additions would not be effective in reducing these minerals to less than the WQC values because the raw wastewater concentrations are higher than these criteria. The average measured effluent TDS concentrations were lower than the influent concentrations by less than 10 percent, likely due to variability in the measurements, unaccounted-for minor precipitation of dissolved constituents, and biological activity, but the difference in the values is considered minor. The calculated mass balances demonstrate that chemicals used in the treatment process at the Noland WWTP do not contribute significantly to TDS, chloride, or sulfate in the effluent.

The possible alternatives identified that could reduce concentrations of the three constituents to required levels or eliminate the discharge are listed below:

1. Product Substitution
2. Recycle/Reuse of Effluent
3. Land Application of Effluent
4. Alternative Discharge Location
5. Evaporation
6. Ion Exchange
7. Membrane Treatment

Of the above alternatives, only membrane treatment is technically feasible, although it is not economically feasible. Present day estimates of construction costs of systems used to treat tertiary water, including microfiltration (MF) and reverse osmosis (RO) systems, range from $5 to $9 per gallon produced per day. Assuming an average of $7 per gallon produced per day, the estimated cost for the membrane system would range from $134 to $152 million. The cost to dispose of or treat the waste stream varies significantly. If deep injection wells are possible, each well can cost $4 to $7 million for a capacity ranging from 100 to 500 gallons per minute (gpm). Assuming the average cost for an average capacity well, the cost for deep injection well disposal would range from $44 million to $50 million. However, since deep well injection is unlikely to be permitted, a zero liquid discharge (ZLD) process would likely be required. The costs for such a system would be about $60 per gallon of waste treated. Therefore, the cost for ZLD could range from $204 million to $234 million. In addition, it is assumed that equalization would be provided in either case to equalize the concentrate flow to the average condition, which would cost about $10 million. The total construction cost for membrane treatment would range from $188 million to $396 million, as summarized in Table ES-4.

TABLE ES-4
**Membrane Treatment Construction Cost Estimate Summary**

| Item | Partial Flow Treatment | | Full Flow Treatment | |
|---|---|---|---|---|
| | Deep Well Injection Concentrate Disposal | ZLD Concentrate Disposal | Deep Well Injection Concentrate Disposal | ZLD Concentrate Disposal |
| MF/RO System | $134,000,000 | $134,000,000 | $152,000,000 | $152,000,000 |
| Deep Injection Well System | $44,000,000 | $0 | $50,000,000 | $0 |
| ZLD System | $0 | $204,000,000 | $0 | $234,000,000 |
| Concentrate Equalization System | $10,000,000 | $10,000,000 | $10,000,000 | $10,000,000 |
| **Total Cost** | **$188,000,000** | **$348,000,000** | **$212,000,000** | **$396,000,000** |

# Minerals Criteria Recommendations

Per USEPA regulation, a state can remove a designated use that is not an existing use, or adopt a subcategory of use with less restrictive criteria, if attaining the designated use is not feasible because one or more of the following conditions (as adapted from 40 Code of Federal Regulations 131.10[g]) are satisfied:

1. Naturally occurring pollutant concentrations prevent the attainment of the use; or
2. Natural, ephemeral, intermittent, or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of a sufficient volume of effluent without violating state water conservation requirements to enable uses to be met; or
3. Human-caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place; or
4. Dams, diversions, or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the waterbody to its original condition or to operate such modification in a way that would result in the attainment of the use; or
5. Physical conditions related to the natural features of the waterbody, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses; or
6. Controls more stringent than those required by Sections 301(b) and 306 of the Clean Water Act would result in substantial and widespread economic and social impact.

As discussed in Sections 5.1 and 5.2, the currently designated uses for the White River and Beaver Lake are consistent with the apparent existing uses. The currently designated uses also appear to be attained or should be attainable with implementation of TMDLs that are intended to remedy ADEQ-identified impairments. Consequently, this UAA does not propose any modifications to the designated uses, as currently defined in Arkansas regulations for this reach of the White River and Beaver Lake.

As described in Section 6, the only potentially feasible alternative, from a technical perspective, to comply with the existing minerals criteria is membrane treatment. While costly membrane treatment options are available to reduce mineral concentrations in the Noland WWTP effluent, based on the findings of this study, if implemented, no improvements to the aquatic biota would be anticipated. This is due to the fact that the concentrations of chloride, sulfate, and TDS in the watershed are not adversely impacting aquatic biota as summarized in Section 3.9. Therefore, the installation of alternative treatment technologies is not only economically infeasible, it would not improve the status of the fisheries designated use in the White River.

Thus, the site-specific minerals criteria that are currently applicable to the White River in the vicinity of the Noland WWTP are not attainable because they would require controls more stringent than those required by Sections 301(b) and 306 of the Clean Water Act, resulting in substantial and widespread economic and social impact (UAA factor 6 above). This justifies new site-specific minerals criteria that would protect all currently designated uses for the proposed reach of the White River. The proposed applicable reach of the river would be from the Noland WWTP outfall at River Mile 17.25 to immediately downstream of Richland Creek at River Mile 11.6. The existing and proposed site-specific minerals criteria for this reach, as described and delineated in Section 4, are summarized in Table ES-5.

TABLE ES-5
**Summary of Existing and Proposed Site-Specific Minerals Criteria for the White River**

| Mineral | Existing Criteria | Proposed UAA Criteria |
|---|---|---|
| Chloride | 20 | 60 |
| Sulfate | 20 | 100 |
| TDS | 160 | 440 |

This UAA also does not propose any modifications to the site-specific criteria currently applicable to Beaver Lake. Furthermore, as described in Section 4, the proposed minerals criteria for the White River also would be protective of currently designated uses and associated minerals criteria for Beaver Lake. This conclusion is based on USGS modeling of varying minerals loads to Beaver Lake compared to anticipated loads from the White River with the Noland WWTP discharging at design capacity. Therefore, the proposed, modified site-specific WQC for the White River study reach are considered to be protective of the Beaver Lake WQC.

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# Abbreviations and Acronyms

| | |
|---|---|
| °C | degrees Celsius |
| °F | degrees Fahrenheit |
| µS/cm | microSiemens per centimeter |
| AADF | average annual daily flow |
| ADEQ | Arkansas Department of Environmental Quality |
| ADPCE | Arkansas Department of Pollution Control and Ecology |
| AIC | American Interplex Corporation |
| ANRC | Arkansas Natural Resources Commission |
| APCEC | Arkansas Pollution Control and Ecology Commission |
| AWRC | University of Arkansas Water Resources Center |
| BFP | belt filter press |
| BMP | best management practice |
| BWD | Beaver Water District |
| Ca | calcium |
| CBOD | carbonaceous biochemical oxygen demand |
| $CBOD_5$ | 5-day carbonaceous biochemical oxygen demand |
| cfs | cubic feet per second |
| CFR | Code of Federal Regulations |
| $Cl^-$ | chloride |
| col./100 mL | colonies per 100 milliliters |
| CPUE | catch per unit effort |
| d/s | downstream |
| DI | diversity index |
| DO | dissolved oxygen |
| ECO | Ecological Conservation Organization |
| EPT | Ephemoptera, Plecoptera, Trichoptera |
| ERF | Ecotoxicology Research Facility |
| ERW | Extraordinary Resource Waters |
| ESW | Ecologically Sensitive Waterbodies |
| FBI | Family Biotic Index |
| FSP | Field Sampling Plan |
| ft | feet, foot |
| $ft^2$ | square feet, foot |

| | |
|---|---|
| g $O_2/m^3$/day | grams of oxygen per cubic meter per day |
| gpm | gallons per minute |
| HBI | Hilsenhoff Biotic Index |
| $HCO_3^-$ | bicarbonate |
| HUC | Hydrologic Unit Code |
| IBI | Index of Biotic Integrity |
| IC25 | 25 percent inhibition concentration |
| IPS | influent pump station |
| K | potassium |
| lb/day | pounds per day |
| LC50 | concentration of a chemical that is expected to cause death in 50 percent of test organisms |
| LE | listed as endangered |
| LOEC | lowest observed effect concentration |
| LT | listed as threatened |
| µhmos/cm | micromhos per centimeter |
| $m^3$ | cubic meter |
| MF | microfiltration |
| Mg | magnesium |
| mgd | million gallons per day |
| mg/L | milligrams per liter |
| mi | mile |
| $mi^2$ | square mile |
| mm | millimeter |
| MS4 | Municipal Separate Storm Sewer System |
| N/A | not applicable |
| NaCl | sodium chloride |
| NaOCl | sodium hypochlorite |
| NOEC | no observed effect concentration |
| NPDES | National Pollutant Discharge Elimination System |
| NPP | net primary production |
| NSW | Natural and Scenic Waterways |
| NTU | nephelometric turbidity unit |
| O&M | operation and maintenance |
| OCS | odor control scrubber |
| P/R | production to respiration |

| | |
|---|---|
| Q7-10 | lowest mean discharge during 7 consecutive days, occurring once every 10 years on average |
| RAS | return activated sludge |
| RBPs | Rapid Bioassessment Protocols |
| RPM | revolutions per minute |
| RO | reverse osmosis |
| $SO_4^{-2}$ | sulfate |
| SU | standard units |
| SWD | side water depth |
| SWMP | Stormwater Management Plan |
| TCR | total community respiration |
| TMDL | total maximum daily load |
| TDS | total dissolved solids |
| TSS | total suspended solids |
| T.V. | tolerance value |
| u/s | upstream |
| UAA | Use Attainability Analysis |
| USACE | U.S. Army Corps of Engineers |
| USEPA | U.S. Environmental Protection Agency |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Survey |
| UV | ultraviolet |
| WET | whole effluent toxicity |
| WERF | Water Environment Research Foundation |
| WQ | water quality |
| WQC | water quality criteria |
| WWTP | wastewater treatment plant |
| ZLD | zero liquid discharge |

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SECTION 1

# Introduction

## 1.1 Background

The City of Fayetteville, Arkansas, is authorized under the National Pollutant Discharge Elimination System (NPDES) to discharge wastewater from the Paul R. Noland Wastewater Treatment Plant (Noland WWTP) to the White River (NPDES Permit No. AR0020010). The Noland WWTP discharges through a single outfall, upstream of Beaver Lake, within the Arkansas Department of Environmental Quality (ADEQ) Reach 23 of Planning Segment 4K. This segment of the White River is listed on the Arkansas draft 2010 303(d) list of impaired waterbodies for exceedances of siltation/turbidity, total dissolved solids (TDS), chloride, and sulfate water quality criteria (WQC). Section 2.511 (Mineral Quality) of the Arkansas Pollution Control and Ecology Commission (APCEC) Regulation No. 2, *Regulation Establishing Water Quality Standards for Surface Waters of the State of Arkansas,* (2011), provides the following mineral criteria for the White River, from its headwaters to the Missouri state line (including Beaver Lake): 20 milligrams per liter (mg/L) for chlorides; 20 mg/L for sulfates; and 160 mg/L for TDS. ADEQ is considering future permit limits for the Noland WWTP, for TDS, chlorides, and sulfates. The permit limits would be driven by the existing site-specific criteria for these minerals.

Concentrations measured in the White River both above and below the Noland WWTP discharge have historically exceeded the site-specific WQC for Reach 23. The City of Fayetteville believes that minerals concentrations in this reach are not preventing the attainment of an existing or designated use and that continued discharge of minerals from the Noland WWTP will have no adverse impacts on downstream designated uses. The City has therefore conducted a Use Attainability Analysis (UAA) pursuant to APCEC Regulation 2.303 to evaluate existing and attainable uses and to recommend modified site-specific WQC for dissolved minerals that would protect existing and attainable designated uses in the White River and downstream affected waters.

## 1.2 Purpose

A UAA is conducted to define reach-specific existing and attainable uses, and, as appropriate, use the results to modify water quality standards or designated uses. The U.S. Environmental Protection Agency (USEPA) and the Clean Water Act federal regulations explicitly authorize a UAA when designated beneficial uses either do not exist today or have not existed since November 28, 1975, or are not attainable (USEPA, 1983). A UAA may also be used to define site-specific criteria for the protection of designated beneficial uses, provided the site-specific criteria are consistent with the purpose and intent of the state surface WQC. In either case (removal of a designated use or setting site-specific criteria), a proposed modification to surface water quality standards must be protective of downstream surface water quality standards. Both the UAA and site-specific criteria processes are set forth in federal regulations (40 Code of Federal Regulations [CFR] 131.10 and 30 CFR 131.11), as well as in Arkansas' APCEC Regulation No. 2 (APCEC, 2011).

## 1.3 Noland Wastewater Treatment Plant

The Noland WWTP is located in Washington County, in northwest Arkansas (Figure 1-1). Noland's WWTP NPDES permit (No. AR0020010), issued in 2006, authorizes the discharge of treated municipal wastewater from the cities of Fayetteville, Farmington, Elkins, Greenland, and Johnson, as well as industrial and commercial enterprises, although the flow from Farmington and Johnson is normally treated in the City's West Side WWTP. The Noland WWTP has a daily average design capacity of 12.6 million gallons per day (mgd) and is permitted to discharge 11.21 mgd of treated effluent to the White River near Fayetteville. The existing permit includes limitations for flow, carbonaceous biochemical oxygen demand (CBOD), total suspended solids (TSS), ammonia nitrogen, dissolved oxygen (DO), total phosphorus, fecal coliform bacteria, pH, and whole effluent toxicity (WET). Effluent water quality is discussed in Section 4 of this UAA report.

FIGURE 1-1
**Location of Noland WWTP**

## 1.4 Study Area and Affected Waters

The study area for this report includes Beaver Lake and portions of the Upper White River watershed upstream of the reservoir (Figure 1-2). The affected waters include waterbodies that could be influenced by the Noland WWTP effluent, to the downstream end of Beaver Lake. This includes Reach 23 of the White River and Beaver Lake. The WWTP is authorized to discharge treated wastewater from its facility located at 1400 North Fox Hunter Road, in the City of Fayetteville, to the White River at Outfall 001 (36°05'00"N, 94°05'00"W). The outfall is located in the Beaver Lake watershed (U.S. Geological Survey [USGS] 8-digit Hydrologic Unit Code [HUC-8] 11010001) in the larger Upper White River watershed (HUC 110100).

## 1.5 Objectives

The primary goal of this UAA is to evaluate existing and designated uses in the study area's receiving streams and to determine if those uses can be attained with alternative criteria for dissolved minerals. Specifically, the objectives of the study are to address the following questions:

1. What are the existing and attainable designated uses in the study area, and are there any non-attainable designated uses in the study area?
2. Do current TDS, chlorides, and sulfates concentrations in discharges from the Noland WWTP have any adverse impacts on existing or attainable uses in the study area?
3. Can onsite controls for TDS, chlorides, and sulfates feasibly result in discharges from the Noland WWTP that will meet existing downstream Arkansas WQC?

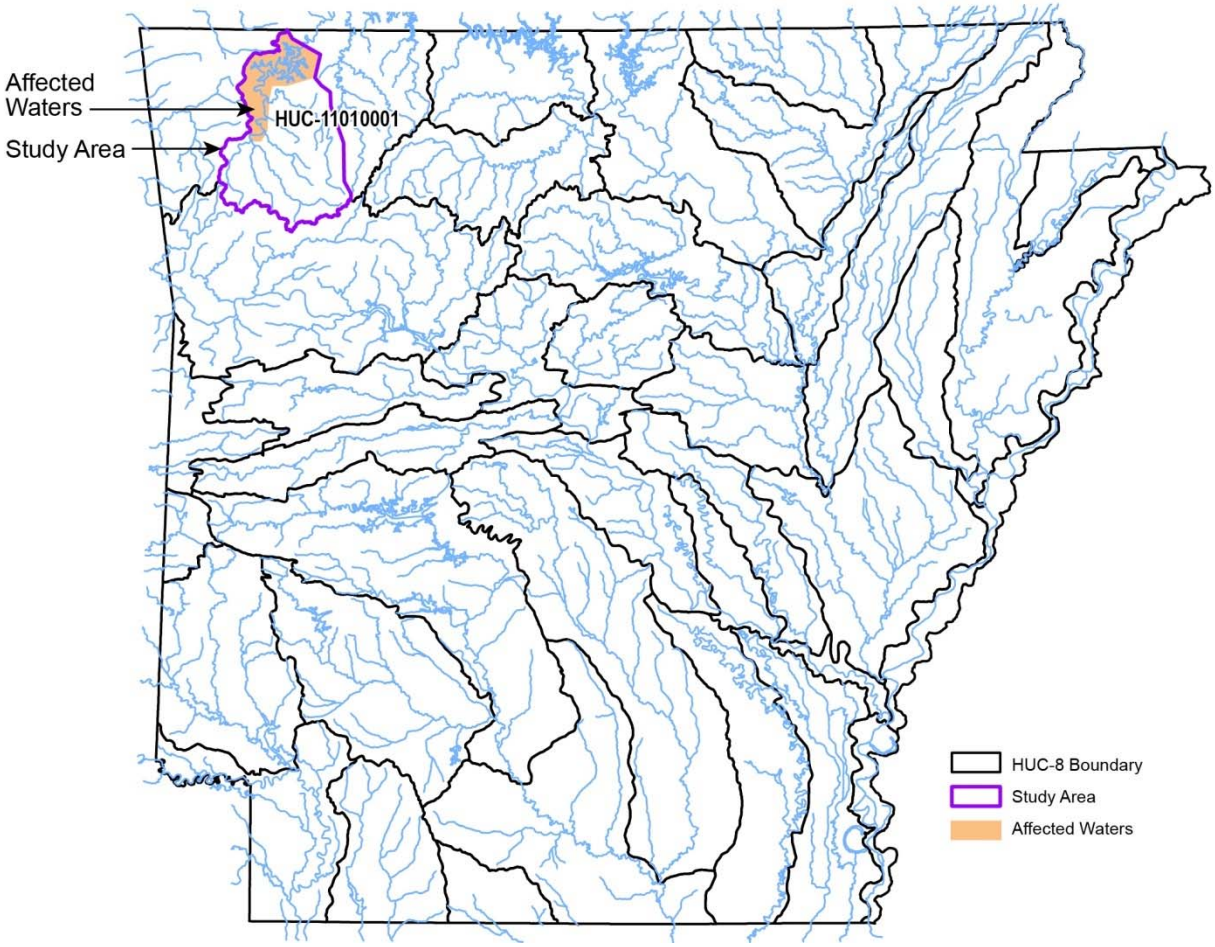


FIGURE 1-2
**Study Area and Affected Waters (adapted from ADEQ, 2008)**

4. Would implementing these controls (if they exist) be economically feasible and result in significantly increased protection for the receiving streams?
5. Would site-specific criteria for TDS, chloride, and sulfate in the receiving streams that are consistent with the range of current effluent concentrations be protective of existing and designated uses? If so, what are the recommended WQC?

## 1.6 Approach

A draft UAA Study Plan was submitted to ADEQ and USEPA in April 2011. The final UAA Study Plan, which addressed comments provided by ADEQ and USEPA, was approved by ADEQ on June 22, 2011. The final UAA approach (as detailed in the UAA Study Plan, provided in Appendix A) was developed to address the objectives outlined above and included:

- An evaluation of historical watershed data
- Field data collection and analysis, including water quality monitoring, physical habitat assessments, and fish and benthic macroinvertebrate community assessments
- WET testing of Noland WWTP effluent samples
- An analysis of water quality in Beaver Lake and a mass balance model for the study area
- A review of existing and attainable designated uses in the study area
- A technical evaluation of alternatives to reduce chloride, sulfate, and TDS from the Noland WWTP effluent

- A recommendation for changes to Regulation No. 2 (APCEC, 2011), based on results of the items listed above that would be protective of the designated uses.

The UAA approach follows applicable guidance contained in the following documents:

- 40 CFR 131.10(a) through (k)
- *USEPA Water Quality Standards Handbook, Second Edition* (1994)
- *USEPA Technical Support Manual: Waterbody Surveys and Assessments for Conducting UAAs, Volume II* (1983)
- Applicable portions of the USEPA Region 6 Water Quality Standards Submission Checklist (date unknown)
- *State of Arkansas Continuing Planning Process* (ADEQ, 2000)
- *Administrative Guidance Document* (APCEC, 1994)
- *Arkansas Regulation No. 2: Regulation establishing water quality standards for surface water of the State of Arkansas* (APCEC, 2011)
- The following Water Environment Research Foundation (WERF) resources:
  - *Suggested Framework for Conducting UAAs and Interpreting Results* (1997a)
  - *Comprehensive UAA Technical Reference* (1997b)
  - *Factors for Success in Developing UAAs* (2007)
  - *Collaborative Water Quality Solutions: Exploring UAAs* (2007), (developed jointly with National Association of Clean Water Agencies)
  - *Bioassessment: A Tool for Managing Aquatic Life Uses for Urban Streams* (2008)

## 1.7 Document Organization

This UAA report follows the outline of the objectives above. Table 1-1 provides a reference to the specific section(s) of the report that includes required components of a UAA, as identified by ADEQ (2000) and APCEC (1994).

TABLE 1-1
**Document Organization**

| Required Components of UAA Report | Reference to Location in Fayetteville UAA Report |
|---|---|
| **Required components of UAA (ADEQ, 2000)** | |
| Evaluation of existing and designated uses | Section 2.3 – Designated Uses<br>Section 2.5 – Use Attainment Status<br>Section 5.1 – Existing Uses |
| Determination of whether the waterbody is used for domestic water supply | Section 5.1.4 – Existing Uses – Domestic Water Supply |
| Evaluation of uses that would be attainable in the absence of nonpoint source pollution or with best management practices (BMPs) | Section 5.2 – Attainable Uses |
| Evaluation of cause of non-attainment | Section 5.2 – Attainable Uses |
| For all discharges in the affected watershed, give the average daily dry and wet weather flows and physical/chemical characteristics of discharge | Section 4 – Effluent Mineral Characterization and Watershed Mass Balance Model |
| Formulation of mathematical model to show projected water quality (WQ) downstream of discharge | Section 4 – Effluent Mineral Characterization and Watershed Mass Balance Model |
| Verification that the discharge will not adversely affect a karst area or groundwater and will not create a public health hazard/nuisance | Section 2.7 – Groundwater |
| Documentation that no other economically or technologically feasible alternative exists for the discharge | Section 6 – Alternatives Evaluation |

TABLE 1-1
**Document Organization**

| Required Components of UAA Report | Reference to Location in Fayetteville UAA Report |
|---|---|
| Solicited comments from Arkansas Department of Health on effects of the proposed discharge | Not applicable because there is no request to change a designated use |
| Solicited comments from Arkansas Game and Fish Commission on the adequacy of treatment in protecting fish and wildlife | To be requested during the public comment period |
| **Required components for site-specific changes in minerals standards (APCEC, 1994)** | |
| Demonstration that the existing water supply use will be maintained | Section 4 – Effluent Mineral Characterization and Watershed Mass Balance Model<br>Section 5.2.2 – Attainable Uses – Domestic, Agricultural, and Industrial Water Supply |
| Approximation of the existing effluent loading of dissolved minerals | Section 4 – Effluent Mineral Characterization and Watershed Mass Balance Model |
| Approximation of the highest monthly average and daily maximum contributions for dissolved minerals that could be expected to occur in the effluent under existing conditions; data used to estimate should also include design discharge flows | Section 4 – Effluent Mineral Characterization and Watershed Mass Balance Model |
| Demonstration that the existing aquatic life use will be maintained (i.e., bioassessments from upstream and downstream show no significant differences in aquatic life communities due to dissolved minerals and WET tests indicate no toxicity at the critical dilutions, or there is no impairment to the aquatic community) | Sections 3.5 – Benthic Macroinvertebrate Community Assessments<br>Section 3.6 – Fish Community Assessment<br>Section 3.8 – Whole Effluent Toxicity Testing<br>Section 5.2.3 – Attainable Uses – Fisheries |
| **Required components for WQ modifications using Reg. 2.306 (ADEQ, 2000)** | |
| Description of watershed, point/nonpoint impacts, designated and existing uses, and sources of wastewater | Section 2 – Physical, Chemical, and Biological Conditions in Study Area<br>Section 2.8 – Natural and Nonpoint Source Pollutants<br>Section 2.9 – Point Source Pollutants<br>Section 2.3 – Designated Uses<br>Section 5.1 – Existing Uses |
| Identification of sources of contaminants that violate criteria or impair use (natural, manmade, correctable, irretrievable) | Section 2.8 – Natural and Nonpoint Source Pollutants<br>Section 2.9 – Point Source Pollutants |
| Concentrations, variations, frequency, and duration of contaminants | Section 2.10 – Water Quality<br>Section 3.2 – Monthly Water Quality Monitoring<br>Section 4 – Effluent Mineral Characterization and Watershed Mass Balance Model |
| Environmental benefits of not removing a use or closing the operation | Removing a designated use is not being proposed, and continued operation of the Noland WWTP is required for environmental health and safety |
| Documentation that all designated uses and criteria will be met in downstream waters | Section 4 – Effluent Mineral Characterization and Watershed Mass Balance Model<br>Section 5.2 – Attainable Uses |
| Documentation that the fishable/swimmable use will be met in affected waterbody | Section 5.2 – Attainable Uses |

TABLE 1-1
**Document Organization**

| Required Components of UAA Report | Reference to Location in Fayetteville UAA Report |
|---|---|
| Potential for correction of sources | Section 4 – Effluent Mineral Characterization and Watershed Mass Balance Model (for minerals in Reach 23 White River)<br>Section 5.2.1.2 (for bacteria in Beaver Lake)<br>Section 5.2.3.1 (for siltation/turbidity in Reach 23 White River)<br>Section 5.2.3.2 (for siltation/turbidity in Beaver Lake) |
| Discussion of control or confinement of contaminants | Section 6 – Alternatives Evaluation |
| Discussion of state-of-the-art treatment technology available | Section 6 – Alternatives Evaluation |
| Economic feasibility of treatment | Section 6 – Alternatives Evaluation |
| Discussion of materials management, materials substitution, and BMPs | Section 6 – Alternatives Evaluation |
| Economic analysis for the local area of closing operation due to noncompliance | Continued operation of the Noland WWTP is required for environmental health and safety |
| Public participation and intergovernmental reviews | Will be documented after public comment period |
| **Required components for petitions seeking to increase dissolved minerals loadings (APCEC, 1994)[a]** | |
| For the purposes of calculating the appropriate water supply dissolved mineral criteria, the instream concentration of dissolved minerals may be calculated as the concentration of dissolved minerals, after mixing, using the harmonic mean flow, 30th percentile flow, or 4 cubic feet per second (cfs), whichever is greater | Section 4 – Effluent Mineral Characterization and Watershed Mass Balance Model |
| Documentation that treatment has been / will be installed to the extent that is technologically available and economically justifiable in comparison to potential for dissolved minerals removal and attainment of WQ standards | Section 6 – Alternatives Evaluation |
| Documentation that the facility will have a sufficient impact on the economy or is essential to the protection and promotion of the public interest and that approval of modification will accommodate important economic or social development in the local area | Continued operation of the Noland WWTP is required for environmental health and safety<br>Section 6 – Alternatives Evaluation |
| Documentation that all other feasible processes to reduce minerals contaminants have been investigated (e.g., product substitution, reduction in wastewater through recycling, reuse or land application, seasonally controlled discharges, improved operation and maintenance (O&M) of existing facility, and alternative discharge locations) | Section 6 – Alternatives Evaluation |

[a] "The Department may authorize dissolved minerals loadings in the NPDES Permits which reflect loadings of dissolved minerals in excess of existing conditions, and will recommend approval of a request to make a corresponding revision to the dissolved mineral water quality criteria…"

SECTION 2

# Physical, Chemical, and Biological Conditions in Study Area

This section includes an assessment of physical, chemical, and biological conditions in the Beaver Lake watershed. Analysis of readily available historical watershed data is used to evaluate natural levels of dissolved minerals in the study area and to identify the primary factors causing stream impairment in affected waters with respect to WQC and designated uses. In Section 3, results of monitoring conducted for the UAA are evaluated to further identify existing conditions and causes for nonattainment of water criteria.

## 2.1 Watershed

The UAA study area is the Beaver Lake watershed (8-digit USGS HUC-8 11010001), which is located primarily in Benton and Washington Counties, in the larger Upper White River watershed (HUC 110100) (Figure 2-1). The Noland WWTP discharges to the White River through Outfall 001, in Reach 23 of ADEQ's Planning Segment 4K. Major stream segments located upstream of Outfall 001 (assessed in ADEQ, 2010) include: the White River from its headwaters to Lake Sequoyah, the Middle Fork White River from its headwaters to Lake Sequoyah, the West Fork White River from its headwaters to the White River, and Mill Creek (a tributary to the White River in the headwaters of the watershed). From the outfall location, the White River flows to Beaver Lake, which was constructed by the U.S. Army Corps of Engineers (USACE) in the 1960s for purposes of flood control, hydropower generation, water supply, and fish and wildlife. Major tributaries to the White River near the impoundment include Richland, Brush, and War Eagle Creeks. Downstream of Beaver Lake, the White River flows northeasterly into Missouri, then back into Arkansas in a south to southeasterly direction, flowing through much of the eastern portion of the state. The White River is part of the Arkansas-White-Little Red River Basin, which flows to the Mississippi River in southeast Arkansas.

## 2.2 Ecoregion

The study area overlaps portions of the Boston Mountains and Ozark Highlands Ecoregions of Arkansas (Figure 2-2). The Ozark Highlands Ecoregion is characterized as relatively forested, mountainous, and having steep gradients and fast-flowing streams. Fractured limestone and dolomite geological features provide connections between surface and groundwater resources. The ecoregion has a relatively large percentage of streams designated as extraordinary resource waters, and karst features, such as caves, springs, and spring-fed streams are prevalent throughout. The Ozark Highlands have animal production rates which are among the highest in Arkansas. Impacts from increasing population growth and development, as well as instream gravel removal, have led to aquatic habitat destruction, surface erosion, and heavy siltation in streams (ADEQ, 2010).

The Boston Mountains Ecoregion is sparsely populated and highly forested, with dominant land uses being recreation (Ozark National Forest), logging, agriculture (livestock farming and hay production), and silviculture. Like the Ozark Highlands Ecoregion, the Boston Mountains Ecoregion includes many streams designated as extraordinary resource waters. While water quality within the ecoregion is of high quality, recent clearing of timberland, road construction/maintenance, and instream gravel removal have caused streambank erosion and increased stream turbidity (ADEQ, 2010).

## 2.3 Designated Uses

The Noland WWTP discharges to the White River through Outfall 001, which is located in Reach 23 of Planning Segment 4K. This 6.2-mile (mi) reach of the White River, from Lake Sequoyah to Beaver Lake, has the following designated uses, per APCEC Regulation No. 2: primary and secondary contact recreation; domestic, industrial, and agricultural water supply; and perennial Ozark Highlands fisheries (2011). Beaver Lake and Lake Sequoyah are designated as primary and secondary contact recreation; domestic, industrial, and agricultural water supply; and lake fisheries. All portions of the study area in the Boston Mountains Ecoregion are designated as primary and secondary contact recreation; domestic, industrial, and agricultural water supply; and perennial/seasonal Boston Mountain fisheries, with the exception of a portion of the White River, which is designated as an extraordinary resource water( APCEC, 2011).

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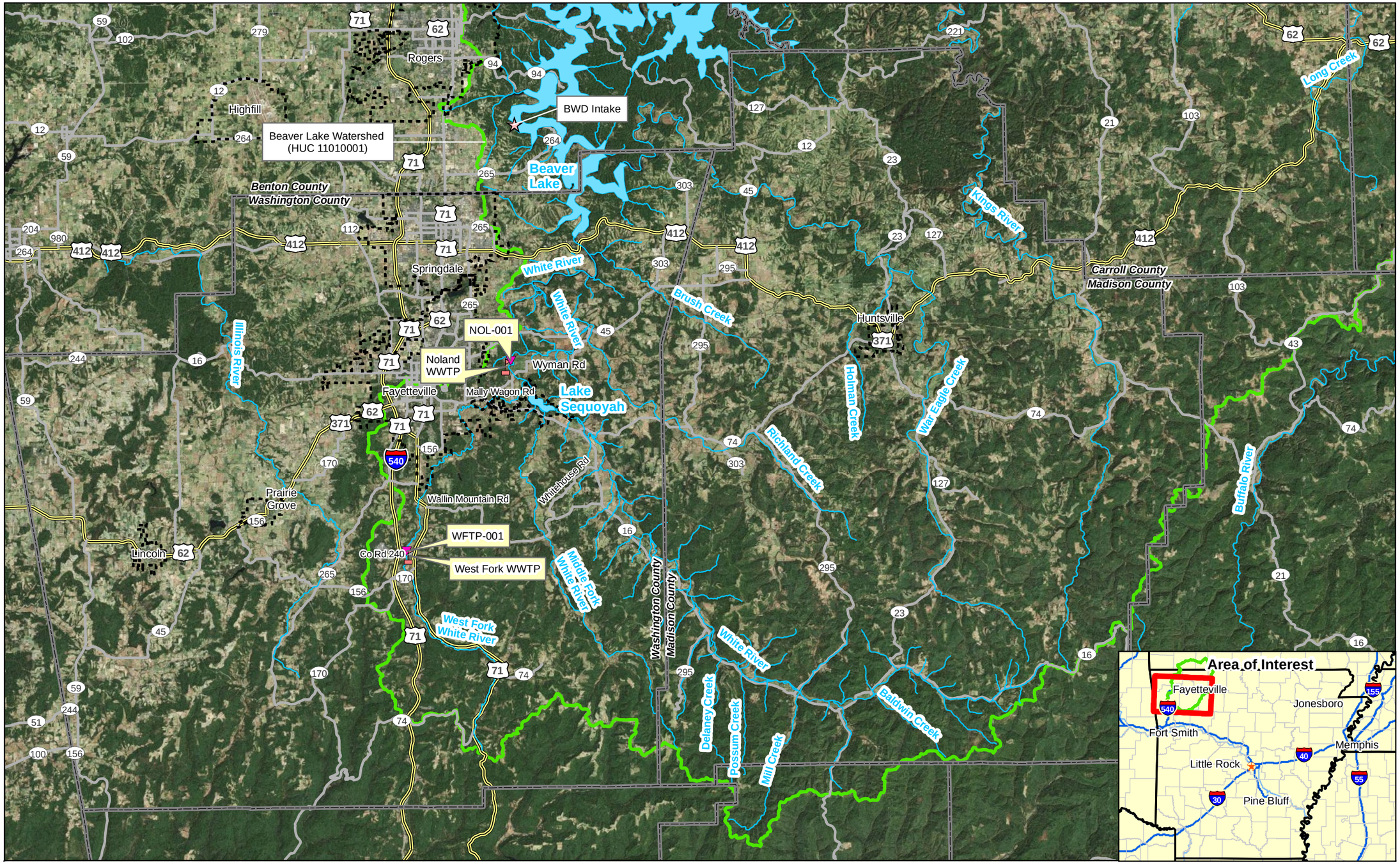


Figure 2-1
**Beaver Lake Watershed (HUC 11010001)**

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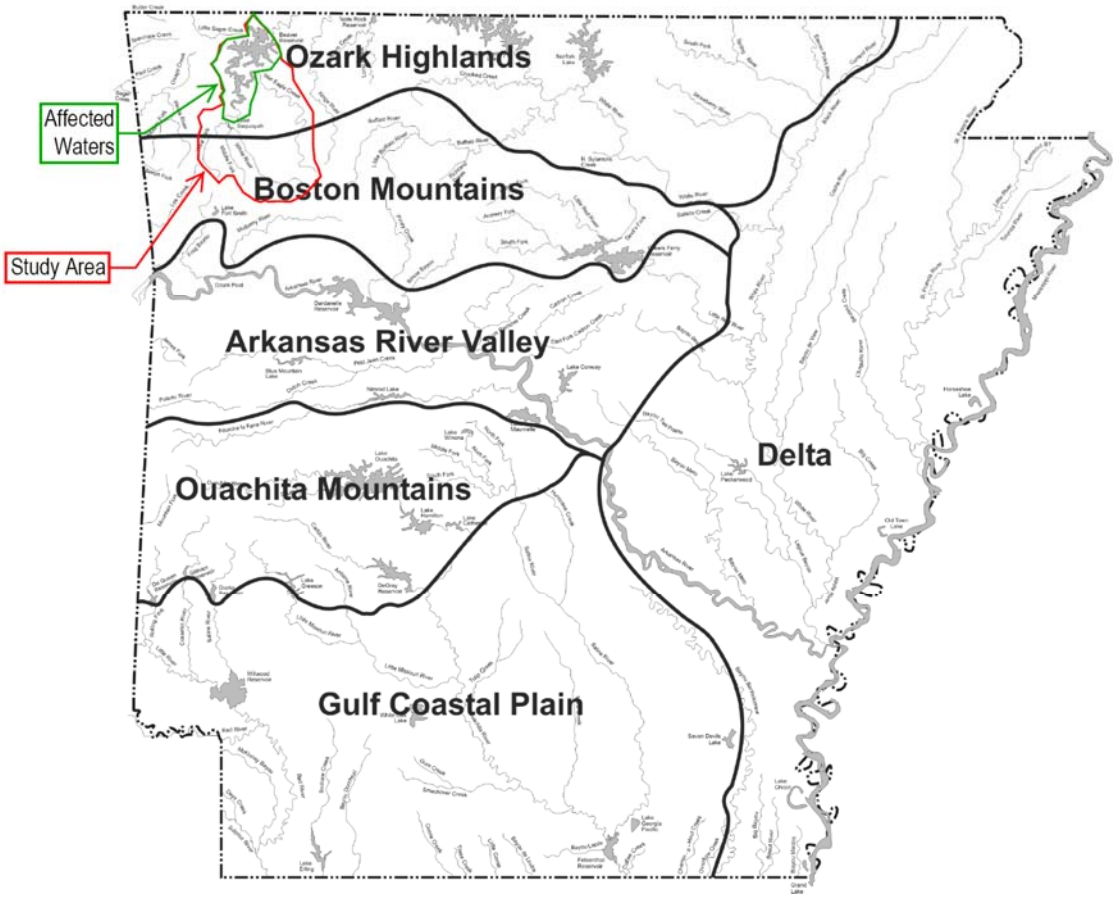



FIGURE 2-2
**Level III Ecoregions of Arkansas (adapted from APCEC, 2011)**

# 2.4 Water Quality Criteria

APCEC Regulation No. 2 includes general (qualitative) criteria, applicable to all surface waters of the State at all times, and specific (quantitative) criteria applicable to all surface waters of the state at all times except during periods when flows are less than the applicable critical flow. For fisheries attainment, the critical flow is 1 cfs minus the design flow of any point source discharge; for minerals criteria, the critical flow is the harmonic mean flow or 4 cfs, except for those waters identified in Reg. 2.511 with an asterisk, for which the critical flow is 4 cfs; for human health criteria, the critical flow is the harmonic mean flow or long-term average flow; for all other criteria, the critical flow is the Q7-10, i.e., the lowest mean discharge during 7 consecutive days, occurring once every 10 years on average (APCEC, 2011).

## 2.4.1 General Water Quality Criteria

Arkansas' general water quality standards include criteria for: biological integrity; color; taste and odor; solids, floating material, and deposits; toxic substances; and oil and grease. The state's biological integrity standards (applicable to waters with a designated use of fisheries) are applicable to this UAA and discussed further below.

Arkansas biological integrity criteria specify: "Aquatic biota should be representative of streams that have the ability to support the designated fishery, taking into consideration the seasonal and natural variability of the aquatic biota community under naturally varying habitat and hydrological conditions; the technical and economic feasibility of the options available to address the relevant conditions; and other factors. An aquatic biota assessment should compare biota communities that are similar in variety and abundance, based upon either an in-stream study including an upstream and downstream comparison, a comparison to a reference waterbody within the same ecoregion, or a comparison to community characteristics from a composite of reference waters.

The reference stream should have similar habitat and hydrologic conditions. Such a comparison should consider the seasonal and natural variability of the aquatic biota community. It is the responsibility of the Department to collect and evaluate the data for an aquatic biota assessment and such data will not be used to develop or impose permit limits" (APCEC, 2011).

## 2.4.2 Specific Water Quality Criteria

Arkansas' specific WQC include: temperature, turbidity, pH, DO, radioactivity, bacteria, toxic substances, nutrients, oil and grease, mineral quality, and ammonia. Some of the specific criteria are applicable statewide, and some are based on the designated use of the waterbody, and on the ecoregion within which the waterbody is located. Water quality criteria applicable to the affected waters are summarized in Tables 2-1 (streams) and 2-2 (lakes/reservoirs).

TABLE 2-1
**Arkansas Specific WQC Applicable to Streams in Study Area**

| Parameter | Water Quality Criterion | % Data Exceeding for Supporting Status Using Current ADEQ Assessment Methodology |
|---|---|---|
| **WQC Specific to Streams in Ozark Highlands** | | |
| Temperature | < 29°C (84.2°F) | ≤ 10% |
| Dissolved Oxygen (DO) | During primary season (at minimum stream flow and at water temperatures ≤ 22°C):<br>> 6 mg/L<br>During critical season (at Q7-10 flows and water temperatures > 22°C):<br>> 2 mg/L, for <10-square-mile ($mi^2$) watershed<br>> 5 mg/L, for 10- to 100-$mi^2$ watershed<br>> 6 mg/L, for > 100-$mi^2$ watershed (applicable to affected waters) | ≤ 10% |
| Turbidity | < 10 NTU (baseflow) | ≤ 25% |
| | < 17 NTU (storm flow) | ≤ 20% |
| **Statewide WQC** | | |
| pH | 6.0 to 9.0 standard units (SU) | ≤ 10% |
| | Change < 1.0 SU over a period of 24 hours | |
| **Statewide WQC for Streams other than Extraordinary Resource Waters (ERW), Ecologically Sensitive Waterbodies (ESW), and Natural and Scenic Waterways (NSW) Designated as Primary Contact Recreation** | | |
| Fecal coliform | **May 1 – September 30:** Geometric mean < 200 col./100 mL and instantaneous value < 400 col./100 mL<br>**October 1 – April 30**: Meet secondary contact WQC | ≤ 25% |
| *Escherichia coli* | **May 1 – September 30:** Geometric mean < 126 col./100 mL and single value < 410 col./100 mL<br>**October 1 – April 30:** Meet secondary contact WQC | ≤ 25% |
| **Statewide WQC for Streams Designated as Secondary Contact Recreation** | | |
| Fecal coliform | Geometric mean < 1,000 col./100 mL and single value < 2,000 col./100 mL | ≤ 25% |
| *Escherichia coli* | Geometric mean < 630 col./100 mL and single value < 2,050 col./100 mL | ≤ 25% |
| **Mineral WQC for Streams Designated as Domestic Water Supply** | | |
| Chloride ($Cl^-$) | 250 mg/L | ≤ 10% |
| Sulfate ($SO_4^{-2}$) | 250 mg/L | ≤ 10% |
| Total Dissolved Solids (TDS) | 500 mg/L | ≤ 10% |

TABLE 2-1
**Arkansas Specific WQC Applicable to Streams in Study Area**

| Parameter | Water Quality Criterion | % Data Exceeding for Supporting Status Using Current ADEQ Assessment Methodology |
|---|---|---|
| **Site-specific Mineral WQC** | | |
| $Cl^-$ | White River (headwaters to Missouri line): 20 mg/L (monthly average)<br>West Fork White River (entire reach): 20 mg/L (monthly average) | ≤ 10% |
| $SO_4^{-2}$ | White River (headwaters to Missouri line): 20 mg/L (monthly average)<br>West Fork White River (entire reach): 20 mg/L (monthly average) | ≤ 10% |
| TDS | White River (headwaters to Missouri line): 160 mg/L (monthly average)<br>West Fork White River (entire reach): 150 mg/L (monthly average) | ≤ 10% |
| **Calculated Ecoregion Reference Stream Values, to be used for Ozark Highlands Waterbodies not Included in Site-specific Mineral WQC [a]** | | |
| $Cl^-$ | 17.3 mg/L | ≤ 10% |
| $SO_4^{-2}$ | 22.7 mg/L | ≤ 10% |
| TDS | 250 mg/L | ≤ 10% |

Source: APCEC Regulation No. 2 (2011) and ADEQ (2010)

°C = degrees Celsius, °F= degrees Fahrenheit, mg/L=milligrams per liter, NTU = nephelometric turbidity unit, col./100 mL = colonies per 100 milliliters

**Note:** Table does not include certain parameters not applicable to this UAA, including radioactivity (see Reg. 2.506), toxic substances (see Reg. 2.508), nutrients (see Reg. 2.509), oil and grease (see Reg. 2.510), or ammonia (see Reg. 2.512)

[a] Significant modifications of water quality are considered to exist if instream concentrations are greater than 1/3 higher than these values for $Cl^-$ and $SO_4^{-2}$, or if this TDS value is exceeded after being increased by the sum of the increases to $Cl^-$ and $SO_4^{-2}$

TABLE 2-2
**Arkansas Specific WQC Applicable to Lakes and Reservoirs in Study Area**

| Parameter | Water Quality Criterion | % Data Exceeding for Supporting Status Using Current ADEQ Assessment Methodology |
|---|---|---|
| **General Criteria for all Lakes/Reservoirs in Arkansas** | | |
| Temperature | 32°C (89.6°F) | ≤ 10% |
| Dissolved Oxygen (DO) | 5 mg/L (for >500-$mi^2$ watershed) | ≤ 10% |
| Turbidity | 25 NTU (baseflow) | ≤ 25% |
| | 45 NTU (storm flow) | ≤ 20% |
| **Statewide WQC** | | |
| pH | 6.0 to 9.0 SU | ≤ 10% |
| | Change < 1.0 SU over a period of 24 hours | |
| **Statewide Primary Contact Recreation WQC (for reservoirs)** | | |
| Fecal coliform | **May 1 – September 30:** Geometric mean < 200 col./100 mL and instantaneous value < 400 col./100 mL<br>**October 1 – April 30**: Meet secondary contact WQC | ≤ 25% |
| *Escherichia coli* | **May 1 – September 30:** Geometric mean < 126 col./100 mL and single value < 298 col./100 mL<br>**October 1 – April 30:** Meet secondary contact WQC | ≤ 25% |
| **Statewide Secondary Contact Recreation WQC (for reservoirs)** | | |
| Fecal coliform | Geometric mean < 1,000 col./100 mL and single value < 2,000 col./100 mL | ≤ 25% |
| *Escherichia coli* | Geometric mean < 630 col./100 mL and single value < 1,490 col./100 mL | ≤ 25% |

TABLE 2-2
**Arkansas Specific WQC Applicable to Lakes and Reservoirs in Study Area**

| Parameter | Water Quality Criterion | % Data Exceeding for Supporting Status Using Current ADEQ Assessment Methodology |
|---|---|---|
| **Domestic Water Supply WQC** | | |
| $Cl^-$ | 250 mg/L | ≤ 10% |
| $SO_4^{-2}$ | 250 mg/L | ≤ 10% |
| TDS | 500 mg/L | ≤ 10% |
| **Site-specific Mineral WQC (specific to White River from headwaters to Missouri line, including Beaver Lake)** | | |
| $Cl^-$ | Beaver Lake: 20 mg/L (monthly average) | ≤ 10% |
| $SO_4^{-2}$ | Beaver Lake: 20 mg/L (monthly average) | ≤ 10% |
| TDS | Beaver Lake: 160 mg/L (monthly average) | ≤ 10% |
| **Calculated Ecoregion Reference Stream Values, to be used for Ozark Highlands Waterbodies not Included in Site-specific Mineral WQC [a]** | | |
| $Cl^-$ | 17.3 mg/L | ≤ 10% |
| $SO_4^{-2}$ | 22.7 mg/L | ≤ 10% |
| TDS | 250 mg/L | ≤ 10% |

Source: APCEC Regulation No. 2 (2011) and ADEQ (2010)

**Note:** Table does not include certain parameters not applicable to this UAA, including radioactivity (see Reg. 2.506), toxic substances (see Reg. 2.508), nutrients (see Reg. 2.509), oil and grease (see Reg. 2.510), or ammonia (see Reg. 2.512)

[a] Significant modifications of water quality are considered to exist if instream concentrations are greater than 1/3 higher than these values for $Cl^-$ and $SO_4^{-2}$, or if this TDS value is exceeded after being increased by the sum of the increases to $Cl^-$ and $SO_4^{-2}$.

## 2.5 Use Attainment Status

The State of Arkansas' biannual Integrated Water Quality Monitoring and Assessment Report identifies exceedances of WQC and evaluates the attainment of applicable designated uses. The parameters used to evaluate use attainment status are summarized in Table 2-3. The criteria used to evaluate these water quality parameters were summarized in Section 2.4.2 (Tables 2-1 and 2-2). Table 2-4 summarizes the biological integrity evaluation protocol for fish and macroinvertebrate communities.

TABLE 2-3
**Summary of Water Quality Parameters Used to Evaluate Designated Uses in Arkansas**

| Designated Use | Parameter(s) Used to Evaluate Use Attainment |
|---|---|
| Aquatic Life/Fisheries[a] | Macroinvertebrate and/or fish community data, if available |
| Domestic water supply | Compounds not easily removed by drinking water treatment facilities; compounds with established secondary maximum contaminant levels, e.g., $Cl^-$, $SO_4^{-2}$, and TDS |
| Primary and Secondary Contract Recreation | *Escherichia coli,* or fecal coliform in the absence of *Escherichia coli* data |
| Industrial and Agriculture Water Supply | Compounds which interfere with industrial uses such as cooling water or the water used in certain manufacturing processes; or waters unsuitable for livestock watering or crop irrigation; most often includes $Cl^-$, $SO_4^{-2}$, and TDS |

[a] If biological data (macroinvertebrate and/or fish communities) exist, the fisheries designated use can be evaluated based on these data, if the data were collected over two seasons, at a minimum, using methods outlined in a quality assurance project plan with requirements equal to or more stringent than those of ADEQ. Prior to the state's draft 2010 List of Impaired Waterbodies, the following parameters were used to evaluate the attainment of the fisheries (then referred to as aquatic life) designated use: DO temperature, turbidity/TSS, toxics, ammonia, or any non-toxic compound which alters the aquatic life community structure beyond that explained in Reg. 2.405.

TABLE 2-4
**Biological Integrity Evaluation Protocol**

| Indicator | Data Type | Supporting | Not Supporting |
|---|---|---|---|
| Macroinvertebrate Community | Macroinvertebrate Community Data Available | Until a Macroinvertebrate Biological Monitoring Index is developed and critiqued, an upstream/downstream comparison of communities will be utilized, or the community data will be compared to historical ecoregion data using total taxa richness, Ephemoptera, Plecoptera, Trichoptera (EPT), and percent dominant taxa, as these metrics are indicative of perturbation/degradation. | |
| | | Hilsenhoff Biotic Index (HBI), EPT, and taxa richness indices are highly, generally, or fairly similar to comparison site. | HBI, EPT, and taxa richness indices are not similar to comparison site. |
| Fish Community | Fish Community Data Available | Index of Biotic Integrity (IBI) score either highly, generally, or fairly similar; general presence of sensitive and indicator species. | IBI score not similar; absence of sensitive and indicator species. |

Source: ADEQ (2010)

**Notes:**
Data must be collected over two seasons, at a minimum, using methods outlined in a quality assurance project plan with requirements equal to or more stringent than those of ADEQ.

A waterbody will be listed as "supporting" the fisheries designated use if: (1) either the fish community or benthic macroinvertebrate community is defined as supporting *and* (2) neither the fish nor benthic macroinvertebrate community is defined as not supporting.

A waterbody will be listed as "supporting" the fisheries designated use if the low fish community IBI score or the macroinvertebrate community is assessed as non-support as the result of an abnormal occurrence in the aquatic life communities and not an environmental factor (low DO, low pH, toxicity)**.**

A summary of the designated use attainment status for all waterbodies in Arkansas' Planning Segment 4K is provided in Table 2-5. The White River, from Lake Sequoyah to Beaver Lake, is listed as not meeting its fisheries designated use due to siltation/turbidity (category 4a). The reach is also listed for violating WQC for TDS, chloride, and sulfate (category 5), though a specific designated use impairment is not identified for these exceedances. At this time, ADEQ does not believe that the magnitude of the minerals is impairing the aquatic life of the stream reach (Wise, 2011, personal communication). The potential source of elevated siltation/turbidity is cited as surface runoff, while the source of the elevated TDS, chloride, and sulfate is listed as unknown. A Total Maximum Daily Load (TMDL) for siltation/turbidity in this stream reach was developed in 2006 (USEPA, 2006); there has not been a TMDL developed for TDS, chloride, or sulfate (ADEQ, 2010).

Upper Beaver Lake (i.e., the upper 1,500 acres of the reservoir) is included on Arkansas' draft 2010 303(d) List as not meeting its designated use of fisheries (formerly "aquatic life"), due to excessive siltation/turbidity, and designated use of primary contact recreation, due to pathogen indicators (bacteria). The source of water quality impairment is cited as surface erosion (includes erosion from agriculture activities, construction activities, unpaved road surfaces, and in-stream erosion mainly from unstable stream banks).

TABLE 2-5
**Summary of Waterbodies in Planning Segment 4K on Arkansas' Draft 2010 List of Impaired Waterbodies**

| Waterbody Name | Reach | Extent | Category [a] | Designated Use Not Supported | Cause of Impairment | Source | Priority |
|---|---|---|---|---|---|---|---|
| White River | 23 | 6.2 mi | 4a | Fisheries | Siltation/ Turbidity | Surface Erosion | N/A |
| White River | 23 | 6.2 mi | 5 | None | $Cl^-$, $SO_4^{-2}$, TDS | Unknown | Medium |
| West Fork White River | 24 | 27.2 mi | 4a | Fisheries | Siltation/ Turbidity | Surface Erosion | N/A |
| West Fork White River | 24 | 27.2 mi | 5 | Fisheries | $SO_4^{-2}$, TDS | Unknown | Medium |
| Kings River | 37 | 19.1 mi | 5 | N/A | TDS | Unknown | Low |
| Kings River | 42 | 39.5 mi | 5 | Fisheries | DO, TDS | Unknown | Low |

TABLE 2-5
**Summary of Waterbodies in Planning Segment 4K on Arkansas' Draft 2010 List of Impaired Waterbodies**

| Waterbody Name | Reach | Extent | Category [a] | Designated Use Not Supported | Cause of Impairment | Source | Priority |
|---|---|---|---|---|---|---|---|
| Holman Creek | 59 | 9.1 mi | 4a | Fisheries | Siltation/ Turbidity | Surface Erosion | N/A |
| Holman Creek | 59 | 9.1 mi | 5 | Drinking Water | $Cl^-$, TDS | Municipal Point Source | Low |
| Leatherwood Creek | 916 | 7.6 mi | 5 | Fisheries | DO | Unknown | Low |
| Beaver Lake – Upper | A | 1,500 acres | 5 | Fisheries, Primary Contact Recreation | Siltation/ Turbidity, Bacteria | Surface Erosion | Low |

Source: (ADEQ, 2010). N/A = not applicable

**Note:** At the time of development of the draft UAA Report, ADEQ suggested using the draft 2010 List of Impaired Waterbodies, instead of the list included in the final 2008 Integrated Water Quality Monitoring and Assessment Report (Wise, 2011, personal communication). Since this time, the draft 2012 List of Impaired Waterbodies has been released and is currently under review.

[a] 4a = impaired, TMDL has been developed for parameter violated; 5 = impaired, TMDL has not been developed.

## 2.6 Federally Protected Aquatic Species

There are two federally protected species that may occur in Benton and/or Washington Counties, Arkansas. The cave crayfish (*Cambarus aculabrum*) is listed as endangered (LE), and the Ozark cavefish (*Amblyopsis rosae)* is listed as threatened (LT) (U.S. Fish and Wildlife Service [USFWS], 2011). There are three candidate species for federal protection that may occur in Benton and/or Washington Counties, Arkansas: two mussel species, the Neosho mucket (*Lampsilis rafinesqueana*) and rabbitsfoot (*Quadrula cylindrica cylindrica*), and one fish species, the Arkansas darter (*Etheostoma cragini*) (USFWS, 2011). Based on a review by the USFWS, Arkansas Ecological Field Services Office, the White River UAA project (defined as including "the option of developing appropriate site-specific WQC for dissolved minerals that would protect existing and attainable designated uses in the White River and downstream affected waters") will have no effect on "Federal trust resources currently protected by the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.; Act) and under [the USFWS] jurisdiction" (Davidson, 2011, personal communication).

## 2.7 Groundwater

The UAA study area is located above the Ozark aquifer, which consists of dolomite, limestone, sandstone, and shale. Based on potentiometric surface maps developed from 2007 groundwater levels, the groundwater depth in portions of the aquifer in northern Arkansas range from 1,169 feet (ft) (near upper Beaver Lake) to 118 feet (in northeastern Arkansas) (Pugh, 2008). Upstream of Beaver Lake, and within the UAA study area, few groundwater wells have been constructed, due to the great depth to the water table and poor water quality (Imes and Emmett, 1994). However, it is known that the depth of the aquifer increases to more than 4,000 ft in the UAA study area, upstream of Beaver Lake, with groundwater quality being affected by increasing amounts of dissolved solids, fluoride, sulfide, and radium, as groundwater flows downgradient (to the west, northwest, and north), away from recharge areas (Imes and Emmett, 1994). In the UAA study area, the great depth to groundwater and the poor water quality limit the viability of the aquifer as a water supply source (Pugh, 2008). The Noland WWTP discharge is therefore not anticipated to affect any karst areas or groundwater resources (because of the depth and existing water quality).

## 2.8 Natural and Nonpoint Source Pollutants

Nonpoint source pollution is a source of water quality impairment throughout the Upper White River watershed. In the 2011-2016 Nonpoint Source Pollution Management Plan, the Arkansas Natural Resources Commission

(ANRC) designated the Upper White River watershed (USGS HUC-11010001), including Reach 23, as a priority watershed (2011). This management plan is focused on implementing BMPs to address four primary parameters of concern: TSS, siltation/turbidity, DO, and nutrients. Within the UAA study area, the White River, West Fork White River, Holman Creek, and upper Beaver Lake have all been included on the state's 303(d) List of Impaired Waterbodies due to excessive siltation and turbidity. The turbidity and siltation are attributed to surface erosion (ADEQ, 2010). Additionally, nonpoint source runoff from agricultural land use and urban development has been cited as sources of increased nutrients, TSS, and bacteria in the watershed.

Additionally, portions of the White River, West Fork White River, Kings River, and Holman Creek are included on the 303(d) List of Impaired Waterbodies due to exceedances of one or more criteria. In some cases, the source of these minerals is unknown. In certain geological settings, mineral concentrations in surface waters may be attributed to the natural erosion of underlying rock layers.

## 2.8.1 Land Cover

Land cover in the watershed is approximately 75 percent forest and 23 percent pasture (USEPA, 2006). During development of the TMDL for siltation/turbidity in the White River and West Fork White River, ADEQ conducted a survey of the watershed to identify nonpoint sources of pollutants. Results of the survey indicated that the watershed is affected by streambank erosion, unpaved roads and roadside ditches, and urban and construction areas (USEPA, 2006). Between 1990 and 2000, the population of the Beaver Lake –White River subwatershed (including the White River from Lake Sequoyah to Beaver Lake) increased by 42.5 percent, and extensive residential development is believed to be contributing nonpoint source pollutants to the watershed. In the West Fork White River subwatershed, it is estimated that 66 percent of sediment loading is attributable to streambank erosion, 17 percent to roads, and the other 17 percent to forest, pasture, urban, and construction runoff (Beaver Water District, 2010).

## 2.8.2 Permitted Stormwater Discharges

Nonpoint source pollution in Arkansas is influenced by local governments, through land use and new development decisions, as well as by ADEQ permitting and enforcement decisions. The Stormwater Section of ADEQ's Permits Branch manages NPDES permits related to stormwater discharge, including construction, industrial, and municipal stormwater permits.

### 2.8.2.1 Municipal Stormwater

The following applicable municipalities are permitted to discharge stormwater, under the Phase II NPDES Municipal Separate Storm Sewer System (MS4) program for medium communities: (1) City of Fayetteville (Permit No. ARR040010), (2) City of Springdale (Permit No. ARR040019), (3) Washington County (Permit No. ARR040023), (4) City of Elkins (Permit No. ARR040006), and (5) the University of Arkansas at Fayetteville (Permit No. ARR040028). Entities that participate in the Phase II program are required to implement a Stormwater Management Plan (SWMP) that meets six "minimum control measures." Arkansas' Individual MS4 Permit (ARS000002) covers storm sewer discharges from the Arkansas State Highway and Transportation Department.

### 2.8.2.2 Industrial Stormwater

Table 2-6 lists facilities that are permitted to discharge industrial stormwater to streams in the Upper White River watershed, upstream of Beaver Lake. The majority of these industries are located in the West Fork White River subwatershed, and many include sand/gravel quarries. Industrial and construction stormwater permit holders are required to develop a Stormwater Pollution Prevention Plan and use BMPs to minimize pollutant discharges to local waterways.

TABLE 2-6
**Industrial Stormwater Permittees in the Study Area**

| Subwatershed | Permitted Facility | Permit No. |
|---|---|---|
| Holman/War Eagle | Beaver Lake Concrete | ARR00A272 |
| | J & K Lumber | ARR00B125 |
| | Butterball, LLC | ARR00B775 |
| | Thompson Redi-mix Concrete | ARR00C114 |
| | Royal Oak Enterprises | ARR00A440 |
| | Huntsville Quarry | ARR00C055 |
| Brush Creek, downstream (d/s) of WHI0112 | Hindsville Quarry | ARR00C051 |
| | Washington County Road Department | ARR00C472 |
| West Fork White River between City of West Fork and White River | J & L Auto Salvage | ARR00B782 |
| | Marshaltown Company | ARR00A390 |
| | Greenland Auto Salvage | ARR00A759 |
| | Arkansas Western Gas | ARR00A92 |
| | AAF International | ARR00A964 |
| | Superior Industries International | ARR00B109 |
| | LKQ Mid-American Auto Parts | ARR00B402 |
| | Fayetteville Executive Airport | ARR00C299 |
| | APAC-Central Inc. West Fork Quarry | ARR000077 |
| | City of Fayetteville Compost Facility | ARR000210 |
| | Hiland Dairy Foods, LLC | ARR000531 |
| | Packaging Specialties, Inc | ARR000639 |
| | Energy Source, LLC | ARR000741 |
| White River upstream of Lake Sequoyah | Arkansas Electric Corporation – Elkins Generating Station | ARR000381 |

Source: ADEQ, 2011 (http://www.adeq.state.ar.us/water/branch_permits/individual_permits/data/npdes_data.htm)

# 2.9 Point Source Pollutants

## 2.9.1 Domestic and Municipal Wastewater

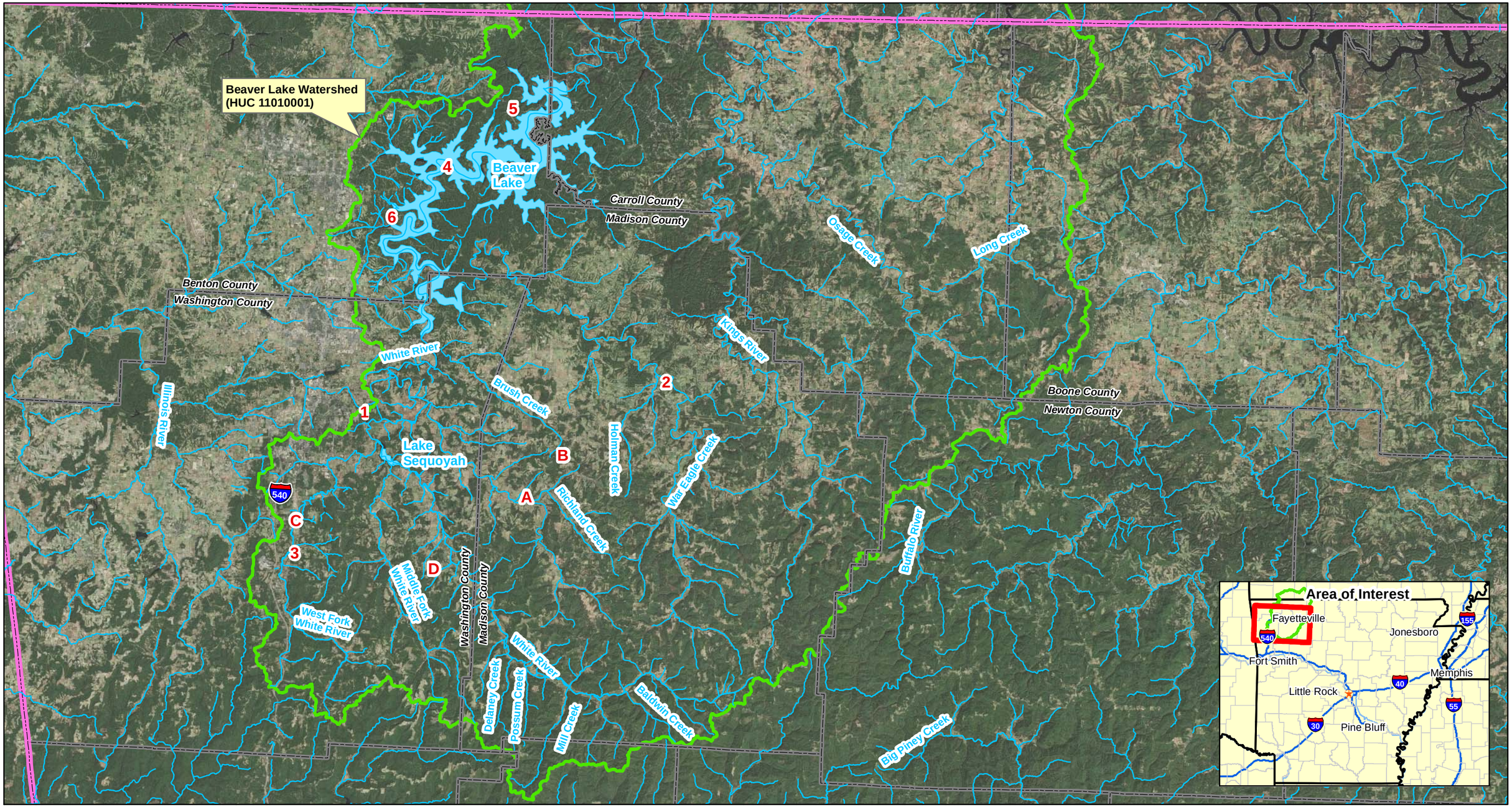
Figure 2-3 shows the domestic and municipal facilities with authority under the NPDES to discharge wastewater in the Upper White River watershed. In addition to the Noland WWTP (represented by "1" in Figure 2-3), there are five NPDES-permitted facilities that discharge to or have the potential to contribute wastewater to the affected waterbody. These include:

- 2 – City of Huntsville WWTP (Permit No. AR0022004)
- 3 – City of West Fork WWTP (Permit No. AR0022373)
- 4 – Heritage Bay Homeowners Association (Permit No. AR0033197)
- 5 – Lost Bridge Village Water and Sewer (Permit No. AR0036676)
- 6 –Mont Ne Beaver Lake Camp (Permit No. AR0037320)

## 2.9.2 Industrial Wastewater

Figure 2-3 also shows the industrial facilities with authority under the NPDES to discharge wastewater in the Upper White River watershed. There are four industrial facilities permitted to discharge wastewater to streams in the Upper White River watershed, upstream of Beaver Lake. Each is listed as a minor permittee:

- A – Washington County Road Department Goshen Tuttle Quarry (Permit No. AR0051501)
- B – U-Hall Gravel (Permit No. ARG500046)
- C – Les Rogers Sand & Gravel (Permit No. ARG500002)
- D – U-Hall Gravel Quarry (Permit No. ARG500032)




**Legend**

- 4 Domestic and Municipal Facilities
- C Industrial Facilities
- Beaver Lake Watershed (HUC 11010001)
- County Boundary
- State Boundary

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FIGURE 2-3
NPDES Wastewater Permitted Facilities in Study Area

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# 2.10 Water Quality

Historically, water quality data have been collected from over 40 locations in the Upper White River watershed, including, and upstream of, Beaver Lake. As part of this UAA, an inventory and analysis of historical chloride, sulfate, and TDS data was completed. Sampling locations included in the analysis are summarized in Table 2-7 and shown in Figure 2-4. A detailed summary of historical minerals concentrations (chloride, sulfate, and TDS) is provided in Appendix B. Key observations are provided below.

TABLE 2-7
**Summary of Water Quality Sampling Stations Included in Historical Minerals Analysis**

| Station ID | Location |
|---|---|
| **ADEQ Ambient WQ Monitoring Stations** | |
| WHI0103 | Middle Fork White River west of Elkins |
| WHI0116 | War Eagle Creek at Highway 45, north of Hindsville (collocated with USGS 7049000) |
| WHI0051 | West Fork White River near Fayetteville (collocated with USGS 7048550) |
| WHI0052 | White River near Goshen (collocated with USGS 7048700) |
| WHI0106 | White River near Durham |
| WHI0070 | Holman Creek below Huntsville |
| **ADEQ Roving WQ Monitoring Stations** | |
| WHI0112 | Brush Creek north of Highway 45 off Highway 303 (collocated with USGS 7048890) |
| WHI0102 | Middle Fork White River at County Road 32, 1 mi south of Sulphur City |
| WHI0105 | White River near Crosses |
| WHI0109 | Richland Creek, 1 mi north of Tuttle |
| WHI0098 | West Fork White River at county road bridge below Dye Creek near West Fork (upstream [u/s] end) |
| **USGS Streamflow Gages (Drainage Area)** | |
| 7048550 | West Fork White River at County Road 195 (123 $mi^2$) |
| 7048000 | West Fork White River at Greenland, Arkansas |
| 7048800 | Richland Creek at West Bowen Blvd (138 $mi^2$) |
| 7049000 | War Eagle Creek near Hindsville at Highway 45 (263 $mi^2$) |
| 7048600 | White River at Wyman Road (d/s of Lake Sequoyah, u/s of Noland WWTP) (400 $mi^2$) |
| 7048700 | White River near Goshen (just u/s of Richland Creek confluence) (412 $mi^2$) |
| **AWRC Stations** | |
| AWRC Goshen | White River at Fayetteville (collocated with USGS 7048700 and WHI0052) |
| AWRC Fayetteville | White River at Wyman Bridge (collocated with USGS 7048600) |
| **ECO Station** | |
| ECO-1 | West Fork White River at Brentwood Mtn. Road |

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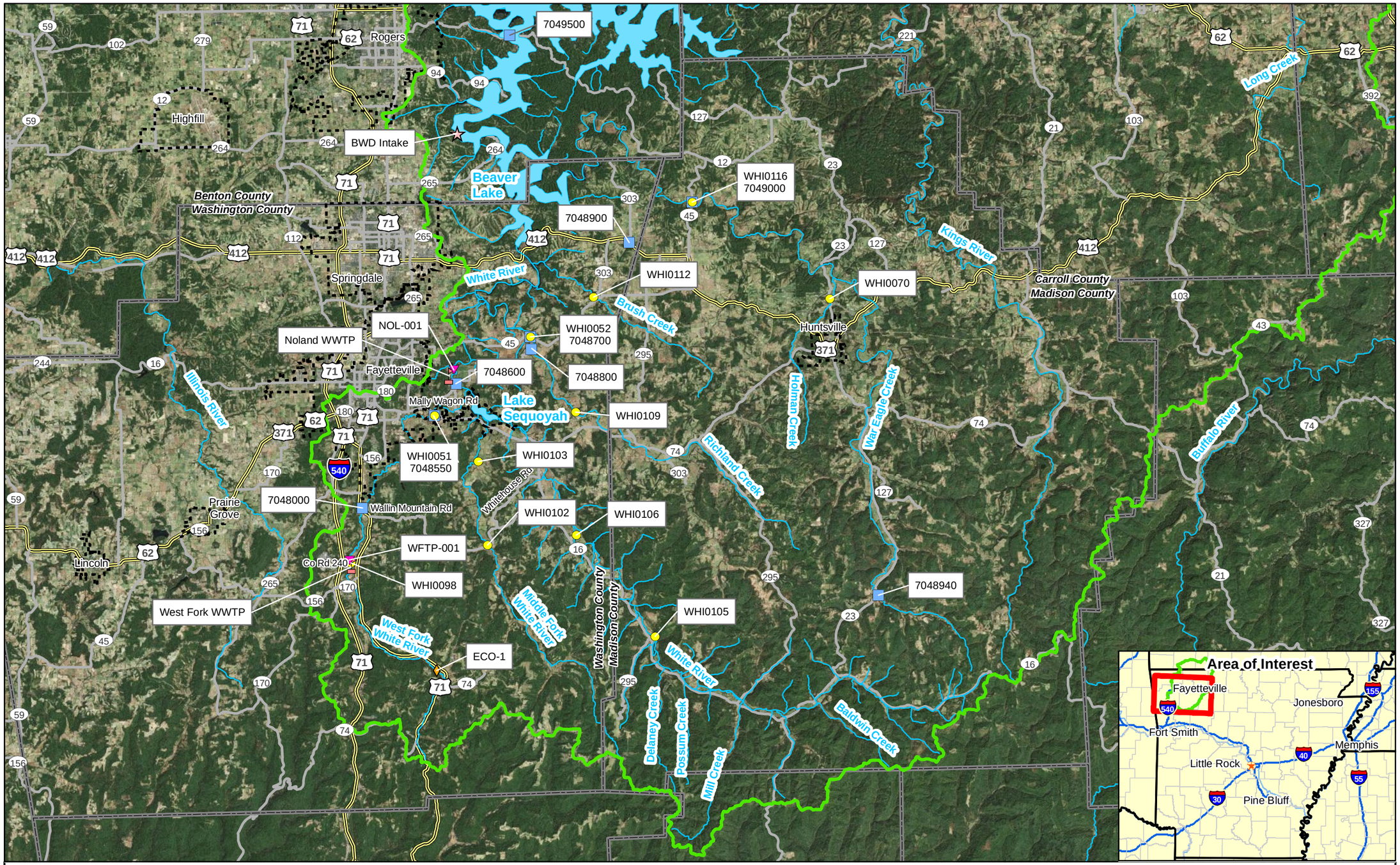


**Legend**

- ADEQ Stations
- ECO Stations
- USGS Stations
- Wastewater Treatment Plants
- Wastewater Treatment Plant Outfalls
- BWD Intake
- Highway
- Major Road
- Drainage Area (UAA Stations)
- HUC 11010001
- City Boundary
- County Boundary

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**Figure 2-4**
**Historical Water Quality Monitoring Stations**

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Average chloride concentrations in the watershed across the period of record range from 1.9 mg/L (White River upstream of Lake Sequoyah) to 100.7 mg/L (in Holman Creek downstream of the Huntsville WWTP). Average sulfate concentrations in the watershed have historically ranged from 3.2 mg/L (White River upstream of Lake Sequoyah) to 31.2 mg/L (in the West Fork White River just upstream of the City of West Fork WWTP). Ranges of chloride and sulfate concentrations are comparable to those measured since 2006.

Chloride and sulfate concentrations have historically been relatively high at locations downstream of the Noland, City of West Fork, and City of Huntsville WWTPs, with the highest concentrations observed downstream of the City of Huntsville WWTP. The highest average levels of chloride in the watershed have been measured in War Eagle Creek and Holman Creek (both downstream of the City of Huntsville WWTP). The highest average levels of sulfate in the watershed occur in the West Fork White River (downstream and just upstream of the West Fork WWTP), Brush Creek, and Holman Creek (downstream of the City of Huntsville WWTP).

Average chloride concentrations downstream of the Noland WWTP are comparable to those measured at Station WHI012 in Brush Creek, which is not influenced by any municipal or domestic point source discharges (Figure 2-3) or any industrial stormwater discharges. It should be noted that the West Fork White River may be influenced by a number of sand and gravel quarries and other industries in the watershed (Table 2-6 and Figure 2-3).

Trends in historical TDS data generally follow those observed in chloride and sulfate data, with relatively high TDS levels measured at the four stations located downstream of a point source discharge, in West Fork White River just upstream of the West Fork WWTP, and in Brush Creek. The highest average TDS concentrations have historically been measured in Brush Creek and Holman Creek.

## 2.11 Physical and Biological Conditions

Physical and biological data have been collected in the White River watershed by various groups (Table 2-8). Table 2-8 summarizes the sampling station locations that were included in biological data analysis for the UAA. These included stations on streams sampled for the UAA Field Data Collection and Analysis (i.e., White River, West Fork White River, and Richland Creek). A summary of the historical study results is provided in Appendix B.

TABLE 2-8
**Summary of Biological Sampling Stations Included in Historical Data Analysis**

| Study (Collection Date) | Station ID | Location |
|---|---|---|
| Brown et al. (2002 and 2003)[a] | Site 6 | West Fork White River, SE of Hwy 156 near the Tilly-Willy Bridge (fish, benthic macroinvertebrates, and physical habitat) |
| ADPCE (1993) | RCH-03 | Richland Creek at Highway 45 (benthic macroinvertebrates) |
| | MFW-03 | Middle Fork White River, 2 mi SW of Elkins (fish and macroinvertebrates) |
| | WFW-03; same location as Site 6 | West Fork White River, SE of Fayetteville (fish and macroinvertebrates) |
| | WHR-01 | White River, upstream end, Madison County (benthic macroinvertebrates) |
| | WHR-02 | White River, d/s of Crosses Creek (benthic macroinvertebrates) |
| | WHR-03 | White River, 2 mi NW of Durham (fish and macroinvertebrates) |
| Beaver Lake Watershed Pre-Impoundment Study (1963) | Same location as WHR-03 | White River, 2 mi NW Durham (fish) |
| | Same location as MFW-02 | Middle Fork White River, 1 mi S of Sulphur City (4-5 mi upstream of MFW-03 ) (fish) |
| | 1-2 mi u/s of WFW-03 | West Fork White River, 1 mi downstream of Highway 71 (fish) |

[a] Site 6 included for comparison to WFW-03

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SECTION 3

# Data Collection and Analysis

The following section includes an assessment of field data collected for the UAA. The technical approach to field sampling and data analysis, as well as the monitoring results, are provided. These results, along with an analysis of existing loadings of dissolved minerals in the watershed (Section 4), and a review of existing and attainable uses (Section 5), will be used to recommend site-specific WQC for TDS, chloride, and sulfate that would be protective of existing and designated uses.

## 3.1 Technical Approach

During the period May 2011 through May 2012, the City of Fayetteville collected physical, chemical, and biological data from representative stream locations in the study area (Table 3-1, Figure 3-1). The City also collected water quality data from the Noland WWTP effluent and conducted a WET test on the Noland WWTP effluent. Technical methods for the field data collection are detailed in the White River UAA Field Sampling Plan (FSP), approved by ADEQ on June 22, 2011 (provided in Appendix C-1). The test methodology and laboratory protocol for the WET test are provided in detail in Appendix C-7. Data collection and laboratory analysis included:

- Monthly water quality sampling (May 2011—May 2012) at 8 instream sampling stations and the Noland WWTP outfall (Table 3-1), including in situ measurements (DO, conductivity, turbidity, pH, temperature) and grab samples for analysis of TDS, chloride, and sulfate (note that water quality sampling at Stations WR-2.5 and RC-02 was initiated in September and October 2011, respectively, for reasons described below).
- Two diurnal DO sampling events, conducted on September 14, 2011 and April 2 and 4, 2012.
- Fish community and physical habitat assessments at five locations, conducted on September 13 and 14, 2011 (with the exception of assessments at RC-02, which were conducted on October 11, 2011).
- Benthic macroinvertebrate community assessments at the same five locations, conducted on October 11, 2011.
- Benthic macroinvertebrate community and physical habitat assessments at the same five locations, conducted on March 7, 2012.
- Calculation of stream flow (methods summarized in Table 3-1) during water quality and biological monitoring events (the stream flow calculations are used in the estimation of existing minerals loadings [Section 4]).
- A WET test to evaluate the toxic threshold for TDS, sulfate, and chloride using cladoceran (*Ceriodaphnia dubia)*.

As outlined in the UAA Study Plan, the original biological sampling locations included three on the White River (WR-01, WR-02, and WR-03) and one on Richland Creek (RC-01). During the fish community sampling event in September 2011, the field team found it necessary to move the location of WR-03 and RC-01, both located near the Highway 45 bridge crossing. These changes, as described below, were made to allow more representative and appropriate biological community samples to be taken while maintaining continuity in the water chemistry monitoring.

WR-03 is one of two stations downstream of the Noland WWTP outfall and upstream of the White River's confluence with Richland Creek. On September 13, 2011, the field team determined that the location was unwadeable due to backwater from Beaver Lake. Accordingly, this station was moved approximately 2.8 mi upstream to a location (designated Station WR-2.5) approximately midway between the Noland WWTP outfall and Station WR-03. This location is more representative of riverine rather than impounded conditions. Fish samples were collected from WR-2.5 in September 2011, monthly water quality sampling was initiated at this location in September 2011, and benthic macroinvertebrates were collected from WR-2.5 during both macroinvertebrate assessments (October 2011 and March 2012).

TABLE 3-1
**Field Data Collection Station Locations and Type**

| Station ID | Location | Drainage Area | Associated Established Station | Method Used to Estimate Stream Discharge | Water Quality | Fish, Benthic, Habitat |
|---|---|---|---|---|---|---|
| 001[a] | Noland WWTP Outfall | N/A | 001 | N/A | X | |
| WR-01 [a] | White River at Wyman Rd. (u/s of Noland WWTP, d/s of Lake Sequoyah) | 400 $mi^2$ | USGS 7048600 | Real-time data from USGS 7048600 | X | X |
| WR-02 [a] | White River, 0.4 mi d/s of Noland WWTP | 403 $mi^2$ | N/A | Real-time data from USGS 7048600 & Noland WWTP continuous effluent flow data | X | X |
| WR-2.5 [b] | White River, 2.7 mi d/s of Noland WWTP | 405 $mi^2$ | N/A | Instream flow measurements during biological monitoring events | X | X |
| WR-03 [a] | White River just u/s of confluence with Richland Creek, at State Hwy 45; 5.5 mi d/s of Noland WWTP | 412 $mi^2$ | ADEQ WHI0052/ USGS 7048700 | Real-time data from USGS 7048700 | X | |
| WF-01 [a] | West Fork White River u/s of West Fork WWTP, at Highway 170 | 62 $mi^2$ | N/A (1 mi upstream of ADEQ WHI0098) | Instream flow measurements during all sampling events | X | |
| WF-02 [a] | West Fork White River at Mally Wagon Road | 123 $mi^2$ | USGS 7048550 | Real-time data from USGS 7048550 | X | |
| RC-01 [a] | Richland Creek at State Hwy 45 | 138 $mi^2$ | USGS 7048800 | Real-time data from USGS 7048800 | X | X |
| RC-02 [c] | Richland Creek at County Road 79 | 119 $mi^2$ | N/A | Instream flow measurements during biological monitoring events | X | X |

[a] Monthly water quality samples collected May 2011-May 2012

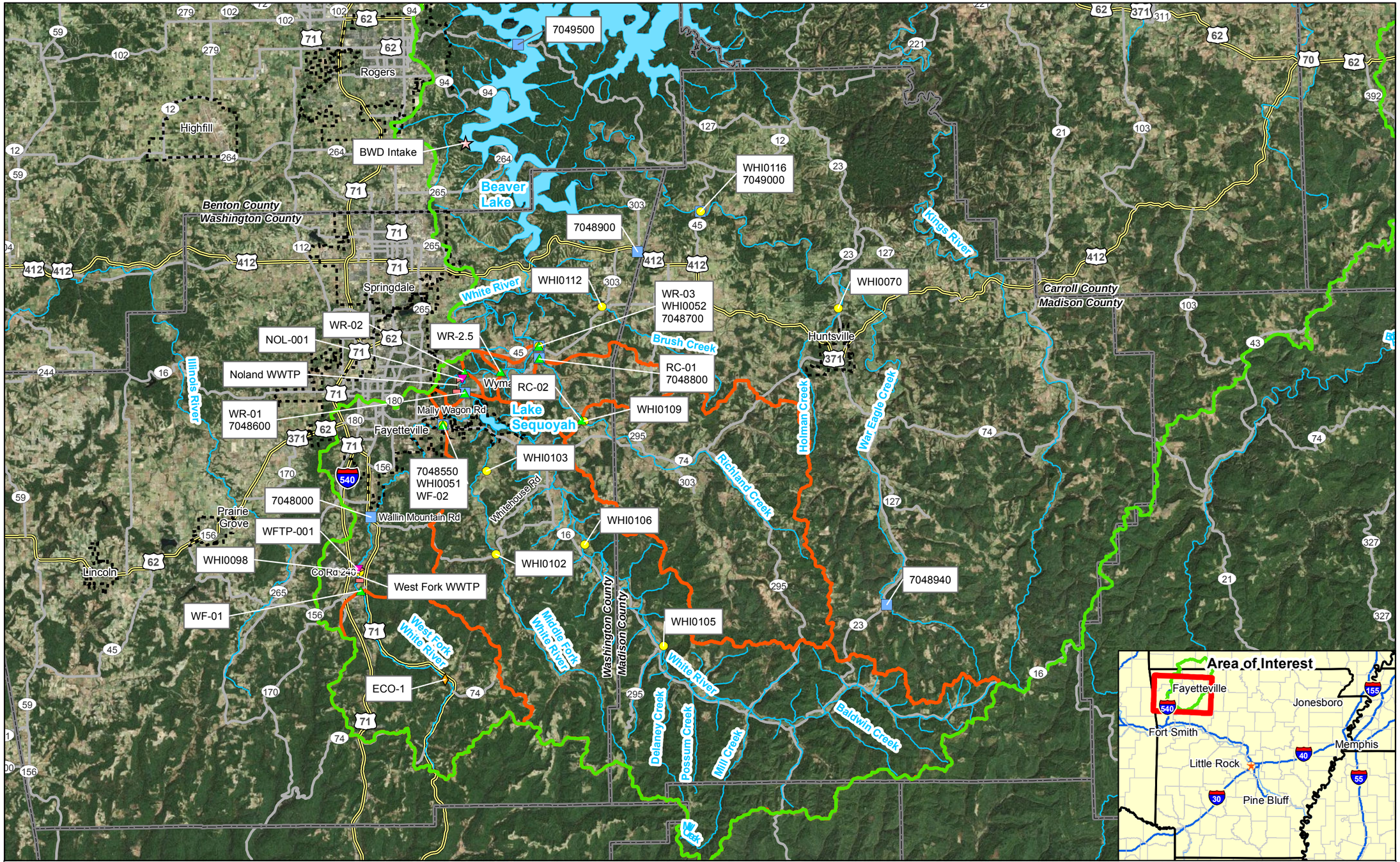
[b] Monthly water quality samples collected September 2011-May 2012

[c] Monthly water quality samples collected October 2011-May 2012

Based on site reconnaissance conducted in the spring of 2012, Station RC-01 was established as a reference location for the White River UAA field data collection. However, at the time of fish sampling (on September 13, 2011), the sampling reach was filled with substantial amounts of sand, resulting in a braided channel and imbedded substrate. The field team determined that Station RC-01 was not suitable as a reference site because of its degraded habitat. A more suitable site (designated Station RC-02) was identified, approximately 5 mi upstream of RC-01, near the County Road 79 bridge crossing. The drainage area at RC-02 (119 $mi^2$) is comparable to that of RC-01 (139 $mi^2$), and Station RC-02 has physical habitat similar to that of the sampling station immediately downstream of the Noland WWTP outfall (i.e., Station WR-02). Fish samples were collected from RC-02 in October 2011, benthic macroinvertebrates were collected during both macroinvertebrate assessments (October 2011 and March 2012), and monthly water quality sampling was initiated at this location in October 2011.

## 3.2 Monthly Water Quality Monitoring

During the period May 2011 through May 2012, the City of Fayetteville collected monthly water quality data from six instream locations and the Noland WWTP outfall. Samples were also collected from the station added on the White River (i.e., WR-2.5), during the period September 2011 through May 2012, and from the station added on Richland Creek (i.e., RC-02), during the period October 2011 through May 2012 (Table 3-1). Water quality monitoring included in situ measurements of DO, conductivity, turbidity, pH, and temperature, using a multi-parameter meter, and grab samples for analysis of TDS, chloride, and sulfate.




**Legend**

- ADEQ Stations
- ECO Stations
- UAA Stations
- USGS Stations
- Wastewater Treatment Plants
- Wastewater Treatment Plant Outfalls
- Highway
- Major Road
- Drainage Area (UAA Stations)
- HUC 11010001
- BWD Intake
- City Boundary
- County Boundary

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Figure 3-1
**White River UAA Monitoring Stations and Historical Water Quality Monitoring Stations**

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### 3.2.1 In Situ Measurements

Appendix C-2 includes the comprehensive in situ data set, as well as summary tables of average pH, temperature, conductivity, DO, and turbidity measured at each sampling station during monthly monitoring events.

Measurements of pH at all stations, during each event, were within the applicable WQC of 6.0 to 9.0 SU.

On July 19, 2011, the water temperature exceeded the state criterion of 29°C at all of the instream stations, with the exception of Station WR-02, located just downstream of Noland WWTP. On this date, instream water temperatures ranged from 28.3°C, at Station WR-02, to 31.9°C, at Station WR-03. The temperature recorded in the Noland WWTP effluent on July 19, 2011 was 27.0°C, which was consistent with several weeks of analysis and operations process control basin effluent temperatures. Effluent temperature data suggest that the Noland WWTP discharge reduces high instream temperatures in the White River, which may have a positive impact on biological communities requiring cooler water temperatures.

The instantaneous in situ DO concentrations at Station RC-01 were below 6 mg/L on two occasions, at WF-02 on five occasions, at WR-01 on three occasions, and at WR-02 on three occasions. In situ DO concentrations at WF-01 were below 5 mg/L on one occasion. Average concentrations at Station WF-02 were consistently lower than at other stations. Instantaneous DO measurements are not directly comparable to the DO criteria because ADEQ Regulation 2.505(C) specifies that during the critical season, DO concentrations may be 1.0 mg/L lower than the criteria for no more than 8 hours during a 24-hour period when stream temperature is above 22°C. See Section 3.3 for diurnal DO monitoring results.

Instream turbidity exceeded the baseflow or storm flow WQC (10 NTUs and 17 NTUs, respectively) on multiple occasions in the White River and on one occasion at Station WF-02. These events generally coincided with a spike in stream discharge (as measured at USGS 07048550) or with stream restoration, which was ongoing upstream of Station WR-2.5 during February and March 2012.

### 3.2.2 Mineral Concentrations

Tables in Appendix C-2 provide summary statistics for chloride, sulfate, and TDS concentrations measured at the sampling locations during monthly monitoring events. Figures 3-2 through 3-4 show the mineral concentrations measured during each event and provide a comparison of seasonal concentrations at the stations.

Existing site-specific chloride criteria (20 mg/L for the White River and West Fork White River) were exceeded on three occasions at WR-02 (July, September, and October 2011) and on two occasions at WR-2.5 and WR-03 (September and October 2011). Chloride concentrations in Richland Creek ranged between 3.1 and 5.1 mg/L, never exceeding the ecoregion reference value of 17.3 mg/L. Chloride concentrations at the Noland WWTP outfall ranged between 37.1 and 57.8 mg/L.

Existing site-specific sulfate criteria (20 mg/L for the White River and West Fork White River) were exceeded during 2 events at WF-01 (September and October 2011), during 12 events at WF-02 (June 2011 through May 2012), during 4 events at WR-01 (July, August, October, and November 2011), 6 events at WR-02 (June through November 2011), 3 events at WR-2.5 (September through November 2011), and 5 events at WR-03 (July through November 2011). Sulfate concentrations in Richland Creek ranged between 8.4 and 20.5 mg/L, never exceeding the ecoregion reference value of 22.7 mg/L. Sulfate concentrations at the Noland WWTP outfall ranged between 40.9 and 103.6 mg/L.

Existing site-specific TDS criteria (160 mg/L for the White River and 150 mg/L for the West Fork White River) were exceeded during 6 events at WF-02 (June through November 2011), 4 events at WR-02 (July through October 2011), and 2 events at WR-2.5 and WR-03 (September and October 2011). TDS concentrations in Richland Creek ranged between 58 and 164 mg/L, never exceeding the ecoregion reference value of 250 mg/L. TDS concentrations at the Noland WWTP outfall ranged between 296 and 376 mg/L.

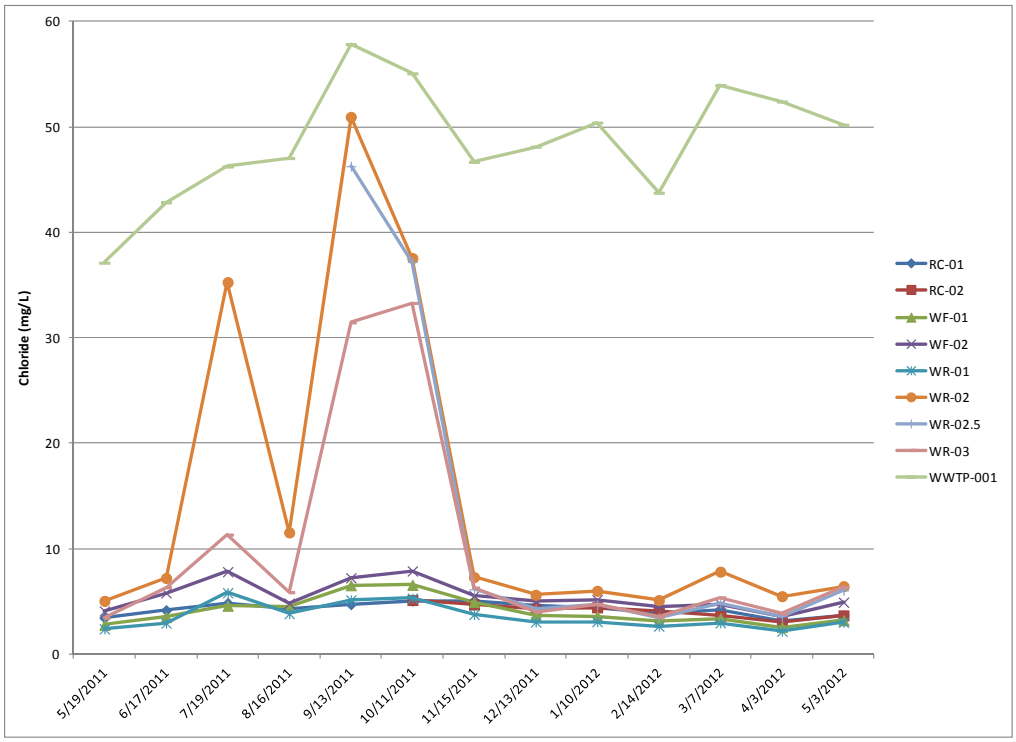


FIGURE 3-2
**Chloride Concentrations During Monthly Monitoring (May 2011 – May 2012)**

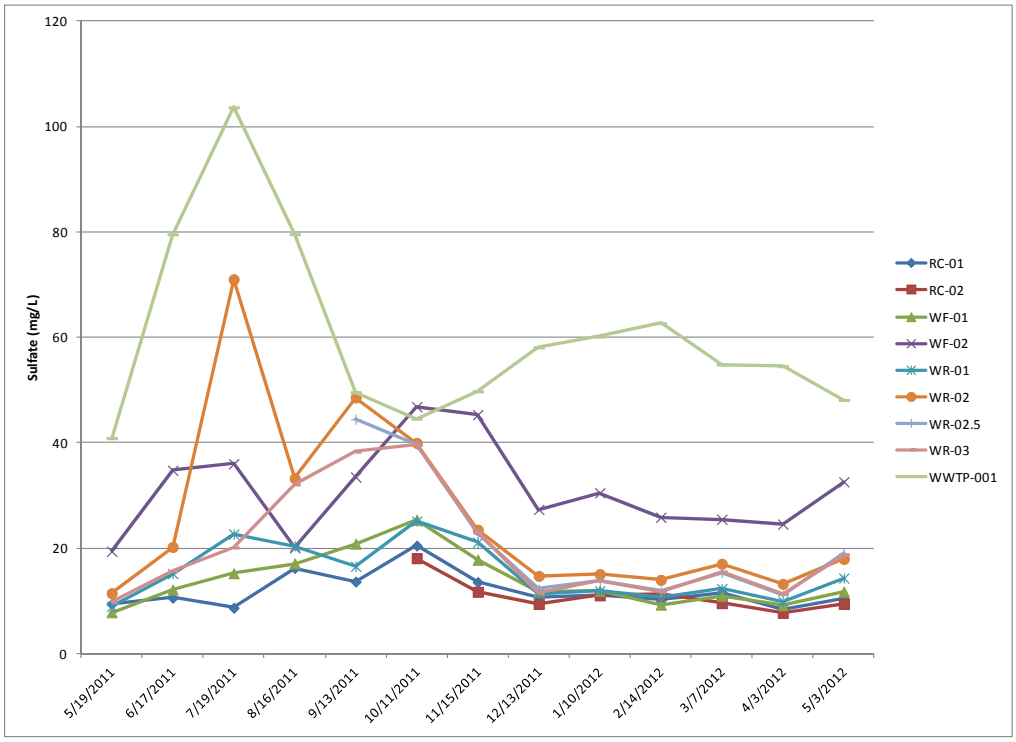


FIGURE 3-3
**Sulfate Concentrations During Monthly Monitoring (May 2011 – May 2012)**

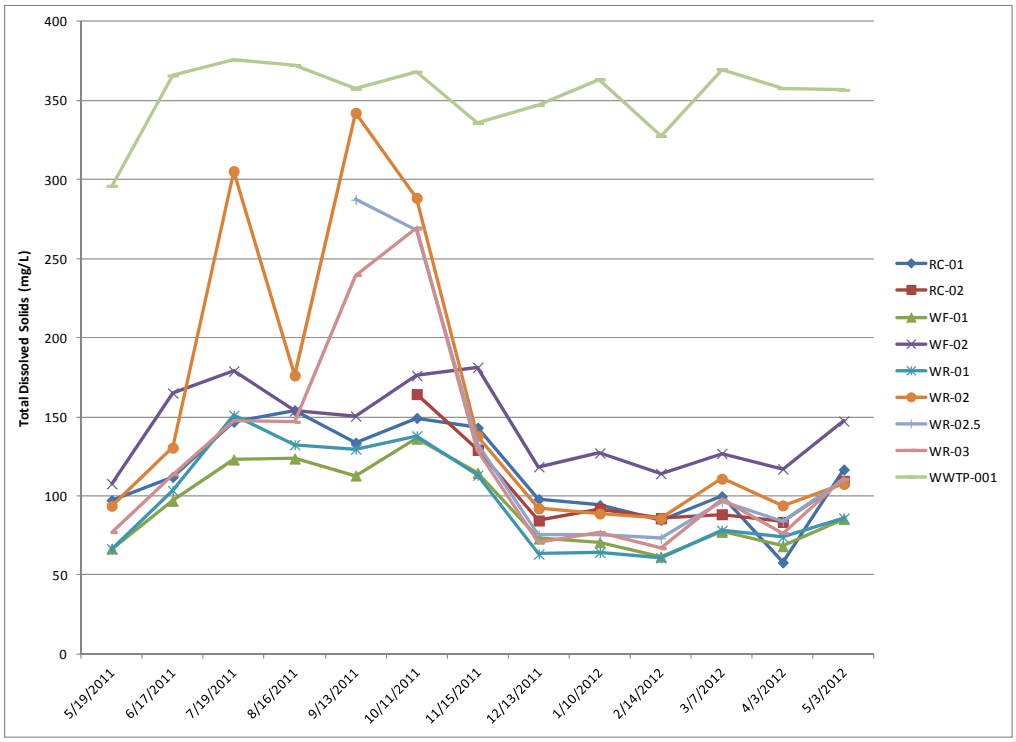


FIGURE 3-4
**TDS Concentrations During Monthly Monitoring (May 2011 – May 2012)**

## 3.3 Diurnal DO Monitoring

Appendix C-3 includes summary tables and raw data for the diurnal DO monitoring events. Figures 3-5 and 3-6 show the DO concentrations measured at the sampling stations during the fall (September and October) 2011 event, and Figure 3-7 shows the DO concentrations measured during the spring (April) 2012 event. As noted earlier, instantaneous DO measurements are not directly comparable to the DO criteria because ADEQ Regulation 2.505(C) specifies that during the critical season, DO concentrations may be 1.0 mg/L lower than the criteria for no more than 8 hours during a 24-hour period when stream temperature is above 22°C. The DO concentration fell below 6 mg/L (the applicable critical season DO criterion for watersheds greater than 100 $mi^2$) at Stations WR-01 and WR-02 during the September 2011 diurnal monitoring event, but did not fall more than 1 mg/L below this criterion. DO concentrations less than 6 mg/L occurred between 4:00 a.m. and 9:30 a.m. at both stations (for less than 8 hours). In addition, river temperatures during this monitoring period were greater than 22°C. Thus, DO criteria were met at both of these stations during the September event.

During September 2011, a DO sag was observed at all stations, with levels generally dropping between 4:30 p.m. and 8:00 a.m. and rising during daylight hours, between 8:00 a.m. and 4:30 p.m. (Figure 3-5). The greater diel variation in DO at Station WR-02 suggests that algal biomass is affecting the site. Station WR-02 likely experiences periods of low DO during periods of high temperatures and daytime cloud cover. At Station RC-02, which was sampled in October 2011, DO concentrations remained above 6 mg/L, and a smaller DO sag occurred (Figure 3-6).

White River flows were extremely low during the September DO survey (0.76 and 0.62 cfs on the 13$^{th}$ and 14$^{th}$, respectively, at Station WR-01 (see Table 3-6), which are lower than the Q7-10 of 0.8 cfs at this location. Such extremely low flows presumably had a substantial influence on water quality and biological conditions at this time.

During the April monitoring event, trends in DO concentrations were comparable among stations, while the DO concentrations at Stations WR-01 and WR-02 were low relative to Stations WR-2.5 and RC-02 (Figure 3-7). DO concentrations during this event also remained above the water quality criterion.

Net primary production (NPP) was estimated at each station as the total increase of DO from 6:30 a.m. (approximately 30 minutes before sunrise) until the DO values stopped rising. Total community respiration (TCR) was estimated as the total decrease in DO from 8:00 p.m. (approximately 30 minutes after sunset) until the DO values stopped decreasing or 30 minutes before the following sunrise, whichever came first. These calculations did not include adjustments for reaeration as a function of current velocity and channel morphology at each location. Therefore the estimates of NPP and TCR provided herein are best suited to indicate only relative differences in NPP and TCR among locations on comparable dates.

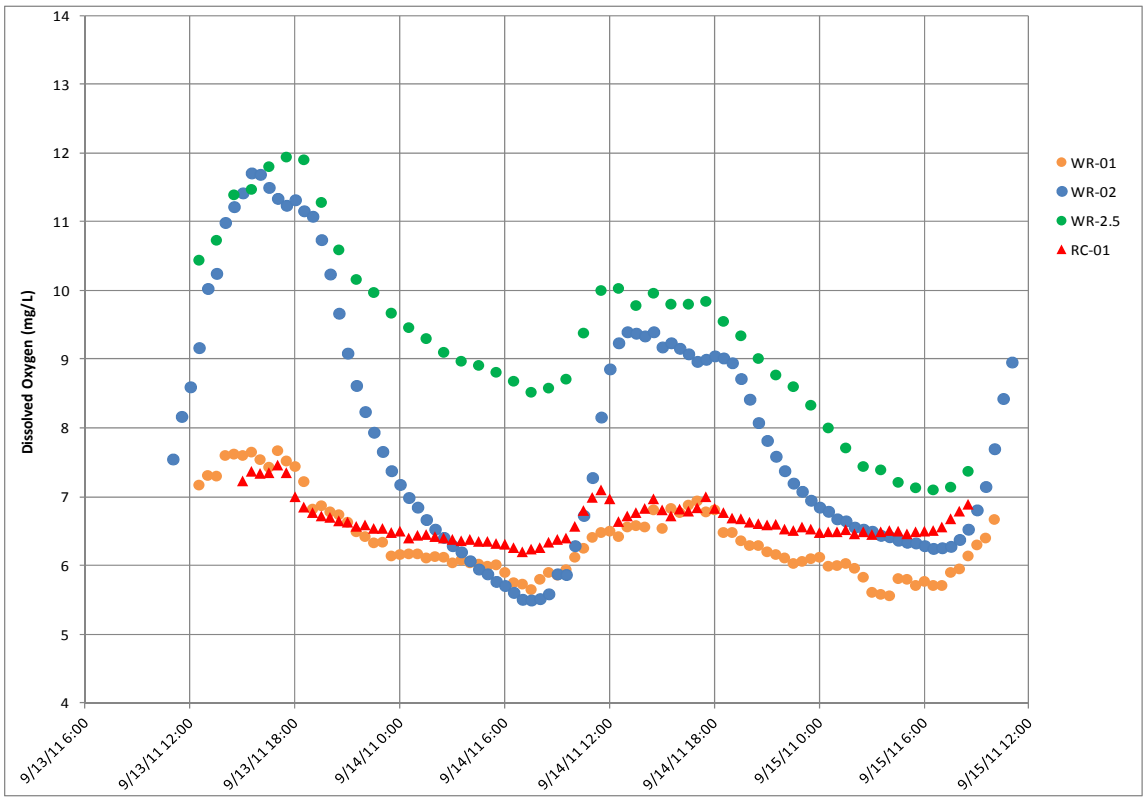


FIGURE 3-5
**Continuous Dissolved Oxygen Concentrations (September 2011)**

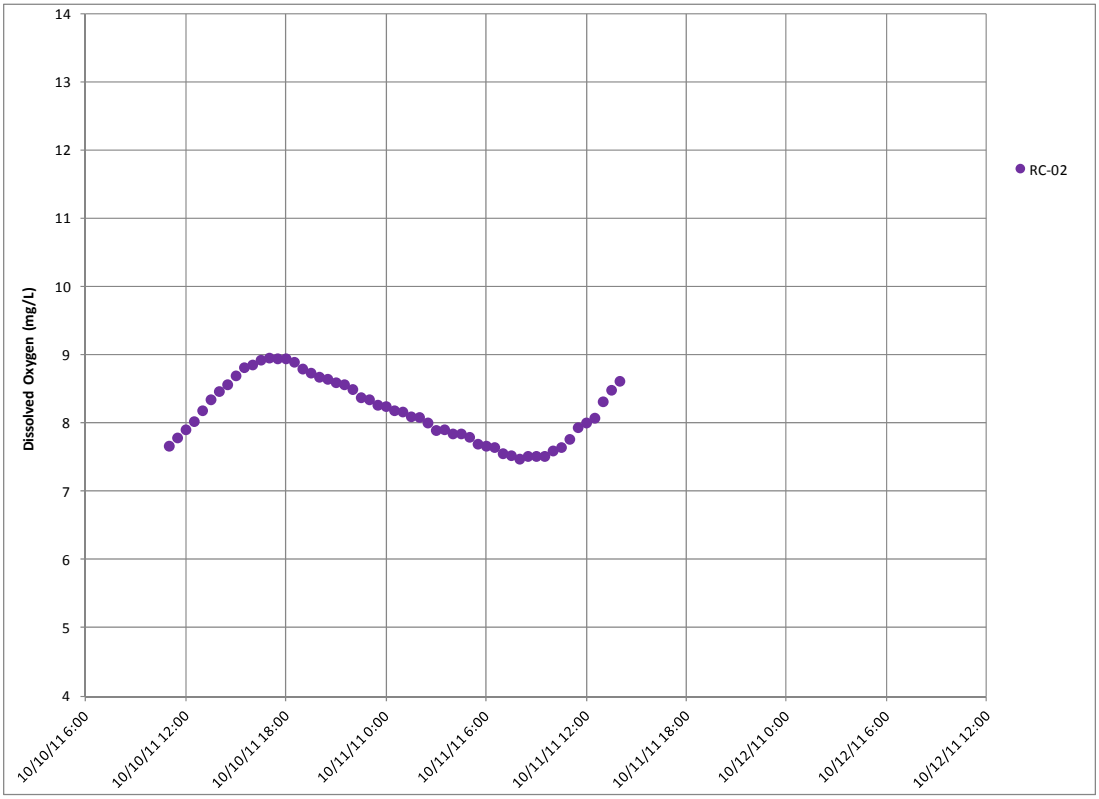


FIGURE 3-6

**Continuous Dissolved Oxygen Concentrations at Station RC-02 (October 2011)**

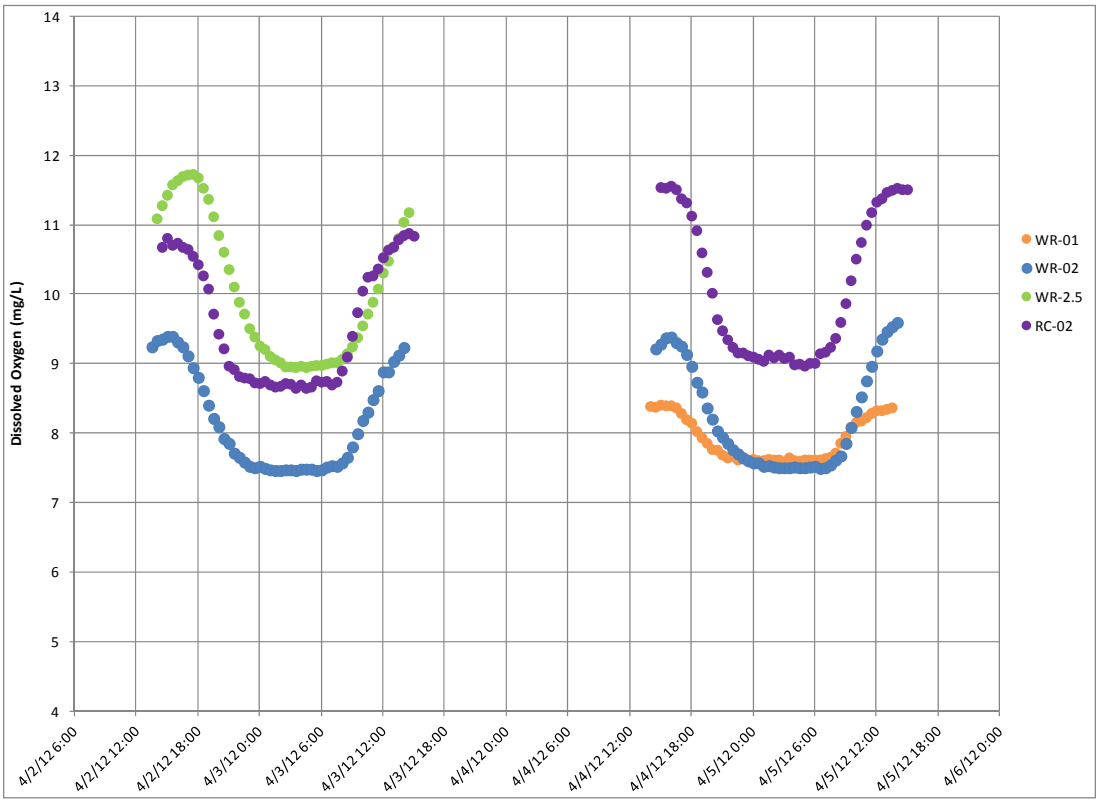


FIGURE 3-7

**Continuous Dissolved Oxygen Concentrations (April 2012)**

Estimated NPP, TCR, and their ratios are summarized in Appendix C-3. September monitoring shows substantially higher rates of both NPP and TCR at the stations downstream of the Noland discharge (WR-02 and WR-2.5) compared to the station upstream of the Noland discharge (WR-01) and reference locations (RC-01 and RC-02). The same pattern is evident in the April monitoring data at the WR stations, with lower overall values of both NPP and TCR at WR-01 compared to WR-02 and WR-2.5. Both NPP and TCR were higher during the April monitoring at the reference location (RC-02).

Higher rates of NPP and TCR would be expected in stream reaches with higher levels of nutrients such as those downstream of municipal wastewater discharges. The Noland WWTP NPDES permit requires a high degree of phosphorus removal (to less than 1.0 mg/L, with actual values generally much lower). Nonetheless, nutrient levels are still expected to be higher downstream of the WWTP, in particular during the September diurnal DO and biological surveys because river flows were extremely low during that period (less than the Q7-10 at times). Higher nutrients can be expected to result in higher levels of both autotrophic and heterotrophic biomass, which will cause greater diel and seasonal extremes in DO and pH. In general, production to respiration (P/R) ratios would be expected to show higher values during seasons of increasing biomass and lower values during season of biomass decline. This seasonality in P/R is not apparent in this data set and would require numerous additional monitoring periods to demonstrate. NPP and TCR show differences upstream and downstream of the Noland discharge that are consistent with expectations based on increased nutrient input from a municipal discharge or other sources of nutrient inputs (e.g., non point source runoff).

These results suggest that lower DO conditions might occur on occasions at WR-02 compared to WR-01, and that these conditions also improve at WR-2.5. DO criteria were met at all stations during the diurnal monitoring, even during the extremely low river flow period in September.

## 3.4 Physical Assessments

Physical habitat assessments and surface water quality physical characterizations were conducted on two occasions at five sampling stations (Table 3-1). Assessment procedures followed those outlined for high gradient streams in USEPA's *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish* (Barbour et al., 1999). The protocol is consistent with this current USEPA-approved assessment method, which was developed as an update to the previous Rapid Bioassessment Protocols (RBPs) (Plafkin et al., 1989). Field sheets for the physical characterization and physical habitat assessments, as well as representative photographs from the monitoring sites, are provided in Appendix C-4.

### 3.4.1 Physical Characterization

In accordance with Barbour et al. (1999), a surface water quality physical characterization is required whenever a physical habitat assessment is performed. The assessment is completed to assess the stream's ability to support biotic communities and to identify any chemical or non-chemical stressors to the stream. Observations noted during the physical characterization are useful for interpretation of water quality and biological monitoring results. Field sheets from the physical characterization as well as representative photographs from each sampling station are included in Appendix C-4. The following physical characteristics were observed at the sampling stations:

- Station WR-01:
  - Stream is approximately 25 ft wide, with very little tree canopy/shade
  - During the fall event, sampling reach was comprised of: 85% pools, 10% riffles, and 5% runs
  - During the spring event, sampling reach was comprised of: 40% pools, 20% riffles, and 20% runs
  - Substrate dominated by an even mix of bedrock, boulder, and cobble
  - Very little large woody debris present
  - During the fall event, approximately 20 percent of the downstream end of the reach (near Wyman Road) covered with attached and floating algae
  - During the spring event, only attached algae was present and covered < 1 percent of the reach

- Station WR-02:
  - Stream reach ranges from 20 to 200 ft wide, with very little tree canopy/shade
  - During the fall event, sampling reach was comprised of: 90% pools, 5% riffles, and 5% runs
  - During the spring event, sampling reach was comprised of: 70% pools, 15% riffles, and 15% runs
  - Dominant substrate is cobble
  - Fair amount of large woody debris present (100 to 300 square feet [$ft^2$] throughout the 1,500-ft reach)
  - During the fall event, at least 50% of the reach included floating algae, attached algae, rooted submergent vegetation, or rooted emergent vegetation, with algal mats floating on top of most pools and filamentous algae covering most pool bottoms; water willows were also present on sand bars and islands
  - During the spring event, 5% of the reach was covered in attached algae, rooted submergent vegetation, or rooted emergent vegetation; there was no floating algae present
- Station WR-2.5:
  - Stream reach is approximately 30 ft wide with at least 50-ft wide benches on both sides of the channel and very little tree canopy/shade
  - During the fall event, sampling reach was comprised of: 70% pools, 20% riffles, and 10% runs
  - During the spring event, sampling reach was comprised of: 45% pools, 25% riffles, and 30% runs
  - Dominant substrate is cobble
  - Small amount of large woody debris present (20 to 100 $ft^2$ throughout the 750-ft reach)
  - During the fall event, approximately 75% of the reach was covered in attached or floating algae, with algal mats floating on top of most pools and filamentous algae covering most pool bottoms; no rooted vegetation was present
  - During the spring event, 1% of the reach was covered in attached algae, with some rooted submergent and emergent vegetation present
- Station RC-01:
  - Stream reach is approximately 40 ft wide with partial tree cover over the stream
  - During the fall event, sampling reach was comprised of: 80% pools, 15% riffles, and 5% runs
  - During the spring event, sampling reach was comprised of: 55% pools, 25% riffles, and 20% runs
  - Dominant substrates are sand gravel, and riffle substrates are embedded
  - Fair amount of large woody debris present (150 $ft^2$ throughout the 1,600-ft reach)
  - Very small amount of aquatic vegetation present, with less than 2% of reach including attached algae
- Station RC-02:
  - Stream reach is approximately 30 ft wide with partial tree cover over the stream
  - During the spring event, sampling reach was comprised of: 30% pools, 40% riffles, and 30% runs
  - Dominant substrate is cobble
  - Fair amount of large woody debris present (50 $ft^2$ throughout the 750-ft reach)
  - Very small amount of aquatic vegetation present, with less than 1% of reach including attached algae

### 3.4.2 Physical Habitat

At each sampling station, the field team assigned each of 10 physical habitat metrics a score from 0 to 20, where scores from 0 to 5 are considered “Poor,” 6 to 10 are “Marginal,” 11 to 15 are “Suboptimal,” and 16 to 20 are “Optimal.” A total habitat score was calculated by summing the average scores of each metric (with the highest possible total score being 200 points), to represent an overall evaluation of the stream habitat based on substrates, habitat diversity and availability, riparian corridors, and streambank conditions.

Physical habitat scores did not demonstrate significant seasonal variation, with the exception of that at RC-01 (Table 3-2). During the spring sampling event, higher flows resulted in higher scores for embeddedness, sediment deposition, and channel flow status. This suggests that flows scoured previously deposited sediment that was observed during the fall sampling event. Station RC-01 also consistently had less epifaunal substrate and available cover than the other four stations. Physical habitat at the other four stations was comparable, with all stations scoring between 141 and 148 of a possible 200 points during the sampling events. Lower physical habitat metrics at these four stations tended to be bank stability and/or bank vegetative cover, while higher metrics tended to be epifaunal substrate/available cover, embeddedness, sediment deposition, and/or channel flow status.

It should be noted that while the reach morphology of Station WR-02 (based on channel width, average velocity, and percent pools) differs from that at the other White River stations, the overall physical habitat is comparable to other stations (Table 3-2). While the composition of substrates varied across White River stations, as did the volume of large woody debris, the overall physical habitat quality, based on 10 physical habitat parameters, was assessed as suboptimal at each White River sampling location. Epifaunal substrate was scored based on the composition of various cover types found at the stations, including but not limited to cobble, large woody debris, undercut banks, rooted aquatic vegetation, and any other available cover.

The reported scores for velocity/depth regime and channel flow status reflect the increase in flow between seasons, as well as the increase in flow downstream of the Noland WWTP discharge. The velocity/depth regime parameter is scored based on the number of velocity/depth regimes present, out of a possible four regimes: fast-shallow, slow-shallow, fast-deep and slow-deep. During fall 2011, two regimes were present at Station WR-01, three at WR-02, and four at Station WR-2.5. While the stream width in portions of the WR-02 sample reach was much larger than at other sites, the sample reach still included three velocity/depth regimes (i.e., included areas of shallow riffles, as well as deep and shallow pools).

Channel flow status is scored based on the how full (wetted) the channel is. Under low-flow conditions in September 2011, Station WR-02 (downstream of the Noland WWTP discharge) exhibited the largest channel flow status, which is to be expected due to the additional flow from the outfall discharge and the reach morphology that results in a large wetted width through much of the reach. At all other sites, the water filled approximately 50 percent of the stream channel. Under higher flow conditions in March 2012, water filled approximately 75 percent of the stream width within the reach at all locations.

TABLE 3-2
**Summary of Physical Habitat Assessment Results – Fall 2011 and Spring 2012**

| | WR-01 | | WR-02 | | WR-2.5 | | RC-01 | | RC-02 | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Metric [a]** | **Fall 2011** | **Spring 2012** | **Fall 2011** | **Spring 2012** | **Fall 2011** | **Spring 2012** | **Fall 2011** | **Spring 2012** | **Fall 2011** | **Spring 2012** |
| Epifaunal substrate/available cover | 14.5 | 15.0 | 16.5 | 16.0 | 17.5 | 18.0 | 10.0 | 11.0 | 16.0 | 16. 0 |
| Embeddedness | 16.5 | 16.0 | 17.5 | 17.0 | 18.0 | 18.0 | 5.5 | 9.0 | 13.0 | 16.0 |
| Velocity/depth regime | 10.0 | 12.0 | 13.5 | 16.0 | 18.5 | 19.0 | 14.0 | 14.0 | 14.0 | 13.0 |
| Sediment deposition | 18.5 | 17.0 | 16.5 | 15.0 | 17.0 | 15.0 | 7.0 | 12.0 | 16.0 | 16.0 |
| Channel flow status | 9.5 | 16.0 | 17.5 | 17.0 | 12.0 | 17.0 | 8.0 | 15.0 | 16.0 | 17.0 |
| Channel alteration | 19.0 | 17.0 | 18.5 | 17.0 | 19.5 | 17.0 | 16.0 | 16.0 | 15.0 | 14.0 |
| Frequency of riffles (or bends) | 13.5 | 15.0 | 8.5 | 10.0 | 17.0 | 16.0 | 9.0 | 11.0 | 11.0 | 11.0 |
| Bank stability | 12.5 | 12.0 | 7.0 | 8.0 | 5.0 | 7.0 | 10.5 | 12.0 | 14.0 | 13.0 |
| Vegetative protection | 14.5 | 13.0 | 11.5 | 11.0 | 11.0 | 9.0 | 13.5 | 12.0 | 12.0 | 9.0 |
| Riparian vegetative zone width | 13.0 | 15.0 | 19.0 | 19.0 | 8.0 | 5.0 | 13.0 | 14.0 | 16.0 | 17.0 |
| **Total Physical Habitat Score [b]** | **141.5** | **148.0** | **146.0** | **146.0** | **143.5** | **141.0** | **106.5** | **126.0** | **143.0** | **142.0** |

[a] Metrics are scored from 0 to 20; 0-5= Poor, 6-10 = Marginal, 11-15 = Suboptimal, 16-20 = Optimal
[b] Out of a possible 200 points

# 3.5 Benthic Macroinvertebrate Community Assessments

Benthic macroinvertebrates were sampled at five locations during fall 2011 and spring 2012. Sampling followed the multi-habitat approach provided in USEPA's RBPs (Barbour et al., 1999), as outlined in the FSP. The RBPs involve obtaining samples collected from the various habitats for analysis and data evaluation, an approach that maximizes the efficiency of field work and provides the broad-based information necessary to make the best assessment of biotic integrity as it relates to stream conditions. In situ measurements and grab samples were collected during each event, to document any adverse water quality that might be affecting the aquatic communities.

## 3.5.1 Water Quality During Benthic Macroinvertebrate Assessments

Tables in Appendix C-5 summarize the water quality at each sampling station during benthic macroinvertebrate assessments. During the macroinvertebrate community assessments, mineral concentrations and conductivity were comparable among Stations RC-01, RC-02 and WR-01. Mineral concentrations and conductivity were comparable among and relatively high at Stations WR-02 and WR-2.5. Minerals concentrations were higher during the fall sampling event. DO was low relative to other sampling stations and was below the state criterion at Station WR-01.

## 3.5.2 Macroinvertebrate Communities

Macroinvertebrates were identified to lowest practical taxonomic level and enumerated to conduct macroinvertebrate assessments. Data analysis included an evaluation of various metrics representing different components of community structure and/or function that cumulatively provide a measure of biotic integrity. Representative metrics include those in four primary categories: (1) richness measures for diversity or variety of the assemblage; (2) composition measures for identity and dominance; (3) tolerance measures that represent sensitivity to perturbation; and (4) trophic or habit measures for information on feeding strategies and guilds. In accordance with ADEQ guidance (ADEQ, 2010), the Family Biotic and Hilsenhoff Biotic Indices (FBI and HBI) were calculated for each sample. Summaries of water quality and organic pollution implications for these indices are provided in Appendix C-5. Appendix C-5 also includes the raw data and summary tables from each sampling event.

Figures 3-8 through 3-11 summarize the composition of the benthic macroinvertebrate communities at each station, during each of the two sampling events. Table 3-3 summarizes selected metrics for each site. A summary of key observations, based on community composition and selected metrics, is provided in Table 3-4.

As stated in ADEQ (2010), until a Macroinvertebrate Biological Monitoring Index is developed and critiqued, an upstream/downstream comparison of communities should be made with taxa richness, number of EPT taxa, percent dominant taxa, and HBI being strong indicators of perturbation/ degradation. A comparison among stations suggests the following:

- The HBI and FBI water quality categories at Stations WR-01 (upstream of Noland) and WR-02 (downstream of Noland) are "fairly poor" to "fair." Station WR-2.5 was rated "Fair," based on both indices, during both events.
- During both sampling events, the number of EPT observed was greater at locations upstream and downstream of Station WR-02 than at Station WR-02. During the fall sampling event, the number of EPT taxa at Richland Creek stations was comparable to the number at WR-01 and WR-2.5. During the spring sampling event, the number of EPT taxa in Richland Creek was higher than at the White River stations.
- During both sampling events, the taxa richness at Station WR-02 was smaller than the taxa richness at all other sampling stations. During the fall sampling event, White River stations showed similar proportions of Chironomidae taxa and individuals. During the fall sampling event, the proportion the population as Coleoptera (beetles) increased from WR-01 to WR-02.
- The percent dominant taxa increases while taxa richness and the number of EPT taxa decrease from Station WR-01 to Station WR-02 indicative of less diverse communities at Station WR-02.

- Based on taxa richness, number of EPT taxa, percent dominant taxa, and HBI, the benthic macroinvertebrate community at Station WR-2.5 (approximately 2.7 mi downstream of the Noland WWTP outfall) is comparable to communities upstream of the Noland WWTP and to those in Richland Creek. Therefore, impacts to benthic macroinvertebrate communities are isolated to directly downstream (as evidenced 0.4 mi downstream) of the Noland WWTP outfall.

TABLE 3-3
**Summary of Selected Benthic Macroinvertebrate Community Metrics**

| Metric | WR-01 | | WR-02 | | WR-2.5 | | RC-01 | | RC-02 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Fall 2011 | Spring 2012 | Fall 2011 | Spring 2012 | Fall 2011 | Spring 2012 | Fall 2011 | Spring 2012 | Fall 2011 | Spring 2012 |
| Number of Taxa | 43 | 30 | 24 | 19 | 25 | 26 | 35 | 25 | 36 | 33 |
| Water Quality Category based on HBI [a] | Fairly Poor | Fair | Fairly Poor | Fairly Poor | Fair | Fair | Fair | Fairly Poor | Fair | Fair |
| Water Quality Category based on FBI [b] | Fairly Poor | Fairly Poor | Fair | Fairly Poor | Fair | Fair | Good | Fairly Poor | Fair | Fair |
| EPT Taxa | 12 | 9 | 5 | 6 | 10 | 8 | 10 | 13 | 12 | 15 |
| Predator Taxa | 9 | 5 | 3 | 2 | 3 | 2 | 4 | 3 | 6 | 4 |
| Filterer Taxa | 3 | 5 | 1 | 3 | 5 | 4 | 5 | 2 | 2 | 2 |
| Scraper Taxa | 4 | 5 | 4 | 1 | 3 | 5 | 3 | 4 | 5 | 5 |
| Shredder Taxa | 4 | 3 | 4 | 2 | 2 | 3 | 6 | 3 | 4 | 4 |
| Clinger Taxa | 9 | 9 | 6 | 6 | 9 | 8 | 6 | 5 | 7 | 14 |
| Intolerant Taxa (T.V. <=3) | 5 | 7 | 1 | 1 | 2 | 2 | 2 | 3 | 4 | 6 |
| Tolerant Taxa (T.V. >=7) | 10 | 5 | 9 | 5 | 5 | 6 | 12 | 6 | 8 | 7 |

EPT = Ephemoptera, Plecoptera, Trichoptera
T.V. = Tolerance Value
[a] With regional modification, as allowed by Hilsenhoff (1987); qualitative categories based on Hilsenhoff (1987)
[b] Qualitative categories based on Hilsenhoff (1988)

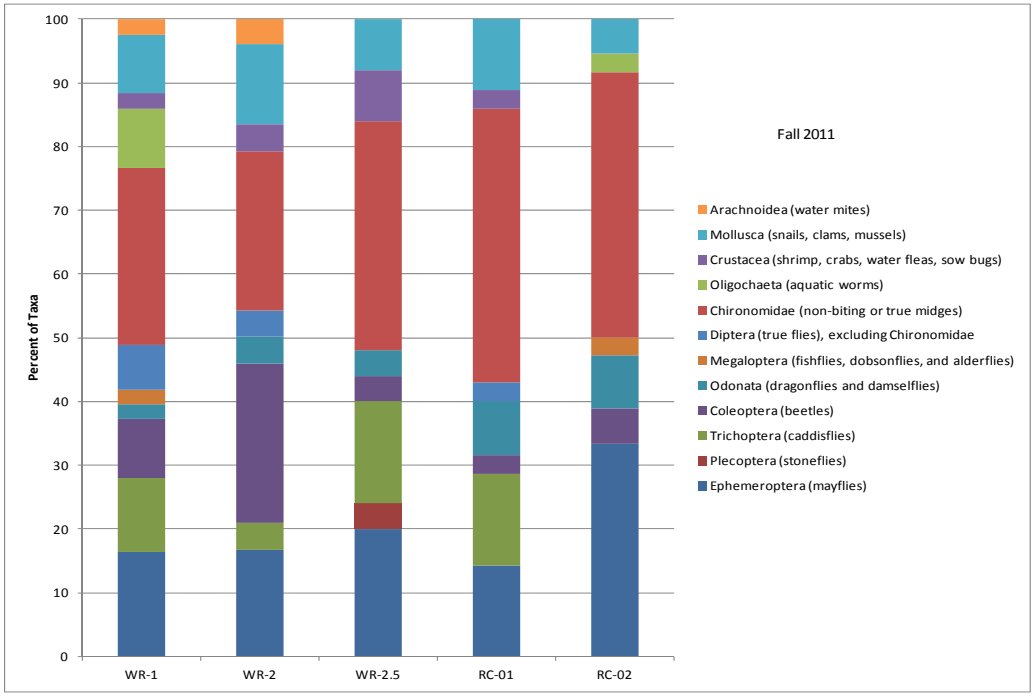


FIGURE 3-8
**Benthic Macroinvertebrate Taxa Composition (Fall 2011)**

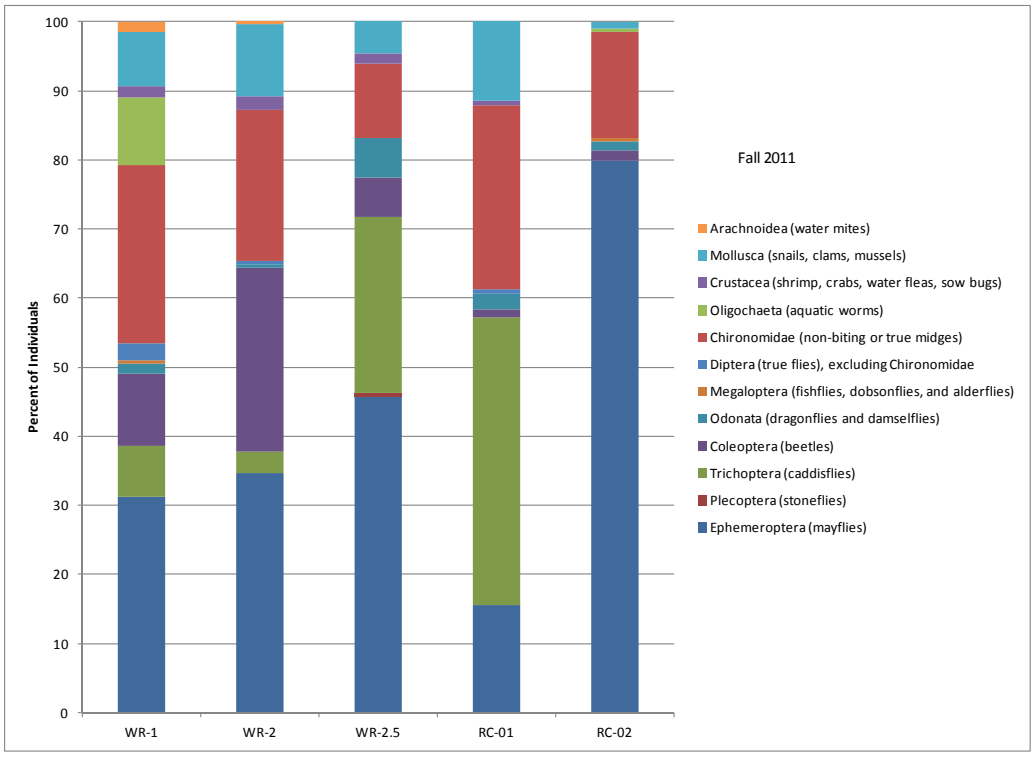


FIGURE 3-9
**Benthic Macroinvertebrate Individual Composition (Fall 2011)**

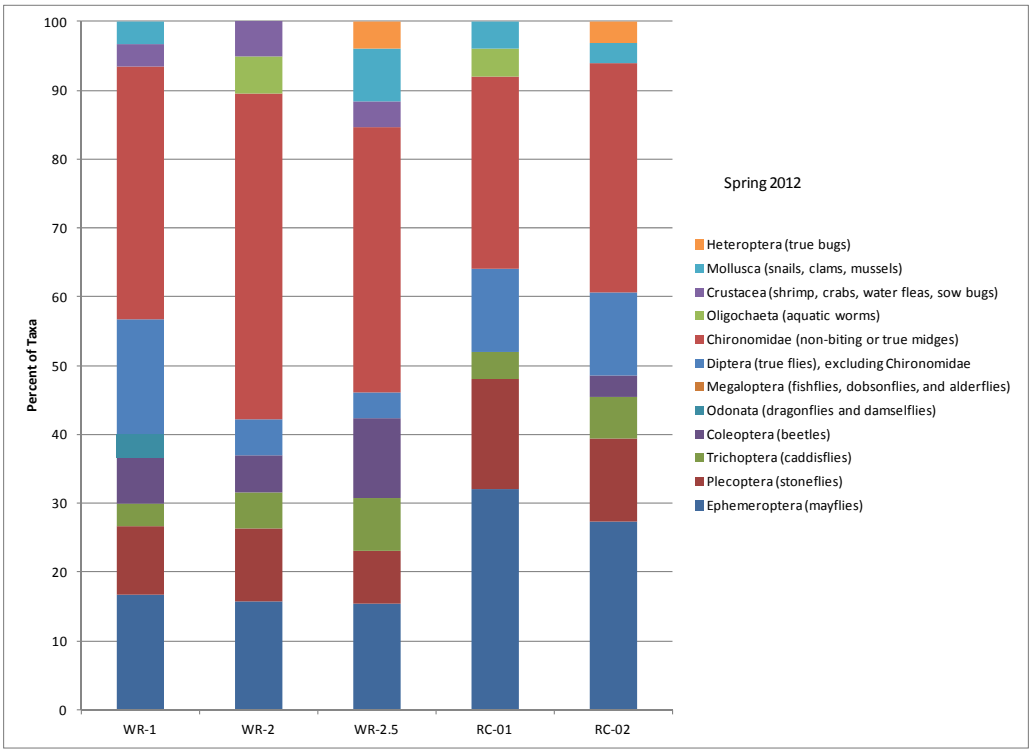


FIGURE 3-10
**Benthic Macroinvertebrate Taxa Composition (Spring 2012)**

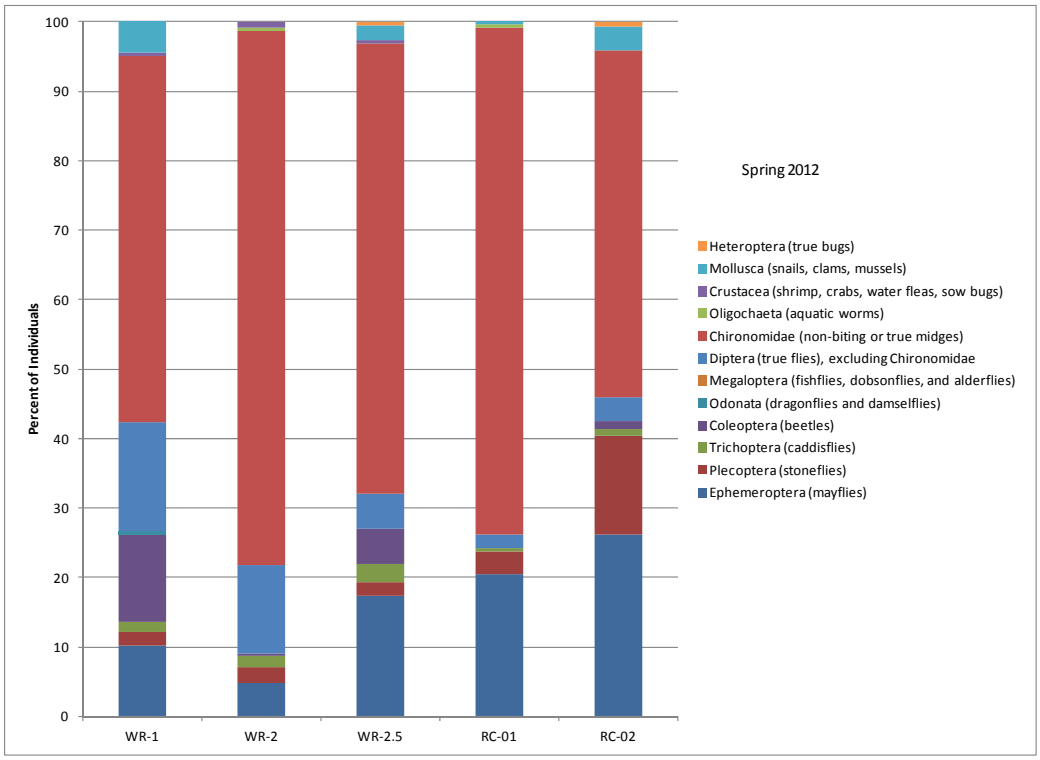


FIGURE 3-11
**Benthic Macroinvertebrate Individual Composition (Spring 2012)**

TABLE 3-4
**Benthic Macroinvertebrate Community Station Observations**

| Sampling Station | Station Observations |
|---|---|
| WR-01 | – Based on HBI and FBI, water quality conditions are “fairly poor” to “fair”<br>– Fall 2011 – dominated by Ephemoptera and Chironomidae<br>– Spring 2012 – EPT decreased and 53% of sample is Chironomidae<br>– Greatest number of taxa during fall 2011<br>– Dominated by clingers |
| WR-02 | – Based on the HBI and FBI, water quality conditions are “fairly poor” to “fair”<br>– Fall 2011 – dominated by Ephemoptera, Coleoptera, and Chironomidae<br>– Spring 2012 – EPT decreased and 77% of sample is Chironomidae<br>– Lowest number of taxa during both events<br>– Dominated by clingers |
| WR-2.5 | – Based on the HBI and FBI, water quality conditions are “fair”<br>– Fall 2011 – dominated by Ephemoptera and Trichoptera<br>– Spring 2012 – EPT decreased and 65% of sample is Chironomidae<br>– Dominated by clingers |
| RC-01 | – Based on the HBI and FBI, water quality conditions are “fairly poor” to “good”<br>– Fall 2011 – dominated by Trichoptera and Chironomidae<br>– Spring 2012 – EPT decreased and 73% of sample is Chironomidae<br>– Dominated by clingers |
| RC-02 | – Based on the HBI and FBI, water quality conditions are “fair”<br>– Fall 2011 – dominated by Ephemoptera<br>– Spring 2012 – EPT decreased and 50% of sample is Chironomidae<br>– Greatest number of taxa during spring 2012<br>– Dominated by scrapers and clingers |

# 3.6 Fish Community Assessment

Fish sampling was conducted in fall 2011 at five locations, in accordance with USEPA RBPs (Plafkin et al., 1989; Barbour et al., 1999), and as outlined in the UAA Field Plan. The RBPs involves using standard field techniques, species identification, enumeration, specimen external examination, and assignment of ratings to a variety of fish community attributes (metrics), which are summed to obtain an overall measure of biotic integrity. ADEQ protocols for evaluating the fisheries designated use attainment in the Ozark Highlands ecoregion of Arkansas were used to evaluate the health of the fish communities at each sampling station. In situ measurements and grab samples were collected during each event, to document any adverse water quality that might be affecting the aquatic communities.

## 3.6.1 Water Quality During Fish Community Assessments

Tables in Appendix C-6 summarize the water quality at each sampling station during the fish community assessments conducted in fall 2011. During the fish community assessments, mineral concentrations and conductivity were comparable among Stations RC-01, RC-02 and WR-01. Mineral concentrations and conductivity were comparable among and relatively high at Stations WR-02 and WR-2.5. DO was low relative to other sampling stations and was below the state criterion at Station WR-02.

## 3.6.2 Fish Communities

Appendix C-6 includes the raw data from fish sampling, as well as tables summarizing the relative species abundance, for all species collected at the five sampling locations.

Arkansas' evaluation protocols specify that waterbodies are supporting fish communities if the fish IBI score is either highly, generally, or fairly similar to the ecoregion least-disturbed condition and there is a general presence of sensitive and indicator species. For the Ozark Highlands Ecoregion, streams supporting the fisheries use have "diverse communities of indigenous or adapted species of fish and other forms of aquatic life. Fish communities are characterized by a preponderance of sensitive species and normally dominated by a diverse minnow community followed by sunfishes and darters." Based on the fish community assessment conducted for this UAA, all stations are dominated by minnows, sunfish, and darters (Figures 3-12 and 3-13).

APCEC (2011) identifies nine fish species as Ozark Highlands "key" species, or those generally dominant within a group (e.g., family, feeding structure), in the Ozark Highlands Ecoregion. Of these, five were observed during the fish community assessment:

- Duskystripe shiner at all 5 stations
- Northern hogsucker at WR-02, WR-2.5, and RC-01
- Smallmouth bass at WR-01
- Slender madtom at WR-01, WR-2.5, RC-01, and RC-02
- Rainbow darter at all 5 stations

APCEC (2011) identifies nine fish species as Ozark Highlands "indicator" species, or those that are prevalent in the Ozark Highlands Ecoregion. Of these, two were observed during the fish community assessment:

- Ozark madtom at WR-02 and WR-2.5
- Ozark minnow at all 5 stations

Figures 3-12 and 3-13 summarize family composition, and Table 3-5 provides the ADEQ metric ratings for the fish communities as well as other selected metrics. The first five sub-metrics that are used to calculate the IBI score (percent sunfish, percent minnows, percent darters, percent herbivores and catch per unit effort [CPUE]) show a change in the fish community immediately downstream of the Noland WWTP outfall, with fewer sunfish, darters, and total taxa and more minnows and herbivores. The increase in herbivores and minnows is predominantly due to an increase in stonerollers, which are herbivorous minnows. At Station WR-2.5 (located approximately 2.2 mi downstream of Station WR-02), fish communities are comparable to those at WR-01, upstream of Noland WWTP. While changes are apparent downstream of the outfall, the changes in the metrics referenced (percent sunfish,

percent minnows, percent darters, percent herbivores and CPUE) are not all indicative of a downward trend. The ADEQ fish biocriteria indicate that the sampling reaches are "somewhat similar" (as defined by ADEQ) at WR-01 and "generally similar" (as defined by ADEQ) at the other sampling stations. Based on ADEQ's Biological Integrity Evaluation Protocol (Table 2-4), the index scores at every station suggest stream reaches that are "supporting" the fisheries designated use, based fish community data only.

TABLE 3-5
**Summary of Selected Metrics for Fish Communities – Fall 2011[a]**

| Metric Category | WR-01 | WR-02 | WR-2.5 | RC-01 | RC-02 |
|---|---|---|---|---|---|
| Shannon-Weaver Diversity Index | 3.01 | 3.36 | 3.45 | 3.40 | 2.4 |
| Number of Species | 21 | 22 | 29 | 31 | 19 |
| Number of Key Species | 4 | 3 | 4 | 4 | 3 |
| Number of Indicator Species | 1 | 2 | 2 | 1 | 1 |
| Total Individuals | 700 | 615 | 1,385 | 3,124 | 638 |
| CPUE | 170 | 48 | 108 | 145 | 119 |
| ADEQ Index Scores for Fish Communities | 23 | 25 | 29 | 27 | 25 |
| Qualitative Category [b] | Somewhat Similar | Generally Similar | Generally Similar | Generally Similar | Generally Similar |

[a] RC-02 sampled October 11, 2011; all other samples collected September 13-14, 2011
[b] 37-45 = Mostly Similar; 25-36 = Generally Similar; 13-24 = Somewhat Similar; 0-12 –Not Similar

The fish communities at WR-01 and WR-02 were very similar with respect to the percentages of both total taxa and total individuals within each family. Although the total taxa and total individuals within each family were similar, there was a shift in dominance of individuals from centrarchids at WR-01 to cyprinids at WR-2. A 72 percent decrease was observed in CPUE from WR-01 to WR-02, which could indicate a decrease in abundance of fishes at WR-02; however, the relatively wide stream channel at Station WR-02 likely allowed more fish to avoid the electroshocker and contributed to the low CPUE. Although CPUE decreased 72 percent from WR-01 to WR-2, CPUE increased 56 percent from WR-02 to WR-2.5. This CPUE increase, along with a more similar family relative abundance, suggests that WR-2.5 is more similar to WR-01 than to WR-02. Biocriteria scores (Table 3-5) also suggest an improvement in fish community quality further downstream of the outfall. The fish communities upstream and downstream of the Noland WWTP outfall are rated as "somewhat similar" (upstream) and "generally similar" (downstream), which is indicative of a sampling reach that supports a healthy fish community (Table 2-4).

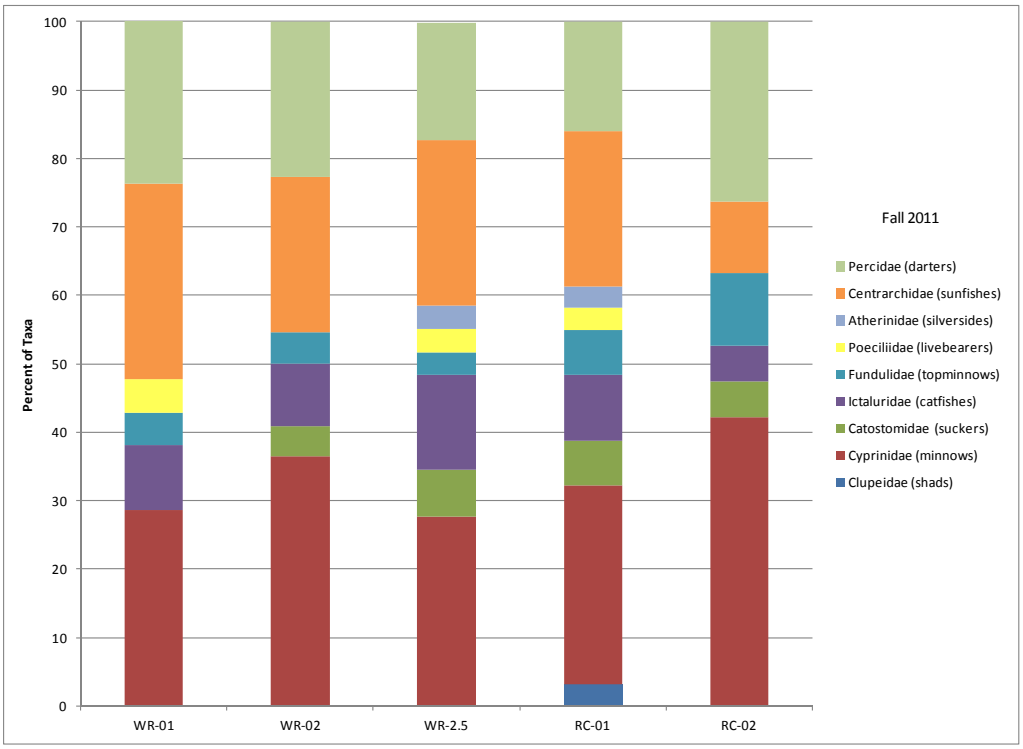


FIGURE 3-12
**Fish Taxa Composition (Fall 2011)**

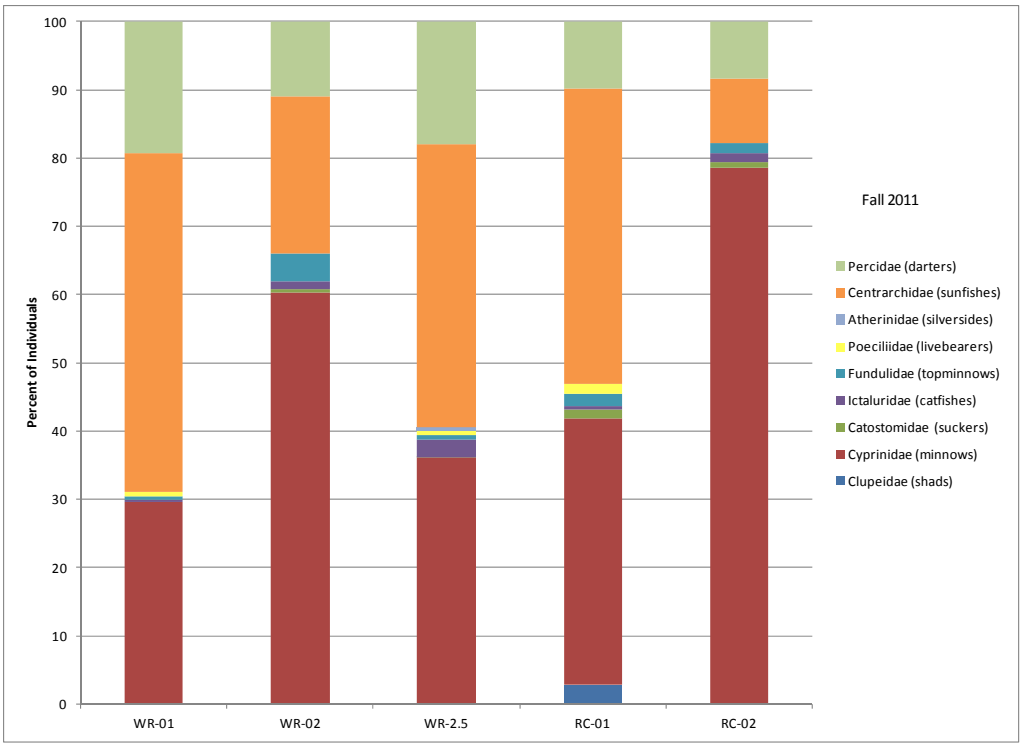


FIGURE 3-13
**Fish Individual Composition (Fall 2011)**

Based on fish community data collected for this UAA, Arkansas' evaluation protocols, and the key and indicator species identified, Reach 23 of the White River is supporting healthy fish communities. Fish communities in the White River at Station WR-02 (0.4 mi downstream of the Noland WWTP outfall) and Station WR-2.5 (2.7 mi downstream of the Noland WWTP outfall) were rated "generally similar;" while the fish community at Station WR-01 (White River at Wyman Road, upstream of the Noland WWTP outfall) was rated "somewhat similar." Additionally, during the 2011 survey, five key species were observed (duskystripe shiner, northern hogsucker, slender madtom, smallmouth bass, and rainbow darter), and two indicator species were observed (Ozark minnow and Ozark madtom). Of these, all except the slender madtom and smallmouth bass were found at WR-02, just downstream of Outfall 001. The smallmouth bass was only observed at Station WR-01 (0.1 percent of the sample), and the slender madtom was observed at the other three stations, also in small proportion (0.1 percent at WR-01, 1.0 percent at WR-2.5, and 0.3 percent at RC-01). Based on ADEQ guidance, the fish community at Station WR-02 is representative of an Ozark highlands fishery; not all indicator or key species are necessary for demonstration of a representative fishery (ADEQ, 2010).

## 3.7 Streamflow Calculations

As detailed in the UAA Field Plan, streamflow was estimated at each station during the water quality and biological monitoring (specific methods for each site summarized in Table 3-1). Streamflow calculations were used in the estimation of existing minerals loadings (Section 4), and applicable results are provided in this section.

Table 3-6 lists flow conditions at WR-01 and the Noland WWTP Outfall 001 during the UAA sampling events. During all 16 sampling events, the daily average flow in the White River at WR-01 was below the long-term monthly average flow. Flows from Outfall 001 exceeded the White River flow just upstream of the discharge during sampling events in July, September, and October 2011. These 3 months included water quality sampling, fish community and physical habitat assessments, and benthic macroinvertebrate sampling. Flow in the White River during the May 3, 2012 water quality sampling event was unusually low compared to typical flows during May.

TABLE 3-6
**White River (Station WR-01) and Noland WWTP (Outfall 001) Flow Conditions during UAA Sampling Events**

| | | White River Flow[b] | | Noland WWTP Outfall 001 Daily Flow | |
|---|---|---|---|---|---|
| UAA Sampling Dates | Event Type[a] | Daily Average[c] (cfs) | Monthly Average[d] (cfs) | (cfs) | (mgd) |
| 5/19/2011 | WQ | 579 | 912 | 15.4 | 9.9 |
| 6/17/2011 | WQ | 77 | 425 | 7.4 | 4.8 |
| 7/19/2011 | WQ | 1.6 | 119 | 4.3 | 2.8 |
| 8/16/2011 | WQ | 27 | 45 | 9.1 | 5.9 |
| 9/13/2011 | WQ, Fish | 0.76 | 154 | 9.8 | 6.3 |
| 9/14/2011 | Fish, Diurnal DO | 0.62 | 154 | 9.6 | 6.2 |
| 10/11/2011 | WQ, BM | 5.9 | 266 | 9.1 | 5.9 |
| 11/15/2011 | WQ | 184 | 588 | 13.9 | 9.0 |
| 12/13/2011 | WQ | 372 | 654 | 10.8 | 7.0 |
| 1/10/2012 | WQ | 147 | 532 | 7.2 | 4.6 |
| 2/14/2012 | WQ | 373 | 766 | 11.4 | 7.4 |
| 3/7/2012 | WQ, BM | 117 | 1,044 | 9.5 | 6.1 |
| 4/2/2012 | Diurnal DO | 340 | 1,196 | 9.4 | 6.1 |
| 4/3/2012 | WQ | 294 | 1,196 | 12.6 | 8.2 |
| 4/4/2012 | Diurnal DO | 272 | 1,196 | 12.3 | 8.0 |
| 5/3/2012 | WQ | 18 | 912 | 7.2 | 4.6 |

[a] WQ = water quality; Fish = fish community and physical habitat; BM = benthic macroinvertebrate.
[b] Based on data from USGS Station 07048600, White River near Fayetteville, AR.
[c] Beginning October 11, 2011, the USGS daily flow values are provisional.
[d] Based on water years 1964 through 2011.

Table 3-7 lists monthly average flows in the White River at WR-01 spanning the UAA sampling period and the period of record for the USGS gage at that location (Station 07048600). The monthly average flows during the UAA sampling period were below the long-term average for 8 out of 13 months. Five of the eight below-average months were only 10 percent or less of the respective, long-term monthly average flow. Monthly average flows during June 2011 through October 2011 were all below the long-term averages; however, July, September, and October flows were especially low, ranging from 3 to 7 percent of the respective, long-term average flow.

TABLE 3-7
**White River Monthly Average Flows at WR-01 during the UAA Sampling Period and the USGS Gage (07048600) Period of Record**

| | Monthly Average Flow[a,b] | | | |
|---|---|---|---|---|
| | **2010** | **2011** | **2012** | **1964 -2011[c]** |
| January | | 129 | 680 | 532 |
| February | | 638 | 594 | 766 |
| March | | 548 | 1,242 | 1,044 |
| April | | 4,016 | 122 | 1,196 |
| May | | 2,924 | 11 | 912 |
| June | | 145 | | 425 |
| July | | 4 | | 119 |
| August | | 20 | | 45 |
| September | | 11 | | 154 |
| October | 25 | 12 | | 266 |
| November | 83 | 756 | | 588 |
| December | 96 | 855 | | 654 |

[a]Based on USGS data from Station 07048600, White River near Fayetteville, AR.
[b]From October 2011 forward, values are computed from provisional USGS data.
[c]Monthly average by water year.

Figure 3-14 shows a pair of flow frequency curves based on daily average values from the USGS gage (Station 07048600) on the White River (WR-01) a short distance upstream of the Noland WWTP Outfall 001 discharge point. The two frequency curves illustrate the similarity of flow characteristics during the period of record for the USGS gage and the shorter, but representative data period used for the UAA study. As of the date of this report, daily values beginning on October 6, 2011 are classified by the USGS as provisional.

Figure 3-15 illustrates the representativeness of the annual average flows in the White River at WR-01 (USGS 07048600) during water years 2006 through 2011 compared to the long-term record of 44 years. Water year 2006 had the third-lowest annual average flow on record, and water year 2008 had the fifth-highest.

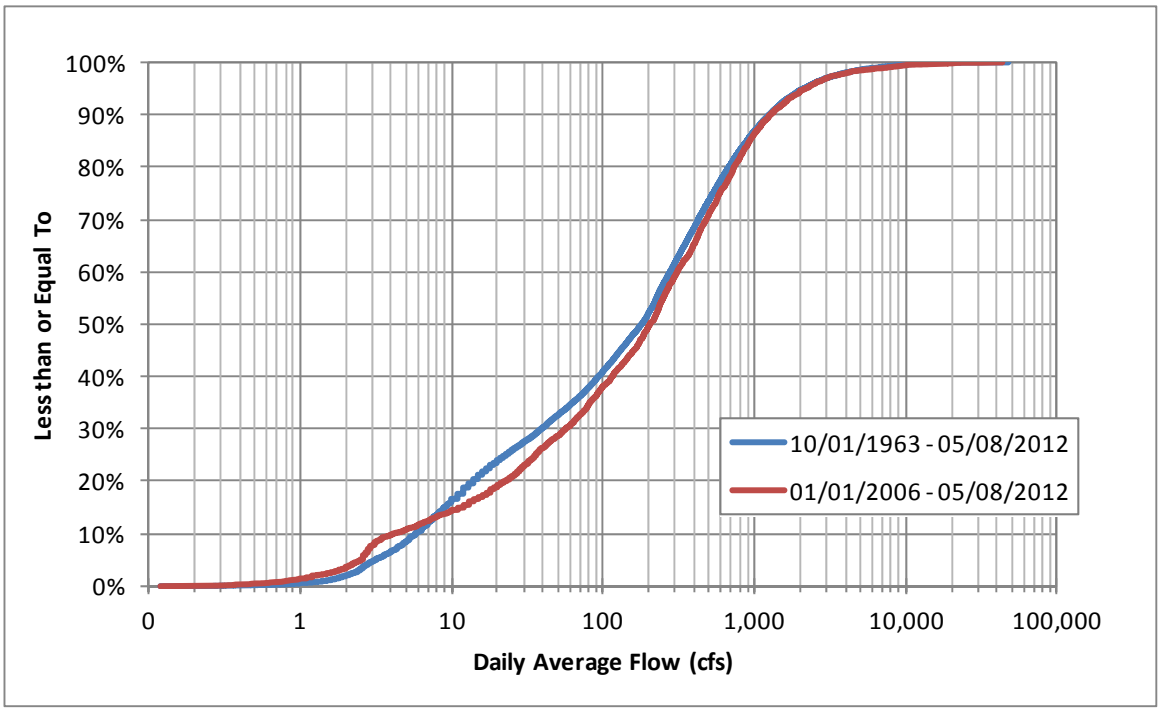


FIGURE 3-14
**White River Daily Average Flow Frequency at WR-01**

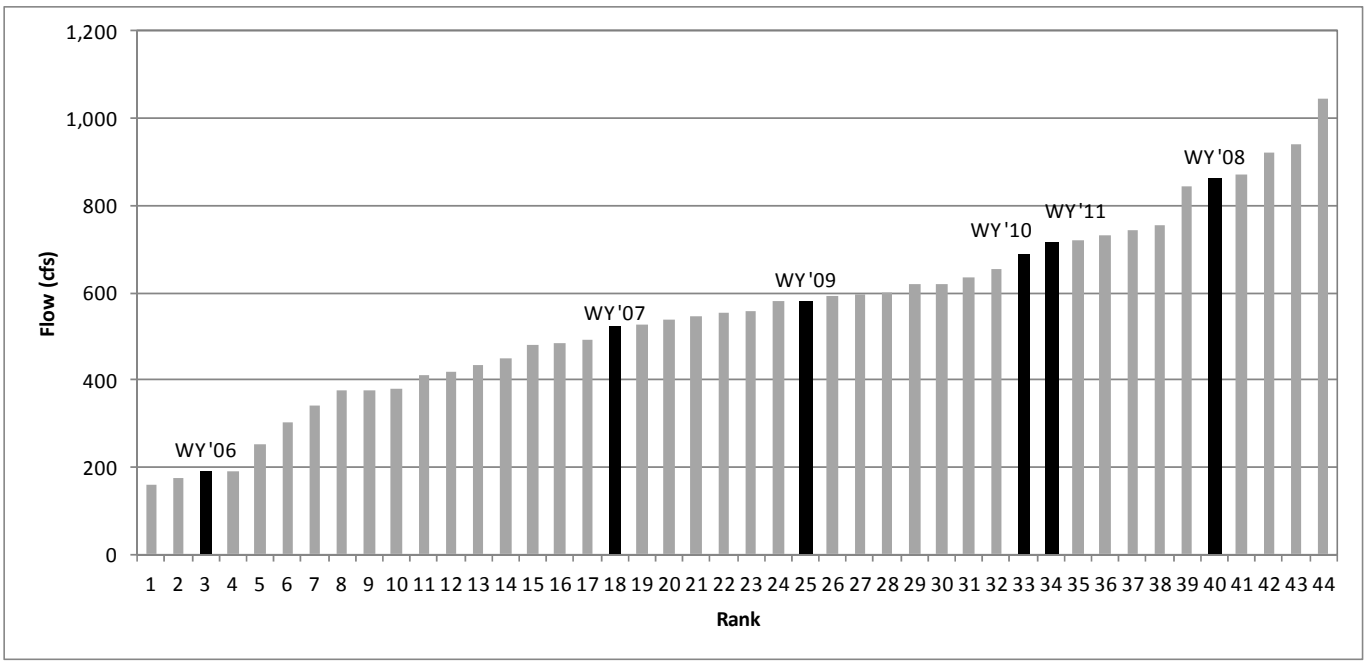


FIGURE 3-15
**Ranked Annual Average Flows in the White River at WR-01 based on Water Years 1964 through 2011**

# 3.8 Whole Effluent Toxicity Testing

The potential for TDS concentrations in the Noland discharge to cause toxicity in biomonitoring tests for NPDES compliance was evaluated using toxicity test on effluent spiked with inorganic salts to mimic elevated TDS in the Noland discharge matrix. The test methodology and laboratory protocol, as well as laboratory results, are provided in detail in Appendix C-7. The objective of this testing was to evaluate the toxic threshold for TDS, sulfate, and chloride by evaluating chronic toxicity (per USEPA, 2002) in a series of increasing TDS, sulfate, and chloride concentrations in the effluent using cladoceran (*Ceriodaphnia dubia)*. The USEPA provides a general guide that TDS may contribute to acute toxicity when conductivity exceeds 3,000 and 6,000 micromhos per centimeter (µhmos/cm) at the LC50 (concentration of a chemical that is expected to cause death in 50 percent of test organisms) for *C. dubia* and fathead minnows (*Pimephales promela*s), respectively (USEPA, 1991). However, *C. dubia* has a higher sensitivity to TDS, as compared to the fathead minnow (USEPA, 1999), and was therefore used in this study to identify the toxic threshold for chronic toxicity.

The toxic threshold for chronic toxicity to *C. dubia s*ets an upper limit for site-specific mineral criteria because a discharge that is toxic due to mineral concentrations must be avoided. Evaluation of existing data indicated that variation in TDS in Outfall 001 is due primarily to variation in bicarbonate ($HCO_3^-$) and sulfate (Appendix C-7). Therefore, the approach to evaluate the toxic threshold was to spike an effluent sample to approximately 8 times (nominal) the existing concentrations of chloride, $HCO_3^-$, sulfate, and TDS, and then prepare a chronic test exposure series by serially diluting the spiked sample using unspiked effluent as diluent. In this way the $HCO_3^-$, sulfate, chloride and TDS concentrations are manipulated while keeping other aspects of the sample matrix relatively unchanged.

The Outfall 001 sample for the spiked effluent test was prepared from a flow-weighted composite of 4 separate grab samples collected at 6-hour intervals during April 24 and 25, 2012. The composite sample was shipped via overnight courier to the Ecotoxicology Research Facility (ERF), Arkansas State University, Jonesboro, AR. The composite sample was then used in testing per the methodology and protocols given in Appendix C-7. The test protocol included collection of aliquots of each test exposure on each day of test renewal for the analysis of selected ions. These measurements documented correct preparation of the test exposures and any changes in ion concentration of the original spiked effluent solution. Appropriately preserved aliquots were shipped via overnight courier to American Interplex Corporation (AIC), 8600 Kanis Road, in Little Rock, Arkansas, for analytical determination of selected ion concentrations. Both laboratories are certified by ADEQ for the analyses performed.

Statistical analysis of the toxicity data used to calculate NOEC (no observed effect concentration), LOEC (lowest observed effect concentration) and IC25 (25 percent inhibition concentration) was performed per USEPA (2002) using Toxstat 3.0 statistical software. IC25 values for TDS and sulfate were estimated using the average measured concentrations at each exposure as input.

The laboratory control using moderately hard lab water met performance criteria for minimum survival (80 percent) and neonate production (average of 15 neonates per female in 3 broods). For the purposes of this evaluation the appropriate comparison to evaluate survival and reproduction in the spiked exposures is with the unspiked effluent. This comparison indicated significant ($P < 0.05$) reductions in survival and reproduction at the 8x and 6x exposures, respectively. Results of the calculations of test endpoints (NOEC, LOEC, and IC25) are summarized in Appendix C-7 and in the next section.

Ion concentrations indicate that all test exposures were properly prepared. Within test exposures the range in measured concentrations of ions that were present at 100 mg/L or more was generally < 10 percent of the average concentration. Ions that were present in lower concentrations (e.g. Ca, Mg, K) showed higher variation relative to the mean. This result is largely due the fact that a constant level of variability applied to smaller numbers will show greater relative variability. Although the procedure attempted to maintain constant hardness across test exposures (see discussion of hardness effects in Appendix C-7) the hardness of the 8x spiked exposure (which was diluted with unspiked sample to prepare the test exposures) was 73 mg/L compared to 130 mg/L in the unspiked sample. This difference was due to the 3.2-fold difference in the measured Ca concentration between the 8x exposure (14 mg/L) and the unspiked sample (45 mg/L). This result suggests that some

precipitation of Ca occurred in the 8x exposure resulting in a gradient of decreasing hardness with increasing ionic strength. Since hardness is known to lessen the toxic effects of dissolved ions, including sulfate (Soucek, 2007; Soucek and Kennedy, 2005, Soucek et al., 2011), the decrease in hardness with increasing ionic strength in this test probably increased the toxicity of the spiked matrix over what it would have been had hardness remained near 130 mg/L across all exposures. Therefore, the bias in this test is probably conservative.

The estimated IC25 values of 1,643 mg/L TDS, 371 mg/L sulfate, and 327 mg/L chloride represent the best estimates of the sublethal toxic thresholds for this data set and are well above the highest TDS, sulfate and chloride concentrations (680 mg/L, 104 mg/L, and 76 mg/L, respectively) observed in the discharge to date.

## 3.9 Summary of Field and Laboratory Data Analysis

Table 3-8 includes a summary of selected parameters, from each of the UAA's field and laboratory data collection components. These parameters are intended to provide a weight of evidence for interpretation of the data, and therefore only those stations where all data were collected are included in the table. Applying comparable significance to each monitoring component and parameter, the overall weight of evidence analysis demonstrates that minerals concentrations in the White River downstream of the Noland WWTP are not adversely affecting aquatic biological communities in the river. The following key observations are made to reach this conclusion:

- The percent dominant taxa and HBI metric are generally higher at Station WR-02 than at the other sampling stations and generally indicate less diverse communities at Station WR-02. Taxa richness, number of EPT taxa, percent dominant taxa, and HBI values indicate the benthic macroinvertebrate community at Station WR-2.5 (approximately 2.7 mi downstream of the Noland WWTP outfall) is comparable to communities upstream of the Noland WWTP and to those in Richland Creek. Therefore, lower diversity of the benthic macroinvertebrate communities is isolated to directly downstream (as evidenced 0.4 mi downstream) of the Noland WWTP outfall.
- Mineral concentrations are relatively high and similar at Stations WR-02 and WR-2.5 (Table 3-8); however, benthic macroinvertebrate communities at these stations are not comparable. Therefore, the differences observed immediately downstream of the outfall are not attributable to minerals but to other water quality conditions, food sources, and/or hydraulic characteristics, since other measures of physical habitat between the stations are comparable (i.e., the physical habitat at each White River station is suboptimal).
- The fish communities downstream of the Noland WWTP outfall at Stations WR-02 and WR-2.5 are rated "generally similar," as defined by ADEQ for the ecoregion. The fish communities at WR-02 and WR-2.5 were rated higher than the community upstream of the outfall (at WR-01), based on the ADEQ thresholds for the Index of Biotic Integrity (IBI) score. However, there was a noticeable difference in the community at Station WR-02, specifically a decrease in sensitive individuals and a higher proportion of members of the Ictaluridae family (catfishes) and primary feeders. These species are indicative of organic loading and their presence is not expected to be related to mineral concentrations at Station WR-02. This is supported by a return to fish community structure at Station WR-2.5 similar to that upstream of the Noland WWTP. Since mineral concentrations are similar at Stations WR-02 and WR-2.5, the altered fish community structure observed at WR-02 is not due to mineral levels. The IBI score for fish at Station WR-02 reveals the fish community is supporting the fisheries designated use. This is particularly meaningful given that White River flows during fish sampling were less than the Q7-10 (the lowest mean discharge during 7 consecutive days, occurring once every 10 years on average).
- The predominance of benthic algae, and the associated increase in community metabolism, at Station WR-02 compared to WR-01 is influencing biological communities downstream of the Noland WWTP (such as lower diversity of macroinvertebrates and higher proportion of benthic herbivore fish species). Although the Noland WWTP permit requires substantial removal of phosphorus from the effluent (to less than 1.0 mg/L), it is expected that phosphorus concentrations would still be somewhat higher downstream than upstream. That said, the levels of nutrients and algae downstream of the Noland WWTP did not result in levels of DO below

the applicable DO criteria during continuous DO monitoring, during extreme low flows during the fall sampling period.

- The estimated IC25 values of 1,643 mg/L TDS, 371 mg/L sulfate and 327 mg/L chloride determined in the WET testing represent the best estimates of the sublethal toxic thresholds for these minerals at this site. These values are much greater than instream minerals concentrations and greater than the highest TDS, sulfate and chloride concentrations measured in the Noland WWTP effluent to date (680 mg/L, 104 mg/L, and 76 mg/L, respectively). This reinforces the results of the biological field data which indicated that minerals concentrations are not having an adverse impact on biological communities.

TABLE 3-8
**Summary of Selected Parameters from UAA Field Data Collection**

| Test | Parameter | | WR-01 | WR-02 | WR-2.5 | RC-02 |
|---|---|---|---|---|---|---|
| Monthly Water Quality [a] | Average | $Cl^-$ (mg/L) | 4 | 15 | 13 | 4 |
| | | $SO_4^{-2}$ (mg/L) | 15 | 26 | 21 | 11 |
| | | TDS (mg/L) | 97 | 158 | 134 | 105 |
| | | DO (mg/L) | 8 | 9 | 10 | 9 |
| | | pH (SU) | 8 | 8 | 8 | 8 |
| Flow | Fall | September 13, 2011 daily average flow (cfs) | 0.76 | 11 | 11 | 1.8 |
| | | September 14, 2011 daily average flow (cfs) | 0.62 | 10 | 10 | 2.0 |
| | | Sep/Oct 2011 average flow (cfs) [b] | 11 | 19 | 19 | 7.7 |
| | | Sep/Oct historical average flow (cfs) [c] | 210 | 221 | 222 | 48 |
| | Spring | March 7, 2012 daily average flow (cfs) [b] | 117 | 127 | 128 | 44 |
| | | Mar/Apr 2012 average flow (cfs) [b] | 673 | 689 | 692 | 177 |
| | | Mar/Apr historical average flow (cfs) [c] | 1,120 | 1,140 | 1,145 | 427 |
| Diurnal DO Monitoring | Fall 2011 | Range of DO (mg/L) | 6-8 | 6-12 | 7-12 | 7-9 |
| | | Range of pH (SU) | 7 | 7-8 | 5-9 | 7 |
| | | Range of Specific Conductance (microSiemens per centimeter [µS/cm]) | 213-218 | 555-606 | 375-512 | 78-276 |
| | | NPP (g $O_2/m^3$/day) | 3.1 | 17.4 | 9.1 | 4.2 |
| | | Total Community Respiration (g $O_2/m^3$/day) | 1.9 | 8.0 | 10.4 | 2.4 |
| | Spring 2012 | Range of DO (mg/L) | 8 | 7-10 | 9-12 | 9-12 |
| | | Range of pH (SU) | 7-8 | 7-8 | 7-8 | 7-8 |
| | | Range of Specific Conductance (µS/cm) | 91-116 | 126-147 | 112-122 | 109-120 |
| | | NPP (g $O_2/m^3$/day) | 2.4 | 5.7 | 5.4 | 6.4 |
| | | Total Community Respiration (g $O_2/m^3$/day) | 0.8 | 2.7 | 7.2 | 5.6 |
| Physical Assessment | Fall 2011 | Embeddedness (-) | 16.5 | 17.5 | 18 | 13 |
| | | Sediment Deposition (-) | 18.5 | 16.5 | 17 | 16 |
| | | Total Physical Habitat (-) | 141.5 | 146 | 143.5 | 143 |
| | | Pool Composition (%) | 85 | 90 | 70 | Not Measured |
| | | Channel Width (ft) | 25 | 20 to 200 | 30 | Not Measured |
| | Spring 2012 | Embeddedness (-) | 16 | 17 | 18 | 16 |
| | | Sediment Deposition (-) | 17 | 15 | 15 | 16 |
| | | Total Physical Habitat (-) | 148 | 146 | 141 | 142 |
| | | Pool Composition (%) | 40 | 70 | 45 | 30 |
| | | Channel Width (ft) | 25 | 20 to 200 | 30 | 30 |

TABLE 3-8
**Summary of Selected Parameters from UAA Field Data Collection**

| Test | | Parameter | WR-01 | WR-02 | WR-2.5 | RC-02 |
|---|---|---|---|---|---|---|
| Benthic Macroinvertebrates | Fall 2011 | HBI | Fairly Poor | Fairly Poor | Fair | Fair |
| | | Number of EPT Taxa | 12 | 5 | 10 | 12 |
| | | Number of Taxa | 43 | 24 | 25 | 36 |
| | | % Dominant Taxa | 16 | 28 | 24 | 37 |
| | | $Cl^-$ (mg/L) | 5 | 38 | 37 | 5 |
| | | $SO_4^{-2}$ (mg/L) | 25 | 40 | 40 | 18 |
| | | TDS (mg/L) | 138 | 288 | 268 | 164 |
| | | DO (mg/L) | 6 | 7 | 8 | 7 |
| | | pH (SU) | 8 | 8 | 8 | 8 |
| Benthic Macroinvertebrates | Spring 2012 | HBI | Fair | Fairly Poor | Fair | Fair |
| | | Number of EPT Taxa | 9 | 6 | 8 | 5 |
| | | Number of Taxa | 30 | 19 | 26 | 33 |
| | | % Dominant Taxa | 19 | 60 | 21 | 32 |
| | | $Cl^-$ (mg/L) | 3 | 8 | 5 | 4 |
| | | $SO_4^{-2}$ (mg/L) | 12 | 17 | 15 | 10 |
| | | TDS (mg/L) | 78 | 111 | 96 | 88 |
| | | DO (mg/L) | 10 | 10 | 10 | 10 |
| | | pH (SU) | 8 | 8 | 8 | 8 |
| Fish Community | Fall 2011 | IBI | 23 | 25 | 29 | 25 |
| | | ADEQ Category | Somewhat Similar | Generally Similar | Generally Similar | Generally Similar |
| | | Total Species | 21 | 22 | 29 | 19 |
| | | $Cl^-$ (mg/L) | 5 | 51 | 46 | 5 |
| | | $SO_4^{-2}$ (mg/L) | 17 | 49 | 45 | 18 |
| | | TDS (mg/L) | 130 | 342 | 287 | 164 |
| | | DO (mg/L) | 7 | 6 | 10 | 7 |
| | | pH (SU) | 8 | 7 | 9 | 8 |

TABLE 3-8
**Summary of Selected Parameters from UAA Field Data Collection**

| Test | Parameter | | WR-01 | WR-02 | WR-2.5 | RC-02 |
|---|---|---|---|---|---|---|
| WET Test | $Cl^-$ (mg/L) | Survival – NOEC/LOEC | 396/533 | | | |
| | | Reproduction – NOEC/LOEC | 306/396 | | | |
| | | IC25 | 327 | | | |
| | $SO_4^{-2}$ (mg/L) | Survival – NOEC/LOEC | 451/596 | | | |
| | | Reproduction – NOEC/LOEC | 347/451 | | | |
| | | IC25 | 371 | | | |
| | TDS (mg/L) | Survival – NOEC/LOEC | 1,929/2,429 | | | |
| | | Reproduction – NOEC/LOEC | 1,557/1,929 | | | |
| | | IC25 | 1,643 | | | |

[a] Average TDS, $Cl^-$, and $SO_4^{-2}$ from May 2011 – May 2012 for Stations WR-01, WR-02, and RC-02; average DO and pH from June 2011 – May 2012 for Stations WR-01, WR-02, and RC-02; average TDS, $Cl^-$, and $SO_4^{-2}$, DO, and pH from September 2011 – May 2012 for Station WR-2.5

[b] Based on provisional USGS data.

[c] The historical average is based on water years 1964 – 2011 for the White River and 1999 – 2011 for Richland Creek; therefore, October 2011 through May 2012 are not included in the historical average values.

SECTION 4

# Effluent Mineral Characterization and Watershed Mass Balance Model

This section provides a summary of mineral concentrations and loads measured in the Noland WWTP effluent. Data inputs to a watershed mass balance spreadsheet model are summarized along with results from numerous modeling scenarios. Modified site-specific WQC are proposed based on the results of the mass balance model. In addition, the influence of the proposed, modified site-specific WQC on Beaver Lake mineral concentrations is addressed based on results from a USGS water quality model for Beaver Lake.

## 4.1 Noland WWTP Effluent

Statistics of mineral concentrations, loads, and daily flow values measured in the Noland WWTP effluent are summarized in Table 4-1. The data and statistics span the period of record from January 1, 2006, through May 31, 2012. Tables 4-2 through 4-4 provide monthly statistics of the same data set for chloride, sulfate, and TDS, respectively. Data listed in Tables 4-2 through 4-4 are plotted in Figures 4-1 through 4-3. Permitted and design capacity flows for the WWTP are 11.21 mgd (17.3 cfs) and 12.6 mgd (19.5 cfs), respectively.

TABLE 4-1
**Noland WWTP Effluent Flow and Mineral Characteristics based on Measured Data from January 1, 2006 through May 31, 2012**

| Statistic | $Cl^-$ (mg/L) | $SO_4^{-2}$ (mg/L) | TDS (mg/L) | Daily Flow (mgd) | Daily Flow (cfs) | $Cl^-$ (lb/day) | $SO_4^{-2}$ (lb/day) | TDS (lb/day) |
|---|---|---|---|---|---|---|---|---|
| Count | 84 | 98 | 98 | 2,323 | 2,323 | 84 | 98 | 98 |
| Maximum | 76 | 104 | 680 | 21.4 | 33.1 | 4,797 | 5,853 | 66,069 |
| 95th percentile | 55 | 86 | 425 | 11.0 | 17.1 | 3,747 | 4,901 | 28,465 |
| Average | 42 | 59 | 354 | 6.1 | 9.4 | 2,444 | 3,092 | 18,675 |
| Median | 43 | 58 | 360 | 5.7 | 8.9 | 2,287 | 3,131 | 18,217 |
| Minimum | 17 | 37 | 140 | 0 | 0 | 1,076 | 936 | 7,579 |
| Standard Dev. | 10 | 13 | 60 | 2.8 | 4.3 | 838 | 1,045 | 7,761 |

TABLE 4-2
**Monthly Statistics of Chloride Concentrations and Loads in the Noland WWTP Effluent**

| Month | Data Range | Sample Size (n) | | Concentration (mg/L) | | | Average Flow | | Load (lb/day) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $Cl^-$ | Flow | Maximum | 95th Perc. | Average | (mgd) | (cfs) | Maximum | 95th Perc. | Average |
| January | 2006 – 2012 | 17 | 216 | 63 | 56 | 42 | 5.8 | 9.0 | 3,544 | 3,493 | 2,407 |
| February | 2006 – 2012 | 6 | 196 | 76 | 72 | 49 | 7.1 | 11.0 | 3,927 | 3,922 | 2,888 |
| March | 2006 – 2012 | 8 | 217 | 54 | 53 | 50 | 7.5 | 11.5 | 4,797 | 4,688 | 2,976 |
| April | 2006 – 2012 | 14 | 206 | 52 | 42 | 30 | 6.9 | 10.8 | 3,561 | 2,808 | 1,750 |
| May | 2006 – 2012 | 16 | 211 | 50 | 49 | 42 | 7.2 | 11.2 | 3,727 | 3,528 | 2,641 |
| June | 2006 – 2011 | 7 | 179 | 48 | 48 | 44 | 5.5 | 8.5 | 3,751 | 3,686 | 2,999 |
| July | 2006 – 2011 | 4 | 185 | 52 | 51 | 47 | 4.9 | 7.6 | 2,099 | 2,056 | 1,559 |
| August | 2006 – 2011 | 1 | 186 | 47 | | | 4.3 | 6.7 | 2,318 | | |
| September | 2006 – 2011 | 1 | 178 | 58 | | | 6.3 | 9.8 | 3,043 | | |
| October | 2006 – 2011 | 1 | 186 | 55 | | | 5.8 | 9.0 | 2,705 | | |
| November | 2006 – 2011 | 4 | 178 | 47 | 47 | 44 | 5.5 | 8.5 | 3,490 | 3,392 | 2,544 |
| December | 2006 – 2011 | 5 | 185 | 48 | 47 | 42 | 5.3 | 8.1 | 2,805 | 2,802 | 2,192 |

TABLE 4-3
**Monthly Statistics of Sulfate Concentrations and Loads in the Noland WWTP Effluent**

| Month | Data Range | Sample Size (n) | | Concentration (mg/L) | | | Average Flow | | Load (lb/day) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $SO_4^{-2}$ | Flow | Maximum | 95th Perc. | Average | (mgd) | (cfs) | Maximum | 95th Perc. | Average |
| January | 2006 – 2012 | 8 | 216 | 60 | 60 | 57 | 5.8 | 9.0 | 3,500 | 3,287 | 2,488 |
| February | 2006 – 2012 | 2 | 196 | 63 | 63 | 62 | 7.1 | 11.0 | 3,853 | 3,819 | 3,506 |
| March | 2006 – 2012 | 12 | 217 | 68 | 65 | 60 | 7.5 | 11.5 | 5,037 | 4,955 | 3,292 |
| April | 2006 – 2012 | 25 | 206 | 66 | 65 | 58 | 6.9 | 10.8 | 4,611 | 4,155 | 3,227 |
| May | 2006 – 2012 | 14 | 211 | 54 | 53 | 48 | 7.2 | 11.2 | 5,853 | 5,738 | 4,166 |
| June | 2006 – 2011 | 16 | 179 | 92 | 88 | 67 | 5.5 | 8.5 | 4,371 | 4,321 | 3,140 |
| July | 2006 – 2011 | 8 | 185 | 104 | 103 | 75 | 4.9 | 7.6 | 4,077 | 3,792 | 2,207 |
| August | 2006 – 2011 | 5 | 186 | 80 | 77 | 61 | 4.3 | 6.7 | 3,921 | 3,387 | 1,696 |
| September | 2006 – 2011 | 1 | 178 | 50 | | | 6.3 | 9.8 | 2,607 | | |
| October | 2006 – 2011 | 1 | 186 | 45 | | | 5.8 | 9.0 | 2,190 | | |
| November | 2006 – 2011 | 1 | 178 | 50 | | | 5.5 | 8.5 | 3,719 | | |
| December | 2006 – 2011 | 5 | 185 | 61 | 61 | 50 | 5.3 | 8.1 | 3,387 | 3,304 | 2,538 |

TABLE 4-4
**Monthly Statistics of TDS Concentrations and Loads in the Noland WWTP Effluent**

| Month | Data Range | Sample Size (n) | | Concentration (mg/L) | | | Average Flow | | Load (lb/day) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | TDS | Flow | Maximum | 95th Perc. | Average | (mgd) | (cfs) | Maximum | 95th Perc. | Average |
| January | 2006 – 2012 | 13 | 216 | 398 | 396 | 346 | 5.8 | 9.0 | 29,842 | 29,303 | 18,578 |
| February | 2006 – 2012 | 2 | 196 | 376 | 374 | 352 | 7.1 | 11.0 | 20,136 | 20,094 | 19,711 |
| March | 2006 – 2012 | 9 | 217 | 434 | 425 | 347 | 7.5 | 11.5 | 32,966 | 28,342 | 19,610 |
| April | 2006 – 2012 | 24 | 206 | 411 | 403 | 361 | 6.9 | 10.8 | 28,278 | 25,483 | 19,873 |
| May | 2006 – 2012 | 12 | 211 | 357 | 348 | 297 | 7.2 | 11.2 | 32,033 | 30,025 | 24,793 |
| June | 2006 – 2011 | 14 | 179 | 381 | 371 | 329 | 5.5 | 8.5 | 27,305 | 25,597 | 16,579 |
| July | 2006 – 2011 | 12 | 185 | 680 | 539 | 411 | 4.9 | 7.6 | 66,069 | 38,185 | 15,790 |
| August | 2006 – 2011 | 5 | 186 | 470 | 464 | 416 | 4.3 | 6.7 | 18,355 | 16,597 | 10,672 |
| September | 2006 – 2011 | 1 | 178 | 357 | | | 6.3 | 9.8 | 18,811 | | |
| October | 2006 – 2011 | 1 | 186 | 368 | | | 5.8 | 9.0 | 18,087 | | |
| November | 2006 – 2011 | 4 | 178 | 397 | 394 | 372 | 5.5 | 8.5 | 25,093 | 23,440 | 16,538 |
| December | 2006 – 2011 | 1 | 185 | 347 | | | 5.3 | 8.1 | 20,235 | | |

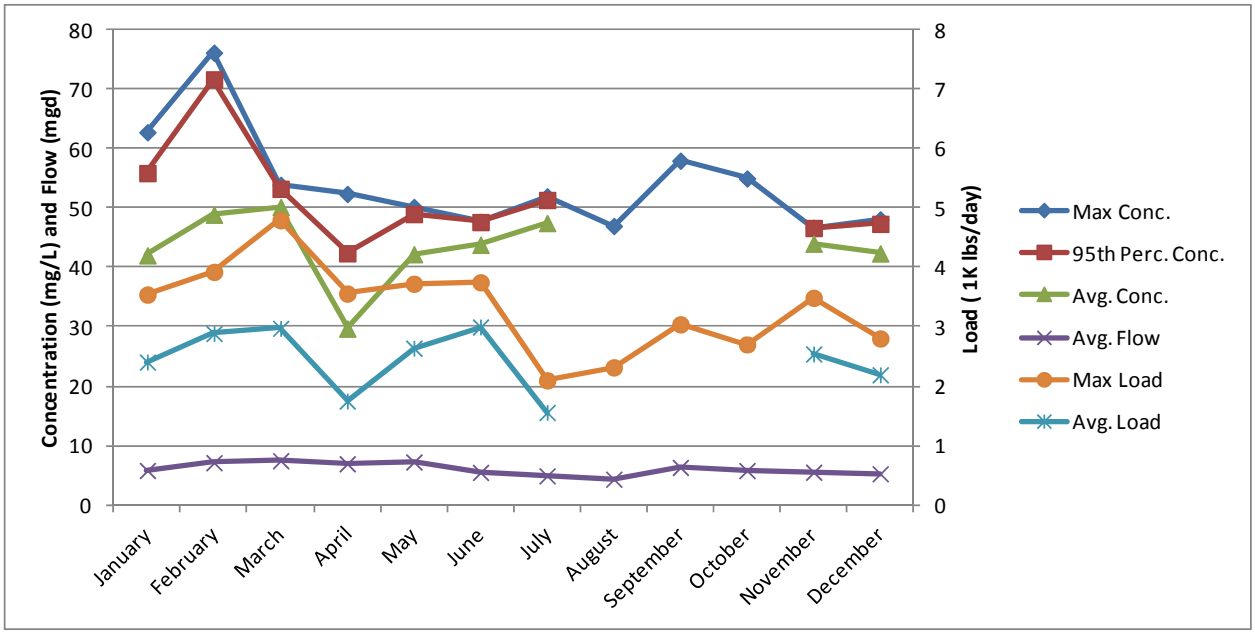


FIGURE 4-1

**Monthly Chloride Concentrations and Loads in the Noland WWTP Effluent, January 2006 through May 2012**

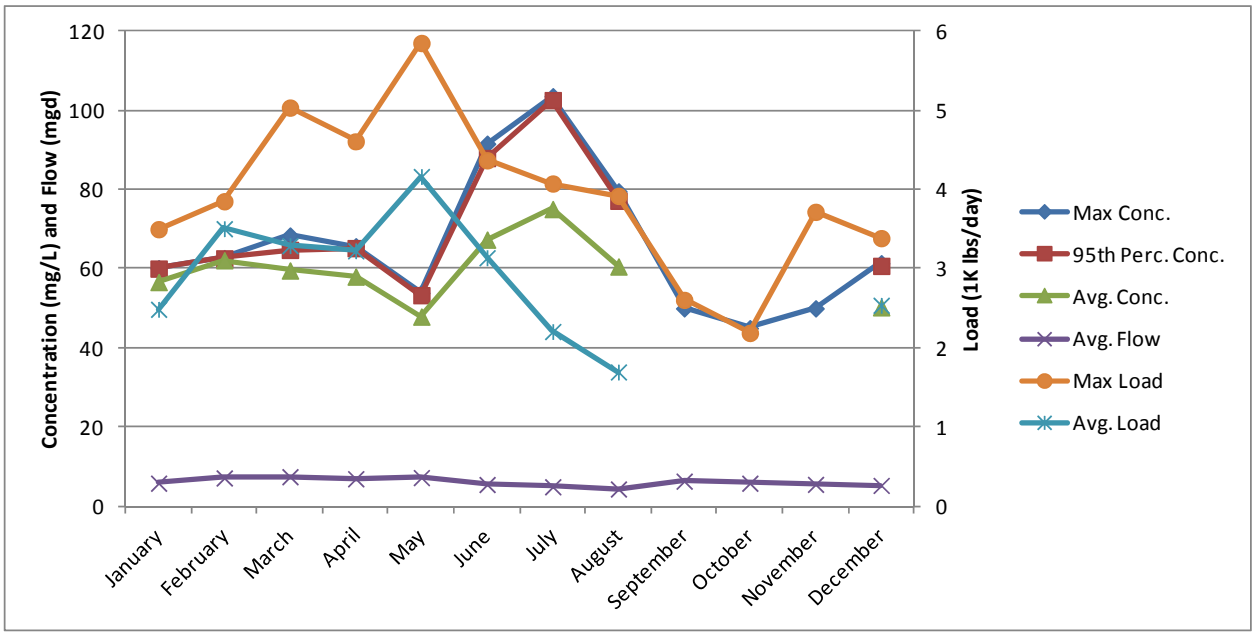


FIGURE 4-2

**Monthly Sulfate Concentrations and Loads in the Noland WWTP Effluent, January 2006 through May 2012**

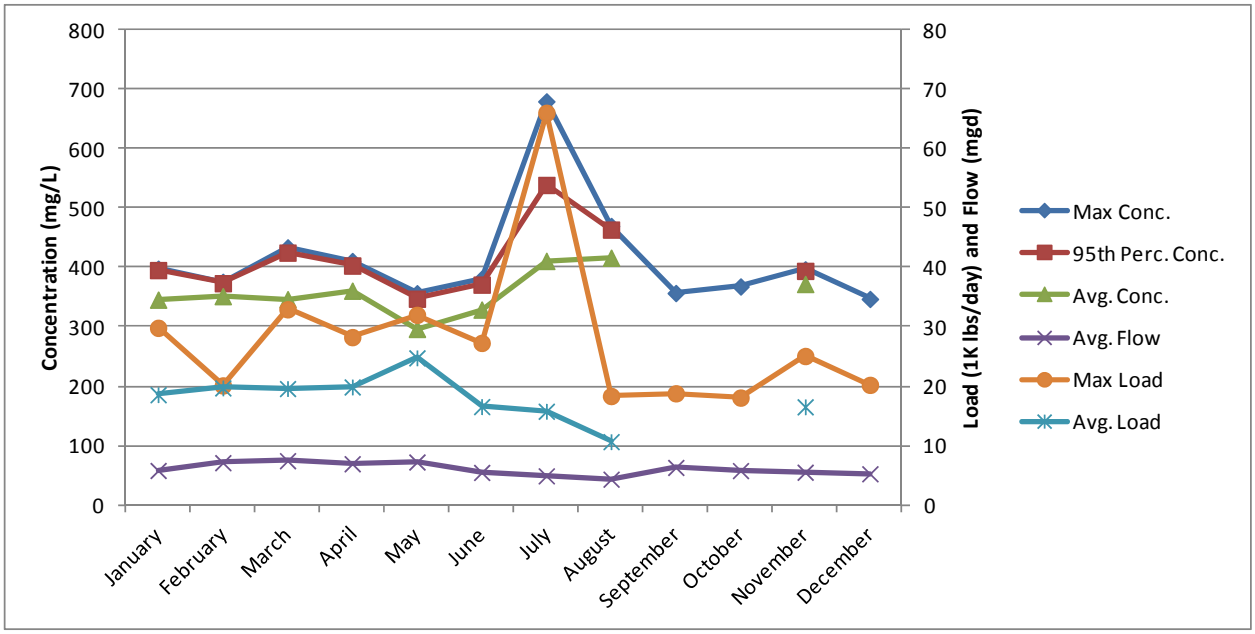


FIGURE 4-3
**Monthly TDS Concentrations and Loads in the Noland WWTP Effluent, January 2006 through 2012**

Table 4-5 and Table 4-6 show the highest computed monthly average and daily maximum load contributions for chloride, sulfate, and TDS for existing conditions at the Noland WWTP using design flow capacity and permitted flow, respectively.

TABLE 4-5
**Highest Computed Monthly Average and Daily Maximum Mineral Loads for Existing Conditions at the Noland WWTP using Design Flow Capacity**

| | Design Flow | | Concentration | | Computed Load at Design Flow | |
|---|---|---|---|---|---|---|
| Parameter | (mgd) | (cfs) | Highest Monthly Average (mg/L) | Daily Max (mg/L) | Highest Monthly Average (lb/day) | Daily Max (lb/day) |
| $Cl^-$ | 12.6 | 19.5 | 50 | 76 | 5,254 | 7,986 |
| $SO_4^{-2}$ | 12.6 | 19.5 | 75 | 104 | 7,881 | 10,929 |
| TDS | 12.6 | 19.5 | 416 | 680 | 43,715 | 71,457 |

TABLE 4-6
**Highest Computed Monthly Average and Daily Maximum Mineral Loads for Existing Conditions at the Noland WWTP using Permitted Flow**

| | Permitted Flow | | Concentration | | Computed Load at Permitted Flow | |
|---|---|---|---|---|---|---|
| Parameter | (mgd) | (cfs) | Highest Monthly Average (mg/L) | Daily Max (mg/L) | Highest Monthly Average (lb/day) | Daily Max (lb/day) |
| $Cl^-$ | 11.21 | 17.3 | 50 | 76 | 4,675 | 7,105 |
| $SO_4^{-2}$ | 11.21 | 17.3 | 75 | 104 | 7,012 | 9,723 |
| TDS | 11.21 | 17.3 | 416 | 680 | 38,892 | 63,574 |

# 4.2 Mass Balance Model

## 4.2.1 Model Inputs

Figure 4-4 is a schematic of the mass balance spreadsheet model developed for the study reach. The schematic illustrates the data sources and relative locations of flow and mineral data evaluation points used in the model.

Tables 4-7 and 4-8 provide a summary of flow and mineral concentration data inputs to the model. The Q7-10 is the lowest mean discharge that occurs over 7 consecutive days and has a 10 percent chance of occurring in any given year. Q7-10 values published by the USGS (Funkhouser et al., 2008), as well as values computed using the publicly available DFLOW computer program, were used in the model.

Minerals concentration data for Lake Sequoyah were obtained from two sources: (1) "Water Quality of Arkansas' Significantly Publicly-Owned Lakes" (ADEQ, 2012); and (2) samples collected by CH2M HILL on July 21, 2011. The ADEQ data (n = 5) are from the epilimnion and hypolimnion measured in 1989, 1994, and 1999. The CH2M HILL samples (n = 3) are from two locations in the lake, one near the inlet and one near the outlet. The upper lake sample was collected at mid-depth. At the deeper location near the outlet, a sample was taken from both the epilimnion and hypolimnion. The combined datasets (n = 8) reveal very little variation in mineral concentrations in Lake Sequoyah. The values of chloride, sulfate, and TDS samples in the lake are 1 mg/L, 2 mg/L, and 12 mg/L, respectively. Therefore, average values were used as inputs to the mass balance model for all scenarios listed in Table 4-8.

TABLE 4-7
**Summary of Mass Balance Flow Inputs (all values in cfs)**

| Statistic | West Fork White River near Mouth | White River at WR-01 | Richland Creek near Mouth |
|---|---|---|---|
| **Q7-10** | | | |
| USGS[a] | 0.40 | 0.80 | 0.21 |
| DFLOW[b] | 0 | 0.70 | 0.36 |
| **Harmonic Mean** | | | |
| Period of Record[b] | zero values | 15.5 | 6.3 |
| Jan 2006 – Apr 2012 | zero values | 11.8 | 8.0 |
| **Median** | | | |
| August | 5 | 5 | 10 |
| June – August | 12 | 51 | 17 |
| June – November | 21 | 68 | 16 |
| **Average** | | | |
| August | 33 | 38 | 24 |
| June – August | 56 | 159 | 50 |
| June – November | 97 | 285 | 81 |

[a] Period:
West Fork White River near Mouth: September 19, 2001 through September 30, 2005.
White River at WR-01: October 1, 1963 through September 30, 2005.
Richland Creek near Mouth: October 1, 1998 through September 30, 2005.

[b] Period of record:
West Fork White River near Mouth: September 19, 2001 through May 8, 2012.
White River at WR-01: October 1, 1963 through May 8, 2012.
Richland Creek near Mouth: October 1, 1998 through May 8, 2012.

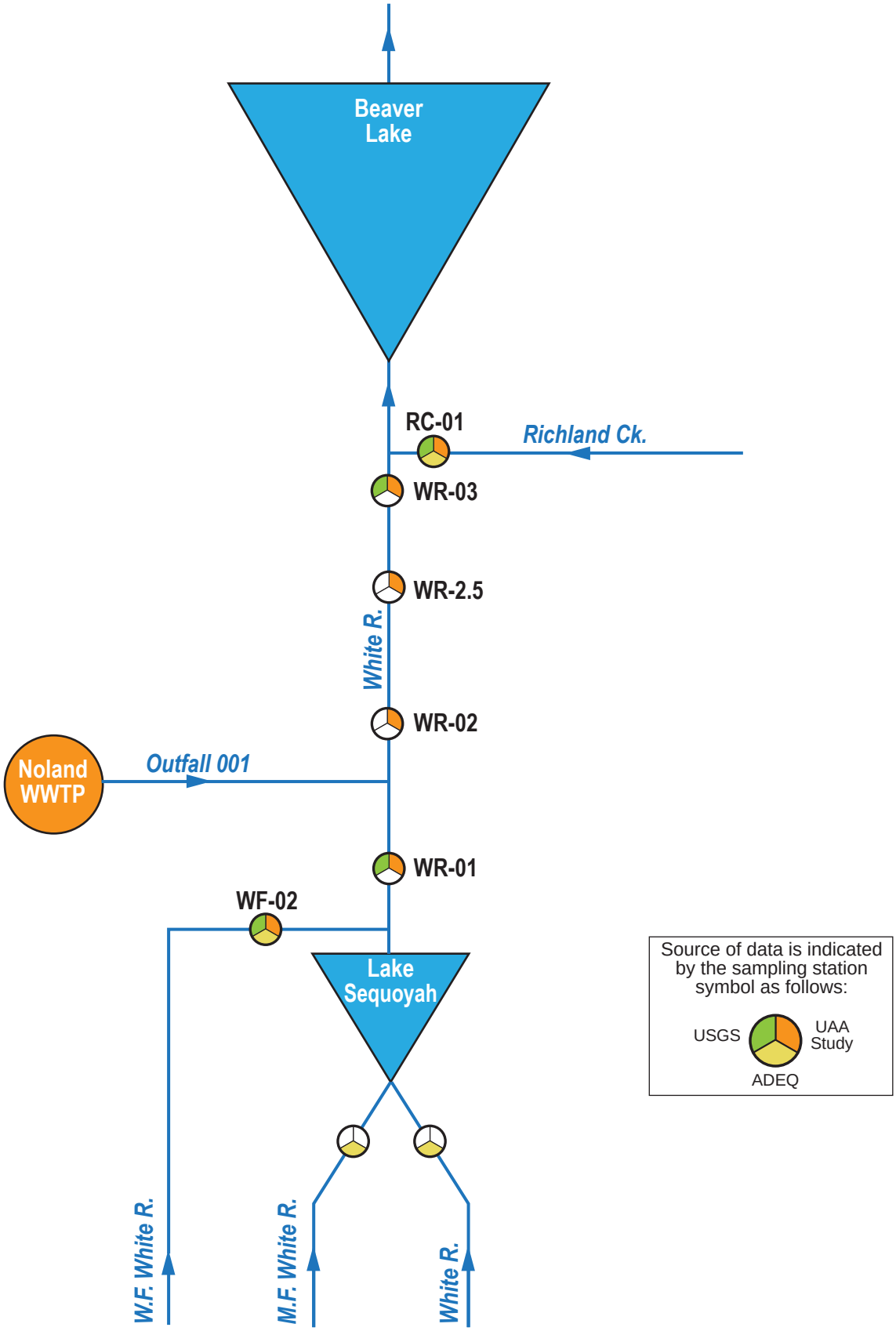


FIGURE 4-4
**Mass Balance Schematic**

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TABLE 4-8
**Summary of Mineral Concentration Inputs to the Mass Balance Spreadsheet Model**

| Modeled Parameter | Middle Fork White River Mouth | White River Inflow to Lake Sequoyah | Lake Sequoyah | West Fork White River WF-02 | White River WR-01 | Noland WWTP Outfall 001 | White River WR-03 | Richland Creek RC-01 |
|---|---|---|---|---|---|---|---|---|
| **95TH PERCENTILE** | | | | | | | | |
| **$Cl^-$ (mg/L)** | | | | | | | | |
| August | 3.8 | 2.8 | 2.7 | 12.1 | 5.6 | 47.0 [a] | 66.7 | 6.0 |
| June – August | 3.6 | 2.8 | 2.7 | 10.2 | 5.6 | 49.7 | 28.7 | 6.0 |
| June – November | 4.2 | 3.0 | 2.7 | 9.4 | 5.7 | 55.5 | 30.7 | 6.1 |
| All months | 4.5 | 3.1 | 2.7 | 13.6 | 5.7 | 54.9 | 26.4 | 6.1 |
| **$SO_4^{-2}$ (mg/L)** | | | | | | | | |
| August | 13.4 | 9.1 | 4.8 | 41.3 | 36.1 | 77.2 | 62.9 | 20.4 |
| June – August | 12.7 | 8.3 | 4.8 | 42.4 | 25.5 | 98.9 | 46.7 | 17.9 |
| June – November | 12.8 | 8.8 | 4.8 | 49.0 | 30.3 | 98.2 | 44.4 | 20.9 |
| All months | 13.5 | 8.3 | 4.8 | 50.9 | 27.3 | 86.0 | 36.8 | 20.1 |
| **TDS (mg/L)** | | | | | | | | |
| August | 100 | 57 | 86 | 193 | 162 | 464 | 318 | 166 |
| June – August | 98 | 60 | 86 | 193 | 155 | 455 | 255 | 161 |
| June – November | 99 | 57 | 86 | 196 | 151 | 446 | 248 | 160 |
| All months | 98 | 57 | 86 | 199 | 137 | 425 | 238 | 159 |
| **AVERAGE** | | | | | | | | |
| **$Cl^-$ (mg/L)** | | | | | | | | |
| August | 3.5 | 2.5 | 2.4 | 6.6 | 4.2 | 47.0 [a] | 20.0 | 4.7 |
| June – August | 3.2 | 2.2 | 2.4 | 6.1 | 3.6 | 45.3 | 14.3 | 4.3 |
| June – November | 3.3 | 2.3 | 2.4 | 6.0 | 3.5 | 46.3 | 13.4 | 4.5 |
| **$SO_4^{-2}$ (mg/L)** | | | | | | | | |
| August | 10.9 | 6.2 | 3.8 | 31.8 | 20.8 | 60.6 | 30.5 | 15.5 |
| June – August | 9.0 | 4.9 | 3.8 | 31.2 | 16.1 | 68.3 | 23.3 | 10.8 |
| June – November | 8.8 | 5.0 | 3.8 | 32.8 | 16.0 | 66.4 | 22.2 | 11.9 |
| **TDS (mg/L)** | | | | | | | | |
| August | 87 | 50 | 81 | 159 | 125 | 416 | 185 | 142 |
| June – August | 81 | 45 | 81 | 157 | 104 | 375 | 145 | 124 |
| June – November | 79 | 44 | 81 | 153 | 103 | 374 | 147 | 124 |

[a] One chloride value was available for the month of August at the Noland WWTP Outfall 001, measured August 16, 2011.

### 4.2.2 Computed Instream Mineral Concentrations

Table 4-9 provides a summary of mass balance results for various model scenarios. White River minerals concentrations are listed for locations immediately upstream and downstream of the Noland WWTP Outfall 001, and immediately upstream and downstream of the confluence with Richland Creek. The shaded values denote concentrations that equal or exceed the existing, site-specific minerals WQC of 20 mg/L for chloride and sulfate, and 160 mg/L for TDS.

TABLE 4-9

**Summary of Mass Balance Model Results for Various Scenarios**

| Mass Balance Scenario | Mass Balance Inputs | | | | Mass Balance Results [a] | | | |
|---|---|---|---|---|---|---|---|---|
| | Watershed | | Noland WWTP Outfall 001 | | Location along White R. Immediately: | $Cl^-$ (mg/L) | $SO_4^{-2}$ (mg/L) | TDS (mg/L) |
| | Flow | Concentration | Flow | Concentration | | | | |
| 1a | Q7-10 (DFLOW) | Jun – Nov 95th percentile | Design capacity | Jun – Nov 95th percentile | Upstream of Outfall 001 | 9 | 49 | 196 |
| | | | | | Downstream of Outfall 001 | 54 | 96 | 437 |
| | | | | | Upstream of Richland Cr | 54 | 96 | 437 |
| | | | | | Downstream of Richland Cr | 53 | 95 | 432 |
| 1b | Q7-10 (DFLOW) | Jun – Nov 95th percentile | NPDES permitted flow | Jun – Nov 95th percentile | Upstream of Outfall 001 | 9 | 49 | 196 |
| | | | | | Downstream of Outfall 001 | 54 | 96 | 436 |
| | | | | | Upstream of Richland Cr | 54 | 96 | 436 |
| | | | | | Downstream of Richland Cr | 53 | 94 | 429 |
| 1c | Q7-10 (USGS) | Jun – Nov 95th percentile | Design capacity | Jun – Nov 95th percentile | Upstream of Outfall 001 | 6 | 27 | 141 |
| | | | | | Downstream of Outfall 001 | 54 | 95 | 434 |
| | | | | | Upstream of Richland Cr | 54 | 95 | 434 |
| | | | | | Downstream of Richland Cr | 53 | 95 | 431 |
| 1d | Q7-10 (USGS) | All months 95th percentile | Design capacity | All months 95th percentile | Upstream of Outfall 001 | 14 | 51 | 199 |
| | | | | | Downstream of Outfall 001 | 53 | 85 | 417 |
| | | | | | Upstream of Richland Cr | 53 | 85 | 417 |
| | | | | | Downstream of Richland Cr | 53 | 84 | 413 |
| 2 | Harmonic mean | Jun – Nov 95th percentile | Design capacity | Jun – Nov 95th percentile | Upstream of Outfall 001 | 5 | 21 | 107 |
| | | | | | Downstream of Outfall 001 | 36 | 69 | 318 |
| | | | | | Upstream of Richland Cr | 36 | 69 | 318 |
| | | | | | Downstream of Richland Cr | 30 | 59 | 286 |
| 3a | August median | August average | Design capacity | August 95th percentile | Upstream of Outfall 001 | 5 | 23 | 124 |
| | | | | | Downstream of Outfall 001 | 35 | 62 | 367 |
| | | | | | Upstream of Richland Cr | 35 | 62 | 366 |
| | | | | | Downstream of Richland Cr | 27 | 49 | 304 |
| 3b | Jun – Aug median | Jun – Aug average | Design capacity | Jun – Aug 95th percentile | Upstream of Outfall 001 | 4 | 14 | 87 |
| | | | | | Downstream of Outfall 001 | 19 | 42 | 208 |
| | | | | | Upstream of Richland Cr | 19 | 41 | 205 |
| | | | | | Downstream of Richland Cr | 15 | 35 | 187 |
| 3c | Jun – Nov median | Jun – Nov average | Design capacity | Jun – Nov 95th percentile | Upstream of Outfall 001 | 4 | 14 | 82 |
| | | | | | Downstream of Outfall 001 | 14 | 31 | 156 |
| | | | | | Upstream of Richland Cr | 14 | 30 | 153 |
| | | | | | Downstream of Richland Cr | 13 | 28 | 149 |
| 4a | August average | August average | Design capacity | August 95th percentile | Upstream of Outfall 001 | 5 | 21 | 115 |
| | | | | | Downstream of Outfall 001 | 15 | 34 | 199 |
| | | | | | Upstream of Richland Cr | 15 | 34 | 197 |
| | | | | | Downstream of Richland Cr | 13 | 30 | 184 |
| 4b | Jun – Aug average | Jun – Aug average | Design capacity | Jun – Aug 95th percentile | Upstream of Outfall 001 | 4 | 15 | 90 |
| | | | | | Downstream of Outfall 001 | 9 | 23 | 128 |
| | | | | | Upstream of Richland Cr | 8 | 23 | 126 |
| | | | | | Downstream of Richland Cr | 8 | 21 | 126 |

TABLE 4-9
**Summary of Mass Balance Model Results for Various Scenarios**

| Mass Balance Scenario | Mass Balance Inputs | | | | Mass Balance Results [a] | | | |
|---|---|---|---|---|---|---|---|---|
| | Watershed | | Noland WWTP Outfall 001 | | Location along White R. Immediately: | $Cl^-$ (mg/L) | $SO_4^{-2}$ (mg/L) | TDS (mg/L) |
| | Flow | Concentration | Flow | Concentration | | | | |
| 4c | Jun – Nov average | Jun – Nov average | Design capacity | Jun – Nov 95th percentile | Upstream of Outfall 001 | 4 | 15 | 88 |
| | | | | | Downstream of Outfall 001 | 7 | 20 | 110 |
| | | | | | Upstream of Richland Cr | 7 | 20 | 109 |
| | | | | | Downstream of Richland Cr | 6 | 18 | 112 |
| 5a | August average | August average | Design capacity | August average | Upstream of Outfall 001 | 5 | 21 | 115 |
| | | | | | Downstream of Outfall 001 | 15 | 30 | 188 |
| | | | | | Upstream of Richland Cr | 15 | 30 | 186 |
| | | | | | Downstream of Richland Cr | 13 | 27 | 175 |
| 5b | Jun – Aug average | Jun – Aug average | Design capacity | Jun – Aug average | Upstream of Outfall 001 | 4 | 15 | 90 |
| | | | | | Downstream of Outfall 001 | 8 | 20 | 120 |
| | | | | | Upstream of Richland Cr | 8 | 20 | 118 |
| | | | | | Downstream of Richland Cr | 7 | 18 | 119 |
| 5c | Jun – Nov average | Jun – Nov average | Design capacity | Jun – Nov average | Upstream of Outfall 001 | 4 | 15 | 88 |
| | | | | | Downstream of Outfall 001 | 6 | 18 | 106 |
| | | | | | Upstream of Richland Cr | 6 | 18 | 104 |
| | | | | | Downstream of Richland Cr | 6 | 17 | 108 |

[a] Shaded cells denote concentrations that equal or exceed the existing, site-specific minerals WQC: 20 mg/L chloride; 20 mg/L sulfate; and 160 mg/L TDS.

Based on the results of the mass balance model, the proposed site-specific WQC that would account for the Q7-10 flows in the White River, coupled with either permitted or design capacity effluent discharge from the Noland WWTP Outfall 001, and, 95$^{th}$ percentile mineral concentrations in the WWTP effluent and watershed, are: 60 mg/L chloride; 100 mg/L sulfate; and, 440 mg/L TDS. These concentrations are well below the toxic thresholds determined in Section 3.8, and below statewide minerals criteria for domestic water supply (see Section 2.4.2); therefore, they are recommended as the proposed, modified site-specific WQC for the White River reach from the Noland WWTP outfall to immediately downstream of Richland Creek. These concentrations are further evaluated with respect to Beaver Lake water quality in Section 4.3.

## 4.3 Beaver Lake Water Quality Model

The USGS has developed a two-dimensional, laterally averaged, hydrodynamic and water quality model using CE-QUAL-W2 for Beaver Lake (Galloway and Green, 2006 and 2007). The model simulates water surface elevation and vertical and longitudinal gradients of water quality constituents (Galloway and Green, 2007). The USGS has recently updated the model to include simulations of chloride, sulfate, and TDS (Green, 2013). The hydrologic simulation period of the updated model is January 1, 2006, through December 31, 2010, a period that includes dry, typical, and wet years.

One of the objectives of the updated model is to evaluate effects of a wide range of mineral concentrations in the watershed on the temporal and spatial variations in the resulting mineral concentrations in Beaver Lake. Estimated daily TDS, chloride, and sulfate loads were increased in the White River and War Eagle Creek tributaries, individually and the two tributaries together, by 1.2, 1.5, 2.0, 5.0, and 10.0 times the baseline conditions to examine fate and transport of these constituents through time at seven locations (segments) in the reservoir, from upstream to downstream in Beaver Lake (Green, 2013).

The results revealed that differences in concentrations between the baseline condition and the 1.2, 1.5, and 2.0 times baseline concentration scenarios were smaller than the differences in the 5.0 and 10.0 times baseline

concentration scenarios (Green, 2013). The resultant average daily TDS, chloride, and sulfate concentrations associated with the different loading factors (multipliers) were reported for each reservoir segment.

Based on the five year simulation period, only the following loading factors applied to inflowing mineral loads from the White River and the White River and War Eagle Creek tributaries combined (two separate model runs), resulted in reservoir mineral concentrations that exceed the Beaver Lake site-specific WQC (20 mg/L chloride and sulfate, and 160 mg/L TDS) in at least one model segment (see Green, 2013, Tables 5, 6, and 7):

- 10x for chloride
- 5x and 10x for sulfate (2x resulted in an exceedance in one segment by 0.6 mg/L or less)
- 5.0x and 10x for TDS

To ensure the proposed site-specific WQC for minerals in the White River are protective of the Beaver Lake minerals WQC, loads associated with low-flow (Q7-10) conditions in the White River (when mineral concentrations would be expected to be high) were combined with conservatively high loads from the Noland WWTP. Specifically, the proposed site-specific WQC for minerals (60 mg/L chloride, 100 mg/L sulfate, and 440 mg/L TDS) were combined with the Q7-10 flow (0.8 cfs) at WR-01 and the design capacity flow (19.5 cfs) for the Noland WWTP. The magnitude of these loads were then compared to the White River daily loads (n = 1,826) used in the USGS model simulation at the various multipliers (2, 5, or 10 times). The results are summarized in Table 4-10.

TABLE 4-10

**Comparison of Mineral Loads in the White River Resulting from Conservatively High Mineral Loads in the Noland WWTP versus Inflowing Mineral Loads used in the USGS Beaver Lake Water Quality Model (Green, 2013)**

| Parameter | Comparison Load[a] (lb/day) | Percent (%) of Modeled White River Daily Inflow Loads at the Different Loading Factors (multipliers) that Exceed the Comparison Load[b] | | |
|---|---|---|---|---|
| | | 2x | 5x | 10x |
| $Cl^-$ | 6,569 | - | 68 | 78 |
| $SO_4^{-2}$ | 10,948 | 68 | 82 | - |
| TDS | 48,169 | 73 | 84 | - |

[a]The "Comparison Loads" are those computed using the proposed, site-specific minerals WQC of 60 mg/L chloride, 100 mg/L sulfate, and 440 mg/L TDS, and the Q7-10 flow (0.8 cfs) at WR-01 and design capacity discharge (19.5 cfs) at the Noland WWTP.
[b]Results are shown only for the two loading scenarios that bracket a resulting WQC exceedance condition in Beaver Lake. For example, the Beaver Lake WQC for chloride was exceeded between the 5.0 and 10.0 times the modeled, inflowing baseline chloride loads. Similarly, the Beaver Lake WQC for TDS was exceeded between the 2.0 and 5.0 times the modeled, inflowing baseline TDS loads.

The results outlined in Table 4-10 reveal that the vast majority of the modeled inflowing daily loads, at the various multipliers required to generate in-reservoir mineral concentrations that exceed the Beaver Lake site-specific minerals WQC, are larger in magnitude than the conservative loading conditions used to generate the "comparison loads" (described above). Therefore, the proposed site-specific minerals WQC for the White River, from the Noland WWTP effluent discharge point to immediately downstream of Richland Creek, would be protective of the minerals WQC for Beaver Lake. No changes to the WWTP are proposed or anticipated that would increase mineral concentrations in the effluent, so the above analysis is conservative. Because the proposed site-specific minerals WQC are below the domestic water supply minerals criteria, and well below the toxic thresholds determined in Section 3.8, they are protective of existing designated uses in Beaver Lake.

SECTION 5

# Review of Existing and Attainable Uses

A UAA is conducted to define reach-specific existing and attainable uses, and, as appropriate, use the results to modify water quality standards or designated uses. The following section evaluates the designated uses (those established through rule-making process) of the affected waters (i.e., Reach 23 of the White River and Beaver Lake), with respect to existing uses (those present any time after November 28, 1975) and attainable uses (i.e., existing uses and those uses that do not exist but can be attained with additional management measures).

All streams within ADEQ's Planning Segment 4K have the following designated uses: fisheries, primary and secondary contact recreation, and domestic, agricultural, and industrial water supplies. Any proposed modification to surface water quality standards must be protective of downstream surface water quality standards. Therefore, the following evaluation includes Segment 23 of the White River and Beaver Lake (the only downstream waterbody expected to be influenced by discharges from the Noland WWTP).

## 5.1 Existing Uses

Existing beneficial uses are those uses that exist or have existed in a given waterbody any time after November 28, 1975, whether or not the use is formally designated for the waterbody (USEPA, 1983). An "existing use" can be established by demonstrating that: (1) the use has actually occurred since November 28, 1975; or (2) the water quality is suitable to allow the use to be attained, unless there are physical problems, such as substrate or flow, that prevent the use from being attained. The following sections provide an evaluation of existing uses in the study area. These are compared to attainable uses in Section 5.2.

### 5.1.1 Primary and Secondary Contact Recreation

APCEC (2010) defines primary contact recreation waters as those where full body contact is involved and secondary contact recreation waters as those where secondary activities occur, such as boating, fishing, or wading. The Arkansas Department of Health designates any streams with watersheds larger than 10 $mi^2$ for primary contact recreation. All waterbodies (streams and lakes/reservoirs) in the Ozark Highlands Ecoregion are designated as secondary contact recreation use.

#### 5.1.1.1 White River

During the field investigations conducted for the UAA, there was no evidence of primary or secondary contact recreation activities occurring on Reach 23 of the White River. However, access to the White River is possible throughout the reach, and it is possible for people to come into contact with the waterbody at many locations. Therefore, primary and secondary contact recreation is considered an existing use in the White River.

#### 5.1.1.2 Beaver Lake

Upper Beaver Lake (i.e., the uppermost 1,500 acres of Beaver Lake) is listed in Arkansas' draft 2010 List of Impaired Waterbodies as not meeting the primary contact recreation use due to elevated bacteria levels. Nonetheless, Beaver Lake is currently used for primary and secondary contact recreation activities. Boating, skiing, fishing, and swimming are popular activities with the approximately 3.1 million annual visitors to the lake (USACE, 2010). Therefore, primary and secondary contact recreation is considered an existing use in Beaver Lake.

### 5.1.2 Industrial Water Supply

The industrial water supply use designation includes waters which will be protected for use as process or cooling water. APCEC (2011) designates all waters in the Ozark Highlands Ecoregion as having an industrial water supply beneficial use.

#### 5.1.2.1 White River

Reach 23 of the White River is not directly used as a water supply for industrial uses. Water use registration data obtained from the ANRC for the White River watershed, upstream of Beaver Lake, identified no registered water withdrawals from the White River, during water years 2000 through 2009, for industrial uses (commercial and mining use categories) (Guess, 2011, personal communication). However, this analysis does not preclude the industrial water supply use since November 28, 1975. Therefore, industrial water supply may or may not be considered an existing use in Reach 23 of the White River, but would be considered an attainable use, as discussed later in this section.

#### 5.1.2.2 Beaver Lake

Beaver Lake is currently used as an industrial water supply. The Beaver Water District, a water utility that withdraws raw water from the reservoir, supplies drinking water to industries in Fayetteville, Springdale, Rogers, Bentonville, and surrounding areas (Beaver Water District, 2012). Therefore, industrial water supply is considered an existing use in Beaver Lake.

### 5.1.3 Agricultural Water Supply

The agricultural water supply use designation includes waters which will be protected for irrigation of crops and/or consumption by livestock. APCEC designates all waters in the Ozark Highlands Ecoregion as agricultural water supplies (2011).

#### 5.1.3.1 White River

Reach 23 of the White River is not directly used as a water supply for agricultural uses. Water use registration data obtained from the ANRC, for the White River watershed, upstream of Beaver Lake, identified three registered water withdrawals from the White River, during water years 2000 through 2009, for agricultural purposes. However, each of the withdrawals (Bar Twenty Ranch and two private landowners) is located upstream of Lake Sequoyah, and not within the affected waters. Since this analysis does not preclude the agricultural water supply use since November 28, 1975, agricultural water supply may or may not be considered an existing use in Reach 23 of the White River, but would be considered an attainable use, as discussed later in this section.

#### 5.1.3.2 Beaver Lake

According to Arkansas' draft *2011-2016 Nonpoint Source Pollution Management Plan*, the Upper White River watershed (including Beaver Lake) has among the highest livestock and poultry distribution in the state of Arkansas (National Agricultural Statistics Service, 2009 and ANRC, 2008). Raw water from Beaver Lake is likely used as a supply for crop irrigation and/or consumption by livestock. Therefore, agricultural water supply is considered an existing use in Beaver Lake.

### 5.1.4 Domestic Water Supply

The domestic water supply use designates water which will be protected for use in public and private water supplies. APCEC designates all waters in the Ozark Highlands Ecoregion as having a domestic water supply beneficial use (2011).

#### 5.1.4.1 White River

Reach 23 of the White River is not directly used as a domestic water supply. Water use registration data obtained from the ANRC for the White River watershed, upstream of Beaver Lake, identified no registered water withdrawals from the White River, during water years 2000 through 2009, for water supply/municipal purposes (Guess, 2011, personal communication). However, this analysis does not preclude the domestic water supply use since November 28, 1975. Therefore, domestic water supply may or may not be considered an existing use in Reach 23 of the White River, but would be considered an attainable use, as discussed later in this section.

#### 5.1.4.2 Beaver Lake

Beaver Lake is used for domestic water supply. Four water utilities depend on Beaver Lake to supply drinking water to their customers: Beaver Water District, Carroll-Boone Water District, Madison County Regional Water District, and Benton-Washington County Water Association. Beaver Water District supplies drinking water to more than 300,000 people and industries in Fayetteville, Springdale, Rogers, Bentonville, and surrounding areas. Approximately 42 mgd of raw water is pumped from Beaver Lake for treatment (http://www.bwdh2o.org).

### 5.1.5 Fisheries

APCEC (2011) defines the fisheries beneficial use as "provides for the protection and propagation of fish, shellfish and other forms of aquatic life." APEC (2011) designates all lakes and reservoirs in the Ozark Highlands Ecoregion as having a fisheries designated use and all streams with a watershed of at least 10 $mi^2$ as having a perennial Ozark Highlands fisheries use, with the exception of certain stream segments (outside of the study area) designated as trout streams.

#### 5.1.5.1 White River

Reach 23 of the White River is listed as not meeting its designated fisheries use due to elevated levels of siltation/turbidity (ADEQ, 2010). However, based on field surveys conducted for this UAA, Reach 23 is currently providing for the protection and propagation of fish, shellfish, and other forms of aquatic life. Therefore, fisheries may or may not be considered an existing use in Reach 23 of the White River, but would be considered an attainable use, as discussed later in this section.

#### 5.1.5.2 Beaver Lake

The upper portion of Beaver Lake is listed as not supporting the fisheries designated use due to high levels of siltation/turbidity (ADEQ, 2010). The fisheries use of the lower portion of the reservoir, however, is not listed as impaired for any cause or pollutant, and recreational fishing does occur in both the upper and lower portions of the reservoir. Thus, it likely can be inferred that the fisheries use is an existing use of the reservoir overall. The use impairment in the upper reservoir is further discussed in Section 5.2.

## 5.2 Attainable Uses

For the affected waters, it was concluded that some of the designated uses are existing uses (Section 5.1), and others may or may not be existing uses because of either (1) a lack of availability of use data back to 1975 or (2) use impairment listings. The following section evaluates whether the designated uses in the affected waters are attainable. For the purposes of this UAA, attainable uses are considered to be the designated uses that: (1) have existed since November 28, 1975, or (2) would be expected to be present if, at a minimum, point sources had required technology-based controls in place (for example, secondary treatment for municipal treatment facilities) and nonpoint sources applied cost-effective and reasonable BMPs. Identifying attainable uses for the White River and Beaver Lake requires consideration of potential reductions in point and nonpoint sources, which may result from TMDL implementation, technology-based permit conditions for point sources, and cost-effective and reasonable BMPs for nonpoint sources.

### 5.2.1 Primary and Secondary Contact Recreation

ADEQ evaluates the attainment of the primary and secondary contact recreation uses based on concentrations of fecal coliform and/or *E. coli*. Specific WQC used to evaluate the use attainment are summarized in Table 2-1 (Section 2.4.2).

#### 5.2.1.1 White River

Reach 23 of the White River is listed as supporting the primary and secondary contact recreation uses (ADEQ, 2010). Thus, both contact recreation uses are considered to be attainable uses.

#### 5.2.1.2 Beaver Lake

Upper Beaver Lake (i.e., the uppermost 1,500 acres of Beaver Lake) is listed in Arkansas' draft 2010 List of Impaired Waterbodies as not meeting the primary contact recreation use due to elevated bacteria levels. As noted in Section 5.1.1.2, primary and secondary contact recreation uses are prevalent in the reservoir, and thus the use is considered to be existing. It is anticipated that the bacteria impairment in the upper reservoir can be rectified via a TMDL and/or implementation of nonpoint source BMPs.

### 5.2.2 Domestic, Agricultural, and Industrial Water Supply

For ADEQ (2010) assessment of state waters, "the domestic, agricultural, and industrial water supply designated uses will be evaluated using (APCEC Regulation 2.511) chloride, sulfate, and TDS in accordance with the Federal Safe Drinking Water Act (40 § CFR 143.3). If greater than 10 percent of the total samples for the period of record exceed the criteria, the waterbody will be included on the 303(d) list as non-support of the mineral standard(s)." If it is determined that the violation in minerals criteria is impairing the domestic, agricultural, and/or industrial water supply uses, the waterbody will be included as non-support of the use(s).

#### 5.2.2.1 White River

Reach 23 of the White River is listed as non-support of the minerals criteria, based on levels of chlorides, sulfates, and TDS. However, Reach 23 is listed as supporting its designated uses of domestic, agricultural, and industrial water supply (ADEQ, 2010). Thus, these uses are considered to be attainable.

#### 5.2.2.2 Beaver Lake

Reach 23 of Beaver Lake is listed as supporting its designated uses of domestic, agricultural, and industrial water supply (ADEQ, 2010). Thus, these uses are considered to be attainable.

### 5.2.3 Fisheries

The state's biological integrity criteria (applicable to waters with a designated use of fisheries) are detailed in Sections 2.4 and 2.5. As noted previously, for an Arkansas waterbody to be listed as "supporting" the fisheries designated use, either the fish community or benthic macroinvertebrate community must be defined as supporting (as defined in Table 2-4), and neither the fish nor benthic macroinvertebrate community may be defined as not supporting (as defined in Table 2-4), if sufficient data are available. A discussion of biological data in the study area, with consideration of these criteria, is provided below.

#### 5.2.3.1 White River

Reach 23 of the White River is listed as not supporting the fisheries designated use, with the cause of impairment cited as siltation/turbidity. At this time, ADEQ does not believe that the magnitude of TDS, chloride, and sulfate in Reach 23 is impairing the aquatic life of the stream reach (Wise, 2011, personal communication). A TMDL to address the fisheries impairment was completed in 2006, with TSS evaluated as a surrogate for siltation/turbidity (USEPA, 2006). The TMDL attributed all TSS loadings to the White River to nonpoint source runoff, and ADEQ cites the cause of runoff as surface erosion (ADEQ, 2010).

In the 2011-2016 Nonpoint Source Pollution Management Plan, ANRC designated the Upper White River watershed (USGS HUC-11010001), including Reach 23, as a priority watershed (2011). Implementation of this plan, or the Priority Watershed Program, is focused on implementing BMPs to address four primary pollutants of concern, including TSS, siltation/turbidity, DO, and nutrients. The BMPs are scheduled to be implemented by ANRC, the Arkansas Forestry Commission, ADEQ, and the Arkansas Department of Health during the period 2011 through 2016. The long-term goal of the program is to restore all designated uses in the Upper White River watershed within 15 years. If the fisheries use is currently impaired, or partially impaired, it is anticipated that the BMPs outlined by the Priority Watershed Program will restore this designated use within the next 15 years.

#### 5.2.3.2 Beaver Lake

Arkansas lakes and reservoirs that support the fisheries use provide "water which is suitable for the protection and propagation of fish and other forms of aquatic life adapted to impounded waters" (APCEC, 2010). Upper Beaver Lake (i.e., the upper 1,500 acres of the reservoir) is listed in Arkansas' draft 2010 List of Impaired Waterbodies as not meeting the fisheries use, with levels of turbidity and siltation cited as the impairment. A TMDL has not been developed for siltation/turbidity in Upper Beaver Lake. However, implementation of the 2011–2016 Nonpoint Source Pollution Management Plan (see Section 5.2.3.1) includes measures to reduce nonpoint source runoff, and associated TSS and siltation/turbidity, in Beaver Lake. Therefore, if the fisheries use is currently impaired, it is expected that the nonpoint source BMPs outlined in the 2011-2016 Nonpoint Source Pollution Management Plan will fully restore this use in the reservoir within the next 15 years.

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SECTION 6

# Alternatives Evaluation

The Noland WWTP currently utilizes primary, secondary, and tertiary methods to treat water from the cities of Fayetteville, Farmington, Elkins, Greenland, and Johnson. The secondary treatment process basically consists of an activated sludge process with anaerobic and aerobic zones for biological phosphorus removal with chemical addition for additional phosphorus removal as needed. The current treatment process does not contribute a significant concentration of TDS to the effluent. The effluent average concentrations of chloride, sulfate, and TDS are 40.4 mg/L, 59.0 mg/L, and 352 mg/L, respectively, based on data collected from November 2010 to November 2011.

This section presents an analysis and economic assessment of different treatment alternatives for reducing the chloride, sulfate, and TDS concentrations in the effluent. The alternatives are analyzed based on their ability to remove target contaminants and their economic feasibility.

## 6.1 Existing Conditions

The Noland WWTP has a daily average design capacity of 12.6 mgd and is permitted to discharge 11.21 mgd of treated effluent to the White River near Fayetteville. In 2011, the Noland WWTP had an average annual daily flow (AADF) of 6.2 mgd. The existing permit includes limitations for flow, 5-day carbonaceous biochemical oxygen demand ($CBOD_5$,) TSS, ammonia nitrogen, DO, total phosphorus, fecal coliform bacteria, pH, and WET.

The process flow diagram of the Noland WWTP is shown in Figure 6-1. Preliminary treatment consists of screening and grit removal. The plant operates a coarse and fine screen. The coarse bar screen removes debris greater than 1.5 in. The fine band screen removes debris greater than 5 millimeters (mm). The plant operates one of two Waste Tech model 1750 XGT vortex grit removal basins at a given time. After screening and grit removal, an influent pump station (IPS) pumps the wastewater to the secondary treatment basins.

Secondary treatment consists of an activated sludge process including a plug-flow basin with an anaerobic and aerobic zone, followed by secondary clarifiers. The WWTP has two parallel trains. Each basin is 300 ft long, 100 ft wide, and 15 ft deep and has a volume of 3.38 million gallons and a maximum hydraulic capacity of 18 mgd. The anaerobic zone of each basin consists of six 200,000-gallon compartments in series that are covered and mixed. Each compartment has a low-revolutions-per-minute (RPM) submersible mixer to keep solids in suspension. The aerobic zone of each basin consists of four 550,000-gallon compartments in-series. Each compartment has a high-RPM surface aerator, with 2-speed motor, subsurface mixer, and surface aeration blades. Flow from the aerobic zone of the basin continues to a clarifier splitter box where it flows into one of four 100-ft-diameter (7,853-$ft^2$) clarifiers with a 14-ft side water depth (SWD). Alum is added prior to the splitter box when additional phosphorus removal is needed. Approximately 12,000 gallons of alum is added during a year. The maximum hydraulic capacity of each clarifier is 8.0 mgd. The settled solids are pumped back to a mixing tank located before the first anaerobic compartment, where influent flow and the return activated sludge (RAS) are combined before entering the anaerobic zone. The clear supernatant flows from the clarifiers to sand filters.

The effluent sand filters consist of 10 cells, each 16 ft wide and 32 ft long with a 7- to 10-inch sand bed and are used to remove TSS. The maximum hydraulic capacity of each cell is 3.6 mgd. Filtered water collects in a clear-well beneath the filter cells. The average backwash flow for the filters is 0.55 mgd. The backwash water used to clean the filter media is pumped back upstream of the grit removal system. Effluent from the clear well flows to a Trojan ultraviolet (UV) disinfection system. After disinfection, 20 to 100 pounds per day (lb/day) of liquid oxygen is supplied to the water by a supersaturated DO system.

A portion of the settled solids from the clarifiers are continuously wasted at a rate of 50,000 to 120,000 gallons per day. Approximately 66 lb/day of diluted cationic water-soluble polymer (Clarifloc C-9545) is added to the wasted solids as they are pumped to belt filter presses (BFPs) for dewatering. Sludge is pressed between porous cloth belts and excess water removed from the biosolids is drained back to the IPS. The dewatered solids are then processed through the solar and/or thermal dryer(s) or taken to a landfill for disposal. The dried biosolids, if meeting Class B requirements, will be land applied. Class A biosolids can be sold as fertilizer.

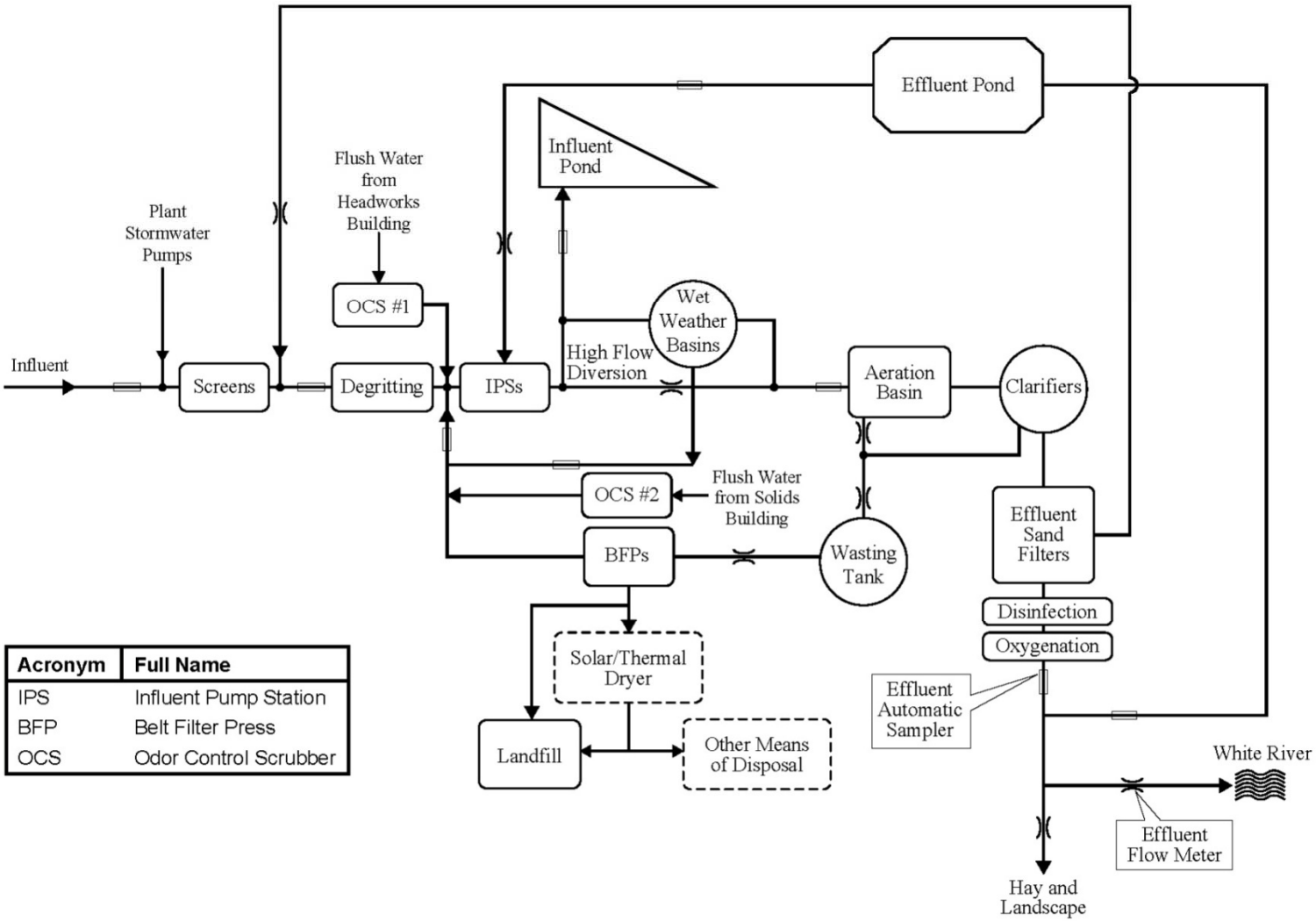


FIGURE 6-1
**Process Flow Diagram**

The Noland WWTP utilizes odor control scrubbers (OCSs) for the headworks and BFPs. OCS #1 pulls air from the headworks building and IPS for hydrogen sulfide treatment. OCS #2 pulls air from the BFP for hydrogen sulfide treatment. The two OCSs use 45-180 lb/day of sodium hypochlorite (NaOCl) to oxidize hydrogen sulfide to sulfur or sulfate; and, 460-805 lb/day sodium hydroxide (caustic) is used to raise the pH to increase the driving force for removal of hydrogen sulfide. The scrubbers are flushed out with potable water. Flush water from the OCSs is pumped back to the IPS. OCS #1 and OCS #2 have constant flush rates of 4 gallons per minute (gpm), respectively.

Chloride, sulfate, and TDS concentrations were measured in influent and effluent between November 2010 and November 2011. Table 6-1 summarizes the influent and effluent concentrations of chloride, sulfate, and TDS measured during this time period. Levels of the three constituents in the influent and effluent water are below USEPA secondary drinking water criteria. The influent concentrations suggest there are no dischargers within the collection area that would contribute to elevated concentrations. According to the typical composition of untreated domestic wastewater, the influent wastewater exhibits medium strength characteristics (Metcalf and Eddy, 2003). The addition of alum for phosphorus removal, and NaOCl and caustic for odor control, to the WWTP are possible contributors to increased concentrations of chloride and sulfate. The average influent and effluent values of the three constituents are all above the existing instream criteria concentrations for minerals applicable to the White River (see Table 6-1).

TABLE 6-1
**Summary of Mineral Concentrations (November 2010—November 2011)**

| | $Cl^-$ (mg/L) | $SO_4^{-2}$ (mg/L) | TDS (mg/L) |
|---|---|---|---|
| **Influent** | | | |
| Average | 35.2 | 47.7 | 378.2 |
| Minimum | 23.0 | 28.1 | 263.0 |
| Maximum | 43.0 | 57.0 | 488.0 |
| Number of Samples | 5 | 15 | 9 |
| **Effluent** | | | |
| Average | 40.4 | 59.0 | 352.0 |
| Minimum | 17.0 | 37.3 | 140.0 |
| Maximum | 76.2 | 100.8 | 470.0 |
| Number of Samples | 49 | 80 | 74 |
| **USEPA Secondary Drinking Water Criteria** | 250 | 250 | 500 |
| **Instream Criteria** | 20 | 20 | 160 |

## 6.1.1 Mass Balances

Mass balances were calculated to determine if chemical addition in the treatment processes contributes significantly to elevating concentrations of chloride, sulfate, and TDS through the WWTP. The following sections present the calculated mass balances for sulfate, chloride, and TDS.

### 6.1.1.1 Sulfate

Figure 6-2 shows the mass balance of sulfate within the WWTP. The 2,474 lb/d of sulfate entering the WWTP were determined by using the average influent concentration and AADF for 2011, reported in the permit renewal application. The sulfate removed with sludge disposal is insignificant; therefore, the sulfate load in the sludge was assumed to be zero. Alum addition added 82.4 lb/d of sulfate to the system. The mass of sulfate in the effluent was calculated to be 2,557 lb/d, or 50.5 mg/L. The calculated effluent concentration of sulfate is 8.5 mg/L less than the average measured effluent concentration of sulfate. It is assumed that the oxidation of any sulfide in the influent (which was not measured) to sulfate in the bioreactor is the cause of higher effluent concentrations

measured. 8.5 mg/L of sulfate would equate to about 3 mg/L of sulfide in the influent which is within the range of sulfide concentrations commonly encountered in municipal wastewater treatment facilities which can be highly variable. Based on this mass balance, it was determined that alum addition does not significantly contribute to an increase in sulfate concentration from influent to effluent.

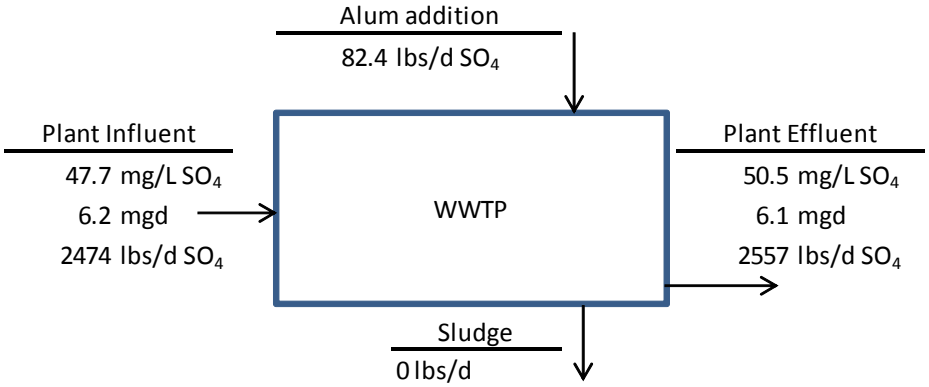


FIGURE 6-2
**Mass Balance of Sulfate**

### 6.1.1.2 Chloride

Figure 6-3 shows the mass balance of chloride in the WWTP. The 1,826 lb/d of chloride in the influent water were determined by using the average influent concentration and AADF for 2011. The chloride removed with sludge disposal is insignificant; therefore, the chloride load in the sludge was estimated to be zero. NaOCl solution addition, containing both NaOCl and sodium chloride (NaCl), added 8.7 lb/d of chloride from NaOCl and 9.1 lb/d of chloride from NaCl to the system. The calculated mass and concentration of chloride in the effluent was 1,844 lb/d and 36.4 mg/L, respectively. The calculated effluent concentration from the mass balance is within 10 percent of the average measured concentration of chloride. It was determined by the mass balance that the addition of NaOCl to OCSs accounts for the minor increase of chloride in the effluent.

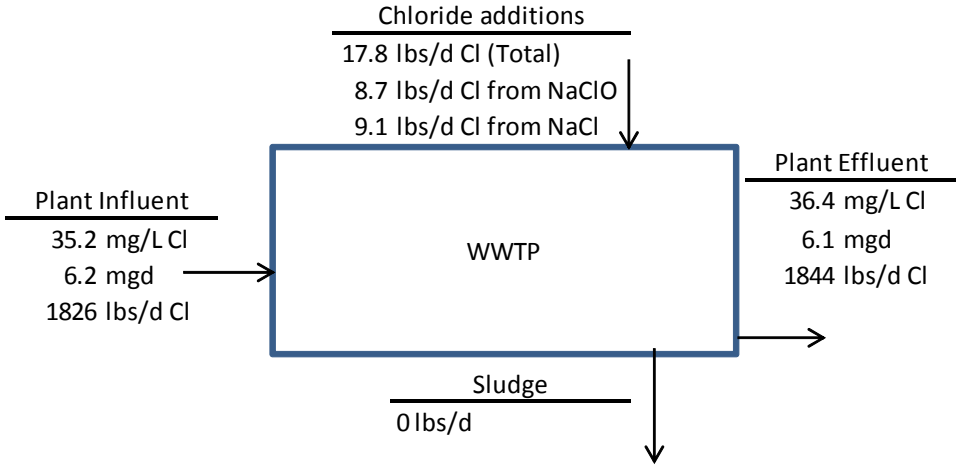


FIGURE 6-3
**Mass Balance of Chloride**

#### 6.1.1.3 TDS

Figure 6-4 shows the mass balance of TDS in the WWTP. The 19,609 lb/d of TDS in the influent water were determined by using the average influent concentration and AADF for 2011. The TDS removed with sludge disposal is insignificant; therefore, the TDS load in the sludge was estimated to be zero. Alum addition added 82.4 lb/d of TDS, assuming the aluminum precipitates and sulfate remained dissolved, and NaOCl and caustic added 463.6 lb/d of TDS to the system. The mass of TDS in the effluent was calculated to be 20,155 lb/d or 398 mg/L. The calculated effluent concentration from the mass balance is within 15 percent of the average measured concentration of TDS. A mass balance of the TDS shows that chemical additions have only a minor effect on effluent values. The additions constitute 3 percent of the effluent TDS concentration, and 5 percent of the effluent TDS load; therefore, the influent is the primary driver of effluent TDS.

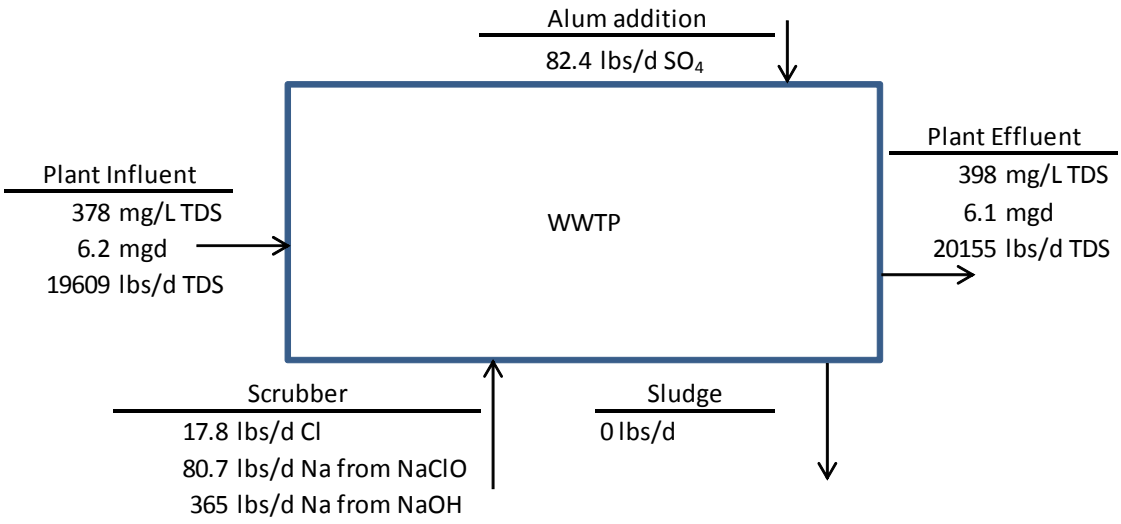


FIGURE 6-4
**Mass Balance of TDS**

### 6.1.2 Mass Balance Conclusions

Based on the calculations, it was determined that changes to the chemical additions would not be effective in reducing these minerals to less than the WQC values because the raw wastewater concentrations are higher than these criteria. The average measured effluent TDS concentrations were lower than the influent concentrations by less than 10 percent, likely due to variability in the measurements, unaccounted-for minor precipitation of dissolved constituents, and biological activity, but the difference in the values is considered minor. The calculated mass balances demonstrate that chemicals used in the treatment process at the Noland WWTP do not contribute significantly to TDS, chloride, or sulfate in the effluent.

## 6.2 Alternatives

Treatment alternatives were identified to reduce concentrations of chloride, sulfate, and TDS to meet the regulatory limits. The alternatives were evaluated based on their effectiveness of treating all three constituents and economic feasibility. A screening level evaluation was conducted first, followed by a detailed economic analysis of the most potentially feasible options.

### 6.2.1 Screening of Alternatives

The possible alternatives identified that could reduce concentrations of the three constituents to required levels or eliminate the discharge are listed below:

1. Product Substitution
2. Recycle/Reuse of Effluent
3. Land Application of Effluent
4. Alternative Discharge Location
5. Evaporation
6. Ion Exchange
7. Membrane Treatment

#### 6.2.1.1 Product Substitution

The first alternative is substituting existing chemicals used in treatment with products that would not increase the level of chloride, sulfate, and TDS. This would be low capital and O&M cost option compared to other alternatives. However, this is not a feasible option because the chemicals used would contribute a minor fraction of the effluent concentrations and substituting chemicals would not reduce the level of the three constituents to the existing WQC concentrations.

#### 6.2.1.2 Alternative Disposal Methods

The second, third, fourth, and fifth alternatives eliminate discharge to the White River. These alternatives would not require changes to the treatment process for chloride, sulfate, or TDS because the limits would no longer apply to the effluent water. However, higher levels of treatment may be required depending on the reuse application.

**Recycle/Reuse.** The second alternative is recycling or reusing the effluent. The effluent water could be reused if a user were identified that had a need for reclaimed water. This alternative is feasible if an economical use for the water is identified. However, no user or combination of users currently exists or are located within reasonable proximity that could take all of the effluent. Because the permit is expected to include concentration-based minerals limits, partial reuse would not result in compliance. This would be a moderate capital and O&M cost option compared to other alternatives.

**Land Application.** The third alternative is land application of effluent. An area of land would need to be identified that could handle the volume of effluent produced from the WWTP to make this alternative feasible. No area of land is known that could handle the volume of water discharged from the treatment plant, and very few farmers in the area use irrigation water. In addition, the climate of the area is not amenable to year-round land application. Again, because the permit is expected to include concentration-based mineral limits, partial reuse would not result in compliance, and because the limits are expected to be in force year-round, seasonal land application also would not comply. This would be a moderate capital and O&M cost option compared to other alternatives.

**Alternative Discharge Location.** The fourth alternative is discharging the effluent to a different waterbody. The only other waterbodies nearby that could be considered include other tributaries to or discharge locations on the White River, and tributaries to the Illinois River system. Other discharge locations in the White River system would not remove mineral loadings to or upstream of impaired or important segments of the White River. Regarding the Illinois River system, the Noland WWTP used to have the option to pump a portion of its effluent over to a tributary in the Illinois River watershed. This option was eliminated from the current NPDES permit and it is not viable to consider sending effluent from the Noland WWTP to the Illinois River basin any time in the foreseeable future due to regulatory issues in Oklahoma. This would be a low to moderate capital and O&M cost option compared to other alternatives.

**Evaporation.** The fifth alternative is evaporating the effluent. This alternative is not feasible due to the volume of effluent and climate conditions at the WWTP. This alternative would require very high energy use and therefore would not be economically practical. The capital and O&M costs for this alternative would be very high compared to other alternatives.

#### 6.2.1.3 Ion Exchange

The sixth alternative is ion exchange. This option is eliminated as a feasible alternative because of its ineffectiveness to reduce the TDS level since by definition ion exchange replaces one dissolved ion with another. Ion exchange can target specific ions such as sulfate or chloride, but this would not address the TDS and therefore is not practical. The capital and O&M costs for this alternative would be moderate to high compared to other alternatives if it were technically feasible.

#### 6.2.1.4 Membrane Treatment

The seventh alternative is membrane treatment using reverse osmosis (RO). Low pressure RO membranes can remove all three constituents to concentrations below the WQC. Membrane treatment appears to be a potentially technically feasible alternative for treatment. Since RO would remove all three constituents to very low concentrations, only a portion of the water would need to be treated. It was determined that the sulfate concentration was the limiting factor for treatment. Based on maximum values of sulfate and treating water to the WQC level, approximately 84 percent of the WWTP effluent would need to be treated by RO and then combined with the balance before being discharged into the White River. If treatment of a portion of the treatment plant effluent is not permissible, then treatment of the full plant flow would be required. A target treatment concentration of 15 percent below the WQC level was chosen based on variability and uncertainty of influent concentrations and to assure compliance. The WWTP would have to meet these levels during peak flows as well as normal flows since they are likely to be concentration based. The concentrate from the process would require disposal in some fashion. This could be through a deep injection well, if suitable geology exists in the area. However, deep well injection is very controversial in the state and it is anticipated that locating an acceptable site and obtaining a permit would both be very difficult. If deep injection wells are not possible, a zero liquid discharge (ZLD) process would be required. Regardless of the concentrate disposal method, the capital and O&M cost for this alternative would be high to very high compared to other alternatives.

### 6.2.2 Detailed Evaluation of Potentially Feasible Screening Level Alternatives

The potentially feasible alternatives were evaluated in more detail to determine whether they were economically feasible for the Noland WWTP to meet the effluent regulations. A more detail evaluation of each alternative is described below.

#### 6.2.2.1 Membrane Treatment

RO membranes reject a large percentage of most dissolved solids found in WWTP effluent water; however, particulate and microbial constituents in the effluent can foul the RO membranes. To minimize the fouling potential of tertiary water a microfiltration (MF) or ultrafiltration system is generally used for pretreatment of the effluent water prior to RO systems. A process schematic for the membrane system discussed herein is shown in Figure 6-5.

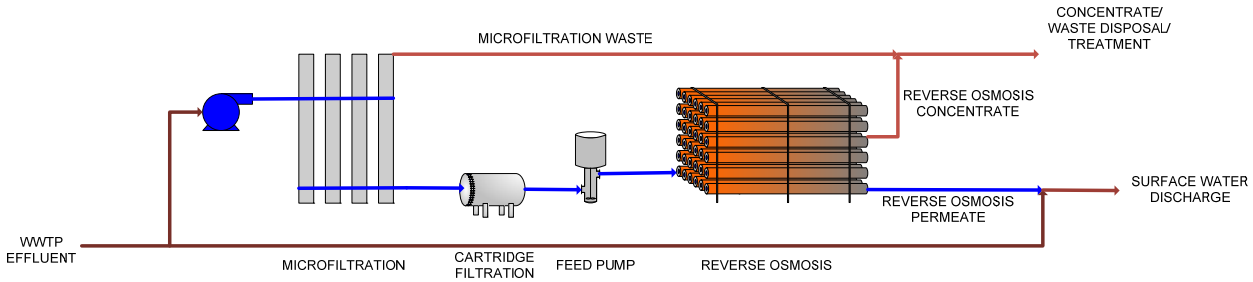


FIGURE 6-5
**Membrane System Schematic**

As shown in Figure 6-5, the membrane system would produce a waste stream. The MF process requires periodic backwash and cleaning processes, producing a waste stream. The RO system would have a recovery of between 75 and 90 percent depending on the ultimate system design and WWTP effluent water quality. This means that it would also have a waste stream (concentrate) with a flow of between 10 and 25 percent of the feed flow to the RO system. The concentrate from the RO system would have high concentrations of the ions that are rejected (do not pass through the RO membrane). The combined waste streams from the membrane system would have to be disposed of or treated.

A preliminary projection using an RO membrane manufacturer's software was done to estimate the concentration of selected ions and TDS in the permeate from an RO system. Based on the maximum WWTP concentrations for sulfate, chloride, and TDS shown in Tables 6-1, discharge concentrations were calculated to be 15 percent below the WQC values. Based on these goals, estimated permeate concentrations and the maximum concentrations of the WWTP effluent, 84 percent of the water being discharged to the White River will need to be treated. The water quality goals, WWTP effluent maximums, RO permeate estimated concentrations and the estimated combined water concentrations are shown in Table 6-2.

TABLE 6-2
**Membrane System Water Quality Parameters**

| | In-stream Criteria (mg/L) | Discharge Goal[a] (mg/L) | WWTP Effluent Maximum Concentration (mg/L) | RO Permeate Concentration (mg/L) | Estimated Combined Water Concentration (mg/L) |
|---|---|---|---|---|---|
| TDS | 160 | 136 | 470 | 8 | 84 |
| $Cl^-$ | 20 | 17 | 76.2 | 1.2 | 13.6 |
| $SO_4^{-2}$ | 20 | 17 | 100.8 | 0.4 | 17 |

[a]Goal for treatment is 15 percent below the WQC to assure compliance.

If it is not permissible to only treat a portion of the treatment plant effluent, more expensive treatment of the full flow would be required. The water quality goals, WWTP effluent maximums, and RO permeate estimated concentrations for treatment of the full flow are shown in Table 6-3.

TABLE 6-3
**Membrane System Water Quality Parameters**

| | In-stream Criteria (mg/L) | Discharge Goal[a] (mg/L) | WWTP Effluent Maximum Concentration (mg/L) | RO Permeate Concentration (mg/L) | Effluent Water Concentration (mg/L) |
|---|---|---|---|---|---|
| TDS | 160 | 136 | 470 | 8 | 8 |
| $Cl^-$ | 20 | 17 | 76.2 | 1.2 | 1.2 |
| $SO_4^{-2}$ | 20 | 17 | 100.8 | 0.4 | 0.4 |

[a]Goal for treatment is 15 percent below the WQC to assure compliance.

The design assumptions and various flow rates for the membrane treatment system and discharge to the White River are shown in Table 6-4. The flow rates shown in Table 6-4 are based on an assumed maximum daily peak flow of 31.5 mgd, which is equivalent to a 2.5 peaking factor of design AADF capacity.

TABLE 6-4
**Membrane System Design Assumptions and Estimated Peak Flows**

| | Partial Flow Treatment | Full Flow Treatment | Units |
|---|---|---|---|
| MF Recovery | 92% | 92% | |
| RO Recovery | 75% | 75% | |
| Estimated discharge to White River | 22.9 | 21.7 | mgd |
| Feed to MF/RO | 27.7 | 31.5 | mgd |
| MF filtrate flow | 25.5 | 29.0 | mgd |
| RO permeate flow | 19.1 | 21.7 | mgd |
| Maximum Daily Concentrate/waste flow | 8.6 | 9.8 | mgd |
| Average Daily Concentrate/waste flow | 3.4 | 3,9 | mgd |
| WWTP effluent flow not demineralized | 3.8 | 0 | mgd |

Present day estimates of construction costs of systems used to treat tertiary water, including MF and RO systems, range from $5 to $9 per gallon produced per day. Assuming an average of $7 per gallon produced per day, the estimated cost for the membrane system would range from $134 to $152 million. The cost to dispose of or treat the waste stream varies significantly. If deep injection wells are possible each well can cost $4 to $7 million for a capacity ranging from 100 to 500 gpm. Assuming the average cost for an average capacity well, the cost for deep injection well disposal would range from $44 million to $50 million. However, since deep well injection is unlikely to be permitted, a ZLD process would likely be required. The costs for such a system would be about $60 per gallon of waste treated. Therefore, the cost for ZLD could range from $204 million to $234 million. In addition, it is assumed that equalization would be provided in either case to equalize the concentrate flow to the average condition, which would cost about $10 million. The total construction cost for membrane treatment would range from $188 million to $396 million, as summarized in Table 6-5.

TABLE 6-5
**Membrane Treatment Construction Cost Estimate Summary**

| | Partial Flow Treatment | | Full Flow Treatment | |
|---|---|---|---|---|
| Item | Deep Well Injection Concentrate Disposal | ZLD Concentrate Disposal | Deep Well Injection Concentrate Disposal | ZLD Concentrate Disposal |
| MF/RO System | $134,000,000 | $134,000,000 | $152,000,000 | $152,000,000 |
| Deep Injection Well System | $44,000,000 | $0 | $50,000,000 | $0 |
| ZLD System | $0 | $204,000,000 | $0 | $234,000,000 |
| Concentrate Equalization System | $10,000,000 | $10,000,000 | $10,000,000 | $10,000,000 |
| Total Cost | $188,000,000 | $348,000,000 | $212,000,000 | $396,000,000 |

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SECTION 7

# UAA Summary and Minerals Criteria Recommendations

## 7.1 Summary of Results

This UAA study involved compiling and summarizing extensive historical water quality and biological data for the White River watershed, and also involved collecting the following additional water quality and biological data specific to this study (see Table 7-1):

- Collection of minerals data for the Noland WWTP effluent and at various river and stream locations on a monthly basis beginning in March 2011 and continuing through May 2012
- Characterization of physical and biological habitat at river and stream stations in fall 2011 and spring 2012
- Collection of benthic macroinvertebrate community samples and diurnal DO measurements at river and stream stations in fall 2011 and spring 2012; benthic macroinvertebrates are generally defined as bottom-dwelling organisms that can be seen with the naked eye, such as aquatic insects, worms, and snails
- Collection of fish community samples at river and stream stations in fall 2011
- WET testing with Noland WWTP effluent spiked with minerals to estimate lethal and sublethal toxic thresholds for an aquatic organism (the water flea, *Ceriodaphnia dubia*) known to be very sensitive to minerals

TABLE 7-1
**Field Data Collection Station Locations and Type**

| Station ID | Location | Drainage Area | Associated Established Station | Method Used to Estimate Stream Discharge | Water Quality | Fish, Benthic, Habitat |
|---|---|---|---|---|---|---|
| 001[a] | Noland WWTP Outfall | N/A | 001 | N/A | X | |
| WR-01 [a] | White River at Wyman Rd. (u/s of Noland WWTP, d/s of Lake Sequoyah) | 400 $mi^2$ | USGS 7048600 | Real-time data from USGS 7048600 | X | X |
| WR-02 [a] | White River, 0.4 mi d/s of Noland WWTP | 403 $mi^2$ | N/A | Real-time data from USGS 7048600 & Noland WWTP continuous effluent flow data | X | X |
| WR-2.5 [b] | White River, 2.7 mi d/s of Noland WWTP | 405 $mi^2$ | N/A | Instream flow measurements during biological monitoring events | X | X |
| WR-03 [a] | White River just u/s of confluence with Richland Creek, at State Hwy 45; 5.5 mi d/s of Noland WWTP | 412 $mi^2$ | ADEQ WHI0052/ USGS 7048700 | Real-time data from USGS 7048700 | X | |
| WF-01 [a] | West Fork White River u/s of West Fork WWTP, at Highway 170 | 62 $mi^2$ | N/A (1 mi upstream of ADEQ WHI0098) | Instream flow measurements during all sampling events | X | |
| WF-02 [a] | West Fork White River at Mally Wagon Road | 123 $mi^2$ | USGS 7048550 | Real-time data from USGS 7048550 | X | |
| RC-01 [a] | Richland Creek at State Hwy 45 | 138 $mi^2$ | USGS 7048800 | Real-time data from USGS 7048800 | X | X |
| RC-02 [c] | Richland Creek at County Road 79 | 119 $mi^2$ | N/A | Instream flow measurements during biological monitoring events | X | X |

[a] Monthly water quality samples collected May 2011-May 2012

[b] Monthly water quality samples collected September 2011-May 2012

[c] Monthly water quality samples collected October 2011-May 2012

A weight of evidence analysis was then developed based on these data (see also Section 3.9 and Table 3-8). Applying comparable significance to each monitoring component and parameter, the overall weight of evidence analysis demonstrates that minerals concentrations in the White River downstream of the Noland WWTP are not adversely affecting aquatic biological communities in the river. The following key observations are made to reach this conclusion:

- The percent dominant taxa and HBI metric are generally higher at Station WR-02 than at the other sampling stations and generally indicate less diverse communities at Station WR-02.Taxa richness, number of EPT taxa, percent dominant taxa, and HBI values indicate the benthic macroinvertebrate community at Station WR-2.5 (approximately 2.7 mi downstream of the Noland WWTP outfall) is comparable to communities upstream of the Noland WWTP and to those in Richland Creek. Therefore, lower diversity of the benthic macroinvertebrate communities is isolated to directly downstream (as evidenced 0.4 mi downstream) of the Noland WWTP outfall.
- Mineral concentrations are relatively high and similar at Stations WR-02 and WR-2.5 (see Table 3-8); however, benthic macroinvertebrate communities at these stations are not comparable. Therefore, the differences observed immediately downstream of the outfall are not attributable to minerals but to other water quality conditions, food sources, and/or hydraulic characteristics, since other measures of physical habitat between the stations are comparable (i.e., the physical habitat at each White River station is suboptimal).
- The fish communities downstream of the Noland WWTP outfall at Stations WR-02 and WR-2.5 are rated "generally similar," as defined by ADEQ for the ecoregion. The fish communities at WR-02 and WR-2.5 were rated higher than the community upstream of the outfall (at WR-01), based on the ADEQ thresholds for the Index of Biotic Integrity (IBI) score. However, there was a noticeable difference in the community at Station WR-02, specifically a decrease in sensitive individuals and a higher proportion of members of the Ictaluridae family (catfishes) and primary feeders. These species are indicative of organic loading and their presence is not expected to be related to mineral concentrations at Station WR-02. This is supported by a return to fish community structure at Station WR-2.5 similar to that upstream of the Noland WWTP. Since mineral concentrations are similar at Stations WR-02 and WR-2.5, the altered fish community structure observed at WR-02 is not due to mineral levels. The IBI score for fish at Station WR-02 reveals the fish community is supporting the fisheries designated use. This is particularly meaningful given that White River flows during fish sampling were less than the Q7-10 (the lowest mean discharge during 7 consecutive days, occurring once every 10 years on average).
- The predominance of benthic algae, and the associated increase in community metabolism, at Station WR-02 compared to WR-01 is influencing biological communities downstream of the Noland WWTP (such as lower diversity of macroinvertebrates and higher proportion of benthic herbivore fish species). Although the Noland WWTP permit requires substantial removal of phosphorus from the effluent (to less than 1.0 milligram per liter [mg/L]), it is expected that phosphorus concentrations would still be somewhat higher downstream than upstream. That said, the levels of nutrients and algae downstream of the Noland WWTP did not result in levels of DO below the applicable DO criteria during continuous DO monitoring, during extreme low flows during the fall sampling period.
- The estimated IC25 values of 1,643 mg/L TDS, 371 mg/L sulfate and 327 mg/L chloride determined in the WET testing represent the best estimates of the sublethal toxic thresholds for these minerals at this site. These values are much greater than instream minerals concentrations and greater than the highest TDS, sulfate and chloride concentrations measured in the Noland WWTP effluent to date (680 mg/L, 104 mg/L, and 76 mg/L, respectively). This reinforces the results of the biological field data which indicated that minerals concentrations are not having an adverse impact on biological communities.

## 7.2 Designated Use Evaluation and Recommended Site Specific Minerals Criteria

Per USEPA regulation, a state can remove a designated use that is not an existing use, or adopt a subcategory of use with less restrictive criteria, if attaining the designated use is not feasible because one or more of the following conditions (as adapted from 40 CFR 131.10[g]) are satisfied:

1. Naturally occurring pollutant concentrations prevent the attainment of the use; or
2. Natural, ephemeral, intermittent, or low flow conditions or water levels prevent the attainment of the use, unless these conditions may be compensated for by the discharge of a sufficient volume of effluent without violating state water conservation requirements to enable uses to be met; or
3. Human-caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place; or
4. Dams, diversions, or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the waterbody to its original condition or to operate such modification in a way that would result in the attainment of the use; or
5. Physical conditions related to the natural features of the waterbody, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses; or
6. Controls more stringent than those required by Sections 301(b) and 306 of the Clean Water Act would result in substantial and widespread economic and social impact.

As discussed in Sections 5.1 and 5.2, the currently designated uses for the White River and Beaver Lake are consistent with the apparent existing uses. The currently designated uses also appear to be attained or should be attainable with implementation of TMDLs that are intended to remedy ADEQ-identified impairments. Consequently, this UAA does not propose any modifications to the designated uses, as currently defined in Arkansas regulations for this reach of the White River and Beaver Lake.

As described in Section 6, the only potentially feasible alternative, from a technical perspective, to comply with the existing minerals criteria is membrane treatment. However, the estimated cost for the City of Fayetteville's Noland WWTP to treat and dispose of membrane waste streams would be extremely high, and therefore not economically feasible. The estimated construction costs to treat the wastewater to comply with the existing minerals criteria would range from $134 to $152 million. The estimated additional construction cost to dispose of or treat the membrane waste streams varies significantly depending on treatment or disposal method, but would range from approximately $54 to $244 million. Thus, the total construction cost to comply with the existing minerals criteria ranges from $188 million to $396 million. While costly membrane treatment options are available to reduce mineral concentrations in the Noland WWTP effluent, based on the findings of this study, if implemented, no improvements to the aquatic biota would be anticipated. This is due to the fact that the concentrations of chloride, sulfate, and TDS in the watershed are not adversely impacting aquatic biota as summarized in Section 3.9. Therefore, the installation of alternative treatment technologies is not only economically infeasible, it would not improve the status of the fisheries designated use in the White River.

Thus, the site-specific minerals criteria that are currently applicable to the White River in the vicinity of the Noland WWTP are not attainable because they would require controls more stringent than those required by Sections 301(b) and 306 of the Clean Water Act, resulting in substantial and widespread economic and social impact (UAA factor 6 above). This justifies new site-specific minerals criteria that would protect all currently designated uses for the proposed reach of the White River. The proposed applicable reach of the river would be from the Noland WWTP outfall at River Mile 17.25 to immediately downstream of Richland Creek at River Mile 11.6. The existing and proposed site-specific minerals criteria for this reach, as described and delineated in Section 4, are summarized in Table 7-2.

TABLE 7-2

**Summary of Existing and Proposed Site Specific Minerals Criteria for the White River**

| Mineral | Existing Criteria | Proposed UAA Criteria |
|---|---|---|
| $Cl^-$ | 20 | 60 |
| $SO_4^{-2}$ | 20 | 100 |
| TDS | 160 | 440 |

This UAA also does not propose any modifications to the site-specific criteria currently applicable to Beaver Lake. Furthermore, as described in Section 4, the proposed minerals criteria for the White River also would be protective of currently designated uses and associated minerals criteria for Beaver Lake. This conclusion is based on results of the USGS modeling of varying minerals loads to Beaver Lake compared to anticipated loads from the White River with the Noland WWTP discharging at design capacity. Therefore, the proposed, modified site-specific WQC for the White River study reach are considered to be protective of the Beaver Lake WQC.

SECTION 8

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# Appendix A
# White River UAA Study Plan

*Report*

# White River Use Attainability Analysis Study Plan

Prepared for

**City of Fayetteville, Arkansas**

Draft Submitted to ADEQ: April 2011

Revised Draft Submitted to ADEQ: May 2011

Project No. 399884

Prepared by

CH2MHILL

ftn Associates Ltd.

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Appendix

A Field Sampling Plan

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# Acronyms and Abbreviations

| | |
|---|---|
| ADEQ | Arkansas Department of Environmental Quality |
| ADH | Arkansas Department of Health |
| AGFC | Arkansas Game & Fish Commission |
| ANRC | Arkansas Natural Resources Commission |
| APCEC | Arkansas Pollution Control and Ecology Commission |
| CBOD | carbonaceous biochemical oxygen demand |
| CPOM | Coarse Particulate Organic Matter |
| DO | dissolved oxygen |
| FSP | Field Sampling Plan |
| mgd | million gallons per day |
| NPDES | National Pollutant Discharge Elimination System |
| Noland WWTP | Paul R. Noland Wastewater Treatment Plant |
| QA/QC | Quality assurance/quality control |
| TSS | total suspended solids |
| USEPA | United States Environmental Protection Agency |
| USGS | United States Geological Survey |
| USFWS | US Fish & Wildlife Service |
| UAA | Use Attainability Analysis |
| WERF | Water Environment Research Foundation |
| WQC | water quality criteria |

# 1. Introduction and Overview

The City of Fayetteville, Arkansas, is authorized under the National Pollutant Discharge Elimination System (NPDES) to discharge wastewater from the Paul R. Noland Wastewater Treatment Plant (Noland WWTP) to the White River at the location shown on Figure 1. The current NPDES permit (No. AR0020010) was issued in 2006. The WWTP discharges through a single outfall to the White River upstream of Beaver Reservoir within the Arkansas Department of Environmental Quality (ADEQ) Planning Segment 4K.

The Arkansas Department of Environmental Quality (ADEQ) is considering future permit limits for total dissolved solids (TDS) and dissolved minerals, specifically chloride and sulfate. The segment of the White River where the Noland WWTP discharges (Reach 23) is listed on the Arkansas 2008 303(d) list of impaired waterbodies for turbidity (sediment), TDS, chloride, and sulfate. Concentrations measured in the White River both above and below the Noland WWTP discharge exceed the current site-specific water quality criteria (WQC) established by Arkansas Pollution Control and Ecology Commission (APCEC) Regulation No. 2, *Regulation Establishing Water Quality Standards for Surface Waters of the State of Arkansas*. Section 2.511 (Mineral Quality) of Regulation No. 2 provides the following mineral criteria: 20 mg/L for chloride; 20 mg/L for sulfate; and 160 mg/L for TDS. The Noland WWTP discharge is subject to the site-specific WQC for the White River.

This study plan describes the scientific approach for performing a Use Attainability Analysis (UAA), which evaluates aspects of a stream with respect to the designated uses of the waterbody. The designated uses for the White River are: primary and secondary contact recreation; domestic, industrial, and agricultural water supply; and, aquatic life, Ozark Highlands ecoregion. The UAA will include the option of developing appropriate site-specific WQC for dissolved minerals that would protect existing and attainable designated uses in the White River and downstream affected waters. Additional supportive action will be jointly undertaken by the City and local personnel of the United States Geological Survey (USGS) to update an existing model of Beaver Lake (Reservoir), the major downstream reservoir and the main water supply for most of Northwest Arkansas, to reflect any potential impacts from theoretical modifications to the WQC that might be proposed as a result of the UAA. The City expects to present all available pertinent data and information to the APCEC after the conclusion of the UAA process.

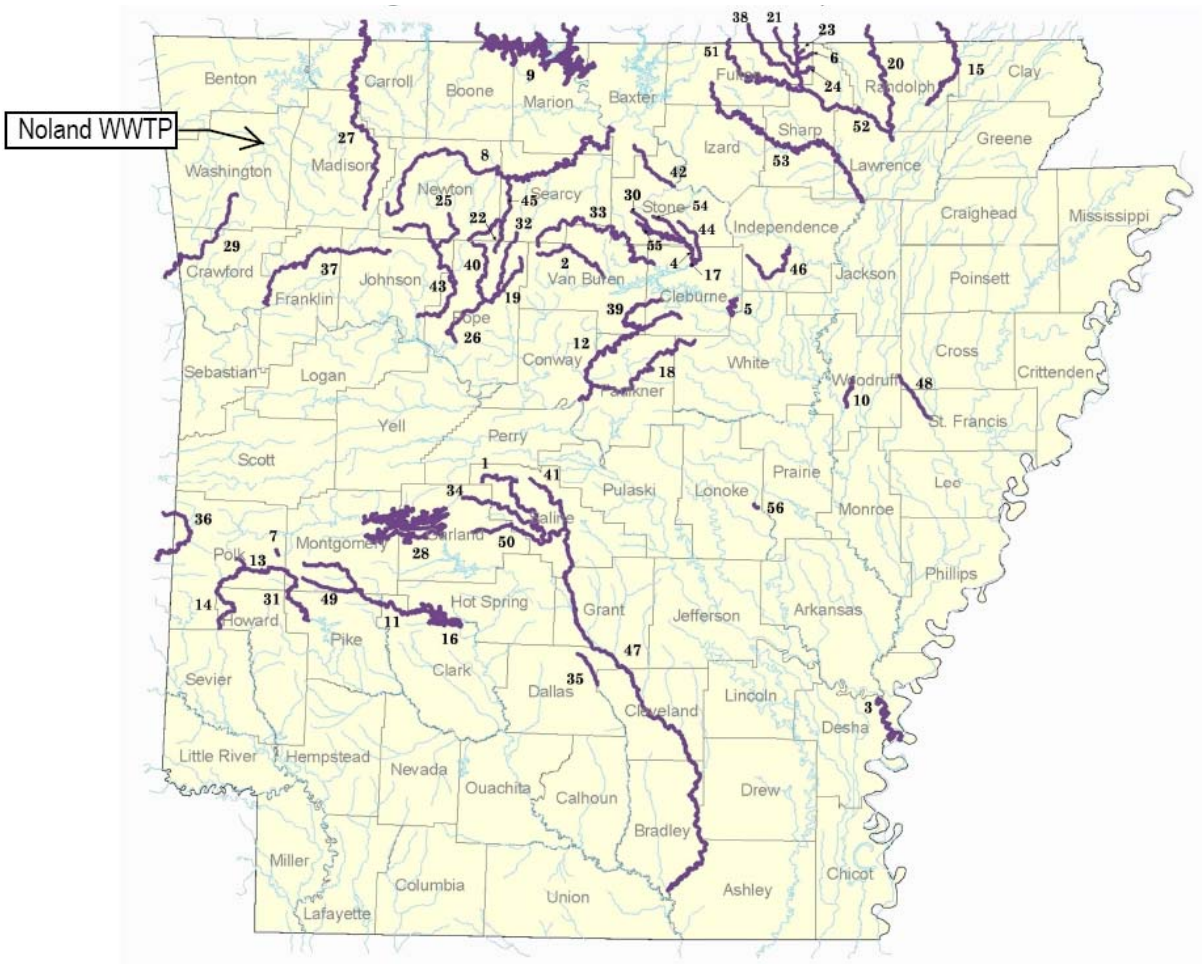



FIGURE 1
Location of Noland WWTP (adapted from ADEQ, 2008)

# 2. Background

## 2.1 NPDES Permit

The Noland WWTP NPDES permit (No. AR0020010) authorizes the discharge of treated municipal wastewater from the cities of Fayetteville, Farmington, Elkins, Greenland, and Johnson, as well as industrial and commercial enterprises, although the flow from Farmington and Johnson is normally treated in the City's West Side WWTP. The Noland WWTP has a daily average design capacity of 12.6 million gallons per day (mgd) and is permitted to discharge 11.21 mgd of treated effluent to the White River near Fayetteville. The existing permit includes limitations for flow, carbonaceous biochemical oxygen demand (CBOD), total suspended solids (TSS), ammonia nitrogen, dissolved oxygen (DO), total phosphorous, fecal coliform bacteria, pH, and whole effluent toxicity.

## 2.2 Outfall 001

The Noland WWTP discharges to the White River through Outfall 001, which is located in Reach 23 of Planning Segment 4K. The stream reach has the following designated uses, per APCEC Regulation No. 2: primary and secondary contact recreation; domestic, industrial, and agricultural water supply; and, aquatic life, Ozark Highlands ecoregion.

## 2.3 Dissolved Mineral Concentrations

At the suggestion of ADEQ, the City of Fayetteville has recently (January 2011) collected TDS, chloride, and sulfate data from the Noland WWTP effluent (Table 1). Review and analysis of these data, including the utilization of the ADEQ reasonable potential analysis for dissolved minerals, indicate that the UAA to evaluate dissolved minerals is necessary.

TABLE 1
Noland WWTP Effluent

| Constituent | White River Criteria | Noland Effluent[1] | Drinking Water Criteria[2] | BWD[3] 2009 Actual[4] |
|---|---|---|---|---|
| Chloride | 20 | Av. 40.5; range 38.2-44.4 | 250 | 9 |
| Sulfate | 20 | Av. 57.1; range 37.3-61.4 | 250 | 27.6 |
| TDS | 160 | Av. 458; range 397-680 | 500 | 95 |

[1] January 2011 sampling.
[2] EPA's Aesthetic standards and ADH's drinking water standards.
[3] Beaver Water District Finished Water.
[4] Consumer Confidence Report (CCR) - The Annual Drinking Water Quality Report (EPA, 2009).

# 3. Technical Approach

## 3.1 Waterbody Information

The Noland WWTP is authorized to discharge treated wastewater from its facility located at 1400 North Fox Hunter Road in Fayetteville, Washington County, Arkansas, to the White River at Outfall 001 (36°05'00"N, 94°05'00"W). The outfall is located in the Beaver Reservoir watershed (8-digit U.S. Geological Survey Hydrologic Unit Code [HUC-8] 11010001) in the larger Upper White River watershed (HUC 110100). Outfall 001 is located in the headwaters of the White River, upstream of Beaver Reservoir. Downstream of Beaver Reservoir Dam, the White River flows northeasterly into Missouri; then back into Arkansas in a south-southeasterly direction, traveling through much of the eastern portion of the state (see Figure 1). The White River is part of the Arkansas-White-Little Red River Basin, which flows to the Mississippi River in southeast Arkansas.

## 3.2 Water Quality Criteria and Designated Uses

Arkansas water quality standards are based on the designated use of the water and ecoregion. Waters within each of the six ecoregions of the state have dissolved mineral criteria that were developed from data collected in least-disturbed streams within each ecoregion. Water quality criteria applicable to the study area are summarized in Table 2.

TABLE 2
Arkansas Water Quality Standards for Upper White River

| Parameter | Water Quality Criterion | Data Points Exceeding Criteria for Supporting |
|---|---|---|
| **General Standards for Ozark Highlands** | | |
| Temperature | 29°C (84.2°F) | ≤ 10% |
| Dissolved Oxygen (DO) | 6 mg/L | ≤ 10% |
| Turbidity | 10 NTU (baseflow) | ≤ 25% |
| | 17 NTU (storm flow) | ≤ 20% |
| pH | 6.0 to 9.0 standard units | |
| **Domestic Water Supply Criteria** | | |
| Chloride ($Cl^-$) | 250 mg/L | ≤ 10% |
| Sulfate ($SO_4^{-2}$) | 250mg/L | ≤ 10% |
| Total Dissolved Solids (TDS) | 500mg/L | ≤ 10% |

TABLE 2
Arkansas Water Quality Standards for Upper White River

| Parameter | Water Quality Criterion | Data Points Exceeding Criteria for Supporting |
|---|---|---|
| **Mineral Quality Criteria in White River (Missouri line to headwaters, including Beaver Reservoir)** | | |
| Chloride ($Cl^-$) | 20 mg/L | ≤ 10% |
| Sulfate ($SO_4^{-2}$) | 20mg/L | ≤ 10% |
| Total Dissolved Solids (TDS) | 160 mg/L | ≤ 10% |

Source: APCEC Regulation No. 2 (2010) and ADEQ (2008)
°C = degrees Celsius, °F= degrees Fahrenheit, mg/L=milligrams per liter, NTU = Nephelometric Turbidity Unit, col./100 mL = colonies per 100 milliliters

## 3.3 Receiving Streams Regulatory Background

A summary of the designated use attainment status for streams in Arkansas' Planning Segment 4K is provided in Table 3. The Noland WWTP outfall is located in Reach 23 of the White River. Additionally, the upper portion of Beaver Reservoir is listed as not supporting aquatic life due to siltation caused by surface erosion.

## 3.4 Project Technical Approach

A goal of the study will be to evaluate existing and attainable uses in the receiving streams and determine if those uses can be attained with less stringent criteria for dissolved minerals.

Specifically the project will address the following questions:

1. Can onsite controls for TDS, chloride, and sulfate result in discharges from the Noland WWTP that will meet existing downstream Arkansas WQC?
2. Will implementing these controls (if they exist) be economically feasible and result in significantly increased protection for the receiving streams?
3. Do current TDS, chloride, and sulfate concentrations in discharges from the Noland WWTP impair aquatic life or other designated uses in the White River?
4. Would site-specific criteria for TDS, chloride, and sulfate in the receiving streams that are consistent with current effluent concentrations and or natural background concentrations be protective of designated uses?

A comprehensive waterbody assessment will be performed to determine the following:

1. The existing and attainable uses of the White River waterway
2. Impacts of the discharge on the existing and attainable uses of the White River

The approach contained within this Study Plan for developing the waterbody assessment follows applicable guidance contained within the following documents:

- The United States Environmental Protection Agency (EPA) WQS Handbook, 2nd Ed. (EPA 1994)
- The EPA Technical Support Manual: Waterbody Surveys and Assessments for Conducting UAAs, Vol. II (EPA 1983)
- The Water Environment Research Foundation (WERF)
  - Suggested Framework for Conducting UAAs and Interpreting Results (1997a)
  - Comprehensive UAA Technical Reference (1997b)
  - Factors for Success in Developing UAAs (2007)
  - Collaborative Water Quality Solutions: Exploring UAAs (2007), (developed jointly with National Association of Clean Water Agencies)
  - Bioassessment: A Tool for Managing Aquatic Life Uses for Urban Streams (2008)
- Applicable portions of the EPA Region 6 WQS Submission Checklist (date unknown)

TABLE 3
Status of Streams in Planning Segment 4K on Arkansas' 2008 Integrated 305(b)/303(d) Report

| Stream Name | Reach[a] | Stream Miles | Aquatic Life[b] | Primary Contact[b] | Secondary Contact[b] | Drinking Water[b] | Agricultural/ Industrial Water[b] | Source[c] | Cause[d] | Status[e] |
|---|---|---|---|---|---|---|---|---|---|---|
| White River | 23 | 6.2 | N | S | S | S | N | UN, UN, UN, SE | TDS, CL, SO4, Si | 5a, 5a, 5a, 4a |
| West Fork White River | 24 | 27.2 | N | S | S | S | N | UN, UN, UN, SE | TDS, SO4, DO, Si | 5a, 5a, 5f, 4a |
| Middle Fork White River | 926 | 13.8 | S | S | S | S | S | | | 1 |
| Middle Fork White River | 26 | 8.1 | N | S | S | S | S | UN | DO | 5d |
| White River | 927 | 6.6 | S | S | S | S | S | | | 1 |
| White River | 27 | 17.2 | N | S | S | N | S | UN, UN | DO, Be | 5d, 5d |
| Mill Creek | 28 | 6.1 | S | S | S | S | S | | | 1 |
| White River | 29 | 13.5 | S | S | S | S | S | | | 1 |
| Richland Creek | 30 | 12.1 | S | S | S | S | S | | | 1 |
| Lollar Creek | 31 | 12.5 | S | S | S | S | S | | | 1 |
| Richland Creek | 32 | 7.1 | S | S | S | S | S | | | 1 |
| Brush Creek | 33 | 13.5 | S | S | S | S | S | | | 1 |
| War Eagle Creek | 34 | 22.2 | S | S | S | N | S | UN | Be | 5d |
| War Eagle Creek | 35 | 8.6 | S | S | S | S | S | | | 1 |
| Leatherwood Creek | 916 | 7.6 | N | S | S | S | S | UN | DO | 5d |
| Clear Creek | 36 | 6.7 | S | S | S | S | S | | | 1 |
| Kings River | 37 | 19.1 | S | S | S | S | N | UN | TDS | 5d |
| Kings River | 38 | 3.4 | S | S | S | S | S | | | 1 |
| Kings River | 40 | 17.9 | S | S | S | S | S | | | 1 |

TABLE 3
Status of Streams in Planning Segment 4K on Arkansas' 2008 Integrated 305(b)/303(d) Report

| Stream Name | Reach[a] | Stream Miles | Aquatic Life[b] | Primary Contact[b] | Secondary Contact[b] | Drinking Water[b] | Agricultural/ Industrial Water[b] | Source[c] | Cause[d] | Status[e] |
|---|---|---|---|---|---|---|---|---|---|---|
| Kings River | 41 | 4.8 | S | S | S | S | S | | | 1 |
| Kings River | 42 | 39.5 | N | S | S | N | N | UN, UN, UN | Be, TDS, DO | 5d |
| Keels Creek | 39 | 7.3 | S | S | S | S | S | | | 1 |
| Dry Fork | 43 | 16.5 | S | S | S | N | S | UN | Be | 5d |
| Piney Creek | 44 | 10.2 | S | S | S | S | S | | | 1 |
| Osage Creek | 945 | 25.6 | S | S | S | S | S | | | 1 |
| Osage Creek | 45 | 5 | S | S | S | S | S | | | 1 |
| South Fork | 46 | 13.8 | S | S | S | S | S | | | 1 |
| Osage Creek | 47 | 13.4 | S | S | S | N | S | UN | Be | 5d |
| Yocum Creek | 52 | 16.2 | S | S | S | N | S | UN | Be | 5d |
| Long Creek | 54 | 8.4 | S | S | S | S | S | | | 1 |
| Dry Creek | 55 | 12 | S | S | S | S | S | | | 1 |
| Long Creek | 56 | 14.3 | S | S | S | S | S | | | 1 |
| Long Creek | 57 | 8.6 | S | S | S | S | S | | | 1 |
| Terrapin Creek | 58 | 11.2 | S | S | S | S | S | | | 1 |
| Holman Creek | 59 | 9.1 | S | S | S | N | N | MP, MP | TDS, NO3 | 5a, 4a |
| War Eagle Creek | 60 | 28.3 | S | S | S | S | S | | | 1 |

Source: (ADEQ, 2008)
[a] As defined by ADEQ
[b] S = fully supporting use, N = not supporting use
[c] MP = municipal point source, SE = surface erosion UN = unknown
[d] SI = siltation/turbidity CL = chlorides, SO4 = sulfates, TDS = total dissolved solids, NO3 = nitrate nitrogen, DO = dissolved oxygen, Be = beryllium
[e] 1 = supporting all designated uses, 4a = impaired, TMDL has been developed for parameter violated, 5a = impaired, TMDL has not been developed, 5d = need additional data to verify the accuracy of the assessment, 5f = not meeting standard due to natural or background water quality conditions

### 3.4.1 UAA Technical Plans

This phase of the process includes development of a UAA Study Plan to lay out strategies and planned tasks for review and comment by ADEQ and APCEC. The technical phase of this UAA also includes historical data compilation; sampling (physical/chemical/ biological) to characterize current conditions; and, analysis and preparation of technical documentation for development of modified Arkansas WQC for TDS, chloride, and sulfate. Refer to the Field Sampling Plan (Appendix A) for specific technical elements of the field sampling tasks. The general approach is described below:

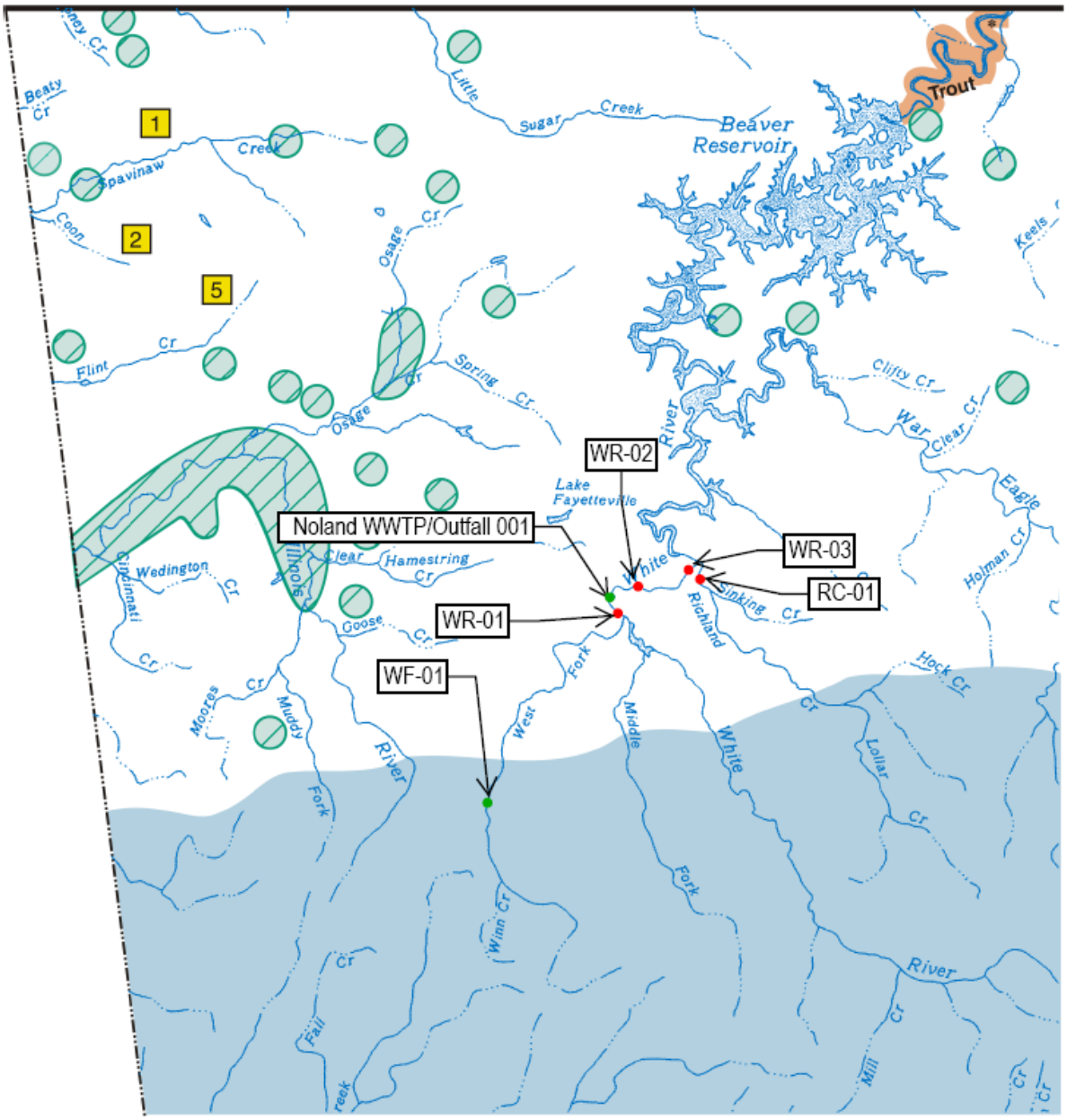
1. *UAA Study Plan Development*:
   - This document—the UAA Study Plan— will be developed and will provide pertinent regulatory information and history about the Noland WWTP discharge and downstream drainages.
   - The UAA Study Plan will be submitted to ADEQ and APCEC in April 2011 to obtain conceptual agreement for the approach during early spring of 2011.
2. *Compilation of Historical Data*: Historical data compilation, review, and identification of data gaps will be performed. Chemistry, habitat, macroinvertebrate, and fishery data collected during special studies performed by ADEQ or others in the area will be reviewed. These include data collected during studies to characterize historical conditions and provide background for the evaluation of existing conditions. Of particular importance is the review of available historical data from the receiving streams to understand the biological communities present at the time designated uses were implemented into the regulations.
3. *Sampling – Toxicity*: Toxicity testing (chronic screens and existing NPDES permit toxicity testing information) for the Noland WWTP whole effluent toxicity evaluations will be used to evaluate potential 'biological' effects of the discharge. An additional toxicity evaluation will be completed to identify the potential for toxicity associated with a range of concentrations of TDS, chloride, and sulfate. Toxicity testing (7-day chronic test, single sample for renewals) will use fathead minnows and *Ceriodaphnia dubia* and will be conducted in samples to represent potential "worst case" dissolved minerals levels in the Noland WWTP discharge.
4. *Sampling – Water Quality and Biological Monitoring*: Details of the sampling effort are described in the Field Sampling Plan (Appendix A). The Field Sampling Plan describes water quality and biological monitoring to be used for characterizing the physical, chemistry and biology present in the downstream aquatic systems and in the effluent of Noland WWTP (Outfall 001). Sampling will include one fish community assessment, two benthic macroinvertebrate assessment, three physical habitat assessments, and twelve water quality/discharge monitoring events. Table 4 provides a summary of the sampling stations and proposed sampling parameters, and Figure 2 illustrates the location of the proposed sampling stations.

TABLE 4

Field Data Collection Station Locations and Type

| Station ID | Location | Drainage Area | Associated Established Station[b] | Method Used to Estimate Stream Discharge[c] | Water Quality | Fish, Benthic, Habitat |
|---|---|---|---|---|---|---|
| 001[a] | Noland WWTP Outfall | N/A | 001 | N/A | X | |
| WR-01 | White River at Wyman Rd. (u/s of Noland WWTP, d/s of Lake Sequoyah) | 400 $mi^2$ | USGS 7048600 | Real-time data from USGS 7048600 | X | X |
| WR-02 | White River d/s of Noland WWTP | 403 $mi^2$ | N/A | Real-time data from USGS 7048600 & Noland WWTP continuous effluent flow data | X | X |
| WR-03 | White River just u/s of confluence with Richland Creek, at State Hwy 45 | 412 $mi^2$ | ADEQ WHI0052/ USGS 7048700 | Real-time data from USGS 7048700 | X | X |
| WF-01 | West Fork u/s of West Fork WWTP, at Highway 170 in West Fork, AR | 62 $mi^2$ | N/A (1 mile upstream of ADEQ WHI0098) | Instream flow measurements during sampling events | X | |
| RC-01 | Richland Creek at State Hwy 45 | 138 $mi^2$ | USGS 7048800 | Real-time data from USGS 7048800 | X | X |

[a] Water quality monitoring at the Noland Outfall will be conducted by Noland staff.
[b] ADEQ stations are Ambient WQ Monitoring Stations.
[c] Methods to be used during water quality events; during biological monitoring events, instream flow measurements will be taken at biological monitoring stations.




- Water Quality Only
- Water Quality and Biological

FIGURE 2
Sampling Station Locations (adapted from APCEC, 2010)

### 3.4.2 Stakeholder Coordination, Project Communications, and Briefings

Communication and coordination with parties (stakeholders) who will have an interest in the potential WQC changes will be necessary and addressed in the form of routine progress reports and presentations as needed to address questions and third-party rulemaking requirements. Based on experience with similar projects, the following stakeholders will likely be actively involved or interested in the third-party rulemaking process:

1. The general public
2. Municipal and county governments
3. The Arkansas Department of Health (ADH)
4. Arkansas Natural Resources Commission (ANRC)
5. ADEQ
6. EPA Region 6
7. APCEC
8. Beaver Water District
9. State and local legislators
10. US Fish & Wildlife Service (USFWS)
11. The Arkansas Game & Fish Commission (AGFC)
12. Arkansas Audubon
13. Other point source dischargers to the White River or its tributaries
14. Local and/or downstream agricultural or industrial interests

### 3.4.3 Legal and Administrative Tasks

Assuming that technical justification for modified Arkansas WQC is developed, the following legal documents will be required during the third-party rulemaking process. These documents, should they be justified and supported by the technical conclusions of the UAA, will be prepared by appropriate legal and technical staff with previous rulemaking process experience:

1. Petition for third-party rulemaking
2. Various public notices
3. Documents for the full APCEC review as well as the APCEC Rules and Regulations Committee
4. Documents for Joint Legislative Committees (Administrative Rules and Regulations and Health, Welfare, and Labor)
5. Responsiveness Summary to Public Comments

6. Statements for Public Hearings
7. Code Revisions to the Arkansas Code
8. Others as necessary

### 3.4.4 Schedule

1. *UAA Study Plan*: the City requests that ADEQ and APCEC expedite their review of this revised Study Plan to provide feedback and technical input to the proposed approach and to limit uncertainty in later phases of the UAA. ADEQ review and approval of this Study Plan is requested by May 2011 prior to beginning water quality sampling, although feedback following that date will also be appreciated.
2. *Technical Phases*: CH2M HILL and FTN plan to complete the technical phases of the project by April 2012. The technical phase primary tasks include:
   - Monthly water quality sampling, May 2011 through April 2012.
   - Fish community and physical habitat assessments in late summer 2011.
   - Benthic macroinvertebrate community and physical habitat assessments in fall 2011 and early spring 2012.
   - Analyses of the information and data from these field tasks.
   - Water quality modeling.
3. *Draft UAA Report*: the City anticipates submitting the UAA Report for agency review in August 2012.
4. *Stakeholder Meetings*: the City will assist ADEQ as necessary to schedule meetings with stakeholders as well as communicate with other agencies to facilitate their review of the project (e.g., state congressmen, APCEC, ANRC, USFWS, AGFC, ADH, BWD, etc.) during September 2012.
5. *Administrative Rulemaking Processes*: If modified Arkansas WQC are justifiable and represent the logical alternative for addressing this situation, a third-party rulemaking process will be initiated in order to develop modified Arkansas WQC for the receiving stream(s). This task involves administrative and legal processes that need to be completed. The overall completion timeframe will depend on ADEQ review of the final UAA Report; APCEC's schedule; public notice requirements and public responses received; legislative review committee schedules; and, other factors.

# 4. Works Cited

Arkansas Department of Environmental Quality (ADEQ). 2008. Integrated Water Quality Monitoring and Assessment Report. Water Division.

Arkansas Pollution Control and Ecology Commission (APCEC). 2010. Regulation Establishing Water Quality Standards for Surface Waters of the State of Arkansas. Adopted December 3, 2010.

Beaver Water District. 2009. The Annual Drinking Water Quality Report - Consumer Confidence Report (CCR).

U.S. Environmental Protection Agency (USEPA). 1983. Technical Support Manual: Waterbody Surveys and Assessments for Conducting Use Attainability Analyses, Office of Water Regulations and Standards. Washington, D.C. November, 1983.

U.S. Environmental Protection Agency (USEPA). 1993. Water Quality Standards Handbook: Second Edition. Office of Science and Technology, Water Quality Standards Branch. Washington, D.C. September 1993.

U.S. Environmental Protection Agency (USEPA). 1994. Water quality standards handbook: Second Edition. EPA-823-B-94-005a. US Environmental Protection Agency, Office of Water. Washington, D.C. August 1994.

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Appendix A

# Field Sampling Plan

**APPENDIX A**

# Field Sampling Plan

## A.1.0 Overview

The City of Fayetteville will conduct monitoring activities in accordance with this Field Sampling Plan (FSP) during the period May 2011 through April 2012. Physical, chemical, and biological data will be gathered from representative stream locations in the Noland Wastewater Treatment Plant (WWTP) study area. Results of the monitoring, in conjunction with analysis of readily available historical water quality data, including data collected by ADEQ, the U.S. Geological Survey (USGS), and the University of Arkansas, will be used to: (1) identify the primary factors causing stream impairment with respect to water quality standards and designated uses; and (2) evaluate natural levels of dissolved minerals in the study area.

The FSP includes methods for:

- Monthly water quality sampling at five instream sampling stations and the Noland WWTP outfall, including in situ measurements (dissolved oxygen [DO], conductivity, turbidity, pH, temperature) using a multi-parameter meter and grab samples for analysis of total dissolved solids (TDS), chloride, and sulfate.
- Fish community and physical habitat assessments at four sampling stations in late summer 2011;
- Benthic macroinvertebrate community and physical habitat assessments at four sampling stations in fall 2011 and early spring 2012;
- Calculation of stream flow during each water quality and biological monitoring event; and
- Two diurnal DO sampling events to coincide with two of the water quality sampling events.

When the activities outlined in the FSP are complete, the City will develop the UAA to determine the feasibility of meeting designated uses and water quality standards in the project area.

# A.2.0 Study Area Characterization

## A.2.1 Watershed

The Noland WWTP is authorized to discharge treated wastewater from its facility located at 1400 North Fox Hunter Road in Fayetteville, Washington County, Arkansas, to the White River at Outfall 001 (36°05'00"N, 94°05'00"W). The outfall is located in the Beaver Reservoir watershed (8-digit USGS Hydrologic Unit Code [HUC-8] 11010001) in the larger Upper White River watershed (HUC 110100). Outfall 001 is located in the headwaters of the White River, upstream of Beaver Reservoir. Downstream of Beaver Reservoir Dam, the White River flows northeasterly into Missouri; then back into Arkansas in a south-southeasterly direction, traveling through much of the eastern portion of the state (see Figure A.1). The White River is part of the Arkansas-White-Little Red River Basin, which flows to the Mississippi River in southeast Arkansas.

## A.2.2 Ecoregion

The Noland WWTP is located within the Ozark Highlands Ecoregion of Arkansas (APCEC, 2011). The ecoregion is characterized as mountainous, with steep gradients and fast-flowing streams, with fractured limestone and dolomite geological features. The Ozark Highlands have among the highest animal production rates in Arkansas, and impacts from increasing development have led to aquatic habitat destruction, surface erosion, and heavy siltation in streams.

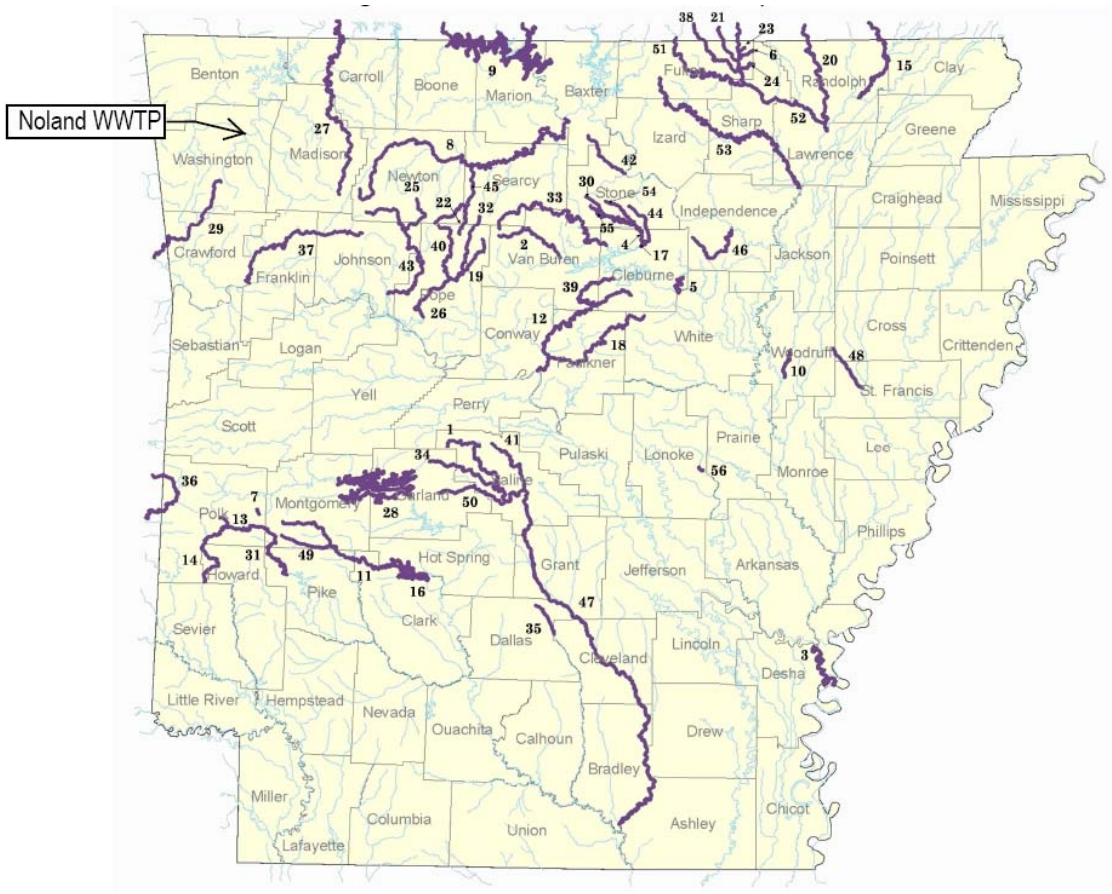


FIGURE A.1
Location of Noland WWTP (adapted from ADEQ, 2008)
*Noland WWTP – Use Attainability Analysis Field Sampling Plan*

## A.2.3 Historical Data

In conjunction with data collected according to this FSP, historical data will be useful to assess attainment status in the study area. ADEQ has collected long-term water quality data since 1982 as part of its Ambient Water Quality Monitoring Network, which currently includes 150 locations. ADEQ collected quarterly water quality data at approximately 200 locations between 1996 and 1998 as part of its Roving Water Quality Monitoring Network. Parameters analyzed at both the Ambient and Roving Water Quality Stations include: temperature, pH, turbidity, DO, 5-day biochemical oxygen demand, total suspended solids (TSS), total dissolved solids (TDS), chloride, sulfate, ammonia, nitrate, nitrite, total phosphorous, ortho-phosphorous, total hardness, boron, beryllium, barium, cadmium, copper, calcium, lead, zinc, iron, potassium, magnesium, manganese, sodium, nickel, cobalt, vanadium, and selenium.

ADEQ monitoring locations applicable to the Noland WWTP UAA are summarized in Table A.1. USGS operates real-time stream gages in the Upper White River watershed and maintains public databases of current and historical data. These data will be used in the UAA process, and the sampling locations summarized in Table A.1 were considered when selecting sampling locations for this FSP.

TABLE A.1
Summary of Established Sampling Stations near Study Area
*Noland WWTP – Use Attainability Analysis Field Sampling Plan*

| Station ID | Location |
|---|---|
| **ADEQ Ambient WQ Monitoring Stations** | |
| WHI0103 | Middle Fork White River west of Elkins |
| WHI0116 | War Eagle Creek at Highway 45, north of Hindsville (collocated with USGS 7049000) |
| WHI0051 | West Fork White River near Fayetteville (collocated with USGS 7048550) |
| WHI0052 | White River near Goshen (collocated with USGS 7048700) |
| WHI0106 | White River near Durham |
| WHI0070 | Holman Creek below Huntsville |
| **ADEQ Roving WQ Monitoring Stations** | |
| WHI0112 | Brush Creek north of Highway 45 off Highway 303 (collocated with USGS 7048890) |
| WHI0102 | Middle Fork White River at County Road 32, 1 mile south of Sulphur City |
| WHI0105 | White River near Crosses |
| WHI0109 | Richland Creek, 1 mile north of Tuttle |
| WHI0113 | War Eagle Creek at county road bridge west of Highway 23 |
| WHI0114 | War Eagle Creek at Highway 412 |
| WHI0098 | West Fork White River at county road bridge below Dye Creek near West Fork (u/s end) |
| **USGS Streamflow Gages (Drainage Area)** | |
| 7048480 | Town Branch (Tributary to West Fork White River) at Martin Luther King, Jr. Blvd (0.86 $mi^2$) |
| 7048490 | Town Branch (Tributary to West Fork White River) at Hwy 16 (1.36 mi2) |
| 7048890 | Brush Creek near Mayfield at County Road 368 (20 $mi^2$) |
| 7048550 | West Fork White River at County Road 195 (123 $mi^2$) |
| 7048800 | Richland Creek at West Bowen Blvd (138 $mi^2$) |
| 7049000 | War Eagle Creek near Hindsville at Highway 45 (263 $mi^2$) |
| 7048600 | White River at Wyman Road (d/s Lake Sequoyah, u/s Noland WWTP) (400 $mi^2$) |
| 7048700 | White River near Goshen (just u/s of Richland Creek confluence) (412 $mi^2$) |

# A.3.0 Technical Approach

Field data collection will include water quality sampling, biological monitoring, and instream flow measurements in locations where USGS real-time gage data is not available. Water quality sampling will be used to gather in situ and chemical data from five stream locations and from the Noland WWTP effluent (Outfall 001). Biological monitoring will include benthic macroinvertebrate, fish community, and physical habitat assessments at four sampling stations. Stream discharge will be calculated or measured during each sampling event using USGS stream gage data and flow data from the Noland WWTP. The field monitoring data will be used to assess the existing chemical, physical, and biological conditions in the watershed and to evaluate factors affecting the designate use attainment of surface waters.

# A.3.1 Study Station Selection

Sampling station locations are shown in Figure A.2 and summarized in Table A.2. A total of three sampling stations were selected to be representative of areas downstream of the Noland WWTP discharge (WR-02, WR-03, and RC-01). Two stations were selected upstream of the Noland WWTP: one just downstream of Lake Sequoyah (WR-01) and the other in the West Fork tributary upstream of the West Fork WWTP (WF-01). Stations WR-01 and RC-01 was chosen as the preliminary reference reaches, located in the Ozark Highlands Ecoregion with similar characteristics to the four downstream sampling stations. The watershed area is approximately equal to that of the White River at the Noland WWTP discharge point. The suitability of the reference locations were field-verified during a site reconnaissance conducted on May 5, 2011.

Including Noland WWTP Outfall 001, a total of six locations will be sampled for water quality parameters. Four of these locations will be sampled for biological parameters (see Table A.2). Methods used to calculate stream discharge at each station, including instream flow measurements, USGS real-time gage data, and Noland WWTP effluent flow data, are summarized in Table A.2.

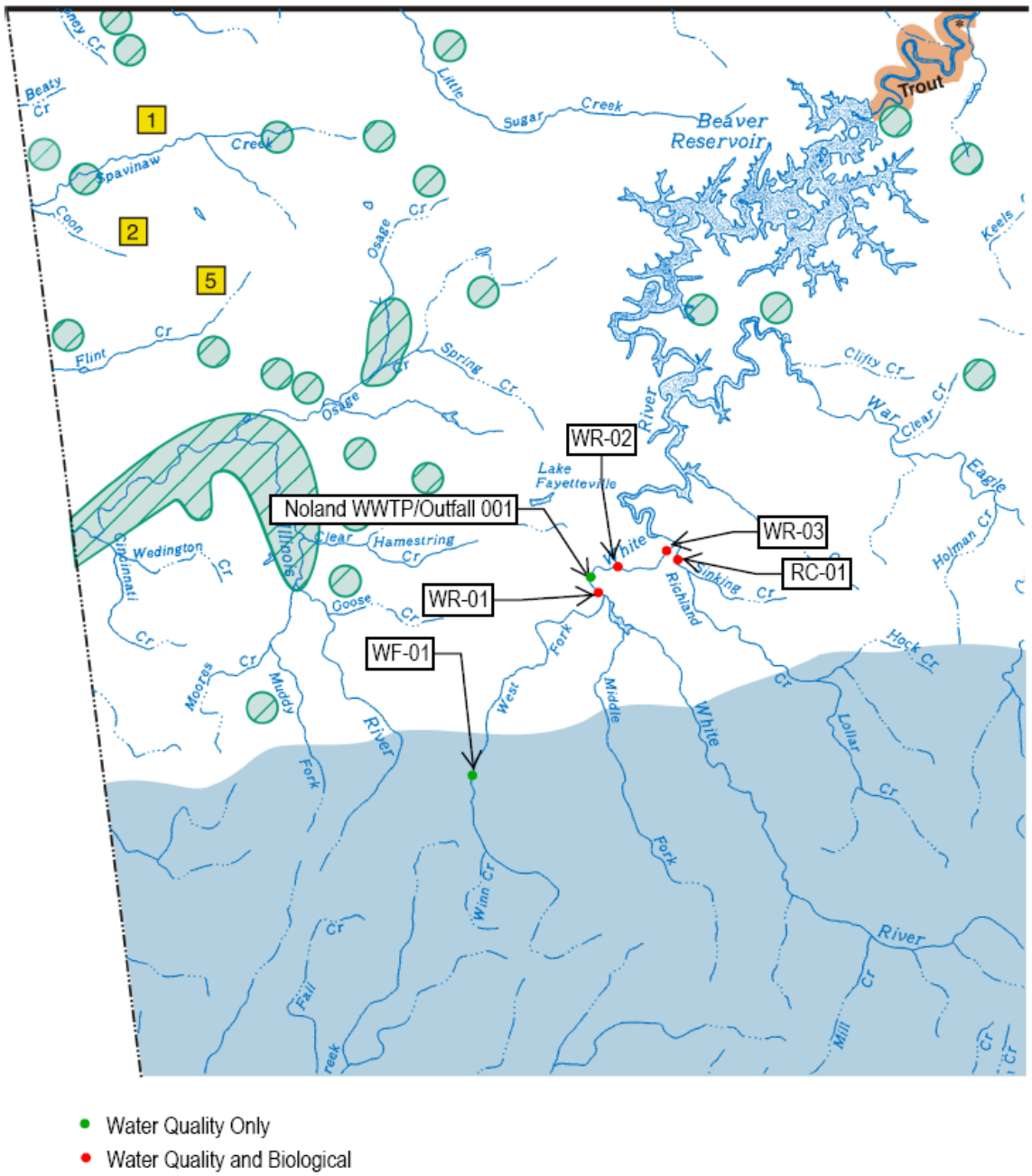


FIGURE A.2
Sampling Station Locations (adapted from APCEC, 2010)
*Noland WWTP – Use Attainability Analysis Field Sampling Plan*

TABLE A.2
Field Data Collection Station Locations and Type
*Noland WWTP – Use Attainability Analysis Field Sampling Plan*

| Station ID | Location | Drainage Area | Associated Established Station[b] | Method Used to Estimate Stream Discharge[c] | Water Quality | Fish, Benthic, Habitat |
|---|---|---|---|---|---|---|
| 001[a] | Noland WWTP Outfall | N/A | 001 | N/A | X | |
| WR-01 | White River at Wyman Rd. (u/s of Noland WWTP, d/s of Lake Sequoyah) | 400 $mi^2$ | USGS 7048600 | Real-time data from USGS 7048600 | X | X |
| WR-02 | White River d/s of Noland WWTP | 403 $mi^2$ | N/A | Real-time data from USGS 7048600 & Noland WWTP continuous effluent flow data | X | X |
| WR-03 | White River just u/s of confluence with Richland Creek, at State Hwy 45 | 412 $mi^2$ | ADEQ WHI0052/ USGS 7048700 | Real-time data from USGS 7048700 | X | X |
| WF-01 | West Fork u/s of West Fork WWTP, at Highway 170 in West Fork, AR | 62 $mi^2$ | N/A (1 mile upstream of ADEQ WHI0098) | Instream flow measurements during sampling events | X | |
| RC-01 | Richland Creek at State Hwy 45 | 138 $mi^2$ | USGS 7048800 | Real-time data from USGS 7048800 | X | X |

[a] Water quality monitoring at the Noland Outfall will be conducted by Noland staff.
[b] ADEQ stations are Ambient WQ Monitoring Stations.
[c] Methods to be used during water quality events; during biological monitoring events, instream flow measurements will be taken at biological monitoring stations.

## A.3.2 Water Quality Monitoring Methods

In situ and chemical parameters will be measured at five instream sampling stations and at the WWTP outfall (Table A.2) as part of the water quality monitoring effort. Water quality monitoring will consist of twelve monthly in situ and grab samples at five instream locations. During two of these events, diurnal DO assessments will be conducted at the sampling stations. Diurnal DO assessments will be conducted in summer and early fall 2011, during the water quality events that most closely coincide with the fish and benthic macroinvertebrate assessments. The DO assessments will involve deployment of an in situ water quality meter for approximately 48-hours, to assess changes in DO conditions over the normal daily cycle.

In situ measurements recorded during each event will include: dissolved oxygen (DO), temperature, pH, conductivity, and turbidity. Measurements will be taken at mid-stream and mid-depth at each station using a multi-parameter sonde. Field teams will follow the manufacturer's guidelines for proper calibration and instrument maintenance. In situ

measurements will be collected prior to all other sampling so as not to disturb sediments or cause potential interference with the measurements. The in situ sampling will consist of placing the sonde in 6 to 10 inches of flowing water while facing upstream and allowing the meter to equilibrate before collecting measurements. Calibration and quality control checks of the sonde will be conducted in the morning before each sampling event, and the results of the equipment calibration and quality control checks will be recorded on field sheets.

Grab samples will be collected in well-mixed stream flow, at approximately mid-stream and mid-depth, where feasible. Parameters to be analyzed are provided in Table A.3. Water quality data analysis will be conducted in an ADEQ-certified laboratory, using EPA-approved analysis methods (40 CFR Part 136). Quality assurance/quality control (QA/QC) processes for field activities and laboratory analysis are detailed in Section 3.2.2 below.

### A.3.2.1 Field Equipment

The following equipment will be used during water quality sampling events:

- Meter for in situ measurements
- Batteries
- Water sample bottles from the laboratory
- Cooler with ice

The list will be expanded to include bottle type and preservative for each parameter to be sampled after consultation with the laboratory. Equipment will be gathered, checked, and loaded into the vehicles the day before each event.

### A.3.2.2 Quality Assurance/Quality Control

QA/QC is designed to assure the reliability and quality of the analysis and data and to identify any contamination that may result from lab methods, equipment, or sample collection. Sample collection, preservation, handling and storage, and analytical procedures will be conducted in accordance with standard methods and practices. Three types of QA/QC will be performed as part of the water quality monitoring. Type 1 includes regular checks of water quality meters and proper documentation of sampling activities and field conditions by the field team members. Type 2 consists of sampling procedures intended to identify the type and estimate the level of contamination. Type 3 provides confirmation of the analytical procedures conducted by the laboratories. In combination, these types of QA/QC provide the equivalent of a modified Level 3 EPA data quality objective.

#### A.3.2.2.1 Type 1: Field Surveys

Type 1 QA/QC encompasses field monitoring activities and calibration of field equipment. Field personnel for this project will be experienced in the calibration and operation of each piece of field equipment used on the project. Field instruments will be calibrated according to manufacturers' specifications, and these procedures will be documented in a field notebook or on specially prepared field sheets. Type 1 activities include documenting other pertinent data concerning the sampling events such as weather conditions and time of sampling. Type 1 documentation can be summarized as follows:

- Instrument identification
- Calibration information (standards used and results)
- Date and time of calibrations and measurement

#### A.3.2.2.2 Type 2: Field Sampling

Two personnel with experience or special training in water quality sampling techniques will conduct field sampling. Type 2 QA/QC activities include sample procedures designed to detect contamination from sampling equipment resulting from improper sample collection. Type 2 activities also include collection of QA/QC duplicate samples, use of trip blanks, preparation of equipment blanks (only if decontamination of equipment is performed), and proper labeling of all samples. The Type 2 QA/QC requirements for this project are detailed below.

Trip Blanks. Trip blanks are sample containers that are taken, as received, into the field and returned without being used. These are used to evaluate any contamination that may have taken place before the containers were received by the sampling team. One trip blank will be used during each sampling event.

Field Duplicates. Field duplicate samples are collected to measure the precision of the sampling process. The field team leader will choose one station per trip to collect duplicate samples for each water quality parameter.

#### 3.2.2.3 Type 3: Laboratory Analysis

Water quality data analysis will be conducted in an ADEQ-certified laboratory, using EPA-approved analysis methods (40 CFR Part 136). The methods and detection limits that will be used for each parameter to ensure proper QA/QC are listed in Table A.3.

TABLE A.3
Parameters, Reporting Limits, and Methods

| Parameter | Method | Reporting Limit | Units |
|---|---|---|---|
| Chloride | EPA 300.0 | 0.02 | mg/L |
| Sulfate | EPA 300.0 | 0.2 | mg/L |
| Total Dissolved Solids | SM2540C | 10.0 | mg/L |

SM = Standard Method, EPA = Environmental Protection Agency, mg/L=milligrams per liter

## A.3.3 Biological Monitoring Methods

Biological monitoring will be conducted at four sampling stations (Table A.2), using the methods outlined in EPA's *Rapid Bioassessment Protocols (RBPs) for Use in Wadeable Streams and Rivers: Periphyton, Benthic Macroinvertebrates, and Fish* (Barbour et al. 1999). These methods have been used by ADEQ for collecting biological monitoring data throughout the state since the 1970s. Biological monitoring methods, summarized in this section, will include assessments of: (1) physical habitat and surface water quality physical characterization, (2) benthic macroinvertebrate communities, and (3) fish communities. Fish sampling will be conducted late summer 2011, and benthic macroinvertebrate sampling will

be conducted in early fall 2011 and early spring 2012. Physical habitat and characterization assessments will be conducted during the fish community assessment and the two benthic macroinvertebrate assessments.

### A.3.3.1 Physical Habitat and Physical Characterization Assessments

Physical habitat assessments and surface water quality physical characterizations will be conducted on three occasions at four sampling stations (Table A.2) following procedures outlined in EPA's *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish* (Barbour et al. 1999). The protocol is consistent with this most current EPA-approved assessment method, which was developed as an update to the previous RBPs (Plafkin et al. 1989).

In accordance with Barbour et al. (1999), a surface water quality physical characterization is required whenever a physical habitat assessment is performed. The assessment is completed to assess the stream's ability to support biotic communities and to identify any chemical or non-chemical stressors to the stream. Observations noted during the physical characterization are useful for interpretation of water quality and biological monitoring results.

#### A.3.3.1.1 Field Methods and Data Analysis

The physical habitat and surface water quality physical characterization assessments will be conducted by at least two qualified team members who have been trained in accordance with Barbour et al. (1999). The field team will walk approximately 100 meters of stream to evaluate the physical habitat and watershed conditions at each station. The area used for the assessments will include the reach to be sampled for benthic macroinvertebrates and fish.

The physical assessment involves rating field parameters that represent an overall evaluation of the stream habitat based on substrates, habitat diversity and availability, riparian corridors and streambank conditions (Table A.4). Using the high gradient Habitat Assessment Field Data Sheet, each parameter will be given a score from 0 to 20, where scores from 0 to 5 are considered "Poor," 6 to 10 are "Marginal," 11 to 15 are "Suboptimal," and 16 to 20 are "Optimal." A more-detailed description of the scoring criteria is provided on the Habitat Assessment Field Data Sheet. For QA/QC purposes, at least two trained field personnel will individually evaluate the physical habitat parameters, and the results will be averaged. A total habitat score will be calculated by summing the average scores of each parameter, with the highest possible total score being 200 points.

TABLE A.4
Habitat Assessment Parameters for High-Gradient Streams

| Parameter | Parameter Description |
|---|---|
| Instream Cover | Measures the availability of habitats, such as substrates, logs, and undercut banks, that are available as refugia, feeding, or sites for spawning and nursery functions for aquatic organisms. |
| Epifaunal Surface | Measures the substrate available in riffle/run complexes and rates the length and width of riffles. |
| Embeddedness | Measures the degree to which cobble, boulders, and other rock substrate are |

TABLE A.4
Habitat Assessment Parameters for High-Gradient Streams

| Parameter | Parameter Description |
|---|---|
| | surrounded by fine sediment. |
| Velocity/Depth Regimes | Measures a stream's characteristic velocity/depth regime. |
| Man-made Channel Alteration | Measures large-scale alteration of instream habitat that affects stream sinuosity and causes scouring. |
| Sediment Deposition | Relates to the amount of sediment that has accumulated and the changes that have occurred to the stream bottom as a result of deposition. |
| Frequency of Riffles | Estimates the frequency or occurrence of riffles as a measure of sinuosity. |
| Channel Flow Status | This is the degree to which the channel is filled with water during base or average annual flow periods. |
| Condition of Banks | Measures the existence of, or the potential for, detachment of soil from the upper and lower stream banks and its movement into the stream. |
| Bank Vegetative Protection | Measures the amount of the stream bank that is covered by vegetation. |
| Riparian Vegetative Zone | Measures the width of natural vegetation from the edge of the upper streambank out through the floodplain. |

For wadeable streams, the surface water quality physical characterization includes completion of two field sheets: (1) the Physical Characterization Field Data Sheet, including an assessment of riparian land use, aquatic vegetation, nonpoint source pollution, water quality indicators, substrate odors and deposits, flow conditions, and stream substrate and (2) the Water Quality Field Data Sheet, involving field parameter measurements. As mentioned in Section 3.2, in situ measurements of DO, temperature, pH, turbidity, and conductivity will be made each event, to document any adverse water chemistry parameters that might affect the aquatic communities.

## A.3.3.2 Benthic Macroinvertebrate Sampling

Benthic macroinvertebrates will be sampled following the multi-habitat approach provided in EPA's RBPs (Barbour et al. 1999), which involves obtaining samples collected from the various habitats for analysis and data evaluation. The multi-habitat approach maximizes the efficiency of field work and provides the broad-based information necessary to make the best assessment of biotic integrity as it relates to stream conditions.

### A.3.3.2.1 Field Methods

In accordance with Barbour et al. (1999) and ADEQ guidelines, benthic macroinvertebrate samples will be collected in early fall 2011 and early spring 2012. A representative sampling reach, approximately 4 stream widths in length will be chosen for biological sample collection at each of the four sampling stations (Table A.2). Sampling will be conducted downstream to upstream, using a D-frame 500-micron net, a 500-micron kick net, #30 sieve bucket, and forceps. Sampling will include a total of 20 samples from various habitat types

(see Table A.5). The distribution of the actual sampling effort among habitat types might differ from that given in Table A.5 due to field conditions or habitat availability. In any case, the habitats and numbers of samples collected from each will be documented. For QA/QC purposes, a duplicate sample will be collected at one of the sampling locations. The duplicate sample should be collected in a reach as similar to the primary reach as possible and may be located either upstream of the reach, within the reach (if there is ample habitat), or on the opposite bank within the reach (if the stream is wide). The sampling methods for each habitat type are detailed below.

TABLE A.5
Number and Type of Benthic Macroinvertebrate Samples

| Habitat Type | Number of Samples |
|---|---|
| Fast Riffle | 1 |
| Slow Riffle | 1 |
| Coarse Particulate Organic Matter | 3 |
| Rock/Log | 6 |
| Root/Bank | 3 |
| Macrophyte Bed | 3 |
| Sand/Bottom | 3 |
| **Total** | **20** |

**Riffle** samples will be collected from one fast riffle and one slow riffle, using a kick net positioned upright and on the stream bed. For each sample, a field team member will disturb approximately 1 square meter of riffle substrate, and the two samples will be elutriated and composited in a #30 sieve bucket. This technique is intended primarily to collect species that require highly oxygenated waters such as those in the Ephemeroptera, Plecoptera, and Trichoptera (EPT) orders.

**Coarse Particulate Organic Matter (CPOM)** samples will be collected from three locations and will include leaf packs that are at least 50 percent decomposed. The three samples will be composited in a #30 sieve bucket and should fill approximately half of the bucket. CPOM samples are used primarily to collect shredder species that prefer decomposed materials that can be easily shredded for a food source.

**Rock/Log** samples include the collection of organisms found on submerged logs and rocks by brushing the surfaces of the habitat to dislodge attached fauna, while holding a sieve bucket or A-frame net downstream of the habitat. The nets and buckets will be rinsed and then visually inspected, and the organisms will be removed with forceps. This technique is used for collecting small organisms from species in the family Chironomidae, Baetidae, Hydroptilidae as well as Oligochaetes and other scrapers/grazers.

**Roots/Banks** that are partially submerged and/or undercut will be sampled by dragging the A-frame net in an upstream direction, across 1 meter of habitat. The samples will be rinsed and then visually inspected, and the organisms will be removed with forceps. These

samples are particularly important for collection of species that prefer low-current environments.

**Macrophyte Beds** are often present along the streambank and in channel beds. Samples will be collected by dragging the A-frame net in an upstream direction, across 1 meter, through the vegetation. The samples will be rinsed and then visually inspected, and the organisms will be removed with forceps.

**Sand/Bottom Substrate** samples will be collected by bumping the A-frame net along sand substrate (instead of dragging the net, to minimize the amount of debris in the sample). The net should be placed approximately 2 to 3 centimeters below the surface of the sand. This technique is especially useful for collecting small organisms, such as species in the family Chironomidae that inhabit sandy substrates.

The samples collected from each habitat type at a station will be composited, bagged, preserved with 100 percent denatured ethanol, and labeled with the following information: date, location, field team, and sampling method (multi-habitat approach). The samples will then be packaged appropriately and shipped to a laboratory certified to conduct macroinvertebrate identification. Samples collected from separate habitat types will be composited for analysis.

#### A.3.3.2.2 Laboratory and Data Analysis

Macroinvertebrates will be identified to lowest practical taxonomic level and enumerated to conduct macroinvertebrate assessments. Comparison of the duplicate sample scores should result in a method precision of at least 95 percent. If the method precision is less than 85 percent, the cause of the discrepancy should be evaluated.

Data analysis includes an evaluation various metrics that represent different components of community structure and/or function and, cumulatively, provide a measure of biotic integrity (see Table A.6). Representative metrics include those in four primary categories: (1) richness measures for diversity or variety of the assemblage; (2) composition measures for identity and dominance; (3) tolerance measures that represent sensitivity to perturbation; and (4) trophic or habit measures for information on feeding strategies and guilds.

TABLE A.6
Benthic Macroinvertebrate Metrics

| Metric Category | Metrics |
|---|---|
| Richness | Taxa Richness<br>Ephemeroptera, Plecoptera, and Trichoptera (EPT) Taxa<br>No. Ephemeroptera Taxa<br>No. Plecoptera Taxa<br>No. Trichoptera Taxa |
| Composition | Percent EPT Individuals<br>Percent Ephemeroptera Individuals<br>Percent Chironomidae Individuals |

TABLE A.6
Benthic Macroinvertebrate Metrics

| Metric Category | Metrics |
|---|---|
| Tolerance | No. Intolerant Taxa<br>Percent of Tolerant Organisms<br>Hilsenoff Biotic Index<br>Percent Dominant Taxon |
| Trophic/Habit | Number Clinger Taxa<br>Percent Clingers<br>Percent Filters<br>Percent Scrapers |

Source: Barbour et al. 1999

## A.3.3.3 Fish Sampling

Fish sampling will be conducted in accordance with EPA RBPs (Plafkin et al. 1989; Barbour et al. 2000), which involves using standard field techniques, species identification, enumeration, specimen external examination, and assignment of ratings to a variety of fish community attributes (metrics), which are summed to obtain an overall measure of biotic integrity. The Index of Biotic Integrity or IBI (Karr et al. 1986) will be used to evaluate the health of the fish communities at four representative sampling stations. Additionally, fish community data will be evaluated based on protocols matching Arkansas Pollution Control and Ecology Commission (APCEC) Regulation No. 2. Field and data analysis methods are discussed in the following paragraphs.

### A.3.3.3.1 Field Methods

Fish will be sampled during summer 201, when streams are wadeable and fish populations are static and stable. A backpack Electroshocker will be used to sample all accessible habitats including riffles, runs, pools, and undercut banks. The upstream and downstream ends of the sampling reach will be blocked with nets to prevent fish from escaping out of the sampling reach. Fish sampling will progress upstream, so as not to disturb sediments and decrease visibility, and team members will be careful not to walk through the sampling area prior to sampling. A trained biologist will operate the shocker and will be assisted by other team members who will help capture stunned fish. Captured fish will be placed in buckets upon capture and moved to aerated holding buckets as soon a practical after capture. The sampling reach will be approximately 40 times the mean wetted width of the stream, and a total of two sampling passes will be made through each sampling reach. At the end of each sampling pass, the number of fish caught and the time of electroshocker use ("pedal down" time) will be recorded.

Fish will be identified and enumerated in the field to the greatest extent practical. A subset of up to 25 fish of each species will be measured to the nearest millimeter and weighed to the nearest 0.1 gram. Fish selected for length-weight measurements should be selected to include a wide range of sizes. Data sheets that include size, weight, and external anomalies of the species collected will be completed at each biological monitoring station, along with detailed notes on habitat and surrounding watershed conditions. Voucher specimens of each species collected, including all fish that cannot be readily identified in the field, will be

preserved in 10 percent formalin for laboratory confirmation of species identification. Although sampling personnel will make every effort to return as many live fish to the stream as possible, a certain level of mortality is inevitable, especially during hot weather.

### A.3.3.3.2 Data Analysis

The Index of Biotic Integrity or IBI (Karr et al. 1986) will be used to evaluate the health of the fish communities at four sampling stations. The IBI, which is used as the model for EPA's RBP (Barbour et al. 1999; Plafkin et al. 1989), integrates a broad range of fish community attributes into an assessment of stream biotic integrity. The methodology involves species identification, enumeration, and external examination of the collected fish; and assignment of ratings to a variety of fish community attributes (metrics), which are summed to obtain an overall measure of biotic integrity. IBI scores will be calculated based on rating 13 metrics of fish community structure in five broad categories: species richness, species composition, trophic function, species abundance, and physical condition. The IBI assumes that each metric correlates either positively or negatively with increased stream degradation. The 13 metrics were modified from Karr et al (1986) and integrate attributes of the entire fish community that are differentially sensitive to various levels of stream perturbation. The final IBI scores will be used to determine the overall qualitative conditions of the fish communities, ranging from "Excellent" to "Very Poor." The 13 metrics rated in this assessment and their descriptions/rationale are listed in Table A.7.

TABLE A.7
IBI Metrics Used to Evaluate Fish Communities

| Metric | Description/Rationale |
|---|---|
| **Species Richness and Composition** | |
| 1. Number of native species | This number decreases with increasing environmental degradation, and is considered to be one of the most powerful IBI metrics. Hybrid and introduced fishes are not included. |
| 2. Number of benthic invertivore species | This metric is a count of all species of darters, sculpins, and madtoms. These species typically feed and reproduce in benthic habitats, and are sensitive to degradation from channelization, siltation, and DO reduction. Species number decreases with increasing degradation. |
| 3a. Number of native sunfish species | These pool-dwelling species decrease in number with increasing siltation and degradation of pool habitats and instream cover. This metric is an effective measure of losses of instream cover and pool habitat and of decreases in the terrestrial food supply due to disruption of the riparian zone (Ohio EPA, 1987). This metric is used for watersheds less than 15 square miles. |
| 3b. Number of native centrarchid species | Similar to the native sunfish species metric, except this metric is used for watersheds greater than 15 square miles. |
| 4. Number of native insectivorous cyprinid species | Minnow species typically comprise a large proportion of the fish community and decrease in number with increasing physical and chemical habitat degradation. Introduced minnow species are not included because they often occur in degraded habitat conditions. |

TABLE A.7
IBI Metrics Used to Evaluate Fish Communities

| Metric | Description/Rationale |
|---|---|
| 5. Number of native round-bodied sucker species | Suckers are known to be sensitive to habitat modification, sedimentation, and changes in water quality. In addition, the relatively long life span of most sucker species provides a long-term assessment of past and present environmental conditions. |
| 6a. Number of sensitive species | Intolerant or sensitive species include those that are highly or moderately intolerant of water quality and habitat degradation. They are among the first to disappear following a disturbance. This metric is used for watersheds less than 15 square miles. |
| 6b. Number of intolerant species | Similar to the number of sensitive species metric, except this metric is used for watersheds greater than 15 square miles. |
| **Trophic Composition** | |
| 7. Evenness | Evenness measures the equity of the proportion of each species in the sample. The greater the equity between species, the more diverse and healthy the fish community should be. This metric is measured by comparing the observed diversity in a sample to a theoretical maximum diversity. |
| 8. Percentage of individuals as Lepomis species | Given the tolerant nature of fish in this genus, an overabundance of these species can be indicative of water quality degradation. |
| 9. Percentage of individuals as insectivorous cyprinids | The relative abundance of these species decreases with degradation, in response to reductions in the invertebrate food supply. |
| 10a. Percentage of individuals as generalist feeders and herbivores | Generalists are opportunistic feeders, consuming significant quantities of both plant and animal materials. Generalists often become abundant in small, highly degraded streams, as specific components of the food base become less reliable. Herbivores consume plant materials (specifically algae), which may become abundant as stream canopy decreases. A dominance of these two trophic guilds in a community could indicate a degraded system |
| 10b. Percentage of individuals as top carnivores | These species (e.g., bass, pickerel) feed as adults primarily on fish, other vertebrates, or crayfish, and indicate a trophically diverse community. Their proportion decreases with increasing degradation. |
| 11. Percentage of individuals as benthic fluvial specialists | The species classified as benthic fluvial specialists (darters, madtoms, sculpins, suckers, and some cyprinids) are insectivorous species that forage and reproduce on the stream bottom. A significant loss of these species could be indicative of increased sedimentation and degradation of the benthic habitat. |
| **Fish Abundance and Condition** | |
| 12. Number of individuals per 200 meters | This metric standardizes comparison of fish abundance. Sites with greater disturbance generally support fewer fish. Highly tolerant and exotic species are excluded because these species may actually increase in abundance under certain disturbance conditions, such as stream channelization (Ohio EPA, 1987). |
| 13. Percentage of individuals with external anomalies | Sites with severe environmental degradation often yield a high number of fish in poor health, as manifested by heavy parasitism, damaged fins, lesions, or other external physical deformities. |

Sources: Karr et al., 1986; Plafkin et al., 1989

Additionally, fish community data will be evaluated based on protocols matching the APCEC Regulation No. 2, *Regulation Establishing Water Quality Standards for Surface Waters of the State of Arkansas* (see Table A.8). The analysis method is based on percent community composition of the parameters listed in Table A.8. A list of the key species and primary feeders, and the methodology for calculating the diversity index will be acquired from ADEQ to complete this analysis.

The cumulative score of the metric categories will provide a rating based on the following ranges:

- 37 to 45 = mostly similar
- 25 to 36 = generally similar
- 13 to 24 = somewhat similar
- 0 to 12 = not similar

TABLE A.8
APCEC Metrics Used to Evaluate Fish Communities

| | Scoring Criteria[a] | | |
|---|---|---|---|
| **Metric** | **5** | **3** | **1** |
| % Sensitive Individuals | >31 | 31 - 20 | <20 |
| % Cyprinidae (Minnows) | 48 to 64 | 39 to 47 or 65 to 73 | < 39 or > 73 |
| % Ictaluridae (Catfishes) | >2[b] | 1 to 2[b] | <1 or >3% bullheads |
| % Centrarchidae (Sunfishes) | 4 - 15[c] | <4 or 15 - 20[c] | >20 or >2% of green sunfish |
| % Percidae (Darters) | >11 | 5 to 11 | <5 |
| % Primary Feeders | <42 | 42 to 49 | >49 |
| % "Key" Individuals | >23 | 23 to 16 | <16 |
| Diversity | >2.77 | 2.77 to 2.37 | <2.37 |
| # Species | > (drainage area × 0.034) + 16.45 | (drainage area × 0.034) + 16.45 to (drainage area × 0.034) + 12.26 | < (drainage area × 0.034) +12.26 |

[a] if a raw metric score is zero, score as zero, except for Primary Feeders
[b] no more than 3 percent bullheads
[c] no more than 2 percent green sunfish

## A.3.3.4 Sampling Equipment

A list of sampling equipment required for the biological sampling is provided in Table A.9.

TABLE A.9
Biological Sampling Equipment

| Sampling Equipment | Quantity |
|---|---|
| **Fish Sampling** | |
| Backpack electroshocker | 1 |

TABLE A.9
Biological Sampling Equipment

| Sampling Equipment | Quantity |
|---|---|
| Shocker wand | 1 |
| Shocker tail | 1 |
| Extra battery for shocker | 1 |
| Empty cooler | 1 |
| Aquarium bubblers | 2 |
| Rubber gloves | 2 pair |
| Fish collection nets (dip nets) | 2 |
| Seine net (10X6 ft) | 1 |
| 5-gallon bucket | 2 |
| 1-gallon plastic jar | 1/station |
| Formalin | 1 liter |
| Data sheets | 1/station |
| Pliers | 1 |
| Plastic ruler | 2 |
| **Benthic Macroinvertebrate Sampling** | |
| A-frame nets | 2 |
| Kick net | 1 |
| #30 Sieve bucket | 2 |
| Sorting pans and plastic trays | 4 |
| Denatured Ethanol | 3 |
| Scrub brush | 2 |
| Tweezers | 4 |
| Winterized gloves | 2 |
| Empty coolers | 6 |
| Habitat assessment data sheets | 2 |
| Squirt bottles | 2 |
| **General Equipment** | |
| Collection permit | 1 |
| Ice | |
| Chain-of-Custody Forms | 6 |
| FedEx shipping forms | 3 |
| Custody seals | 6 |

TABLE A.9
Biological Sampling Equipment

| Sampling Equipment | Quantity |
|---|---|
| Camera | 1 |
| Memory card | 1 |
| Packing tape (rolls) | 2 |
| Analyte-free water (1-gal containers) | 2 |
| Ziploc freezer bags (1-gal, 20 per box) | 2 |
| Ziploc freezer bags (2-gal, 20 per box) | 2 |
| Paper towels (rolls) | 2 |
| Latex gloves (box) | 1 |
| Phone list | 1 |
| Sampling plans | 1 |
| Field Safety Instruction | 1 |
| Vermiculite | 2 bags |
| **In situ Water Quality Monitoring** | |
| Meter for in situ measurements | 1 |
| **Personal Equipment** | |
| Rain Gear | |
| Hat | |
| Gloves | |
| Rubber boots | |
| Sunscreen | |
| Pens (waterproof ink)/pencils | |
| Field sheets | |
| Compass/Global Positioning System (GPS) unit | |
| Field notebook | |
| Thermos | |
| Waders, hip boots | |
| Potable water | |

## A.3.4 Flow Measurements

Because there are numerous USGS gages in the study area, they will provide the majority of stream flow data for the study. Flow data from the existing Parshall flume at Outfall 001 will

be used for the WWTP effluent. A list of sampling stations and corresponding USGS gages are outlined in Table A.2. A summary of the flow measurement methods is as follows:

- During the three biological monitoring events (one fish assessment and two benthic macroinvertebrate assessments), flow will be measured at each biological sampling station using a flow meter which conforms to USGS/ International Organization for Standardization (USGS/ISO) methods.
- During the 12 monthly water quality events:
  - For Stations WR-01, WR-03, and RC-01 flow will be determined based on data from collocated USGS gages (WR-01/USGS 07048600, WR-03/USGS 07048700, and RC-01/USGS 07048800).
  - For Station WR-02 (downstream of Noland WWTP), flow will be determined based on flow at Station WR-01 (see above) and Noland WWTP effluent flow data measured in an existing Parshall flume equipped with a continuous recorder. The difference in drainage areas between WR-02 and the nearby USGS gage is only 3 square miles.
  - For Station WF-01 (West Fork White River at Highway 170 in West Fork, Arkansas), flow will be measured using a current meter. Either a portable acoustic doppler current meter or Marsh McBirney electromagnetic current meter will be used. Because there is also a USGS real-time stream flow gage (7048550) on the West Fork White River, measured flows will be compared to the USGS gage data to see if a strong correlation between the flows at the two different locations can be established after at least four sampling events. If a strong correlation is obtained, flows from the USGS gage can be used to estimate flow at WF-01 based on a standard drainage area ratio method.

Equipment necessary for flow measurements includes a flow meter, wading rod, tape measure, and field sheets. The manufacturer's instruction manual for the flow meter will be followed, and proper maintenance and diagnostics, according to manufacturer specifications, will be conducted and documented on a regular basis. During biological monitoring, velocity and depth measurements will be taken carefully, so the habitat is disturbed as little as possible. During water quality monitoring, flow should be measured after the chemical data samples have been collected.

## A.3.5 Chain-of-Custody and Shipping

Any sampling and analytical program must follow a system for sample control from collection to data reporting. This includes the ability to trace the possession and handling of samples from the time of collection through analysis and final disposition. The documentation of the sample history is referred to as "chain-of-custody." A sample is considered to be in a person's custody if it is: (1) in the person's physical possession, (2) in view of the person after he/she has taken possession, (3) secured by that person so that no one can tamper with the sample, or (4) in a designated secure area. The following section details the chain-of-custody system which will be followed as part of the watershed monitoring activities.

### A.3.5.1 Chain-of-Custody Record

To establish the documentation necessary to trace sample possession from the time of collection, a chain-of-custody (COC) record, which can be obtained from the laboratory, will be completed for every sample event. In order to maintain the COC record, every person who has custody of the sample at any time will sign, date, and note the time on the COC record. Samples will not be left unattended unless placed in a secured and sealed container with the COC record inside the container.

The COC record will include special instructions for the laboratory to follow, such as composite preparation or clean metal analysis, which will be consistent with the contract. If discrepancies are identified, the field team leader will inform the Project Manager before the samples are analyzed. The following special instructions will be included on the COC forms:

- **Benthic Macroinvertebrates—** Identify samples to the lowest taxonomic level practicable and complete the assessment for the metrics listed in the contract.
- **Water Quality—** Analyze samples for the parameters listed in the contract (these parameters will also be listed on the COC form).

### A.3.5.2 Biological Sample Labeling and Shipment

Benthic macroinvertebrate samples will be placed in a Ziploc bag and preserved with 10 percent formalin after collection at each station. For each benthic macroinvertebrate sample, the following information will be marked on the outside of the bag:

- Field Team Leader Name
- City of Fayetteville
- Date
- Station Number
- Station Identifier

In addition, a labeled tag will be inserted into the benthic macroinvertebrate sample with the same information. Water-proof paper will be used to prepare the tag, and the labels on both bags and tags will be marked with indelible ink. After the samples have been labeled and preserved, they will be double-bagged with a one-gallon Ziploc bag and then a 2-gallon Ziploc bag; the outer bag will then be duct-taped shut.

Benthic macroinvertebrate samples will be stored in coolers and remain in the custody of the field team leader until the cooler is full or ready for shipment. Coolers prepared for shipping will be packed to minimize movement of samples and will include vermiculite in case of any leakage. Each shipping container will contain a COC form with the analytical directions for the laboratory. Benthic macroinvertebrate samples will be shipped to the laboratory within five days of collection.

### A.3.5.3 Water Quality Sample Labeling and Shipment

For each water quality sample, the following information will be clearly marked and labeled on the sample container:

- City of Fayetteville – Noland WWTP

- Sample or Station Number
- Location
- Analyses
- Preservative
- Date and Time
- Sampled by

During sampling, filled and labeled containers will be stored in coolers on ice to maintain a temperature of less than or equal to six degrees Celsius. The coolers will remain in the custody of the field team leader until the end of the sampling event, and the samples will be shipped, transported, or delivered to a laboratory courier in a cooler, on ice. If used, glass containers will be wrapped in bubble-wrap to prevent breakage.

Coolers prepared for shipping will be lined with a cooler liner and packed with ice in double-wrapped Ziploc bags so that movement of samples will be minimized. A COC form will be included in each shipment container describing: the type of sample, number of containers, type and kind of analysis, QA/QC instructions and samples, and special processing and handling procedures. It is imperative that the samples taken to fulfill the QA/QC requirements to be completed by the lab are included on the COC. The field team leader will keep the copy of the COC form.

### A.3.5.4 Custody Seals

Custody seals are used to detect tampering with samples following collection, up to the time of analysis. When samples are packed for shipping, custody seals will be placed across the latch and across the lid opening of the coolers to confirm that they arrive at the laboratory unopened. The custody seal placed across the lid opening will be secured with strapping tape. The tape will be placed over the custody seal and wrapped completely around the cooler so that it remains closed during shipping.

# A.4.0 Project Schedule

The field sampling activities will be conducted during the period May 2011 through April 2012. The schedule for each field sampling component is outlined in Table A.10 and will also be dependent on weather and flow conditions. The detailed sampling schedule and sequence of sampling will be evaluated on a daily basis at the discretion of the field team leader. Scheduling decisions will take into account recent rain events as they affect turbidity, water levels, and field team safety. When the activities outlined in the FSP are complete, the City of Fayetteville will develop the UAA in conjunction with permit renewal requirements to determine the feasibility of meeting designated uses based on existing water quality standards in the project area.

TABLE A.10
Project Schedule Summary[a]

| Monitoring Component | Frequency | Time Period |
|---|---|---|
| Water Quality Monitoring | 12 events, monthly | May 2011 – April 2012 |
| Diurnal DO monitoring | 2 events, concurrent with 2 water quality monitoring events | Summer 2011 (water quality event closest to fish sampling) & early fall 2011 (water quality event closest to benthic macroinvertebrate sampling) |
| Fish Sampling | 1 event, during base flows with limited turbidity | Summer 2011 |
| Benthic Macroinvertebrate Sampling | 2 events, during base flows with limited turbidity | Early Fall 2011, Early Spring 2012 |
| Physical Habitat Assessments | 3 events, during fish and benthic macroinvertebrate community assessments | Summer 2011, Early Fall 2011, Early Spring 2012 |

[a] Weather-dependent

# A.5.0 Works Cited

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# Appendix B
# Historical Water Quality, Biological, and Physical Data Analysis

# B.1 Water Quality

## B.1.1 Historical Data Included in Analysis

Historically, water quality data have been collected from over 40 locations in the Upper White River watershed, including, and upstream of, Beaver Lake. Both continuous and special study data collection has been conducted by various organizations, including the Arkansas Department of Pollution Control and Ecology (ADPCE), ADEQ, the University of Arkansas Water Resources Center (AWRC), Beaver Water District (BWD), Ecological Conservation Organization (ECO), the U.S. Army Corps of Engineers (USACE), USEPA, and the USGS.

As part of this UAA, an inventory and analysis of historical chloride, sulfate, and TDS data was completed. Sampling locations included in the analysis are summarized in Table B-1 and shown in Figure B-1. ADEQ has collected long-term water quality data since 1982 as part of its Ambient Water Quality Monitoring Network, which currently includes 150 locations. ADEQ collected quarterly water quality data at approximately 200 locations between 1996 and 1998 as part of its Roving Water Quality Monitoring Network. USGS operates real-time stream gages in the Upper White River watershed and maintains public databases of current and historical data. The AWRC initiated water quality sampling at seven sites in the upper White River watershed in July 2009 and collected samples approximately weekly through December 2010. ECO collected data from one site on the West Fork White River, in conjunction with a stream restoration project. A summary of historical minerals concentrations (chloride, sulfate, and TDS) is provided in the following section.

TABLE B-1
**Summary of Water Quality Sampling Stations Included in Historical Minerals Analysis**

| Station ID | Location |
|---|---|
| **ADEQ Ambient WQ Monitoring Stations** | |
| WHI0103 | Middle Fork White River west of Elkins |
| WHI0116 | War Eagle Creek at Highway 45, north of Hindsville (collocated with USGS 7049000) |
| WHI0051 | West Fork White River near Fayetteville (collocated with USGS 7048550) |
| WHI0052 | White River near Goshen (collocated with USGS 7048700) |
| WHI0106 | White River near Durham |
| WHI0070 | Holman Creek below Huntsville |
| **ADEQ Roving WQ Monitoring Stations** | |
| WHI0112 | Brush Creek north of Highway 45 off Highway 303 (collocated with USGS 7048890) |
| WHI0102 | Middle Fork White River at County Road 32, 1 mi south of Sulphur City |
| WHI0105 | White River near Crosses |
| WHI0109 | Richland Creek, 1 mi north of Tuttle |
| WHI0098 | West Fork White River at county road bridge below Dye Creek near West Fork (u/s end) |
| **USGS Streamflow Gages (Drainage Area)** | |
| 7048550 | West Fork White River at County Road 195 (123 $mi^2$) |
| 7048000 | West Fork White River at Greenland, Arkansas |
| 7048800 | Richland Creek at West Bowen Blvd (138 $mi^2$) |
| 7049000 | War Eagle Creek near Hindsville at Highway 45 (263 $mi^2$) |
| 7048600 | White River at Wyman Road (d/s of Lake Sequoyah, u/s of Noland WWTP) (400 $mi^2$) |
| 7048700 | White River near Goshen (just u/s of Richland Creek confluence) (412 $mi^2$) |
| **AWRC Stations** | |
| AWRC Goshen | White River at Fayetteville (collocated with USGS 7048700 and WHI0052) |
| AWRC Fayetteville | White River at Wyman Bridge (collocated with USGS 7048600) |
| **ECO Station** | |
| ECO-1 | West Fork White River at Brentwood Mtn. Road |

## B.1.2 Upper White River Minerals Concentrations

Tables B-2 through B-7 provide a summary of chloride, sulfate, and TDS levels measured at various locations in the Upper White River watershed for the period of record available (as shown in the tables), as well as the period of analysis (2006 through present). Figures B-2 through B-4 show average concentrations of minerals, and the standard deviation, throughout the period of analysis. The period of analysis was selected as 2006 through the present to sufficiently and accurately represent existing operations of the Noland WWTP. Of the water quality monitoring stations included in the data analysis, the following spatial relationships to point source discharges are provided, to complement the comparison of instream minerals concentrations and municipal wastewater discharges:

- Station WHI0052/07048700 (White River) is located approximately 5.5 mi downstream of the Noland WWTP.
- Station WHI0051/07048550 (West Fork White River) is located approximately 13.1 mi downstream of the City of West Fork WWTP and 4.3 mi upstream of the Noland WWTP.
- Station WHI0098 (West Fork White River) is located approximately 0.3 mi upstream of the City of West Fork WWTP and 17.7 mi upstream of the Noland WWTP.
- Station WHI0070 (Holman Creek) is located approximately 0.9 mi downstream of the City of Huntsville WWTP and has no relationship to the Noland WWTP.
- Station WHI0116/07049000 (War Eagle Creek) is located approximately 15.9 mi downstream of the City of Huntsville WWTP and has no relationship to the Noland WWTP.

### B.1.2.1 Chloride

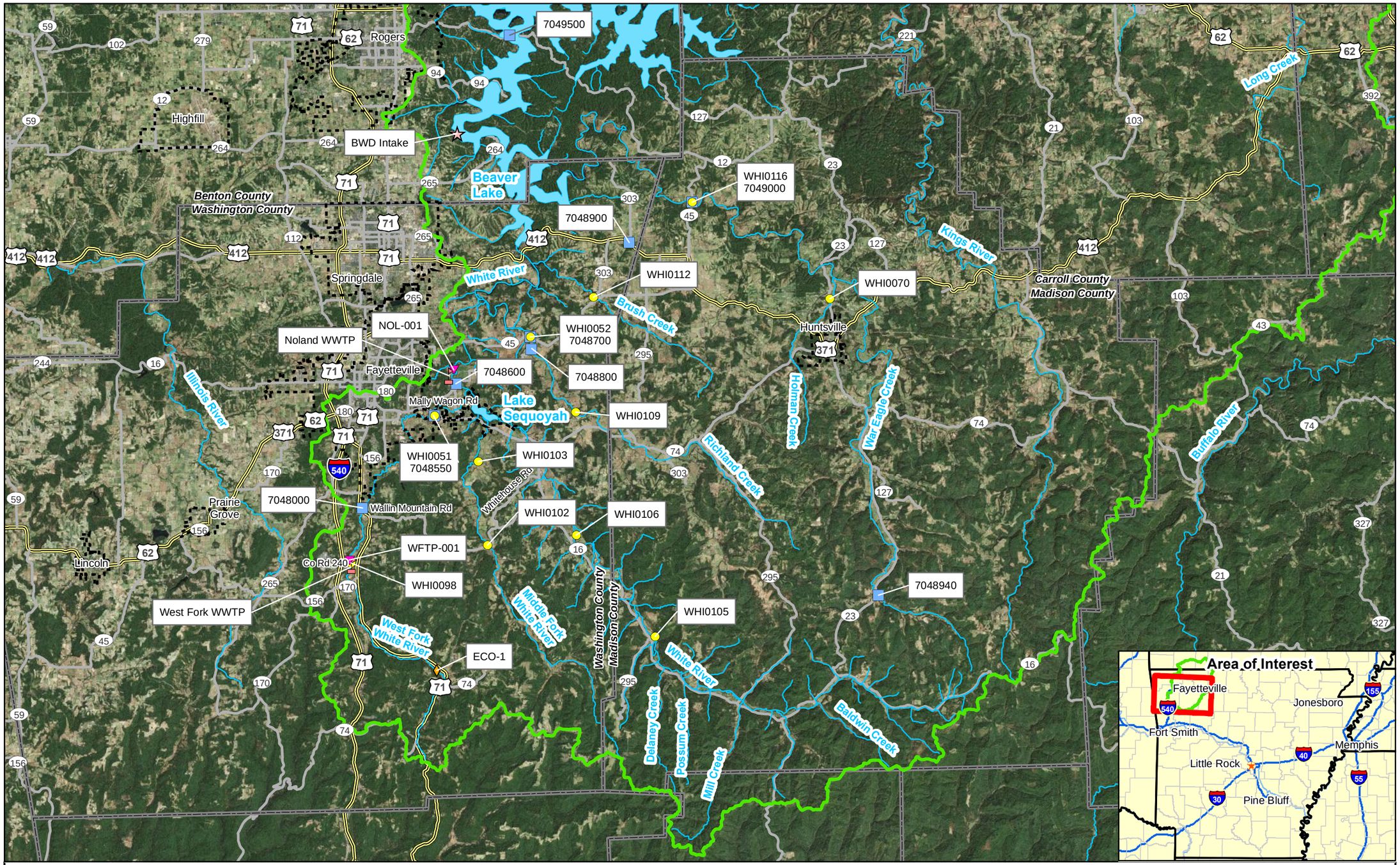
Based on APCEC (2011), 17.3 mg/L is considered to be the maximum naturally occurring chlorides level in the Ozark Highlands Ecoregion, as determined from Arkansas' least-disturbed ecoregion reference streams. Average chloride concentrations in the watershed across the period of record range from 1.9 mg/L (White River upstream of Lake Sequoyah ) to 100.7 mg/L (in Holman Creek downstream of the Huntsville WWTP).These ranges are comparable to those measured since 2006.

Chloride concentrations are relatively high at locations downstream of the Noland, City of West Fork, and City of Huntsville WWTPs. Average concentrations downstream of the City of Huntsville WWTP are higher than those downstream of the Noland and West Fork WWTPs. The highest average levels of chloride in the watershed have been measured in War Eagle Creek and Holman Creek (both downstream of the City of Huntsville WWTP).

Levels in the White River at Goshen (downstream of the Noland discharge) have historically been higher than levels upstream of Noland (at USGS 07048600); however, the average concentration at Goshen (10.6 mg/L based on 598 samples) is less than the naturally occurring level in reference streams and is less than the Arkansas WQC for Reach 23 of the White River (20 mg/L). Average chloride concentrations downstream of the Noland WWTP are comparable to those measured at Station WHI012 in Brush Creek, which is not influenced by any municipal or domestic point source discharges (Figure B-2) or any industrial stormwater discharges.

### B.1.2.2 Sulfate

Based on APCEC (2011), 22.7 mg/L is considered to be the maximum naturally occurring sulfates level in the Ozark Highlands Ecoregion, as determined from Arkansas' least-disturbed ecoregion reference streams. Average sulfate concentrations in the watershed have historically ranged from 3.2 mg/L (White River upstream of Lake Sequoyah) to 31.2 mg/L (in the West Fork White River just upstream of the City of West Fork WWTP). These ranges are comparable to those measured since 2006.




**Legend**

- ADEQ Stations
- ECO Stations
- USGS Stations
- Wastewater Treatment Plants
- Wastewater Treatment Plant Outfalls
- BWD Intake
- Highway
- Major Road
- Drainage Area (UAA Stations)
- HUC 11010001
- City Boundary
- County Boundary

N

0 2.5 5 10 Miles

**Figure B-1**
**Historical Water Quality Monitoring Stations**

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CH2MHILL

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Sulfate concentrations are relatively high at locations downstream of the Noland WWTP, City of Huntsville WWTP, and West Fork WWTP, with the highest average levels downstream of the City of Huntsville WWTP. The highest average levels of sulfate in the watershed occur in the West Fork White River (downstream and just upstream of the West Fork WWTP), Brush Creek, and Holman Creek (downstream of the City of Huntsville WWTP). It should be noted that the West Fork White River may be influenced by a number of sand and gravel quarries and other industries in the watershed (Table 2-6 and Figure 2-3 in UAA report).

Since 2006, average sulfate concentrations in the White River at Goshen have been 17.4 mg/L, higher than the average concentration at USGS 07048600, downstream of the Noland discharge (13.1 mg/L). However, both average concentrations are lower than those identified by ADEQ as the maximum naturally occurring concentration in the ecoregion. Both average concentrations are also below the 20-mg/L water quality criterion.

### B.1.2.3 TDS

Based on APCEC (2011), 250 mg/L is considered to be the maximum naturally occurring TDS level in the Ozark Highlands Ecoregion, as determined from Arkansas' least-disturbed ecoregion reference streams. Trends in historical TDS data generally follow those observed in chloride and sulfate data, with relatively high TDS measured at the four stations located downstream of a point source discharge, in West Fork White River just upstream of the West Fork WWTP, and in Brush Creek (Figure B-4).

Table B-8 summarizes average TDS levels and the average percent of TDS consisting of sulfate and chloride for each sampling station. The highest average TDS concentrations have historically been measured in Brush Creek and Holman Creek (Figure B-4). Only the average concentration in Holman Creek (340 mg/L) exceeds Arkansas' WQC for the Ozark Highlands Ecoregion. During the period of analysis, the percentage of TDS consisting of sulfate and chloride ranged from 12.7 percent at Station WHI0102 (Middle Fork White River) to 31.0 percent at Station WHI0070 (Holman Creek downstream of Huntsville WWTP) (Table B-8).

TABLE B-2

**Summary Statistics of Chloride Concentrations (Period of Record)**

| Station ID | Location | No. Samples | Period Begin | Period End | Minimum $Cl^-$ (mg/L) | Average $Cl^-$ (mg/L) | Maximum $Cl^-$ (mg/L) | Standard Deviation (mg/L) |
|---|---|---|---|---|---|---|---|---|
| ADEQ WHI0070 | Holman Creek, upstream of confluence with War Eagle Creek | 98 | Sep-02 | Feb-11 | 0.8 | 100.7 | 326.0 | 86.5 |
| USGS 7049000/ ADEQ WHI0116 | War Eagle Creek, near Hindsville | 298 | Jul-50 | Nov-11 | 1.0 | 11.3 | 66.6 | 10.3 |
| ADEQ WHI0112 | Brush Creek, near Mayfield | 24 | Oct-03 | Jun-07 | 3.9 | 10.2 | 12.4 | 2.0 |
| ADEQ WHI0109 | Richland Creek, just downstream of confluence with Lollar Creek | 21 | Oct-03 | Jun-07 | 3.4 | 5.1 | 11.0 | 1.7 |
| USGS 7048800 | Richland Creek at Goshen | 128 | Aug-63 | Nov-11 | 1.4 | 4.6 | 9.4 | 1.4 |
| ADEQ WHI0105 | White River, upstream end | 11 | Oct-03 | Jul-05 | 1.5 | 1.9 | 2.6 | 0.4 |
| ADEQ WHI0106 | White River, upstream of Lake Sequoyah | 102 | Sep-02 | Aug-11 | 1.2 | 2.3 | 3.5 | 0.5 |
| USGS 7048600/ AWRC Fayetteville | White River, near Fayetteville | 248 | Aug-58 | Nov-11 | 1.0 | 3.4 | 10.8 | 1.4 |
| USGS 7048700/ ADEQ WHI0052/ AWRC Goshen | White River near Goshen | 598 | Aug-63 | Aug-11 | 1.0 | 10.6 | 71.8 | 11.3 |
| ADEQ WHI0102 | Middle Fork White River, mid-reach | 19 | Oct-03 | Jan-08 | 2.3 | 3.1 | 4.4 | 0.5 |
| ADEQ WHI0103 | Middle Fork White River, upstream of Lake Sequoya | 116 | Sep-02 | Aug-11 | 1.4 | 3.4 | 12.7 | 1.4 |
| ECO-1 | West Fork White River at Brentwood Mtn. Road | 201 | Sep-07 | May-10 | 0.4 | 3.2 | 5.5 | 0.8 |
| ADEQ WHI0098 | West Fork White River, upstream end | 24 | Oct-03 | Jun-07 | 2.6 | 4.4 | 12.3 | 1.9 |
| USGS 7048000 | West Fork White River at Greenland, Arkansas | 18 | Apr-46 | Aug-63 | 1.5 | 3.6 | 9.0 | 1.6 |
| USGS 7048550/ ADEQ WHI0051 | West Fork White River, east of Fayetteville | 424 | Jun-75 | Jan-12 | 1.0 | 6.6 | 84.0 | 5.8 |

Sources: ADEQ (2011), USGS (2012), STORET (2011)

TABLE B-3

**Summary Statistics of Chloride Concentrations (2006-present)**

| Station ID | Location | No. Samples | Period Begin | Period End | Minimum $Cl^-$ (mg/L) | Average $Cl^-$ (mg/L) | Maximum $Cl^-$ (mg/L) | Standard Deviation (mg/L) |
|---|---|---|---|---|---|---|---|---|
| ADEQ WHI0070 | Holman Creek, upstream of confluence with War Eagle Creek | 59 | Jan-06 | Feb-11 | 4.3 | 96.2 | 326.0 | 87.1 |
| USGS 7049000 / ADEQ WHI0116 | War Eagle Creek, near Hindsville | 111 | Jan-06 | Nov-11 | 1.0 | 13.2 | 66.6 | 11.3 |
| ADEQ WHI0112 | Brush Creek, near Mayfield | 11 | Jan-06 | Jun-07 | 3.9 | 10.0 | 12.4 | 2.5 |
| ADEQ WHI0109 | Richland Creek, just downstream of confluence with Lollar Creek | 10 | Apr-06 | Jun-07 | 3.4 | 4.5 | 5.8 | 0.8 |
| USGS 7048800 | Richland Creek at Goshen | 53 | May-06 | Nov-11 | 1.4 | 4.2 | 9.4 | 1.6 |
| ADEQ WHI0106 | White River, upstream of Lake Sequoyah | 62 | Jan-06 | Aug-11 | 1.2 | 2.3 | 3.5 | 0.5 |
| USGS 7048600/ AWRC Fayetteville | White River, near Fayetteville | 140 | May-06 | Nov-11 | 1.0 | 3.4 | 10.8 | 1.3 |
| USGS 7048700/ ADEQ WHI0052/ AWRC Goshen | White River near Goshen | 196 | Jan-06 | Aug-11 | 1.3 | 9.8 | 71.8 | 9.8 |
| ADEQ WHI0102 | Middle Fork White River, mid-reach | 8 | Mar-06 | Jan-08 | 2.7 | 3.2 | 3.9 | 0.4 |
| ADEQ WHI0103 | Middle Fork White River, upstream of Lake Sequoya | 76 | Jan-06 | Aug-11 | 1.4 | 3.3 | 12.7 | 1.4 |
| ECO | West Fork White River at Brentwood Mtn. Road | 201 | Sep-07 | May-10 | 0.4 | 3.2 | 5.5 | 0.8 |
| ADEQ WHI0098 | West Fork White River, upstream end | 11 | Jan-06 | Jun-07 | 3.0 | 5.0 | 12.3 | 2.5 |
| USGS 7048550 / ADEQ WHI0051 | West Fork White River, east of Fayetteville | 122 | Jan-06 | Jan-12 | 1.4 | 6.9 | 84.0 | 8.1 |

Sources: ADEQ (2011), USGS (2012), STORET (2011)

TABLE B-4

**Summary Statistics of Sulfate Concentrations (Period of Record)**

| Station ID | Location | No. Samples | Period Begin | Period End | Minimum Sulfate (mg/L) | Average Sulfate (mg/L) | Maximum Sulfate (mg/L) | Standard Deviation (mg/L) |
|---|---|---|---|---|---|---|---|---|
| ADEQ WHI0070 | Holman Creek, upstream of confluence with War Eagle Creek | 250 | Sep-90 | Oct-11 | 0.9 | 18.7 | 45.6 | 6.7 |
| USGS 7049000 / ADEQ WHI0116 | War Eagle Creek, near Hindsville | 419 | Jul-50 | Nov-11 | 1.0 | 6.4 | 34.7 | 2.4 |
| ADEQ WHI0112 | Brush Creek, near Mayfield | 31 | May-92 | Jun-07 | 7.6 | 20.8 | 44.8 | 8.1 |
| ADEQ WHI0109 | Richland Creek, just downstream of confluence with Lollar Creek | 28 | May-92 | Jun-07 | 7.6 | 10.4 | 14.5 | 1.9 |
| USGS 7048800 | Richland Creek at Goshen | 128 | Aug-63 | Nov-11 | 3.9 | 11.1 | 33.0 | 4.6 |
| ADEQ WHI0105 | White River, upstream end | 15 | Dec-92 | Jul-05 | 2.5 | 3.2 | 4.8 | 0.7 |
| ADEQ WHI0106 | White River, upstream of Lake Sequoyah | 216 | May-92 | Aug-11 | 1.3 | 6.0 | 82.6 | 6.5 |
| USGS 7048600/ AWRC Fayetteville | White River, near Fayetteville | 248 | Aug-58 | Nov-11 | 3.2 | 13.2 | 45.0 | 7.7 |
| USGS 7048700/ ADEQ WHI0052/ AWRC Goshen | White River near Goshen | 722 | Aug-63 | Aug-11 | 1.0 | 18.8 | 111.0 | 15.9 |
| ADEQ WHI0102 | Middle Fork White River, mid-reach | 26 | May-92 | Jan-08 | 2.2 | 4.6 | 6.5 | 1.0 |
| ADEQ WHI0103 | Middle Fork White River, upstream of Lake Sequoya | 233 | May-92 | Aug-11 | 3.5 | 8.5 | 28.4 | 3.4 |
| ECO-1 | West Fork White River at Brentwood Mtn. Road | 200 | Sep-07 | May-10 | 2.9 | 4.7 | 32.3 | 2.5 |
| ADEQ WHI0098 | West Fork White River, upstream end | 31 | Nov-90 | Jun-07 | 5.9 | 31.2 | 86.5 | 20.0 |
| USGS 7048000 | West Fork White River at Greenland, Arkansas | 19 | Apr-46 | Aug-63 | 4.0 | 6.2 | 9.0 | 1.5 |
| USGS 7048550 / ADEQ WHI0051 | West Fork White River, east of Fayetteville | 556 | Jun-74 | Jan-12 | 3.0 | 24.2 | 75.0 | 12.3 |

Sources: ADEQ (2011), USGS (2012), STORET (2011)

TABLE B-5

**Summary Statistics of Sulfate Concentrations (2006-present)**

| Station ID | Location | No. Samples | Period Begin | Period End | Minimum Sulfate (mg/L) | Average Sulfate (mg/L) | Maximum Sulfate (mg/L) | Standard Deviation (mg/L) |
|---|---|---|---|---|---|---|---|---|
| ADEQ WHI0070 | Holman Creek, upstream of confluence with War Eagle Creek | 64 | Jan-06 | Apr-11 | 6.9 | 21.3 | 42.5 | 8.1 |
| USGS 7049000/ ADEQ WHI0116 | War Eagle Creek, near Hindsville | 114 | Jan-06 | Nov-11 | 2.2 | 6.8 | 15.4 | 2.1 |
| ADEQ WHI0112 | Brush Creek, near Mayfield | 11 | Jan-06 | Jun-07 | 17.8 | 25.9 | 44.8 | 8.5 |
| ADEQ WHI0109 | Richland Creek, just downstream of confluence with Lollar Creek | 10 | Apr-06 | Jun-07 | 8.0 | 10.0 | 14.0 | 1.8 |
| USGS 7048800 | Richland Creek at Goshen | 53 | May-06 | Nov-11 | 3.9 | 10.4 | 29.7 | 5.2 |
| ADEQ WHI0106 | White River, upstream of Lake Sequoyah | 62 | Jan-06 | Aug-11 | 2.9 | 4.7 | 13.4 | 1.8 |
| USGS 7048600/ AWRC Fayetteville | White River, near Fayetteville | 140 | May-06 | Nov-11 | 3.8 | 13.1 | 43.2 | 6.9 |
| USGS 7048700/ ADEQ WHI0052/ AWRC Goshen | White River near Goshen | 196 | Jan-06 | Aug-11 | 4.1 | 17.4 | 67.7 | 10.7 |
| ADEQ WHI0102 | Middle Fork White River, mid-reach | 8 | Mar-06 | Jan-08 | 3.9 | 5.1 | 6.5 | 0.8 |
| ADEQ WHI0103 | Middle Fork White River, upstream of Lake Sequoya | 76 | Jan-06 | Aug-11 | 4.1 | 8.2 | 28.4 | 3.6 |
| ECO-1 | West Fork White River at Brentwood Mtn. Road | 200 | Sep-07 | May-10 | 2.9 | 4.7 | 32.3 | 2.5 |
| ADEQ WHI0098 | West Fork White River, upstream end | 11 | Jan-06 | Jun-07 | 12.1 | 33.2 | 67.3 | 16.5 |
| USGS 7048550/ ADEQ WHI0051 | West Fork White River, east of Fayetteville | 122 | Jan-06 | Jan-12 | 3.1 | 27.3 | 61.2 | 13.1 |

Sources: ADEQ (2011), USGS (2012), STORET (2011)

TABLE B-6

**Summary Statistics of TDS Concentrations (Period of Record)**

| Station ID | Location | No. Samples | Period Begin | Period End | Minimum TDS (mg/L) | Average TDS (mg/L) | Maximum TDS (mg/L) | Standard Deviation (mg/L) |
|---|---|---|---|---|---|---|---|---|
| ADEQ WHI0070 | Holman Creek, upstream of confluence with War Eagle Creek | 253 | Sep-90 | Oct-11 | 64 | 320 | 1125 | 190 |
| USGS 7049000 / ADEQ WHI0116 | War Eagle Creek, near Hindsville | 414 | Jul-50 | Nov-11 | 45 | 124 | 279 | 41 |
| ADEQ WHI0112 | Brush Creek, near Mayfield | 31 | May-92 | Jun-07 | 105 | 206 | 261 | 31 |
| ADEQ WHI0109 | Richland Creek, just downstream of confluence with Lollar Creek | 28 | May-92 | Jun-07 | 66 | 104 | 172 | 30 |
| USGS 7048800 | Richland Creek at Goshen | 124 | Aug-63 | Nov-11 | 35 | 106 | 181 | 32 |
| ADEQ WHI0106 | White River, upstream of Lake Sequoyah | 218 | May-92 | Aug-11 | 10 | 44 | 190 | 15 |
| USGS 7048600/ AWRC Fayetteville | White River, near Fayetteville | 160 | Aug-58 | Nov-11 | 30 | 83 | 183 | 31 |
| USGS 7048700/ ADEQ WHI0052/ AWRC Goshen | White River near Goshen | 532 | Aug-63 | Aug-11 | 44 | 119 | 564 | 70 |
| ADEQ WHI0102 | Middle Fork White River, mid-reach | 26 | May-92 | Jan-08 | 47 | 68 | 99 | 15 |
| ADEQ WHI0103 | Middle Fork White River, upstream of Lake Sequoya | 233 | May-92 | Aug-11 | 33 | 76 | 197 | 16 |
| ADEQ WHI0098 | West Fork White River, upstream end | 31 | Nov-90 | Jun-07 | 53 | 126 | 247 | 48 |
| USGS 7048000 | West Fork White River at Greenland, Arkansas | 9 | Apr-46 | Aug-63 | 46 | 57 | 75 | 9 |
| USGS 7048550 / ADEQ WHI0051 | West Fork White River, east of Fayetteville | 521 | Nov-77 | Jan-12 | 47 | 129 | 323 | 39 |

Sources: ADEQ (2011), USGS (2012), STORET (2011)

TABLE B-7

**Summary Statistics of TDS Concentrations (2006-present)**

| Station ID | Location | No. Samples | Period Begin | Period End | Minimum TDS (mg/L) | Average TDS (mg/L) | Maximum TDS (mg/L) | Standard Deviation (mg/L) |
|---|---|---|---|---|---|---|---|---|
| ADEQ WHI0070 | Holman Creek, upstream of confluence with War Eagle Creek | 64 | Jan-06 | Apr-11 | 64 | 340 | 893 | 208 |
| USGS 7049000 / ADEQ WHI0116 | War Eagle Creek, near Hindsville | 114 | Jan-06 | Nov-11 | 45 | 131 | 279 | 46 |
| ADEQ WHI0112 | Brush Creek, near Mayfield | 11 | Jan-06 | Jun-07 | 185 | 213 | 230 | 13 |
| ADEQ WHI0109 | Richland Creek, just downstream of confluence with Lollar Creek | 10 | Apr-06 | Jun-07 | 66 | 93 | 140 | 22 |
| USGS 7048800 | Richland Creek at Goshen | 52 | May-06 | Nov-11 | 35 | 101 | 177 | 37 |
| ADEQ WHI0106 | White River, upstream of Lake Sequoyah | 62 | Jan-06 | Aug-11 | 10 | 41 | 69 | 10 |
| USGS 7048600/ AWRC Fayetteville | White River, near Fayetteville | 53 | May-06 | Nov-11 | 30 | 80 | 169 | 29 |
| USGS 7048700/ ADEQ WHI0052/ AWRC Goshen | White River near Goshen | 113 | Jan-06 | Aug-11 | 44 | 118 | 564 | 70 |
| ADEQ WHI0102 | Middle Fork White River, mid-reach | 8 | Mar-06 | Jan-08 | 48 | 67 | 92 | 14 |
| ADEQ WHI0103 | Middle Fork White River, upstream of Lake Sequoya | 76 | Jan-06 | Aug-11 | 33 | 75 | 197 | 19 |
| ADEQ WHI0098 | West Fork White River, upstream end | 11 | Jan-06 | Jun-07 | 89 | 128 | 201 | 36 |
| USGS 7048550 / ADEQ WHI0051 | West Fork White River, east of Fayetteville | 122 | Jan-06 | Jan-12 | 53 | 133 | 323 | 44 |

Sources: ADEQ (2011), USGS (2012), STORET (2011)

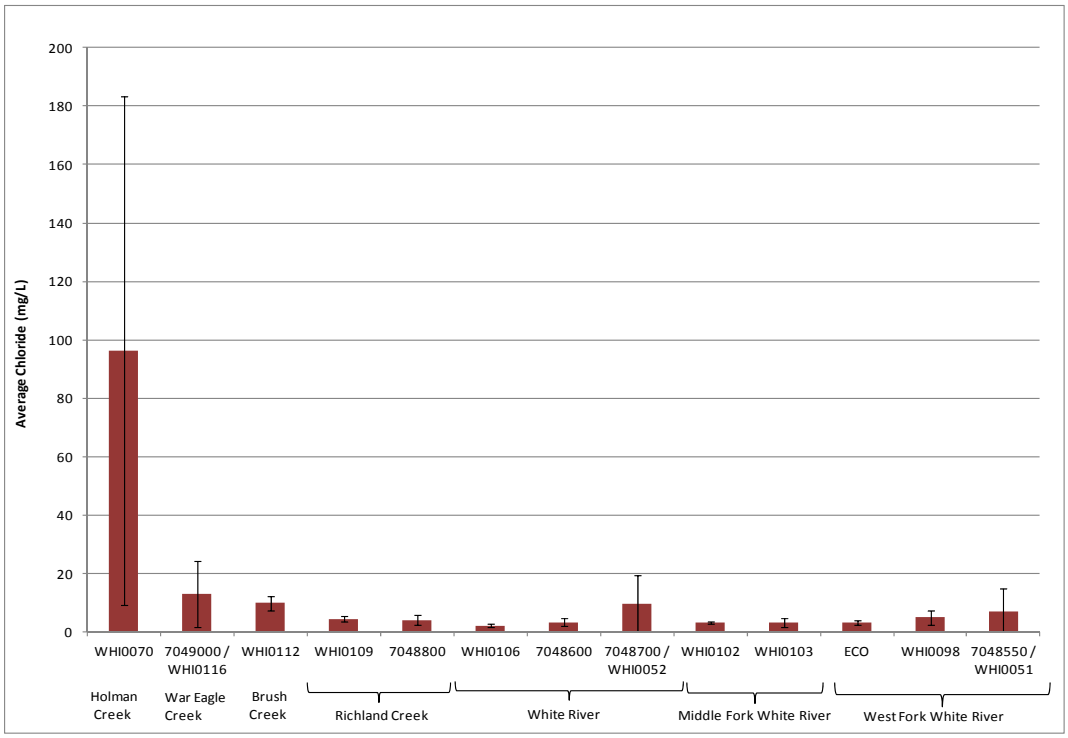


FIGURE B-2

**Average Chloride Concentrations and Standard Deviation (2006-present)**

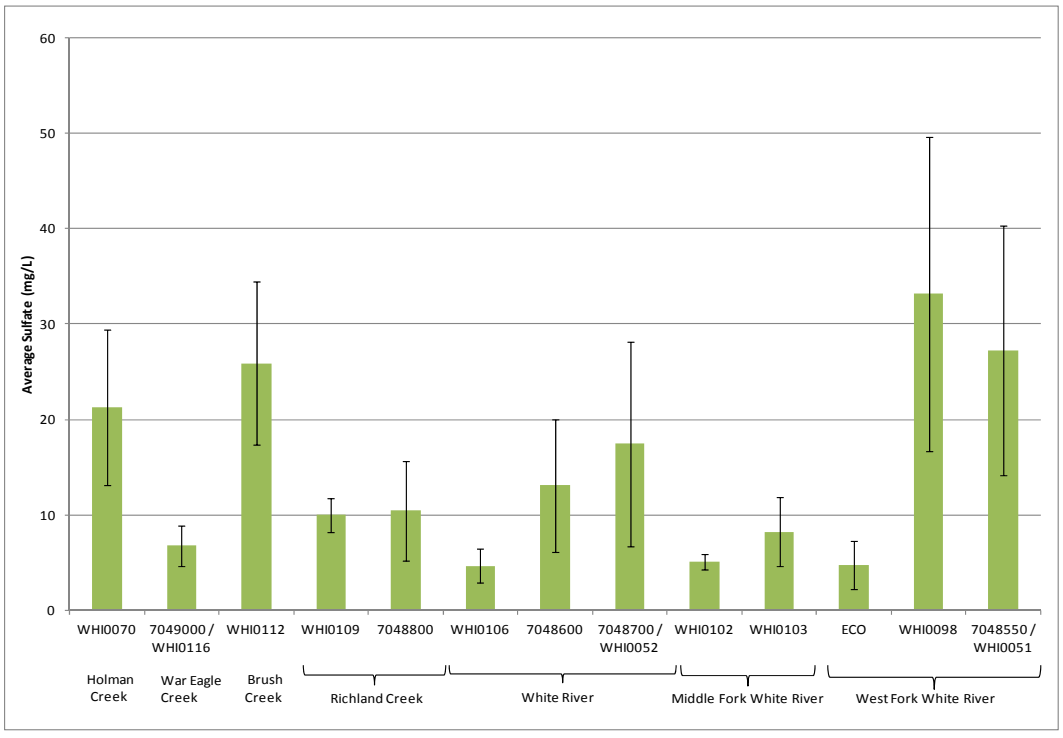


FIGURE B-3

**Average Sulfate Concentrations and Standard Deviation (2006-present)**

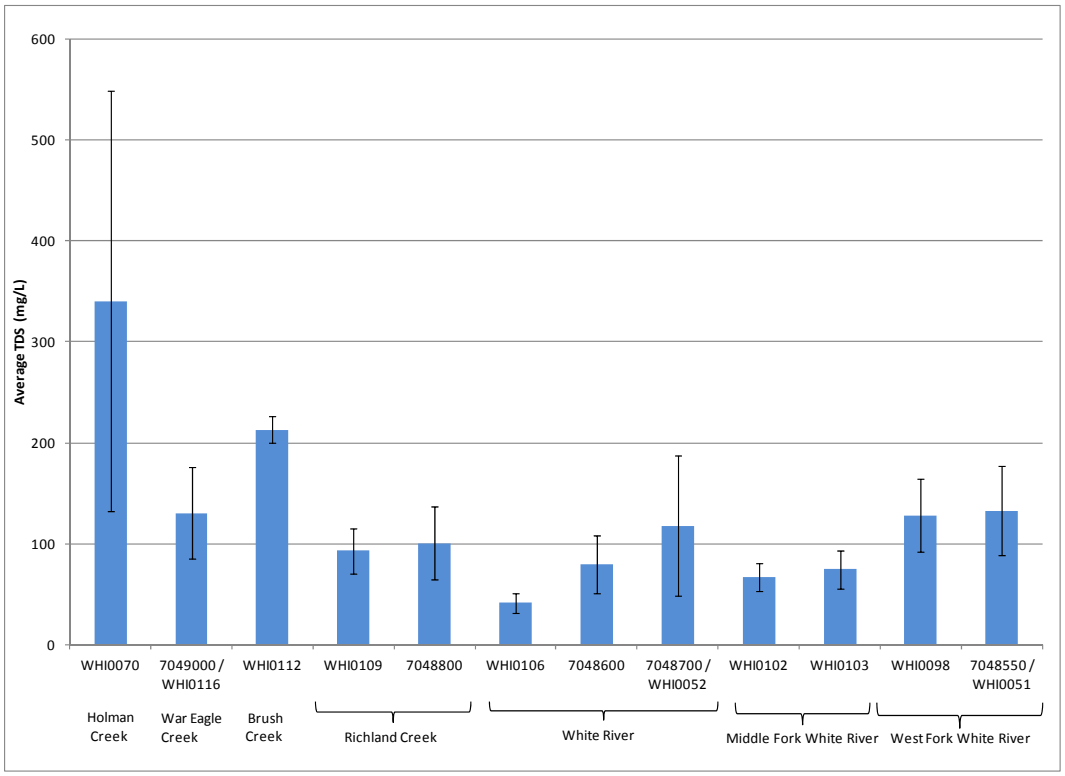


FIGURE B-4
**Average TDS Concentrations and Standard Deviation (2006-present)**

TABLE B-8
**Summary of TDS Concentrations and TDS as Cl and SO4 (2006-present)**

| Sampling Station | Location Relative to Point Source Discharge | Average TDS | Average % of TDS as $Cl^-$ and $SO_4^{-2}$ | Number Samples |
|---|---|---|---|---|
| WHI0070 – Holman Creek | 0.9 mi downstream of Huntsville WWTP | 340.4 | 31.0% | 64 |
| WHI0098 – West Fork White River | 0.3 mi u/s of West Fork WWTP | 128.1 | 29.3% | 11 |
| 7048550 / WHI0051 – West Fork White River | 13.1 mi downstream of West Fork WWTP | 132.5 | 24.6% | 140 |
| 7048700/ WHI0052 – White River | 5.4 mi downstream of Noland WWTP | 117.9 | 22.6% | 209 |
| 7048600 – White River | 1.0 mi u/s of Noland WWTP | 79.4 | 18.6% | 143 |
| WHI0106 – White River | N/A | 41.2 | 17.5% | 62 |
| WHI0112 / 7048890 – Brush Creek | N/A | 212.9 | 16.8% | 11 |
| WHI0109 – Richland Creek | N/A | 92.9 | 16.0% | 10 |
| WHI0103 – Middle Fork | N/A | 74.6 | 15.6% | 76 |
| 7048800 – Richland Creek | N/A | 100.7 | 14.6% | 56 |
| 7049000 /WHI0116 – War Eagle Creek | 15.9 mi downstream of City of Huntsville WWTP | 130.6 | 14.3% | 117 |
| WHI0102 – Middle Fork White River | N/A | 66.8 | 12.7% | 8 |

# B.2 Physical and Biological Conditions

## B.2.1 Historical Data Included in Analysis

Physical and biological data have been collected in the White River watershed by various groups. As part of the *Water Quality, Macroinvertebrate, and Fish Community Survey of the Upper White River Watershed, Northwest Arkansas* (ADPCE, 1995), fish community assessments were conducted in the White River, Middle Fork White, River, West Fork White River, and War Eagle Creek to characterize existing fish communities and for comparison to fish community samples collected in 1962 and 1963 as part of the Beaver Lake watershed pre-impoundment study. In addition, assessments of the benthic macroinvertebrate community and physical habitat were conducted in May 1993 at 27 locations within the White River watershed. ADEQ completed benthic macroinvertebrate community and physical habitat assessments at Kings River, Long Creek, Yocum Creek, and War Eagle Creek in 2000 and 2001, as part of its assessment framework program. In 2002 and 2003, the University of Arkansas completed surveys of fish and macroinvertebrates at eight locations on the West Fork White River, including the West Fork White River station sampled in 1993 by ADPCE (Brown et al., 2003).

Benthic macroinvertebrate sampling and data analysis completed by ADPCE (1995) and by the University of Arkansas (2002) followed the then-current USEPA Rapid Bioassessment Protocols (RBPs) (Plafkin et al., 1989). Physical habitat assessments conducted in 1993 included a visual evaluation of the instream substrate, riparian conditions, streambank vegetation and stability, and surrounding land use type. The physical habitat for each site was scored based on its correlation with the habitat at a reference location (ADPCE, 1995).

Table B-9 summarizes the sampling station locations that were included in biological data analysis for the UAA. These included stations on streams sampled for the UAA Field Data Collection and Analysis (i.e., White River, West Fork White River, Middle Fork White River, and Richland Creek). Results of historical biological monitoring are provided in the following section.

TABLE B-9
**Summary of Biological Sampling Stations Included in Historical Data Analysis**

| Study (Collection Date) | Station ID | Location |
|---|---|---|
| Brown et al. (2002 and 2003)[a] | Site 6 | West Fork White River, SE of Hwy 156 near the Tilly-Willy Bridge (fish, benthic macroinvertebrates, and physical habitat) |
| ADPCE (1993) | RCH-03 | Richland Creek at Highway 45 (benthic macroinvertebrates) |
| | MFW-03 | Middle Fork White River, 2 mi SW of Elkins (fish and macroinvertebrates) |
| | WFW-03; same location as Site 6 | West Fork White River, SE of Fayetteville (fish and macroinvertebrates) |
| | WHR-01 | White River, upstream end, Madison County (benthic macroinvertebrates) |
| | WHR-02 | White River, d/s of Crosses Creek (benthic macroinvertebrates) |
| | WHR-03 | White River, 2 mi NW of Durham (fish and macroinvertebrates) |
| Beaver Lake Watershed Pre-Impoundment Study (1963) | Same location as WHR-03 | White River, 2 mi NW Durham (fish) |
| | Same location as MFW-02 | Middle Fork White River, 1 mi S of Sulphur City (4-5 mi upstream of MFW-03 ) (fish) |
| | 1-2 mi u/s of WFW-03 | West Fork White River, 1 mi downstream of Highway 71 (fish) |

[a] Site 6 included for comparison to WFW-03

## B.2.2 White River Watershed Fish Communities

Table B-10 provides a summary of the fish community assemblages in the White River, West Fork White River, and Middle Fork White River, during the 1963 and 1993 sampling events and the index of similarity (as defined in ADPCE, 1993) between the two years. The total number of species and individuals was lower during the 1993 event, at each sampling station, and the index of similarity between events ranged from 0.65 ("somewhat dissimilar") to 0.7 ("relatively similar").

Fish communities in the White River at Station WHR-03 (White River, 2 mi northwest of Durham) were dominated by Percidae (darters) and Cyprinidae (minnows) during the 1963 and 1993 events. Eight fewer species were present in 1993, and the two samples were considered "relatively similar," as defined in ADPCE (1993). The minnow population increased from 1963 to 1993, primarily due to an increase in stonerollers, and the darter population decreased, primarily due to a decline in rainbow and yoke darter individuals. Species that were present during the 1963 sampling event but not the 1993 sampling event included hornyhead chub, checkered madtom, speckled darter, and smallmouth bass. Based on ADPCE conclusions (1993), the shift from a population preferring stable, clean-gravel habitat (darters) to one dominated by herbivores, detrivores, and omnivore trophic feeders (minnows) indicates a watershed area that has been impacted by land use changes.

In the Middle Fork White River, fish communities were dominated by Percidae, Cyprinidae, and Centrarchidae (sunfishes). Five fewer species were observed in 1993, and the two samples were considered "somewhat dissimilar," as defined in ADPCE (1993). Major differences between the two sampling events contrasted with those seen in the White River, with a substantial decline in species and individuals of minnows and an increase in darter abundance (though the diversity of darter taxa still decreased). Species that were present during the 1963 sample but not the 1993 sample included hornyhead chub, speckled darter, yoke darter, bigeye chub, and smallmouth bass. According to ADPCE (1993), these changes in fish communities over time were not expected, based on the substantial changes to land use that had occurred in the watershed, including timber harvesting and cattle and poultry production. However, an increase in the stonerollers (despite a decrease in overall minnows) was indicative of increased nutrient inputs to the stream.

The West Fork White River demonstrated the largest decrease in total species and total individuals between 1963 and 1993. The two samples were considered "somewhat dissimilar," and nine fewer species were collected during the latter sampling event. Notable changes in the fish assemblages between 1963 and 1993 were an increase in the relative abundance of Cyprinidae, a decrease in the relative abundance of Ictaluridae (catfishes), and a decline in the relative abundance and number of Percidae species. Species that were present during the 1963 sample but not the 1993 sample included hornyhead chub, telescope shiner, Ozark bass, yoke darter, and stippled darter. At the time of the 1993 sampling, the West Fork White River watershed was dominated by overgrazed pasture land with disrupted riparian zones and recent major highway construction. ADPCE attributed changes in the fish community to water quality and physical habitat impacts resulting from these land use conditions (ADPCE, 1993).

TABLE B-10

**Summary of Historical Fish Sampling Data (1962, 1963, and 1993)**

| | White River (WHR-03) | | | | Middle Fork White River (MFW-02) | | Middle Fork White River (MFW-03) | | 1-2 mi upstream of WFW-03 | | West Fork White River (WFW-03) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 26-Jun 1963 | | 26-Jul 1993 | | 06-Jun 1963 | | 30-Jun 1993 | | 02-Jul 1962 | | 26-Jul 1993 | |
| Family | % of Taxa | % of Individuals | % of Taxa | % Individuals | % of Taxa | % Individuals | % of Taxa | % Individuals | % of Taxa | % Individuals | % of Taxa | % Individuals |
| Clupeidae (shads) | 2.5 | 2.2 | 0.0 | 0.0 | 0.0 | 0.0 | 3.4 | 0.1 | 2.9 | 0.7 | 0.0 | 0.0 |
| Cyprinidae (minnows) | 27.5 | 35.0 | 31.3 | 55.0 | 32.4 | 60.3 | 27.6 | 38.9 | 31.4 | 30.5 | 26.9 | 66.6 |
| Catostomidae (suckers) | 12.5 | 2.8 | 9.4 | 5.1 | 8.8 | 2.8 | 10.3 | 1.9 | 11.4 | 2.0 | 11.5 | 9.9 |
| Ictaluridae (catfishes) | 12.5 | 5.0 | 9.4 | 4.0 | 5.9 | 3.0 | 6.9 | 16.6 | 5.7 | 16.4 | 7.7 | 3.9 |
| Poeciliidae (livebearers) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.9 | 0.0 | 0.0 | 0.0 |
| Atherinidae (silversides) | 2.5 | 0.2 | 0.0 | 0.0 | 2.9 | 0.3 | 3.4 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Centrarchidae (sunfishes) | 17.5 | 7.5 | 18.8 | 8.4 | 20.6 | 14.9 | 24.1 | 5.0 | 14.3 | 7.4 | 23.1 | 9.4 |
| Percidae (darters) | 20.0 | 46.5 | 25.0 | 27.3 | 23.5 | 18.3 | 20.7 | 37.2 | 22.9 | 41.6 | 19.2 | 9.4 |
| Cottidae (sculpins) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.9 | 0.2 | 0.0 | 0.0 |
| Cyprinodontidae (killfishes) | 5.0 | 0.9 | 3.1 | 0.2 | 2.9 | 0.5 | 3.4 | 0.1 | 5.7 | 1.0 | 3.8 | 0.3 |
| Lepisosteidae (gars) | 0.0 | 0.0 | 3.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.8 | 0.2 |
| Petromyzontidae (lampreys) | 0.0 | 0.0 | 0.0 | 0.0 | 2.9 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 3.8 | 0.4 |
| Total Species | 40 | | 32 | | 34 | | 29 | | 35 | | 26 | |
| Total Individuals | 2253 | | 1240 | | 1521 | | 1130 | | 2135 | | 1088 | |
| Diversity Index [a] | 3.79 | | 3.65 | | 3.63 | | 3.23 | | 3.66 | | 3.34 | |
| Similarity Index [b] | 0.7 (Relatively Similar) | | | | 0.65 (Somewhat dissimilar) | | | | 0.65 (Somewhat dissimilar) | | | |

Source: Source: ADEQ, 2011 and APCEC, 1995

[a] Shannon-Wiener Dominance Diversity Index to $\log_2$

[b] Modification of Odum's index of similarity (1971)

### B.2.3 White River Watershed Benthic Macroinvertebrate Communities and Physical Habitat

Benthic macroinvertebrate community assemblages from 1993 are summarized Table B-11. Table B-12 summarizes selected benthic macroinvertebrate indices for three stations on the White River, one on West Fork White River, one on Middle Fork White River, and one on Richland Creek. Benthic macroinvertebrate communities ranged from 73 percent comparable (between the reference site and the site on Middle Fork White River) to 93 percent comparable (between the reference site and the site on the West Fork White River). Benthic macroinvertebrate community scores ranged from 41 percent comparable ("moderately impaired"), on the White River, downstream of Crosses Creek, to 82.35 percent comparable ("not significantly impaired"), on Richland Creek and the White River, 2 mi northwest of Durham. Of the stations, three were "moderately impaired," one was "slightly to moderately impaired," and two were "not significantly impaired."

The following summaries were included in APCEC (1995) and provide a comparison between conditions in 1963 and those in 1993:

- **West Fork White River, southeast of Fayetteville:** Significant diversity reduction from 1963 to 1993 was exhibited at this station. Only 11 taxa were collected. The impairment status may be a result of excessive siltation from road construction and gravel mining activities in the watershed.
- **Middle Fork White River, 2 mi southwest of Elkins:** The ratio of scrapers to filterer-collectors is affecting the RBP score. The five dominant taxa, all from the EPT complex, comprise a large portion of the total macroinvertebrate fauna. Two of these five taxa are considered more pollution-tolerant. The RBP score is perhaps influenced by some differences in habitat, but impairment is still indicated.
- **Richland Creek at Highway 45:** This station displayed a good diversity (diversity index [DI]>3.0) and good taxa richness with 17 taxa present. The only impairment indicator was the scraper/filterer-collector ratio. This site's proximity to Beaver Lake is perhaps influencing the macroinvertebrate fauna.
- **White River, upstream end:** Instream gravel mining and the resulting channel alteration may be the causative agents of the impairment. The channel had been altered between the winter reconnaissance visit and the summer sampling event. The tracks from heavy equipment were still evident in the stream bed at the time of sampling.
- **White River, 2 mi northwest of Durham:** The macroinvertebrate community displayed a significant improvement over the upstream community. Two of the five dominant taxa were the tolerant forms of caddisflies, but the dominant taxon had shifted to mayfly. The taxa richness had increased, resulting in an increase in diversity.
- **White River, downstream of Crosses Creek:** The station exhibited a severe reduction in taxa richness and an associated reduction in diversity in 1993, as compared to 1963. The macroinvertebrate fauna was dominated by tolerant forms of caddisflies. No indication of the specific cause of impairment was found in examining the benthic community. The RBP score at the next downstream station showed good recovery. Therefore, the causative agent may be confined to the immediate vicinity.

TABLE B-11
**Summary of Benthic Macroinvertebrate Data Collected May 1, 1993**

| Metric | Middle Fork White River (MFW-03) | Richland Creek (RCH-03) | West Fork White River (WFW-03) | White River (WHR-01) | White River (WHR-03) | White River (WHR-02) |
|---|---|---|---|---|---|---|
| % EPT | 90 | 79.8 | 91 | 65 | 91.0 | 89.1 |
| % Ephemeroptera | 30 | 14.6 | 41 | 33 | 63.3 | 28.7 |
| % Plecoptera | 0 | 15.5 | 0 | 0 | 0.9 | 0 |
| % Trichoptera | 60 | 49.5 | 50 | 32 | 26.7 | 60.3 |
| % Diptera | 4 | 2.7 | 2 | 2 | 2.9 | 0 |
| % Chironomidae | 2 | 0 | 1 | 1 | 1.9 | 0 |
| % Filterer | 24 | 25.6 | 16 | 0 | 21.7 | 24.7 |
| % Scraper | 13 | 5.5 | 11 | 53 | 31.6 | 18.8 |
| % Collector | 56 | 36.6 | 68 | 44 | 39.6 | 46.5 |
| % Predator | 5 | 10.0 | 4 | 2 | 5.9 | 9.9 |
| % Shredder | 2 | 18.3 | 1 | 1 | 0.9 | 0 |
| No. Clinger Taxa | 6 | 6 | 5 | 5 | 6 | 4 |
| % Clinger | 76 | 59.6 | 64 | 86 | 63.3 | 89.1 |
| Total Taxa | 11 | 18 | 11 | 11 | 13 | 7 |
| No. EPT Taxa | 5 | 9 | 4 | 4 | 8 | 5 |
| No. Ephemeroptera Taxa | 3 | 4 | 2 | 3 | 4 | 3 |
| No. Plecoptera Taxa | 0 | 1 | 0 | 0 | 1 | 0 |
| No. Trichoptera Taxa | 2 | 4 | 2 | 1 | 3 | 2 |
| No. Diptera Taxa | 2 | 2 | 2 | 2 | 2 | 0 |
| No. Chironomidae Taxa | 1 | 0 | 1 | 1 | 1 | 0 |
| No. Coleoptera Taxa | 2 | 3 | 1 | 3 | 1 | 0 |
| No. Intolerant Taxa | 2 | 5 | 2 | 2 | 3 | 2 |
| % Tolerant | 6 | 1.8 | 0 | 3 | 2.9 | 0.9 |
| % Dominant | 36 | 23.8 | 36 | 32 | 31.6 | 35.6 |
| Hilsenhoff Biotic Index | 4.6 | 4.4 | 4.2 | 4.1 | 3.3 | 4.5 |
| **RBP Score [a]** | **52.94%** | **82.35%** | **47.06%** | **64.71%** | **82.35%** | **41.17%** |
| **Habitat Correlation** | **73.28%** | **83.15%** | **93.10%** | **91.17%** | **89.16%** | **91.56%** |
| **Qualitative Category** | **Moderately Impaired** | **Not Significantly Impaired** | **Moderately Impaired** | **Slightly to Moderately Impaired** | **Not Significantly Impaired** | **Moderately Impaired** |

Source: ADEQ, 2011 and APCEC, 1995

[a] % of Reference based on the following metrics: 1) taxa richness, 2) HBI, 3) scraper/filterer-collector, 4) functional feeding group ratio, 5) EPT, and 6) community loss index; >83% = Not Significantly Impaired, 54 to 79% = Slightly Impaired, 21 to 50 percent = Moderately Impaired, <17% = Extremely Impaired, it is up to the investigator to decide the impairment for scores falling between categories; qualitative categories provided in APCEC, 1995

TABLE B-12
**Summary of Benthic Macroinvertebrate Metrics – May 1993**

| Metric | Middle Fork White River (MFW-03) | Richland Creek (RCH-03) | West Fork White River (WFW-03) | White River (WHR-01) | White River (WHR-03) | White River (WHR-02) |
|---|---|---|---|---|---|---|
| % EPT | 90% | 79.8% | 91% | 65% | 91.0% | 89.1% |
| No. EPT Taxa | 5 | 9 | 4 | 4 | 8 | 5 |
| % Dominant | 36% | 23.8% | 36% | 32% | 31.6% | 35.6% |
| HBI | 4.6 | 4.4 | 4.2 | 4.1 | 3.3 | 4.5 |
| Total Taxa | 11 | 18 | 11 | 11 | 13 | 7 |
| **Qualitative Category** | **Moderately Impaired** | **Not Significantly Impaired** | **Moderately Impaired** | **Slightly to Moderately Impaired** | **Not Significantly Impaired** | **Moderately Impaired** |

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# Appendix C
# Field Data Collection – Field Plan, Field Sheets, and Summary Tables

# Appendix C-1
# White River UAA Field Plan

# Field Sampling Plan

## C.1.0 Overview

The City of Fayetteville will conduct monitoring activities in accordance with this Field Sampling Plan (FSP) during the period May 2011 through April 2012. Physical, chemical, and biological data will be gathered from representative stream locations in the Noland Wastewater Treatment Plant (WWTP) study area. Results of the monitoring, in conjunction with analysis of readily available historical water quality data, including data collected by ADEQ, the U.S. Geological Survey (USGS), and the University of Arkansas, will be used to: (1) identify the primary factors causing stream impairment with respect to water quality standards and designated uses; and (2) evaluate natural levels of dissolved minerals in the study area.

The FSP includes methods for:

- Monthly water quality sampling at five instream sampling stations and the Noland WWTP outfall, including in situ measurements (dissolved oxygen [DO], conductivity, turbidity, pH, temperature) using a multi-parameter meter and grab samples for analysis of total dissolved solids (TDS), chloride, and sulfate.
- Fish community and physical habitat assessments at four sampling stations in late summer 2011;
- Benthic macroinvertebrate community and physical habitat assessments at four sampling stations in fall 2011 and early spring 2012;
- Calculation of stream flow during each water quality and biological monitoring event; and
- Two diurnal DO sampling events to coincide with two of the water quality sampling events.

When the activities outlined in the FSP are complete, the City will develop the UAA to determine the feasibility of meeting designated uses and water quality standards in the project area.

# C.2.0 Study Area Characterization

## C.2.1 Watershed

The Noland WWTP is authorized to discharge treated wastewater from its facility located at 1400 North Fox Hunter Road in Fayetteville, Washington County, Arkansas, to the White River at Outfall 001 (36°05'00"N, 94°05'00"W). The outfall is located in the Beaver Reservoir watershed (8-digit USGS Hydrologic Unit Code [HUC-8] 11010001) in the larger Upper White River watershed (HUC 110100). Outfall 001 is located in the headwaters of the White River, upstream of Beaver Reservoir. Downstream of Beaver Reservoir Dam, the White River flows northeasterly into Missouri; then back into Arkansas in a south-southeasterly direction, traveling through much of the eastern portion of the state (see Figure C.1). The White River is part of the Arkansas-White-Little Red River Basin, which flows to the Mississippi River in southeast Arkansas.

## C.2.2 Ecoregion

The Noland WWTP is located within the Ozark Highlands Ecoregion of Arkansas (APCEC, 2011). The ecoregion is characterized as mountainous, with steep gradients and fast-flowing streams, with fractured limestone and dolomite geological features. The Ozark Highlands have among the highest animal production rates in Arkansas, and impacts from increasing development have led to aquatic habitat destruction, surface erosion, and heavy siltation in streams.

**FIGURE C.1**
Location of Noland WWTP (adapted from ADEQ, 2008)
*Noland WWTP – Use Attainability Analysis Field Sampling Plan*

## C.2.3 Historical Data

In conjunction with data collected according to this FSP, historical data will be useful to assess attainment status in the study area. ADEQ has collected long-term water quality data since 1982 as part of its Ambient Water Quality Monitoring Network, which currently includes 150 locations. ADEQ collected quarterly water quality data at approximately 200 locations between 1996 and 1998 as part of its Roving Water Quality Monitoring Network. Parameters analyzed at both the Ambient and Roving Water Quality Stations include: temperature, pH, turbidity, DO, 5-day biochemical oxygen demand, total suspended solids (TSS), total dissolved solids (TDS), chloride, sulfate, ammonia, nitrate, nitrite, total phosphorous, ortho-phosphorous, total hardness, boron, beryllium, barium, cadmium, copper, calcium, lead, zinc, iron, potassium, magnesium, manganese, sodium, nickel, cobalt, vanadium, and selenium.

ADEQ monitoring locations applicable to the Noland WWTP UAA are summarized in Table C.1. USGS operates real-time stream gages in the Upper White River watershed and maintains public databases of current and historical data. These data will be used in the UAA process, and the sampling locations summarized in Table C.1 were considered when selecting sampling locations for this FSP.

**TABLE C.1**
Summary of Established Sampling Stations near Study Area
*Noland WWTP – Use Attainability Analysis Field Sampling Plan*

| Station ID | Location |
|---|---|
| **ADEQ Ambient WQ Monitoring Stations** | |
| WHI0103 | Middle Fork White River west of Elkins |
| WHI0116 | War Eagle Creek at Highway 45, north of Hindsville (collocated with USGS 7049000) |
| WHI0051 | West Fork White River near Fayetteville (collocated with USGS 7048550) |
| WHI0052 | White River near Goshen (collocated with USGS 7048700) |
| WHI0106 | White River near Durham |
| WHI0070 | Holman Creek below Huntsville |
| **ADEQ Roving WQ Monitoring Stations** | |
| WHI0112 | Brush Creek north of Highway 45 off Highway 303 (collocated with USGS 7048890) |
| WHI0102 | Middle Fork White River at County Road 32, 1 mile south of Sulphur City |
| WHI0105 | White River near Crosses |
| WHI0109 | Richland Creek, 1 mile north of Tuttle |
| WHI0113 | War Eagle Creek at county road bridge west of Highway 23 |
| WHI0114 | War Eagle Creek at Highway 412 |
| WHI0098 | West Fork White River at county road bridge below Dye Creek near West Fork (u/s end) |
| **USGS Streamflow Gages (Drainage Area)** | |
| 7048480 | Town Branch (Tributary to West Fork White River) at Martin Luther King, Jr. Blvd (0.86 $mi^2$) |
| 7048490 | Town Branch (Tributary to West Fork White River) at Hwy 16 (1.36 mi2) |
| 7048890 | Brush Creek near Mayfield at County Road 368 (20 $mi^2$) |
| 7048550 | West Fork White River at County Road 195 (123 $mi^2$) |
| 7048800 | Richland Creek at West Bowen Blvd (138 $mi^2$) |
| 7049000 | War Eagle Creek near Hindsville at Highway 45 (263 $mi^2$) |
| 7048600 | White River at Wyman Road (d/s Lake Sequoyah, u/s Noland WWTP) (400 $mi^2$) |
| 7048700 | White River near Goshen (just u/s of Richland Creek confluence) (412 $mi^2$) |

# C.3.0 Technical Approach

Field data collection will include water quality sampling, biological monitoring, and instream flow measurements in locations where USGS real-time gage data is not available. Water quality sampling will be used to gather in situ and chemical data from five stream locations and from the Noland WWTP effluent (Outfall 001). Biological monitoring will include benthic macroinvertebrate, fish community, and physical habitat assessments at four sampling stations. Stream discharge will be calculated or measured during each sampling event using USGS stream gage data and flow data from the Noland WWTP. The field monitoring data will be used to assess the existing chemical, physical, and biological conditions in the watershed and to evaluate factors affecting the designate use attainment of surface waters.

# C.3.1 Study Station Selection

Sampling station locations are shown in Figure C.2 and summarized in Table C.2. A total of three sampling stations were selected to be representative of areas downstream of the Noland WWTP discharge (WR-02, WR-03, and RC-01). Two stations were selected upstream of the Noland WWTP: one just downstream of Lake Sequoyah (WR-01) and the other in the West Fork tributary upstream of the West Fork WWTP (WF-01). Stations WR-01 and RC-01 was chosen as the preliminary reference reaches, located in the Ozark Highlands Ecoregion with similar characteristics to the four downstream sampling stations. The watershed area is approximately equal to that of the White River at the Noland WWTP discharge point. The suitability of the reference locations were field-verified during a site reconnaissance conducted on May 5, 2011.

Including Noland WWTP Outfall 001, a total of six locations will be sampled for water quality parameters. Four of these locations will be sampled for biological parameters (see Table C.2). Methods used to calculate stream discharge at each station, including instream flow measurements, USGS real-time gage data, and Noland WWTP effluent flow data, are summarized in Table C.2.

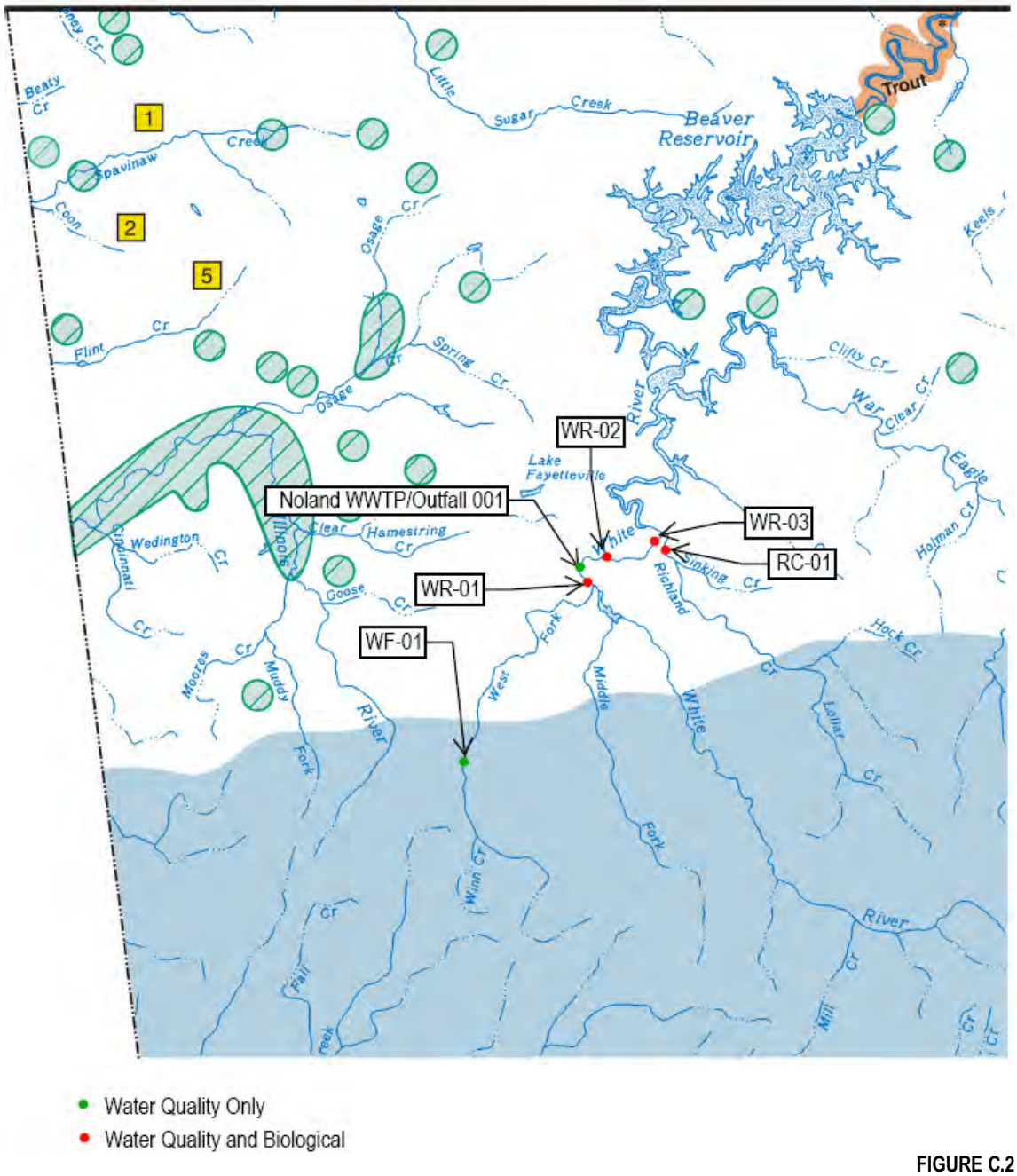


**FIGURE C.2**
Sampling Station Locations (adapted from APCEC, 2010)
*Noland WWTP – Use Attainability Analysis Field Sampling Plan*

**TABLE C.2**
Field Data Collection Station Locations and Type
*Noland WWTP – Use Attainability Analysis Field Sampling Plan*

| Station ID | Location | Drainage Area | Associated Established Station[b] | Method Used to Estimate Stream Discharge[c] | Water Quality | Fish, Benthic, Habitat |
|---|---|---|---|---|---|---|
| 001[a] | Noland WWTP Outfall | N/A | 001 | N/A | X | |
| WR-01 | White River at Wyman Rd. (u/s of Noland WWTP, d/s of Lake Sequoyah) | 400 $mi^2$ | USGS 7048600 | Real-time data from USGS 7048600 | X | X |
| WR-02 | White River d/s of Noland WWTP | 403 $mi^2$ | N/A | Real-time data from USGS 7048600 & Noland WWTP continuous effluent flow data | X | X |
| WR-03 | White River just u/s of confluence with Richland Creek, at State Hwy 45 | 412 $mi^2$ | ADEQ WHI0052/ USGS 7048700 | Real-time data from USGS 7048700 | X | X |
| WF-01 | West Fork u/s of West Fork WWTP, at Highway 170 in West Fork, AR | 62 $mi^2$ | N/A (1 mile upstream of ADEQ WHI0098) | Instream flow measurements during sampling events | X | |
| RC-01 | Richland Creek at State Hwy 45 | 138 $mi^2$ | USGS 7048800 | Real-time data from USGS 7048800 | X | X |

[a] Water quality monitoring at the Noland Outfall will be conducted by Noland staff.
[b] ADEQ stations are Ambient WQ Monitoring Stations.
[c] Methods to be used during water quality events; during biological monitoring events, instream flow measurements will be taken at biological monitoring stations.

## C.3.2 Water Quality Monitoring Methods

In situ and chemical parameters will be measured at five instream sampling stations and at the WWTP outfall (Table C.2) as part of the water quality monitoring effort. Water quality monitoring will consist of twelve monthly in situ and grab samples at five instream locations. During two of these events, diurnal DO assessments will be conducted at the sampling stations. Diurnal DO assessments will be conducted in summer and early fall 2011, during the water quality events that most closely coincide with the fish and benthic macroinvertebrate assessments. The DO assessments will involve deployment of an in situ water quality meter for approximately 48-hours, to assess changes in DO conditions over the normal daily cycle.

In situ measurements recorded during each event will include: dissolved oxygen (DO), temperature, pH, conductivity, and turbidity. Measurements will be taken at mid-stream and mid-depth at each station using a multi-parameter sonde. Field teams will follow the manufacturer's guidelines for proper calibration and instrument maintenance. In situ

measurements will be collected prior to all other sampling so as not to disturb sediments or cause potential interference with the measurements. The in situ sampling will consist of placing the sonde in 6 to 10 inches of flowing water while facing upstream and allowing the meter to equilibrate before collecting measurements. Calibration and quality control checks of the sonde will be conducted in the morning before each sampling event, and the results of the equipment calibration and quality control checks will be recorded on field sheets.

Grab samples will be collected in well-mixed stream flow, at approximately mid-stream and mid-depth, where feasible. Parameters to be analyzed are provided in Table C.3. Water quality data analysis will be conducted in an ADEQ-certified laboratory, using EPA-approved analysis methods (40 CFR Part 136). Quality assurance/quality control (QA/QC) processes for field activities and laboratory analysis are detailed in Section 3.2.2 below.

## C.3.2.1 Field Equipment

The following equipment will be used during water quality sampling events:

- Meter for in situ measurements
- Batteries
- Water sample bottles from the laboratory
- Cooler with ice

The list will be expanded to include bottle type and preservative for each parameter to be sampled after consultation with the laboratory. Equipment will be gathered, checked, and loaded into the vehicles the day before each event.

## C.3.2.2 Quality Assurance/Quality Control

QA/QC is designed to assure the reliability and quality of the analysis and data and to identify any contamination that may result from lab methods, equipment, or sample collection. Sample collection, preservation, handling and storage, and analytical procedures will be conducted in accordance with standard methods and practices. Three types of QA/QC will be performed as part of the water quality monitoring. Type 1 includes regular checks of water quality meters and proper documentation of sampling activities and field conditions by the field team members. Type 2 consists of sampling procedures intended to identify the type and estimate the level of contamination. Type 3 provides confirmation of the analytical procedures conducted by the laboratories. In combination, these types of QA/QC provide the equivalent of a modified Level 3 EPA data quality objective.

### C.3.2.2.1 Type 1: Field Surveys

Type 1 QA/QC encompasses field monitoring activities and calibration of field equipment. Field personnel for this project will be experienced in the calibration and operation of each piece of field equipment used on the project. Field instruments will be calibrated according to manufacturers' specifications, and these procedures will be documented in a field notebook or on specially prepared field sheets. Type 1 activities include documenting other pertinent data concerning the sampling events such as weather conditions and time of sampling. Type 1 documentation can be summarized as follows:

- Instrument identification
- Calibration information (standards used and results)
- Date and time of calibrations and measurement

#### C.3.2.2.2 Type 2: Field Sampling

Two personnel with experience or special training in water quality sampling techniques will conduct field sampling. Type 2 QA/QC activities include sample procedures designed to detect contamination from sampling equipment resulting from improper sample collection. Type 2 activities also include collection of QA/QC duplicate samples, use of trip blanks, preparation of equipment blanks (only if decontamination of equipment is performed), and proper labeling of all samples. The Type 2 QA/QC requirements for this project are detailed below.

**Trip Blanks.** Trip blanks are sample containers that are taken, as received, into the field and returned without being used. These are used to evaluate any contamination that may have taken place before the containers were received by the sampling team. One trip blank will be used during each sampling event.

**Field Duplicates.** Field duplicate samples are collected to measure the precision of the sampling process. The field team leader will choose one station per trip to collect duplicate samples for each water quality parameter.

#### 3.2.2.3 Type 3: Laboratory Analysis

Water quality data analysis will be conducted in an ADEQ-certified laboratory, using EPA-approved analysis methods (40 CFR Part 136). The methods and detection limits that will be used for each parameter to ensure proper QA/QC are listed in Table C.3.

**TABLE C.3**
Parameters, Reporting Limits, and Methods

| Parameter | Method | Reporting Limit | Units |
|---|---|---|---|
| Chloride | EPA 300.0 | 0.02 | mg/L |
| Sulfate | EPA 300.0 | 0.2 | mg/L |
| Total Dissolved Solids | SM2540C | 10.0 | mg/L |

SM = Standard Method, EPA = Environmental Protection Agency, mg/L=milligrams per liter

## C.3.3 Biological Monitoring Methods

Biological monitoring will be conducted at four sampling stations (Table C.2), using the methods outlined in EPA's *Rapid Bioassessment Protocols (RBPs) for Use in Wadeable Streams and Rivers: Periphyton, Benthic Macroinvertebrates, and Fish* (Barbour et al. 1999). These methods have been used by ADEQ for collecting biological monitoring data throughout the state since the 1970s. Biological monitoring methods, summarized in this section, will include assessments of: (1) physical habitat and surface water quality physical characterization, (2) benthic macroinvertebrate communities, and (3) fish communities. Fish sampling will be conducted late summer 2011, and benthic macroinvertebrate sampling will

be conducted in early fall 2011 and early spring 2012. Physical habitat and characterization assessments will be conducted during the fish community assessment and the two benthic macroinvertebrate assessments.

## C.3.3.1 Physical Habitat and Physical Characterization Assessments

Physical habitat assessments and surface water quality physical characterizations will be conducted on three occasions at four sampling stations (Table C.2) following procedures outlined in EPA's *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish* (Barbour et al. 1999). The protocol is consistent with this most current EPA-approved assessment method, which was developed as an update to the previous RBPs (Plafkin et al. 1989).

In accordance with Barbour et al. (1999), a surface water quality physical characterization is required whenever a physical habitat assessment is performed. The assessment is completed to assess the stream's ability to support biotic communities and to identify any chemical or non-chemical stressors to the stream. Observations noted during the physical characterization are useful for interpretation of water quality and biological monitoring results.

### C.3.3.1.1 Field Methods and Data Analysis

The physical habitat and surface water quality physical characterization assessments will be conducted by at least two qualified team members who have been trained in accordance with Barbour et al. (1999). The field team will walk approximately 100 meters of stream to evaluate the physical habitat and watershed conditions at each station. The area used for the assessments will include the reach to be sampled for benthic macroinvertebrates and fish.

The physical assessment involves rating field parameters that represent an overall evaluation of the stream habitat based on substrates, habitat diversity and availability, riparian corridors and streambank conditions (Table C.4). Using the high gradient Habitat Assessment Field Data Sheet, each parameter will be given a score from 0 to 20, where scores from 0 to 5 are considered "Poor," 6 to 10 are "Marginal," 11 to 15 are "Suboptimal," and 16 to 20 are "Optimal." A more-detailed description of the scoring criteria is provided on the Habitat Assessment Field Data Sheet. For QA/QC purposes, at least two trained field personnel will individually evaluate the physical habitat parameters, and the results will be averaged. A total habitat score will be calculated by summing the average scores of each parameter, with the highest possible total score being 200 points.

**TABLE C.4**
Habitat Assessment Parameters for High-Gradient Streams

| Parameter | Parameter Description |
|---|---|
| Instream Cover | Measures the availability of habitats, such as substrates, logs, and undercut banks, that are available as refugia, feeding, or sites for spawning and nursery functions for aquatic organisms. |
| Epifaunal Surface | Measures the substrate available in riffle/run complexes and rates the length and width of riffles. |
| Embeddedness | Measures the degree to which cobble, boulders, and other rock substrate are |

**TABLE C.4**
Habitat Assessment Parameters for High-Gradient Streams

| Parameter | Parameter Description |
|---|---|
| | surrounded by fine sediment. |
| Velocity/Depth Regimes | Measures a stream's characteristic velocity/depth regime. |
| Man-made Channel Alteration | Measures large-scale alteration of instream habitat that affects stream sinuosity and causes scouring. |
| Sediment Deposition | Relates to the amount of sediment that has accumulated and the changes that have occurred to the stream bottom as a result of deposition. |
| Frequency of Riffles | Estimates the frequency or occurrence of riffles as a measure of sinuosity. |
| Channel Flow Status | This is the degree to which the channel is filled with water during base or average annual flow periods. |
| Condition of Banks | Measures the existence of, or the potential for, detachment of soil from the upper and lower stream banks and its movement into the stream. |
| Bank Vegetative Protection | Measures the amount of the stream bank that is covered by vegetation. |
| Riparian Vegetative Zone | Measures the width of natural vegetation from the edge of the upper streambank out through the floodplain. |

For wadeable streams, the surface water quality physical characterization includes completion of two field sheets: (1) the Physical Characterization Field Data Sheet, including an assessment of riparian land use, aquatic vegetation, nonpoint source pollution, water quality indicators, substrate odors and deposits, flow conditions, and stream substrate and (2) the Water Quality Field Data Sheet, involving field parameter measurements. As mentioned in Section 3.2, in situ measurements of DO, temperature, pH, turbidity, and conductivity will be made each event, to document any adverse water chemistry parameters that might affect the aquatic communities.

## C.3.3.2 Benthic Macroinvertebrate Sampling

Benthic macroinvertebrates will be sampled following the multi-habitat approach provided in EPA's RBPs (Barbour et al. 1999), which involves obtaining samples collected from the various habitats for analysis and data evaluation. The multi-habitat approach maximizes the efficiency of field work and provides the broad-based information necessary to make the best assessment of biotic integrity as it relates to stream conditions.

### C.3.3.2.1 Field Methods

In accordance with Barbour et al. (1999) and ADEQ guidelines, benthic macroinvertebrate samples will be collected in early fall 2011 and early spring 2012. A representative sampling reach, approximately 4 stream widths in length will be chosen for biological sample collection at each of the four sampling stations (Table C.2). Sampling will be conducted downstream to upstream, using a D-frame 500-micron net, a 500-micron kick net, #30 sieve bucket, and forceps. Sampling will include a total of 20 samples from various habitat types

(see Table C.5). The distribution of the actual sampling effort among habitat types might differ from that given in Table C.5 due to field conditions or habitat availability. In any case, the habitats and numbers of samples collected from each will be documented. For QA/QC purposes, a duplicate sample will be collected at one of the sampling locations. The duplicate sample should be collected in a reach as similar to the primary reach as possible and may be located either upstream of the reach, within the reach (if there is ample habitat), or on the opposite bank within the reach (if the stream is wide). The sampling methods for each habitat type are detailed below.

**TABLE C.5**
Number and Type of Benthic Macroinvertebrate Samples

| Habitat Type | Number of Samples |
|---|---|
| Fast Riffle | 1 |
| Slow Riffle | 1 |
| Coarse Particulate Organic Matter | 3 |
| Rock/Log | 6 |
| Root/Bank | 3 |
| Macrophyte Bed | 3 |
| Sand/Bottom | 3 |
| **Total** | **20** |

**Riffle** samples will be collected from one fast riffle and one slow riffle, using a kick net positioned upright and on the stream bed. For each sample, a field team member will disturb approximately 1 square meter of riffle substrate, and the two samples will be elutriated and composited in a #30 sieve bucket. This technique is intended primarily to collect species that require highly oxygenated waters such as those in the Ephemeroptera, Plecoptera, and Trichoptera (EPT) orders.

**Coarse Particulate Organic Matter (CPOM)** samples will be collected from three locations and will include leaf packs that are at least 50 percent decomposed. The three samples will be composited in a #30 sieve bucket and should fill approximately half of the bucket. CPOM samples are used primarily to collect shredder species that prefer decomposed materials that can be easily shredded for a food source.

**Rock/Log** samples include the collection of organisms found on submerged logs and rocks by brushing the surfaces of the habitat to dislodge attached fauna, while holding a sieve bucket or A-frame net downstream of the habitat. The nets and buckets will be rinsed and then visually inspected, and the organisms will be removed with forceps. This technique is used for collecting small organisms from species in the family Chironomidae, Baetidae, Hydroptilidae as well as Oligochaetes and other scrapers/grazers.

**Roots/Banks** that are partially submerged and/or undercut will be sampled by dragging the A-frame net in an upstream direction, across 1 meter of habitat. The samples will be rinsed and then visually inspected, and the organisms will be removed with forceps. These

samples are particularly important for collection of species that prefer low-current environments.

**Macrophyte Beds** are often present along the streambank and in channel beds. Samples will be collected by dragging the A-frame net in an upstream direction, across 1 meter, through the vegetation. The samples will be rinsed and then visually inspected, and the organisms will be removed with forceps.

**Sand/Bottom Substrate** samples will be collected by bumping the A-frame net along sand substrate (instead of dragging the net, to minimize the amount of debris in the sample). The net should be placed approximately 2 to 3 centimeters below the surface of the sand. This technique is especially useful for collecting small organisms, such as species in the family Chironomidae that inhabit sandy substrates.

The samples collected from each habitat type at a station will be composited, bagged, preserved with 100 percent denatured ethanol, and labeled with the following information: date, location, field team, and sampling method (multi-habitat approach). The samples will then be packaged appropriately and shipped to a laboratory certified to conduct macroinvertebrate identification. Samples collected from separate habitat types will be composited for analysis.

#### C.3.3.2.2 Laboratory and Data Analysis

Macroinvertebrates will be identified to lowest practical taxonomic level and enumerated to conduct macroinvertebrate assessments. Comparison of the duplicate sample scores should result in a method precision of at least 95 percent. If the method precision is less than 85 percent, the cause of the discrepancy should be evaluated.

Data analysis includes an evaluation various metrics that represent different components of community structure and/or function and, cumulatively, provide a measure of biotic integrity (see Table C.6). Representative metrics include those in four primary categories: (1) richness measures for diversity or variety of the assemblage; (2) composition measures for identity and dominance; (3) tolerance measures that represent sensitivity to perturbation; and (4) trophic or habit measures for information on feeding strategies and guilds.

**TABLE C.6**
Benthic Macroinvertebrate Metrics

| Metric Category | Metrics |
|---|---|
| Richness | Taxa Richness<br>Ephemeroptera, Plecoptera, and Trichoptera (EPT) Taxa<br>No. Ephemeroptera Taxa<br>No. Plecoptera Taxa<br>No. Trichoptera Taxa |
| Composition | Percent EPT Individuals<br>Percent Ephemeroptera Individuals<br>Percent Chironomidae Individuals |

**TABLE C.6**
Benthic Macroinvertebrate Metrics

| Metric Category | Metrics |
|---|---|
| Tolerance | No. Intolerant Taxa<br>Percent of Tolerant Organisms<br>Hilsenoff Biotic Index<br>Percent Dominant Taxon |
| Trophic/Habit | Number Clinger Taxa<br>Percent Clingers<br>Percent Filters<br>Percent Scrapers |

Source: Barbour et al. 1999

## C.3.3.3 Fish Sampling

Fish sampling will be conducted in accordance with EPA RBPs (Plafkin et al. 1989; Barbour et al. 2000), which involves using standard field techniques, species identification, enumeration, specimen external examination, and assignment of ratings to a variety of fish community attributes (metrics), which are summed to obtain an overall measure of biotic integrity. The Index of Biotic Integrity or IBI (Karr et al. 1986) will be used to evaluate the health of the fish communities at four representative sampling stations. Additionally, fish community data will be evaluated based on protocols matching Arkansas Pollution Control and Ecology Commission (APCEC) Regulation No. 2. Field and data analysis methods are discussed in the following paragraphs.

### C.3.3.3.1 Field Methods

Fish will be sampled during summer 2001, when streams are wadeable and fish populations are static and stable. A backpack Electroshocker will be used to sample all accessible habitats including riffles, runs, pools, and undercut banks. The upstream and downstream ends of the sampling reach will be blocked with nets to prevent fish from escaping out of the sampling reach. Fish sampling will progress upstream, so as not to disturb sediments and decrease visibility, and team members will be careful not to walk through the sampling area prior to sampling. A trained biologist will operate the shocker and will be assisted by other team members who will help capture stunned fish. Captured fish will be placed in buckets upon capture and moved to aerated holding buckets as soon a practical after capture. The sampling reach will be approximately 40 times the mean wetted width of the stream, and a total of two sampling passes will be made through each sampling reach. At the end of each sampling pass, the number of fish caught and the time of electroshocker use ("pedal down" time) will be recorded.

Fish will be identified and enumerated in the field to the greatest extent practical. A subset of up to 25 fish of each species will be measured to the nearest millimeter and weighed to the nearest 0.1 gram. Fish selected for length-weight measurements should be selected to include a wide range of sizes. Data sheets that include size, weight, and external anomalies of the species collected will be completed at each biological monitoring station, along with detailed notes on habitat and surrounding watershed conditions. Voucher specimens of each species collected, including all fish that cannot be readily identified in the field, will be

preserved in 10 percent formalin for laboratory confirmation of species identification. Although sampling personnel will make every effort to return as many live fish to the stream as possible, a certain level of mortality is inevitable, especially during hot weather.

### C.3.3.3.2 Data Analysis

The Index of Biotic Integrity or IBI (Karr et al. 1986) will be used to evaluate the health of the fish communities at four sampling stations. The IBI, which is used as the model for EPA's RBP (Barbour et al. 1999; Plafkin et al. 1989), integrates a broad range of fish community attributes into an assessment of stream biotic integrity. The methodology involves species identification, enumeration, and external examination of the collected fish; and assignment of ratings to a variety of fish community attributes (metrics), which are summed to obtain an overall measure of biotic integrity. IBI scores will be calculated based on rating 13 metrics of fish community structure in five broad categories: species richness, species composition, trophic function, species abundance, and physical condition. The IBI assumes that each metric correlates either positively or negatively with increased stream degradation. The 13 metrics were modified from Karr et al (1986) and integrate attributes of the entire fish community that are differentially sensitive to various levels of stream perturbation. The final IBI scores will be used to determine the overall qualitative conditions of the fish communities, ranging from "Excellent" to "Very Poor." The 13 metrics rated in this assessment and their descriptions/rationale are listed in Table C.7.

**TABLE C.7**
IBI Metrics Used to Evaluate Fish Communities

| Metric | Description/Rationale |
|---|---|
| **Species Richness and Composition** | |
| 1. Number of native species | This number decreases with increasing environmental degradation, and is considered to be one of the most powerful IBI metrics. Hybrid and introduced fishes are not included. |
| 2. Number of benthic invertivore species | This metric is a count of all species of darters, sculpins, and madtoms. These species typically feed and reproduce in benthic habitats, and are sensitive to degradation from channelization, siltation, and DO reduction. Species number decreases with increasing degradation. |
| 3a. Number of native sunfish species | These pool-dwelling species decrease in number with increasing siltation and degradation of pool habitats and instream cover. This metric is an effective measure of losses of instream cover and pool habitat and of decreases in the terrestrial food supply due to disruption of the riparian zone (Ohio EPA, 1987). This metric is used for watersheds less than 15 square miles. |
| 3b. Number of native centrarchid species | Similar to the native sunfish species metric, except this metric is used for watersheds greater than 15 square miles. |
| 4. Number of native insectivorous cyprinid species | Minnow species typically comprise a large proportion of the fish community and decrease in number with increasing physical and chemical habitat degradation. Introduced minnow species are not included because they often occur in degraded habitat conditions. |

**TABLE C.7**
IBI Metrics Used to Evaluate Fish Communities

| Metric | Description/Rationale |
|---|---|
| 5. Number of native round-bodied sucker species | Suckers are known to be sensitive to habitat modification, sedimentation, and changes in water quality. In addition, the relatively long life span of most sucker species provides a long-term assessment of past and present environmental conditions. |
| 6a. Number of sensitive species | Intolerant or sensitive species include those that are highly or moderately intolerant of water quality and habitat degradation. They are among the first to disappear following a disturbance. This metric is used for watersheds less than 15 square miles. |
| 6b. Number of intolerant species | Similar to the number of sensitive species metric, except this metric is used for watersheds greater than 15 square miles. |
| **Trophic Composition** | |
| 7. Evenness | Evenness measures the equity of the proportion of each species in the sample. The greater the equity between species, the more diverse and healthy the fish community should be. This metric is measured by comparing the observed diversity in a sample to a theoretical maximum diversity. |
| 8. Percentage of individuals as Lepomis species | Given the tolerant nature of fish in this genus, an overabundance of these species can be indicative of water quality degradation. |
| 9. Percentage of individuals as insectivorous cyprinids | The relative abundance of these species decreases with degradation, in response to reductions in the invertebrate food supply. |
| 10a. Percentage of individuals as generalist feeders and herbivores | Generalists are opportunistic feeders, consuming significant quantities of both plant and animal materials. Generalists often become abundant in small, highly degraded streams, as specific components of the food base become less reliable. Herbivores consume plant materials (specifically algae), which may become abundant as stream canopy decreases. A dominance of these two trophic guilds in a community could indicate a degraded system |
| 10b. Percentage of individuals as top carnivores | These species (e.g., bass, pickerel) feed as adults primarily on fish, other vertebrates, or crayfish, and indicate a trophically diverse community. Their proportion decreases with increasing degradation. |
| 11. Percentage of individuals as benthic fluvial specialists | The species classified as benthic fluvial specialists (darters, madtoms, sculpins, suckers, and some cyprinids) are insectivorous species that forage and reproduce on the stream bottom. A significant loss of these species could be indicative of increased sedimentation and degradation of the benthic habitat. |
| **Fish Abundance and Condition** | |
| 12. Number of individuals per 200 meters | This metric standardizes comparison of fish abundance. Sites with greater disturbance generally support fewer fish. Highly tolerant and exotic species are excluded because these species may actually increase in abundance under certain disturbance conditions, such as stream channelization (Ohio EPA, 1987). |
| 13. Percentage of individuals with external anomalies | Sites with severe environmental degradation often yield a high number of fish in poor health, as manifested by heavy parasitism, damaged fins, lesions, or other external physical deformities. |

Sources: Karr et al., 1986; Plafkin et al., 1989

Additionally, fish community data will be evaluated based on protocols matching the APCEC Regulation No. 2, *Regulation Establishing Water Quality Standards for Surface Waters of the State of Arkansas* (see Table C.8). The analysis method is based on percent community composition of the parameters listed in Table C.8. A list of the key species and primary feeders, and the methodology for calculating the diversity index will be acquired from ADEQ to complete this analysis.

The cumulative score of the metric categories will provide a rating based on the following ranges:

- 37 to 45 = mostly similar
- 25 to 36 = generally similar
- 13 to 24 = somewhat similar
- 0 to 12 = not similar

**TABLE C.8**
APCEC Metrics Used to Evaluate Fish Communities

| | Scoring Criteria[a] | | |
|---|---|---|---|
| **Metric** | **5** | **3** | **1** |
| % Sensitive Individuals | >31 | 31 - 20 | <20 |
| % Cyprinidae (Minnows) | 48 to 64 | 39 to 47 or 65 to 73 | < 39 or > 73 |
| % Ictaluridae (Catfishes) | >2[b] | 1 to 2[b] | <1 or >3% bullheads |
| % Centrarchidae (Sunfishes) | 4 - 15[c] | <4 or 15 - 20[c] | >20 or >2% of green sunfish |
| % Percidae (Darters) | >11 | 5 to 11 | <5 |
| % Primary Feeders | <42 | 42 to 49 | >49 |
| % "Key" Individuals | >23 | 23 to 16 | <16 |
| Diversity | >2.77 | 2.77 to 2.37 | <2.37 |
| # Species | > (drainage area × 0.034) + 16.45 | (drainage area × 0.034) + 16.45 to (drainage area × 0.034) + 12.26 | < (drainage area × 0.034) +12.26 |

[a] if a raw metric score is zero, score as zero, except for Primary Feeders
[b] no more than 3 percent bullheads
[c] no more than 2 percent green sunfish

## C.3.3.4 Sampling Equipment

A list of sampling equipment required for the biological sampling is provided in Table C.9.

**TABLE C.9**
Biological Sampling Equipment

| Sampling Equipment | Quantity |
|---|---|
| **Fish Sampling** | |
| Backpack electroshocker | 1 |

**TABLE C.9**
Biological Sampling Equipment

| Sampling Equipment | Quantity |
|---|---|
| Shocker wand | 1 |
| Shocker tail | 1 |
| Extra battery for shocker | 1 |
| Empty cooler | 1 |
| Aquarium bubblers | 2 |
| Rubber gloves | 2 pair |
| Fish collection nets (dip nets) | 2 |
| Seine net (10X6 ft) | 1 |
| 5-gallon bucket | 2 |
| 1-gallon plastic jar | 1/station |
| Formalin | 1 liter |
| Data sheets | 1/station |
| Pliers | 1 |
| Plastic ruler | 2 |
| **Benthic Macroinvertebrate Sampling** | |
| A-frame nets | 2 |
| Kick net | 1 |
| #30 Sieve bucket | 2 |
| Sorting pans and plastic trays | 4 |
| Denatured Ethanol | 3 |
| Scrub brush | 2 |
| Tweezers | 4 |
| Winterized gloves | 2 |
| Empty coolers | 6 |
| Habitat assessment data sheets | 2 |
| Squirt bottles | 2 |
| **General Equipment** | |
| Collection permit | 1 |
| Ice | |
| Chain-of-Custody Forms | 6 |
| FedEx shipping forms | 3 |
| Custody seals | 6 |

**TABLE C.9**
Biological Sampling Equipment

| Sampling Equipment | Quantity |
|---|---|
| Camera | 1 |
| Memory card | 1 |
| Packing tape (rolls) | 2 |
| Analyte-free water (1-gal containers) | 2 |
| Ziploc freezer bags (1-gal, 20 per box) | 2 |
| Ziploc freezer bags (2-gal, 20 per box) | 2 |
| Paper towels (rolls) | 2 |
| Latex gloves (box) | 1 |
| Phone list | 1 |
| Sampling plans | 1 |
| Field Safety Instruction | 1 |
| Vermiculite | 2 bags |
| **In situ Water Quality Monitoring** | |
| Meter for in situ measurements | 1 |
| **Personal Equipment** | |
| Rain Gear | |
| Hat | |
| Gloves | |
| Rubber boots | |
| Sunscreen | |
| Pens (waterproof ink)/pencils | |
| Field sheets | |
| Compass/Global Positioning System (GPS) unit | |
| Field notebook | |
| Thermos | |
| Waders, hip boots | |
| Potable water | |

# C.3.4 Flow Measurements

Because there are numerous USGS gages in the study area, they will provide the majority of stream flow data for the study. Flow data from the existing Parshall flume at Outfall 001 will

be used for the WWTP effluent. A list of sampling stations and corresponding USGS gages are outlined in Table C.2. A summary of the flow measurement methods is as follows:

- During the three biological monitoring events (one fish assessment and two benthic macroinvertebrate assessments), flow will be measured at each biological sampling station using a flow meter which conforms to USGS/ International Organization for Standardization (USGS/ISO) methods.
- During the 12 monthly water quality events:
  - For Stations WR-01, WR-03, and RC-01 flow will be determined based on data from collocated USGS gages (WR-01/USGS 07048600, WR-03/USGS 07048700, and RC-01/USGS 07048800).
  - For Station WR-02 (downstream of Noland WWTP), flow will be determined based on flow at Station WR-01 (see above) and Noland WWTP effluent flow data measured in an existing Parshall flume equipped with a continuous recorder. The difference in drainage areas between WR-02 and the nearby USGS gage is only 3 square miles.
  - For Station WF-01 (West Fork White River at Highway 170 in West Fork, Arkansas), flow will be measured using a current meter. Either a portable acoustic doppler current meter or Marsh McBirney electromagnetic current meter will be used. Because there is also a USGS real-time stream flow gage (7048550) on the West Fork White River, measured flows will be compared to the USGS gage data to see if a strong correlation between the flows at the two different locations can be established after at least four sampling events. If a strong correlation is obtained, flows from the USGS gage can be used to estimate flow at WF-01 based on a standard drainage area ratio method.

Equipment necessary for flow measurements includes a flow meter, wading rod, tape measure, and field sheets. The manufacturer's instruction manual for the flow meter will be followed, and proper maintenance and diagnostics, according to manufacturer specifications, will be conducted and documented on a regular basis. During biological monitoring, velocity and depth measurements will be taken carefully, so the habitat is disturbed as little as possible. During water quality monitoring, flow should be measured after the chemical data samples have been collected.

## C.3.5 Chain-of-Custody and Shipping

Any sampling and analytical program must follow a system for sample control from collection to data reporting. This includes the ability to trace the possession and handling of samples from the time of collection through analysis and final disposition. The documentation of the sample history is referred to as "chain-of-custody." A sample is considered to be in a person's custody if it is: (1) in the person's physical possession, (2) in view of the person after he/she has taken possession, (3) secured by that person so that no one can tamper with the sample, or (4) in a designated secure area. The following section details the chain-of-custody system which will be followed as part of the watershed monitoring activities.

### C.3.5.1 Chain-of-Custody Record

To establish the documentation necessary to trace sample possession from the time of collection, a chain-of-custody (COC) record, which can be obtained from the laboratory, will be completed for every sample event. In order to maintain the COC record, every person who has custody of the sample at any time will sign, date, and note the time on the COC record. Samples will not be left unattended unless placed in a secured and sealed container with the COC record inside the container.

The COC record will include special instructions for the laboratory to follow, such as composite preparation or clean metal analysis, which will be consistent with the contract. If discrepancies are identified, the field team leader will inform the Project Manager before the samples are analyzed. The following special instructions will be included on the COC forms:

- **Benthic Macroinvertebrates—**Identify samples to the lowest taxonomic level practicable and complete the assessment for the metrics listed in the contract.
- **Water Quality—**Analyze samples for the parameters listed in the contract (these parameters will also be listed on the COC form).

### C.3.5.2 Biological Sample Labeling and Shipment

Benthic macroinvertebrate samples will be placed in a Ziploc bag and preserved with 10 percent formalin after collection at each station. For each benthic macroinvertebrate sample, the following information will be marked on the outside of the bag:

- Field Team Leader Name
- City of Fayetteville
- Date
- Station Number
- Station Identifier

In addition, a labeled tag will be inserted into the benthic macroinvertebrate sample with the same information. Water-proof paper will be used to prepare the tag, and the labels on both bags and tags will be marked with indelible ink. After the samples have been labeled and preserved, they will be double-bagged with a one-gallon Ziploc bag and then a 2-gallon Ziploc bag; the outer bag will then be duct-taped shut.

Benthic macroinvertebrate samples will be stored in coolers and remain in the custody of the field team leader until the cooler is full or ready for shipment. Coolers prepared for shipping will be packed to minimize movement of samples and will include vermiculite in case of any leakage. Each shipping container will contain a COC form with the analytical directions for the laboratory. Benthic macroinvertebrate samples will be shipped to the laboratory within five days of collection.

### C.3.5.3 Water Quality Sample Labeling and Shipment

For each water quality sample, the following information will be clearly marked and labeled on the sample container:

- City of Fayetteville – Noland WWTP

- Sample or Station Number
- Location
- Analyses
- Preservative
- Date and Time
- Sampled by

During sampling, filled and labeled containers will be stored in coolers on ice to maintain a temperature of less than or equal to six degrees Celsius. The coolers will remain in the custody of the field team leader until the end of the sampling event, and the samples will be shipped, transported, or delivered to a laboratory courier in a cooler, on ice. If used, glass containers will be wrapped in bubble-wrap to prevent breakage.

Coolers prepared for shipping will be lined with a cooler liner and packed with ice in double-wrapped Ziploc bags so that movement of samples will be minimized. A COC form will be included in each shipment container describing: the type of sample, number of containers, type and kind of analysis, QA/QC instructions and samples, and special processing and handling procedures. It is imperative that the samples taken to fulfill the QA/QC requirements to be completed by the lab are included on the COC. The field team leader will keep the copy of the COC form.

### C.3.5.4 Custody Seals

Custody seals are used to detect tampering with samples following collection, up to the time of analysis. When samples are packed for shipping, custody seals will be placed across the latch and across the lid opening of the coolers to confirm that they arrive at the laboratory unopened. The custody seal placed across the lid opening will be secured with strapping tape. The tape will be placed over the custody seal and wrapped completely around the cooler so that it remains closed during shipping.

# C.4.0 Project Schedule

The field sampling activities will be conducted during the period May 2011 through April 2012. The schedule for each field sampling component is outlined in Table C.10 and will also be dependent on weather and flow conditions. The detailed sampling schedule and sequence of sampling will be evaluated on a daily basis at the discretion of the field team leader. Scheduling decisions will take into account recent rain events as they affect turbidity, water levels, and field team safety. When the activities outlined in the FSP are complete, the City of Fayetteville will develop the UAA in conjunction with permit renewal requirements to determine the feasibility of meeting designated uses based on existing water quality standards in the project area.

**TABLE C.10**
Project Schedule Summary[a]

| Monitoring Component | Frequency | Time Period |
|---|---|---|
| Water Quality Monitoring | 12 events, monthly | May 2011 – April 2012 |
| Diurnal DO monitoring | 2 events, concurrent with 2 water quality monitoring events | Summer 2011 (water quality event closest to fish sampling) & early fall 2011 (water quality event closest to benthic macroinvertebrate sampling) |
| Fish Sampling | 1 event, during base flows with limited turbidity | Summer 2011 |
| Benthic Macroinvertebrate Sampling | 2 events, during base flows with limited turbidity | Early Fall 2011, Early Spring 2012 |
| Physical Habitat Assessments | 3 events, during fish and benthic macroinvertebrate community assessments | Summer 2011, Early Fall 2011, Early Spring 2012 |

[a] Weather-dependent

# C.5.0 Works Cited

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# Appendix C-2
# Monthly Water Quality Monitoring – Summary Tables, Field Sheets, and Laboratory Reports

TABLE C-1

**Average In Situ Measurements during Monthly Monitoring (June 2011-May 2012)**

| Station ID | Location | No. Samples | pH (SU) | Temperature (˚C) | Conductivity (µS/cm) | DO (mg/L) | Turbidity (NTU) |
|---|---|---|---|---|---|---|---|
| RC-02[a] | Richland Creek at County Road 79 | 8 | 7.64 | 14.3 | 169 | 9.05 | 2.40 |
| RC-01 | Richland Creek at State Hwy 45 | 12 | 8.06 | 19.3 | 186 | 8.76 | 4.16 |
| WF-01 | West Fork White River u/s of West Fork WWTP, at Highway 170 | 12 | 7.51 | 17.6 | 161 | 8.72 | 1.67 |
| WF-02 | West Fork White River at Mally Wagon Road | 12 | 7.65 | 18.0 | 244 | 7.74 | 7.63 |
| WR-01 | White River at Wyman Rd. (u/s of Noland WWTP, d/s of Lake Sequoyah) | 12 | 7.71 | 18.5 | 161 | 8.19 | 9.58 |
| 001 | Noland WWTP Outfall | 12 | 7.40 | 20.2 | 577 | 8.88 | 1.83 |
| WR-02 | White River, 0.4 mi d/s of Noland WWTP | 12 | 7.53 | 18.4 | 260 | 8.54 | 9.49 |
| WR-02.5[b] | White River, 2.7 mi d/s of Noland WWTP | 9 | 7.90 | 15.4 | 218 | 9.70 | 12.85 |
| WR-03 | White River just u/s of confluence with Richland Creek, at State Hwy 45; 5.5 mi d/s of Noland WWTP | 12 | 7.92 | 19.0 | 217 | 8.73 | 10.76 |

[a] Samples collected October 2011 – May 2011

[b] Samples collected September 2011 – May 2011

TABLE C-2

**Summary Statistics of Chloride Concentrations**

| Station ID | Location | No. Samples | Minimum $Cl^-$ (mg/L) | Average $Cl^-$ (mg/L) | Maximum $Cl^-$ (mg/L) | Standard Deviation (mg/L) |
|---|---|---|---|---|---|---|
| RC-02 | Richland Creek at County Road 79 | 8 | 3.1 | 4.1 | 5.1 | 0.7 |
| RC-01 | Richland Creek at State Hwy 45 | 13 | 3.2 | 4.3 | 5.1 | 0.7 |
| WF-01 | West Fork White River u/s of West Fork WWTP, at Highway 170 | 13 | 2.6 | 4.1 | 6.6 | 1.3 |
| WF-02 | West Fork White River at Mally Wagon Road | 13 | 3.5 | 5.5 | 7.9 | 1.4 |
| WR-01 | White River at Wyman Rd. (u/s of Noland WWTP, d/s of Lake Sequoyah) | 13 | 2.2 | 3.6 | 5.8 | 1.2 |
| 001 | Noland WWTP Outfall | 13 | 37.1 | 48.6 | 57.8 | 5.6 |
| WR-02 | White River, 0.4 mi d/s of Noland WWTP | 13 | 5.1 | 14.7 | 50.9 | 15.6 |
| WR-02.5 | White River, 2.7 mi d/s of Noland WWTP | 9 | 3.5 | 13.0 | 46.3 | 16.5 |
| WR-03 | White River just u/s of confluence with Richland Creek, at State Hwy 45; 5.5 mi d/s of Noland WWTP | 13 | 3.4 | 9.7 | 33.3 | 10.3 |

TABLE C-3
**Summary Statistics of Sulfate Concentrations**

| Station ID | Location | No. Samples | Minimum Sulfate (mg/L) | Average Sulfate (mg/L) | Maximum Sulfate (mg/L) | Standard Deviation (mg/L) |
|---|---|---|---|---|---|---|
| RC-02 | Richland Creek at County Road 79 | 8 | 7.7 | 11.0 | 18.1 | 3.1 |
| RC-01 | Richland Creek at State Hwy 45 | 13 | 8.4 | 11.9 | 20.5 | 3.4 |
| WF-01 | West Fork White River u/s of West Fork WWTP, at Highway 170 | 13 | 7.9 | 13.9 | 25.4 | 5.1 |
| WF-02 | West Fork White River at Mally Wagon Road | 13 | 19.4 | 31.0 | 46.8 | 8.5 |
| WR-01 | White River at Wyman Rd. (u/s of Noland WWTP, d/s of Lake Sequoyah) | 13 | 9.0 | 15.4 | 25.1 | 5.3 |
| 001 | Noland WWTP Outfall | 13 | 40.9 | 60.5 | 103.6 | 17.5 |
| WR-02 | White River, 0.4 mi d/s of Noland WWTP | 13 | 11.5 | 26.2 | 71.0 | 17.6 |
| WR-02.5 | White River, 2.7 mi d/s of Noland WWTP | 9 | 11.1 | 21.2 | 44.5 | 12.5 |
| WR-03 | White River just u/s of confluence with Richland Creek, at State Hwy 45; 5.5 mi d/s of Noland WWTP | 13 | 9.9 | 20.1 | 39.6 | 10.3 |

TABLE C-4
**Summary Statistics of TDS Concentrations**

| Station ID | Location | No. Samples | Minimum TDS (mg/L) | Average TDS (mg/L) | Maximum TDS (mg/L) | Standard Deviation (mg/L) |
|---|---|---|---|---|---|---|
| RC-02 | Richland Creek at County Road 79 | 8 | 84 | 105 | 164 | 29 |
| RC-01 | Richland Creek at State Hwy 45 | 13 | 58 | 115 | 154 | 29 |
| WF-01 | West Fork White River u/s of West Fork WWTP, at Highway 170 | 13 | 62 | 93 | 136 | 256 |
| WF-02 | West Fork White River at Mally Wagon Road | 13 | 108 | 143 | 181 | 26 |
| WR-01 | White River at Wyman Rd. (u/s of Noland WWTP, d/s of Lake Sequoyah) | 13 | 61 | 97 | 151 | 32 |
| 001 | Noland WWTP Outfall | 13 | 296 | 353 | 376 | 22 |
| WR-02 | White River, 0.4 mi d/s of Noland WWTP | 13 | 86 | 158 | 342 | 92 |
| WR-02.5 | White River, 2.7 mi d/s of Noland WWTP | 9 | 73 | 134 | 287 | 84 |
| WR-03 | White River just u/s of confluence with Richland Creek, at State Hwy 45; 5.5 mi d/s of Noland WWTP | 13 | 67 | 125 | 270 | 64 |

Transcribed from field book on 7/19/2011 -LM

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 5/19/2011 Time: 14:15

Field Crew: Wade Cash

Station ID: WR-01 GPS Coordinates: _____

Stream Name: White River

Location Description: Wyman Road (just downstream of Lake Sequoyah)

Equipment Used: _____ Date Calibrated: _____

Equipment Used: _____ Date Calibrated: _____

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y (N)

Flow Measurements Collected: Y (N)

Water Quality Measurements: Not collected during this event

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | | SU | | |
| Temperature | | °C | | |
| Conductivity | | µS/cm | | |
| Dissolved Oxygen | | mg/L | | |
| Flow | | cfs | | |
| Turbidity | | | | |

Other notes (weather, field conditions, etc.):

Transcribed from field book on 7/19/2011 -LM

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 5/19/2011 Time: 13:50

Field Crew: Wade Cash & Tim Luther

Station ID: WR-02 GPS Coordinates: _____

Stream Name: White River

Location Description: Downstream of Noland WWTP

Equipment Used: _____ Date Calibrated: _____

Equipment Used: _____ Date Calibrated: _____

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements: None collected during this event

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | | SU | | |
| Temperature | | °C | | |
| Conductivity | | µS/cm | | |
| Dissolved Oxygen | | mg/L | | |
| Flow | | cfs | | |
| Turbidity | | | | |

Other notes (weather, field conditions, etc.):

Transcribed from field book on 7/19/2011 - LM

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 5/19/2011 Time: 13:10

Field Crew: Wade Cash

Station ID: WR-03 GPS Coordinates: _____

Stream Name: White River

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: _____ Date Calibrated: _____

Equipment Used: _____ Date Calibrated: _____

Backwater Conditions (if applicable): Yes

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements: None collected during this event

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | | SU | | |
| Temperature | | °C | | |
| Conductivity | | µS/cm | | |
| Dissolved Oxygen | | mg/L | | |
| Flow | | cfs | | |
| Turbidity | | | | |

Other notes (weather, field conditions, etc.):

Transcribed from field book on 7/19/2011 -LM

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 5/19/2011 Time: 15:30

Field Crew: Wade Cash

Station ID: WF-01 GPS Coordinates: _____

Stream Name: West Fork White River

Location Description: Main St./Hwy 156

Equipment Used: Marsh McBirney Flowmate 2000 Date Calibrated: N/A

Equipment Used: _____ Date Calibrated: _____

Equipment Used: _____ Date Calibrated: _____

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: (Y)/N Yes

Water Quality Measurements: None collected during this event

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | | SU | | |
| Temperature | | °C | | |
| Conductivity | | µS/cm | | |
| Dissolved Oxygen | | mg/L | | |
| Flow | 27.34 | cfs | Marsh-McBirney | In situ |
| Turbidity | | | | |

Other notes (weather, field conditions, etc.):

Transcribed from field book on 7/19/2011 - LM

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 5/19/2011 Time: 14:25

Field Crew: Wade Cash

Station ID: WF-02 GPS Coordinates: _____

Stream Name: West Fork White River

Location Description: Mally Wagon Road

Equipment Used: _____ Date Calibrated: [illegible]

Equipment Used: _____ Date Calibrated: _____

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements: Not collected during this event

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | | SU | | |
| Temperature | | °C | | |
| Conductivity | | µS/cm | | |
| Dissolved Oxygen | | mg/L | | |
| Flow | | cfs | | |
| Turbidity | | | | |

Other notes (weather, field conditions, etc.):

Transcribed from field book on 7/19/2011 - LM

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 5/19/2011 Time: 13:00

Field Crew: Wade Cash

Station ID: RC-01 GPS Coordinates: _____

Stream Name: Richland Creek

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: _____ Date Calibrated: _____

Equipment Used: _____ Date Calibrated: _____

Backwater Conditions (if applicable): ~~N/A~~ Yes

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements: Not collected during this event

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | | SU | | |
| Temperature | | °C | | |
| Conductivity | | µS/cm | | |
| Dissolved Oxygen | | mg/L | | |
| Flow | | cfs | | |
| Turbidity | | | | |

Other notes (weather, field conditions, etc.):

Transcribed from field book on 7/19/2011 - LM

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 5/19/2011 Time: 13:55

Field Crew: Wade Cash & Tim Luther

Station ID: 001 GPS Coordinates: _____

Stream Name: N/A

Location Description: Noland Creek WWTP Effluent

Equipment Used: _____ Date Calibrated: _____

Equipment Used: _____ Date Calibrated: _____

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements: None collected during this event

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | | SU | | |
| Temperature | | °C | | |
| Conductivity | | µS/cm | | |
| Dissolved Oxygen | | mg/L | | |
| Flow | | cfs | | |
| Turbidity | | | | |

Other notes (weather, field conditions, etc.):

Transcribed from field book on 7/19/2011 - LM

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 6/17/2011 Time: 9:30 AM

Field Crew: Wade Cash

Station ID: RC-01 GPS Coordinates: _____

Stream Name: Richland Creek

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: YSI 85 Date Calibrated: 6/17/2011

Equipment Used: Oakton pH Testr 30 Date Calibrated: ~~6/8/2011~~ 6/8/11

Backwater Conditions (if applicable): ~~N/A~~ Yes

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements: (SB)

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.80 | SU | Oakton | ~~[illegible]~~ SB |
| Temperature | 26.3 | °C | YSI | ~~[illegible]~~ SB |
| Conductivity | 203 | µS/cm | YSI | SB |
| Dissolved Oxygen | 5.05 | mg/L | YSI | SB |
| Flow | | cfs | | |
| Turbidity | | | | Lab |

Other notes (weather, field conditions, etc.):

Blank collected at this site

Calibration information:

| | Standard | Measurement | Actions |
|---|---|---|---|
| pH | 7.00 | 6.99 | None |
| Cond | 100 | 99 | None |

Transcribed from field book on 7/19/2011 -LM

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 6/17/2011 Time: 9:45 AM

Field Crew: Wade Cash

Station ID: WR-03 GPS Coordinates:

Stream Name: White River

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: YSI 85 Multiprobe Date Calibrated: 6/17/2011

Equipment Used: Oakton pH Testr 30 Date Calibrated: ~~6/8/2011~~ 6/8/11

Backwater Conditions (if applicable): Yes

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.55 | SU | Oakton | Streambank |
| Temperature | 27 | °C | YSI | streambank |
| Conductivity | 204 | µS/cm | YSI | streambank |
| Dissolved Oxygen | 7.37 | mg/L | YSI | Streambank |
| Flow | | cfs | | |
| Turbidity | | | | Lab |

Other notes (weather, field conditions, etc.):

Transcribed from field book on 7/19/2011 - LM

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 6/17/2011 Time: 10:20 AM

Field Crew: Wade Cash

Station ID: WR-02 GPS Coordinates:

Stream Name: White River

Location Description: Downstream of Noland WWTP

Equipment Used: YSI 85 Multiprobe Date Calibrated: 6/17/2011

Equipment Used: Oakton pH Testr 30 Date Calibrated: ~~6/8/2011~~ 6/8/11

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.27 | SU | Oakton | In situ |
| Temperature | 25.6 | °C | YSI | In Situ |
| Conductivity | 209 | µS/cm | YSI | In Situ |
| Dissolved Oxygen | 7.95 | mg/L | YSI | In Situ |
| Flow | | cfs | | |
| Turbidity | | NTU | | Lab |

Other notes (weather, field conditions, etc.):

Transcribed from field book on 7/19/2011 - LM

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 6/17/2011 Time: 10:45 AM

Field Crew: Wade Cash

Station ID: WR-01 GPS Coordinates:

Stream Name: White River

Location Description: Wyman Road (just downstream of Lake Sequoyah)

Equipment Used: YSI 85 Multiprobe Date Calibrated: 6/17/2011

Equipment Used: Oakton pH Testr 30 Date Calibrated: ~~6/8/2011~~ 6/8/11

Backwater Conditions (if applicable): N/A

Field Duplicate Station: (Y)/N

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.26 | SU | [redacted] Oakton | Streambank |
| Temperature | 26.8 | °C | YSI | streambank |
| Conductivity | 171 | µS/cm | YSI | Streambank |
| Dissolved Oxygen | 8.34 | mg/L | YSI | streambank |
| Flow | [redacted] | cfs | | |
| Turbidity | | | | Lab |

Other notes (weather, field conditions, etc.):

Transcribed from field book on 7/19/2011 - LM

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 6/17/2011 Time: 10:00 AM

Field Crew: Wade Cash

Station ID: 001 GPS Coordinates:

Stream Name: N/A

Location Description: Noland Creek WWTP Effluent

Equipment Used: YSI 85 Date Calibrated: 6/17/2011

Equipment Used: Oakton pH Testr 30 Date Calibrated: ~~6/13/2011~~ 6/8/11

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.12 | SU | | streambank |
| Temperature | 24 | °C | | streambank |
| Conductivity | 582 | µS/cm | | streambank |
| Dissolved Oxygen | 8.07 | mg/L | | streambank |
| Flow | | cfs | | |
| Turbidity | | | | Lab |

Other notes (weather, field conditions, etc.):

Transcribed from field book on 7/19/2011 -LM

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 6/17/2011 Time: 11:00 AM

Field Crew: Wade Cash

Station ID: WF-02 GPS Coordinates:

Stream Name: West Fork White River

Location Description: Mally Wagon Road

Equipment Used: YSI 85 Multi probe Date Calibrated: 6/17/2011

Equipment Used: Oakton pH Testr 30 Date Calibrated: ~~6/13/2011~~ 6/8/11

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y (N)

Flow Measurements Collected: Y (N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.23 | SU | | In Situ |
| Temperature | 26.3 | °C | | In Situ |
| Conductivity | 284 | µS/cm | | In Situ |
| Dissolved Oxygen | 7.71 | mg/L | | In Situ |
| Flow | | cfs | | |
| Turbidity | | | | Lab |

Other notes (weather, field conditions, etc.):

Transcribed from field book on 7/19/2011 - LM

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 6/17/2011 Time: 11:30 AM

Field Crew: Wade Cash

Station ID: WF-01 GPS Coordinates:

Stream Name: West Fork White River

Location Description: Main St./Hwy 156

Equipment Used: YSI 85 Multiprobe Date Calibrated: 6/17/2011

Equipment Used: Oakton pH Testr 30 Date Calibrated: ~~6/18/2011~~ 6/8/11

Equipment Used: Date Calibrated: N/A

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: (Y)/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | ~~7.48~~ 7.48 | SU | | Insitu |
| Temperature | 25.2 | °C | | In situ |
| Conductivity | 167 | µS/cm | | In situ |
| Dissolved Oxygen | 9.28 | mg/L | | In situ |
| Flow | 8.08 | cfs | | In situ |
| Turbidity | | | | Lab |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 7/19/2011 Time: 11:41 AM

Field Crew: Cash & Massey

Station ID: RC-01 GPS Coordinates: 36° 06' 15.5" N ; 94° 00' 28.7" W

Stream Name: Richland Creek

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: Oakton pH Testr 30 Date Calibrated: 7/18/2011

Equipment Used: YSI 85 Date Calibrated: 7/19/2011

Backwater Conditions (if applicable): ~~N/A~~ Yes

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.79 | SU | Oakton | Streambank |
| Temperature | 30.6 | °C | YSI | ↓ |
| Conductivity | 118 | µS/cm | YSI | ↓ |
| Dissolved Oxygen | 5.97 | mg/L | YSI | ↓ |
| Flow | | cfs | | |
| Turbidity | | | | Lab |

Other notes (weather, field conditions, etc.):

Hot, Sunny

Calibration of field probe results — Measurement / Standard

pH 7.01 / 7.0 (7/18/2011)

Cond 97 / 100 (7/19/2011)

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 7/19/2011 Time: 11:33

Field Crew: Wade Cash, Leslie Massey

Station ID: WR-03 GPS Coordinates: 36° 06' 19.2"N 94° 00' 38.1"

Stream Name: White River

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: Oakton pH Testr 30 Date Calibrated: 07/18/2011

Equipment Used: YSI 85 Date Calibrated: 07/19/2011

Backwater Conditions (if applicable): YES

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 8.73 | SU | Oakton | Streambank |
| Temperature | 31.9 | °C | YSI | Streambank |
| Conductivity | 246 | µS/cm | YSI | Streambank |
| Dissolved Oxygen | 8.74 | mg/L | YSI | Streambank |
| Flow | | cfs | | |
| Turbidity | | | | Lab |

Other notes (weather, field conditions, etc.):

Hot & Sunny

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 7/19/2011 Time: 10:57 AM

Field Crew: Wade Cash & Leslie Massey

Station ID: WR-02 GPS Coordinates: 36° 05' 19.5" N; 94° 04' 51.2" W

Stream Name: White River

Location Description: Downstream of Noland WWTP

Equipment Used: Oakton pH Testr 30 Date Calibrated: 7/18/2011

Equipment Used: YSI 85 Date Calibrated: 7/19/2011

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.61 | SU | | Insitu |
| Temperature | 26.3 | °C | | ↓ |
| Conductivity | 484 | µS/cm | | ↓ |
| Dissolved Oxygen | 5.64 | mg/L | | ↓ |
| Flow | | cfs | | |
| Turbidity | | | | Lab |

Other notes (weather, field conditions, etc.):

Conductivity measured across stream.

| Width (ft) | Conductivity |
|---|---|
| 0 | 494 |
| 3 | 486 |
| 6 | 485 |
| 9 | 487 |
| 12 | 486 |
| 15 | 487 |
| 18 | 486 |
| 21 | 484 |
| 24 | 484 |
| 27 | 484 |
| 30 | bank |

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 7/19/2011 Time: 10:15 AM

Field Crew: Wade Cash & Leslie Massey

Station ID: WR-01 GPS Coordinates: 36° 04' 23.7" N ; 94°04'51.3" W

Stream Name: White River

Location Description: Wyman Road (just downstream of Lake Sequoyah)

Equipment Used: Oakton pH Testr 30 Date Calibrated: 7/18/2011

Equipment Used: YSI 85 Date Calibrated: 7/19/2011

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH 7.74 | ~~[illegible]~~ | SU | Oakton | Streambank |
| Temperature | 29.2 | °C | YSI | Streambank |
| Conductivity | 243 | µS/cm | YSI | Streambank |
| Dissolved Oxygen | 5.0 | mg/L | YSI | Streambank |
| Flow | | cfs | | |
| Turbidity | | | | Lab |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 7/19/2011 Time: 10:32 AM

Field Crew: Wade Cash & Leslie Massey

Station ID: 001 GPS Coordinates: 36° 04' 54.7" N 094° 05' 10.0 "

Stream Name: N/A

Location Description: Noland Creek WWTP Effluent

Equipment Used: _____ Date Calibrated: _____

Equipment Used: _____ Date Calibrated: _____

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/N

Flow Measurements Collected: Y/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.19 | SU | | Streambank |
| Temperature | 26.9 | °C | | Streambank |
| Conductivity | 579 | µS/cm | | Streambank |
| Dissolved Oxygen | 9.22 | mg/L | | Streambank |
| Flow | | cfs | | |
| Turbidity | | | | |

Other notes (weather, field conditions, etc.):

Collected from 001 using onsite pitcher

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 7/19/2011 Time: 9:58 AM

Field Crew: Wade Cash & Leslie Massey

Station ID: WF-02 GPS Coordinates: 36° 03' 14.1 N ; 94° 04' 59.2" W

Stream Name: West Fork White River

Location Description: Mally Wagon Road

Equipment Used: YSI 85 Date Calibrated: 7/19/2011

Equipment Used: Oakton pH Testr 30 Date Calibrated: 7/18/2011

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.55 | SU | | In situ |
| Temperature | 29.9 | °C | | In situ |
| Conductivity | 315 | µS/cm | | In situ |
| Dissolved Oxygen | 3.82 | mg/L | | In situ |
| Flow | | cfs | | |
| Turbidity | | | | |

Other notes (weather, field conditions, etc.):

rocks covered in algae, stagnant water,

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 7/19/2011 Time: 9:00 AM

Field Crew: Wade Cash, Leslie Massey

Station ID: WF-01 GPS Coordinates: 35°55'40.2"N; 94°11'03.2"W

Stream Name: West Fork White River

Location Description: Main St./Hwy 156

Equipment Used: YSI 85 Date Calibrated: 7/19/2011

Equipment Used: Oakton pH Testr 30 Date Calibrated: 7/18/2011

Equipment Used: Marsh McBirney Flowmeter Date Calibrated: N/A

Backwater Conditions (if applicable): N/A

Field Duplicate Station: (Y)/N & Field blank

Flow Measurements Collected: (Y)/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.45 | SU | Oakton | In Situ |
| Temperature | 29.3 | °C | YSI | In Situ |
| Conductivity | 218 | µS/cm | YSI | In Situ |
| Dissolved Oxygen | 8.09 | mg/L | YSI | In Situ |
| Flow | 0.418 | cfs | Marsh McBirney | In Situ |
| Turbidity | | | | Lab |

Other notes (weather, field conditions, etc.):

Sunny, Hot

Flow:

| Width (ft) | depth (ft) | velocity (ft/s) |
|---|---|---|
| 0 | 0 | 0 |
| 3 | 0.42 | 0.22 |
| 4 | 0.43 | 0 |
| 5 | 0.42 | 0.19 |
| 6 | 0.49 | 0.45 |
| 7 | 0.51 | 0.05 |
| 8 | 0 | 0 |

Stage 0.42 ft at Southeast edge of boulder

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 8-16-11 Time: 900

Field Crew: WC

Station ID: _____ GPS Coordinates: _____

Stream Name: BLANK

Location Description: _____

Equipment Used: PH TESTR 30 Date Calibrated: 8-16-11 645 → 6.99/7.0

Equipment Used: YSI 85 Date Calibrated: 8-16-11 645 CONDUCTIVITY 96/100

Equipment Used: _____ Date Calibrated: _____

Backwater Conditions (if applicable): _____

Field Duplicate Station: Y/N

Flow Measurements Collected: Y/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 6.11 | SU | PH TESTR 30 | STREAMBANK |
| Temperature | 26.2 | °C | YSI 85 | \| |
| Conductivity | 3,1 | uS/cm | \| | \| |
| Dissolved Oxygen | 6.29 | MG/L | \| | \| |
| Flow | | CFS | \| | \| |
| Turbidity | 0.02 | NTU | WTW TURB 550 | LAB |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 8-16-11 Time: 905

Field Crew: WL

Station ID: WF-01 GPS Coordinates: 35°55'40.2" 94°11'03.2"

Stream Name: West Fork White River

Location Description: Main St./Hwy 156

Equipment Used: PH TESTR 30 Date Calibrated: 8-16-11 GE

Equipment Used: YSI 85 Date Calibrated: / /

Equipment Used: MARSH MCBIRNEY FLOWMATE Date Calibrated:

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y (N)

Flow Measurements Collected: Y/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.51 | SU | PH TESTR 30 | IS |
| Temperature | 24.9 | °C | YSI 85 | \| |
| Conductivity | 191 | µS/cm | \| | \| |
| Dissolved Oxygen | 6.83 | mg/L | \| | \| |
| Flow | 6.86 | cfs | | \| |
| Turbidity | 2.76 | NTU | WTW TURB 550 | LAB |

Other notes (weather, field conditions, etc.):

PARTLY CLOUDY, HUMID

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 8-16-11 Time: 935

Field Crew: WF

Station ID: WF-02 GPS Coordinates: 36°03'14.1" 94°04'59.2"

Stream Name: West Fork White River

Location Description: Mally Wagon Road

Equipment Used: PM YSI 30 Date Calibrated: 8-16-11 645

Equipment Used: YSI 85 Date Calibrated: / /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: (Y)/N

Flow Measurements Collected: Y/(N)

Water Quality Measurements: → DUPLICATE

| Parameter | Value | DUP | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|---|
| pH | 7.52 | 7.52 | SU | PM YSI 30 | IS |
| Temperature | 26.1 | 26.0 | °C | YSI 85 | \| |
| Conductivity | 239 | 239 | µS/cm | \| | \| |
| Dissolved Oxygen | 4.89 | 4.94 | mg/L | \| | \| |
| Flow | | | cfs | | \| |
| Turbidity | 24.3 | 26.0 | NTU | | LAB |

Other notes (weather, field conditions, etc.):

PARTLY CLOUDY

TURBID WATER

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 8-16-11 Time: 950

Field Crew: WC

Station ID: WR-01 GPS Coordinates: 36°04'23.7" 94°04'51.3"

Stream Name: White River

Location Description: Wyman Road (just downstream of Lake Sequoyah)

Equipment Used: PM TRSTR 30 Date Calibrated: 8-16-11 645

Equipment Used: YSI 85 Date Calibrated: / /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y (N)

Flow Measurements Collected: Y (N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.53 | SU | PM TRSTR 30 | SB |
| Temperature | 25.9 | °C | YSI 85 | \| |
| Conductivity | 204 | µS/cm | \| | \| |
| Dissolved Oxygen | 5.15 | mg/L | \| | \| |
| Flow | | cfs | | \| |
| Turbidity | 22.7 | NTU | WTW TURB 550 | LM |

Other notes (weather, field conditions, etc.):

PARTLY CLOUDY

TURBID

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 8-16-11 Time: 1000

Field Crew: WS

Station ID: 001 GPS Coordinates: 36°04'54.7" 94°05'10.0"

Stream Name: N/A

Location Description: Noland Creek WWTP Effluent

Equipment Used: PH TESTR 30 Date Calibrated: 8-16-11 645

Equipment Used: YSI 85 Date Calibrated: / /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y (N)

Flow Measurements Collected: Y (N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.23 | SU | PH TEST 30 | SB |
| Temperature | 25.8 | °C | YSI 85 | " |
| Conductivity | 598 | µS/cm | " | " |
| Dissolved Oxygen | 8.47 | mg/L | " | " |
| Flow | | cfs | | |
| Turbidity | 0.77 | NTU | WTW TURB 550 | LAB |

Other notes (weather, field conditions, etc.):

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 8-16-11 Time: 1020

Field Crew: WS

Station ID: WR-02 GPS Coordinates: 36°05'19.5" 94°04'51.2"

Stream Name: White River

Location Description: Downstream of Noland WWTP

Equipment Used: PM YSI 30 Date Calibrated: 8-16-11 645

Equipment Used: YSI 85 Date Calibrated: / /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.57 | SU | PM YSI 30 | IS |
| Temperature | 26.2 | °C | YSI 85 | " |
| Conductivity | 281 | µS/cm | " | " |
| Dissolved Oxygen | 5.30 | mg/L | " | " |
| Flow | | cfs | | |
| Turbidity | 27.4 | NTU | WTW 9551 | LAB |

Other notes (weather, field conditions, etc.):

MOSTLY CLOUDY

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 8-16-11 Time: 1050

Field Crew: WF

Station ID: RC-01 GPS Coordinates: 36°06'15.5" 94°00'28.7"

Stream Name: Richland Creek

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: PH TESTR 30 Date Calibrated: 8-16-11 645

Equipment Used: YSI 85 Date Calibrated: 1 1

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y (N)

Flow Measurements Collected: Y (N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 8.06 | SU | PH TESTR 30 | SB |
| Temperature | 26.7 | °C | YSI 85 | " |
| Conductivity | 257 | µS/cm | " | " |
| Dissolved Oxygen | 6.81 | mg/L | " | " |
| Flow | | cfs | | |
| Turbidity | 5.78 | | WTW TURB 550 | LAB |

Other notes (weather, field conditions, etc.):

CLOUDY, THUNDER

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 8-16-11 Time: 1120

Field Crew: WL

Station ID: WR-03 GPS Coordinates: 36°06'19.2" 94°00'38.1"

Stream Name: White River

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: PH TRSTR 30 Date Calibrated: 8-16-11 6/5

Equipment Used: YSI 85 Date Calibrated: 1 1

Backwater Conditions (if applicable): YES

Field Duplicate Station: Y (N)

Flow Measurements Collected: Y (N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.71 | SU | PH TRSTR 30 | SB |
| Temperature | 24.1 | °C | YSI 85 | " |
| Conductivity | 247 | µS/cm | " | " |
| Dissolved Oxygen | 6.95 | mg/L | " | " |
| Flow | | cfs | | |
| Turbidity | 22.7 | NTU | WTW TURB 550 | LAB |

Other notes (weather, field conditions, etc.):

CLOUDY, RAIN DROPS

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 9-13-11 Time: 1105

Field Crew: WC

Station ID: RC-01 GPS Coordinates: 36°06'15.5" 94°00'28.7"

Stream Name: Richland Creek

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: pH Testr 30 Date Calibrated: _____

Equipment Used: YSI 85 Date Calibrated: _____

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | (In Situ)/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.99 | SU | pH Testr 30 | IS |
| Temperature | 22.3 | °C | YSI 85 | IS |
| Conductivity | 227 | µS/cm | YSI 85 | IS |
| Dissolved Oxygen | 7.29 | mg/L | YSI 85 | IS |
| Flow | -- | cfs | -- | -- |
| Turbidity | 9.04 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

~~SUN~~ SUN BROKE THROUGH

LOW FLOW

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 9-13-11 Time: 1055

Field Crew: WE

Station ID: WR-03 GPS Coordinates: 36°06'19.2" 94°00'38.1"

Stream Name: White River

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: pH Testr 30 Date Calibrated: _____

Equipment Used: YSI 85 Date Calibrated: _____

Backwater Conditions (if applicable): YES

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ (Streambank)/ Laboratory |
|---|---|---|---|---|
| pH | 8.15 | SU | pH Testr 30 | S |
| Temperature | 23.6 | °C | YSI 85 | S |
| Conductivity | 404 | µS/cm | YSI 85 | S |
| Dissolved Oxygen | 7.75 | mg/L | YSI 85 | S |
| Flow | -- | cfs | -- | -- |
| Turbidity | 11.0 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

transcribed at office 9/13/2011 LM

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 9-13-11 Time: 1135

Field Crew: WC

Station ID: WR 02.5 GPS Coordinates: _____

Stream Name: White River

Location Description: Extra site - 1/2 between WR 02 & WR 03

Equipment Used: pH Testr 30 Date Calibrated: 9-13-11 745

Equipment Used: YSI 85 Date Calibrated: 9-13-11 745

Equipment Used: _____ Date Calibrated: _____

Backwater Conditions (if applicable): _____

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | (In Situ)/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 8.51 | SU | pH Testr 30 | In situ |
| Temperature | 23.4 | °C | YSI 85 | In situ |
| Conductivity | 493 | µs/cm | YSI 85 | In situ |
| Dissolved Oxygen | 10.05 | mg/L | YSI 85 | In situ |
| Flow | — | — | — | — |
| Turbidity | 9.35 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 9.13.11 Time: 1015

Field Crew: WC

Station ID: WR-02 GPS Coordinates: 36°05'19.5" 94°04'51.2"

Stream Name: White River

Location Description: Downstream of Noland WWTP

Equipment Used: pH Testr 30 Date Calibrated: _____

Equipment Used: YSI 85 Date Calibrated: _____

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y (N)

Flow Measurements Collected: Y (N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 6.74 | SU | pH Testr 30 | IS |
| Temperature | 23.0 | °C | YSI 85 | IS |
| Conductivity | 553 | µS/cm | YSI 85 | IS |
| Dissolved Oxygen | 5.75 | mg/L | YSI 85 | IS |
| Flow | -- | cfs | -- | -- |
| Turbidity | 2.74 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

CLOUDY-LOW FLOW

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 9-13-11 Time: 945

Field Crew: WE

Station ID: WR-01 GPS Coordinates: 36°04'23.7" 94°04'51.3"

Stream Name: White River

Location Description: Wyman Road (just downstream of Lake Sequoyah)

Equipment Used: pH Testr 30 Date Calibrated: _____

Equipment Used: YSI 85 Date Calibrated: _____

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y (N)

Flow Measurements Collected: Y (N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/(Streambank)/ Laboratory |
|---|---|---|---|---|
| pH | 7.95 | SU | pH Testr 30 | S |
| Temperature | 22.5 | °C | YSI 85 | S |
| Conductivity | 216 | µS/cm | YSI 85 | S |
| Dissolved Oxygen | 6.88 | mg/L | YSI 85 | S |
| Flow | -- | cfs | -- | -- |
| Turbidity | 8.14 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

Cloudy

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 9-13-11 Time: 1035

Field Crew: WE

Station ID: 001 GPS Coordinates: 36°04'54.7" 94°05'10.0"

Stream Name: N/A

Location Description: Noland Creek WWTP Effluent

Equipment Used: pH Testr 30 Date Calibrated: _____

Equipment Used: YSI 85 Date Calibrated: _____

Backwater Conditions (if applicable): N/A

Field Duplicate Station: (Y)/N

Flow Measurements Collected: Y/(N)

Water Quality Measurements: DUI

| Parameter | Value | | Units | Equipment Used | In Situ/(Streambank)/ Laboratory |
|---|---|---|---|---|---|
| pH | 7.44 | 7.46 | SU | pH Testr 30 | S |
| Temperature | 23.7 | 23.7 | °C | YSI 85 | S |
| Conductivity | 574 | 575 | µS/cm | YSI 85 | S |
| Dissolved Oxygen | 8.35 | 8.43 | mg/L | YSI 85 | S |
| Flow | -- | | cfs | -- | -- |
| Turbidity | 0.89 | 0.78 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

CLOUDY, SPRINKLING

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 9-13-11 Time: 930

Field Crew: WF

Station ID: WF-02 GPS Coordinates: 36°03'14.1" 94°04'59.2"

Stream Name: West Fork White River

Location Description: Mally Wagon Road

Equipment Used: pH Testr 30 Date Calibrated: 9-13-11 745

Equipment Used: YSI 85 Date Calibrated: 9-13-11 745

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y (N)

Flow Measurements Collected: Y (N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.41 | SU | pH Testr 30 | IS |
| Temperature | 22.5 | °C | YSI 85 | IS |
| Conductivity | 266 | µS/cm | YSI 85 | IS |
| Dissolved Oxygen | 4.20 | mg/L | YSI 85 | IS |
| Flow | -- | cfs | -- | -- |
| Turbidity | 7.31 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

CLOUDY, BARELY FLOWING

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 9-13-11 Time: 905

Field Crew: WC

Station ID: WF-01 GPS Coordinates: 35°55'40.2" 94°11'03.2"

Stream Name: West Fork White River

Location Description: Main St./Hwy 156

Equipment Used: pH Testr 30 Date Calibrated: 9-13-11 745

Equipment Used: YSI 85 Date Calibrated: 9-13-11 745

Equipment Used: FLOW MATE 2000 Date Calibrated: 9-13-11

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: (Y)/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.41 | SU | pH Testr 30 | In Situ |
| Temperature | 23.6 | °C | YSI 85 | In Situ |
| Conductivity | 219 | µS/cm | YSI 85 | In Situ |
| Dissolved Oxygen | 4.88 | mg/L | YSI 85 | In Situ |
| Flow | 0.838 | cfs | FLOW MATE | In Situ |
| Turbidity | 0.46 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

CLOUDY, LIGHT RAIN EARLIER

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 9-13-11 Time: 900

Field Crew: WF

Station ID: Field Blank GPS Coordinates: N/A

Stream Name: Field Blank

Location Description: WF-01

Equipment Used: pH Testr 30 Date Calibrated: 9-13-11 745

Equipment Used: YSI 85 Date Calibrated: 9-13-11 745

Equipment Used: WTW Turb 550 Date Calibrated: 9-13-11

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 5.64 | su | pH Testr 30 | Streambank |
| Temperature | 22.3 | deg C | YSI 85 | Streambank |
| Conductivity | 2.8 | µS/cm | YSI 85 | Streambank |
| Dissolved Oxygen | 6.11 | mg/L | YSI 85 | Streambank |
| Flow | -- | -- | -- | -- |
| Turbidity | 0.02 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

EXTRA SITE IN SITU 9-13-11 1135

WR 02.5 transcribed to a separate field sheet

C - 493

T - 23.4

DO - 10.05

PH - 8.51

TURB - 9.35

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 10-11-11 Time: 1200

Field Crew: WC

Station ID: RC-01 GPS Coordinates: 36°06'15.5" 94°00'28.7"

Stream Name: Richland Creek

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: pH Testr 30 Date Calibrated: 10-11-11

Equipment Used: YSI 85 Date Calibrated:

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y (N)

Flow Measurements Collected: Y (N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 8.07 | SU | pH Testr 30 | IS |
| Temperature | 20.2 | °C | YSI 85 | \| |
| Conductivity | 252 | µS/cm | YSI 85 | \| |
| Dissolved Oxygen | 8.55 | mg/L | YSI 85 | \| |
| Flow | -- | cfs | -- | -- |
| Turbidity | 3.25 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

RAINING

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 10-11-11 Time: ~~930~~ 945

Field Crew: WC

Station ID: ~~Field Blank~~ RC-02 GPS Coordinates: N/A

Stream Name: ~~Field Blank~~

Location Description:

Equipment Used: pH Testr 30 Date Calibrated: 10-11-11

Equipment Used: YSI 85 Date Calibrated: /

Equipment Used: WTW Turb 550 Date Calibrated:

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.66 | su | pH Testr 30 | Streambank |
| Temperature | 18.7 | deg C | YSI 85 | Streambank |
| Conductivity | 270 | µS/cm | YSI 85 | Streambank |
| Dissolved Oxygen | 6.82 | mg/L | YSI 85 | Streambank |
| Flow | -- | -- | -- | -- |
| Turbidity | 3.15 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

SPRINKLING

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 10-11-11 Time: 1215

Field Crew: WR

Station ID: WR-03 GPS Coordinates: 36°06'19.2" 94°00'38.1"

Stream Name: White River

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: pH Testr 30 Date Calibrated: 10-11-11

Equipment Used: YSI 85 Date Calibrated:

Backwater Conditions (if applicable):

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 8.14 | SU | pH Testr 30 | SB |
| Temperature | 20.2 | °C | YSI 85 | \| |
| Conductivity | 439 | µS/cm | YSI 85 | \| |
| Dissolved Oxygen | 7.74 | mg/L | YSI 85 | \| |
| Flow | -- | cfs | -- | -- |
| Turbidity | 11.9 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 10-11-11 Time: 1030

Field Crew: WC

Station ID: ~~Field Blank~~ WR-2.5 GPS Coordinates: N/A

Stream Name: ~~Field Blank~~

Location Description:

Equipment Used: pH Testr 30 Date Calibrated: 10-11-11

Equipment Used: YSI 85 Date Calibrated: /

Equipment Used: WTW Turb 550 Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 8.16 | su | pH Testr 30 | Streambank |
| Temperature | 20.6 | deg C | YSI 85 | Streambank |
| Conductivity | 456 | µS/cm | YSI 85 | Streambank |
| Dissolved Oxygen | 8.15 | mg/L | YSI 85 | Streambank |
| Flow | -- | -- | -- | -- |
| Turbidity | 5.89 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

DAVID CLARK

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 10-11-11 Time: 1130

Field Crew: WC

Station ID: WR-02 GPS Coordinates: 36°05'19.5" 94°04'51.2"

Stream Name: White River

Location Description: Downstream of Noland WWTP

Equipment Used: pH Testr 30 Date Calibrated: 10-11-11

Equipment Used: YSI 85 Date Calibrated: 1

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.73 | SU | pH Testr 30 | IS |
| Temperature | 21.2 | °C | YSI 85 | |
| Conductivity | 477 | µS/cm | YSI 85 | |
| Dissolved Oxygen | 6.72 | mg/L | YSI 85 | |
| Flow | -- | cfs | -- | -- |
| Turbidity | 4.09 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

RAINING

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 10-11-11 Time: 1100

Field Crew: WC

Station ID: WR-01 GPS Coordinates: 36°04'23.7" 94°04'51.3"

Stream Name: White River

Location Description: Wyman Road (just downstream of Lake Sequoyah)

Equipment Used: pH Testr 30 Date Calibrated: 10-11-11

Equipment Used: YSI 85 Date Calibrated: 1

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.57 | SU | pH Testr 30 | SB |
| Temperature | 19.5 | °C | YSI 85 | \| |
| Conductivity | 227 | µS/cm | YSI 85 | \| |
| Dissolved Oxygen | 5.71 | mg/L | YSI 85 | \| |
| Flow | -- | cfs | -- | -- |
| Turbidity | 3.56 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

SPRINKLING

STAGNANT LOOKING

LOTS OF LEAVES

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 10-11-11 Time: 1110

Field Crew: WR

Station ID: 001 GPS Coordinates: 36°04'54.7" 94°05'10.0"

Stream Name: N/A

Location Description: Noland Creek WWTP Effluent

Equipment Used: pH Testr 30 Date Calibrated: 10-11-11

Equipment Used: YSI 85 Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.39 | SU | pH Testr 30 | SB |
| Temperature | 22.5 | °C | YSI 85 | \| |
| Conductivity | 595 | µS/cm | YSI 85 | \| |
| Dissolved Oxygen | 9.03 | mg/L | YSI 85 | \| |
| Flow | -- | cfs | -- | -- |
| Turbidity | 0.68 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 10-11-11 Time: 1000

Field Crew: WF

Station ID: WF-02 GPS Coordinates: 36°03'14.1" 94°04'59.2"

Stream Name: West Fork White River

Location Description: Mally Wagon Road

Equipment Used: pH Testr 30 Date Calibrated: 10-11-11

Equipment Used: YSI 85 Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: (Y)/N

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|---|
| pH | 7.57 | 7.56 | SU | pH Testr 30 | IS |
| Temperature | 19.3 | 19.3 | °C | YSI 85 | \| |
| Conductivity | 290 | 289 | µS/cm | YSI 85 | \| |
| Dissolved Oxygen | 5.69 | 5.45 | mg/L | YSI 85 | \| |
| Flow | -- | | cfs | -- | -- |
| Turbidity | 6.26 | 6.02 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

SPRINKLING

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 10-11-11 Time: 905

Field Crew: WL

Station ID: WF-01 GPS Coordinates: 35°55'40.2" 94°11'03.2"

Stream Name: West Fork White River

Location Description: Main St./Hwy 156

Equipment Used: pH Testr 30 Date Calibrated: 10-11-11

Equipment Used: YSI 85 Date Calibrated: /

Equipment Used: Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: (Y)/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.56 | SU | pH Testr 30 | In Situ |
| Temperature | 19.8 | °C | YSI 85 | In Situ |
| Conductivity | 227 | µS/cm | YSI 85 | In Situ |
| Dissolved Oxygen | 6.55 | mg/L | YSI 85 | In Situ |
| Flow | 1.887 | cfs | OTT ADC | In Situ |
| Turbidity | 0.53 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

Cloudy

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 10-11-11 Time: 900

Field Crew: WE

Station ID: Field Blank GPS Coordinates: N/A

Stream Name: Field Blank

Location Description: WEST FORK / MAIN ST.

Equipment Used: pH Testr 30 Date Calibrated: 10-11-11 7:45 7.03/7.00

Equipment Used: YSI 85 Date Calibrated: 10-11-11 7:45 106/100 µS/cm

Equipment Used: WTW Turb 550 Date Calibrated: 10-11-11 1300 9.78/10 NTU

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 5.95 | su | pH Testr 30 | Streambank |
| Temperature | 18.7 | deg C | YSI 85 | Streambank |
| Conductivity | 2.2 | µS/cm | YSI 85 | Streambank |
| Dissolved Oxygen | 5.34 | mg/L | YSI 85 | Streambank |
| Flow | -- | -- | -- | -- |
| Turbidity | 0.15 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 11-15-11 Time: 900

Field Crew: WF

Station ID: Field Blank GPS Coordinates: N/A

Stream Name: Field Blank

Location Description:

Equipment Used: pH Testr 30 Date Calibrated: 11-15-11 7 4 7.02/7.00

Equipment Used: YSI 85 Date Calibrated: 94/100 µS/cm

Equipment Used: WTW Turb 550 Date Calibrated:

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/N

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 6.67 | su | pH Testr 30 | Streambank |
| Temperature | 14.2 | deg C | YSI 85 | Streambank |
| Conductivity | 1.7 | µS/cm | YSI 85 | Streambank |
| Dissolved Oxygen | 7.56 | mg/L | YSI 85 | Streambank |
| Flow | -- | -- | -- | -- |
| Turbidity | 0.02 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 11-15-11 Time: 905

Field Crew: WE

Station ID: WF-01 GPS Coordinates: 35°55'40.2" 94°11'03.2"

Stream Name: West Fork White River

Location Description: Main St./Hwy 156

Equipment Used: pH Testr 30 Date Calibrated: 11-15-11 7YS

Equipment Used: YSI 85 Date Calibrated: / /

Equipment Used: FLOWMATE Date Calibrated: / /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: (Y)/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.53 | SU | pH Testr 30 | In Situ |
| Temperature | 14.9 | °C | YSI 85 | In Situ |
| Conductivity | 187 | µS/cm | YSI 85 | In Situ |
| Dissolved Oxygen | 8.77 | mg/L | YSI 85 | In Situ |
| Flow | 33.48 | cfs | FLOWMATE | In Situ |
| Turbidity | 1.70 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

CLOUDY

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 11-15-11 Time: 930

Field Crew: WL

Station ID: ~~WR-01~~ RC-01 GPS Coordinates: ~~36°04'23.7" 94°04'51.3"~~

Stream Name: ~~White River~~

Location Description: ~~Wyman Road (just downstream of Lake Sequoyah)~~

Equipment Used: pH Testr 30 Date Calibrated: 11-15-11 TWS

Equipment Used: YSI 85 Date Calibrated: / /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/N

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.53 | SU | pH Testr 30 | SB |
| Temperature | 16.1 | °C | YSI 85 | |
| Conductivity | 204 | µS/cm | YSI 85 | |
| Dissolved Oxygen | 8.20 | mg/L | YSI 85 | |
| Flow | -- | cfs | -- | -- |
| Turbidity | 2.35 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

CLOUDY

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 11-15-11 Time: 1000

Field Crew: WS

Station ID: WF-02 GPS Coordinates: 36°03'14.1" 94°04'59.2"

Stream Name: West Fork White River

Location Description: Mally Wagon Road

Equipment Used: pH Testr 30 Date Calibrated: 11-15-11 745

Equipment Used: YSI 85 Date Calibrated: / /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.75 | SU | pH Testr 30 | SB |
| Temperature | 14.8 | °C | YSI 85 | |
| Conductivity | 0281 | µS/cm | YSI 85 | |
| Dissolved Oxygen | 8.30 | mg/L | YSI 85 | |
| Flow | -- | cfs | -- | -- |
| Turbidity | 5.60 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 11-15-11 Time: 1030

Field Crew: WL

Station ID: WR-~~01~~ 2.5 GPS Coordinates: ~~36°04'23.7" 94°04'51.3"~~

Stream Name: White River

Location Description: ~~Wyman Road (just downstream of Lake Sequoyah)~~

Equipment Used: pH Testr 30 Date Calibrated: 11-15-11 745

Equipment Used: YSI 85 Date Calibrated: 1 /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: (Y)/N

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory | DUP |
|---|---|---|---|---|---|
| pH | 7.76 | SU | pH Testr 30 | IS | ~~7.74~~ 7.74 |
| Temperature | 14.6 | °C | YSI 85 | \| | 14.6 |
| Conductivity | 197 | µS/cm | YSI 85 | \| | 198 |
| Dissolved Oxygen | 8.90 | mg/L | YSI 85 | \| | 8.76 |
| Flow | -- | cfs | -- | -- | |
| Turbidity | 17.4 | NTU | WTW Turb 550 | Laboratory | 17.8 |

Other notes (weather, field conditions, etc.):

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 11-15-11 Time: 1100

Field Crew: WR

Station ID: WR-01 GPS Coordinates: 36°04'23.7" 94°04'51.3"

Stream Name: White River

Location Description: Wyman Road (just downstream of Lake Sequoyah)

Equipment Used: pH Testr 30 Date Calibrated: 11-15-11 745

Equipment Used: YSI 85 Date Calibrated: 1 /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.81 | SU | pH Testr 30 | SB |
| Temperature | 15.0 | °C | YSI 85 | \| |
| Conductivity | 172 | µS/cm | YSI 85 | \| |
| Dissolved Oxygen | 8.50 | mg/L | YSI 85 | \| |
| Flow | -- | cfs | -- | -- |
| Turbidity | 19.1 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

SPRINKLING

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 11-15-11 Time: 1110

Field Crew: W

Station ID: 001 GPS Coordinates: 36°04'54.7" 94°05'10.0"

Stream Name: N/A

Location Description: Noland Creek WWTP Effluent

Equipment Used: pH Testr 30 Date Calibrated: 11-15-11 745

Equipment Used: YSI 85 Date Calibrated: / /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.49 | SU | pH Testr 30 | SB |
| Temperature | 18.9 | °C | YSI 85 | \| |
| Conductivity | 556 | µS/cm | YSI 85 | \| |
| Dissolved Oxygen | 6.17 | mg/L | YSI 85 | \| |
| Flow | -- | cfs | -- | -- |
| Turbidity | 0.84 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

RAINING

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 11-15-11 Time: 1200

Field Crew: WC

Station ID: WR-02 GPS Coordinates: 36°05'19.5" 94°04'51.2"

Stream Name: White River

Location Description: Downstream of Noland WWTP

Equipment Used: pH Testr 30 Date Calibrated: 11-15-11 7YS

Equipment Used: YSI 85 Date Calibrated: / /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.70 | SU | pH Testr 30 | IS |
| Temperature | 15.1 | °C | YSI 85 | \| |
| Conductivity | 204 | µS/cm | YSI 85 | \| |
| Dissolved Oxygen | 8.99 | mg/L | YSI 85 | \| |
| Flow | -- | cfs | -- | -- |
| Turbidity | 18.1 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

RAINING

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 11-15-11 Time: 1230

Field Crew: W—

Station ID: RC-01 GPS Coordinates: 36°06'15.5" 94°00'28.7"

Stream Name: Richland Creek

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: pH Testr 30 Date Calibrated: 11-15-11 7Y5

Equipment Used: YSI 85 Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.75 | SU | pH Testr 30 | IS |
| Temperature | 16.3 | °C | YSI 85 | / |
| Conductivity | 226 | µS/cm | YSI 85 | / |
| Dissolved Oxygen | 8.62 | mg/L | YSI 85 | / |
| Flow | -- | cfs | -- | -- |
| Turbidity | 2.78 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 11-15-11 Time: 1240

Field Crew: WR

Station ID: WR-03 GPS Coordinates: 36°06'19.2" 94°00'38.1"

Stream Name: White River

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: pH Testr 30 Date Calibrated: 11-15-11 7x5

Equipment Used: YSI 85 Date Calibrated: / /

Backwater Conditions (if applicable): (Y) NO

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.73 | SU | pH Testr 30 | SB |
| Temperature | 16.3 | °C | YSI 85 | \| |
| Conductivity | 226 | µS/cm | YSI 85 | \| |
| Dissolved Oxygen | 8.17 | mg/L | YSI 85 | \| |
| Flow | -- | cfs | -- | -- |
| Turbidity | 16.9 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 12-13-11 Time: 900

Field Crew: WC

Station ID: Field Blank GPS Coordinates: N/A

Stream Name: Field Blank

Location Description: WF-01

Equipment Used: pH Testr 30 Date Calibrated: 12-13-11

Equipment Used: YSI 85 Date Calibrated: /

Equipment Used: WTW Turb 550 Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y (N)

Flow Measurements Collected: Y/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.68 | su | pH Testr 30 | Streambank |
| Temperature | 7.2 | deg C | YSI 85 | Streambank |
| Conductivity | 2.9 | µS/cm | YSI 85 | Streambank |
| Dissolved Oxygen | 9.12 | mg/L | YSI 85 | Streambank |
| Flow | -- | -- | -- | -- |
| Turbidity | .02 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 12-13-11 Time: 905

Field Crew: WF

Station ID: WF-01 GPS Coordinates: 35°55'40.2" 94°11'03.2"

Stream Name: West Fork White River

Location Description: Main St./Hwy 156

Equipment Used: pH Testr 30 Date Calibrated: 12-13-11

Equipment Used: YSI 85 Date Calibrated: /

Equipment Used: FLOWMATE Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y (N)

Flow Measurements Collected: (Y) N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.36 | SU | pH Testr 30 | In Situ |
| Temperature | 7.5 | °C | YSI 85 | In Situ |
| Conductivity | 123 | µS/cm | YSI 85 | In Situ |
| Dissolved Oxygen | 10.80 | mg/L | YSI 85 | In Situ |
| Flow | 63.3 | cfs | FLOWMATE | In Situ |
| Turbidity | 1.84 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

CLOUDY, RAIN LAST NIGHT

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 12-13-11 Time: 945

Field Crew: WE

Station ID: RC-02 GPS Coordinates: ~~36° 5' 13.8" 94° 2' 51.6"~~ 36° 2' 53.9" 93° 58' 29.4"

Stream Name: Richland Creek

Location Description:

Equipment Used: pH Testr30 Date Calibrated: 12-13-11

Equipment Used: YSI 85 Date Calibrated:

Equipment Used: Date Calibrated:

Backwater Conditions (if applicable):

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.66 | SU | pH Testr 30 | SB |
| Temperature | 10.2 | °C | YSI 85 | |
| Conductivity | 139 | µS/cm | YSI 85 | |
| Dissolved Oxygen | 9.95 | mg/L | YSI 85 | |
| Flow | | cfs | -- | |
| Turbidity | 1.51 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 12-13-11 Time: 1000

Field Crew: WR

Station ID: WF-02 GPS Coordinates: 36°03'14.1" 94°04'59.2"

Stream Name: West Fork White River

Location Description: Mally Wagon Road

Equipment Used: pH Testr 30 Date Calibrated: 12-13-11

Equipment Used: YSI 85 Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.94 | SU | pH Testr 30 | SB |
| Temperature | 6.3 | °C | YSI 85 | / |
| Conductivity | 199 | µS/cm | YSI 85 | / |
| Dissolved Oxygen | 11.73 | mg/L | YSI 85 | / |
| Flow | -- | cfs | -- | -- |
| Turbidity | 2.89 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 12-13-11 Time: 1050

Field Crew: WR

Station ID: WR-02.5 GPS Coordinates: 36°5'13.8" 94°2'51.6"

Stream Name: White River

Location Description:

Equipment Used: pH Testr30 Date Calibrated: 12-15-11

Equipment Used: YSI 85 Date Calibrated: /

Equipment Used: Date Calibrated:

Backwater Conditions (if applicable):

Field Duplicate Station: (Y)/N

Flow Measurements Collected: Y/(N)

*Water Quality Measurements:*

| Parameter | Value | | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|---|
| pH | 7.84 | 7.89 | SU | pH Testr 30 | IS |
| Temperature | 6.7 | 6.7 | °C | YSI 85 | |
| Conductivity | 119 | 120 | µS/cm | YSI 85 | |
| Dissolved Oxygen | 11.45 | 11.38 | mg/L | YSI 85 | |
| Flow | | | cfs | -- | |
| Turbidity | 5.23 | 5.18 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

SUN POPPED OUT

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 12-13-11 Time: 1100

Field Crew: WR

Station ID: WR-01 GPS Coordinates: 36°04'23.7" 94°04'51.3"

Stream Name: White River

Location Description: Wyman Road (just downstream of Lake Sequoyah)

Equipment Used: pH Testr 30 Date Calibrated: 12-13-11

Equipment Used: YSI 85 Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.77 | SU | pH Testr 30 | SB |
| Temperature | 6.8 | °C | YSI 85 | / |
| Conductivity | 108 | µS/cm | YSI 85 | / |
| Dissolved Oxygen | 10.91 | mg/L | YSI 85 | / |
| Flow | -- | cfs | -- | -- |
| Turbidity | 5.41 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 12-13-11 Time: 1120

Field Crew: WC

Station ID: 001 GPS Coordinates: 36°04'54.7" 94°05'10.0"

Stream Name: N/A

Location Description: Noland Creek WWTP Effluent

Equipment Used: pH Testr 30 Date Calibrated: 12-13-11

Equipment Used: YSI 85 Date Calibrated: 1

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.44 | SU | pH Testr 30 | SIS |
| Temperature | 14.9 | °C | YSI 85 | \| |
| Conductivity | 574 | µS/cm | YSI 85 | \| |
| Dissolved Oxygen | 9.05 | mg/L | YSI 85 | \| |
| Flow | -- | cfs | -- | -- |
| Turbidity | 0.58 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 12-13-11 Time: 1135

Field Crew: WC

Station ID: WR-02 GPS Coordinates: 36°05'19.5" 94°04'51.2"

Stream Name: White River

Location Description: Downstream of Noland WWTP

Equipment Used: pH Testr 30 Date Calibrated: 12-13-11

Equipment Used: YSI 85 Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 6.57 | SU | pH Testr 30 | IS |
| Temperature | 7.2 | °C | YSI 85 | / |
| Conductivity | 141 | µS/cm | YSI 85 | / |
| Dissolved Oxygen | 11.74 | mg/L | YSI 85 | / |
| Flow | -- | cfs | -- | -- |
| Turbidity | 5.08 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

Cloudy

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 12-15-11 Time: 1215

Field Crew: WR

Station ID: RC-01 GPS Coordinates: 36°06'15.5" 94°00'28.7"

Stream Name: Richland Creek

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: pH Testr 30 Date Calibrated: 12-15-11

Equipment Used: YSI 85 Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 8.11 | SU | pH Testr 30 | IS |
| Temperature | 10.2 | °C | YSI 85 | / |
| Conductivity | 159 | µS/cm | YSI 85 | / |
| Dissolved Oxygen | 11.09 | mg/L | YSI 85 | / |
| Flow | -- | cfs | -- | -- |
| Turbidity | 1.67 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 12-15-11 Time: ~~1215~~ 1225

Field Crew: WR

Station ID: WR-03 GPS Coordinates: 36°06'19.2" 94°00'38.1"

Stream Name: White River

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: pH Testr 30 Date Calibrated: 12-15-11

Equipment Used: YSI 85 Date Calibrated: /

Backwater Conditions (if applicable): NO

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.84 | SU | pH Testr 30 | SB |
| Temperature | 7.5 | °C | YSI 85 | / |
| Conductivity | 116 | µS/cm | YSI 85 | / |
| Dissolved Oxygen | 10.77 | mg/L | YSI 85 | / |
| Flow | -- | cfs | -- | -- |
| Turbidity | 5.80 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

CLOUDY

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 1-10-12 Time: 9:00

Field Crew: WE + JM

Station ID: Field Blank GPS Coordinates: N/A

Stream Name: Field Blank

Location Description:

Equipment Used: pH Testr 30 Date Calibrated: 1-10-12 7.01/7

Equipment Used: YSI 85 Date Calibrated: / 99/100

Equipment Used: WTW Turb 550 Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.07 | su | pH Testr 30 | Streambank |
| Temperature | 13.5 | deg C | YSI 85 | Streambank |
| Conductivity | 1.8 | µS/cm | YSI 85 | Streambank |
| Dissolved Oxygen | 6.37 | mg/L | YSI 85 | Streambank |
| Flow | -- | -- | -- | -- |
| Turbidity | .43 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 1-10-12 Time: 9:05

Field Crew: JM & WC

Station ID: WF-01 GPS Coordinates: 35°55'40.2" 94°11'03.2"

Stream Name: West Fork White River

Location Description: Main St./Hwy 156

Equipment Used: pH Testr 30 Date Calibrated:

Equipment Used: YSI 85 Date Calibrated:

Equipment Used: Date Calibrated:

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.61 | SU | pH Testr 30 | In Situ |
| Temperature | 7.5 | °C | YSI 85 | In Situ |
| Conductivity | 122 | µS/cm | YSI 85 | In Situ |
| Dissolved Oxygen | 10.83 | mg/L | YSI 85 | In Situ |
| Flow | 20.8 | cfs | Flowmate | In Situ |
| Turbidity | 0.86 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 1-10-12 Time: 9:40 am

Field Crew: WC & JM

Station ID: RC-02 GPS Coordinates: _____

Stream Name: Richland Creek

Location Description: _____

Equipment Used: pH Testr30 Date Calibrated: _____

Equipment Used: YSI 85 Date Calibrated: _____

Equipment Used: _____ Date Calibrated: _____

Backwater Conditions (if applicable): _____

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.60 | SU | pH Testr 30 | streambank |
| Temperature | 9.6 | °C | YSI 85 | streambank |
| Conductivity | 152 | µS/cm | YSI 85 | streambank |
| Dissolved Oxygen | 9.74 | mg/L | YSI 85 | streambank |
| Flow | | cfs | -- | |
| Turbidity | 1.32 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 1-10-12 Time: 9:57

Field Crew: WC + JM

Station ID: WF-02 GPS Coordinates: 36°03'14.1" 94°04'59.2"

Stream Name: West Fork White River

Location Description: Mally Wagon Road

Equipment Used: pH Testr 30 Date Calibrated:

Equipment Used: YSI 85 Date Calibrated:

Backwater Conditions (if applicable): N/A

Field Duplicate Station: (Y)/N

Flow Measurements Collected: ~~Y~~/N

Water Quality Measurements:

| Parameter | Value | Value Dup | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|---|
| pH | 7.89 | 7.90 | SU | pH Testr 30 | In situ |
| Temperature | 7.2 | 7.1 | °C | YSI 85 | In situ |
| Conductivity | 215 | ~~221~~ 215 | µS/cm | YSI 85 | In situ |
| Dissolved Oxygen | 11.00 | 10.98 | mg/L | YSI 85 | In situ |
| Flow | | -- | cfs | -- | -- |
| Turbidity | 2.89 | 2.89 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 1-10-12 Time: 10:22

Field Crew: WC & JM

Station ID: WR-02.5 GPS Coordinates: _____

Stream Name: White River

Location Description: _____

Equipment Used: pH Testr30 Date Calibrated: _____

Equipment Used: YSI 85 Date Calibrated: _____

Equipment Used: _____ Date Calibrated: _____

Backwater Conditions (if applicable): _____

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.73 | SU | pH Testr 30 | In situ |
| Temperature | 7.0 | °C | YSI 85 | In situ |
| Conductivity | 130 | µS/cm | YSI 85 | In situ |
| Dissolved Oxygen | 11.02 | mg/L | YSI 85 | In situ |
| Flow | | cfs | -- | |
| Turbidity | 6.28 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 1-10-12 Time: 10:39

Field Crew: WC & JM

Station ID: WR-01 GPS Coordinates: 36°04'23.7" 94°04'51.3"

Stream Name: White River

Location Description: Wyman Road (just downstream of Lake Sequoyah)

Equipment Used: pH Testr 30 Date Calibrated: _____

Equipment Used: YSI 85 Date Calibrated: _____

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.71 | SU | pH Testr 30 | Streambank |
| Temperature | 7.1 | °C | YSI 85 | streambank |
| Conductivity | 109 | µS/cm | YSI 85 | streambank |
| Dissolved Oxygen | 10.89 | mg/L | YSI 85 | streambank |
| Flow | -- | cfs | -- | -- |
| Turbidity | 8.15 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 1-10-12 Time: 10:51

Field Crew: WC & JM

Station ID: 001 GPS Coordinates: 36°04'54.7" 94°05'10.0"

Stream Name: N/A

Location Description: Noland Creek WWTP Effluent

Equipment Used: pH Testr 30 Date Calibrated: _____

Equipment Used: YSI 85 Date Calibrated: _____

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/N

Flow Measurements Collected: Y/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.44 | SU | pH Testr 30 | Streambank |
| Temperature | 13.0 | °C | YSI 85 | streambank |
| Conductivity | 582 | µS/cm | YSI 85 | streambank |
| Dissolved Oxygen | 10.72 | mg/L | YSI 85 | streambank |
| Flow | -- | cfs | -- | -- |
| Turbidity | 1.35 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 1-10-12 Time: 11:05

Field Crew: WC + JM

Station ID: WR-02 GPS Coordinates: 36°05'19.5" 94°04'51.2"

Stream Name: White River

Location Description: Downstream of Noland WWTP

Equipment Used: pH Testr 30 Date Calibrated: _____

Equipment Used: YSI 85 Date Calibrated: _____

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.78 | SU | pH Testr 30 | In situ |
| Temperature | 7.3 | °C | YSI 85 | In situ |
| Conductivity | 142 | µS/cm | YSI 85 | In situ |
| Dissolved Oxygen | 11.25 | mg/L | YSI 85 | In situ |
| Flow | -- | cfs | -- | -- |
| Turbidity | 6.88 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 1-10-12 Time: 11:36

Field Crew: WC + JM

Station ID: RC-01 GPS Coordinates: 36°06'15.5" 94°00'28.7"

Stream Name: Richland Creek

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: pH Testr 30 Date Calibrated: _____

Equipment Used: YSI 85 Date Calibrated: _____

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 8.21 | SU | pH Testr 30 | Streambank |
| Temperature | 8.5 | °C | YSI 85 | streambank |
| Conductivity | 162 | µS/cm | YSI 85 | streambank |
| Dissolved Oxygen | 11.23 | mg/L | YSI 85 | Streambank |
| Flow | -- | cfs | -- | -- |
| Turbidity | 1.24 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 1-10-12 Time: 11:45

Field Crew: WC & JM

Station ID: WR-03 GPS Coordinates: 36°06'19.2" 94°00'38.1"

Stream Name: White River

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: pH Testr 30 Date Calibrated: _____

Equipment Used: YSI 85 Date Calibrated: _____

Backwater Conditions (if applicable): No

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.91 | SU | pH Testr 30 | streambank |
| Temperature | 7.2 | °C | YSI 85 | streambank |
| Conductivity | 134 | µS/cm | YSI 85 | streambank |
| Dissolved Oxygen | 10.87 | mg/L | YSI 85 | streambank |
| Flow | -- | cfs | -- | -- |
| Turbidity | 6.06 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 2-14-12 Time: 855

Field Crew: WC

Station ID: Field Blank GPS Coordinates: N/A

Stream Name: Field Blank

Location Description:

Equipment Used: pH Testr 30 Date Calibrated: 2-14-12 7.01/7.00

Equipment Used: YSI 85 Date Calibrated: 2-14-12 96/100

Equipment Used: WTW Turb 550 Date Calibrated: 2-14-12

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 6.98 | su | pH Testr 30 | Streambank |
| Temperature | 16.8 | deg C | YSI 85 | Streambank |
| Conductivity | 2.4 | µS/cm | YSI 85 | Streambank |
| Dissolved Oxygen | 7.70 | mg/L | YSI 85 | Streambank |
| Flow | -- | -- | -- | -- |
| Turbidity | .55 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 2-14-12 Time: 900

Field Crew: WF

Station ID: WF-01 GPS Coordinates: 35°55'40.2" 94°11'03.2"

Stream Name: West Fork White River

Location Description: Main St./Hwy 156

Equipment Used: pH Testr 30 Date Calibrated: 2-14-12

Equipment Used: YSI 85 Date Calibrated: /

Equipment Used: ADC Date Calibrated:

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.21 | SU | pH Testr 30 | In Situ |
| Temperature | 4.8 | °C | YSI 85 | In Situ |
| Conductivity | 97.6 | µS/cm | YSI 85 | In Situ |
| Dissolved Oxygen | 12.10 | mg/L | YSI 85 | In Situ |
| Flow | 53.2 | cfs | ADC | In Situ |
| Turbidity | 2.56 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 2-14-12 Time: 945

Field Crew: WR

Station ID: RC-02 GPS Coordinates: _____

Stream Name: Richland Creek

Location Description: _____

Equipment Used: pH Testr30 Date Calibrated: 2-14-12

Equipment Used: YSI 85 Date Calibrated: _____

Equipment Used: _____ Date Calibrated: _____

Backwater Conditions (if applicable): _____

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.57 | SU | pH Testr 30 | (IS) SB |
| Temperature | 7.3 | °C | YSI 85 | |
| Conductivity | 138 | µS/cm | YSI 85 | |
| Dissolved Oxygen | 11.15 | mg/L | YSI 85 | |
| Flow | — | cfs | -- | |
| Turbidity | 2.66 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 2-14-12 Time: 1000

Field Crew: LE

Station ID: WF-02 GPS Coordinates: 36°03'14.1" 94°04'59.2"

Stream Name: West Fork White River

Location Description: Mally Wagon Road

Equipment Used: pH Testr 30 Date Calibrated: 2-14-12

Equipment Used: YSI 85 Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: (Y)/N

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory | DUP |
|---|---|---|---|---|---|
| pH | 7.86 | SU | pH Testr 30 | IS | 7.91 |
| Temperature | 4.2 | °C | YSI 85 | / | 4.2 |
| Conductivity | 189 | µS/cm | YSI 85 | / | 189 |
| Dissolved Oxygen | 12.78 | mg/L | YSI 85 | / | 12.63 |
| Flow | -- | cfs | -- | -- | |
| Turbidity | 3.39 | NTU | WTW Turb 550 | Laboratory | 3.23 |

Other notes (weather, field conditions, etc.):

SUNNY

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 7-14-12 Time: 1030

Field Crew: WR

Station ID: WR-02.5 GPS Coordinates: _____

Stream Name: White River

Location Description: _____

Equipment Used: pH Testr30 Date Calibrated: 7/14-12

Equipment Used: YSI 85 Date Calibrated: /

Equipment Used: _____ Date Calibrated: _____

Backwater Conditions (if applicable): _____

Field Duplicate Station: Y (N)

Flow Measurements Collected: Y (N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.89 | SU | pH Testr 30 | IS |
| Temperature | 5.1 | °C | YSI 85 | / |
| Conductivity | 111 | µS/cm | YSI 85 | / |
| Dissolved Oxygen | 12.48 | mg/L | YSI 85 | / |
| Flow | — | cfs | -- | |
| Turbidity | 37.8 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

SUNNY

There are disturbances downstream of WR02, because of a current streambank restoration project.

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 7-14-12 Time: 1100

Field Crew: WE

Station ID: WR-01 GPS Coordinates: 36°04'23.7" 94°04'51.3"

Stream Name: White River

Location Description: Wyman Road (just downstream of Lake Sequoyah)

Equipment Used: pH Testr 30 Date Calibrated: 7-14-12

Equipment Used: YSI 85 Date Calibrated:

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y (N)

Flow Measurements Collected: Y (N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.77 | SU | pH Testr 30 | SB |
| Temperature | 5.1 | °C | YSI 85 | / |
| Conductivity | 111 | µS/cm | YSI 85 | / |
| Dissolved Oxygen | 11.72 | mg/L | YSI 85 | / |
| Flow | -- | cfs | -- | -- |
| Turbidity | 6.91 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 2-14-12 Time: 1125

Field Crew: W

Station ID: 001 GPS Coordinates: 36°04'54.7" 94°05'10.0"

Stream Name: N/A

Location Description: Noland Creek WWTP Effluent

Equipment Used: pH Testr 30 Date Calibrated: 2-14-12

Equipment Used: YSI 85 Date Calibrated:

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.42 | SU | pH Testr 30 | SB |
| Temperature | 11.7 | °C | YSI 85 | |
| Conductivity | 535 | µS/cm | YSI 85 | |
| Dissolved Oxygen | 10.81 | mg/L | YSI 85 | |
| Flow | -- | cfs | -- | -- |
| Turbidity | 1.56 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 7-14-12 Time: 11:40

Field Crew: WR

Station ID: WR-02 GPS Coordinates: 36°05'19.5" 94°04'51.2"

Stream Name: White River

Location Description: Downstream of Noland WWTP

Equipment Used: pH Testr 30 Date Calibrated: 7-14-12

Equipment Used: YSI 85 Date Calibrated: "

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.79 | SU | pH Testr 30 | IS |
| Temperature | 5.5 | °C | YSI 85 | " |
| Conductivity | 126.6 | µS/cm | YSI 85 | " |
| Dissolved Oxygen | 12.48 | mg/L | YSI 85 | " |
| Flow | -- | cfs | -- | -- |
| Turbidity | 6.29 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

SUNNY

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 7-14-12 Time: 1210

Field Crew: WR

Station ID: RC-01 GPS Coordinates: 36°06'15.5" 94°00'28.7"

Stream Name: Richland Creek

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: pH Testr 30 Date Calibrated: 7-14-12

Equipment Used: YSI 85 Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.84 | SU | pH Testr 30 | IS |
| Temperature | 8.7 | °C | YSI 85 | \| |
| Conductivity | 135 | µS/cm | YSI 85 | \| |
| Dissolved Oxygen | 11.40 | mg/L | YSI 85 | \| |
| Flow | -- | cfs | -- | -- |
| Turbidity | 2.85 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 2-14-12 Time: 1225

Field Crew: WC

Station ID: WR-03 GPS Coordinates: 36°06'19.2" 94°00'38.1"

Stream Name: White River

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: pH Testr 30 Date Calibrated: 2-14-12

Equipment Used: YSI 85 Date Calibrated: /

Backwater Conditions (if applicable): NO

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.73 | SU | pH Testr 30 | SB |
| Temperature | 5.8 | °C | YSI 85 | / |
| Conductivity | 112 | µS/cm | YSI 85 | / |
| Dissolved Oxygen | 12.07 | mg/L | YSI 85 | / |
| Flow | -- | cfs | -- | -- |
| Turbidity | 7.16 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

There are disturbances downstream of WR02, because of a current streambank restoration project.

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 3-7-12 Time: 940

Field Crew: WF

Station ID: Field Blank GPS Coordinates: N/A

Stream Name: Field Blank

Location Description:

Equipment Used: pH Testr 30 Date Calibrated: 3-7-12 7.00/7.00

Equipment Used: YSI 85 Date Calibrated: / 96/100

Equipment Used: WTW Turb 550 Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: (Y)/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 6.65 | su | pH Testr 30 | Streambank |
| Temperature | 19.5 | deg C | YSI 85 | Streambank |
| Conductivity | 1.9 | µS/cm | YSI 85 | Streambank |
| Dissolved Oxygen | 6.98 | mg/L | YSI 85 | Streambank |
| Flow | -- | -- | -- | -- |
| Turbidity | 0.08 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

MOSTLY CLOUDY, WINDY

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 3-7-12 Time: 945

Field Crew: MC

Station ID: WF-01 GPS Coordinates: 35°55'40.2" 94°11'03.2"

Stream Name: West Fork White River

Location Description: Main St./Hwy 156

Equipment Used: pH Testr 30 Date Calibrated: 3-7-12

Equipment Used: YSI 85 Date Calibrated: /

Equipment Used: _____ Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: (Y)/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.56 | SU | pH Testr 30 | In Situ |
| Temperature | 12.2 | °C | YSI 85 | In Situ |
| Conductivity | 117 | µS/cm | YSI 85 | In Situ |
| Dissolved Oxygen | 10.09 | mg/L | YSI 85 | In Situ |
| Flow | 27.9 | cfs | OTT | In Situ |
| Turbidity | 2.28 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 3-7-12 Time: 1030

Field Crew: WE

Station ID: RC-02 GPS Coordinates: _____

Stream Name: Richland Creek

Location Description: _____

Equipment Used: pH Testr30 Date Calibrated: 3-7-12

Equipment Used: YSI 85 Date Calibrated: _____

Equipment Used: _____ Date Calibrated: _____

Backwater Conditions (if applicable): _____

Field Duplicate Station: (Y)/N

Flow Measurements Collected: Y/N

Water Quality Measurements:

| Parameter | Value | | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|---|
| pH | 8.03 | 8.05 | SU | pH Testr 30 | SB |
| Temperature | 14.0 | 14.0 | °C | YSI 85 | |
| Conductivity | 130 | 130 | µS/cm | YSI 85 | |
| Dissolved Oxygen | 9.95 | 10.16 | mg/L | YSI 85 | |
| Flow | | | cfs | -- | |
| Turbidity | 2.18 | 2.14 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 3-7-12 Time: 1100

Field Crew: WR

Station ID: WF-02 GPS Coordinates: 36°03'14.1" 94°04'59.2"

Stream Name: West Fork White River

Location Description: Mally Wagon Road

Equipment Used: pH Testr 30 Date Calibrated: 3-7-12

Equipment Used: YSI 85 Date Calibrated: |

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.88 | SU | pH Testr 30 | IS |
| Temperature | 13.9 | °C | YSI 85 | \| |
| Conductivity | 203 | µS/cm | YSI 85 | \| |
| Dissolved Oxygen | 9.65 | mg/L | YSI 85 | \| |
| Flow | -- | cfs | -- | -- |
| Turbidity | 8.13 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 3-7-14 Time: 1130

Field Crew: WC

Station ID: WR-02.5 GPS Coordinates: _____

Stream Name: White River

Location Description: _____

Equipment Used: pH Testr30 Date Calibrated: 3-7-14

Equipment Used: YSI 85 Date Calibrated: /

Equipment Used: _____ Date Calibrated: /

Backwater Conditions (if applicable): _____

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.78 | SU | pH Testr 30 | IS |
| Temperature | 14.0 | °C | YSI 85 | / |
| Conductivity | 148 | µS/cm | YSI 85 | / |
| Dissolved Oxygen | 9.69 | mg/L | YSI 85 | / |
| Flow | * | cfs | -- | / |
| Turbidity | 16.9 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

PARTLY CLOUDY, WINDY

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 3-7-12 Time: 1200

Field Crew: WR

Station ID: WR-01 GPS Coordinates: 36°04'23.7" 94°04'51.3"

Stream Name: White River

Location Description: Wyman Road (just downstream of Lake Sequoyah)

Equipment Used: pH Testr 30 Date Calibrated: 3-7-12

Equipment Used: YSI 85 Date Calibrated:

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.91 | SU | pH Testr 30 | SB |
| Temperature | 14.7 | °C | YSI 85 | \| |
| Conductivity | 119 | µS/cm | YSI 85 | \| |
| Dissolved Oxygen | 9.56 | mg/L | YSI 85 | \| |
| Flow | -- | cfs | -- | -- |
| Turbidity | 13.9 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 3-7-14 Time: 1215

Field Crew: WR

Station ID: 001 GPS Coordinates: 36°04'54.7" 94°05'10.0"

Stream Name: N/A

Location Description: Noland Creek WWTP Effluent

Equipment Used: pH Testr 30 Date Calibrated: 3-7-14

Equipment Used: YSI 85 Date Calibrated:

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.55 | SU | pH Testr 30 | SB |
| Temperature | 17.0 | °C | YSI 85 | \| |
| Conductivity | 577 | µS/cm | YSI 85 | \| |
| Dissolved Oxygen | 8.60 | mg/L | YSI 85 | \| |
| Flow | -- | cfs | -- | -- |
| Turbidity | 3.07 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 3-7-12 Time: 1245

Field Crew: WR

Station ID: WR-02 GPS Coordinates: 36°05'19.5" 94°04'51.2"

Stream Name: White River

Location Description: Downstream of Noland WWTP

Equipment Used: pH Testr 30 Date Calibrated: 3-7-12

Equipment Used: YSI 85 Date Calibrated:

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.98 | SU | pH Testr 30 | IS |
| Temperature | 14.3 | °C | YSI 85 | |
| Conductivity | 169 | µS/cm | YSI 85 | |
| Dissolved Oxygen | 10.28 | mg/L | YSI 85 | |
| Flow | -- | cfs | -- | -- |
| Turbidity | 11.1 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 3-7-12 Time: 1315

Field Crew: WZ

Station ID: RC-01 GPS Coordinates: 36°06'15.5" 94°00'28.7"

Stream Name: Richland Creek

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: pH Testr 30 Date Calibrated: 3-7-12

Equipment Used: YSI 85 Date Calibrated:

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 8.61 | SU | pH Testr 30 | SB |
| Temperature | 15.4 | °C | YSI 85 | \| |
| Conductivity | 156 | µS/cm | YSI 85 | \| |
| Dissolved Oxygen | 10.62 | mg/L | YSI 85 | \| |
| Flow | -- | cfs | -- | -- |
| Turbidity | 2.08 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 3-7-12 Time: ~~WE~~ 1330

Field Crew: WE

Station ID: WR-03 GPS Coordinates: 36°06'19.2" 94°00'38.1"

Stream Name: White River

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: pH Testr 30 Date Calibrated: 3-7-12

Equipment Used: YSI 85 Date Calibrated: /

Backwater Conditions (if applicable): NONE

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.95 | SU | pH Testr 30 | SB |
| Temperature | 14.9 | °C | YSI 85 | / |
| Conductivity | 152 | µS/cm | YSI 85 | / |
| Dissolved Oxygen | 9.46 | mg/L | YSI 85 | / |
| Flow | -- | cfs | -- | -- |
| Turbidity | 17.5 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 4-3-12 Time: 950

Field Crew: WR

Station ID: Field Blank GPS Coordinates: N/A

Stream Name: Field Blank

Location Description:

Equipment Used: pH Testr 30 Date Calibrated: 4-3-12 7.04/7.00

Equipment Used: YSI 85 Date Calibrated: / 96/100

Equipment Used: WTW Turb 550 Date Calibrated:

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.26 | su | pH Testr 30 | Streambank |
| Temperature | 22.4 | deg C | YSI 85 | Streambank |
| Conductivity | 2.2 | µS/cm | YSI 85 | Streambank |
| Dissolved Oxygen | 7.05 | mg/L | YSI 85 | Streambank |
| Flow | -- | -- | -- | -- |
| Turbidity | 0.03 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 4-3-12 Time: 935

Field Crew: WR

Station ID: WF-01 GPS Coordinates: 35°55'40.2" 94°11'03.2"

Stream Name: West Fork White River

Location Description: Main St./Hwy 156

Equipment Used: pH Testr 30 Date Calibrated: 4-3-12

Equipment Used: YSI 85 Date Calibrated: /

Equipment Used: OTT Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/N

Flow Measurements Collected: (Y)/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.77 | SU | pH Testr 30 | In Situ |
| Temperature | 18.8 | °C | YSI 85 | In Situ |
| Conductivity | 106 | µS/cm | YSI 85 | In Situ |
| Dissolved Oxygen | 9.13 | mg/L | YSI 85 | In Situ |
| Flow | 45.7 | cfs | OTT | In Situ |
| Turbidity | 3.63 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

PARTLY SUNNY

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 4-3-12 Time: 1020

Field Crew: WR

Station ID: RC-02 GPS Coordinates: _____

Stream Name: Richland Creek

Location Description: _____

Equipment Used: pH Testr30 Date Calibrated: 4-3-12

Equipment Used: YSI 85 Date Calibrated: /

Equipment Used: _____ Date Calibrated: /

Backwater Conditions (if applicable): _____

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.45 | SU | pH Testr 30 | SB |
| Temperature | 18.5 | °C | YSI 85 | / |
| Conductivity | 128 | µS/cm | YSI 85 | / |
| Dissolved Oxygen | 8.65 | mg/L | YSI 85 | / |
| Flow | — | cfs | -- | / |
| Turbidity | 4.29 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 4-3-12 Time: 1045

Field Crew: WL

Station ID: WF-02 GPS Coordinates: 36°03'14.1" 94°04'59.2"

Stream Name: West Fork White River

Location Description: Mally Wagon Road

Equipment Used: pH Testr 30 Date Calibrated: 4-3-12

Equipment Used: YSI 85 Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.59 | SU | pH Testr 30 | IS |
| Temperature | 21.5 | °C | YSI 85 | / |
| Conductivity | 194 | µS/cm | YSI 85 | / |
| Dissolved Oxygen | 8.01 | mg/L | YSI 85 | / |
| Flow | -- | cfs | -- | -- |
| Turbidity | ~~10~~ 7.33 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

Cloudy

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 4-3-12 Time: 1130

Field Crew: WR

Station ID: WR-02.5 GPS Coordinates: _____

Stream Name: White River

Location Description: _____

Equipment Used: pH Testr30 Date Calibrated: 4-3-12

Equipment Used: YSI 85 Date Calibrated: /

Equipment Used: _____ Date Calibrated: _____

Backwater Conditions (if applicable): _____

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.83 | SU | pH Testr 30 | IS |
| Temperature | 22.0 | °C | YSI 85 | \| |
| Conductivity | 122 | µS/cm | YSI 85 | \| |
| Dissolved Oxygen | 9.16 | mg/L | YSI 85 | \| |
| Flow | — | cfs | -- | \| |
| Turbidity | 9.76 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 1-3-12 Time: 1140

Field Crew: WR

Station ID: WR-01 GPS Coordinates: 36°04'23.7" 94°04'51.3"

Stream Name: White River

Location Description: Wyman Road (just downstream of Lake Sequoyah)

Equipment Used: pH Testr 30 Date Calibrated: 1-3-12

Equipment Used: YSI 85 Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: (Y)/N

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|---|
| pH | 7.72 | 7.69 | SU | pH Testr 30 | SB |
| Temperature | 22.3 | 22.3 | °C | YSI 85 | / |
| Conductivity | 105 | 105 | µS/cm | YSI 85 | / |
| Dissolved Oxygen | 8.57 | 8.46 | mg/L | YSI 85 | / |
| Flow | -- | | cfs | -- | -- |
| Turbidity | 11.0 | 11.4 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

PARTLY CLOUDY

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 4-3-12 Time: 1155

Field Crew: WR

Station ID: 001 GPS Coordinates: 36°04'54.7" 94°05'10.0"

Stream Name: N/A

Location Description: Noland Creek WWTP Effluent

Equipment Used: pH Testr 30 Date Calibrated: 4-3-12

Equipment Used: YSI 85 Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.56 | SU | pH Testr 30 | SB |
| Temperature | 20.9 | °C | YSI 85 | / |
| Conductivity | 580 | µS/cm | YSI 85 | / |
| Dissolved Oxygen | 7.59 | mg/L | YSI 85 | / |
| Flow | -- | cfs | -- | -- |
| Turbidity | 1.76 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 4-3-12 Time: 1210

Field Crew: WR

Station ID: WR-02 GPS Coordinates: 36°05'19.5" 94°04'51.2"

Stream Name: White River

Location Description: Downstream of Noland WWTP

Equipment Used: pH Testr 30 Date Calibrated: 4-3-12

Equipment Used: YSI 85 Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.88 | SU | pH Testr 30 | IS |
| Temperature | 22.2 | °C | YSI 85 | / |
| Conductivity | 140 | µS/cm | YSI 85 | / |
| Dissolved Oxygen | 9.66 | mg/L | YSI 85 | / |
| Flow | -- | cfs | -- | -- |
| Turbidity | 10.2 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

CLOUDY

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 4-8-14 Time: 1230

Field Crew: WR

Station ID: RC-01 GPS Coordinates: 36°06'15.5" 94°00'28.7"

Stream Name: Richland Creek

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: pH Testr 30 Date Calibrated: 4-8-14

Equipment Used: YSI 85 Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 8.36 | SU | pH Testr 30 | S/S |
| Temperature | 20.2 | °C | YSI 85 | / |
| Conductivity | 141 | µS/cm | YSI 85 | / |
| Dissolved Oxygen | 10.58 | mg/L | YSI 85 | / |
| Flow | -- | cfs | -- | -- |
| Turbidity | 4.35 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

SPRINKLING

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 7-3-12 Time: 1240

Field Crew: WR

Station ID: WR-03 GPS Coordinates: 36°06'19.2" 94°00'38.1"

Stream Name: White River

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: pH Testr 30 Date Calibrated: 7-3-12

Equipment Used: YSI 85 Date Calibrated: /

Backwater Conditions (if applicable): YES

Field Duplicate Station: Y/N

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.68 | SU | pH Testr 30 | SB |
| Temperature | 22.3 | °C | YSI 85 | |
| Conductivity | 125 | µS/cm | YSI 85 | |
| Dissolved Oxygen | 7.87 | mg/L | YSI 85 | |
| Flow | -- | cfs | -- | -- |
| Turbidity | 10.6 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 5-3-12 Time: 920

Field Crew: WC

Station ID: Field Blank GPS Coordinates: N/A

Stream Name: Field Blank

Location Description:

Equipment Used: pH Testr 30 Date Calibrated: 5-3-12 7.02/7.00

Equipment Used: YSI 85 Date Calibrated: 95/98

Equipment Used: WTW Turb 550 Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.36 | su | pH Testr 30 | Streambank |
| Temperature | 23.5 | deg C | YSI 85 | Streambank |
| Conductivity | 1.9 | µS/cm | YSI 85 | Streambank |
| Dissolved Oxygen | 6.45 | mg/L | YSI 85 | Streambank |
| Flow | -- | -- | -- | -- |
| Turbidity | 0.05 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 5-3-12 Time: 930

Field Crew: WE

Station ID: WF-01 GPS Coordinates: 35°55'40.2" 94°11'03.2"

Stream Name: West Fork White River

Location Description: Main St./Hwy 156

Equipment Used: pH Testr 30 Date Calibrated: 5-3-12

Equipment Used: YSI 85 Date Calibrated: /

Equipment Used: Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: (Y)/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.61 | SU | pH Testr 30 | In Situ |
| Temperature | 23.1 | °C | YSI 85 | In Situ |
| Conductivity | 153 | µS/cm | YSI 85 | In Situ |
| Dissolved Oxygen | 7.30 | mg/L | YSI 85 | In Situ |
| Flow | 7.6 | cfs | OTT | In Situ |
| Turbidity | 1.74 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

MOSTLY SUNNY

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 5-3-12 Time: 1015

Field Crew: WF

Station ID: RC-02 GPS Coordinates: _____

Stream Name: Richland Creek

Location Description: _____

Equipment Used: pH Testr30 Date Calibrated: 5-3-12

Equipment Used: YSI 85 Date Calibrated: /

Equipment Used: _____ Date Calibrated: /

Backwater Conditions (if applicable): _____

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.65 | SU | pH Testr 30 | SB |
| Temperature | 19.7 | °C | YSI 85 | / |
| Conductivity | 188 | µS/cm | YSI 85 | / |
| Dissolved Oxygen | 7.91 | mg/L | YSI 85 | / |
| Flow | | cfs | -- | |
| Turbidity | 1.7 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 5-3-12 Time: 1045

Field Crew: WF

Station ID: WF-02 GPS Coordinates: 36°03'14.1" 94°04'59.2"

Stream Name: West Fork White River

Location Description: Mally Wagon Road

Equipment Used: pH Testr 30 Date Calibrated: 5-3-12

Equipment Used: YSI 85 Date Calibrated:

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.57 | SU | pH Testr 30 | ~~SB~~ IS |
| Temperature | 21.4 | °C | YSI 85 | |
| Conductivity | 251 | µS/cm | YSI 85 | |
| Dissolved Oxygen | 5.31 | mg/L | YSI 85 | |
| Flow | -- | cfs | -- | -- |
| Turbidity | 7.25 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 5-3-12 Time: 1115

Field Crew: WE

Station ID: WR-02.5 GPS Coordinates: _____

Stream Name: White River

Location Description: _____

Equipment Used: pH Testr30 Date Calibrated: 5-3-12

Equipment Used: YSI 85 Date Calibrated: _____

Equipment Used: _____ Date Calibrated: _____

Backwater Conditions (if applicable): _____

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.62 | SU | pH Testr 30 | SB |
| Temperature | 25.6 | °C | YSI 85 | |
| Conductivity | 189 | µS/cm | YSI 85 | |
| Dissolved Oxygen | 6.37 | mg/L | YSI 85 | |
| Flow | | cfs | -- | |
| Turbidity | 7.02 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 5-3-12 Time: 1145

Field Crew: WL

Station ID: WR-01 GPS Coordinates: 36°04'23.7" 94°04'51.3"

Stream Name: White River

Location Description: Wyman Road (just downstream of Lake Sequoyah)

Equipment Used: pH Testr 30 Date Calibrated: 5-3-12

Equipment Used: YSI 85 Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/N

Flow Measurements Collected: Y/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH 7.77 | ~~7.03~~ | SU | pH Testr 30 | SB |
| Temperature | 26.6 | °C | YSI 85 | |
| Conductivity | 148 | µS/cm | YSI 85 | |
| Dissolved Oxygen | 7.03 | mg/L | YSI 85 | |
| Flow | -- | cfs | -- | -- |
| Turbidity | 9.13 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 5-3-12 Time: 1205

Field Crew: WC

Station ID: 001 GPS Coordinates: 36°04'54.7" 94°05'10.0"

Stream Name: N/A

Location Description: Noland Creek WWTP Effluent

Equipment Used: pH Testr 30 Date Calibrated: 5-3-12

Equipment Used: YSI 85 Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.55 | SU | pH Testr 30 | SB |
| Temperature | 23.6 | °C | YSI 85 | / |
| Conductivity | 593 | µS/cm | YSI 85 | / |
| Dissolved Oxygen | 10.40 | mg/L | YSI 85 | / |
| Flow | -- | cfs | -- | -- |
| Turbidity | 0.56 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 5-3-12 Time: 1230

Field Crew: WF

Station ID: WR-02 GPS Coordinates: 36°05'19.5" 94°04'51.2"

Stream Name: White River

Location Description: Downstream of Noland WWTP

Equipment Used: pH Testr 30 Date Calibrated: 5-3-12

Equipment Used: YSI 85 Date Calibrated:

Backwater Conditions (if applicable): N/A

Field Duplicate Station: (Y)/N

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.68 \| 7.65 | SU | pH Testr 30 | I S |
| Temperature | 25.4 \| 25.4 | °C | YSI 85 | / |
| Conductivity | 189 \| 189 | µS/cm | YSI 85 | / |
| Dissolved Oxygen | 6.68 \| 6.81 | mg/L | YSI 85 | / |
| Flow | -- | cfs | -- | -- |
| Turbidity | 6.85 \| 6.97 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 5-3-12 Time: 1300

Field Crew: WE

Station ID: RC-01 GPS Coordinates: 36°06'15.5" 94°00'28.7"

Stream Name: Richland Creek

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: pH Testr 30 Date Calibrated: 5-3-12

Equipment Used: YSI 85 Date Calibrated: /

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 8.15 | SU | pH Testr 30 | SB |
| Temperature | 26.4 | °C | YSI 85 | / |
| Conductivity | 200 | µS/cm | YSI 85 | / |
| Dissolved Oxygen | 7.94 | mg/L | YSI 85 | / |
| Flow | -- | cfs | -- | -- |
| Turbidity | 2.95 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

CLOUDY

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 5-3-12 Time: 1315

Field Crew: WC

Station ID: WR-03 GPS Coordinates: 36°06'19.2" 94°00'38.1"

Stream Name: White River

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: pH Testr 30 Date Calibrated: 5-3-12

Equipment Used: YSI 85 Date Calibrated: /

Backwater Conditions (if applicable): YES

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.87 | SU | pH Testr 30 | SIS |
| Temperature | 26.7 | °C | YSI 85 | |
| Conductivity | 201 | µS/cm | YSI 85 | |
| Dissolved Oxygen | 6.97 | mg/L | YSI 85 | |
| Flow | -- | cfs | -- | -- |
| Turbidity | 8.37 | NTU | WTW Turb 550 | Laboratory |

Other notes (weather, field conditions, etc.):

*State of Arkansas*
*Department of Environmental Quality*
*Laboratory Certification Program*

# U of A AWRC Water Quality Lab

**Fayetteville, AR**

*has earned certification by law in accordance with Code Annotated §8-2-201 et seq., the State Environmental Laboratory Certification Program Act for the following parameters:*

| | | | |
|---|---|---|---|
| Alkalinity | TOC | Cobalt | Vanadium |
| Ammonia | Total Phosphorus | Copper | Zinc |
| Chloride | Total Solids | Iron | |
| Conductivity | TSS | Lead | |
| Fluoride | Turbidity | Magnesium | |
| Hardness | Aluminum | Manganese | |
| Nitrate | Arsenic | Molybdenum | |
| Orthophosphate | Barium | Nickel | |
| pH | Boron | Potassium | |
| Sulfate | Cadmium | Selenium | |
| TDS | Calcium | Sodium | |
| TKN | Chromium | Titanium | |

Laboratory ID: **72-0749**

Certificate Number: **11-034-0**

Issued Date: **14 February 2011**

Expired Date: **14 February 2012**

Teresa Marks

ADEQ Director

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

**Project West Fork OMI**

**Dr. Brian Haggard**
**ENGR 203**

**Lab Number:** 110337
**Date Reported:** 5/25/11
**Date Received:** 5/19/11 16:15

| Sample | Client ID | Date Sampled | Result | Units | Date Analyzed |
|---|---|---|---|---|---|
| **Chloride** | | **Method: EPA 300.0** | **PQL: 0.24** | **Holding Time Expires: 6/17/11** | |
| 110337-01 | RC-01 | 5/19/11 13:00 | **3.444** | mg/l | 5/20/11 |
| 110337-02 | WR-03 | 5/19/11 13:10 | **3.414** | mg/l | 5/20/11 |
| 110337-03 | 001 | 5/19/11 13:35 | **37.108** | mg/l | 5/20/11 |
| 110337-04 | WR-02 | 5/19/11 13:50 | **5.050** | mg/l | 5/20/11 |
| 110337-05 | WR-01 | 5/19/11 14:15 | **2.397** | mg/l | 5/20/11 |
| 110337-06 | WF-02 | 5/19/11 14:25 | **4.082** | mg/l | 5/20/11 |
| 110337-07 | WF-01 | 5/19/11 15:30 | **2.780** | mg/l | 5/20/11 |
| **Sulfate** | | **Method: EPA 300.0** | **PQL: 0.23** | **Holding Time Expires: 6/17/11** | |
| 110337-01 | RC-01 | 5/19/11 13:00 | **9.428** | mg/l | 5/20/11 |
| 110337-02 | WR-03 | 5/19/11 13:10 | **9.849** | mg/l | 5/20/11 |
| 110337-03 | 001 | 5/19/11 13:35 | **40.877** | mg/l | 5/20/11 |
| 110337-04 | WR-02 | 5/19/11 13:50 | **11.462** | mg/l | 5/20/11 |
| 110337-05 | WR-01 | 5/19/11 14:15 | **8.960** | mg/l | 5/20/11 |
| 110337-06 | WF-02 | 5/19/11 14:25 | **19.417** | mg/l | 5/20/11 |
| 110337-07 | WF-01 | 5/19/11 15:30 | **7.850** | mg/l | 5/20/11 |
| **Total Dissolved Solids** | | **Method: EPA 160.1** | **PQL: 34.9** | **Holding Time Expires: 5/27/11** | |
| 110337-01 | RC-01 | 5/19/11 13:00 | **97.3** | mg/l | 5/20/11 |
| 110337-02 | WR-03 | 5/19/11 13:10 | **77.1** | mg/l | 5/20/11 |
| 110337-03 | 001 | 5/19/11 13:35 | **296.0** | mg/l | 5/20/11 |
| 110337-04 | WR-02 | 5/19/11 13:50 | **93.8** | mg/l | 5/20/11 |
| 110337-05 | WR-01 | 5/19/11 14:15 | **66.7** | mg/l | 5/20/11 |
| 110337-06 | WF-02 | 5/19/11 14:25 | **107.8** | mg/l | 5/20/11 |
| 110337-07 | WF-01 | 5/19/11 15:30 | **66.7** | mg/l | 5/20/11 |

**Verified By:** 05/27/2011

**QA/QC Reviewer:** Bessie B. Massey

PQL = Practical Quantitation Limit

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

# LabQCReport

**For Lab Number:** 110337 5/24/11

## Chloride

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| vhg | 5/20/11 | 1.095 | mg/l | 1.200 | mg/l | 91.3% |
| vhgcl5 | 5/20/11 | 4.745 | mg/l | 5.000 | mg/l | 94.9% |
| vhg | 5/20/11 | 1.087 | mg/l | 1.200 | mg/l | 90.5% |
| std4 | 5/20/11 | 29.329 | mg/l | 30.000 | mg/l | 97.8% |
| vhg | 5/20/11 | 1.098 | mg/l | 1.200 | mg/l | 91.5% |
| vhgcl5 | 5/20/11 | 4.651 | mg/l | 5.000 | mg/l | 93.0% |
| std5 | 5/20/11 | 48.807 | mg/l | 50.000 | mg/l | 97.6% |
| vhgcl5 | 5/20/11 | 4.685 | mg/l | 5.000 | mg/l | 93.7% |
| std5 | 5/20/11 | 48.998 | mg/l | 50.000 | mg/l | 98.0% |
| vhgcl5 | 5/20/11 | 4.746 | mg/l | 5.000 | mg/l | 94.9% |
| vhg | 5/20/11 | 1.101 | mg/l | 1.200 | mg/l | 91.7% |
| std3 | 5/20/11 | 10.063 | mg/l | 10.000 | mg/l | 100.6% |
| | | | | | **AVG* =** | 94.6% |
| | | | | | **RPD**=** | 3.4% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# LabQCReport

**For Lab Number:** 110337 5/24/11

## Sulfate

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| std4 | 5/20/11 | 29.153 | mg/l | 30.000 | mg/l | 97.2% |
| vhg | 5/20/11 | 5.632 | mg/l | 6.000 | mg/l | 93.9% |
| vhg | 5/20/11 | 5.784 | mg/l | 6.000 | mg/l | 96.4% |
| std5 | 5/20/11 | 49.058 | mg/l | 50.000 | mg/l | 98.1% |
| std3 | 5/20/11 | 10.010 | mg/l | 10.000 | mg/l | 100.1% |
| vhg | 5/20/11 | 5.829 | mg/l | 6.000 | mg/l | 97.1% |
| std5 | 5/20/11 | 49.104 | mg/l | 50.000 | mg/l | 98.2% |
| vhg | 5/20/11 | 5.712 | mg/l | 6.000 | mg/l | 95.2% |
| | | | | | **AVG* =** | 97.0% |
| | | | | | **RPD**=** | 5.4% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

# LabQCReport

**For Lab Number:** 110337 5/24/11

## Chloride

| Spikes: | Date | Sample | Result | Spike Level | Spike + Result | % Recovery |
|---|---|---|---|---|---|---|
| | 5/20/11 | 110337-01 | 3.444 mg/l | 4.9 | 8.472 mg/l | 102.6 |

## Sulfate

| Spikes: | Date | Sample | Result | Spike Level | Spike + Result | % Recovery |
|---|---|---|---|---|---|---|
| | 5/20/11 | 110337-01 | 9.428 mg/l | 4.9 | 13.562 mg/l | 84.4 |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

**Arkansas Water Resources Center**
**Water Quality Lab**
**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

# LabQCReport

**For Lab Number:** 110337 5/24/11

## Total Dissolved Solids

| DUPLICATES: | Date | Sample | Result | Duplicate Result | % RSD |
|---|---|---|---|---|---|
| | 5/20/11 | 110337-03 | 296.0 mg/l | 299.1 mg/l | 1.05% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**


## LabQCReport

**For Lab Number:** **110337** **5/24/2011**

### Chloride

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 5/20/11 | blank | 0.0147 mg/l | 0.000 mg/l |

### Sulfate

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 5/20/11 | blank | 0 mg/l | 0.000 mg/l |

### Total Dissolved Solids

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 5/20/11 | blank | -0.67 mg/l | 0.000 mg/l |

AWRC - Water Quality Laboratory
University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701
(501) 575-7317, Fax (501) 575-6720



Name Wade Cash/Dr. Brian Haggard

Mailing Address

City, State, Zip

Phone/Fax

Lab Number:

Project Name WEST FORK OMI

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 110337-1 | ~~RICHLAND~~ RC-01 | 5/19 | 1300 | W | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | ~~Anions, TSS, Turbidity~~ SO4 Cl |
| -B | acid sulfuric | | | 250 | ~~TN/TP, Ammonia~~ TDS |
| -C | filtered | | | 40 | ~~PO4-P (Split/filtered in lab)~~ |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -2 | WR-03 | | 1310 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -3 | 001 | | 1335 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -4 | WR-02 | | 1350 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |

Relinquished By: W

Date/Time: 5-19-11 1615

Received By: W

Date/Time: 5-19-11 1615

AWRC - Water Quality Laboratory
University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701
(501) 575-7317, Fax (501) 575-6720



Name Wade Cash/Dr. Brian Haggard

Mailing Address

City, State, Zip

Phone/Fax

Lab Number:

Project Name WEST FORK

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 110337-5 | WR-01 | 5/19 | 1415 | W | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -6 | ~~WR-04~~ WF-02 | | 1425 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -7 | ~~WR-03~~ WF-01 | | 1530 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| | | | | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |

Relinquished By: WR

Date/Time: 5-19-11 1615

Received By: WR

Date/Time: 5-19-11 1615

# Arkansas Water Resources Center
# Water Quality Lab

University of Arkansas, BIOR 106, 2435 North Hatch
Fayetteville, AR 72704
479-575-7317

**Project** White River UAA
**Dr. Brian Haggard**
**ENGR 203**

RECEIVED
JUN 2 8 2011
BY:_____

**Lab Number:** 110376
**Date Reported:** 6/22/11
**Date Received:** 6/17/11 12:00

| Sample | Client ID | Date Sampled | Result | Units | Date Analyzed |
|---|---|---|---|---|---|
| **Chloride** | | **Method: EPA 300.0** | **PQL: 0.24** | **Holding Time Expires: 7/16/11** | |
| 110376-01 | Blank | 6/17/11 9:30 | **0.090** | mg/l | 6/17/11 |
| 110376-02 | RC-01 | 6/17/11 9:30 | **4.168** | mg/l | 6/17/11 |
| 110376-03 | WR-03 | 6/17/11 9:45 | **6.334** | mg/l | 6/17/11 |
| 110376-04 | 001 | 6/17/11 10:00 | **42.834** | mg/l | 6/17/11 |
| 110376-05 | WR-02 | 6/17/11 10:20 | **7.222** | mg/l | 6/17/11 |
| 110376-06 | WR-01 | 6/17/11 10:45 | **2.941** | mg/l | 6/17/11 |
| 110376-07 | WR-01 - dup | 6/17/11 10:45 | **2.943** | mg/l | 6/17/11 |
| 110376-08 | WF-02 | 6/17/11 11:00 | **5.815** | mg/l | 6/17/11 |
| 110376-09 | WF-01 | 6/17/11 11:30 | **3.518** | mg/l | 6/17/11 |
| **Sulfate** | | **Method: EPA 300.0** | **PQL: 0.23** | **Holding Time Expires: 7/16/11** | |
| 110376-01 | Blank | 6/17/11 9:30 | **0.055** | mg/l | 6/17/11 |
| 110376-02 | RC-01 | 6/17/11 9:30 | **10.598** | mg/l | 6/17/11 |
| 110376-03 | WR-03 | 6/17/11 9:45 | **15.715** | mg/l | 6/17/11 |
| 110376-04 | 001 | 6/17/11 10:00 | **79.533** | mg/l | 6/21/11 |
| 110376-05 | WR-02 | 6/17/11 10:20 | **20.236** | mg/l | 6/17/11 |
| 110376-06 | WR-01 | 6/17/11 10:45 | **15.194** | mg/l | 6/17/11 |
| 110376-07 | WR-01 - dup | 6/17/11 10:45 | **15.194** | mg/l | 6/17/11 |
| 110376-08 | WF-02 | 6/17/11 11:00 | **34.750** | mg/l | 6/17/11 |
| 110376-09 | WF-01 | 6/17/11 11:30 | **12.160** | mg/l | 6/17/11 |
| **Total Dissolved Solids** | | **Method: EPA 160.1** | **PQL: 34.9** | **Holding Time Expires: 6/25/11** | |
| 110376-01 | Blank | 6/17/11 9:30 | **0.0** | mg/l | 6/20/11 |
| 110376-02 | RC-01 | 6/17/11 9:30 | **112.0** | mg/l | 6/20/11 |
| 110376-03 | WR-03 | 6/17/11 9:45 | **113.6** | mg/l | 6/20/11 |
| 110376-04 | 001 | 6/17/11 10:00 | **365.8** | mg/l | 6/20/11 |
| 110376-05 | WR-02 | 6/17/11 10:20 | **130.5** | mg/l | 6/20/11 |
| 110376-06 | WR-01 | 6/17/11 10:45 | **104.7** | mg/l | 6/20/11 |
| 110376-07 | WR-01 - dup | 6/17/11 10:45 | **102.2** | mg/l | 6/20/11 |
| 110376-08 | WF-02 | 6/17/11 11:00 | **165.1** | mg/l | 6/20/11 |
| 110376-09 | WF-01 | 6/17/11 11:30 | **96.9** | mg/l | 6/20/11 |

PQL = Practical Quantitation Limit

| Sample | Client ID | Date Sampled | Result | Units | Date Analyzed |
|---|---|---|---|---|---|
| **Turbidity** | | **Method: EPA 180.1** | **PQL: 0.5** | **Holding Time Expires: 6/20/11** | |
| 110376-01 | Blank | 6/17/11 9:30 | **0.05** | NTU's | 6/17/11 |
| 110376-02 | RC-01 | 6/17/11 9:30 | **5.7** | NTU's | 6/17/11 |
| 110376-03 | WR-03 | 6/17/11 9:45 | **5.7** | NTU's | 6/17/11 |
| 110376-04 | 001 | 6/17/11 10:00 | **0.7** | NTU's | 6/17/11 |
| 110376-05 | WR-02 | 6/17/11 10:20 | **10.3** | NTU's | 6/17/11 |
| 110376-06 | WR-01 | 6/17/11 10:45 | **8.3** | NTU's | 6/17/11 |
| 110376-07 | WR-01 - dup | 6/17/11 10:45 | **8.7** | NTU's | 6/17/11 |
| 110376-08 | WF-02 | 6/17/11 11:00 | **8.3** | NTU's | 6/17/11 |
| 110376-09 | WF-01 | 6/17/11 11:30 | **1.1** | NTU's | 6/17/11 |

**Verified By:** 06/22/11

**QA/QC Reviewer:** Kerri Massey

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

# LabQCReport

**For Lab Number:** 110376 6/22/11

## Chloride

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| vhg | 6/17/11 | 1.171 | mg/l | 1.200 | mg/l | 97.6% |
| vhgcl5 | 6/17/11 | 4.867 | mg/l | 5.000 | mg/l | 97.3% |
| vhg | 6/17/11 | 1.245 | mg/l | 1.200 | mg/l | 103.7% |
| vhgcl5 | 6/17/11 | 4.805 | mg/l | 5.000 | mg/l | 96.1% |
| std3 | 6/17/11 | 10.209 | mg/l | 10.000 | mg/l | 102.1% |
| std5 | 6/17/11 | 49.866 | mg/l | 50.000 | mg/l | 99.7% |
| | | | | | **AVG* =** | 99.4% |
| | | | | | **RPD**=** | 3.0% |

## Sulfate

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| vhg | 6/17/11 | 5.903 | mg/l | 6.000 | mg/l | 98.4% |
| std3 | 6/17/11 | 9.909 | mg/l | 10.000 | mg/l | 99.1% |
| std5 | 6/17/11 | 50.014 | mg/l | 50.000 | mg/l | 100.0% |
| vhg | 6/17/11 | 5.812 | mg/l | 6.000 | mg/l | 96.9% |
| vhg | 6/21/11 | 5.987 | mg/l | 6.000 | mg/l | 99.8% |
| std3 | 6/21/11 | 10.211 | mg/l | 10.000 | mg/l | 102.1% |
| std5 | 6/21/11 | 50.422 | mg/l | 50.000 | mg/l | 100.8% |
| vhg | 6/21/11 | 5.898 | mg/l | 6.000 | mg/l | 98.3% |
| | | | | | **AVG* =** | 99.4% |
| | | | | | **RPD**=** | 4.6% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# LabQCReport

**For Lab Number:** 110376 6/22/11

## Turbidity

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| Std1.0 | 6/17/11 | 1.000 | NTU's | 1.000 | NTU's | 100.0% |
| Std20 | 6/17/11 | 19.800 | NTU's | 20.000 | NTU's | 99.0% |
| Std10 | 6/17/11 | 9.900 | NTU's | 10.000 | NTU's | 99.0% |
| Std10 | 6/17/11 | 10.100 | NTU's | 10.000 | NTU's | 101.0% |
| | | | | | **AVG* =** | 99.7% |
| | | | | | **RPD**=** | 5.6% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

# LabQCReport

**For Lab Number:** 110376 6/22/11

## Chloride

| Spikes: Date | Sample | Result | Spike Level | Spike + Result | % Recovery |
|---|---|---|---|---|---|
| 6/17/11 | 110376-01 | 0.090 mg/l | 4.9 | 4.934 mg/l | 98.9 |

## Sulfate

| Spikes: Date | Sample | Result | Spike Level | Spike + Result | % Recovery |
|---|---|---|---|---|---|
| 6/17/11 | 110376-01 | 0.055 mg/l | 4.9 | 4.682 mg/l | 94.4 |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

**Arkansas Water Resources Center**
**Water Quality Lab**

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

# LabQCReport

**For Lab Number:** 110376 6/22/11

## Total Dissolved Solids

| DUPLICATES: | Date | Sample | Result | Duplicate Result | % RSD |
|---|---|---|---|---|---|
| | 6/20/11 | 110376-02 | 112.0 mg/l | 115.3 mg/l | 2.94% |

## Turbidity

| DUPLICATES: | Date | Sample | Result | Duplicate Result | % RSD |
|---|---|---|---|---|---|
| | 6/17/11 | 110376-01 | 0.1 NTU's | 0.0 NTU's | 85.71% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

# LabQCReport

**For Lab Number:** **110376** **6/22/2011**

## Chloride

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 6/17/11 | blank | 0.0374 mg/l | 0.000 mg/l |

## Sulfate

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 6/17/11 | blank | 0.0275 mg/l | 0.000 mg/l |
| | 6/21/11 | blank | 0.0368 mg/l | 0.000 mg/l |

## Total Dissolved Solids

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 6/20/11 | blank | 0.44 mg/l | 0.000 mg/l |

## Turbidity

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 6/17/11 | blank | 0.02 NTU's | 0.000 NTU's |

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**



Name Wade Cash/Dr. Brian Haggard

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name W4I7R RIVER USA

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 110376-1 | BLANK | 6/17 | 930 | W | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, ~~TSS~~, Turbidity Cl + SO4 |
| -B | acid sulfuric | | | 250 | ~~TN/TP, Ammonia~~ |
| -C | filtered | | | 40 | ~~PO4-P (Split/filtered in lab)~~ TDS |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -2 | RC-01 | | 930 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -3 | WR-03 | | 945 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -4 | 001 | | 1000 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |

Relinquished By: WR

Date/Time: 6-17-11 1200

Received By: WR

Date/Time: 6-17-11 1200

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**



Name Wade Cash/Dr. Brian Haggard

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name WHITE RIVER USA

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 11D376-5 | WR-02 | 6/17 | 1020 | LL | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -6 | WR-01 | | 1045 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -7 | WR-01 DUP | | 1045 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -8 | WF-02 | | 1100 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |

Relinquished By: WE

Date/Time: 6-17-11 1200

Received By: WE

Date/Time: 6-17-11 1200

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**



Name Wade Cash/Dr. Brian Haggard

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name WG172 Illinois DAR

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 110376-9 | L.F-01 | 6/17 | 1130 | WL | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| | | | | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| | | | | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| | | | | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |

Relinquished By: WL

Date/Time: 6-17-11 1200

Received By: WL

Date/Time: 6-17-11 1200

# Arkansas Water Resources Center
# Water Quality Lab

University of Arkansas, BIOR 106, 2435 North Hatch
Fayetteville, AR 72704
479-575-7317

RECEIVED
AUG 10 2011
BY:

**Project** White River UAA

**Dr. Brian Haggard**
**ENGR 203**

**Lab Number:** 120015
**Date Reported:** 7/29/11
**Date Received:** 7/19/11 12:30

| Sample | Client ID | Date Sampled | Result | Units | Date Analyzed |
|---|---|---|---|---|---|
| **Chloride** | | **Method: EPA 300.0** | **PQL: 0.24** | **Holding Time Expires: 8/17/11** | |
| 120015-01 | Blank | 7/19/11 9:00 | **0.100** | mg/l | 7/20/11 |
| 120015-02 | WF-01 | 7/19/11 9:00 | **4.579** | mg/l | 7/20/11 |
| 120015-03 | WF-01 - dup | 7/19/11 9:00 | **4.604** | mg/l | 7/20/11 |
| 120015-04 | WF-02 | 7/19/11 9:58 | **7.822** | mg/l | 7/20/11 |
| 120015-05 | WR-01 | 7/19/11 10:15 | **5.825** | mg/l | 7/20/11 |
| 120015-06 | 001 | 7/19/11 10:32 | **46.235** | mg/l | 7/20/11 |
| 120015-07 | WR-02 | 7/19/11 10:57 | **35.269** | mg/l | 7/20/11 |
| 120015-08 | WR-03 | 7/19/11 11:33 | **11.329** | mg/l | 7/20/11 |
| 120015-09 | RC-01 | 7/19/11 11:41 | **4.850** | mg/l | 7/20/11 |
| **Sulfate** | | **Method: EPA 300.0** | **PQL: 0.23** | **Holding Time Expires: 8/17/11** | |
| 120015-01 | Blank | 7/19/11 9:00 | **0.000** | mg/l | 7/20/11 |
| 120015-02 | WF-01 | 7/19/11 9:00 | **15.214** | mg/l | 7/20/11 |
| 120015-03 | WF-01 - dup | 7/19/11 9:00 | **15.267** | mg/l | 7/20/11 |
| 120015-04 | WF-02 | 7/19/11 9:58 | **36.041** | mg/l | 7/20/11 |
| 120015-05 | WR-01 | 7/19/11 10:15 | **22.678** | mg/l | 7/20/11 |
| 120015-06 | 001 | 7/19/11 10:32 | **103.60** | mg/l | 7/21/11 |
| 120015-07 | WR-02 | 7/19/11 10:57 | **71.006** | mg/l | 7/21/11 |
| 120015-08 | WR-03 | 7/19/11 11:33 | **20.146** | mg/l | 7/20/11 |
| 120015-09 | RC-01 | 7/19/11 11:41 | **8.703** | mg/l | 7/20/11 |
| **Total Dissolved Solids** | | **Method: EPA 160.1** | **PQL: 34.9** | **Holding Time Expires: 7/27/11** | |
| 120015-01 | Blank | 7/19/11 9:00 | **1.1** | mg/l | 7/20/11 |
| 120015-02 | WF-01 | 7/19/11 9:00 | **123.6** | mg/l | 7/20/11 |
| 120015-03 | WF-01 - dup | 7/19/11 9:00 | **122.4** | mg/l | 7/20/11 |
| 120015-04 | WF-02 | 7/19/11 9:58 | **178.9** | mg/l | 7/20/11 |
| 120015-05 | WR-01 | 7/19/11 10:15 | **150.9** | mg/l | 7/20/11 |
| 120015-06 | 001 | 7/19/11 10:32 | **375.6** | mg/l | 7/20/11 |
| 120015-07 | WR-02 | 7/19/11 10:57 | **305.3** | mg/l | 7/20/11 |
| 120015-08 | WR-03 | 7/19/11 11:33 | **147.8** | mg/l | 7/20/11 |
| 120015-09 | RC-01 | 7/19/11 11:41 | **146.9** | mg/l | 7/20/11 |

PQL = Practical Quantitation Limit

| Sample | Client ID | Date Sampled | Result | Units | Date Analyzed |
|---|---|---|---|---|---|
| **Turbidity** | | **Method: EPA 180.1** | **PQL: 0.5** | **Holding Time Expires: 7/22/11** | |
| 120015-01 | Blank | 7/19/11 9:00 | **0.02** | NTU's | 7/20/11 |
| 120015-02 | WF-01 | 7/19/11 9:00 | **0.61** | NTU's | 7/20/11 |
| 120015-03 | WF-01 - dup | 7/19/11 9:00 | **0.5** | NTU's | 7/20/11 |
| 120015-04 | WF-02 | 7/19/11 9:58 | **7.2** | NTU's | 7/20/11 |
| 120015-05 | WR-01 | 7/19/11 10:15 | **6.3** | NTU's | 7/20/11 |
| 120015-06 | 001 | 7/19/11 10:32 | **1.4** | NTU's | 7/20/11 |
| 120015-07 | WR-02 | 7/19/11 10:57 | **4.9** | NTU's | 7/20/11 |
| 120015-08 | WR-03 | 7/19/11 11:33 | **5.4** | NTU's | 7/20/11 |
| 120015-09 | RC-01 | 7/19/11 11:41 | **8.2** | NTU's | 7/20/11 |

**Verified By:** 08/08/2011

**QA/QC Reviewer:** Leslie B. Massey

PQL = Practical Quantitation Limit

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

# LabQCReport

**For Lab Number:** 120015 7/29/11

## Chloride

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| vhgcl5 | 7/20/11 | 4.752 | mg/l | 5.000 | mg/l | 95.0% |
| vhgcl5 | 7/20/11 | 4.748 | mg/l | 5.000 | mg/l | 95.0% |
| std4 | 7/20/11 | 29.900 | mg/l | 30.000 | mg/l | 99.7% |
| vhgcl5 | 7/20/11 | 4.797 | mg/l | 5.000 | mg/l | 95.9% |
| std3 | 7/20/11 | 10.013 | mg/l | 10.000 | mg/l | 100.1% |
| std5 | 7/20/11 | 50.009 | mg/l | 50.000 | mg/l | 100.0% |
| | | | | | **AVG* =** | 97.6% |
| | | | | | **RPD**=** | 2.6% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# LabQCReport

**For Lab Number:** 120015 7/29/11

## Sulfate

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| std4 | 7/20/11 | 29.878 | mg/l | 30.000 | mg/l | 99.6% |
| vhg | 7/20/11 | 5.812 | mg/l | 6.000 | mg/l | 96.9% |
| std3 | 7/20/11 | 10.013 | mg/l | 10.000 | mg/l | 100.1% |
| std5 | 7/20/11 | 50.018 | mg/l | 50.000 | mg/l | 100.0% |
| vhg | 7/20/11 | 5.850 | mg/l | 6.000 | mg/l | 97.5% |
| vhg | 7/20/11 | 5.858 | mg/l | 6.000 | mg/l | 97.6% |
| vhg | 7/21/11 | 5.813 | mg/l | 6.000 | mg/l | 96.9% |
| vhg | 7/21/11 | 5.848 | mg/l | 6.000 | mg/l | 97.5% |
| std4 | 7/21/11 | 29.851 | mg/l | 30.000 | mg/l | 99.5% |
| vhg | 7/21/11 | 5.840 | mg/l | 6.000 | mg/l | 97.3% |
| std5 | 7/21/11 | 50.152 | mg/l | 50.000 | mg/l | 100.3% |
| std3 | 7/21/11 | 10.004 | mg/l | 10.000 | mg/l | 100.0% |
| | | | | | **AVG* =** | 98.6% |
| | | | | | **RPD**=** | 4.1% |

## Turbidity

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| Std1.0 | 7/20/11 | 1.000 | NTU's | 1.000 | NTU's | 100.0% |
| Std10 | 7/20/11 | 10.200 | NTU's | 10.000 | NTU's | 102.0% |
| Std10 | 7/20/11 | 9.800 | NTU's | 10.000 | NTU's | 98.0% |
| Std10 | 7/20/11 | 10.100 | NTU's | 10.000 | NTU's | 101.0% |
| | | | | | **AVG* =** | 100.2% |
| | | | | | **RPD**=** | 5.8% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

# LabQCReport

**For Lab Number:** 120015 7/29/11

## Chloride

| Spikes: | Date | Sample | Result | Spike Level | Spike + Result | % Recovery |
|---|---|---|---|---|---|---|
| | 7/20/11 | 120015-01 | 0.100 mg/l | 4.9 | 4.987 mg/l | 99.7 |

## Sulfate

| Spikes: | Date | Sample | Result | Spike Level | Spike + Result | % Recovery |
|---|---|---|---|---|---|---|
| | 7/20/11 | 120015-01 | 0.000 mg/l | 4.9 | 4.745 mg/l | 96.8 |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

**Arkansas Water Resources Center**
**Water Quality Lab**

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

# LabQCReport

**For Lab Number:** 120015 7/29/11

## Total Dissolved Solids

| DUPLICATES: | Date | Sample | Result | Duplicate Result | % RSD |
|---|---|---|---|---|---|
| | 7/20/11 | 120015-02 | 123.6 mg/l | 124.0 mg/l | 0.36% |

## Turbidity

| DUPLICATES: | Date | Sample | Result | Duplicate Result | % RSD |
|---|---|---|---|---|---|
| | 7/20/11 | 120015-01 | 0.0 NTU's | 0.0 NTU's | 0.00% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**


## LabQCReport

**For Lab Number:** **120015** **7/29/2011**

### Chloride

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 7/20/11 | blank | 0.0904 mg/l | 0.000 mg/l |

### Sulfate

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 7/20/11 | blank | 0.0477 mg/l | 0.000 mg/l |
| | 7/21/11 | blank | 0.0394 mg/l | 0.000 mg/l |

### Total Dissolved Solids

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 7/20/11 | blank | -0.22 mg/l | 0.000 mg/l |

### Turbidity

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 7/20/11 | blank | 0.02 NTU's | 0.000 NTU's |

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**



Name Wade Cash/Dr. Brian Haggard

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name WRUAA

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 120015-1 | BLANK | 7/19 | 900 | WR | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -2 | WF-01 | | 900 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -3 | WF-01-DUP | | 900 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -4 | WF-02 | | 958 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |

Relinquished By: WR

Date/Time: 7-19-11 1230

Received By: WR

Date/Time: 7-19-11 1230

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**

Page____of____

Name LC

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name WRUAA

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 12015-5 | WR-01 | 7/19 | 1015 | LC | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -6 | 001 | | 1042 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -7 | WR-02 | | 1057 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -8 | WR-03 | | 1133 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |

Relinquished By: LC

Date/Time: 7-19-11 1230

Received By: LC

Date/Time: 7-19-11 1230

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**



Name _____

Mailing Address _____

City, State, Zip _____

Phone/Fax _____

**Lab Number:**

Project Name WRUNA

Cost Ctr. No./P.O. No. _____

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 1210E-9 | RC-01 | 7/14 | 1141 | WL | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| | | | | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| | | | | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| | | | | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |

Relinquished By: WL

Date/Time: 12-19-11 1230

Received By: WL

Date/Time: 12-19-11 1230

Transcribed from field book on 7/19/2011 - LM

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 6/17/2011 Time: 9:30 AM

Field Crew: Wade Cash

Station ID: RC-01 GPS Coordinates: _____

Stream Name: Richland Creek

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: YSI 85 Date Calibrated: 6/17/2011

Equipment Used: Oakton pH Testr 30 Date Calibrated: ~~6/8/2011~~ 6/8/11

Backwater Conditions (if applicable): ~~N/A~~ Yes

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank (SB)/ Laboratory |
|---|---|---|---|---|
| pH | 7.90 | SU | Oakton | SB |
| Temperature | 26.3 | °C | YSI | SB |
| Conductivity | 203 | µS/cm | YSI | SB |
| Dissolved Oxygen | 5.05 | mg/L | YSI | SB |
| Flow | | cfs | | |
| Turbidity | | | | Lab |

Other notes (weather, field conditions, etc.):

Blank collected at this site

Calibration information:

| | Standard | Measurement | Actions |
|---|---|---|---|
| pH | 7.00 | 6.99 | None |
| Cond | 100 | 99 | None |

Transcribed from field book on 7/19/2011 - LM

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 6/17/2011 Time: 9:45 AM

Field Crew: Wade Cash

Station ID: WR-03 GPS Coordinates:

Stream Name: White River

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: YSI 85 Multiprobe Date Calibrated: 6/17/2011

Equipment Used: Oakton pH Testr 30 Date Calibrated: ~~6/8/2011~~ 6/8/11

Backwater Conditions (if applicable): YES

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.55 | SU | Oakton | Streambank |
| Temperature | 27 | °C | YSI | streambank |
| Conductivity | 204 | µS/cm | YSI | streambank |
| Dissolved Oxygen | 7.37 | mg/L | YSI | Streambank |
| Flow | | cfs | | |
| Turbidity | | | | Lab |

Other notes (weather, field conditions, etc.):

Transcribed from field book on 7/19/2011 - LM

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 6/17/2011 Time: 10:20 AM

Field Crew: Wade Cash

Station ID: WR-02 GPS Coordinates:

Stream Name: White River

Location Description: Downstream of Noland WWTP

Equipment Used: YSI 85 Multiprobe Date Calibrated: 6/17/2011

Equipment Used: Oakton pH Testr 30 Date Calibrated: ~~6/8/2011~~ 6/8/11

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.27 | SU | Oakton | In situ |
| Temperature | 25.6 | °C | YSI | In Situ |
| Conductivity | 209 | µS/cm | YSI | In Situ |
| Dissolved Oxygen | 7.95 | mg/L | YSI | In Situ |
| Flow | | cfs | | |
| Turbidity | | NTU | | Lab |

Other notes (weather, field conditions, etc.):

Transcribed from field book on 7/19/2011 - LM

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 6/17/2011 Time: 10:45 AM

Field Crew: Wade Cash

Station ID: WR-01 GPS Coordinates:

Stream Name: White River

Location Description: Wyman Road (just downstream of Lake Sequoyah)

Equipment Used: YSI 85 Multiprobe Date Calibrated: 6/17/2011

Equipment Used: Oakton pH Testr 30 Date Calibrated: ~~6/8/2011~~ 6/8/11

Backwater Conditions (if applicable): N/A

Field Duplicate Station: (Y)/N

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.26 | SU | [redacted] Oakton | Streambank |
| Temperature | 26.8 | °C | YSI | streambank |
| Conductivity | 171 | µS/cm | YSI | Streambank |
| Dissolved Oxygen | 8.34 | mg/L | YSI | streambank |
| Flow | [redacted] | cfs | | |
| Turbidity | | | | Lab |

Other notes (weather, field conditions, etc.):

Transcribed from field book on 7/19/2011 - LM

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 6/17/2011 Time: 10:00 AM

Field Crew: Wade Cash

Station ID: 001 GPS Coordinates:

Stream Name: N/A

Location Description: Noland Creek WWTP Effluent

Equipment Used: YSI 85 Date Calibrated: 6/17/2011

Equipment Used: Oakton pH Testr 30 Date Calibrated: ~~6/12/2011~~ 6/8/11

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.12 | SU | | streambank |
| Temperature | 24 | °C | | streambank |
| Conductivity | 582 | µS/cm | | streambank |
| Dissolved Oxygen | 8.07 | mg/L | | streambank |
| Flow | | cfs | | |
| Turbidity | | | | Lab |

Other notes (weather, field conditions, etc.):

Transcribed from field book on 7/19/2011 -LM

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 6/17/2011 Time: 11:00 AM

Field Crew: Wade Cash

Station ID: WF-02 GPS Coordinates:

Stream Name: West Fork White River

Location Description: Mally Wagon Road

Equipment Used: YSI 85 Multi probe Date Calibrated: 6/17/2011

Equipment Used: Oakton pH Testr 30 Date Calibrated: ~~6/13/2011~~ 6/8/11

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.23 | SU | | In Situ |
| Temperature | 26.3 | °C | | In Situ |
| Conductivity | 284 | µS/cm | | In Situ |
| Dissolved Oxygen | 7.71 | mg/L | | In Situ |
| Flow | | cfs | | |
| Turbidity | | | | Lab |

Other notes (weather, field conditions, etc.):

Transcribed from field book on 7/19/2011 - LM

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 6/17/2011 Time: 11:30 AM

Field Crew: Wade Cash

Station ID: WF-01 GPS Coordinates:

Stream Name: West Fork White River

Location Description: Main St./Hwy 156

Equipment Used: YSI 85 Multiprobe Date Calibrated: 6/17/2011

Equipment Used: Oakton pH Testr 30 Date Calibrated: ~~6/13/2011~~ 6/8/11

Equipment Used: Date Calibrated: N/A

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: (Y)/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | ~~7.48~~ 7.48 | SU | | Insitu |
| Temperature | 25.2 | °C | | In situ |
| Conductivity | 167 | µS/cm | | In situ |
| Dissolved Oxygen | 9.28 | mg/L | | In situ |
| Flow | 8.08 | cfs | | In situ |
| Turbidity | | | | Lab |

Other notes (weather, field conditions, etc.):

Transcribed from field book on 7/19/2011 -LM

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 5/19/2011 Time: 14:15

Field Crew: Wade Cash

Station ID: WR-01 GPS Coordinates: _____

Stream Name: White River

Location Description: Wyman Road (just downstream of Lake Sequoyah)

Equipment Used: _____ Date Calibrated: _____

Equipment Used: _____ Date Calibrated: _____

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y (N)

Flow Measurements Collected: Y (N)

Water Quality Measurements: Not collected during this event

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | | SU | | |
| Temperature | | °C | | |
| Conductivity | | µS/cm | | |
| Dissolved Oxygen | | mg/L | | |
| Flow | | cfs | | |
| Turbidity | | | | |

Other notes (weather, field conditions, etc.):

Transcribed from field book on 7/19/2011 -LM

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 5/19/2011 Time: 13:50

Field Crew: Wade Cash & Tim Luther

Station ID: WR-02 GPS Coordinates: _____

Stream Name: White River

Location Description: Downstream of Noland WWTP

Equipment Used: _____ Date Calibrated: _____

Equipment Used: _____ Date Calibrated: _____

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements: None, Collected during this event

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | | SU | | |
| Temperature | | °C | | |
| Conductivity | | µS/cm | | |
| Dissolved Oxygen | | mg/L | | |
| Flow | | cfs | | |
| Turbidity | | | | |

Other notes (weather, field conditions, etc.):

Transcribed from field book on 7/19/2011 - LM

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 5/19/2011 Time: 13:10

Field Crew: Wade Cash

Station ID: WR-03 GPS Coordinates: _____

Stream Name: White River

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: _____ Date Calibrated: _____

Equipment Used: _____ Date Calibrated: _____

Backwater Conditions (if applicable): Yes

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements: None collected during this event

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | | SU | | |
| Temperature | | °C | | |
| Conductivity | | µS/cm | | |
| Dissolved Oxygen | | mg/L | | |
| Flow | | cfs | | |
| Turbidity | | | | |

Other notes (weather, field conditions, etc.):

Transcribed from field book on 7/19/2011 -LM

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 5/19/2011 Time: 15:30

Field Crew: Wade Cash

Station ID: WF-01 GPS Coordinates: _____

Stream Name: West Fork White River

Location Description: Main St./Hwy 156

Equipment Used: Marsh McBirney Flowmate 2000 Date Calibrated: N/A

Equipment Used: _____ Date Calibrated: _____

Equipment Used: _____ Date Calibrated: _____

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: (Y)/N Yes

Water Quality Measurements: None collected during this event

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | | SU | | |
| Temperature | | °C | | |
| Conductivity | | µS/cm | | |
| Dissolved Oxygen | | mg/L | | |
| Flow | 27.34 | cfs | Marsh-McBirney | In situ |
| Turbidity | | | | |

Other notes (weather, field conditions, etc.):

Transcribed from field book on 7/19/2011 - LM

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 5/19/2011 Time: 14:25

Field Crew: Wade Cash

Station ID: WF-02 GPS Coordinates: _____

Stream Name: West Fork White River

Location Description: Mally Wagon Road

Equipment Used: _____ Date Calibrated: [illegible]

Equipment Used: _____ Date Calibrated: _____

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements: Not collected during this event

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | | SU | | |
| Temperature | | °C | | |
| Conductivity | | µS/cm | | |
| Dissolved Oxygen | | mg/L | | |
| Flow | | cfs | | |
| Turbidity | | | | |

Other notes (weather, field conditions, etc.):

Transcribed from field book on 7/19/2011 - LM

## City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 5/19/2011 Time: 13:00

Field Crew: Wade Cash

Station ID: RC-01 GPS Coordinates: _____

Stream Name: Richland Creek

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: _____ Date Calibrated: _____

Equipment Used: _____ Date Calibrated: _____

Backwater Conditions (if applicable): ~~N/A~~ Yes

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements: Not collected during this event

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | | SU | | |
| Temperature | | °C | | |
| Conductivity | | µS/cm | | |
| Dissolved Oxygen | | mg/L | | |
| Flow | | cfs | | |
| Turbidity | | | | |

Other notes (weather, field conditions, etc.):

Transcribed from field book on 7/19/2011 - LM

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 5/19/2011 Time: 13:55

Field Crew: Wade Cash & Tim Luther

Station ID: 001 GPS Coordinates: _____

Stream Name: N/A

Location Description: Noland Creek WWTP Effluent

Equipment Used: _____ Date Calibrated: _____

Equipment Used: _____ Date Calibrated: _____

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements: None collected during this event

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | | SU | | |
| Temperature | | °C | | |
| Conductivity | | µS/cm | | |
| Dissolved Oxygen | | mg/L | | |
| Flow | | cfs | | |
| Turbidity | | | | |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 7/19/2011 Time: 11:41 AM

Field Crew: Cash & Massey

Station ID: RC-01 GPS Coordinates: 36° 06' 15.5" N ; 94° 00' 28.7" W

Stream Name: Richland Creek

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: Oakton pH Testr 30 Date Calibrated: 7/18/2011

Equipment Used: YSI 85 Date Calibrated: 7/19/2011

Backwater Conditions (if applicable): ~~N/A~~ Yes

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.79 | SU | Oakton | Streambank |
| Temperature | 30.6 | °C | YSI | ↓ |
| Conductivity | 118 | µS/cm | YSI | ↓ |
| Dissolved Oxygen | 5.97 | mg/L | YSI | ↓ |
| Flow | | cfs | | |
| Turbidity | | | | Lab |

Other notes (weather, field conditions, etc.):

Hot, Sunny

Calibration of field probe results

| | Measurement | Standard | |
|---|---|---|---|
| pH | 7.01 | 7.0 | (7/18/2011) |
| Cond | 97 | 100 | (7/19/2011) |

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 7/19/2011 Time: 11:33

Field Crew: Wade Cash; Leslie Massey

Station ID: WR-03 GPS Coordinates: 36° 06' 19.2" N 94° 00' 38.1"

Stream Name: White River

Location Description: State Hwy 45/Bowen Blvd

Equipment Used: Oakton pH Testr 30 Date Calibrated: 07/18/2011

Equipment Used: YSI 85 Date Calibrated: 07/19/2011

Backwater Conditions (if applicable): Yes

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 8.73 | SU | Oakton | streambank |
| Temperature | 31.9 | °C | YSI | streambank |
| Conductivity | 246 | µS/cm | YSI | streambank |
| Dissolved Oxygen | 8.74 | mg/L | YSI | streambank |
| Flow | | cfs | | |
| Turbidity | | | | lab |

Other notes (weather, field conditions, etc.):

Hot & Sunny

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 7/19/2011 Time: 10:57 AM

Field Crew: Wade Cash & Leslie Massey

Station ID: WR-02 GPS Coordinates: 36° 05' 19.5" N, 94° 04' 51.2" W

Stream Name: White River

Location Description: Downstream of Noland WWTP

Equipment Used: Oakton pH Testr 30 Date Calibrated: 7/18/2011

Equipment Used: YSI 85 Date Calibrated: 7/19/2011

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.01 | SU | | In situ |
| Temperature | 26.3 | °C | | ↓ |
| Conductivity | 484 | µS/cm | | ↓ |
| Dissolved Oxygen | 5.64 | mg/L | | ↓ |
| Flow | | cfs | | |
| Turbidity | | | | Lab |

Other notes (weather, field conditions, etc.):

Conductivity measured across stream.

| Width (ft) | (conductivity) |
|---|---|
| 0 | 494 |
| 3 | 486 |
| 6 | 485 |
| 9 | 487 |
| 12 | 486 |
| 15 | 487 |
| 18 | 486 |
| 21 | 484 |
| 24 | 484 |
| 27 | 484 |
| 30 | bank |

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 7/19/2011 Time: 10:15 AM

Field Crew: Wade Cash & Leslie Massey

Station ID: WR-01 GPS Coordinates: 36° 04' 23.7" N ; 94°04'51.3" W

Stream Name: White River

Location Description: Wyman Road (just downstream of Lake Sequoyah)

Equipment Used: Oakton pH Testr 30 Date Calibrated: 7/18/2011

Equipment Used: YSI 85 Date Calibrated: 7/19/2011

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH 7.74 | ~~7.74~~ | SU | Oakton | Streambank |
| Temperature | 29.2 | °C | YSI | Streambank |
| Conductivity | 243 | µS/cm | YSI | Streambank |
| Dissolved Oxygen | 5.0 | mg/L | YSI | Streambank |
| Flow | | cfs | | |
| Turbidity | | | | Lab |

Other notes (weather, field conditions, etc.):

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 7/19/2011 Time: 10:32 AM

Field Crew: Wade Cash & Leslie Massey

Station ID: 001 GPS Coordinates: 36° 04' 54.7" N 094° 05' 10.0 "

Stream Name: N/A

Location Description: Noland Creek WWTP Effluent

Equipment Used: _____ Date Calibrated: _____

Equipment Used: _____ Date Calibrated: _____

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/N

Flow Measurements Collected: Y/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.19 | SU | | Streambank |
| Temperature | 26.9 | °C | | Streambank |
| Conductivity | 579 | µS/cm | | Streambank |
| Dissolved Oxygen | 9.22 | mg/L | | Streambank |
| Flow | | cfs | | |
| Turbidity | | | | Lab |

Other notes (weather, field conditions, etc.):

Collected from 001 using onsite pitcher

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 7/19/2011 Time: 9:58 AM

Field Crew: Wade Cash & Leslie Massey

Station ID: WF-02 GPS Coordinates: 36° 03' 14.1 N; 94° 04' 59.2" W

Stream Name: West Fork White River

Location Description: Mally Wagon Road

Equipment Used: YSI 85 Date Calibrated: 7/19/2011

Equipment Used: Oakton pH Testr 30 Date Calibrated: 7/18/2011

Backwater Conditions (if applicable): N/A

Field Duplicate Station: Y/(N)

Flow Measurements Collected: Y/(N)

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.55 | SU | | In situ |
| Temperature | 29.9 | °C | | In situ |
| Conductivity | 315 | µS/cm | | In situ |
| Dissolved Oxygen | 3.82 | mg/L | | In situ |
| Flow | | cfs | | |
| Turbidity | | | | Lab |

Other notes (weather, field conditions, etc.):

rocks covered in algae, stagnant water,

# City of Fayetteville - Water Quality Sampling for the White River Use Attainability Analysis

Date: 7/19/2011 Time: 9:00 AM

Field Crew: Wade Cash, Leslie Massey

Station ID: WF-01 GPS Coordinates: 35° 55' 40.2" N; 94° 11' 03.2" W

Stream Name: West Fork White River

Location Description: Main St./Hwy 156

Equipment Used: YSI 85 Date Calibrated: 7/19/2011

Equipment Used: Oakton pH Testr 30 Date Calibrated: 7/10/2011

Equipment Used: Marsh McBirney Flowmeter Date Calibrated: N/A

Backwater Conditions (if applicable): N/A

Field Duplicate Station: (Y)/N & Field blank

Flow Measurements Collected: (Y)/N

Water Quality Measurements:

| Parameter | Value | Units | Equipment Used | In Situ/ Streambank/ Laboratory |
|---|---|---|---|---|
| pH | 7.45 | SU | Oakton | In Situ |
| Temperature | 29.3 | °C | YSI | In Situ |
| Conductivity | 218 | µS/cm | YSI | In Situ |
| Dissolved Oxygen | 8.09 | mg/L | YSI | In Situ |
| Flow | 0.418 | cfs | Marsh McBirney | In Situ |
| Turbidity | | | | Lab |

Other notes (weather, field conditions, etc.):

Sunny, Hot

Flow:

| Width (ft) | depth (ft) | velocity (ft/s) |
|---|---|---|
| 0 | 0 | 0 |
| 3 | 0.42 | 0.22 |
| 4 | 0.43 | 0 |
| 5 | 0.42 | 0.19 |
| 6 | 0.49 | 0.45 |
| 7 | 0.51 | 0.05 |
| 8 | 0 | 0 |

Stage 0.42 ft at southeast edge of boulder

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

**Project** White River UAA

**Dr. Brian Haggard**
**ENGR 203**

**Lab Number:** 120056
**Date Reported:** 9/13/11
**Date Received:** 8/16/11 12:00

| Sample | Client ID | Date Sampled | Result | Units | Date Analyzed |
|---|---|---|---|---|---|
| **Chloride** | | **Method: EPA 300.0** | **PQL: 0.24** | **Holding Time Expires: 9/14/11** | |
| 120056-01 | Blank | 8/16/11 9:00 | **0.074** | mg/l | 9/10/11 |
| 120056-02 | WF - 01 | 8/16/11 9:05 | **4.491** | mg/l | 9/10/11 |
| 120056-03 | WF - 02 | 8/16/11 9:35 | **4.865** | mg/l | 9/10/11 |
| 120056-04 | WF - 02 - dup | 8/16/11 9:35 | **4.806** | mg/l | 9/10/11 |
| 120056-05 | WR - 01 | 8/16/11 9:50 | **3.853** | mg/l | 9/10/11 |
| 120056-06 | 001 | 8/16/11 10:00 | **47.034** | mg/l | 9/10/11 |
| 120056-07 | WR - 02 | 8/16/11 10:20 | **11.538** | mg/l | 9/10/11 |
| 120056-08 | RC - 01 | 8/16/11 10:50 | **4.297** | mg/l | 9/12/11 |
| 120056-09 | WR - 03 | 8/16/11 11:20 | **5.861** | mg/l | 9/12/11 |
| **Sulfate** | | **Method: EPA 300.0** | **PQL: 0.23** | **Holding Time Expires: 9/14/11** | |
| 120056-01 | Blank | 8/16/11 9:00 | **0.026** | mg/l | 9/10/11 |
| 120056-02 | WF - 01 | 8/16/11 9:05 | **17.095** | mg/l | 9/10/11 |
| 120056-03 | WF - 02 | 8/16/11 9:35 | **10.708** | mg/l | 9/10/11 |
| 120056-04 | WF - 02 - dup | 8/16/11 9:35 | **29.485** | mg/l | 9/10/11 |
| 120056-05 | WR - 01 | 8/16/11 9:50 | **20.438** | mg/l | 9/10/11 |
| 120056-06 | 001 | 8/16/11 10:00 | **79.548** | mg/l | 9/10/11 |
| 120056-07 | WR - 02 | 8/16/11 10:20 | **33.269** | mg/l | 9/10/11 |
| 120056-08 | RC - 01 | 8/16/11 10:50 | **16.248** | mg/l | 9/12/11 |
| 120056-09 | WR - 03 | 8/16/11 11:20 | **32.088** | mg/l | 9/12/11 |
| **Total Dissolved Solids** | | **Method: EPA 160.1** | **PQL: 34.9** | **Holding Time Expires: 8/24/11** | |
| 120056-01 | Blank | 8/16/11 9:00 | **0.4** | mg/l | 8/18/11 |
| 120056-02 | WF - 01 | 8/16/11 9:05 | **123.6** | mg/l | 8/18/11 |
| 120056-03 | WF - 02 | 8/16/11 9:35 | **153.1** | mg/l | 8/18/11 |
| 120056-04 | WF - 02 - dup | 8/16/11 9:35 | **154.4** | mg/l | 8/18/11 |
| 120056-05 | WR - 01 | 8/16/11 9:50 | **132.4** | mg/l | 8/18/11 |
| 120056-06 | 001 | 8/16/11 10:00 | **372.4** | mg/l | 8/18/11 |
| 120056-07 | WR - 02 | 8/16/11 10:20 | **176.2** | mg/l | 8/18/11 |
| 120056-08 | RC - 01 | 8/16/11 10:50 | **154.2** | mg/l | 8/18/11 |
| 120056-09 | WR - 03 | 8/16/11 11:20 | **146.9** | mg/l | 8/18/11 |

PQL = Practical Quantitation Limit

| Sample | Client ID | Date Sampled | Result | Units | Date Analyzed |
|---|---|---|---|---|---|
| **Turbidity** | | **Method: EPA 180.1** | **PQL: 0.5** | **Holding Time Expires: 8/19/11** | |
| 120056-01 | Blank | 8/16/11 9:00 | **0.02** | NTU's | 8/16/11 |
| 120056-02 | WF - 01 | 8/16/11 9:05 | **2.8** | NTU's | 8/16/11 |
| 120056-03 | WF - 02 | 8/16/11 9:35 | **24.3** | NTU's | 8/16/11 |
| 120056-04 | WF - 02 - dup | 8/16/11 9:35 | **26.0** | NTU's | 8/16/11 |
| 120056-05 | WR - 01 | 8/16/11 9:50 | **22.7** | NTU's | 8/16/11 |
| 120056-06 | 001 | 8/16/11 10:00 | **0.8** | NTU's | 8/16/11 |
| 120056-07 | WR - 02 | 8/16/11 10:20 | **27.4** | NTU's | 8/16/11 |
| 120056-08 | RC - 01 | 8/16/11 10:50 | **5.8** | NTU's | 8/16/11 |
| 120056-09 | WR - 03 | 8/16/11 11:20 | **22.7** | NTU's | 8/16/11 |

**Verified By:** JM 9/14/2011

**QA/QC Reviewer:** Jessie B. Massey

PQL = Practical Quantitation Limit

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

# LabQCReport

**For Lab Number:** 120056 9/13/11

## Chloride

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| std3 | 9/10/11 | 10.191 | mg/l | 10.000 | mg/l | 101.9% |
| vhgcl5 | 9/10/11 | 4.791 | mg/l | 5.000 | mg/l | 95.8% |
| vhg | 9/10/11 | 1.211 | mg/l | 1.200 | mg/l | 100.9% |
| std5 | 9/10/11 | 49.363 | mg/l | 50.000 | mg/l | 98.7% |
| vhgcl5 | 9/10/11 | 5.113 | mg/l | 5.000 | mg/l | 102.3% |
| vhg | 9/10/11 | 1.181 | mg/l | 1.200 | mg/l | 98.4% |
| std4 | 9/12/11 | 30.057 | mg/l | 30.000 | mg/l | 100.2% |
| vhgcl5 | 9/12/11 | 5.301 | mg/l | 5.000 | mg/l | 106.0% |
| vhg | 9/12/11 | 1.166 | mg/l | 1.200 | mg/l | 97.1% |
| std3 | 9/12/11 | 10.836 | mg/l | 10.000 | mg/l | 108.4% |
| vhg | 9/12/11 | 1.179 | mg/l | 1.200 | mg/l | 98.3% |
| std2 | 9/12/11 | 2.009 | mg/l | 2.000 | mg/l | 100.5% |
| vhgcl5 | 9/12/11 | 4.725 | mg/l | 5.000 | mg/l | 94.5% |
| vhgcl5 | 9/12/11 | 4.776 | mg/l | 5.000 | mg/l | 95.5% |
| | | | | | **AVG* =** | 99.9% |
| | | | | | **RPD**=** | 3.9% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# LabQCReport

**For Lab Number:** 120056 9/13/11

## Sulfate

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| vhg | 9/10/11 | 6.005 | mg/l | 6.000 | mg/l | 100.1% |
| std3 | 9/10/11 | 10.127 | mg/l | 10.000 | mg/l | 101.3% |
| vhg | 9/10/11 | 5.978 | mg/l | 6.000 | mg/l | 99.6% |
| std5 | 9/10/11 | 49.508 | mg/l | 50.000 | mg/l | 99.0% |
| vhg | 9/12/11 | 5.995 | mg/l | 6.000 | mg/l | 99.9% |
| std3 | 9/12/11 | 10.074 | mg/l | 10.000 | mg/l | 100.7% |
| vhg | 9/12/11 | 5.996 | mg/l | 6.000 | mg/l | 99.9% |
| std4 | 9/12/11 | 30.074 | mg/l | 30.000 | mg/l | 100.2% |
| vhg | 9/12/11 | 5.970 | mg/l | 6.000 | mg/l | 99.5% |
| std2 | 9/12/11 | 2.009 | mg/l | 2.000 | mg/l | 100.5% |
| | | | | | **AVG* =** | 100.1% |
| | | | | | **RPD**=** | 4.6% |

## Turbidity

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| Std10 | 8/16/11 | 9.990 | NTU's | 10.000 | NTU's | 99.9% |
| Std5.0 | 8/16/11 | 4.830 | NTU's | 5.000 | NTU's | 96.6% |
| Std10 | 8/16/11 | 9.830 | NTU's | 10.000 | NTU's | 98.3% |
| Std10 | 8/16/11 | 9.620 | NTU's | 10.000 | NTU's | 96.2% |
| | | | | | **AVG* =** | 97.7% |
| | | | | | **RPD**=** | 6.3% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

# LabQCReport

**For Lab Number:** 120056 9/13/11

## Chloride

| Spikes: Date | Sample | Result | Spike Level | Spike + Result | % Recovery |
|---|---|---|---|---|---|
| 9/10/11 | 120056-01 | 0.074 mg/l | 4.9 | 4.722 mg/l | 94.9 |

## Sulfate

| Spikes: Date | Sample | Result | Spike Level | Spike + Result | % Recovery |
|---|---|---|---|---|---|
| 9/10/11 | 120056-01 | 0.025 mg/l | 4.9 | 4.919 mg/l | 99.9 |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**


# LabQCReport

**For Lab Number:** 120056 9/13/11

## Total Dissolved Solids

| DUPLICATES: | Date | Sample | Result | Duplicate Result | % RSD |
|---|---|---|---|---|---|
| | 8/18/11 | 120056-02 | 123.6 mg/l | 123.8 mg/l | 0.18% |

## Turbidity

| DUPLICATES: | Date | Sample | Result | Duplicate Result | % RSD |
|---|---|---|---|---|---|
| | 8/16/11 | 120056-01 | 0.0 NTU's | 0.0 NTU's | 0.00% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

AWRC - Water Quality Laboratory
University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701
(501) 575-7317, Fax (501) 575-6720



Name WL

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name WRUA

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 12 H0056-1 | BLANK | 8/16 | 900 | WL | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -2 | WF-01 | | 905 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -3 | WF-02 | | 935 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -4 | WF-02-DUP | | 935 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |

Relinquished By: WL

Date/Time: 8-16-11 1200

Received By: WL

Date/Time: 8-16-11 1200

AWRC - Water Quality Laboratory
University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701
(501) 575-7317, Fax (501) 575-6720



Name WR

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name WRUAA

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 12 H0056-5 | WR-01 | 8/16 | 950 | WR | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -6 | 001 | | 1000 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -7 | WR-02 | | 1020 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -8 | RC-01 | | 1050 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |

Relinquished By: WR

Date/Time: 8-16-11 1200

Received By: WR

Date/Time: 8-16-11 1200

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**



Name WL

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name WR WR

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 12 4005 69 | WR-03 | 8/16 | 1120 | WL | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| | | | | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| | | | | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| | | | | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |

Relinquished By: WL

Date/Time: 8-16-11 1200

Received By:

Date/Time: 8-16-11 1200

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

**Project** White River UAA

**Dr. Brian Haggard**
**ENGR 203**

**Lab Number:** 120081
**Date Reported:** 9/19/11
**Date Received:** 9/13/11 12:30

| Sample | Client ID | Date Sampled | Result | Units | Date Analyzed |
|---|---|---|---|---|---|
| **Chloride** | | **Method: EPA 300.0** | **PQL: 0.24** | **Holding Time Expires: 10/12/11** | |
| 120081-01 | Blank | 9/13/11 9:00 | **0.133** | mg/l | 9/14/11 |
| 120081-02 | WF-01 | 9/13/11 9:00 | **6.523** | mg/l | 9/14/11 |
| 120081-03 | WF-02 | 9/13/11 9:30 | **7.242** | mg/l | 9/14/11 |
| 120081-04 | WR-01 | 9/13/11 9:45 | **5.136** | mg/l | 9/14/11 |
| 120081-05 | WR-02 | 9/13/11 10:15 | **50.944** | mg/l | 9/14/11 |
| 120081-06 | 001 | 9/13/11 10:35 | **59.758** | mg/l | 9/16/11 |
| 120081-07 | 001-D | 9/13/11 10:35 | **55.886** | mg/l | 9/16/11 |
| 120081-08 | WR-03 | 9/13/11 10:55 | **31.449** | mg/l | 9/14/11 |
| 120081-09 | RC-01 | 9/13/11 11:05 | **4.740** | mg/l | 9/14/11 |
| 120081-10 | Extra Site (WR-02.5) | 9/13/11 11:35 | **46.266** | mg/l | 9/14/11 |
| **Sulfate** | | **Method: EPA 300.0** | **PQL: 0.23** | **Holding Time Expires: 10/12/11** | |
| 120081-01 | Blank | 9/13/11 9:00 | **0.000** | mg/l | 9/14/11 |
| 120081-02 | WF-01 | 9/13/11 9:00 | **20.860** | mg/l | 9/14/11 |
| 120081-03 | WF-02 | 9/13/11 9:30 | **33.485** | mg/l | 9/14/11 |
| 120081-04 | WR-01 | 9/13/11 9:45 | **16.558** | mg/l | 9/14/11 |
| 120081-05 | WR-02 | 9/13/11 10:15 | **48.580** | mg/l | 9/14/11 |
| 120081-06 | 001 | 9/13/11 10:35 | **50.502** | mg/l | 9/14/11 |
| 120081-07 | 001-D | 9/13/11 10:35 | **48.573** | mg/l | 9/14/11 |
| 120081-08 | WR-03 | 9/13/11 10:55 | **38.305** | mg/l | 9/14/11 |
| 120081-09 | RC-01 | 9/13/11 11:05 | **13.659** | mg/l | 9/14/11 |
| 120081-10 | Extra Site (WR-02.5) | 9/13/11 11:35 | **44.453** | mg/l | 9/14/11 |
| **Total Dissolved Solids** | | **Method: EPA 160.1** | **PQL: 34.9** | **Holding Time Expires: 9/21/11** | |
| 120081-01 | Blank | 9/13/11 9:00 | **0.0** | mg/l | 9/14/11 |
| 120081-02 | WF-01 | 9/13/11 9:00 | **112.9** | mg/l | 9/14/11 |
| 120081-03 | WF-02 | 9/13/11 9:30 | **150.4** | mg/l | 9/14/11 |
| 120081-04 | WR-01 | 9/13/11 9:45 | **129.6** | mg/l | 9/14/11 |
| 120081-05 | WR-02 | 9/13/11 10:15 | **342.2** | mg/l | 9/14/11 |
| 120081-06 | 001 | 9/13/11 10:35 | **356.9** | mg/l | 9/14/11 |
| 120081-07 | 001-D | 9/13/11 10:35 | **358.0** | mg/l | 9/14/11 |
| 120081-08 | WR-03 | 9/13/11 10:55 | **239.6** | mg/l | 9/14/11 |
| 120081-09 | RC-01 | 9/13/11 11:05 | **133.6** | mg/l | 9/14/11 |
| 120081-10 | Extra Site (WR-02.5) | 9/13/11 11:35 | **287.3** | mg/l | 9/14/11 |

PQL = Practical Quantitation Limit

| Sample | Client ID | Date Sampled | Result | Units | Date Analyzed |
|---|---|---|---|---|---|
| **Turbidity** | | **Method: EPA 180.1** | **PQL: 0.5** | **Holding Time Expires: 9/16/11** | |
| 120081-01 | Blank | 9/13/11 9:00 | **0.02** | NTU's | 9/13/11 |
| 120081-02 | WF-01 | 9/13/11 9:00 | **0.5** | NTU's | 9/13/11 |
| 120081-03 | WF-02 | 9/13/11 9:30 | **7.3** | NTU's | 9/13/11 |
| 120081-04 | WR-01 | 9/13/11 9:45 | **8.1** | NTU's | 9/13/11 |
| 120081-05 | WR-02 | 9/13/11 10:15 | **2.7** | NTU's | 9/13/11 |
| 120081-06 | 001 | 9/13/11 10:35 | **0.9** | NTU's | 9/13/11 |
| 120081-07 | 001-D | 9/13/11 10:35 | **0.8** | NTU's | 9/13/11 |
| 120081-08 | WR-03 | 9/13/11 10:55 | **11.0** | NTU's | 9/13/11 |
| 120081-09 | RC-01 | 9/13/11 11:05 | **9.0** | NTU's | 9/13/11 |
| 120081-10 | Extra Site (WR-02.5) | 9/13/11 11:35 | **9.4** | NTU's | 9/13/11 |

**Verified By:**

**QA/QC Reviewer:** Leslie B. Massey

PQL = Practical Quantitation Limit

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

# LabQCReport

**For Lab Number:** 120081 9/20/11

## Chloride

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| std4 | 9/14/11 | 30.711 | mg/l | 30.000 | mg/l | 102.4% |
| std5 | 9/14/11 | 49.761 | mg/l | 50.000 | mg/l | 99.5% |
| vhg | 9/14/11 | 1.324 | mg/l | 1.200 | mg/l | 110.3% |
| std3 | 9/14/11 | 10.282 | mg/l | 10.000 | mg/l | 102.8% |
| vhgcl5 | 9/14/11 | 5.047 | mg/l | 5.000 | mg/l | 100.9% |
| vhg | 9/14/11 | 1.286 | mg/l | 1.200 | mg/l | 107.1% |
| std5 | 9/14/11 | 50.904 | mg/l | 50.000 | mg/l | 101.8% |
| vhg | 9/14/11 | 1.216 | mg/l | 1.200 | mg/l | 101.3% |
| vhgcl5 | 9/14/11 | 4.915 | mg/l | 5.000 | mg/l | 98.3% |
| vhgcl5 | 9/14/11 | 5.140 | mg/l | 5.000 | mg/l | 102.8% |
| std5 | 9/16/11 | 50.095 | mg/l | 50.000 | mg/l | 100.2% |
| vhg | 9/16/11 | 1.290 | mg/l | 1.200 | mg/l | 107.5% |
| std5 | 9/16/11 | 50.354 | mg/l | 50.000 | mg/l | 100.7% |
| vhgcl5 | 9/16/11 | 4.833 | mg/l | 5.000 | mg/l | 96.7% |
| vhg | 9/16/11 | 1.232 | mg/l | 1.200 | mg/l | 102.7% |
| vhgcl5 | 9/16/11 | 4.873 | mg/l | 5.000 | mg/l | 97.5% |
| std3 | 9/16/11 | 10.013 | mg/l | 10.000 | mg/l | 100.1% |
| vhg | 9/16/11 | 1.219 | mg/l | 1.200 | mg/l | 101.6% |
| std4 | 9/16/11 | 30.136 | mg/l | 30.000 | mg/l | 100.5% |
| vhgcl5 | 9/16/11 | 5.263 | mg/l | 5.000 | mg/l | 105.3% |
| vhgcl5 | 9/16/11 | 4.781 | mg/l | 5.000 | mg/l | 95.6% |
| vhg | 9/16/11 | 1.265 | mg/l | 1.200 | mg/l | 105.4% |
| | | | | | **AVG* =** | 101.9% |
| | | | | | **RPD**=** | 3.5% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# LabQCReport

**For Lab Number:** 120081 9/20/11

## Nitrate

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| 5std | 9/16/11 | 6.087 | mg/l as N | 6.000 | mg/l as N | 101.4% |
| QCS0.904 | 9/16/11 | 0.820 | mg/l as N | 0.904 | mg/l as N | 90.7% |
| QCS0.904 | 9/16/11 | 0.825 | mg/l as N | 0.904 | mg/l as N | 91.3% |
| QCS0.904 | 9/16/11 | 0.836 | mg/l as N | 0.904 | mg/l as N | 92.5% |
| 5std | 9/16/11 | 6.073 | mg/l as N | 6.000 | mg/l as N | 101.2% |
| QCS0.904 | 9/16/11 | 0.833 | mg/l as N | 0.904 | mg/l as N | 92.2% |
| std3 | 9/16/11 | 0.487 | mg/l as N | 0.500 | mg/l as N | 97.4% |
| std4 | 9/16/11 | 1.816 | mg/l as N | 2.000 | mg/l as N | 90.8% |
| | | | | | **AVG* =** | 94.7% |
| | | | | | **RPD**=** | 8.4% |

## Sulfate

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| std5 | 9/14/11 | 49.133 | mg/l | 50.000 | mg/l | 98.3% |
| std5 | 9/14/11 | 50.859 | mg/l | 50.000 | mg/l | 101.7% |
| std4 | 9/14/11 | 30.756 | mg/l | 30.000 | mg/l | 102.5% |
| vhg | 9/14/11 | 6.542 | mg/l | 6.000 | mg/l | 109.0% |
| std3 | 9/14/11 | 10.743 | mg/l | 10.000 | mg/l | 107.4% |
| vhg | 9/14/11 | 6.377 | mg/l | 6.000 | mg/l | 106.3% |
| vhg | 9/14/11 | 6.380 | mg/l | 6.000 | mg/l | 106.3% |
| | | | | | **AVG* =** | 104.5% |
| | | | | | **RPD**=** | 12.0% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# LabQCReport

**For Lab Number:** 120081 9/20/11

## Turbidity

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| Std10 | 9/13/11 | 10.100 | NTU's | 10.000 | NTU's | 101.0% |
| Std5.0 | 9/13/11 | 5.210 | NTU's | 5.000 | NTU's | 104.2% |
| Std10 | 9/13/11 | 9.950 | NTU's | 10.000 | NTU's | 99.5% |
| Std1.0 | 9/13/11 | 1.060 | NTU's | 1.000 | NTU's | 106.0% |
| | | | | | **AVG* =** | 102.7% |
| | | | | | **RPD**=** | 14.9% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
# Water Quality Lab

University of Arkansas, BIOR 106, 2435 North Hatch
Fayetteville, AR 72704
479-575-7317

# LabQCReport

**For Lab Number:** 120081 9/20/11

## Chloride

| Spikes: Date | Sample | Result | Spike Level | Spike + Result | % Recovery |
|---|---|---|---|---|---|
| 9/14/11 | 120081-01 | 0.133 mg/l | 4.9 | 5.095 mg/l | 101.3 |

## Sulfate

| Spikes: Date | Sample | Result | Spike Level | Spike + Result | % Recovery |
|---|---|---|---|---|---|
| 9/14/11 | 120081-01 | 0.000 mg/l | 4.9 | 5.356 mg/l | 109.3 |

*The average % Recovery is a measure of accuracy.
**RPD=Relative Percent Deviation, a measure of Precision.

**Arkansas Water Resources Center**
**Water Quality Lab**

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

# LabQCReport

**For Lab Number:** 120081 9/20/11

## Total Dissolved Solids

| DUPLICATES: | Date | Sample | Result | Duplicate Result | % RSD |
|---|---|---|---|---|---|
| | 9/14/11 | 120081-02 | 112.9 mg/l | 121.7 mg/l | 7.46% |

## Turbidity

| DUPLICATES: | Date | Sample | Result | Duplicate Result | % RSD |
|---|---|---|---|---|---|
| | 9/13/11 | 120081-01 | 0.0 NTU's | 0.0 NTU's | 0.00% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

## LabQCReport

**For Lab Number:** **120081** **9/20/2011**

### Chloride

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 9/14/11 | blank | 0.1073 mg/l | 0.000 mg/l |
| | 9/16/11 | blank | 0.0875 mg/l | 0.000 mg/l |

### Nitrate

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 9/16/11 | blank | 0.0842 mg/l as N | 0.000 mg/l as N |

### Sulfate

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 9/14/11 | blank | 0.0611 mg/l | 0.000 mg/l |

### Total Dissolved Solids

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 9/14/11 | blank | 3.56 mg/l | 0.000 mg/l |

### Turbidity

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 9/13/11 | blank | 0.02 NTU's | 0.000 NTU's |

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**



Name WL

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name WRUAA

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 120881-1 | BLANK | 9/13 | 900 | WL | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -2 | WF-01 | | 905 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -3 | WF-02 | | 930 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -4 | WR-01 | | 945 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |

Relinquished By: WL

Date/Time: 9-13-11 1230

Received By: WL

Date/Time: 9-13-11 1230

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**

Page____ of ____

Name _____
Mailing Address _____
City, State, Zip _____
Phone/Fax _____

**Lab Number:**

Project Name WRUAA
Cost Ctr. No./P.O. No. _____

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 120089-5 | WR-02 | 9/13 | 1015 | LT | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -6 | 001 | | 1035 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -7 | 001-D | | 1035 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -8 | WR-03 | | 1055 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |

Relinquished By: LT
Date/Time: 9-13-11 1230

Received By: LT
Date/Time: 9-13-11 1230

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**



Name _____
Mailing Address _____
City, State, Zip _____
Phone/Fax _____

**Lab Number:**

Project Name WRURA
Cost Ctr. No./P.O. No. _____

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 120081-9 | RC-01 | 9/13 | 1105 | WZ | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -10 | EXTRA SITE | | 1135 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| | | | | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| | | | | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |

Relinquished By: WZ
Date/Time: 9-13-11 1230

Received By: WZ
Date/Time: 9-13-11 1230

# Arkansas Water Resources Center
# Water Quality Lab

University of Arkansas, BIOR 106, 2435 North Hatch
Fayetteville, AR 72704
479-575-7317

**Project** White River UAA

**Dr. Brian Haggard**
**ENGR 203**

**Lab Number:** 120129
**Date Reported:** 10/17/11
**Date Received:** 10/11/11 12:45

| Sample | Client ID | Date Sampled | Result | Units | Date Analyzed |
|---|---|---|---|---|---|
| **Chloride** | | **Method: EPA 300.0** | **PQL: 0.24** | **Holding Time Expires 11/9/11** | |
| 120129-01 | Blank | 10/11/11 9:00 | 0.100 | mg/l | 10/13/11 |
| 120129-02 | WF-01 | 10/11/11 9:05 | 6.566 | mg/l | 10/13/11 |
| 120129-03 | RC-02 | 10/11/11 9:45 | 5.131 | mg/l | 10/13/11 |
| 120129-04 | WF-02 | 10/11/11 10:00 | 7.918 | mg/l | 10/13/11 |
| 120129-05 | WF-02 - dup | 10/11/11 10:00 | 7.864 | mg/l | 10/13/11 |
| 120129-06 | WR-2.5 | 10/11/11 10:30 | 37.187 | mg/l | 10/13/11 |
| 120129-07 | WR-01 | 10/11/11 11:00 | 5.307 | mg/l | 10/13/11 |
| 120129-08 | 001 | 10/11/11 11:10 | 55.068 | mg/l | 10/14/11 |
| 120129-09 | WR-02 | 10/11/11 11:30 | 37.554 | mg/l | 10/13/11 |
| 120129-10 | RC-01 | 10/11/11 12:00 | 5.067 | mg/l | 10/13/11 |
| 120129-11 | WR-03 | 10/11/11 12:15 | 33.307 | mg/l | 10/13/11 |
| **Sulfate** | | **Method: EPA 300.0** | **PQL: 0.23** | **Holding Time Expires 11/9/11** | |
| 120129-01 | Blank | 10/11/11 9:00 | 0.061 | mg/l | 10/13/11 |
| 120129-02 | WF-01 | 10/11/11 9:05 | 25.390 | mg/l | 10/13/11 |
| 120129-03 | RC-02 | 10/11/11 9:45 | 18.104 | mg/l | 10/13/11 |
| 120129-04 | WF-02 | 10/11/11 10:00 | 46.793 | mg/l | 10/13/11 |
| 120129-05 | WF-02 - dup | 10/11/11 10:00 | 46.870 | mg/l | 10/13/11 |
| 120129-06 | WR-2.5 | 10/11/11 10:30 | 39.691 | mg/l | 10/13/11 |
| 120129-07 | WR-01 | 10/11/11 11:00 | 25.134 | mg/l | 10/13/11 |
| 120129-08 | 001 | 10/11/11 11:10 | 44.576 | mg/l | 10/13/11 |
| 120129-09 | WR-02 | 10/11/11 11:30 | 39.970 | mg/l | 10/13/11 |
| 120129-10 | RC-01 | 10/11/11 12:00 | 20.487 | mg/l | 10/13/11 |
| 120129-11 | WR-03 | 10/11/11 12:15 | 39.638 | mg/l | 10/13/11 |
| **Total Dissolved Solids** | | **Method: EPA 160.1** | **PQL: 34.9** | **Holding Time Expires 10/19/11** | |
| 120129-01 | Blank | 10/11/11 9:00 | 2.9 | mg/l | 10/12/11 |
| 120129-02 | WF-01 | 10/11/11 9:05 | 136.2 | mg/l | 10/12/11 |
| 120129-03 | RC-02 | 10/11/11 9:45 | 164.4 | mg/l | 10/12/11 |
| 120129-04 | WF-02 | 10/11/11 10:00 | 176.9 | mg/l | 10/12/11 |
| 120129-05 | WF-02 - dup | 10/11/11 10:00 | 175.3 | mg/l | 10/12/11 |
| 120129-06 | WR-2.5 | 10/11/11 10:30 | 268.0 | mg/l | 10/12/11 |
| 120129-07 | WR-01 | 10/11/11 11:00 | 138.0 | mg/l | 10/12/11 |
| 120129-08 | 001 | 10/11/11 11:10 | 368.2 | mg/l | 10/12/11 |
| 120129-09 | WR-02 | 10/11/11 11:30 | 288.4 | mg/l | 10/12/11 |
| 120129-10 | RC-01 | 10/11/11 12:00 | 149.3 | mg/l | 10/12/11 |
| 120129-11 | WR-03 | 10/11/11 12:15 | 269.6 | mg/l | 10/12/11 |

PQL = Practical Quantitation Limit

| Sample | Client ID | Date Sampled | Result | Units | Date Analyzed |
|---|---|---|---|---|---|
| **Turbidity** | | **Method: EPA 180.1** | **PQL: 0.5** | **Holding Time Expires** | **10/14/11** |
| 120129-01 | Blank | 10/11/11 9:00 | 0.2 | NTU's | 10/11/11 |
| 120129-02 | WF-01 | 10/11/11 9:05 | 0.5 | NTU's | 10/11/11 |
| 120129-03 | RC-02 | 10/11/11 9:45 | 3.2 | NTU's | 10/11/11 |
| 120129-04 | WF-02 | 10/11/11 10:00 | 6.3 | NTU's | 10/11/11 |
| 120129-05 | WF-02 - dup | 10/11/11 10:00 | 6.0 | NTU's | 10/11/11 |
| 120129-06 | WR-2.5 | 10/11/11 10:30 | 5.9 | NTU's | 10/11/11 |
| 120129-07 | WR-01 | 10/11/11 11:00 | 3.6 | NTU's | 10/11/11 |
| 120129-08 | 001 | 10/11/11 11:10 | 0.7 | NTU's | 10/11/11 |
| 120129-09 | WR-02 | 10/11/11 11:30 | 4.1 | NTU's | 10/11/11 |
| 120129-10 | RC-01 | 10/11/11 12:00 | 3.3 | NTU's | 10/11/11 |
| 120129-11 | WR-03 | 10/11/11 12:15 | 11.9 | NTU's | 10/11/11 |

**Verified By:** 10/19/2011

**QA/QC Reviewer:** Bernie B Massey

PQL = Practical Quantitation Limit

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

# LabQCReport

**For Lab Number:** 120129 10/17/11

## Chloride

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| vhg | 10/13/11 | 1.148 | mg/l | 1.200 | mg/l | 95.7% |
| std3 | 10/13/11 | 10.662 | mg/l | 10.000 | mg/l | 106.6% |
| vhgcl5 | 10/13/11 | 4.786 | mg/l | 5.000 | mg/l | 95.7% |
| std5 | 10/13/11 | 50.160 | mg/l | 50.000 | mg/l | 100.3% |
| vhg | 10/13/11 | 1.179 | mg/l | 1.200 | mg/l | 98.3% |
| vhgcl5 | 10/13/11 | 4.879 | mg/l | 5.000 | mg/l | 97.6% |
| vhg | 10/13/11 | 1.186 | mg/l | 1.200 | mg/l | 98.9% |
| vhgcl5 | 10/13/11 | 4.768 | mg/l | 5.000 | mg/l | 95.4% |
| std4 | 10/13/11 | 30.228 | mg/l | 30.000 | mg/l | 100.8% |
| vhgcl5 | 10/14/11 | 4.780 | mg/l | 5.000 | mg/l | 95.6% |
| vhgcl5 | 10/14/11 | 4.791 | mg/l | 5.000 | mg/l | 95.8% |
| vhg | 10/14/11 | 1.199 | mg/l | 1.200 | mg/l | 99.9% |
| vhg | 10/14/11 | 1.240 | mg/l | 1.200 | mg/l | 103.4% |
| std4 | 10/14/11 | 30.202 | mg/l | 30.000 | mg/l | 100.7% |
| std5 | 10/14/11 | 50.050 | mg/l | 50.000 | mg/l | 100.1% |
| | | | | | **AVG* =** | 99.0% |
| | | | | | **RPD**=** | 3.3% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# LabQCReport

**For Lab Number:** 120129 10/17/11

## Sulfate

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| std5 | 10/13/11 | 50.134 | mg/l | 50.000 | mg/l | 100.3% |
| vhg | 10/13/11 | 5.880 | mg/l | 6.000 | mg/l | 98.0% |
| std4 | 10/13/11 | 30.135 | mg/l | 30.000 | mg/l | 100.4% |
| vhg | 10/13/11 | 5.900 | mg/l | 6.000 | mg/l | 98.3% |
| std3 | 10/13/11 | 10.002 | mg/l | 10.000 | mg/l | 100.0% |
| vhg | 10/13/11 | 5.883 | mg/l | 6.000 | mg/l | 98.0% |
| | | | | | **AVG* =** | 99.2% |
| | | | | | **RPD**=** | 4.5% |

## Turbidity

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| Std10 | 10/11/11 | 9.780 | NTU's | 10.000 | NTU's | 97.8% |
| Std5.0 | 10/11/11 | 5.310 | NTU's | 5.000 | NTU's | 106.2% |
| Std10 | 10/11/11 | 9.840 | NTU's | 10.000 | NTU's | 98.4% |
| Std10 | 10/11/11 | 9.840 | NTU's | 10.000 | NTU's | 98.4% |
| | | | | | **AVG* =** | 100.2% |
| | | | | | **RPD**=** | 8.5% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

# LabQCReport

**For Lab Number:** 120129 10/17/11

## Chloride

| Spikes: Date | Sample | Result | Spike Level | Spike + Result | % Recovery |
|---|---|---|---|---|---|
| 10/13/11 | 120129-01 | 0.100 mg/l | 4.9 | 4.733 mg/l | 94.5 |

## Sulfate

| Spikes: Date | Sample | Result | Spike Level | Spike + Result | % Recovery |
|---|---|---|---|---|---|
| 10/13/11 | 120129-01 | 0.061 mg/l | 4.9 | 4.914 mg/l | 99.0 |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
## Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**


# LabQCReport

**For Lab Number:** 120129 10/17/11

## Total Dissolved Solids

| DUPLICATES: Date | Sample | Result | Duplicate Result | % RSD |
|---|---|---|---|---|
| 10/12/11 | 120129-11 | 269.6 mg/l | 258.3 mg/l | 4.26% |
| | 120129-02 | 136.2 mg/l | 138.2 mg/l | 1.46% |

## Turbidity

| DUPLICATES: Date | Sample | Result | Duplicate Result | % RSD |
|---|---|---|---|---|
| 10/11/11 | 120129-01 | 0.2 NTU's | 0.2 NTU's | 12.50% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

# LabQCReport

**For Lab Number:** **120129** **10/17/2011**

## Chloride

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 10/13/11 | blank | 0.0794 mg/l | 0.000 mg/l |
| | 10/14/11 | blank | 0.1926 mg/l | 0.000 mg/l |

## Sulfate

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 10/13/11 | blank | 0 mg/l | 0.000 mg/l |

## Total Dissolved Solids

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 10/12/11 | blank | 0.44 mg/l | 0.000 mg/l |
| | 10/12/11 | blank | -0.22 mg/l | 0.000 mg/l |

## Turbidity

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 10/11/11 | blank | 0.02 NTU's | 0.000 NTU's |

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**



Name WRUNA

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name WRUNA

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| L01129-1 | BLANK | 10/11 | 900 | WJ | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -2 | WF-01 | | 905 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -3 | RC-02 | | CNS | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -4 | WF-02 | | 1000 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |

Relinquished By: WR

Date/Time: 10-11-11 1245

Received By: WR

Date/Time: 10-11-11 1245

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**



Name WRUA

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name WLJAA

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 12029-5 | WF-02-D | 10/11 | 1000 | WJ | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -6 | WR-25 | | 1020 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -7 | WR-01 | | 1100 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -8 | 001 | | 1110 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |

Relinquished By: WR

Date/Time: 10-11-11 1245

Received By: W

Date/Time: 10-11-11 1245

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**



Name WRJAA

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name WRJAA

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 12014-9 | WR-02 | 10/11 | 1130 | JM | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -10 | RC-01 | | 1200 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -11 | WR-03 | | 1215 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| | | | | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |

Relinquished By: WR

Date/Time: 10-11-11 1245

Received By: JR

Date/Time: 10-11-11 1245

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

**Project White River UAA**

**Dr. Brian Haggard**
**ENGR 203**

**Lab Number:** 120215
**Date Reported:** 11/17/11
**Date Received:** 11/15/11 13:30

| Sample | Client ID | Date Sampled | Result | Units | Date Analyzed |
|---|---|---|---|---|---|
| **Chloride** | | **Method: EPA 300.0** | **PQL: 0.6** | **Holding Time Expires: 12/14/11** | |
| 120215-01 | Blank | 11/15/11 9:00 | **0.169** | mg/l | 11/16/11 |
| 120215-02 | WF-01 | 11/15/11 9:05 | **4.957** | mg/l | 11/16/11 |
| 120215-03 | RC-02 | 11/15/11 9:30 | **4.708** | mg/l | 11/16/11 |
| 120215-04 | WF-02 | 11/15/11 10:00 | **5.555** | mg/l | 11/16/11 |
| 120215-05 | WR-2.5 | 11/15/11 10:30 | **6.150** | mg/l | 11/16/11 |
| 120215-06 | WR-01 | 11/15/11 11:00 | **3.763** | mg/l | 11/16/11 |
| 120215-07 | 001 | 11/15/11 11:10 | **46.699** | mg/l | 11/16/11 |
| 120215-08 | WR-02 | 11/15/11 12:00 | **7.302** | mg/l | 11/16/11 |
| 120215-09 | RC-01 | 11/15/11 12:30 | **5.048** | mg/l | 11/16/11 |
| 120215-10 | WR-03 | 11/15/11 12:40 | **6.319** | mg/l | 11/16/11 |
| 120215-11 | WR-2.5 - dup | 11/15/11 10:30 | **6.235** | mg/l | 11/16/11 |
| **Sulfate** | | **Method: EPA 300.0** | **PQL: 0.14** | **Holding Time Expires: 12/14/11** | |
| 120215-01 | Blank | 11/15/11 9:00 | **0.129** | mg/l | 11/16/11 |
| 120215-02 | WF-01 | 11/15/11 9:05 | **17.813** | mg/l | 11/16/11 |
| 120215-03 | RC-02 | 11/15/11 9:30 | **11.733** | mg/l | 11/16/11 |
| 120215-04 | WF-02 | 11/15/11 10:00 | **45.352** | mg/l | 11/16/11 |
| 120215-05 | WR-2.5 | 11/15/11 10:30 | **22.795** | mg/l | 11/16/11 |
| 120215-06 | WR-01 | 11/15/11 11:00 | **21.133** | mg/l | 11/16/11 |
| 120215-07 | 001 | 11/15/11 11:10 | **49.774** | mg/l | 11/16/11 |
| 120215-08 | WR-02 | 11/15/11 12:00 | **23.525** | mg/l | 11/16/11 |
| 120215-09 | RC-01 | 11/15/11 12:30 | **13.578** | mg/l | 11/16/11 |
| 120215-10 | WR-03 | 11/15/11 12:40 | **23.078** | mg/l | 11/16/11 |
| 120215-11 | WR-2.5 - dup | 11/15/11 10:30 | **22.776** | mg/l | 11/16/11 |
| **Total Dissolved Solids** | | **Method: EPA 160.1** | **PQL: 34.9** | **Holding Time Expires: 11/23/11** | |
| 120215-01 | Blank | 11/15/11 9:00 | **6.9** | mg/l | 11/15/11 |
| 120215-02 | WF-01 | 11/15/11 9:05 | **114.5** | mg/l | 11/15/11 |
| 120215-03 | RC-02 | 11/15/11 9:30 | **129.1** | mg/l | 11/15/11 |
| 120215-04 | WF-02 | 11/15/11 10:00 | **181.3** | mg/l | 11/15/11 |
| 120215-05 | WR-2.5 | 11/15/11 10:30 | **133.1** | mg/l | 11/15/11 |
| 120215-06 | WR-01 | 11/15/11 11:00 | **113.1** | mg/l | 11/15/11 |
| 120215-07 | 001 | 11/15/11 11:10 | **335.8** | mg/l | 11/15/11 |
| 120215-08 | WR-02 | 11/15/11 12:00 | **138.0** | mg/l | 11/15/11 |
| 120215-09 | RC-01 | 11/15/11 12:30 | **143.1** | mg/l | 11/15/11 |
| 120215-10 | WR-03 | 11/15/11 12:40 | **128.7** | mg/l | 11/15/11 |
| 120215-11 | WR-2.5 - dup | 11/15/11 10:30 | **124.1** | mg/l | 11/15/11 |

PQL = Practical Quantitation Limit

| Sample | Client ID | Date Sampled | Result | Units | Date Analyzed |
|---|---|---|---|---|---|
| Turbidity | | Method: EPA 180.1 | PQL: 0.5 | Holding Time Expires: | 11/18/11 |
| 120215-01 | Blank | 11/15/11 9:00 | **0.0** | NTU's | 11/15/11 |
| 120215-02 | WF-01 | 11/15/11 9:05 | **1.7** | NTU's | 11/15/11 |
| 120215-03 | RC-02 | 11/15/11 9:30 | **2.4** | NTU's | 11/15/11 |
| 120215-04 | WF-02 | 11/15/11 10:00 | **5.6** | NTU's | 11/15/11 |
| 120215-05 | WR-2.5 | 11/15/11 10:30 | **17.4** | NTU's | 11/15/11 |
| 120215-06 | WR-01 | 11/15/11 11:00 | **19.1** | NTU's | 11/15/11 |
| 120215-07 | 001 | 11/15/11 11:10 | **0.8** | NTU's | 11/15/11 |
| 120215-08 | WR-02 | 11/15/11 12:00 | **18.1** | NTU's | 11/15/11 |
| 120215-09 | RC-01 | 11/15/11 12:30 | **2.8** | NTU's | 11/15/11 |
| 120215-10 | WR-03 | 11/15/11 12:40 | **16.9** | NTU's | 11/15/11 |
| 120215-11 | WR-2.5 - dup | 11/15/11 10:30 | **17.8** | NTU's | 11/15/11 |

**Verified By:** KBM 12/6/11

**QA/QC Reviewer:** Bernie B. Massey

PQL = Practical Quantitation Limit

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

# LabQCReport

**For Lab Number:** 120215 11/30/11

## Chloride

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| std5 | 11/16/11 | 50.239 | mg/l | 50.000 | mg/l | 100.5% |
| vhg | 11/16/11 | 1.236 | mg/l | 1.200 | mg/l | 103.0% |
| vhgcl5 | 11/16/11 | 5.064 | mg/l | 5.000 | mg/l | 101.3% |
| std3 | 11/16/11 | 10.093 | mg/l | 10.000 | mg/l | 100.9% |
| vhg | 11/16/11 | 1.182 | mg/l | 1.200 | mg/l | 98.5% |
| vhgcl5 | 11/16/11 | 4.866 | mg/l | 5.000 | mg/l | 97.3% |
| std4 | 11/16/11 | 30.132 | mg/l | 30.000 | mg/l | 100.4% |
| vhgcl5 | 11/16/11 | 4.810 | mg/l | 5.000 | mg/l | 96.2% |
| vhg | 11/16/11 | 1.264 | mg/l | 1.200 | mg/l | 105.4% |
| vhgcl5 | 11/16/11 | 4.882 | mg/l | 5.000 | mg/l | 97.6% |
| std5 | 11/16/11 | 50.112 | mg/l | 50.000 | mg/l | 100.2% |
| vhg | 11/16/11 | 1.187 | mg/l | 1.200 | mg/l | 98.9% |
| | | | | | **AVG* =** | 100.0% |
| | | | | | **RPD**=** | 2.5% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# LabQCReport

**For Lab Number:** 120215 11/30/11

## Sulfate

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| std5 | 11/16/11 | 50.092 | mg/l | 50.000 | mg/l | 100.2% |
| vhg | 11/16/11 | 5.925 | mg/l | 6.000 | mg/l | 98.8% |
| std5 | 11/16/11 | 50.052 | mg/l | 50.000 | mg/l | 100.1% |
| vhg | 11/16/11 | 5.967 | mg/l | 6.000 | mg/l | 99.5% |
| std3 | 11/16/11 | 10.054 | mg/l | 10.000 | mg/l | 100.5% |
| vhg | 11/16/11 | 5.927 | mg/l | 6.000 | mg/l | 98.8% |
| std4 | 11/16/11 | 30.138 | mg/l | 30.000 | mg/l | 100.5% |
| vhg | 11/16/11 | 5.933 | mg/l | 6.000 | mg/l | 98.9% |
| | | | | | **AVG* =** | 99.6% |
| | | | | | **RPD**=** | 3.3% |

## Turbidity

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| Std10 | 11/15/11 | 10.000 | NTU's | 10.000 | NTU's | 100.0% |
| Std5.0 | 11/15/11 | 4.930 | NTU's | 5.000 | NTU's | 98.6% |
| Std10 | 11/15/11 | 9.970 | NTU's | 10.000 | NTU's | 99.7% |
| Std10 | 11/15/11 | 9.780 | NTU's | 10.000 | NTU's | 97.8% |
| | | | | | **AVG* =** | 99.0% |
| | | | | | **RPD**=** | 4.3% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

# LabQCReport

**For Lab Number:** 120215 11/30/11

## Chloride

| Spikes: Date | Sample | Result | Spike Level | Spike + Result | % Recovery |
|---|---|---|---|---|---|
| 11/16/11 | 120215-01 | 0.169 mg/l | 4.9 | 4.930 mg/l | 97.2 |

## Sulfate

| Spikes: Date | Sample | Result | Spike Level | Spike + Result | % Recovery |
|---|---|---|---|---|---|
| 11/16/11 | 120215-01 | 0.129 mg/l | 4.9 | 5.318 mg/l | 105.9 |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
## Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**


# LabQCReport

**For Lab Number:** 120215 11/30/11

## Total Dissolved Solids

| DUPLICATES: | Date | Sample | Result | Duplicate Result | % RSD |
|---|---|---|---|---|---|
| | 11/15/11 | 120215-02 | 114.4 mg/l | 114.7 mg/l | 0.19% |
| | | 120215-11 | 124.1 mg/l | 121.4 mg/l | 2.24% |

## Turbidity

| DUPLICATES: | Date | Sample | Result | Duplicate Result | % RSD |
|---|---|---|---|---|---|
| | 11/15/11 | 120215-01 | 0.0 NTU's | 0.0 NTU's | 40.00% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
## Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**


# LabQCReport

**For Lab Number:** **120215** **11/30/2011**

### Chloride

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 11/16/11 | blank | 0.0454 mg/l | 0.000 mg/l |

### Sulfate

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 11/16/11 | blank | 0 mg/l | 0.000 mg/l |

### Total Dissolved Solids

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 11/15/11 | blank | -7.56 mg/l | 0.000 mg/l |
| | 11/15/11 | blank | -3.11 mg/l | 0.000 mg/l |

### Turbidity

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 11/15/11 | blank | 0.02 NTU's | 0.000 NTU's |

**AWRC - Water Quality Laboratory**
**University of Arkansas, 2435 N. Hatch, Fayetteville, AR 72704**
**(479) 575-7317, Fax (479) 575-6720**



Name WL

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name WRUM

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 1102 15-1 | BLANK | 11/5 | 908 | W | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| ~2 | WF-01 | | 905 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| ~4 | RC-02 | | 930 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| ~5 | WF-02 | | 1000 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |

Relinquished By: WL

Date/Time: 11-15-11 1330

Received By: WL

Date/Time: 11-15-11 1330

**AWRC - Water Quality Laboratory**
**University of Arkansas, 2435 N. Hatch, Fayetteville, AR 72704**
**(479) 575-7317, Fax (479) 575-6720**



Name WR

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name WRUA

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 112015-5 | WR-2.5 | 11/15 | 1030 | WJ | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -6 | WR-01 | | 1100 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -7 | 001 | | 1110 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -8 | WR-02 | | 1200 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |

Relinquished By: WR

Date/Time: 11-15-11 1530

Received By: WR

Date/Time: 11-15-11 1530

**AWRC - Water Quality Laboratory**
**University of Arkansas, 2435 N. Hatch, Fayetteville, AR 72704**
**(479) 575-7317, Fax (479) 575-6720**



Name WL

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name WRWA

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 12015-9 | RC-01 | 10/14 | 1230 | LT | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -10 | WR-03 | | 1240 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -11 | WR-2.5-001 | | 1040 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| | | | | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |

Relinquished By: LT

Date/Time: 11-15-11 1330

Received By: WL

Date/Time: 11-15-11 1330

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

**Project** White River UAA

**Dr. Brian Haggard**
**ENGR 203**

**Lab Number:** 120260
**Date Reported:** 2/17/12
**Date Received:** 12/13/11 13:15

| Sample | Client ID | Date Sampled | Result | Units | Date Analyzed |
|---|---|---|---|---|---|
| **Chloride** | | **Method: EPA 300.0** | **PQL: 0.6** | **Holding Time Expires: 1/11/12** | |
| 120260-01 | Blank | 12/13/11 9:00 | **0.472** | mg/l | 12/15/11 |
| 120260-02 | WF-01 | 12/13/11 9:05 | **3.714** | mg/l | 12/15/11 |
| 120260-03 | RC-02 | 12/13/11 9:45 | **4.291** | mg/l | 12/15/11 |
| 120260-04 | WF-02 | 12/13/11 10:00 | **5.020** | mg/l | 12/15/11 |
| 120260-05 | WR-2.5 | 12/13/11 10:30 | **4.227** | mg/l | 12/15/11 |
| 120260-06 | WR-2.5 dup | 12/13/11 10:30 | **4.291** | mg/l | 12/15/11 |
| 120260-07 | WR-01 | 12/13/11 11:00 | **3.054** | mg/l | 12/15/11 |
| 120260-08 | 001 | 12/13/11 11:20 | **48.116** | mg/l | 12/15/11 |
| 120260-09 | WR-02 | 12/13/11 11:35 | **5.626** | mg/l | 12/15/11 |
| 120260-10 | RC-01 | 12/13/11 0:15 | **4.609** | mg/l | 12/15/11 |
| 120260-11 | WR-03 | 12/13/11 0:25 | **4.034** | mg/l | 12/15/11 |
| **Sulfate** | | **Method: EPA 300.0** | **PQL: 0.14** | **Holding Time Expires: 1/11/12** | |
| 120260-01 | Blank | 12/13/11 9:00 | **1.261** | mg/l | 12/15/11 |
| 120260-02 | WF-01 | 12/13/11 9:05 | **11.802** | mg/l | 12/15/11 |
| 120260-03 | RC-02 | 12/13/11 9:45 | **9.417** | mg/l | 12/15/11 |
| 120260-04 | WF-02 | 12/13/11 10:00 | **27.345** | mg/l | 12/15/11 |
| 120260-05 | WR-2.5 | 12/13/11 10:30 | **12.310** | mg/l | 12/15/11 |
| 120260-06 | WR-2.5 dup | 12/13/11 10:30 | **12.288** | mg/l | 12/15/11 |
| 120260-07 | WR-01 | 12/13/11 11:00 | **11.301** | mg/l | 12/15/11 |
| 120260-08 | 001 | 12/13/11 11:20 | **58.104** | mg/l | 12/15/11 |
| 120260-09 | WR-02 | 12/13/11 11:35 | **14.756** | mg/l | 12/15/11 |
| 120260-10 | RC-01 | 12/13/11 0:15 | **10.597** | mg/l | 12/15/11 |
| 120260-11 | WR-03 | 12/13/11 0:25 | **11.549** | mg/l | 12/15/11 |
| **Total Dissolved Solids** | | **Method: EPA 160.1** | **PQL: 34.9** | **Holding Time Expires: 12/21/11** | |
| 120260-01 | Blank | 12/13/11 9:00 | **0.0** | mg/l | 12/15/11 |
| 120260-02 | WF-01 | 12/13/11 9:05 | **73.1** | mg/l | 12/15/11 |
| 120260-03 | RC-02 | 12/13/11 9:45 | **84.5** | mg/l | 12/15/11 |
| 120260-04 | WF-02 | 12/13/11 10:00 | **118.5** | mg/l | 12/15/11 |
| 120260-05 | WR-2.5 | 12/13/11 10:30 | **74.2** | mg/l | 12/15/11 |
| 120260-06 | WR-2.5 dup | 12/13/11 10:30 | **76.7** | mg/l | 12/15/11 |
| 120260-07 | WR-01 | 12/13/11 11:00 | **63.3** | mg/l | 12/15/11 |
| 120260-08 | 001 | 12/13/11 11:20 | **347.1** | mg/l | 12/15/11 |
| 120260-09 | WR-02 | 12/13/11 11:35 | **92.2** | mg/l | 12/15/11 |
| 120260-10 | RC-01 | 12/13/11 0:15 | **98.0** | mg/l | 12/15/11 |
| 120260-11 | WR-03 | 12/13/11 0:25 | **70.7** | mg/l | 12/15/11 |

PQL = Practical Quantitation Limit

| Sample | Client ID | Date Sampled | Result | Units | Date Analyzed |
|---|---|---|---|---|---|
| Turbidity | | Method: EPA 180.1 | PQL: 0.5 | Holding Time Expires: | 12/16/11 |
| 120260-01 | Blank | 12/13/11 9:00 | **0.02** | NTU's | 12/13/11 |
| 120260-02 | WF-01 | 12/13/11 9:05 | **1.8** | NTU's | 12/13/11 |
| 120260-03 | RC-02 | 12/13/11 9:45 | **1.5** | NTU's | 12/13/11 |
| 120260-04 | WF-02 | 12/13/11 10:00 | **2.9** | NTU's | 12/13/11 |
| 120260-05 | WR-2.5 | 12/13/11 10:30 | **5.2** | NTU's | 12/13/11 |
| 120260-06 | WR-2.5 dup | 12/13/11 10:30 | **5.2** | NTU's | 12/13/11 |
| 120260-07 | WR-01 | 12/13/11 11:00 | **5.4** | NTU's | 12/13/11 |
| 120260-08 | 001 | 12/13/11 11:20 | **0.6** | NTU's | 12/13/11 |
| 120260-09 | WR-02 | 12/13/11 11:35 | **5.1** | NTU's | 12/13/11 |
| 120260-10 | RC-01 | 12/13/11 0:15 | **1.7** | NTU's | 12/13/11 |
| 120260-11 | WR-03 | 12/13/11 0:25 | **5.8** | NTU's | 12/13/11 |

**Verified By:** KBM 02/17/12

**QA/QC Reviewer:** Jennifer Massey

PQL = Practical Quantitation Limit

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

**Project White River UAA**

**Dr. Brian Haggard**
**ENGR 203**

**Lab Number:** 120289
**Date Reported:** 1/18/12
**Date Received:** 1/10/12 12:45

| Sample | Client ID | Date Sampled | Result | Units | Date Analyzed |
|---|---|---|---|---|---|
| **Chloride** | | **Method: EPA 300.0** | **PQL: 0.6** | **Holding Time Expires: 2/8/12** | |
| 120289-01 | Blank | 1/10/12 9:00 | **0.036** | mg/l | 1/10/12 |
| 120289-02 | WF-01 | 1/10/12 9:05 | **3.615** | mg/l | 1/10/12 |
| 120289-03 | RC-02 | 1/10/12 9:40 | **4.442** | mg/l | 1/10/12 |
| 120289-04 | WF-02 | 1/10/12 9:57 | **5.075** | mg/l | 1/10/12 |
| 120289-05 | WF-02 dup | 1/10/12 9:57 | **5.269** | mg/l | 1/10/12 |
| 120289-06 | WR-2-5 | 1/10/12 10:22 | **4.681** | mg/l | 1/10/12 |
| 120289-07 | WR-01 | 1/10/12 10:39 | **3.091** | mg/l | 1/10/12 |
| 120289-08 | 001 | 1/10/12 10:51 | **50.397** | mg/l | 1/10/12 |
| 120289-09 | WR-02 | 1/10/12 11:05 | **6.006** | mg/l | 1/10/12 |
| 120289-10 | RC-01 | 1/10/12 11:36 | **4.378** | mg/l | 1/10/12 |
| 120289-11 | WR-03 | 1/10/12 11:45 | **4.725** | mg/l | 1/10/12 |
| **Sulfate** | | **Method: EPA 300.0** | **PQL: 0.14** | **Holding Time Expires: 2/8/12** | |
| 120289-01 | Blank | 1/10/12 9:00 | **0.333** | mg/l | 1/10/12 |
| 120289-02 | WF-01 | 1/10/12 9:05 | **11.883** | mg/l | 1/10/12 |
| 120289-03 | RC-02 | 1/10/12 9:40 | **11.077** | mg/l | 1/10/12 |
| 120289-04 | WF-02 | 1/10/12 9:57 | **30.503** | mg/l | 1/10/12 |
| 120289-05 | WF-02 dup | 1/10/12 9:57 | **30.542** | mg/l | 1/10/12 |
| 120289-06 | WR-2-5 | 1/10/12 10:22 | **13.772** | mg/l | 1/10/12 |
| 120289-07 | WR-01 | 1/10/12 10:39 | **11.894** | mg/l | 1/10/12 |
| 120289-08 | 001 | 1/10/12 10:51 | **60.149** | mg/l | 1/10/12 |
| 120289-09 | WR-02 | 1/10/12 11:05 | **15.090** | mg/l | 1/10/12 |
| 120289-10 | RC-01 | 1/10/12 11:36 | **11.193** | mg/l | 1/10/12 |
| 120289-11 | WR-03 | 1/10/12 11:45 | **13.828** | mg/l | 1/10/12 |
| **Total Dissolved Solids** | | **Method: EPA 160.1** | **PQL: 34.9** | **Holding Time Expires: 1/18/12** | |
| 120289-01 | Blank | 1/10/12 9:00 | **7.6** | mg/l | 1/11/12 |
| 120289-02 | WF-01 | 1/10/12 9:05 | **70.7** | mg/l | 1/11/12 |
| 120289-03 | RC-02 | 1/10/12 9:40 | **91.8** | mg/l | 1/11/12 |
| 120289-04 | WF-02 | 1/10/12 9:57 | **131.6** | mg/l | 1/11/12 |
| 120289-05 | WF-02 dup | 1/10/12 9:57 | **122.7** | mg/l | 1/11/12 |
| 120289-06 | WR-2-5 | 1/10/12 10:22 | **75.8** | mg/l | 1/11/12 |
| 120289-07 | WR-01 | 1/10/12 10:39 | **64.4** | mg/l | 1/11/12 |
| 120289-08 | 001 | 1/10/12 10:51 | **363.3** | mg/l | 1/11/12 |
| 120289-09 | WR-02 | 1/10/12 11:05 | **88.9** | mg/l | 1/11/12 |
| 120289-10 | RC-01 | 1/10/12 11:36 | **94.2** | mg/l | 1/11/12 |
| 120289-11 | WR-03 | 1/10/12 11:45 | **77.1** | mg/l | 1/11/12 |

PQL = Practical Quantitation Limit

| Sample | Client ID | Date Sampled | Result | Units | Date Analyzed |
|---|---|---|---|---|---|
| Turbidity | | Method: EPA 180.1 | PQL: 0.5 | Holding Time Expires: | 1/13/12 |
| 120289-01 | Blank | 1/10/12 9:00 | 0.4 | NTU's | 1/10/12 |
| 120289-02 | WF-01 | 1/10/12 9:05 | 0.9 | NTU's | 1/10/12 |
| 120289-03 | RC-02 | 1/10/12 9:40 | 1.3 | NTU's | 1/10/12 |
| 120289-04 | WF-02 | 1/10/12 9:57 | 2.9 | NTU's | 1/10/12 |
| 120289-05 | WF-02 dup | 1/10/12 9:57 | 2.9 | NTU's | 1/10/12 |
| 120289-06 | WR-2-5 | 1/10/12 10:22 | 6.3 | NTU's | 1/10/12 |
| 120289-07 | WR-01 | 1/10/12 10:39 | 8.2 | NTU's | 1/10/12 |
| 120289-08 | 001 | 1/10/12 10:51 | 1.4 | NTU's | 1/10/12 |
| 120289-09 | WR-02 | 1/10/12 11:05 | 6.9 | NTU's | 1/10/12 |
| 120289-10 | RC-01 | 1/10/12 11:36 | 1.2 | NTU's | 1/10/12 |
| 120289-11 | WR-03 | 1/10/12 11:45 | 6.1 | NTU's | 1/10/12 |

**Verified By:** John Metraila 1-23-12

**QA/QC Reviewer:** Jessie B. Massey 1-24-12

PQL = Practical Quantitation Limit

# Arkansas Water Resources Center
# Water Quality Lab

University of Arkansas, BIOR 106, 2435 North Hatch
Fayetteville, AR 72704
479-575-7317

# LabQCReport

**For Lab Number:** 120289 1/18/12

## Chloride

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| std3 | 1/10/12 | 9.706 | mg/l | 10.000 | mg/l | 97.1% |
| vhgcl5 | 1/10/12 | 4.781 | mg/l | 5.000 | mg/l | 95.6% |
| std5 | 1/10/12 | 50.181 | mg/l | 50.000 | mg/l | 100.4% |
| vhgcl5 | 1/10/12 | 4.706 | mg/l | 5.000 | mg/l | 94.1% |
| vhg | 1/10/12 | 1.322 | mg/l | 1.200 | mg/l | 110.1% |
| vhg | 1/10/12 | 1.305 | mg/l | 1.200 | mg/l | 108.7% |
| | | | | | AVG* = | 101.0% |
| | | | | | RPD**= | 6.8% |

## Sulfate

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| vhg | 1/10/12 | 5.992 | mg/l | 6.000 | mg/l | 99.9% |
| std3 | 1/10/12 | 10.131 | mg/l | 10.000 | mg/l | 101.3% |
| std5 | 1/10/12 | 50.232 | mg/l | 50.000 | mg/l | 100.5% |
| vhg | 1/10/12 | 6.050 | mg/l | 6.000 | mg/l | 100.8% |
| std4 | 1/10/12 | 30.344 | mg/l | 30.000 | mg/l | 101.1% |
| vhg | 1/10/12 | 5.906 | mg/l | 6.000 | mg/l | 98.4% |
| | | | | | AVG* = | 100.3% |
| | | | | | RPD**= | 7.9% |

*The average % Recovery is a measure of accuracy.
**RPD=Relative Percent Deviation, a measure of Precision.

# LabQCReport

**For Lab Number:** 120289 1/18/12

## Turbidity

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| Std10 | 1/10/12 | 9.860 | NTU's | 10.000 | NTU's | 98.6% |
| Std5.0 | 1/10/12 | 5.070 | NTU's | 5.000 | NTU's | 101.4% |
| Std10 | 1/10/12 | 9.760 | NTU's | 10.000 | NTU's | 97.6% |
| Std10 | 1/10/12 | 9.200 | NTU's | 10.000 | NTU's | 92.0% |
| | | | | | **AVG* =** | 97.4% |
| | | | | | **RPD**=** | 11.9% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**


# LabQCReport

**For Lab Number:** 120289 1/18/12

## Chloride

| Spikes: | Date | Sample | Result | Spike Level | Spike + Result | % Recovery |
|---|---|---|---|---|---|---|
| | 1/10/12 | 120289-01 | 0.036 mg/l | 4.9 | 4.781 mg/l | 96.8 |

## Sulfate

| Spikes: | Date | Sample | Result | Spike Level | Spike + Result | % Recovery |
|---|---|---|---|---|---|---|
| | 1/10/12 | 120289-01 | 0.333 mg/l | 4.9 | 5.816 mg/l | 111.9 |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**


# LabQCReport

**For Lab Number:** 120289 1/18/12

## Total Dissolved Solids

| DUPLICATES: Date | Sample | Result | | Duplicate Result | | % RSD |
|---|---|---|---|---|---|---|
| 1/11/12 | 120289-02 | 70.7 | mg/l | 71.6 | mg/l | 1.25% |
| | 120289-11 | 77.1 | mg/l | 79.1 | mg/l | 2.56% |

## Turbidity

| DUPLICATES: Date | Sample | Result | | Duplicate Result | | % RSD |
|---|---|---|---|---|---|---|
| 1/10/12 | 120289-01 | 0.4 | NTU's | 0.5 | NTU's | 6.74% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**


# LabQCReport

**For Lab Number:** **120289** **1/18/2012**

## Chloride

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 1/10/12 | blank | 0.0739 mg/l | 0.000 mg/l |

## Sulfate

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 1/10/12 | blank | 0 mg/l | 0.000 mg/l |

## Total Dissolved Solids

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 1/11/12 | blank | -4.0 mg/l | 0.000 mg/l |
| | 1/11/12 | blank | -2.89 mg/l | 0.000 mg/l |

## Turbidity

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 1/10/12 | blank | 0.02 NTU's | 0.000 NTU's |

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**



Name Wade Cash/Dr. Brian Haggard

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name WRUAK

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 120284-1 | BLANK | 1/10 | 900 | LM | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity Cl & SO4 |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia TDS |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) Turbidity |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -2 | WF-01 | | 905 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | ~~Anions, TSS~~, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia Cl & SO4 |
| -C | filtered | | | 40 | ~~PO4-P (Split/filtered in lab)~~ TDS |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -4 | WRED RC-02 | | 940 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | ~~Anions, TSS~~, Turbidity |
| -B | acid sulfuric | | | 250 | ~~TN/TP~~, Ammonia TDS |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) Cl & SO4 |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -5 | WF-02 | | 957 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | ~~Anions, TSS~~, Turbidity |
| -B | acid sulfuric | | | 250 | ~~TN/TP~~, Ammonia Cl & SO4 |
| -C | filtered | | | 40 | ~~PO4-P (Split/filtered in lab)~~ TDS |
| -D | | | | | |

Relinquished By: WC

Date/Time: 1-10-12 1245

Received By: WC

Date/Time: 1-10-12 1245

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**



Name Wade Cash/Dr. Brian Haggard

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name WRUM

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 120289-5 | ~~WR-05~~ WF-01-Dup | 1/10 | ~~1000~~ | WJ | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | 9.57 | 500 | ~~Anions, TSS,~~ Turbidity |
| -B | acid sulfuric | | | 250 | ~~TN/TP,~~ Ammonia Cl & SO4 |
| -C | filtered | | | 40 | ~~PO4-P (Split/filtered in lab)~~ TDS |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -6 | ~~WR-04~~ WR-2-5 | | ~~1004~~ | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | 10.52 | 500 | ~~Anions, TSS,~~ Turbidity |
| -B | acid sulfuric | | | 250 | ~~TN/TP,~~ Ammonia Cl & SO4 |
| -C | filtered | | | 40 | ~~PO4-P (Split/filtered in lab)~~ TDS |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -7 | WR-01 | | 1014 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | ~~Anions, TSS,~~ Turbidity |
| -B | acid sulfuric | | | 250 | ~~TN/TP,~~ Ammonia Cl & SO4 |
| -C | filtered | | | 40 | ~~PO4-P (Split/filtered in lab)~~ TDS |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -8 | 001 | | 1051 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | ~~Anions, TSS,~~ Turbidity |
| -B | acid sulfuric | | | 250 | ~~TN/TP,~~ Ammonia Cl & SO4 |
| -C | filtered | | | 40 | ~~PO4-P (Split/filtered in lab)~~ TDS |
| -D | | | | | |

Relinquished By: WC

Date/Time: 1-10-12 1245

Received By: WC

Date/Time: 1-10-12 1245

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**

Name Wade Cash/Dr. Brian Haggard

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name WRUA

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 20 289-9 | WR-02 | 1/10 | 1105 | WT | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | ~~Anions, TSS~~, Turbidity |
| -B | acid sulfuric | | | 250 | ~~TN/TP, Ammonia~~ Cl & SO4 |
| -C | filtered | | | 40 | ~~PO4-P (Split/filtered in lab)~~ TDS |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -10 | RC-01 | | 1136 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | ~~Anions, TSS~~, Turbidity |
| -B | acid sulfuric | | | 250 | ~~TN/TP, Ammonia~~ Cl & SO4 |
| -C | filtered | | | 40 | ~~PO4-P (Split/filtered in lab)~~ TDS |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -11 | WR-03 | | 1145 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | ~~Anions, TSS~~, Turbidity |
| -B | acid sulfuric | | | 250 | ~~TN/TP, Ammonia~~ Cl & SO4 |
| -C | filtered | | | 40 | ~~PO4-P (Split/filtered in lab)~~ TDS |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| | | | | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |

Relinquished By: WC

Date/Time: 1-10-12 1245

Received By: LR

Date/Time: 1-10-12 1245

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

**Project** White River UAA

**Dr. Brian Haggard**
**ENGR 203**

**Lab Number:** 120351
**Date Reported:** 2/20/12
**Date Received:** 2/14/12 13:15

| Sample | Client ID | Date Sampled | Result | Units | Date Analyzed |
|---|---|---|---|---|---|
| **Chloride** | | **Method: EPA 300.0** | **PQL: 1.11** | **Holding Time Expires: 3/14/12** | |
| 120351-01 | Blank | 2/14/12 8:55 | **0.116** | mg/l | 2/15/12 |
| 120351-02 | WF-01 | 2/14/12 9:00 | **3.194** | mg/l | 2/15/12 |
| 120351-03 | RC-02 | 2/14/12 9:45 | **4.082** | mg/l | 2/15/12 |
| 120351-04 | WF-02 | 2/14/12 10:00 | **4.541** | mg/l | 2/15/12 |
| 120351-05 | WF-02 - dup | 2/14/12 10:00 | **4.434** | mg/l | 2/15/12 |
| 120351-06 | WR-2-5 | 2/14/12 10:30 | **3.480** | mg/l | 2/15/12 |
| 120351-07 | WR-01 | 2/14/12 11:00 | **2.662** | mg/l | 2/15/12 |
| 120351-08 | 001 | 2/14/12 11:25 | **43.752** | mg/l | 2/15/12 |
| 120351-09 | WR-02 | 2/14/12 11:40 | **5.126** | mg/l | 2/15/12 |
| 120351-10 | RC-01 | 2/14/12 12:10 | **3.855** | mg/l | 2/15/12 |
| 120351-11 | WR-03 | 2/14/12 12:25 | **3.542** | mg/l | 2/15/12 |
| **Sulfate** | | **Method: EPA 300.0** | **PQL: 0.16** | **Holding Time Expires: 3/14/12** | |
| 120351-01 | Blank | 2/14/12 8:55 | **0.000** | mg/l | 2/15/12 |
| 120351-02 | WF-01 | 2/14/12 9:00 | **9.293** | mg/l | 2/15/12 |
| 120351-03 | RC-02 | 2/14/12 9:45 | **11.224** | mg/l | 2/15/12 |
| 120351-04 | WF-02 | 2/14/12 10:00 | **25.900** | mg/l | 2/15/12 |
| 120351-05 | WF-02 - dup | 2/14/12 10:00 | **25.850** | mg/l | 2/15/12 |
| 120351-06 | WR-2-5 | 2/14/12 10:30 | **11.875** | mg/l | 2/15/12 |
| 120351-07 | WR-01 | 2/14/12 11:00 | **10.759** | mg/l | 2/15/12 |
| 120351-08 | 001 | 2/14/12 11:25 | **62.689** | mg/l | 2/16/12 |
| 120351-09 | WR-02 | 2/14/12 11:40 | **13.991** | mg/l | 2/15/12 |
| 120351-10 | RC-01 | 2/14/12 12:10 | **10.179** | mg/l | 2/15/12 |
| 120351-11 | WR-03 | 2/14/12 12:25 | **11.735** | mg/l | 2/15/12 |
| **Total Dissolved Solids** | | **Method: EPA 160.1** | **PQL: 21.6** | **Holding Time Expires: 2/22/12** | |
| 120351-01 | Blank | 2/14/12 8:55 | **0.0** | mg/l | 2/15/12 |
| 120351-02 | WF-01 | 2/14/12 9:00 | **61.6** | mg/l | 2/15/12 |
| 120351-03 | RC-02 | 2/14/12 9:45 | **85.8** | mg/l | 2/15/12 |
| 120351-04 | WF-02 | 2/14/12 10:00 | **116.0** | mg/l | 2/15/12 |
| 120351-05 | WF-02 - dup | 2/14/12 10:00 | **112.4** | mg/l | 2/15/12 |
| 120351-06 | WR-2-5 | 2/14/12 10:30 | **73.3** | mg/l | 2/15/12 |
| 120351-07 | WR-01 | 2/14/12 11:00 | **60.9** | mg/l | 2/15/12 |
| 120351-08 | 001 | 2/14/12 11:25 | **327.6** | mg/l | 2/15/12 |
| 120351-09 | WR-02 | 2/14/12 11:40 | **85.8** | mg/l | 2/15/12 |
| 120351-10 | RC-01 | 2/14/12 12:10 | **84.9** | mg/l | 2/15/12 |
| 120351-11 | WR-03 | 2/14/12 12:25 | **66.9** | mg/l | 2/15/12 |

PQL = Practical Quantitation Limit

| Sample | Client ID | Date Sampled | Result | Units | Date Analyzed |
|---|---|---|---|---|---|
| Turbidity | | Method: EPA 180.1 | PQL: 0.5 | Holding Time Expires: | 2/17/12 |
| 120351-01 | Blank | 2/14/12 8:55 | 0.4 | NTU's | 2/14/12 |
| 120351-02 | WF-01 | 2/14/12 9:00 | 2.6 | NTU's | 2/14/12 |
| 120351-03 | RC-02 | 2/14/12 9:45 | 2.7 | NTU's | 2/14/12 |
| 120351-04 | WF-02 | 2/14/12 10:00 | 3.4 | NTU's | 2/14/12 |
| 120351-05 | WF-02 - dup | 2/14/12 10:00 | 3.2 | NTU's | 2/14/12 |
| 120351-06 | WR-2-5 | 2/14/12 10:30 | 37.8 | NTU's | 2/14/12 |
| 120351-07 | WR-01 | 2/14/12 11:00 | 6.9 | NTU's | 2/14/12 |
| 120351-08 | 001 | 2/14/12 11:25 | 1.6 | NTU's | 2/14/12 |
| 120351-09 | WR-02 | 2/14/12 11:40 | 6.3 | NTU's | 2/14/12 |
| 120351-10 | RC-01 | 2/14/12 12:10 | 2.9 | NTU's | 2/14/12 |
| 120351-11 | WR-03 | 2/14/12 12:25 | 7.2 | NTU's | 2/14/12 |

**Verified By:** VBM 02/21/12

**QA/QC Reviewer:** Kerri B. Massey

PQL = Practical Quantitation Limit

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

# LabQCReport

**For Lab Number:** 120351 2/20/12

## Chloride

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| vhg | 2/15/12 | 1.283 | mg/l | 1.200 | mg/l | 106.9% |
| vhg | 2/15/12 | 1.250 | mg/l | 1.200 | mg/l | 104.2% |
| vhgcl5 | 2/15/12 | 4.859 | mg/l | 5.000 | mg/l | 97.2% |
| std5 | 2/15/12 | 49.944 | mg/l | 50.000 | mg/l | 99.9% |
| vhgcl5 | 2/15/12 | 4.836 | mg/l | 5.000 | mg/l | 96.7% |
| std4 | 2/15/12 | 30.161 | mg/l | 30.000 | mg/l | 100.5% |
| vhg | 2/15/12 | 1.273 | mg/l | 1.200 | mg/l | 106.1% |
| std3 | 2/15/12 | 10.059 | mg/l | 10.000 | mg/l | 100.6% |
| vhgcl5 | 2/15/12 | 4.851 | mg/l | 5.000 | mg/l | 97.0% |
| | | | | | **AVG* =** | 101.0% |
| | | | | | **RPD**=** | 3.9% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# LabQCReport

**For Lab Number:** 120351 2/20/12

## Sulfate

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| std5 | 2/15/12 | 49.983 | mg/l | 50.000 | mg/l | 100.0% |
| vhg | 2/15/12 | 5.995 | mg/l | 6.000 | mg/l | 99.9% |
| vhg | 2/15/12 | 5.966 | mg/l | 6.000 | mg/l | 99.4% |
| std4 | 2/15/12 | 30.003 | mg/l | 30.000 | mg/l | 100.0% |
| vhg | 2/15/12 | 5.967 | mg/l | 6.000 | mg/l | 99.5% |
| std3 | 2/15/12 | 10.489 | mg/l | 10.000 | mg/l | 104.9% |
| std4 | 2/16/12 | 30.089 | mg/l | 30.000 | mg/l | 100.3% |
| vhg | 2/16/12 | 5.923 | mg/l | 6.000 | mg/l | 98.7% |
| std5 | 2/16/12 | 49.923 | mg/l | 50.000 | mg/l | 99.8% |
| vhg | 2/16/12 | 5.997 | mg/l | 6.000 | mg/l | 99.9% |
| | | | | | **AVG* =** | 100.2% |
| | | | | | **RPD**=** | 5.5% |

## Turbidity

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| Std10 | 2/14/12 | 9.960 | NTU's | 10.000 | NTU's | 99.6% |
| Std5.0 | 2/14/12 | 5.870 | NTU's | 5.000 | NTU's | 117.4% |
| Std10 | 2/14/12 | 9.910 | NTU's | 10.000 | NTU's | 99.1% |
| Std10 | 2/14/12 | 9.660 | NTU's | 10.000 | NTU's | 96.6% |
| | | | | | **AVG* =** | 103.2% |
| | | | | | **RPD**=** | 14.8% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

# LabQCReport

**For Lab Number:** 120351 2/20/12

## Chloride

| Spikes: Date | Sample | Result | Spike Level | Spike + Result | % Recovery |
|---|---|---|---|---|---|
| 2/15/12 | 120351-01 | 0.116 mg/l | 4.9 | 4.864 mg/l | 96.9 |

## Sulfate

| Spikes: Date | Sample | Result | Spike Level | Spike + Result | % Recovery |
|---|---|---|---|---|---|
| 2/15/12 | 120351-01 | 0.000 mg/l | 4.9 | 5.880 mg/l | 120.0 |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**


# LabQCReport

**For Lab Number:** 120351 2/20/12

## Total Dissolved Solids

| DUPLICATES: | Date | Sample | Result | | Duplicate Result | | % RSD |
|---|---|---|---|---|---|---|---|
| | 2/15/12 | 120351-11 | 66.9 | mg/l | 66.0 | mg/l | 1.34% |
| | | 120351-02 | 61.5 | mg/l | 61.8 | mg/l | 0.36% |

## Turbidity

| DUPLICATES: | Date | Sample | Result | | Duplicate Result | | % RSD |
|---|---|---|---|---|---|---|---|
| | 2/14/12 | 120351-01 | 0.3 | NTU's | 0.4 | NTU's | 5.56% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
## Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**


# LabQCReport

**For Lab Number:** **120351** **2/20/2012**

### Chloride

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 2/15/12 | blank | 0.1512 mg/l | 0.000 mg/l |

### Sulfate

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 2/15/12 | blank | 0 mg/l | 0.000 mg/l |
| | 2/16/12 | blank | 0 mg/l | 0.000 mg/l |

### Total Dissolved Solids

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 2/15/12 | blank | -0.22 mg/l | 0.000 mg/l |
| | 2/15/12 | blank | -0.44 mg/l | 0.000 mg/l |

### Turbidity

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 2/14/12 | blank | 0.03 NTU's | 0.000 NTU's |

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**



Name Dr. Haggard/ Wade Cash

Mailing Address _____

City, State, Zip _____

Phone/Fax _____

**Lab Number:**

Project Name ~~Eager Creek~~ WRUK

Cost Ctr. No./P.O. No. _____

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 12031-1 | BLANK | 2/14 | 855 | WD | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 1000 | TSS, Chlorophyll a, Turbidity |
| -B | raw, sulfuric acid | | | 250 | Ammonia, N+N, TN/TP |
| -C | filter, no acid | | | 40 | SRP |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -2 | WF-01 | | 900 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 1000 | TSS, Chlorophyll a, Turbidity |
| -B | raw, sulfuric acid | | | 250 | Ammonia, N+N, TN/TP |
| -C | filter, no acid | | | 40 | SRP |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -3 | RC-02 | | 945 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 1000 | TSS, Chlorophyll a, Turbidity |
| -B | raw, sulfuric acid | | | 250 | Ammonia, N+N, TN/TP |
| -C | filter, no acid | | | 40 | SRP |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -4 | WF-02 | | 1000 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 1000 | TSS, Chlorophyll a, Turbidity |
| -B | raw, sulfuric acid | | | 250 | Ammonia, N+N, TN/TP |
| -C | filter, no acid | | | 40 | SRP |
| -D | | | | | |

Relinquished By: WR

Date/Time: 2-14-12 1315

Received By: WR

Date/Time: 2-14-12 1315

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**



Name Dr. Haggard/ Wade Cash

Mailing Address _____

City, State, Zip _____

Phone/Fax _____

**Lab Number:**

Project Name Sager creek WRUA

Cost Ctr. No./P.O. No. _____

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 12051-5 | ~~WR 2.5~~ WF-02-12 dr | 2/14 | 1000 | WF | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 1000 | TSS, Chlorophyll a, Turbidity |
| -B | raw, sulfuric acid | | | 250 | Ammonia, N+N, TN/TP |
| -C | filter, no acid | | | 40 | SRP |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -6 | WR-2.5 | | 1030 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 1000 | TSS, Chlorophyll a, Turbidity |
| -B | raw, sulfuric acid | | | 250 | Ammonia, N+N, TN/TP |
| -C | filter, no acid | | | 40 | SRP |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -7 | WR-0.1 | | 1100 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 1000 | TSS, Chlorophyll a, Turbidity |
| -B | raw, sulfuric acid | | | 250 | Ammonia, N+N, TN/TP |
| -C | filter, no acid | | | 40 | SRP |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -8 | 001 | | 1125 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 1000 | TSS, Chlorophyll a, Turbidity |
| -B | raw, sulfuric acid | | | 250 | Ammonia, N+N, TN/TP |
| -C | filter, no acid | | | 40 | SRP |
| -D | | | | | |

Relinquished By: WF WR

Date/Time: 2-14-12 1315

Received By: LR

Date/Time: 2-14-12 1315

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**



Name Dr. Haggard/ Wade Cash

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name ~~Seger creek~~ WR JAL

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 120351-9 | WR-02 | 9/14 | 1140 | WR | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 1000 | TSS, Chlorophyll a, Turbidity |
| -B | raw, sulfuric acid | | | 250 | Ammonia, N+N, TN/TP |
| -C | filter, no acid | | | 40 | SRP |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -10 | RC-01 | | 1210 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 1000 | TSS, Chlorophyll a, Turbidity |
| -B | raw, sulfuric acid | | | 250 | Ammonia, N+N, TN/TP |
| -C | filter, no acid | | | 40 | SRP |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -11 | WR-03 | | 1225 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 1000 | TSS, Chlorophyll a, Turbidity |
| -B | raw, sulfuric acid | | | 250 | Ammonia, N+N, TN/TP |
| -C | filter, no acid | | | 40 | SRP |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| | | | | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 1000 | TSS, Chlorophyll a, Turbidity |
| -B | raw, sulfuric acid | | | 250 | Ammonia, N+N, TN/TP |
| -C | filter, no acid | | | 40 | SRP |
| -D | | | | | |

Relinquished By: WR

Date/Time: 9-14-12 1315

Received By: WR

Date/Time: 9-14-12 1315

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

**Project White River UAA**

**Duyen Tran**
**CH2M HILL**
**1400 N. Fox Hunter Rd.**
**Fayetteville, AR 72701**

**Lab Number:** 120377
**Date Reported:** 3/27/12
**Date Received:** 3/7/12 15:15

| Sample | Client ID | Date Sampled | Result | Units | Date Analyzed |
|---|---|---|---|---|---|
| Chloride | | Method: EPA 300.0 | PQL: 1.11 | Holding Time Expires: 4/5/12 | |
| 120377-01 | Blank | 3/7/12 9:40 | 0.061 | mg/l | 3/7/12 |
| 120377-02 | WF-01 | 3/7/12 9:45 | 3.401 | mg/l | 3/7/12 |
| 120377-03 | RC-02 | 3/7/12 10:30 | 3.640 | mg/l | 3/7/12 |
| 120377-04 | RC-02 dup | 3/7/12 10:30 | 3.593 | mg/l | 3/7/12 |
| 120377-05 | WF-02 | 3/7/12 11:00 | 4.769 | mg/l | 3/7/12 |
| 120377-06 | WR-2.5 | 3/7/12 11:30 | 4.875 | mg/l | 3/7/12 |
| 120377-07 | WR-01 | 3/7/12 12:00 | 2.974 | mg/l | 3/7/12 |
| 120377-08 | 001 | 3/7/12 12:15 | 53.937 | mg/l | 3/7/12 |
| 120377-09 | WR-02 | 3/7/12 12:45 | 7.819 | mg/l | 3/7/12 |
| 120377-10 | RC-01 | 3/7/12 13:15 | 4.146 | mg/l | 3/7/12 |
| 120377-11 | WR-03 | 3/7/12 13:30 | 5.384 | mg/l | 3/7/12 |
| Sulfate | | Method: EPA 300.0 | PQL: 0.16 | Holding Time Expires: 4/5/12 | |
| 120377-01 | Blank | 3/7/12 9:40 | 1.225 | mg/l | 3/7/12 |
| 120377-02 | WF-01 | 3/7/12 9:45 | 10.995 | mg/l | 3/7/12 |
| 120377-03 | RC-02 | 3/7/12 10:30 | 9.585 | mg/l | 3/7/12 |
| 120377-04 | RC-02 dup | 3/7/12 10:30 | 9.540 | mg/l | 3/7/12 |
| 120377-05 | WF-02 | 3/7/12 11:00 | 25.481 | mg/l | 3/7/12 |
| 120377-06 | WR-2.5 | 3/7/12 11:30 | 15.376 | mg/l | 3/7/12 |
| 120377-07 | WR-01 | 3/7/12 12:00 | 12.321 | mg/l | 3/7/12 |
| 120377-08 | 001 | 3/7/12 12:15 | 54.849 | mg/l | 3/7/12 |
| 120377-09 | WR-02 | 3/7/12 12:45 | 17.045 | mg/l | 3/7/12 |
| 120377-10 | RC-01 | 3/7/12 13:15 | 11.621 | mg/l | 3/7/12 |
| 120377-11 | WR-03 | 3/7/12 13:30 | 15.566 | mg/l | 3/7/12 |
| Total Dissolved Solids | | Method: EPA 160.1 | PQL: 21.6 | Holding Time Expires: 3/15/12 | |
| 120377-01 | Blank | 3/7/12 9:40 | 10.7 | mg/l | 3/9/12 |
| 120377-02 | WF-01 | 3/7/12 9:45 | 77.3 | mg/l | 3/9/12 |
| 120377-03 | RC-02 | 3/7/12 10:30 | 87.8 | mg/l | 3/9/12 |
| 120377-04 | RC-02 dup | 3/7/12 10:30 | 89.1 | mg/l | 3/9/12 |
| 120377-05 | WF-02 | 3/7/12 11:00 | 126.9 | mg/l | 3/9/12 |
| 120377-06 | WR-2.5 | 3/7/12 11:30 | 96.4 | mg/l | 3/9/12 |
| 120377-07 | WR-01 | 3/7/12 12:00 | 78.2 | mg/l | 3/9/12 |
| 120377-08 | 001 | 3/7/12 12:15 | 369.6 | mg/l | 3/9/12 |
| 120377-09 | WR-02 | 3/7/12 12:45 | 110.9 | mg/l | 3/9/12 |
| 120377-10 | RC-01 | 3/7/12 13:15 | 99.8 | mg/l | 3/9/12 |
| 120377-11 | WR-03 | 3/7/12 13:30 | 97.6 | mg/l | 3/9/12 |

PQL = Practical Quantitation Limit

| Sample | Client ID | Date Sampled | Result | Units | Date Analyzed |
|---|---|---|---|---|---|
| Turbidity | | Method: EPA 180.1 | PQL: 0.5 | Holding Time Expires: | 3/10/12 |
| 120377-01 | Blank | 3/7/12 9:40 | **0.08** | NTU's | 3/7/12 |
| 120377-02 | WF-01 | 3/7/12 9:45 | **2.3** | NTU's | 3/7/12 |
| 120377-03 | RC-02 | 3/7/12 10:30 | **2.2** | NTU's | 3/7/12 |
| 120377-04 | RC-02 dup | 3/7/12 10:30 | **2.1** | NTU's | 3/7/12 |
| 120377-05 | WF-02 | 3/7/12 11:00 | **8.1** | NTU's | 3/7/12 |
| 120377-06 | WR-2.5 | 3/7/12 11:30 | **16.9** | NTU's | 3/7/12 |
| 120377-07 | WR-01 | 3/7/12 12:00 | **13.9** | NTU's | 3/7/12 |
| 120377-08 | 001 | 3/7/12 12:15 | **3.1** | NTU's | 3/7/12 |
| 120377-09 | WR-02 | 3/7/12 12:45 | **11.1** | NTU's | 3/7/12 |
| 120377-10 | RC-01 | 3/7/12 13:15 | **2.1** | NTU's | 3/7/12 |
| 120377-11 | WR-03 | 3/7/12 13:30 | **17.5** | NTU's | 3/7/12 |

**Verified By:** Debbie B. Massey

**QA/QC Reviewer:** 03/27/12 DBM

PQL = Practical Quantitation Limit

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

# LabQCReport

**For Lab Number:** 120377 3/27/12

## Chloride

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| std4 | 3/7/12 | 30.358 | mg/l | 30.000 | mg/l | 101.2% |
| vhgcl5 | 3/7/12 | 5.048 | mg/l | 5.000 | mg/l | 101.0% |
| std5 | 3/7/12 | 50.988 | mg/l | 50.000 | mg/l | 102.0% |
| vhg | 3/7/12 | 1.150 | mg/l | 1.200 | mg/l | 95.9% |
| vhgcl5 | 3/7/12 | 4.767 | mg/l | 5.000 | mg/l | 95.3% |
| std3 | 3/7/12 | 9.730 | mg/l | 10.000 | mg/l | 97.3% |
| vhg | 3/7/12 | 1.106 | mg/l | 1.200 | mg/l | 92.2% |
| vhg | 3/7/12 | 1.215 | mg/l | 1.200 | mg/l | 101.3% |
| vhgcl5 | 3/7/12 | 4.883 | mg/l | 5.000 | mg/l | 97.7% |
| | | | | | **AVG* =** | 98.2% |
| | | | | | **RPD**=** | 3.4% |

## Sulfate

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| vhg | 3/7/12 | 5.999 | mg/l | 6.000 | mg/l | 100.0% |
| std5 | 3/7/12 | 50.146 | mg/l | 50.000 | mg/l | 100.3% |
| vhg | 3/7/12 | 6.070 | mg/l | 6.000 | mg/l | 101.2% |
| std3 | 3/7/12 | 10.003 | mg/l | 10.000 | mg/l | 100.0% |
| std4 | 3/7/12 | 30.101 | mg/l | 30.000 | mg/l | 100.3% |
| | | | | | **AVG* =** | 100.4% |
| | | | | | **RPD**=** | 3.9% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# LabQCReport

**For Lab Number:** 120377 3/27/12

## Turbidity

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| Std1.0 | 3/7/12 | 1.210 | NTU's | 1.000 | NTU's | 121.0% |
| Std10 | 3/7/12 | 9.970 | NTU's | 10.000 | NTU's | 99.7% |
| Std10 | 3/7/12 | 9.780 | NTU's | 10.000 | NTU's | 97.8% |
| Std10 | 3/7/12 | 9.920 | NTU's | 10.000 | NTU's | 99.2% |
| | | | | | **AVG* =** | 104.4% |
| | | | | | **RPD**=** | 14.5% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**


# LabQCReport

**For Lab Number:** 120377 3/27/12

## Chloride

| Spikes: | Date | Sample | Result | Spike Level | Spike + Result | % Recovery |
|---|---|---|---|---|---|---|
| | 3/7/12 | 120377-01 | 0.061 mg/l | 4.9 | 4.581 mg/l | 92.3 |

## Sulfate

| Spikes: | Date | Sample | Result | Spike Level | Spike + Result | % Recovery |
|---|---|---|---|---|---|---|
| | 3/7/12 | 120377-01 | 1.225 mg/l | 4.9 | 6.043 mg/l | 98.3 |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**


# LabQCReport

**For Lab Number:** 120377 3/27/12

## Total Dissolved Solids

| DUPLICATES: | Date | Sample | Result | | Duplicate Result | | % RSD |
|---|---|---|---|---|---|---|---|
| | 3/9/12 | 120377-02 | 77.3 | mg/l | 78.4 | mg/l | 1.43% |
| | | 120377-11 | 97.6 | mg/l | 99.1 | mg/l | 1.58% |

## Turbidity

| DUPLICATES: | Date | Sample | Result | | Duplicate Result | | % RSD |
|---|---|---|---|---|---|---|---|
| | 3/7/12 | 120377-01 | 0.1 | NTU's | 0.1 | NTU's | 22.22% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**


## LabQCReport

**For Lab Number:** **120377** **3/27/2012**

### Chloride

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 3/7/12 | blank | 0 mg/l | 0.000 mg/l |

### Sulfate

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 3/7/12 | blank | 0 mg/l | 0.000 mg/l |

### Total Dissolved Solids

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 3/9/12 | blank | 0.89 mg/l | 0.000 mg/l |
| | 3/9/12 | blank | 1.33 mg/l | 0.000 mg/l |

### Turbidity

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 3/7/12 | blank | 0.02 NTU's | 0.000 NTU's |

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**



Name WR

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name WRUAA

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 120377-1 | BLANK | 3/7 | ~~1330~~ | WJ | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | 6/0 | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -2 | WF-01 | | 945 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -3 | RC-02 | | 1040 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -4 | RC-02-DUP | | 1050 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |

Relinquished By: WR

Date/Time: 3-7-12 1515

Received By: WR

Date/Time: 3-7-12 1515

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**



Name WF

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name WRWA

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 120377-5th | WF-02 | 3/7 | 1100 | W | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -6 | WR-2.5 | | 1130 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -7 | WR-01 | | 1200 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -8 | 001 | | 1215 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | M | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |

Relinquished By: WF

Date/Time: 3-7-12 1515

Received By: WF

Date/Time: 3-7-12 1515

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**



Name WR

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name WRUA7

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 120377-9 | WR-02 | 3/7 | 1245 | WR | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -10 | RC-01 | | 1315 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -11 | WR-03 | | 1330 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| | | | | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | | | | | |
| -B | | | | | |
| -C | | | | | |
| -D | | | | | |

Relinquished By: WR

Date/Time: 3-7-12 1515

Received By: WR

Date/Time: 3-7-12 1515

# Arkansas Water Resources Center
# Water Quality Lab

University of Arkansas, BIOR 106, 2435 North Hatch
Fayetteville, AR 72704
479-575-7317

**Project** White River UAA

**Duyen Tran**
**CH2M HILL**
**1400 N. Fox Hunter Rd.**
**Fayetteville, AR 72701**

**Lab Number:** 120448
**Date Reported:** 4/13/12
**Date Received:** 4/3/12 13:30

| Sample | Client ID | Date Sampled | Result | Units | Date Analyzed |
|---|---|---|---|---|---|
| **Chloride** | | **Method: EPA 300.0** | **PQL: 1.11** | **Holding Time Expires: 5/2/12** | |
| 120448-01 | Blank | 4/3/12 9:50 | **0.046** | mg/l | 4/3/12 |
| 120448-02 | WF-01 | 4/3/12 9:35 | **2.566** | mg/l | 4/3/12 |
| 120448-03 | RC-02 | 4/3/12 10:20 | **3.073** | mg/l | 4/3/12 |
| 120448-04 | WF-02 | 4/3/12 10:45 | **3.513** | mg/l | 4/3/12 |
| 120448-05 | WR-2-5 | 4/3/12 11:30 | **3.579** | mg/l | 4/3/12 |
| 120448-06 | WR-01 | 4/3/12 11:40 | **2.178** | mg/l | 4/3/12 |
| 120448-07 | WR-01 dup | 4/3/12 11:40 | **2.204** | mg/l | 4/3/12 |
| 120448-08 | 001 | 4/3/12 11:55 | **52.397** | mg/l | 4/3/12 |
| 120448-09 | WR-02 | 4/3/12 0:00 | **5.495** | mg/l | 4/3/12 |
| 120448-10 | RC-01 | 4/3/12 0:00 | **3.158** | mg/l | 4/3/12 |
| 120448-11 | WR-03 | 4/3/12 0:00 | **3.843** | mg/l | 4/3/12 |
| **Sulfate** | | **Method: EPA 300.0** | **PQL: 0.16** | **Holding Time Expires: 5/2/12** | |
| 120448-01 | Blank | 4/3/12 9:50 | **0.000** | mg/l | 4/3/12 |
| 120448-02 | WF-01 | 4/3/12 9:35 | **9.192** | mg/l | 4/3/12 |
| 120448-03 | RC-02 | 4/3/12 10:20 | **7.719** | mg/l | 4/3/12 |
| 120448-04 | WF-02 | 4/3/12 10:45 | **24.571** | mg/l | 4/3/12 |
| 120448-05 | WR-2-5 | 4/3/12 11:30 | **11.114** | mg/l | 4/3/12 |
| 120448-06 | WR-01 | 4/3/12 11:40 | **9.957** | mg/l | 4/3/12 |
| 120448-07 | WR-01 dup | 4/3/12 11:40 | **10.060** | mg/l | 4/3/12 |
| 120448-08 | 001 | 4/3/12 11:55 | **54.525** | mg/l | 4/3/12 |
| 120448-09 | WR-02 | 4/3/12 0:00 | **13.238** | mg/l | 4/3/12 |
| 120448-10 | RC-01 | 4/3/12 0:00 | **8.353** | mg/l | 4/3/12 |
| 120448-11 | WR-03 | 4/3/12 0:00 | **11.410** | mg/l | 4/3/12 |
| **Total Dissolved Solids** | | **Method: EPA 160.1** | **PQL: 21.6** | **Holding Time Expires: 4/11/12** | |
| 120448-01 | Blank | 4/3/12 9:50 | **4.4** | mg/l | 4/4/12 |
| 120448-02 | WF-01 | 4/3/12 9:35 | **68.2** | mg/l | 4/4/12 |
| 120448-03 | RC-02 | 4/3/12 10:20 | **83.6** | mg/l | 4/4/12 |
| 120448-04 | WF-02 | 4/3/12 10:45 | **117.1** | mg/l | 4/4/12 |
| 120448-05 | WR-2-5 | 4/3/12 11:30 | **84.0** | mg/l | 4/4/12 |
| 120448-06 | WR-01 | 4/3/12 11:40 | **74.0** | mg/l | 4/4/12 |
| 120448-07 | WR-01 dup | 4/3/12 11:40 | **64.7** | mg/l | 4/4/12 |
| 120448-08 | 001 | 4/3/12 11:55 | **357.8** | mg/l | 4/4/12 |
| 120448-09 | WR-02 | 4/3/12 0:00 | **94.0** | mg/l | 4/4/12 |
| 120448-10 | RC-01 | 4/3/12 0:00 | **58.0** | mg/l | 4/4/12 |
| 120448-11 | WR-03 | 4/3/12 0:00 | **76.5** | mg/l | 4/4/12 |

PQL = Practical Quantitation Limit

| Sample | Client ID | Date Sampled | Result | Units | Date Analyzed |
|---|---|---|---|---|---|
| Turbidity | | Method: EPA 180.1 | PQL: 0.5 | Holding Time Expires: | 4/6/12 |
| 120448-01 | Blank | 4/3/12 9:50 | 0.03 | NTU's | 4/3/12 |
| 120448-02 | WF-01 | 4/3/12 9:35 | 3.6 | NTU's | 4/3/12 |
| 120448-03 | RC-02 | 4/3/12 10:20 | 4.3 | NTU's | 4/3/12 |
| 120448-04 | WF-02 | 4/3/12 10:45 | 7.3 | NTU's | 4/3/12 |
| 120448-05 | WR-2-5 | 4/3/12 11:30 | 9.8 | NTU's | 4/3/12 |
| 120448-06 | WR-01 | 4/3/12 11:40 | 11.0 | NTU's | 4/3/12 |
| 120448-07 | WR-01 dup | 4/3/12 11:40 | 11.4 | NTU's | 4/3/12 |
| 120448-08 | 001 | 4/3/12 11:55 | 1.8 | NTU's | 4/3/12 |
| 120448-09 | WR-02 | 4/3/12 0:00 | 10.2 | NTU's | 4/3/12 |
| 120448-10 | RC-01 | 4/3/12 0:00 | 4.4 | NTU's | 4/3/12 |
| 120448-11 | WR-03 | 4/3/12 0:00 | 10.6 | NTU's | 4/3/12 |

**Verified By:** KBM 04/17/2012

**QA/QC Reviewer:** Kristi B Massey

PQL = Practical Quantitation Limit

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

# LabQCReport

**For Lab Number:** 120448 4/16/12

## Chloride

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| std3 | 4/3/12 | 9.910 | mg/l | 10.000 | mg/l | 99.1% |
| vhgcl5 | 4/3/12 | 4.794 | mg/l | 5.000 | mg/l | 95.9% |
| std5 | 4/3/12 | 50.006 | mg/l | 50.000 | mg/l | 100.0% |
| vhg | 4/3/12 | 1.274 | mg/l | 1.200 | mg/l | 106.1% |
| vhgcl5 | 4/3/12 | 4.840 | mg/l | 5.000 | mg/l | 96.8% |
| std4 | 4/3/12 | 30.414 | mg/l | 30.000 | mg/l | 101.4% |
| vhg | 4/3/12 | 1.164 | mg/l | 1.200 | mg/l | 97.0% |
| vhgcl5 | 4/3/12 | 4.790 | mg/l | 5.000 | mg/l | 95.8% |
| vhg | 4/3/12 | 1.141 | mg/l | 1.200 | mg/l | 95.1% |
| | | | | | **AVG* =** | 98.6% |
| | | | | | **RPD**=** | 3.6% |

## Sulfate

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| std3 | 4/3/12 | 10.112 | mg/l | 10.000 | mg/l | 101.1% |
| vhg | 4/3/12 | 5.887 | mg/l | 6.000 | mg/l | 98.1% |
| std5 | 4/3/12 | 49.974 | mg/l | 50.000 | mg/l | 99.9% |
| vhg | 4/3/12 | 5.967 | mg/l | 6.000 | mg/l | 99.5% |
| std4 | 4/3/12 | 30.184 | mg/l | 30.000 | mg/l | 100.6% |
| vhg | 4/3/12 | 6.007 | mg/l | 6.000 | mg/l | 100.1% |
| | | | | | **AVG* =** | 99.9% |
| | | | | | **RPD**=** | 4.6% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# LabQCReport

**For Lab Number:** 120448 4/16/12

## Turbidity

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| Std5.0 | 4/3/12 | 5.360 | NTU's | 5.000 | NTU's | 107.2% |
| Std10 | 4/3/12 | 10.000 | NTU's | 10.000 | NTU's | 100.0% |
| Std10 | 4/3/12 | 9.280 | NTU's | 10.000 | NTU's | 92.8% |
| Std10 | 4/3/12 | 9.980 | NTU's | 10.000 | NTU's | 99.8% |
| | | | | | **AVG* =** | 99.9% |
| | | | | | **RPD**=** | 10.5% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**


# LabQCReport

**For Lab Number:** 120448 4/17/12

## Chloride

| Spikes: | Date | Sample | Result | Spike Level | Spike + Result | % Recovery |
|---|---|---|---|---|---|---|
| | 4/3/12 | 120448-01 | 0.046 mg/l | 4.9 | 4.637 mg/l | 93.7 |

## Sulfate

| Spikes: | Date | Sample | Result | Spike Level | Spike + Result | % Recovery |
|---|---|---|---|---|---|---|
| | 4/3/12 | 120448-01 | 0.000 mg/l | 4.9 | 5.726 mg/l | 116.9 |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**


# LabQCReport

**For Lab Number:** 120448 4/16/12

## Total Dissolved Solids

| DUPLICATES: | Date | Sample | Result | | Duplicate Result | | % RSD |
|---|---|---|---|---|---|---|---|
| | 4/4/12 | 120448-02 | 68.2 | mg/l | 68.5 | mg/l | 0.37% |
| | | 120448-11 | 76.4 | mg/l | 75.8 | mg/l | 0.88% |

## Turbidity

| DUPLICATES: | Date | Sample | Result | | Duplicate Result | | % RSD |
|---|---|---|---|---|---|---|---|
| | 4/3/12 | 120448-01 | 0.0 | NTU's | 0.0 | NTU's | 0.00% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
## Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**


# LabQCReport

**For Lab Number:** 120448 **4/16/2012**

### Chloride

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 4/3/12 | blank | 0.0595 mg/l | 0.000 mg/l |

### Sulfate

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 4/3/12 | blank | 0 mg/l | 0.000 mg/l |

### Total Dissolved Solids

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 4/4/12 | blank | -2.22 mg/l | 0.000 mg/l |
| | 4/4/12 | blank | -2.89 mg/l | 0.000 mg/l |

### Turbidity

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 4/3/12 | blank | 0.02 NTU's | 0.000 NTU's |

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**

Page____of____

Name Dr. Haggard/ Wade Cash

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name ~~Seger creek~~ WRUA

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 140478-1 | BLANK | 4/3 | 950 | W | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 1000 | TSS, Chlorophyll a, Turbidity |
| -B | raw, sulfuric acid | | | 250 | Ammonia, N+N, TN/TP |
| -C | filter, no acid | | | 40 | SRP |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -2 | WF-01 | | 935 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 1000 | TSS, Chlorophyll a, Turbidity |
| -B | raw, sulfuric acid | | | 250 | Ammonia, N+N, TN/TP |
| -C | filter, no acid | | | 40 | SRP |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -3 | RC-01 | | 1020 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 1000 | TSS, Chlorophyll a, Turbidity |
| -B | raw, sulfuric acid | | | 250 | Ammonia, N+N, TN/TP |
| -C | filter, no acid | | | 40 | SRP |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -4 | WF-02 | | 1045 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 1000 | TSS, Chlorophyll a, Turbidity |
| -B | raw, sulfuric acid | | | 250 | Ammonia, N+N, TN/TP |
| -C | filter, no acid | | | 40 | SRP |
| -D | | | | | |

Relinquished By: WC

Date/Time: 4-3-12 1330

Received By: WR

Date/Time: 4-3-12 1330

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**



Name Dr. Haggard/ Wade Cash

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name ~~Seger creek~~ WRWA

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 120478-5 | WR-2.5 | 4/3 | 1130 | WD | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 1000 | TSS, Chlorophyll a, Turbidity |
| -B | raw, sulfuric acid | | | 250 | Ammonia, N+N, TN/TP |
| -C | filter, no acid | | | 40 | SRP |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -6 | WR-01 | | 1140 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 1000 | TSS, Chlorophyll a, Turbidity |
| -B | raw, sulfuric acid | | | 250 | Ammonia, N+N, TN/TP |
| -C | filter, no acid | | | 40 | SRP |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -7 | WR-01 AUX | | 1140 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 1000 | TSS, Chlorophyll a, Turbidity |
| -B | raw, sulfuric acid | | | 250 | Ammonia, N+N, TN/TP |
| -C | filter, no acid | | | 40 | SRP |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -8 | 001 | | 1155 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 1000 | TSS, Chlorophyll a, Turbidity |
| -B | raw, sulfuric acid | | | 250 | Ammonia, N+N, TN/TP |
| -C | filter, no acid | | | 40 | SRP |
| -D | | | | | |

Relinquished By: WR

Date/Time: 4-3-14 1330

Received By: WR

Date/Time: 4-3-14 1330

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**



Name Dr. Haggard/ Wade Cash

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name Sager creek

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 120548-9 | WR-02 | 4/3 | | WL | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 1000 | TSS, Chlorophyll a, Turbidity |
| -B | raw, sulfuric acid | | | 250 | Ammonia, N+N, TN/TP |
| -C | filter, no acid | | | 40 | SRP |
| -D | hydrochloric | | | 40 | TOC |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -10 | RC-01 | | | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, Turb., EC, TSS, split for below |
| -B | filtered, nitric | | | 30 | Metals |
| -C | filter, no acid | | | 40 | SRP |
| -D | hydrochloric | | | 40 | TOC |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -11 | WR-03 | | | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, Turb., EC, TSS, split for below |
| -B | filtered, nitric | | | 30 | Metals |
| -C | filter, no acid | | | 40 | SRP |
| -D | hydrochloric | | | 40 | TOC |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| | | | | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, Turb., EC, TSS, split for below |
| -B | filtered, nitric | | | 30 | Metals |
| -C | filter, no acid | | | 40 | SRP |
| -D | hydrochloric | | | 40 | TOC |

Relinquished By: WL

Date/Time: 4-3-12 1330

Received By: WL

Date/Time: 4-3-12 1330

# Arkansas Water Resources Center
# Water Quality Lab

University of Arkansas, BIOR 106, 2435 North Hatch
Fayetteville, AR 72704
479-575-7317

**Project** White River UAA

**Duyen Tran**
**CH2M HILL**
**1400 N. Fox Hunter Rd.**
**Fayetteville, AR 72701**

**Lab Number:** 120507
**Date Reported:** 5/8/12
**Date Received:** 5/3/12 14:15

| Sample | Client ID | Date Sampled | Result | Units | Date Analyzed |
|---|---|---|---|---|---|
| **Chloride** | | **Method: EPA 300.0** | **PQL: 1.11** | **Holding Time Expires: 6/1/12** | |
| 120507-01 | Blank | 5/3/12 9:20 | **0.122** | mg/l | 5/3/12 |
| 120507-02 | WF-01 | 5/3/12 9:30 | **3.217** | mg/l | 5/3/12 |
| 120507-03 | RC-02 | 5/3/12 10:15 | **3.672** | mg/l | 5/3/12 |
| 120507-04 | WF-02 | 5/3/12 10:45 | **4.916** | mg/l | 5/3/12 |
| 120507-05 | WR-2.5 | 5/3/12 11:15 | **6.060** | mg/l | 5/3/12 |
| 120507-06 | WR-01 | 5/3/12 11:45 | **3.020** | mg/l | 5/3/12 |
| 120507-07 | 001 | 5/3/12 12:05 | **50.199** | mg/l | 5/3/12 |
| 120507-08 | WR-02 | 5/3/12 12:30 | **6.442** | mg/l | 5/3/12 |
| 120507-09 | RC-01 | 5/3/12 13:00 | **3.671** | mg/l | 5/3/12 |
| 120507-10 | WR-03 | 5/3/12 13:15 | **6.355** | mg/l | 5/3/12 |
| 120507-11 | WR-02 dup | 5/3/12 12:30 | **6.369** | mg/l | 5/3/12 |
| **Sulfate** | | **Method: EPA 300.0** | **PQL: 0.16** | **Holding Time Expires: 6/1/12** | |
| 120507-01 | Blank | 5/3/12 9:20 | **0.180** | mg/l | 5/3/12 |
| 120507-02 | WF-01 | 5/3/12 9:30 | **11.754** | mg/l | 5/3/12 |
| 120507-03 | RC-02 | 5/3/12 10:15 | **9.455** | mg/l | 5/3/12 |
| 120507-04 | WF-02 | 5/3/12 10:45 | **32.609** | mg/l | 5/3/12 |
| 120507-05 | WR-2.5 | 5/3/12 11:15 | **19.067** | mg/l | 5/3/12 |
| 120507-06 | WR-01 | 5/3/12 11:45 | **14.335** | mg/l | 5/3/12 |
| 120507-07 | 001 | 5/3/12 12:05 | **48.115** | mg/l | 5/3/12 |
| 120507-08 | WR-02 | 5/3/12 12:30 | **17.970** | mg/l | 5/3/12 |
| 120507-09 | RC-01 | 5/3/12 13:00 | **10.445** | mg/l | 5/3/12 |
| 120507-10 | WR-03 | 5/3/12 13:15 | **18.742** | mg/l | 5/3/12 |
| 120507-11 | WR-02 dup | 5/3/12 12:30 | **17.948** | mg/l | 5/3/12 |
| **Total Dissolved Solids** | | **Method: EPA 160.1** | **PQL: 21.6** | **Holding Time Expires: 5/11/12** | |
| 120507-01 | Blank | 5/3/12 9:20 | **4.4** | mg/l | 5/4/12 |
| 120507-02 | WF-01 | 5/3/12 9:30 | **85.4** | mg/l | 5/4/12 |
| 120507-03 | RC-02 | 5/3/12 10:15 | **109.6** | mg/l | 5/4/12 |
| 120507-04 | WF-02 | 5/3/12 10:45 | **147.3** | mg/l | 5/4/12 |
| 120507-05 | WR-2.5 | 5/3/12 11:15 | **110.2** | mg/l | 5/4/12 |
| 120507-06 | WR-01 | 5/3/12 11:45 | **86.0** | mg/l | 5/4/12 |
| 120507-07 | 001 | 5/3/12 12:05 | **356.7** | mg/l | 5/4/12 |
| 120507-08 | WR-02 | 5/3/12 12:30 | **107.6** | mg/l | 5/4/12 |
| 120507-09 | RC-01 | 5/3/12 13:00 | **116.7** | mg/l | 5/4/12 |
| 120507-10 | WR-03 | 5/3/12 13:15 | **110.9** | mg/l | 5/4/12 |
| 120507-11 | WR-02 dup | 5/3/12 12:30 | **107.8** | mg/l | 5/4/12 |

PQL = Practical Quantitation Limit

| Sample | Client ID | Date Sampled | Result | Units | Date Analyzed |
|---|---|---|---|---|---|
| Turbidity | | Method: EPA 180.1 | PQL: 0.5 | Holding Time Expires: | 5/6/12 |
| 120507-01 | Blank | 5/3/12 9:20 | 0.1 | NTU's | 5/3/12 |
| 120507-02 | WF-01 | 5/3/12 9:30 | 1.7 | NTU's | 5/3/12 |
| 120507-03 | RC-02 | 5/3/12 10:15 | 1.7 | NTU's | 5/3/12 |
| 120507-04 | WF-02 | 5/3/12 10:45 | 7.3 | NTU's | 5/3/12 |
| 120507-05 | WR-2.5 | 5/3/12 11:15 | 7.0 | NTU's | 5/3/12 |
| 120507-06 | WR-01 | 5/3/12 11:45 | 9.1 | NTU's | 5/3/12 |
| 120507-07 | 001 | 5/3/12 12:05 | 0.6 | NTU's | 5/3/12 |
| 120507-08 | WR-02 | 5/3/12 12:30 | 6.9 | NTU's | 5/3/12 |
| 120507-09 | RC-01 | 5/3/12 13:00 | 3.0 | NTU's | 5/3/12 |
| 120507-10 | WR-03 | 5/3/12 13:15 | 8.4 | NTU's | 5/3/12 |
| 120507-11 | WR-02 dup | 5/3/12 12:30 | 7.0 | NTU's | 5/3/12 |

**Verified By:** Yessie BMassey

**QA/QC Reviewer:** YBM 05/08/12

PQL = Practical Quantitation Limit

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**


# LabQCReport

**For Lab Number:** 120507 5/8/12

## Chloride

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| std4 | 5/3/12 | 29.963 | mg/l | 30.000 | mg/l | 99.9% |
| vhgcl5 | 5/3/12 | 4.869 | mg/l | 5.000 | mg/l | 97.4% |
| vhg | 5/3/12 | 1.130 | mg/l | 1.200 | mg/l | 94.2% |
| std5 | 5/3/12 | 50.055 | mg/l | 50.000 | mg/l | 100.1% |
| vhgcl5 | 5/3/12 | 4.779 | mg/l | 5.000 | mg/l | 95.6% |
| vhg | 5/3/12 | 1.128 | mg/l | 1.200 | mg/l | 94.0% |
| | | | | | **AVG* =** | 96.8% |
| | | | | | **RPD**=** | 2.8% |

## Sulfate

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| std4 | 5/3/12 | 29.225 | mg/l | 30.000 | mg/l | 97.4% |
| vhg | 5/3/12 | 5.746 | mg/l | 6.000 | mg/l | 95.8% |
| std5 | 5/3/12 | 49.992 | mg/l | 50.000 | mg/l | 100.0% |
| vhg | 5/3/12 | 5.849 | mg/l | 6.000 | mg/l | 97.5% |
| | | | | | **AVG* =** | 97.7% |
| | | | | | **RPD**=** | 4.6% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# LabQCReport

**For Lab Number:** 120507 5/8/12

## Turbidity

| STANDARDS: | Date | Result | | True Value | | % Recovery |
|---|---|---|---|---|---|---|
| Std5.0 | 5/3/12 | 5.310 | NTU's | 5.000 | NTU's | 106.2% |
| Std10 | 5/3/12 | 9.990 | NTU's | 10.000 | NTU's | 99.9% |
| Std10 | 5/3/12 | 10.100 | NTU's | 10.000 | NTU's | 101.0% |
| Std10 | 5/3/12 | 9.950 | NTU's | 10.000 | NTU's | 99.5% |
| | | | | | **AVG* =** | 101.6% |
| | | | | | **RPD**=** | 7.6% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

# LabQCReport

**For Lab Number:** 120507 5/8/12

## Chloride

| Spikes: | Date | Sample | Result | Spike Level | Spike + Result | % Recovery |
|---|---|---|---|---|---|---|
| | 5/3/12 | 120507-01 | 0.122 mg/l | 4.9 | 4.677 mg/l | 92.9 |

## Sulfate

| Spikes: | Date | Sample | Result | Spike Level | Spike + Result | % Recovery |
|---|---|---|---|---|---|---|
| | 5/3/12 | 120507-01 | 0.180 mg/l | 4.9 | 5.888 mg/l | 116.5 |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

**Arkansas Water Resources Center**
**Water Quality Lab**
**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**

# LabQCReport

**For Lab Number:** 120507 5/8/12

## Total Dissolved Solids

| DUPLICATES: | Date | Sample | Result | | Duplicate Result | | % RSD |
|---|---|---|---|---|---|---|---|
| | 5/4/12 | 120507-02 | 85.4 | mg/l | 87.1 | mg/l | 2.03% |
| | | 120507-11 | 107.8 | mg/l | 109.8 | mg/l | 1.84% |

## Turbidity

| DUPLICATES: | Date | Sample | Result | | Duplicate Result | | % RSD |
|---|---|---|---|---|---|---|---|
| | 5/3/12 | 120507-01 | 0.1 | NTU's | 0.1 | NTU's | 0.00% |

***The average % Recovery is a measure of accuracy.**
****RPD=Relative Percent Deviation, a measure of Precision.**

# Arkansas Water Resources Center
# Water Quality Lab

**University of Arkansas, BIOR 106, 2435 North Hatch**
**Fayetteville, AR 72704**
**479-575-7317**


# LabQCReport

**For Lab Number:** **120507** **5/8/2012**

## Chloride

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 5/3/12 | blank | 0.0356 mg/l | 0.000 mg/l |

## Sulfate

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 5/3/12 | blank | 0 mg/l | 0.000 mg/l |

## Total Dissolved Solids

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 5/4/12 | blank | 2.89 mg/l | 0.000 mg/l |
| | 5/4/12 | blank | 0.0 mg/l | 0.000 mg/l |

## Turbidity

| BLANKS: | Date | Standard | Result | True Value |
|---|---|---|---|---|
| | 5/3/12 | blank | 0.02 NTU's | 0.000 NTU's |

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**



Name Wade Cash/Dr. Brian Haggard

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name WRUAB

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 120507-1 | BLANK | 5/3 | 9/20 | WC | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| 2 | WF-01 | | 930 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| 3 | RC-02 | | 1015 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| 4 | WF-02 | | 1045 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |

Relinquished By: WC

Date/Time: 5-3-12 1415

Received By: WC

Date/Time: 5-3-12 1415

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**



Name Wade Cash/Dr. Brian Haggard

Mailing Address _____

City, State, Zip _____

Phone/Fax _____

**Lab Number:**

Project Name WRWA

Cost Ctr. No./P.O. No. _____

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 120507-5 | WR-2.5 | 5/3 | 1115 | WC | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| 6 | WR-01 | | 1145 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| 7 | 001 | | 1205 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| 8 | WR-02 | | 1230 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |

Relinquished By: WC

Date/Time: 5-2-12 1415

Received By: WC

Date/Time: 5-3-12 1415

**AWRC - Water Quality Laboratory**
**University of Arkansas, Chemistry 101 (Rm. 204), Fayetteville, AR 72701**
**(501) 575-7317, Fax (501) 575-6720**



Name Wade Cash/Dr. Brian Haggard

Mailing Address

City, State, Zip

Phone/Fax

**Lab Number:**

Project Name WRUAA

Cost Ctr. No./P.O. No.

| Lab Sample Number | Customer Sample ID | Date | Time | Taken by | Comments |
|---|---|---|---|---|---|
| 120507-19 | RC-01 | 5/3 | 1300 | WC | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -20 | WR-03 | | 1315 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| -21 | WR-02 -DUP | | 1230 | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |
| **Lab Sample Number** | **Customer Sample ID** | **Date** | **Time** | **Taken by** | **Comments** |
| | | | | | |
| **Lab Sub Sample Number** | **Preservative** | **Temp.** | **pH** | **Vol. mL** | **Analysis** |
| -A | raw | | | 500 | Anions, TSS, Turbidity |
| -B | acid sulfuric | | | 250 | TN/TP, Ammonia |
| -C | filtered | | | 40 | PO4-P (Split/filtered in lab) |
| -D | | | | | |

Relinquished By: WC

Date/Time: 5-3-12 1115

Received By: WC

Date/Time: 5-3-12 1115

# Appendix C-3
# Diurnal DO Monitoring – Summary

## Evaluation of Community Metabolism

Net primary production (NPP) and total community respiration (TCR) were estimated based on semi-continuous DO measurement taken on September 13 and 14, 2011 and on April 2 through 5, 2012. Monitors programmed to measure and record DO, temperature, pH and specific conductance (conductivity) and 30 min. intervals were deployed at stations RC-01, RC-02, WR-01, WR-02 and WR-2.5 on September 13 and 14, 2012. On April 2 and 3, monitors were deployed at stations RC-02, WR-01, WR-02 and WR-2.5. During the April 2-3 monitoring period, the DO function on the instrument deployed at Station WR-01 malfunctioned. Additional monitors were subsequently deployed at RC-02, WR-01, and WR-02 on April 4 and 5. Electronic data were downloaded to Excel spreadsheets. Percent DO saturation was calculated from simultaneous temperature and DO measurements per Mortimer (1981).

NPP was estimated at each station as the total increase of DO from 0630 (30 minutes before sunrise) until the DO values stopped rising (generally by 1500). TCR was estimated as the total decrease in DO from 2000 (30 minutes after sunset) until the DO values stopped decreasing or 30 minutes before the following sunrise, whichever came first. Changes in DO were expressed as g $O_2/m^3$/day. These calculations did not include adjustments for reaeration as a function of current velocity and channel morphology at each location. Therefore the estimates of NPP and TCR provided herein are best suited to indicate only relative differences in NPP and TCR among locations on comparable dates.

Estimated NPP, TCR and their ratios are summarized in Table 1. September monitoring shows substantially higher rates of both NPP and TCR at the stations downstream of the Noland discharge (WR-02 and WR-2.5) compared to the station upstream of the Noland discharge (WR-01) reference locations (RC-01 and RC-02). The same pattern is evident in the April monitoring data at the WR stations with lower overall values of both NPP and TCR at WR-01 compared to WR-02 and WR-2.5. Both NPP and TCR were higher during the April monitoring at the reference location (RC-02).

Higher rates of NPP and TCR would be expected in stream reaches with higher levels of nutrients such as those downstream of municipal wastewater discharges. Higher nutrients can be expected to result in higher levels of both autotrophic and heterotrophic biomass which will cause greater diel and seasonal extremes in DO and pH. Coincident with these effects, differences in benthic macroinvertebrate and fish community composition (species and functional feeding groups) would be expected among stations.

In general, P/R ratios would be expected to show higher values during seasons of increasing biomass and lower values during season of biomass decline. This seasonality in P/R is not apparent in this data set and would require numerous additional monitoring periods to demonstrate. Overall, NPP and TCR show differences upstream and downstream of the Noland discharge that are consistent with expectations based on increased nutrient input from a municipal discharge or other sources of nutrient inputs (e.g. non point source runoff).

TABLE C-5

**Summary of Estimates of Net Primary Production, Total Community Respiration, and Their Ratios from Semi-continuous DO Monitoring**

| Parameter | Monitoring Period | Station | | | | |
|---|---|---|---|---|---|---|
| | | RC-01 | RC-02 | WR-01 | WR-02 | WR-2.5 |
| NPP (g $O_2/m^3$/day) | September 13-14, 2011 | 3.9 | 4.2 | 3.1 | 17.4 | 9.1 |
| | April 2-5, 2012 | ND | **6.4** | 2.4 | **5.7** | 5.4 |
| TCR (g $O_2/m^3$/day) | September 13-14, 2011 | 1.3 | 2.4 | 1.9 | 8.0 | 10.4 |
| | April 2-5, 2012 | ND | **5.6** | 0.8 | **2.7** | 7.2 |
| P/R (NPP ÷ TCR) | September 13-14, 2011 | 3.1 | 1.8 | 1.6 | 2.1 | 0.9 |
| | April 2-5, 2012 | ND | **1.2** | 2.6 | **2.2** | 0.7 |

Bold numbers indicate average values from monitoring on April 2-3 and April 4-5.

TABLE C-6
**Estimates of Net Primary Production, Total Community Respiration, and Their Ratios from Semi-Continuous DO Monitoring**

| Parameter | Monitoring Period | RC-01 | RC-02 | WR-01 | WR-02 | WR-2.5 |
|---|---|---|---|---|---|---|
| NPP ($g\ O_2/m^3/day$) | September 13-14, 2011 | 3.9 | 4.2 | 3.1 | 17.4 | 9.1 |
| | April 2-3, 2012 | ND | 6.1 | [a] | 4.6 | 5.4 |
| | April 4-5, 2012 | ND | 6.7 | 2.4 | 6.7 | ND |
| | April 2-4, 2012 | ND | 6.4 | 2.4 | 5.65 | 5.4 |
| TCR ($g\ O_2/m^3/day$) | September 13-14, 2011 | 1.3 | 2.4 | 1.9 | 8 | 10.4 |
| | April 2-3, 2012 | ND | 6.5 | [a] | 2 | 7.2 |
| | April 4-5, 2012 | ND | 4.7 | 0.8 | 3.3 | ND |
| | April 2-4, 2012 | ND | 5.6 | 0.8 | 2.65 | 7.2 |
| P/R (NPP ÷ TCR) | September 13-14, 2011 | 3.1 | 1.8 | 1.6 | 2.1 | 0.9 |
| | April 2-3, 2012 | ND | 0.9 | [a] | 2.3 | 0.7 |
| | April 4-5, 2012 | ND | 1.4 | 2.6 | 2.1 | ND |
| | April 2-4, 2012 | ND | 1.15 | 2.6 | 2.2 | 0.7 |

[a] Instrument malfunction; ND = no instrument deployed

## Literature Cited

Mortimer, C.H. 1981. The oxygen content of air-saturated fresh waters over ranges of temperature and atmospheric pressure of limnological interest. *Int. Assoc. Theoret. Appl. Limnol.,* Communication No. 22, Stuttgart, West Germany.

# Appendix C-4
# Physical Assessment – Field Sheets and Photographs

WR-1 POD

# PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

| | |
|---|---|
| **WATERSHED FEATURES** | **Predominant Surrounding Landuse**<br>☒ Forest ☐ Commercial<br>☒ Field/Pasture ☐ Industrial<br>☐ Agricultural ☐ Other _____<br>☐ Residential<br><br>**Local Watershed** sed<br>☐ No evidence ☒ Some potential sources<br>☐ Obvious sources<br><br>**Local Watershed Erosion**<br>☐ None ☒ Moderate ☐ Heavy |
| **RIPARIAN VEGETATION (18 meter buffer)** | **Indicate the dominant type and record the dominant species present**<br>☒ Trees ☒ Shrubs ☐ Grasses ☐ Herbaceous<br>**dominant species present** _____ |
| **INSTREAM FEATURES**<br>WR-1 POD | **Estimated Reach Length** _____m 150 ft<br>**Estimated Stream Width** _____m x 30<br>**Sampling Reach Area** _____$m^2$<br>**Area in $km^2$ ($m^2$x1000)** _____$km^2$<br>**Estimated Stream Depth** _____m<br>**Surface Velocity (at thalweg)** _____m/sec<br><br>**Canopy Cover** open<br>☒ Partly open ☐ Partly shaded ☐ Shaded<br>**High Water Mark**_____m 10 ft<br>**Proportion of Reach Represented by Stream Morphology Types**<br>☐ Riffle 10 % ☐ Run 50 %<br>☐ Pool 40 %<br>45<br>**Channelized** ☐ Yes ☒ No<br>**Dam Present** ☐ Yes ☒ No |
| **LARGE WOODY DEBRIS** | **LWD** 0 $m^2$<br>**Density of LWD** _____$m^2/km^2$ **(LWD/reach area)** |
| **AQUATIC VEGETATION** | **Indicate the dominant type and record the dominant species present**<br>☐ Rooted emergent ☐ Rooted submergent ☐ Rooted Floating ☒ Free floating<br>☒ Floating Algae ☒ Attached Algae<br>dominant species present algae<br>Portion of the reach with aquatic vegetation 20 % more coverage d/s |
| **WATER QUALITY** | **Temperature**_____°C<br>**Specific Conductance** _____<br>**Dissolved Oxygen** _____<br>**pH**_____<br>**Turbidity** _____<br>**WQ Instrument Used** _____<br><br>**Water Odors**<br>☒ Normal/None ☐ Sewage<br>☐ Petroleum ☐ Chemical<br>☐ Fishy ☐ Other _____<br><br>**Water Surface Oils** not oily<br>☐ Slick ☒ Sheen ☐ Globs ☐ Flecks<br>☒ None ☐ Other _____<br><br>**Turbidity (if not measured)**<br>☒ Clear ☐ Slightly turbid ☐ Turbid<br>☐ Opaque ☐ Stained ☐ Other_____ |
| **SEDIMENT/ SUBSTRATE** | **Odors**<br>☒ Normal ☐ Sewage ☐ Petroleum<br>☐ Chemical ☐ Anaerobic ☐ None<br>☐ Other _____<br><br>**Oils**<br>☒ Absent ☐ Slight ☐ Moderate ☐ Profuse<br><br>**Deposits**<br>☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand<br>☐ Relict shells ☐ Other _____<br><br>**Looking at stones which are not deeply embedded, are the undersides black in color?**<br>☒ Yes ☐ No |

| INORGANIC SUBSTRATE COMPONENTS (should add up to 100%) | | | ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%) | | |
|---|---|---|---|---|---|
| **Substrate Type** | **Diameter** | **% Composition in Sampling Reach** | **Substrate Type** | **Characteristic** | **% Composition in Sampling Area** |
| Bedrock | | 20 30 50 | Detritus | Sticks, wood, coarse plant materials (CPOM) | 0 |
| Boulder | > 256 mm (10") | 10 5 | | | |
| Cobble | 64-256 mm (2.5" – 10") | 30 35 | Muck-Mud | Black, very fine organic (FPOM) | 0 |
| Gravel | 2-64 mm (0.1" – 2.5") | 10 10 | | | |
| Sand | 0.06 – 2mm (gritty) | | Marl | Grey, shell fragments | 0 |
| Silt | 0.004-0.06 mm | | | | |
| Clay | <0.004 mm (slick) | | | | |

thin silty on rocks in shallow water

# PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

| | | |
|---|---|---|
| STREAM NAME White R. | LOCATION U/S Wyman kr | |
| STATION # WR1 RIVERMILE ____ | STREAM CLASS | |
| LAT ____ LONG ____ | RIVER BASIN | |
| STORET # | AGENCY | |
| INVESTIGATORS | | |
| FORM COMPLETED BY POD | DATE 9/14/11<br>TIME 1546 AM PM | REASON FOR SURVEY Ott |

**WEATHER CONDITIONS**

| Now | | Past 24 Hours |
|---|---|---|
| ☐ | storm (heavy rain) | ☐ |
| ☐ | rain (steady rain) | ☐ |
| ☐ | showers (intermittent) | ☐ |
| 100 % ☐ | %cloud cover | ☐ 50 % |
| ☐ | clear/sunny | ☐ |

Has there been a heavy rain in the last 7 days? ☐ Yes ☒ No

Air Temperature ____ °C

Other ____

**SITE LOCATION/MAP**

Draw a map of the site and indicate the areas sampled (or attach a photograph)

**STREAM CHARACTERIZATION**

**Stream Subsystem**
☒ Perennial ☐ Intermittent ☐ Tidal

**Stream Type**
☐ Coldwater ☒ Warmwater

**Stream Origin**
☐ Glacial ☐ Spring-fed
☐ Non-glacial montane ☒ Mixture of origins
☐ Swamp and bog ☐ Other ____

**Catchment Area** ____ $km^2$

## HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

| | |
|---|---|
| STREAM NAME White R | LOCATION US Wyman Br |
| STATION # WR1 RIVERMILE | STREAM CLASS |
| LAT LONG | RIVER BASIN |
| STORET # | AGENCY |
| INVESTIGATORS | |
| FORM COMPLETED BY PWD | DATE 9/11 TIME 1540 AM (PM) |
| REASON FOR SURVEY UAA | |

Parameters to be evaluated in sampling reach

| Habitat Parameter | Condition Category | | | |
|---|---|---|---|---|
| | Optimal | Suboptimal | Marginal | Poor |
| 1. Epifaunal Substrate/ Available Cover | Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient). | 40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale). | 20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed. | Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking. |
| SCORE | 20 19 (18) 17 16 | (15) 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| 2. Embeddedness | Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. | Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment. | Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment. | Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment. |
| SCORE | 20 19 18 17 (16) | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| 3. Velocity/Depth Regime | All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.) | Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes). | Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low). | Dominated by 1 velocity/ depth regime (usually slow-deep). |
| SCORE | 20 19 18 17 16 | 15 14 13 12 11 | (10) 9 8 7 6 | 5 4 3 2 1 0 |
| 4. Sediment Deposition | Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition. | Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools. | Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent. | Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition. |
| SCORE | 20 19 (18) 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| 5. Channel Flow Status | Water reaches base of both lower banks, and minimal amount of channel substrate is exposed. | Water fills >75% of the available channel; or <25% of channel substrate is exposed. | Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed. | Very little water in channel and mostly present as standing pools. |
| SCORE | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 (8) 7 6 | 5 4 3 2 1 0 |

WR-1 POD

## HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

| Habitat Parameter | Condition Category | | | |
|---|---|---|---|---|
| | **Optimal** | **Suboptimal** | **Marginal** | **Poor** |
| **6. Channel Alteration** | Channelization or dredging absent or minimal; stream with normal pattern. | Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present. | Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted. | Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely. |
| **SCORE** | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **7. Frequency of Riffles (or bends)** | Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important. | Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15. | Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25. | Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25. |
| **SCORE** | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **8. Bank Stability (score each bank)** Note: determine left or right side by facing downstream. | Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected. | Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. | Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods. | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars. |
| SCORE ___ (LB) | Left Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| SCORE ___ (RB) | Right Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| **9. Vegetative Protection** (score each bank) | More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. | 70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. | 50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. | Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height. |
| SCORE ___ (LB) | Left Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| SCORE ___ (RB) | Right Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| **10. Riparian Vegetative Zone Width** (score each bank riparian zone) | Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone. | Width of riparian zone 12-18 meters; human activities have impacted zone only minimally. | Width of riparian zone 6-12 meters; human activities have impacted zone a great deal. | Width of riparian zone <6 meters: little or no riparian vegetation due to human activities. |
| SCORE ___ (LB) | Left Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| SCORE ___ (RB) | Right Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |

**Total Score** _____

# PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

| | |
|---|---|
| STREAM NAME White River | LOCATION Wyman Rd. |
| STATION # WR-01 RIVERMILE ____ | STREAM CLASS |
| LAT ____ LONG ____ | RIVER BASIN |
| STORET # | AGENCY |
| INVESTIGATORS L. Chamblin, P. Downey | |
| FORM COMPLETED BY L. Chamblin | DATE 9-14 TIME 4:00 AM (PM) |
| | REASON FOR SURVEY Fayetteville UAA |

**WEATHER CONDITIONS**

| Now | | Past 24 Hours |
|---|---|---|
| ☐ | storm (heavy rain) | ☐ |
| ☐ | rain (steady rain) | ☐ |
| ☐ | showers (intermittent) | ☐ |
| 100% ☒ | %cloud cover | ☐ ____% |
| ☐ | clear/sunny | ☐ |

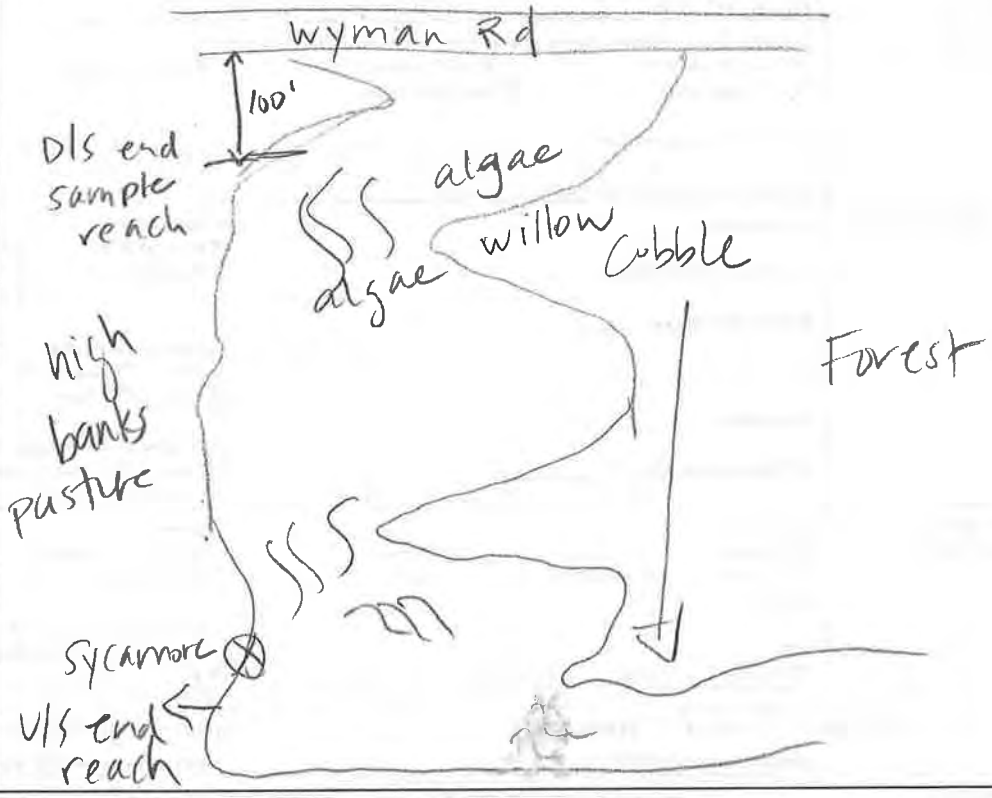
Has there been a heavy rain in the last 7 days? ☐ Yes ☒ No

Air Temperature 70°F

Other ____

**SITE LOCATION/MAP**

Draw a map of the site and indicate the areas sampled (or attach a photograph)




**STREAM CHARACTERIZATION**

**Stream Subsystem**
☒ Perennial ☐ Intermittent ☐ Tidal

**Stream Type**
☐ Coldwater ☒ Warmwater

**Stream Origin**
☐ Glacial ☐ Spring-fed
☐ Non-glacial montane ☒ Mixture of origins
☐ Swamp and bog ☐ Other ____

**Catchment Area** ____ km²

LC WR-01

# PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

| | |
|---|---|
| **WATERSHED FEATURES** | **Predominant Surrounding Landuse**<br>☒ Forest ☐ Commercial<br>☒ Field/Pasture ☐ Industrial<br>☐ Agricultural ☐ Other _____<br>☐ Residential<br><br>**Local Watershed**<br>☐ No evidence ☒ Some potential sources<br>☐ Obvious sources<br><br>**Local Watershed Erosion**<br>☐ None ☒ Moderate ☐ Heavy |
| **RIPARIAN VEGETATION (18 meter buffer)** | **Indicate the dominant type and record the dominant species present**<br>☒ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous<br>**dominant species present** _____ |
| **INSTREAM FEATURES** | **Estimated Reach Length** ____m ~1000'<br>**Estimated Stream Width** ____m 25'<br>**Sampling Reach Area** ____$m^2$<br>**Area in $km^2$ ($m^2$x1000)** ____$km^2$<br>**Estimated Stream Depth** ____m 1" – 1'<br>**Surface Velocity (at thalweg)** ____m/sec 1'/sec<br><br>**Canopy Cover** OPEN<br>☐ Partly open ☐ Partly shaded ☐ Shaded<br>**High Water Mark** ____m 8'<br>**Proportion of Reach Represented by Stream Morphology Types**<br>☐ Riffle 95 % ☐ Run 5 %<br>☐ Pool 90 %<br>**Channelized** ☐ Yes ☒ No<br>**Dam Present** ☐ Yes ☒ No |
| **LARGE WOODY DEBRIS** | **LWD** 0 $m^2$<br>**Density of LWD** _____ $m^2/km^2$ **(LWD/reach area)** |
| **AQUATIC VEGETATION** | **Indicate the dominant type and record the dominant species present**<br>☐ Rooted emergent ☐ Rooted submergent ☐ Rooted Floating ☐ Free floating<br>☒ Floating Algae ☒ Attached Algae<br>dominant species present _____ (WR2 was >50% up to 75%)<br>Portion of the reach with aquatic vegetation 20 % (almost all located @ d/s end) |
| **WATER QUALITY** | **Temperature**_____°C<br>**Specific Conductance** _____<br>**Dissolved Oxygen** _____<br>**pH**_____<br>**Turbidity** _____<br>**WQ Instrument Used** _____<br><br>**Water Odors**<br>☒ Normal/None ☐ Sewage<br>☐ Petroleum ☐ Chemical<br>☐ Fishy ☐ Other _____<br><br>**Water Surface Oils**<br>☐ Slick ☒ Sheen ☐ Globs ☐ Flecks unknown<br>☐ None ☐ Other _____ not likely oil<br><br>**Turbidity (if not measured)**<br>☒ Clear ☐ Slightly turbid ☐ Turbid<br>☐ Opaque ☐ Stained ☐ Other_____ |
| **SEDIMENT/ SUBSTRATE** | **Odors**<br>☒ Normal ☐ Sewage ☐ Petroleum<br>☐ Chemical ☐ Anaerobic ☐ None<br>☐ Other _____<br><br>**Oils**<br>☒ Absent ☐ Slight ☐ Moderate ☐ Profuse<br><br>**Deposits**<br>☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand<br>☐ Relict shells ☐ Other silty layer on rocks in pool<br><br>**Looking at stones which are not deeply embedded, are the undersides black in color?**<br>☒ Yes ☐ No |

| INORGANIC SUBSTRATE COMPONENTS (should add up to 100%) | | | ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%) | | |
|---|---|---|---|---|---|
| **Substrate Type** | **Diameter** | **% Composition in Sampling Reach** | **Substrate Type** | **Characteristic** | **% Composition in Sampling Area** |
| Bedrock | | 50 | Detritus | Sticks, wood, coarse plant materials (CPOM) | 0 |
| Boulder | > 256 mm (10") | 5 | | | |
| Cobble | 64-256 mm (2.5" – 10") | 35 | Muck-Mud | Black, very fine organic (FPOM) | 0 |
| Gravel | 2-64 mm (0.1" – 2.5") | 10 | | | |
| Sand | 0.06 – 2mm (gritty) | | Marl | Grey, shell fragments | |
| Silt | 0.004-0.06 mm | thin layer | | | |
| Clay | <0.004 mm (slick) | | | | |

## HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

| | |
|---|---|
| STREAM NAME White River | LOCATION Wyman Rd. |
| STATION # WR-01 RIVERMILE | STREAM CLASS |
| LAT _____ LONG _____ | RIVER BASIN White |
| STORET # | AGENCY |
| INVESTIGATORS L. Chamblin, P. Downey | |
| FORM COMPLETED BY L. Chamblin | DATE 9/14 TIME 4:36 AM (PM) REASON FOR SURVEY Fayetteville UAA |

Parameters to be evaluated in sampling reach

| Habitat Parameter | Condition Category: Optimal | Suboptimal (no LWD) | Marginal | Poor |
|---|---|---|---|---|
| 1. Epifaunal Substrate/ Available Cover | Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient). | 40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale). | 20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed. | Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking. |
| SCORE | 20 19 18 17 16 | 15 (14) 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| 2. Embeddedness | Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. | Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment. | Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment. | Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment. |
| SCORE | 20 19 18 (17) 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| 3. Velocity/Depth Regime | All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.) | Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes). | Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low). | Dominated by 1 velocity/ depth regime (usually slow-deep). |
| SCORE | 20 19 18 17 16 | 15 14 13 12 11 | (10) 9 8 7 6 | 5 4 3 2 1 0 |
| 4. Sediment Deposition | Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition. | Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools. | Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent. | Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition. |
| SCORE | 20 (19) 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| 5. Channel Flow Status | Water reaches base of both lower banks, and minimal amount of channel substrate is exposed. | Water fills >75% of the available channel; or <25% of channel substrate is exposed. | Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed. | Very little water in channel and mostly present as standing pools. |
| SCORE | 20 19 18 17 16 | (15) 14 13 12 (11) | 10 9 8 7 6 | 5 4 3 2 1 0 |

17
68
45
34
79

LC WR-01 White River @ Wyman Rd.

## HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

| Habitat Parameter | Condition Category | | | |
|---|---|---|---|---|
| | **Optimal** | **Suboptimal** | **Marginal** | **Poor** |
| **6. Channel Alteration** | Channelization or dredging absent or minimal; stream with normal pattern. | Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present. | Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted. | Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely. |
| **SCORE** | 20 19 (18) 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **7. Frequency of Riffles (or bends)** | Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important. | Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15. | Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25. | Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25. |
| **SCORE** | 20 19 18 17 16 | 15 14 (13) 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **8. Bank Stability (score each bank)** Note: determine left or right side by facing downstream. | Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected. | Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. | Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods. | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars. |
| SCORE ___ (LB) | Left Bank 10 9 | 8 7 6 | 5 (4) 3 | 2 1 0 |
| SCORE ___ (RB) | Right Bank 10 9 | (8) 7 6 | 5 4 3 | 2 1 0 |
| **9. Vegetative Protection** (score each bank) | More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. | 70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. | 50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. | Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height. |
| SCORE ___ (LB) | Left Bank 10 9 | 8 7 (6) | 5 4 3 | 2 1 0 |
| SCORE ___ (RB) | Right Bank (10) 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| **10. Riparian Vegetative Zone Width** (score each bank riparian zone) | Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone. | Width of riparian zone 12-18 meters; human activities have impacted zone only minimally. | Width of riparian zone 6-12 meters; human activities have impacted zone a great deal. | Width of riparian zone <6 meters: little or no riparian vegetation due to human activities. |
| SCORE ___ (LB) | Left Bank 10 9 | 8 7 6 | 5 4 (3) | 2 1 0 |
| SCORE ___ (RB) | Right Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |

**Total Score** _____

# PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

| | | |
|---|---|---|
| STREAM NAME White R | LOCATION d/s 001 | |
| STATION # WR-2 RIVERMILE ____ | STREAM CLASS | |
| LAT ____ LONG ____ | RIVER BASIN | |
| STORET # | AGENCY | |
| INVESTIGATORS | | |
| FORM COMPLETED BY POD | DATE 9/14/11<br>TIME 1000 (AM) PM | REASON FOR SURVEY UAA |

**WEATHER CONDITIONS**

Now

- ☐ storm (heavy rain)
- ☐ rain (steady rain)
- ☐ showers (intermittent)
- 50 % ☐ %cloud cover
- ☐ clear/sunny

Past 24 Hours

- ☐
- ☐
- ☐
- ☐ 80 %
- ☐

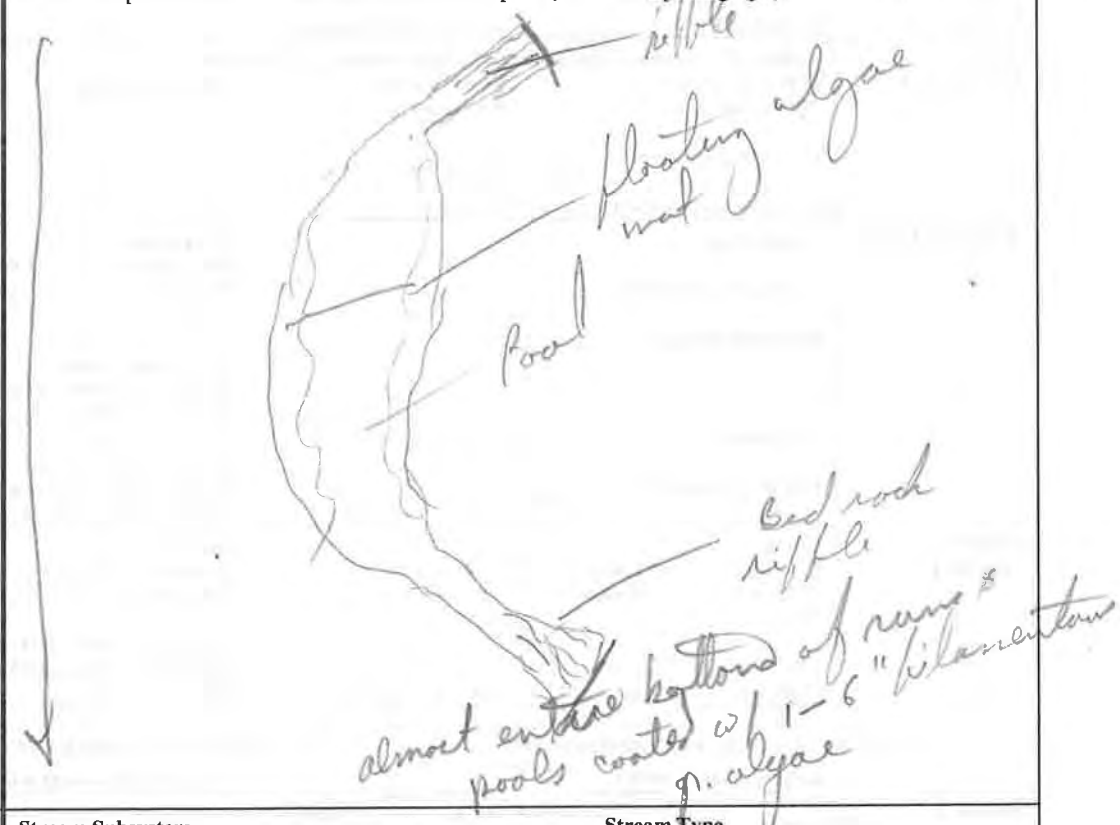
Has there been a heavy rain in the last 7 days? ☐ Yes ☒ No

Air Temperature ____ °C

Other ____

**SITE LOCATION/MAP**

Draw a map of the site and indicate the areas sampled (or attach a photograph)




**STREAM CHARACTERIZATION**

**Stream Subsystem**
☒ Perennial ☐ Intermittent ☐ Tidal

**Stream Type**
☐ Coldwater ☐ Warmwater

**Stream Origin**
☐ Glacial ☐ Spring-fed
☐ Non-glacial montane ☒ Mixture of origins
☐ Swamp and bog ☐ Other ____

**Catchment Area** ____ km²

WR 2

# PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

**WATERSHED FEATURES**

**Predominant Surrounding Landuse**
☒ Forest ☐ Commercial
☒ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other _____
☐ Residential

**Local Watershed** sedimentation
☐ No evidence ☒ Some potential sources
☒ Obvious sources 001

**Local Watershed Erosion**
☐ None ☒ Moderate ☐ Heavy

**RIPARIAN VEGETATION (18 meter buffer)**

**Indicate the dominant type and record the dominant species present**
☒ Trees ☐ Shrubs ☒ Grasses ☐ Herbaceous
**dominant species present** _____

**INSTREAM FEATURES**

**Estimated Reach Length** 1508 ft m
**Estimated Stream Width** 40 ft m 20-200'
**Sampling Reach Area** _____ $m^2$
**Area in $km^2$ ($m^2$x1000)** _____ $km^2$
**Estimated Stream Depth** _____ m ~2ft
**Surface Velocity (at thalweg)** _____ m/sec ≤2ft/sec

**Canopy Cover** open
☒ Partly open ☐ Partly shaded ☐ Shaded
**High Water Mark** ~ m 15ft

**Proportion of Reach Represented by Stream Morphology Types**
☐ Riffle 5 % ☐ Run 5 %
☐ Pool 90 %

**Channelized** ☐ Yes ☒ No
**Dam Present** ☐ Yes ☒ No

**LARGE WOODY DEBRIS**

**LWD** 10 $m^2$
**Density of LWD** _____ $m^2/km^2$ **(LWD/reach area)**

**AQUATIC VEGETATION**

**Indicate the dominant type and record the dominant species present**
☒ Rooted emergent ☒ Rooted submergent ☐ Rooted Floating ☐ Free floating
☒ Floating Algae ☒ Attached Algae
dominant species present Water willow/algae
Portion of the reach with aquatic vegetation 50 %

**WATER QUALITY**

**Temperature**_____°C
**Specific Conductance** _____
**Dissolved Oxygen** _____
**pH**_____
**Turbidity** _____
**WQ Instrument Used** _____

**Water Odors**
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other _____

**Water Surface Oils**
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☒ None ☐ Other _____

**Turbidity (if not measured)**
☒ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other_____

**SEDIMENT/ SUBSTRATE**

**Odors**
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other _____

**Oils**
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

**Deposits**
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other _____

**Looking at stones which are not deeply embedded, are the undersides black in color?**
☒ Yes ☐ No

| INORGANIC SUBSTRATE COMPONENTS (should add up to 100%) | | | ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%) | | |
|---|---|---|---|---|---|
| **Substrate Type** | **Diameter** | **% Composition in Sampling Reach** | **Substrate Type** | **Characteristic** | **% Composition in Sampling Area** |
| Bedrock | | 10 | Detritus | Sticks, wood, coarse plant materials (CPOM) | 10 |
| Boulder | > 256 mm (10") | 10 | | | |
| Cobble | 64-256 mm (2.5" – 10") | 40 | Muck-Mud | Black, very fine organic (FPOM) | 0<1 |
| Gravel | 2-64 mm (0.1" – 2.5") | 40 | | | |
| Sand | 0.06 – 2mm (gritty) | | Marl | Grey, shell fragments | 0 |
| Silt | 0.004-0.06 mm | | | | |
| Clay | <0.004 mm (slick) | | | | |

## HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

WR2

| | |
|---|---|
| STREAM NAME White R | LOCATION WR2 / 10 d/s 001 |
| STATION # WR2 RIVERMILE | STREAM CLASS |
| LAT _____ LONG _____ | RIVER BASIN |
| STORET # | AGENCY |
| INVESTIGATORS | |
| FORM COMPLETED BY POD | DATE 9/14/11 TIME 0930 (AM) PM — REASON FOR SURVEY UAA |

Parameters to be evaluated in sampling reach

| Habitat Parameter | Condition Category: Optimal | Suboptimal | Marginal | Poor |
|---|---|---|---|---|
| 1. Epifaunal Substrate/ Available Cover | Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient). | 40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale). | 20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed. | Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking. |
| SCORE | 20 19 (18) 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| 2. Embeddedness | Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. | Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment. | Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment. | Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment. |
| SCORE | 20 19 (18) 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| 3. Velocity/Depth Regime | All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.) | Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes). | Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low). | Dominated by 1 velocity/ depth regime (usually slow-deep). |
| SCORE | 20 19 ~~18~~ 17 16 | 15 (14) 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| 4. Sediment Deposition | Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition. | Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools. | Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent. | Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition. |
| SCORE | 20 19 18 17 (16) | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| 5. Channel Flow Status | Water reaches base of both lower banks, and minimal amount of channel substrate is exposed. | Water fills >75% of the available channel; or <25% of channel substrate is exposed. | Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed. | Very little water in channel and mostly present as standing pools. |
| SCORE | 20 19 (18) 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |

WR-2 POD

## HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

| Habitat Parameter | Condition Category | | | |
|---|---|---|---|---|
| | **Optimal** | **Suboptimal** | **Marginal** | **Poor** |
| **6. Channel Alteration** | Channelization or dredging absent or minimal; stream with normal pattern. | Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present. | Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted. | Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely. |
| **SCORE** | (20) 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **7. Frequency of Riffles (or bends)** | Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important. | Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15. | Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25. | Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25. |
| **SCORE** | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 (7) 6 | 5 4 3 2 1 0 |
| **8. Bank Stability (score each bank)** Note: determine left or right side by facing downstream. | Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected. | Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. | Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods. | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars. |
| SCORE ___ (LB) | Left Bank 10 9 | 8 7 6 | 5 (4) 3 | 2 1 0 |
| SCORE ___ (RB) | Right Bank 10 9 | 8 7 6 | 5 (4) 3 | 2 1 0 |
| **9. Vegetative Protection** (score each bank) | More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. | 70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. | 50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. | Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height. |
| SCORE ___ (LB) | Left Bank 10 9 | 8 7 (6) | 5 4 3 | 2 1 0 |
| SCORE ___ (RB) | Right Bank 10 9 | 8 7 (6) | 5 4 3 | 2 1 0 |
| **10. Riparian Vegetative Zone Width** (score each bank riparian zone) | Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone. | Width of riparian zone 12-18 meters; human activities have impacted zone only minimally. | Width of riparian zone 6-12 meters; human activities have impacted zone a great deal. | Width of riparian zone <6 meters: little or no riparian vegetation due to human activities. |
| SCORE ___ (LB) | Left Bank (10) 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| SCORE ___ (RB) | Right Bank (10) 9 | 8 7 6 | 5 4 3 | 2 1 0 |

**Total Score** _____

# PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

| | |
|---|---|
| STREAM NAME White River | LOCATION D/s of Niland WWTP |
| STATION # WR-02 RIVERMILE ____ | STREAM CLASS |
| MAP DATUM: ____ Zone: ____ | RIVER BASIN |
| UTM: Easting ____ Northing ____ | AGENCY |
| INVESTIGATORS L. Chamblin, P. Downey | |
| FORM COMPLETED BY L. Chamblin | DATE 9/14 TIME 10:30 (AM) PM |
| REASON FOR SURVEY White River UAA | |

**WEATHER CONDITIONS**

| Now | | Past 24 Hours |
|---|---|---|
| ☐ | storm (heavy rain) | ☐ |
| ☐ | rain (steady rain) | ☐ |
| ☐ | showers (intermittent) | ☐ |
| ____% ☑ | %cloud cover | ☐ ____% |
| ☐ | clear/sunny | ☐ |

Has there been a heavy rain in the last 7 days? ☐ Yes ☑ No

Air Temperature 80°F

Other ____

**SITE LOCATION/MAP**

Flow:

| Tape Reading from LB/RB | Depth (ft) | Section Length (ft) | Velocity (f/s) |
|---|---|---|---|
| | | | |

Draw a map of the site and indicate the areas sampled (or attach a photograph)

in field book

**STREAM CHARACTERIZATION**

**Stream Subsystem**
☑ Perennial ☐ Intermittent ☐ Tidal

**Stream Type**
☐ Coldwater ☑ Warmwater

**Stream Origin**
☐ Glacial ☐ Spring-fed
☐ Non-glacial montane ☑ Mixture of origins
☐ Swamp and bog ☐ Other ____

**Catchment Area** ____ $km^2$

LC WR-02

# PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

| | |
|---|---|
| **WATERSHED FEATURES** | **Predominant Surrounding Landuse**<br>☐ Forest ☐ Commercial<br>☒ Field/Pasture ☐ Industrial<br>☐ Agricultural ☒ Other WWTP<br>☐ Residential<br><br>**Local Watershed**<br>☐ No evidence ☒ Some potential sources<br>☒ Obvious sources – WWTP<br><br>**Local Watershed Erosion**<br>☐ None ☒ Moderate ☐ Heavy |
| **RIPARIAN VEGETATION (18 meter buffer)** | **Indicate the dominant type and record the dominant species present**<br>☒ Trees ☐ Shrubs ☒ Grasses ☐ Herbaceous<br>**dominant species present** _____ |
| **INSTREAM FEATURES** | **Estimated Reach Length** _____m 1500'<br>**Estimated Stream Width** _____m 20-200'<br>**Sampling Reach Area** _____$m^2$<br>**Area in $km^2$ ($m^2$x1000)** _____$km^2$<br>**Estimated Stream Depth** _____m 0.5' - 4'<br>**Surface Velocity (at thalweg)** _____m/sec (Avg 2') < 2'/sec<br><br>**Canopy Cover**<br>☒ Partly open ☐ Partly shaded ☐ Shaded<br>open<br>**High Water Mark**_____m 20'<br><br>**Proportion of Reach Represented by Stream Morphology Types**<br>☐ Riffle 5 % ☐ Run 5 %<br>☐ Pool 90 %<br><br>**Channelized** ☐ Yes ☒ No<br>**Dam Present** ☐ Yes ☒ No |
| **LARGE WOODY DEBRIS** | **LWD** 10 $m^2$<br>**Density of LWD** _____$m^2/km^2$ (LWD/reach area) |
| **AQUATIC VEGETATION** | **Indicate the dominant type and record the dominant species present**<br>☒ Rooted emergent ☒ Rooted submergent ☐ Rooted Floating ☐ Free floating<br>☒ Floating Algae ☒ Attached Algae<br>Dominant species present algae, water willow (islands)<br>Portion of the reach with aquatic vegetation 50 % |
| **WATER QUALITY** | **Temperature**_____°C<br>**Specific Conductance** _____<br>**Dissolved Oxygen** _____<br>**pH**_____<br>**Turbidity** _____<br>**WQ Instrument Used** _____<br><br>**Water Odors**<br>☒ Normal/None ☐ Sewage<br>☒ Petroleum ☐ Chemical<br>☐ Fishy ☐ Other _____<br><br>**Water Surface Oils**<br>☐ Slick ☐ Sheen ☐ Globs ☐ Flecks<br>☒ None ☐ Other _____<br><br>**Turbidity (if not measured)**<br>☒ Clear ☒ Slightly turbid ☐ Turbid<br>☐ Opaque ☒ Stained ☐ Other_____ |
| **SEDIMENT/ SUBSTRATE** | **Odors**<br>☒ Normal ☐ Sewage ☐ Petroleum<br>☐ Chemical ☐ Anaerobic ☐ None<br>☐ Other _____<br><br>**Oils**<br>☒ Absent ☐ Slight ☐ Moderate ☐ Profuse<br><br>**Deposits**<br>☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand<br>☐ Relict shells ☐ Other _____<br><br>**Looking at stones which are not deeply embedded, are the undersides black in color?**<br>☒ Yes ☐ No |

| INORGANIC SUBSTRATE COMPONENTS (should add up to 100%) | | | ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%) | | |
|---|---|---|---|---|---|
| **Substrate Type** | **Diameter** | **% Composition in Sampling Reach** | **Substrate Type** | **Characteristic** | **% Composition in Sampling Area** |
| Bedrock | | 15 | Detritus | Sticks, wood, coarse plant materials (CPOM) | 5 |
| Boulder | > 256 mm (10") | 0 | | | |
| Cobble | 64-256 mm (2.5" – 10") | 35 | Muck-Mud | Black, very fine organic (FPOM) | <1 |
| Gravel | 2-64 mm (0.1" – 2.5") | 45 | | | |
| Sand | 0.06 – 2mm (gritty) | 5 | Marl | Grey, shell fragments | |
| Silt | 0.004-0.06 mm | | | | |
| Clay | <0.004 mm (slick) | | | | |

# PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

WR

| | |
|---|---|
| STREAM NAME White R | LOCATION [illegible] Farm |
| STATION # WR-2.5 RIVERMILE ____ | STREAM CLASS |
| LAT ____ LONG ____ | RIVER BASIN |
| STORET # | AGENCY |
| INVESTIGATORS | |
| FORM COMPLETED BY PJD | DATE 9/13/11 TIME 1600 AM PM |
| REASON FOR SURVEY UAA | |

**WEATHER CONDITIONS**

| Now | | Past 24 Hours |
|---|---|---|
| ☐ | storm (heavy rain) | ☐ |
| ☐ | rain (steady rain) | ☐ |
| ☐ | showers (intermittent) | ☐ |
| 50% ☐ | %cloud cover | ☐ 50 % |
| ☐ | clear/sunny | ☐ |

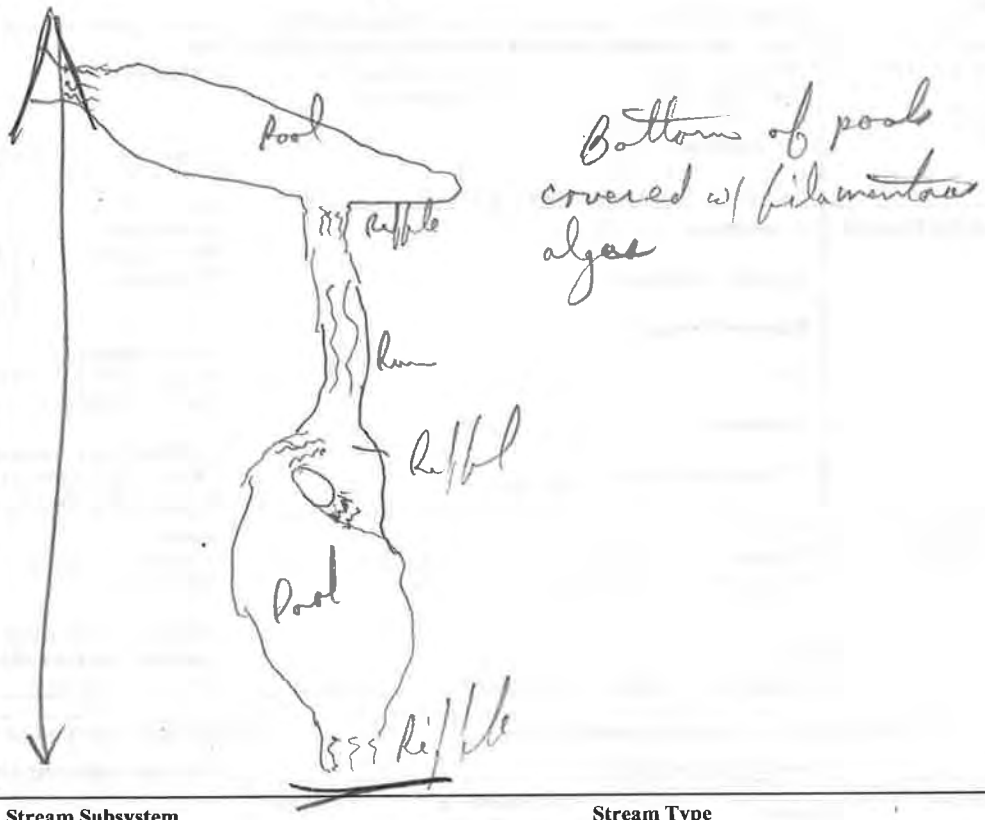
Has there been a heavy rain in the last 7 days? ☐ Yes ☒ No

Air Temperature ____ °C

Other ____

**SITE LOCATION/MAP**

Draw a map of the site and indicate the areas sampled (or attach a photograph)




**STREAM CHARACTERIZATION**

**Stream Subsystem**
☒ Perennial ☐ Intermittent ☐ Tidal

**Stream Type**
☐ Coldwater ☒ Warmwater

**Stream Origin**
☐ Glacial ☐ Spring-fed
☐ Non-glacial montane ☒ Mixture of origins
☐ Swamp and bog ☐ Other ____

**Catchment Area** ____ km²

WR 2.5

# PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

**WATERSHED FEATURES**

**Predominant Surrounding Landuse**
☐ Forest ☐ Commercial
☒ Field/Pasture ☐ Industrial
☒ Agricultural ☐ Other _____
☐ Residential

**Local Watershed** Cows pasture
☒ No evidence ☒ Some potential sources
☐ Obvious sources

**Local Watershed Erosion**
☐ None ☒ Moderate ☐ Heavy

**RIPARIAN VEGETATION (18 meter buffer)**

**Indicate the dominant type and record the dominant species present**
☐ Trees ☒ Shrubs ☒ Grasses ☐ Herbaceous
**dominant species present** _____

**INSTREAM FEATURES**

**Estimated Reach Length** _____m 350'
**Estimated Stream Width** _____m 30'
**Sampling Reach Area** _____$m^2$
**Area in $km^2$ ($m^2$x1000)** _____$km^2$
**Estimated Stream Depth** _____m ~~3-1.5m~~ ≤ 4
**Surface Velocity (at thalweg)** _____m/sec 4 ft/sec

**Canopy Cover** open
☐ Partly open ☐ Partly shaded ☐ Shaded
**High Water Mark** 2 m
**Proportion of Reach Represented by Stream Morphology Types**
☐ Riffle 20 % ☐ Run 10 %
☐ Pool 70 %
**Channelized** ☐ Yes ☒ No
**Dam Present** ☐ Yes ☒ No

**LARGE WOODY DEBRIS**

**LWD** 02 $m^2$
**Density of LWD** 0 $m^2/km^2$ **(LWD/reach area)**

**AQUATIC VEGETATION**

**Indicate the dominant type and record the dominant species present**
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted Floating ☒ Free floating
☒ Floating Algae ☒ Attached Algae
dominant species present _____
Portion of the reach with aquatic vegetation 0% rooted 80% Attached/floating

**WATER QUALITY**

**Temperature**_____°C
**Specific Conductance** _____
**Dissolved Oxygen** _____
**pH**_____
**Turbidity** _____
**WQ Instrument Used** _____

**Water Odors**
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other _____

**Water Surface Oils**
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☒ None ☐ Other _____

**Turbidity (if not measured)**
☒ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other_____

**SEDIMENT/ SUBSTRATE**

**Odors**
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other _____

**Oils**
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

**Deposits**
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other _____

**Looking at stones which are not deeply embedded, are the undersides black in color?**
☐ Yes ☒ No

**INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)**

| Substrate Type | Diameter | % Composition in Sampling Reach |
|---|---|---|
| Bedrock | | |
| Boulder | > 256 mm (10") | 5 |
| Cobble | 64-256 mm (2.5" – 10") | ~~90~~ 55 |
| Gravel | 2-64 mm (0.1" – 2.5") | ~~10~~ 40 |
| Sand | 0.06 – 2mm (gritty) | |
| Silt | 0.004-0.06 mm | |
| Clay | <0.004 mm (slick) | |

**ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)**

| Substrate Type | Characteristic | % Composition in Sampling Area |
|---|---|---|
| Detritus | Sticks, wood, coarse plant materials (CPOM) | 045 |
| Muck-Mud | Black, very fine organic (FPOM) | 0 |
| Marl | Grey, shell fragments | 0 |

WR-2.5

## HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

| | | |
|---|---|---|
| STREAM NAME White R | LOCATION WR 2.5 | |
| STATION # _____ RIVERMILE _____ | STREAM CLASS | |
| LAT _____ LONG _____ | RIVER BASIN | |
| STORET # | AGENCY | |
| INVESTIGATORS | | |
| FORM COMPLETED BY JED | DATE 9/13/11 TIME 1545 AM PM | REASON FOR SURVEY WAA |

Parameters to be evaluated in sampling reach

| Habitat Parameter | Condition Category: Optimal | Suboptimal | Marginal | Poor |
|---|---|---|---|---|
| **1. Epifaunal Substrate/ Available Cover** | Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient). | 40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale). | 20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed. | Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking. |
| **SCORE** | 20 19 (18) 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **2. Embeddedness** | Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. | Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment. | Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment. | Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment. |
| **SCORE** | 20 19 (18) 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **3. Velocity/Depth Regime** | All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.) | Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes). | Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low). | Dominated by 1 velocity/ depth regime (usually slow-deep). |
| **SCORE** | 20 19 (18) 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **4. Sediment Deposition** | Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition. | Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools. | Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent. | Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition. |
| **SCORE** | 20 19 (18) 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **5. Channel Flow Status** | Water reaches base of both lower banks, and minimal amount of channel substrate is exposed. | Water fills >75% of the available channel; or <25% of channel substrate is exposed. | Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed. | Very little water in channel and mostly present as standing pools. |
| **SCORE** | 20 19 18 17 (16) | (15) 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |

4 19 3 90 5 — 85+74 159 106 0 86+70

UR 2.5

## HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

| | Habitat Parameter | Condition Category: Optimal | Suboptimal | Marginal | Poor |
|---|---|---|---|---|---|
| Parameters to be evaluated broader than sampling reach | **6. Channel Alteration** | Channelization or dredging absent or minimal; stream with normal pattern. | Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present. | Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted. | Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely. |
| | SCORE | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| | **7. Frequency of Riffles (or bends)** | Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important. | Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15. | Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25. | Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25. |
| | SCORE | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| | **8. Bank Stability (score each bank)** Note: determine left or right side by facing downstream. | Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected. | Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. | Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods. | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars. |
| | SCORE ___ (LB) | Left Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| | SCORE ___ (RB) | Right Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| | **9. Vegetative Protection** (score each bank) | More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. | 70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. | 50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. | Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height. |
| | SCORE ___ (LB) | Left Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| | SCORE ___ (RB) | Right Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| | **10. Riparian Vegetative Zone Width** (score each bank riparian zone) | Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone. | Width of riparian zone 12-18 meters; human activities have impacted zone only minimally. | Width of riparian zone 6-12 meters; human activities have impacted zone a great deal. | Width of riparian zone <6 meters: little or no riparian vegetation due to human activities. |
| | SCORE ___ (LB) | Left Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| | SCORE ___ (RB) | Right Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |

**Total Score** _____

# PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

| | |
|---|---|
| STREAM NAME White River | LOCATION off Wyman Road |
| STATION # WR-2.5 RIVERMILE ____ | STREAM CLASS |
| MAP DATUM: ____ Zone: ____ | RIVER BASIN |
| UTM: Easting ____ Northing ____ | AGENCY |
| INVESTIGATORS L. Chamblin, FTN (Rupe, Downey, Masterson, Griffis) | |
| FORM COMPLETED BY L. Chamblin | DATE 9/13 TIME 4:00 AM (PM) / REASON FOR SURVEY White River UAA |

**WEATHER CONDITIONS**: sunny, partly cloudy

| Now | | Past 24 Hours |
|---|---|---|
| ☐ | storm (heavy rain) | ☐ |
| ☐ | rain (steady rain) | ☐ |
| ☐ | showers (intermittent) | ☐ |
| 50% ☑ | %cloud cover | ☐ ____% |
| ☐ | clear/sunny | ☐ |

Has there been a heavy rain in the last 7 days? ☐ Yes ☐ No

Air Temperature ____ °C

Other ____

recorded @ u/s end of reach

**SITE LOCATION/MAP**

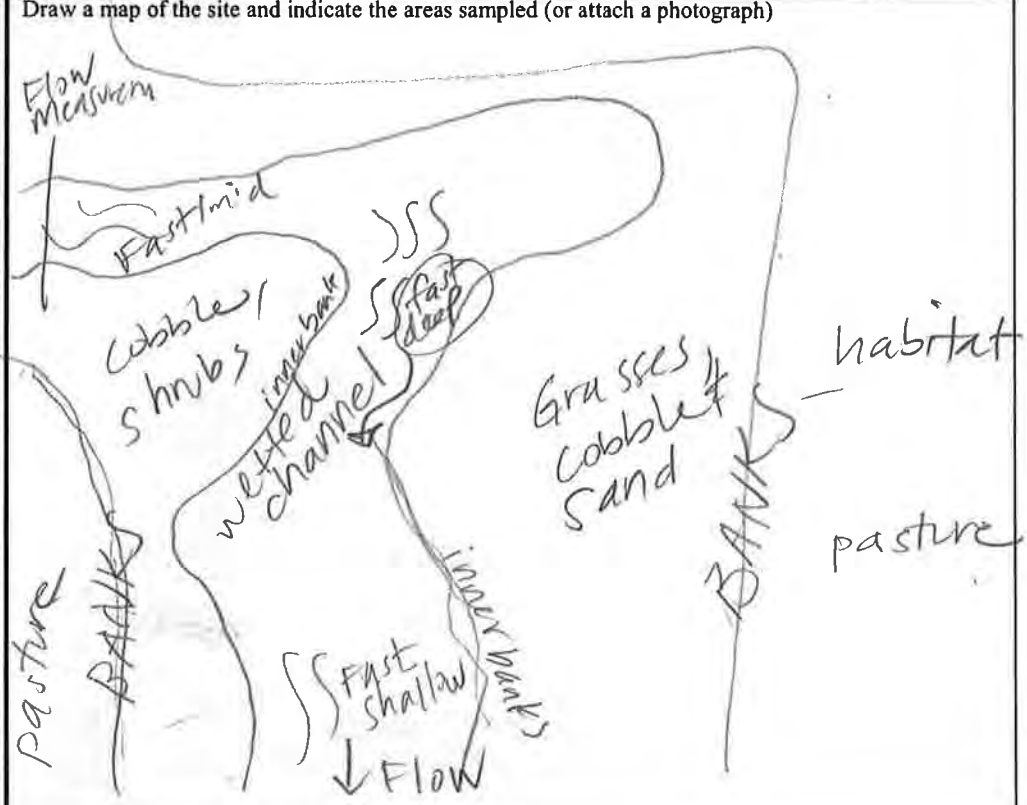
Flow:

| Tape Reading from LB/RB | Depth (ft) | Section Length (ft) | Velocity (f/s) |
|---|---|---|---|
| 3'8" | 0.53 | | 0.15 |
| 21'3" | 0.20 | 5' 11 | 0.30 |
| 20'8" | 0.50 | | 0.22 |
| 20'3" | 0.49 | | 0.79 |
| 19'8" | 0.63 | | 0.80 |
| 19'3" | 0.67 | V | 0.24 |
| 18'8" | 0.75 | | 0.70 |
| 18'3" | 0.76 | | 0.71 |
| 17'8" | 0.78 | | 0.88 |
| 17'3" | 0.80 | | 0.92 |
| 16'8" | 0.81 | | 0.79 |
| 16'3" | 0.79 | | 0.81 |
| 15'8" | 0.70 | | 1.03 |
| 15'3" | 0.60 | | 1.15 |
| 14'8" | 0.70 | | 0.95 |
| 14'3" | 0.57 | | 0.91 |
| 13'8" | 0.65 | | 0.94 |
| 13'3" | 0.75 | | 0.90 |
| 12'8" | 0.76 | | 0.97 |
| 12'3" | 0.74 | | 0.99 |
| 11'8" | 0.81 | | 0.86 |
| 11'3" | 0.86 | | 1.12 |
| 10'8" | 0.89 | | 0.94 |
| 10'3" | 0.90 | | 0.77 |
| 9'8" | 0.82 | | 0.64 |

3'8" - RB
21'8" - LB

Distance - inches
Depth - tenths feet

Draw a map of the site and indicate the areas sampled (or attach a photograph)




**STREAM CHARACTERIZATION**

**Stream Subsystem**
☒ Perennial ☐ Intermittent ☐ Tidal

**Stream Type**
☐ Coldwater ☒ Warmwater

**Stream Origin**
☐ Glacial ☐ Spring-fed
☐ Non-glacial montane ☒ Mixture of origins
☐ Swamp and bog ☐ Other ____

**Catchment Area** ____ km²

| | | |
|---|---|---|
| 9'3" | 0.78 | 0.54 |
| 8'8" | 0.76 | 0.52 |
| 8'3" | 0.73 | 0.49 |
| 7'8" | 0.60 | 0.45 |
| 7'3" | 0.45 | 0.28 |
| 6'8" | 0.40 | 0.33 |
| 6'3" | 0.38 | 0.56 |
| 5'8" | 0.30 | 0.45 |
| 5'3" | 0.30 | 0.39 |
| 4'8" | 0.27 | 0.54 |
| 4'3" | 0.21 | 0.14 |
| 3'8" | 0.11 | 0.00 |

WR-2.5 LC

# PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

| | |
|---|---|
| **WATERSHED FEATURES** | **Predominant Surrounding Landuse**<br>☐ Forest ☐ Commercial<br>☒ Field/Pasture ☐ Industrial<br>☐ Agricultural ☐ Other _____<br>☐ Residential<br><br>**Local Watershed**<br>☐ No evidence ☒ Some potential sources<br>☐ Obvious sources<br>cows cleared<br><br>**Local Watershed Erosion**<br>☐ None ☒ Moderate ☐ Heavy |
| **RIPARIAN VEGETATION (18 meter buffer)** | **Indicate the dominant type and record the dominant species present**<br>☐ Trees ☒ Shrubs ☐ Grasses ☐ Herbaceous<br>dominant species present _____ |
| **INSTREAM FEATURES** | **Estimated Reach Length** _____m 1200'<br>**Estimated Stream Width** _____m 30'<br>**Sampling Reach Area** _____$m^2$<br>**Area in $km^2$ ($m^2$x1000)** _____$km^2$<br>**Estimated Stream Depth** _____m 1" → 3'<br>**Surface Velocity (at thalweg)** _____m/sec to 4'/sec<br><br>**Canopy Cover**<br>☐ Partly open ☐ Partly shaded ☐ Shaded<br>open<br>**High Water Mark** 6' m<br><br>**Proportion of Reach Represented by Stream Morphology Types**<br>☐ Riffle 20 % ☐ Run 10 %<br>☐ Pool 70 %<br>Riffle – 20<br>Run – 10<br>Pool – 70<br><br>**Channelized** ☐ Yes ☒ No<br><br>**Dam Present** ☐ Yes ☒ No |
| **LARGE WOODY DEBRIS** | **LWD** 2 _____$m^2$<br>**Density of LWD** _____$m^2/km^2$ **(LWD/reach area)** |
| **AQUATIC VEGETATION** | **Indicate the dominant type and record the dominant species present**<br>☐ Rooted emergent ☐ Rooted submergent ☐ Rooted Floating ☒ Free floating<br>☒ Floating Algae ☒ Attached Algae<br><br>Dominant species present _____<br><br>Portion of the reach with aquatic vegetation ~~25~~ % 75% attached/floating algae |
| **WATER QUALITY** | **Temperature**_____°C<br>**Specific Conductance** _____<br>**Dissolved Oxygen** _____<br>**pH**_____<br>**Turbidity** _____<br>**WQ Instrument Used** _____<br><br>**Water Odors**<br>☒ Normal/None ☐ Sewage<br>☐ Petroleum ☐ Chemical<br>☐ Fishy ☐ Other _____<br><br>**Water Surface Oils**<br>☐ Slick ☐ Sheen ☐ Globs ☐ Flecks<br>☒ None ☐ Other _____<br><br>**Turbidity (if not measured)**<br>☒ Clear ☐ Slightly turbid ☐ Turbid<br>☐ Opaque ☐ Stained ☐ Other _____ |
| **SEDIMENT/ SUBSTRATE** | **Odors**<br>☒ Normal ☐ Sewage ☐ Petroleum<br>☐ Chemical ☐ Anaerobic ☐ None<br>☐ Other _____<br><br>**Oils**<br>☒ Absent ☐ Slight ☐ Moderate ☐ Profuse<br><br>**Deposits**<br>☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand<br>☐ Relict shells ☐ Other _____<br><br>**Looking at stones which are not deeply embedded, are the undersides black in color?**<br>☐ Yes ☒ No |

| INORGANIC SUBSTRATE COMPONENTS (should add up to 100%) | | | ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%) | | |
|---|---|---|---|---|---|
| **Substrate Type** | **Diameter** | **% Composition in Sampling Reach** | **Substrate Type** | **Characteristic** | **% Composition in Sampling Area** |
| Bedrock | | | Detritus | Sticks, wood, coarse plant materials (CPOM) | <5 |
| Boulder | > 256 mm (10") | 5 | | | |
| Cobble | 64-256 mm (2.5" – 10") | BOTH 55 | Muck-Mud | Black, very fine organic (FPOM) | 0 |
| Gravel | 2-64 mm (0.1" – 2.5") | BOTH 40 | | | |
| Sand | 0.06 – 2mm (gritty) | | Marl | Grey, shell fragments | 0 |
| Silt | 0.004-0.06 mm | | | | |
| Clay | <0.004 mm (slick) | | | | |

## HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

| | |
|---|---|
| STREAM NAME White River | LOCATION off Wyman Rd |
| STATION # WR 8.5 RIVERMILE | STREAM CLASS |
| LAT _____ LONG _____ | RIVER BASIN |
| STORET # | AGENCY |
| INVESTIGATORS L. Chamblin, P. Downey | |
| FORM COMPLETED BY L. Chamblin | DATE 9/13/2011 TIME 3:30 AM (PM) REASON FOR SURVEY |

Parameters to be evaluated in sampling reach

| Habitat Parameter | Condition Category: Optimal | Suboptimal | Marginal | Poor |
|---|---|---|---|---|
| **1. Epifaunal Substrate/ Available Cover** | Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient). | 40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale). | 20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed. | Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking. |
| **SCORE** | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **2. Embeddedness** | Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. | Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment. | Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment. | Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment. |
| **SCORE** | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **3. Velocity/Depth Regime** | All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m). | Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes). | Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low). | Dominated by 1 velocity/ depth regime (usually slow-deep). |
| **SCORE** | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **4. Sediment Deposition** | Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition. | Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools. | Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent. | Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition. |
| **SCORE** | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **5. Channel Flow Status** | Water reaches base of both lower banks, and minimal amount of channel substrate is exposed. | Water fills >75% of the available channel; or <25% of channel substrate is exposed. | Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed. | Very little water in channel and mostly present as standing pools. |
| **SCORE** | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |

Score 1: using outer banks: 138
Score 2: " inner banks: 153

LC WR-2.5

## HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

| Habitat Parameter | Condition Category | | | |
|---|---|---|---|---|
| | **Optimal** | **Suboptimal** | **Marginal** | **Poor** |
| **6. Channel Alteration** | Channelization or dredging absent or minimal; stream with normal pattern. | Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present. | Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted. | Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely. |
| **SCORE** | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **7. Frequency of Riffles (or bends)** | Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important. | Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15. | Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25. | Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25. |
| **SCORE** | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **8. Bank Stability (score each bank)** Note: determine left or right side by facing downstream. | Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected. | Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. | Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods. | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars. |
| SCORE ___ (LB) | Left Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| SCORE ___ (RB) | Right Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| **9. Vegetative Protection** (score each bank) | More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. | 70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. | 50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. | Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height. |
| SCORE ___ (LB) | Left Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| SCORE ___ (RB) | Right Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| **10. Riparian Vegetative Zone Width** (score each bank riparian zone) | Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone. | Width of riparian zone 12-18 meters; human activities have impacted zone only minimally. | Width of riparian zone 6-12 meters; human activities have impacted zone a great deal. | Width of riparian zone <6 meters: little or no riparian vegetation due to human activities. |
| SCORE ___ (LB) | Left Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| SCORE ___ (RB) | Right Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |

**Total Score** _____

# PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

| | | | |
|---|---|---|---|
| STREAM NAME Richland Cr | | LOCATION HWY 45 Bridge | |
| STATION # RC-1 | RIVERMILE | STREAM CLASS | |
| MAP DATUM: | Zone: | RIVER BASIN | |
| UTM: Easting | Northing | AGENCY | |
| INVESTIGATORS | | | |
| FORM COMPLETED BY POD | DATE 9/13/11<br>TIME 1307 AM PM | REASON FOR SURVEY UAA | |

**WEATHER CONDITIONS**

Now
- ☐ storm (heavy rain)
- ☐ rain (steady rain)
- ☒ showers (intermittent)
- 90 % ☐ %cloud cover
- ☐ clear/sunny

Past 24 Hours
- ☐
- ☐
- ☐ 50
- ☐ 0 %
- ☐

Has there been a heavy rain in the last 7 days?
☐ Yes ☒ No

Air Temperature ____ °C

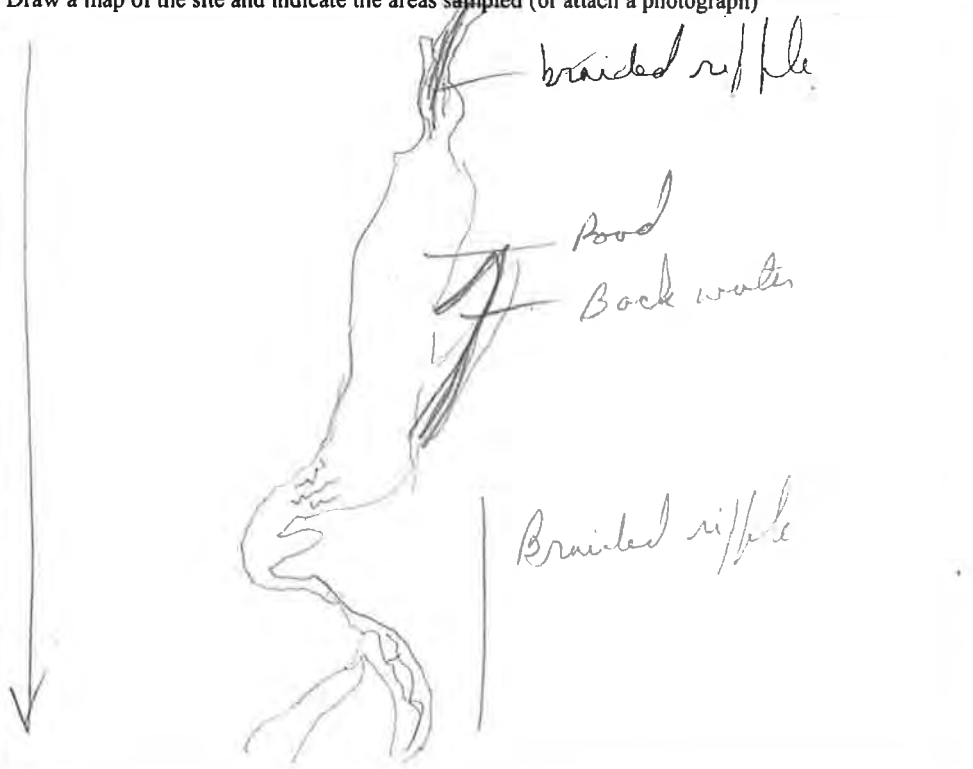
Other_____

**SITE LOCATION/MAP**

Flow:

| Tape Reading from LB/RB | Depth (ft) | Section Length (ft) | Velocity (f/s) |
|---|---|---|---|
| | | | |

Draw a map of the site and indicate the areas sampled (or attach a photograph)




**STREAM CHARACTERIZATION**

**Stream Subsystem**
☒ Perennial ☐ Intermittent ☐ Tidal

**Stream Type**
☐ Coldwater ☒ Warmwater

**Stream Origin**
☐ Glacial ☐ Spring-fed
☐ Non-glacial montane ☐ Mixture of origins
☐ Swamp and bog ☐ Other BB

**Catchment Area**_____km²

RC 1

# PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

| | |
|---|---|
| **WATERSHED FEATURES** | **Predominant Surrounding Landuse**<br>☐ Forest ☐ Commercial<br>☒ Field/Pasture ☐ Industrial<br>☐ Agricultural ☐ Other _____<br>☒ Residential<br><br>**Local Watershed**<br>☐ No evidence ☒ Some potential sources (sediment)<br>☐ Obvious sources<br><br>**Local Watershed Erosion**<br>☐ None ☒ Moderate ☐ Heavy |
| **RIPARIAN VEGETATION (18 meter buffer)** | **Indicate the dominant type and record the dominant species present**<br>☒ Trees ☐ Shrubs ☒ Grasses ☐ Herbaceous<br>**dominant species present** _____ |
| **INSTREAM FEATURES** | **Estimated Reach Length** ____m (1600 ft)<br>**Estimated Stream Width** ____m ($\bar{X}$ = 40 ft)<br>**Sampling Reach Area** ____$m^2$<br>**Area in $km^2$ ($m^2$x1000)** ____$km^2$<br>**Estimated Stream Depth** ____m (1' - 3')<br>**Surface Velocity (at thalweg)** ____m/sec (<1' - 1 ft/sec)<br><br>**Canopy Cover**<br>☐ Partly open ☒ Partly shaded ☐ Shaded<br>**High Water Mark** 2 m<br><br>**Proportion of Reach Represented by Stream Morphology Types**<br>☐ Riffle 15 % ☐ Run 5 %<br>☐ Pool 80 %<br><br>**Channelized** ☐ Yes ☒ No<br>**Dam Present** ☐ Yes ☒ No |
| **LARGE WOODY DEBRIS** | **LWD** 0 $m^2$<br>**Density of LWD** _____$m^2/km^2$ **(LWD/reach area)** |
| **AQUATIC VEGETATION** | **Indicate the dominant type and record the dominant species present**<br>☐ Rooted emergent ☐ Rooted submergent ☐ Rooted Floating ☐ Free floating<br>☒ Floating Algae ☐ Attached Algae<br>Dominant species present None/algae<br>Portion of the reach with aquatic vegetation <1 % |
| **WATER QUALITY** | **Temperature**_____°C<br>**Specific Conductance** _____<br>**Dissolved Oxygen** _____ (see hydrolab)<br>**pH**_____<br>**Turbidity** _____<br>**WQ Instrument Used** _____<br><br>**Water Odors**<br>☒ Normal/None ☐ Sewage<br>☐ Petroleum ☐ Chemical<br>☐ Fishy ☐ Other _____<br><br>**Water Surface Oils**<br>☐ Slick ☐ Sheen ☐ Globs ☐ Flecks<br>☒ None ☐ Other _____<br><br>**Turbidity (if not measured)**<br>☒ Clear ☒ Slightly turbid ☐ Turbid<br>☐ Opaque ☐ Stained ☐ Other_____ |
| **SEDIMENT/ SUBSTRATE** | **Odors**<br>☒ Normal ☐ Sewage ☐ Petroleum<br>☐ Chemical ☐ Anaerobic ☐ None<br>☐ Other _____<br><br>**Oils**<br>☒ Absent ☐ Slight ☐ Moderate ☐ Profuse<br><br>**Deposits**<br>☐ Sludge ☐ Sawdust ☐ Paper fiber ☒ Sand<br>☐ Relict shells ☐ Other _____<br><br>**Looking at stones which are not deeply embedded, are the undersides black in color?**<br>☐ Yes ☒ No |

| INORGANIC SUBSTRATE COMPONENTS (should add up to 100%) | | | ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%) | | |
|---|---|---|---|---|---|
| **Substrate Type** | **Diameter** | **% Composition in Sampling Reach** | **Substrate Type** | **Characteristic** | **% Composition in Sampling Area** |
| Bedrock | | | Detritus | Sticks, wood, coarse plant materials (CPOM) | 5 |
| Boulder | > 256 mm (10") | 0 | | | |
| Cobble | 64-256 mm (2.5" – 10") | 10 | Muck-Mud | Black, very fine organic (FPOM) | <1 |
| Gravel | 2-64 mm (0.1" – 2.5") | 20 | | | |
| Sand | 0.06 – 2mm (gritty) | 60 | Marl | Grey, shell fragments | 0 |
| Silt | 0.004-0.06 mm | 11 | | | |
| Clay | <0.004 mm (slick) | | | | |

## HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

| | | |
|---|---|---|
| STREAM NAME Rich Land Cr | LOCATION RC-1 U/S HWY 45 Bg. | |
| STATION # RC-1 RIVERMILE | STREAM CLASS | |
| LAT LONG | RIVER BASIN | |
| STORET # | AGENCY | |
| INVESTIGATORS | | |
| FORM COMPLETED BY RD | DATE 9/13/11 TIME 10 AM PM | REASON FOR SURVEY UAA |

Parameters to be evaluated in sampling reach

| Habitat Parameter | Condition Category | | | |
|---|---|---|---|---|
| | Optimal | Suboptimal | Marginal | Poor |
| **1. Epifaunal Substrate/ Available Cover** 10 | Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient). | 40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale). | 20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed. | Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking. |
| **SCORE** | 20 19 18 17 16 | 15 14 13 12 11 | (10) 9 8 7 6 | (5) 4 3 2 1 0 |
| **2. Embeddedness** 5 | Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. | Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment. | Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment. | Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment. |
| **SCORE** | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | (5) 4 3 2 1 0 |
| **3. Velocity/Depth Regime** 15 | All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.) | Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes). | Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low). | Dominated by 1 velocity/ depth regime (usually slow-deep). |
| **SCORE** | 20 19 18 17 16 | (15) 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **4. Sediment Deposition** 8 | Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition. | Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools. | Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent. | Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition. |
| **SCORE** | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 (8) 7 6 | 5 4 3 2 1 0 |
| **5. Channel Flow Status** 8 | Water reaches base of both lower banks, and minimal amount of channel substrate is exposed. | Water fills >75% of the available channel; or <25% of channel substrate is exposed. | Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed. | Very little water in channel and mostly present as standing pools. |
| **SCORE** | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 (8) 7 6 | 5 4 3 2 1 0 |

RC-1

## HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

| Habitat Parameter | Condition Category | | | |
|---|---|---|---|---|
| | Optimal | Suboptimal | Marginal | Poor |
| **6. Channel Alteration** | Channelization or dredging absent or minimal; stream with normal pattern. | Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present. | Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted. | Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely. |
| SCORE | 20 19 (18) 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **7. Frequency of Riffles (or bends)** | Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important. | Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15. | Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25. | Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25. |
| SCORE | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 (8) 7 6 | 5 4 3 2 1 0 |
| **8. Bank Stability (score each bank)** Note: determine left or right side by facing downstream. | Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected. | Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. | Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods. | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars. |
| SCORE 7 (LB) | Left Bank 10 9 | (8) (7) 6 | 5 4 3 | 2 1 0 |
| SCORE 5 (RB) | Right Bank 10 9 | 8 7 6 | (5) 4 3 | 2 1 0 |
| **9. Vegetative Protection** (score each bank) | More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. | 70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. | 50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. | Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height. |
| SCORE 9 (LB) | Left Bank 10 (9) | 8 7 6 | (5) 4 3 | 2 1 0 |
| SCORE 5 (RB) | Right Bank 10 9 | 8 7 6 | (5) 4 3 | 2 1 0 |
| **10. Riparian Vegetative Zone Width** (score each bank riparian zone) | Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone. | Width of riparian zone 12-18 meters; human activities have impacted zone only minimally. | Width of riparian zone 6-12 meters; human activities have impacted zone a great deal. | Width of riparian zone <6 meters: little or no riparian vegetation due to human activities. |
| SCORE 10 (LB) | Left Bank (10) 9 | 8 7 6 | (5) 4 3 | 2 1 0 |
| SCORE 5 (RB) | Right Bank (10) 9 | 8 7 6 | (5) 4 3 | 2 1 0 |

**Total Score** _____

# PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

| | | | |
|---|---|---|---|
| STREAM NAME Richland Creek | LOCATION Highway 45 | | |
| STATION # RC-01 | RIVERMILE ____ | STREAM CLASS J | |
| MAP DATUM:____ | Zone:____ | RIVER BASIN White | |
| UTM: Easting ____ | Northing ____ | AGENCY | |
| INVESTIGATORS L. Chamblin, FTN (Downey, Rupe, Griffis, Masteson) | | | |
| FORM COMPLETED BY L. Chamblin | DATE 9/13 | TIME 10:00 (AM) PM | REASON FOR SURVEY |

**WEATHER CONDITIONS** sprinkled this morning

| Now | | Past 24 Hours |
|---|---|---|
| ☐ | storm (heavy rain) | ☐ |
| ☐ | rain (steady rain) | ☐ |
| ☐ | showers (intermittent) | ☐ |
| 75 % ☐ | %cloud cover | ☐ ____% |
| ☐ | clear/sunny | ☐ |

Has there been a heavy rain in the last 7 days? ☐ Yes ☒ No

Air Temperature 75°F

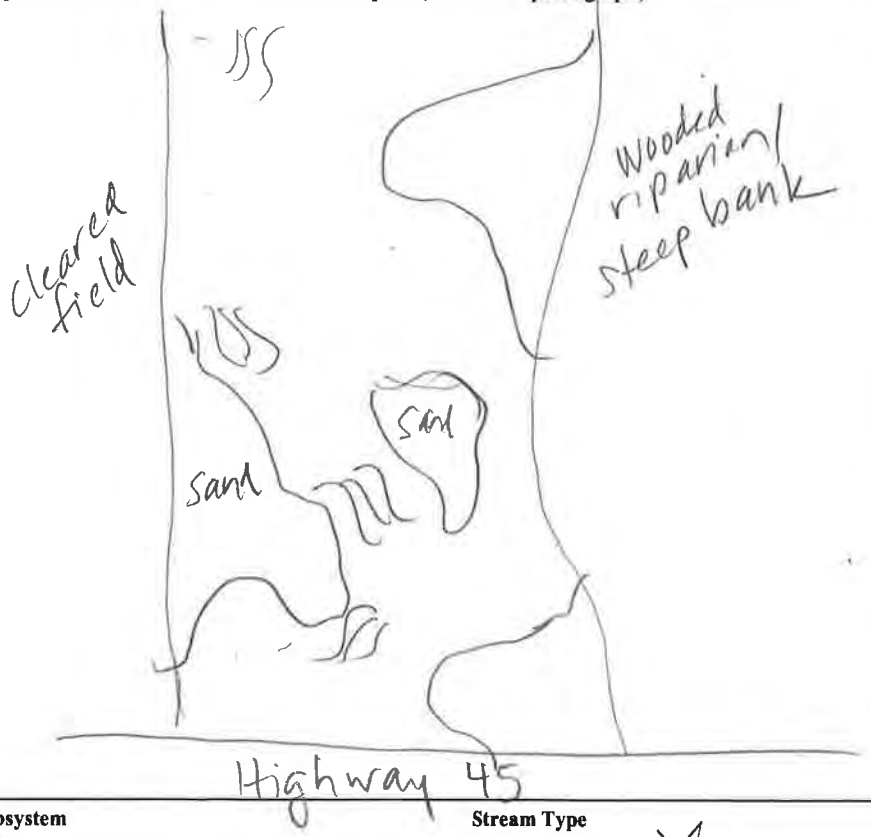
Other____

**SITE LOCATION/MAP**

Flow: N/A

| Tape Reading from LB/RB | Depth (ft) | Section Length (ft) | Velocity (f/s) |
|---|---|---|---|
| | | | |

Draw a map of the site and indicate the areas sampled (or attach a photograph)




**STREAM CHARACTERIZATION**

**Stream Subsystem**
☒ Perennial ☐ Intermittent ☐ Tidal

**Stream Type**
☐ Coldwater ☒ Warmwater

**Stream Origin**
☐ Glacial ☐ Spring-fed
☐ Non-glacial montane ☒ Mixture of origins springs, gw, surface
☐ Swamp and bog ☐ Other____

**Catchment Area**____km²

LC RC-01

# PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

**WATERSHED FEATURES**

**Predominant Surrounding Landuse**
- ☐ Forest
- ☐ Commercial
- ☒ Field/Pasture
- ☐ Industrial
- ☐ Agricultural
- ☐ Other _____
- ☒ Residential

**Local Watershed**
- ☐ No evidence
- ☒ Some potential sources
- ☐ Obvious sources

**Local Watershed Erosion**
- ☐ None ☐ Moderate ☐ Heavy

**RIPARIAN VEGETATION (18 meter buffer)**

**Indicate the dominant type and record the dominant species present**
- ☒ Trees
- ☐ Shrubs
- ☒ Grasses
- ☐ Herbaceous

**dominant species present** _____

**INSTREAM FEATURES**

**Estimated Reach Length** ____m 1600'

**Estimated Stream Width** ____m 40'

**Sampling Reach Area** ____$m^2$

**Area in $km^2$ ($m^2$x1000)** ____$km^2$

**Estimated Stream Depth** ____m 1" – 3'

**Surface Velocity (at thalweg)** ____m/sec up to 1'/sec

**Canopy Cover**
- ☐ Partly open
- ☒ Partly shaded
- ☐ Shaded

**High Water Mark** ____m 6'

**Proportion of Reach Represented by Stream Morphology Types**
- ☐ Riffle 15 %
- ☐ Run 5 %
- ☐ Pool 80 %

**Channelized** ☐ Yes ☒ No

**Dam Present** ☐ Yes ☒ No

**LARGE WOODY DEBRIS**

**LWD** 20 $m^2$

**Density of LWD** _____$m^2/km^2$ **(LWD/reach area)** % of channel →

**AQUATIC VEGETATION**

**Indicate the dominant type and record the dominant species present**
- ☒ Rooted emergent
- ☒ Rooted submergent
- ☐ Rooted Floating
- ☐ Free floating
- ☒ Floating Algae
- ☐ Attached Algae

Dominant species present _____

Portion of the reach with aquatic vegetation < 1 %

**WATER QUALITY**

**Temperature**_____°C

**Specific Conductance** _____

**Dissolved Oxygen** _____

**pH**_____

**Turbidity** _____

**WQ Instrument Used** _____

**Water Odors**
- ☒ Normal/None
- ☐ Sewage
- ☐ Petroleum
- ☐ Chemical
- ☐ Fishy
- ☐ Other _____

**Water Surface Oils**
- ☐ Slick
- ☐ Sheen
- ☐ Globs
- ☐ Flecks
- ☒ None
- ☐ Other _____

**Turbidity (if not measured)**
- ☒ Clear
- ☒ Slightly turbid
- ☐ Turbid
- ☐ Opaque
- ☐ Stained
- ☐ Other _____

**SEDIMENT/ SUBSTRATE**

**Odors**
- ☒ Normal
- ☐ Sewage
- ☐ Petroleum
- ☐ Chemical
- ☐ Anaerobic
- ☒ None
- ☐ Other _____

**Oils**
- ☒ Absent
- ☐ Slight
- ☐ Moderate
- ☐ Profuse

**Deposits**
- ☐ Sludge
- ☐ Sawdust
- ☐ Paper fiber
- ☒ Sand
- ☐ Relict shells
- ☐ Other _____

**Looking at stones which are not deeply embedded, are the undersides black in color?**
- ☐ Yes
- ☒ No

**INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)**

| Substrate Type | Diameter | % Composition in Sampling Reach |
|---|---|---|
| Bedrock | | |
| Boulder | > 256 mm (10") | |
| Cobble | 64-256 mm (2.5" – 10") | 10 |
| Gravel | 2-64 mm (0.1" – 2.5") | 20 |
| Sand | 0.06 – 2mm (gritty) | 60 |
| Silt | 0.004-0.06 mm | 10 |
| Clay | <0.004 mm (slick) | |

**ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)**

| Substrate Type | Characteristic | % Composition in Sampling Area |
|---|---|---|
| Detritus | Sticks, wood, coarse plant materials (CPOM) | 10 |
| Muck-Mud | Black, very fine organic (FPOM) | 5 |
| Marl | Grey, shell fragments | D |

## HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

| | |
|---|---|
| STREAM NAME Richland Creek | LOCATION Highway 45 |
| STATION # RC-01 RIVERMILE | STREAM CLASS |
| LAT LONG | RIVER BASIN White |
| STORET # | AGENCY |
| INVESTIGATORS L. Chamblin / P. Downey | |
| FORM COMPLETED BY L. Chamblin | DATE 9/13 TIME 9:30 (AM) PM |
| REASON FOR SURVEY Fayetteville UAA | |

| Parameters to be evaluated in sampling reach | Habitat Parameter | Condition Category: Optimal | Suboptimal | Marginal | Poor |
|---|---|---|---|---|---|
| | 1. Epifaunal Substrate/ Available Cover | Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient). | 40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale). | 20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed. | Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking. |
| | SCORE 10 | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| | 2. Embeddedness | Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. | Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment. | Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment. | Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment. |
| | SCORE 6 | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| | 3. Velocity/Depth Regime | All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.) | Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes). | Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low). | Dominated by 1 velocity/ depth regime (usually slow-deep). |
| | SCORE 13 | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| | 4. Sediment Deposition | Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition. | Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools. | Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent. | Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition. |
| | SCORE 6 | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| | 5. Channel Flow Status | Water reaches base of both lower banks, and minimal amount of channel substrate is exposed. | Water fills >75% of the available channel; or <25% of channel substrate is exposed. | Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed. | Very little water in channel and mostly present as standing pools. |
| | SCORE 8 | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |

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LC RC-01

## HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

| Habitat Parameter | Condition Category: Optimal | Suboptimal | Marginal | Poor |
|---|---|---|---|---|
| **6. Channel Alteration** | Channelization or dredging absent or minimal; stream with normal pattern. | Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present. | Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted. | Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely. |
| SCORE 14 | 20 19 18 17 16 | 15 (14) 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **7. Frequency of Riffles (or bends)** | Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important. | Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15. | Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25. | Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25. |
| SCORE 10 | 20 19 18 17 16 | 15 14 13 12 11 | (10) 9 8 7 6 | 5 4 3 2 1 0 |
| **8. Bank Stability (score each bank)** Note: determine left or right side by facing downstream. | Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected. | Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. | Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods. | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars. |
| SCORE 9 (LB) | Left Bank 10 9 | 8 7 (6) | 5 4 3 | 2 1 0 |
| SCORE 3 (RB) | Right Bank 10 9 | 8 7 6 | 5 4 (3) | 2 1 0 |
| **9. Vegetative Protection** (score each bank) | More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. | 70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. | 50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. | Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height. |
| SCORE 8 (LB) | Left Bank 10 9 | (8) 7 6 | 5 4 3 | 2 1 0 |
| SCORE 5 (RB) | Right Bank 10 9 | 8 7 6 | (5) 4 3 | 2 1 0 |
| **10. Riparian Vegetative Zone Width** (score each bank riparian zone) | Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone. | Width of riparian zone 12-18 meters; human activities have impacted zone only minimally. | Width of riparian zone 6-12 meters; human activities have impacted zone a great deal. | Width of riparian zone <6 meters: little or no riparian vegetation due to human activities. |
| SCORE 8 (LB) | Left Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| SCORE 3 (RB) | Right Bank 10 9 | 8 7 6 | 5 4 (3) | 2 1 0 |

**Total Score** 100

# PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

| | | |
|---|---|---|
| STREAM NAME White River | LOCATION White River @ Wyman Bridge | |
| STATION # WR-01 RIVERMILE | STREAM CLASS | |
| LAT LONG | RIVER BASIN | |
| STORET # | AGENCY FTN | |
| INVESTIGATORS DNR/SEM | | |
| FORM COMPLETED BY DNR | DATE 7-March-12<br>TIME 1810 AM PM | REASON FOR SURVEY UAA |

**WEATHER CONDITIONS**

| Now | | Past 24 Hours |
|---|---|---|
| ☐ | storm (heavy rain) | ☐ |
| ☐ | rain (steady rain) | ☐ |
| ☐ | showers (intermittent) | ☐ |
| 40 % ☑ | %cloud cover | ☐ ____% |
| ☐ | clear/sunny | ☒ |

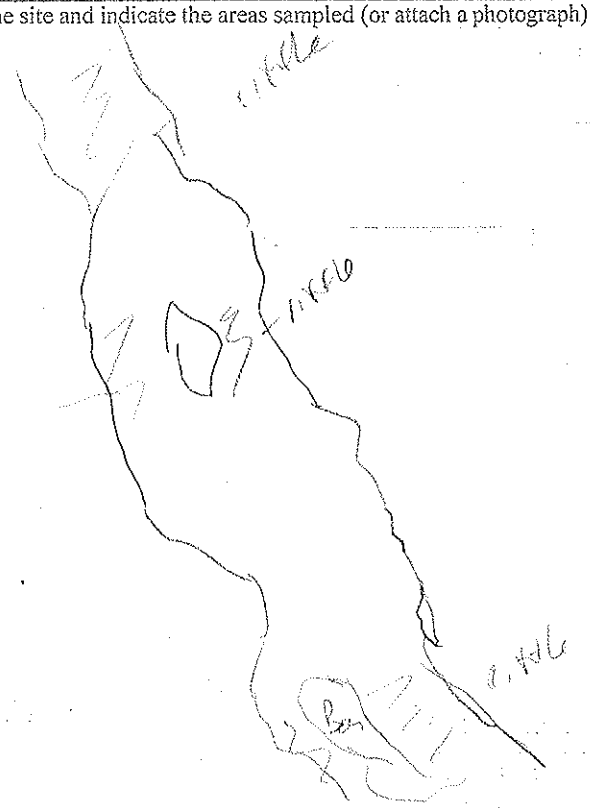
Has there been a heavy rain in the last 7 days? ☐ Yes ☒ No

Air Temperature 60 °F/°C

Other ____

**SITE LOCATION/MAP**

Draw a map of the site and indicate the areas sampled (or attach a photograph)




**STREAM CHARACTERIZATION**

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☒ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Non-glacial montane ☐ Mixture of origins
☐ Swamp and bog ☐ Other ____

Catchment Area ____ km²

# PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

**WATERSHED FEATURES**

Predominant Surrounding Landuse
☐ Forest ☐ Commercial
☒ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other _____
☐ Residential

Local Watershed
☐ No evidence ☒ Some potential sources
☐ Obvious sources CAFO

Local Watershed Erosion
☐ None ☒ Moderate ☐ Heavy

**RIPARIAN VEGETATION (18 meter buffer)**

Indicate the dominant type and record the dominant species present
☒ Trees ☒ Shrubs ☐ Grasses ☐ Herbaceous
dominant species present Sycamore

**INSTREAM FEATURES**

Estimated Reach Length 160 m
Estimated Stream Width ~~6-10~~ m 12-14 m
Sampling Reach Area _____ $m^2$
Area in $km^2$ ($m^2$x1000) _____ $km^2$
Estimated Stream Depth 0.3-0.75 m
Surface Velocity (at thalweg) _____ m/sec

Canopy Cover
☐ Partly open ☒ Partly shaded ☐ Shaded
High Water Mark 3 m
Proportion of Reach Represented by Stream Morphology Types
☐ Riffle 20 % ☒ Run 20 %
☐ Pool 40 %
Channelized ☐ Yes ☒ No
Dam Present ☐ Yes ☒ No

**LARGE WOODY DEBRIS**

LWD 42 $m^2$
Density of LWD _____ $m^2/km^2$ (LWD/reach area)

**AQUATIC VEGETATION**

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☐ Rooted submergent ☐ Rooted Floating ☐ Free floating
☐ Floating Algae ☒ Attached Algae
dominant species present _____
Portion of the reach with aquatic vegetation 21 %

**WATER QUALITY**

Temperature _____ °C
Specific Conductance _____
Dissolved Oxygen _____
pH _____
Turbidity _____
WQ Instrument Used _____

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other _____

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☒ None ☐ Other _____

Turbidity (if not measured)
☒ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other _____

**SEDIMENT/ SUBSTRATE**

Odors
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other _____

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other _____

Looking at stones which are not deeply embedded, are the undersides black in color?
☒ Yes ☐ No

**INORGANIC SUBSTRATE COMPONENTS** (should add up to 100%)

| Substrate Type | Diameter | % Composition in Sampling Reach |
|---|---|---|
| Bedrock | | 30 |
| Boulder | > 256 mm (10") | 30 30 |
| Cobble | 64-256 mm (2.5" – 10") | 30 20 |
| Gravel | 2-64 mm (0.1" – 2.5") | 10 |
| Sand | 0.06 – 2mm (gritty) | |
| Silt | 0.004-0.06 mm | |
| Clay | <0.004 mm (slick) | |

**ORGANIC SUBSTRATE COMPONENTS** (does not necessarily add up to 100%)

| Substrate Type | Characteristic | % Composition in Sampling Area |
|---|---|---|
| Detritus | Sticks, wood, coarse plant materials (CPOM) | |
| Muck-Mud | Black, very fine organic (FPOM) | |
| Marl | Grey, shell fragments | |

## HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

| | | |
|---|---|---|
| STREAM NAME White River | LOCATION White River @ Wynn Bridge | |
| STATION # WR-01 RIVERMILE | STREAM CLASS | |
| LAT _____ LONG _____ | RIVER BASIN | |
| STORET # | AGENCY FTN | |
| INVESTIGATORS DMR/SEM | | |
| FORM COMPLETED BY DMR | DATE 7-Nov-13<br>TIME 0810 AM PM | REASON FOR SURVEY WAA |

Parameters to be evaluated in sampling reach

| Habitat Parameter | Condition Category | | | |
|---|---|---|---|---|
| | Optimal | Suboptimal | Marginal | Poor |
| 1. Epifaunal Substrate/ Available Cover | Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient). | 40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale). | 20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed. | Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking. |
| SCORE 15 | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| 2. Embeddedness | Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. | Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment. | Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment. | Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment. |
| SCORE 16 | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| 3. Velocity/Depth Regime | All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.) | Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes). | Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low). | Dominated by 1 velocity/ depth regime (usually slow-deep). |
| SCORE 14 | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| 4. Sediment Deposition | Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition. | Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools. | Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent. | Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantinl sediment deposition. |
| SCORE 17 | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| 5. Channel Flow Status | Water reaches base of both lower banks, and minimal amount of channel substrate is exposed. | Water fills >75% of the available channel; or <25% of channel substrate is exposed. | Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed. | Very little water in channel and mostly present as standing pools. |
| SCORE 16 | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |

## HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

| Habitat Parameter | Condition Category | | | |
|---|---|---|---|---|
| | **Optimal** | **Suboptimal** | **Marginal** | **Poor** |
| **6. Channel Alteration** | Channelization or dredging absent or minimal; stream with normal pattern. | Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present. | Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted. | Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely. |
| SCORE 17 | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **7. Frequency of Riffles (or bends)** | Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important. | Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15. | Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25. | Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25. |
| SCORE 15 | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **8. Bank Stability (score each bank)** Note: determine left or right side by facing downstream. | Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected. | Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. | Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods. | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars. |
| SCORE 7 (LB) | Left Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| SCORE 5 (RB) | Right Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| **9. Vegetative Protection** (score each bank) | More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. | 70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. | 50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. | Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height. |
| SCORE 6 (LB) | Left Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| SCORE 7 (RB) | Right Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| **10. Riparian Vegetative Zone Width** (score each bank riparian zone) | Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone. | Width of riparian zone 12-18 meters; human activities have impacted zone only minimally. | Width of riparian zone 6-12 meters; human activities have impacted zone a great deal. | Width of riparian zone <6 meters: little or no riparian vegetation due to human activities. |
| SCORE 5 (LB) | Left Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| SCORE 10 (RB) | Right Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |

**Total Score** _____

# PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
## (FRONT)

| | |
|---|---|
| STREAM NAME White River | LOCATION White River below outfall |
| STATION # WR-02 RIVERMILE _____ | STREAM CLASS |
| LAT _____ LONG _____ | RIVER BASIN |
| STORET # | AGENCY FTN |
| INVESTIGATORS DMR/SEM | |
| FORM COMPLETED BY DMR | DATE 7-Nov-12 TIME 0845 (AM) PM |
| REASON FOR SURVEY UAA | |

**WEATHER CONDITIONS**

| Now | | Past 24 Hours |
|---|---|---|
| ☐ | storm (heavy rain) | ☐ |
| ☐ | rain (steady rain) | ☐ |
| ☐ | showers (intermittent) | ☐ |
| 70% ☒ | %cloud cover | ☐ ____% |
| ☐ | clear/sunny | ☒ |

Has there been a heavy rain in the last 7 days? ☐ Yes ☒ No

Air Temperature 60 °F

Other _____

**SITE LOCATION/MAP**

Draw a map of the site and indicate the areas sampled (or attach a photograph)

**STREAM CHARACTERIZATION**

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☒ Non-glacial montane ☒ Mixture of origins
☐ Swamp and bog ☐ Other _____

Catchment Area _____ km²

# PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
## (BACK)

**WATERSHED FEATURES**

Predominant Surrounding Landuse
- ☒ Forest
- ☐ Commercial
- ☐ Field/Pasture
- ☒ Industrial
- ☐ Agricultural
- ☐ Other _____
- ☐ Residential

Local Watershed
- ☐ No evidence
- ☐ Some potential sources
- ☒ Obvious sources

Local Watershed Erosion
- ☐ None
- ☒ Moderate
- ☐ Heavy

**RIPARIAN VEGETATION (18 meter buffer)**

Indicate the dominant type and record the dominant species present
- ☒ Trees
- ☒ Shrubs
- ☐ Grasses
- ☐ Herbaceous

dominant species present Sycamore, Ironwood, Sweetgum, River Birch, Box Elder

**INSTREAM FEATURES**

Estimated Reach Length 320 m

Estimated Stream Width 20-25 m

Sampling Reach Area _____ $m^2$

Area in $km^2$ ($m^2$x1000) _____ $km^2$

Estimated Stream Depth 0.25 m

Surface Velocity (at thalweg) _____ m/sec

Canopy Cover
- ☐ Partly open
- ☒ Partly shaded
- ☐ Shaded

High Water Mark 4 m

Proportion of Reach Represented by Stream Morphology Types
- ☒ Riffle 15 %
- ☒ Run 15 %
- ☒ Pool 70 %

Channelized ☐ Yes ☒ No

Dam Present ☐ Yes ☒ No

**LARGE WOODY DEBRIS**

LWD 20-30 $m^2$

Density of LWD _____ $m^2/km^2$ (LWD/reach area)

**AQUATIC VEGETATION**

Indicate the dominant type and record the dominant species present
- ☒ Rooted emergent
- ☒ Rooted submergent
- ☐ Rooted Floating
- ☐ Free floating
- ☐ Floating Algae
- ☒ Attached Algae

dominant species present Justicia americana - senescent / Algae

Portion of the reach with aquatic vegetation 5 % - No floating algae

**WATER QUALITY**

Temperature _____ °C

Specific Conductance _____

Dissolved Oxygen _____

pH _____

Turbidity _____

WQ Instrument Used _____

Water Odors
- ☒ Normal/None
- ☐ Sewage
- ☐ Petroleum
- ☐ Chemical
- ☐ Fishy
- ☐ Other _____

Water Surface Oils
- ☐ Slick
- ☐ Sheen
- ☐ Globs
- ☐ Flecks
- ☒ None
- ☐ Other _____

Turbidity (if not measured)
- ☒ Clear
- ☐ Slightly turbid
- ☐ Turbid
- ☐ Opaque
- ☐ Stained
- ☐ Other _____

**SEDIMENT/ SUBSTRATE**

Odors
- ☒ Normal
- ☐ Sewage
- ☐ Petroleum
- ☐ Chemical
- ☐ Anaerobic
- ☐ None
- ☐ Other _____

Oils
- ☒ Absent
- ☐ Slight
- ☐ Moderate
- ☐ Profuse

Deposits
- ☐ Sludge
- ☐ Sawdust
- ☐ Paper fiber
- ☐ Sand
- ☐ Relict shells
- ☐ Other _____

Looking at stones which are not deeply embedded, are the undersides black in color?
- ☐ Yes
- ☒ No

| INORGANIC SUBSTRATE COMPONENTS (should add up to 100%) | | | ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%) | | |
|---|---|---|---|---|---|
| Substrate Type | Diameter | % Composition in Sampling Reach | Substrate Type | Characteristic | % Composition in Sampling Area |
| Bedrock | | 15 | Detritus | Sticks, wood, coarse plant materials (CPOM) | <1 |
| Boulder | > 256 mm (10") | 10 | | | |
| Cobble | 64-256 mm (2.5" – 10") | 60 | Muck-Mud | Black, very fine organic (FPOM) | — |
| Gravel | 2-64 mm (0.1" – 2.5") | 15 | | | |
| Sand | 0.06 – 2mm (gritty) | | Marl | Grey, shell fragments | — |
| Silt | 0.004-0.06 mm | | | | |
| Clay | <0.004 mm (slick) | | | | |

## HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

| | | |
|---|---|---|
| STREAM NAME White River | LOCATION White River d/s outfall | |
| STATION # UR-20 RIVERMILE | STREAM CLASS | |
| LAT _____ LONG _____ | RIVER BASIN | |
| STORET # | AGENCY FTN | |
| INVESTIGATORS DMR | | |
| FORM COMPLETED BY DMR | DATE 7-Mar-12 TIME 0656 AM PM | REASON FOR SURVEY UAA |

Parameters to be evaluated in sampling reach

| Habitat Parameter | Condition Category | | | |
|---|---|---|---|---|
| | Optimal | Suboptimal | Marginal | Poor |
| **1. Epifaunal Substrate/ Available Cover** | Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient). | 40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale). | 20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed. | Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking. |
| SCORE 16 | 20 19 18 17 (16) | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **2. Embeddedness** | Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. | Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment. | Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment. | Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment. |
| SCORE 17 | 20 19 18 (17) 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **3. Velocity/Depth Regime** | All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.) | Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes). | Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low). | Dominated by 1 velocity/ depth regime (usually slow-deep). |
| SCORE 16 | 20 19 18 17 (16) | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **4. Sediment Deposition** | Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition. | Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools. | Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affeeted; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent. | Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition. |
| SCORE 15 | 20 19 18 17 16 | (15) 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **5. Channel Flow Status** | Water reaches base of both lower banks, and minimal amount of channel substrate is exposed. | Water fills >75% of the available channel; or <25% of channel substrate is exposed. | Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed. | Very little water in channel and mostly present as standing pools. |
| SCORE 17 | 20 19 18 (17) 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |

## HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

| Habitat Parameter | Condition Category | | | |
|---|---|---|---|---|
| | **Optimal** | **Suboptimal** | **Marginal** | **Poor** |
| **6. Channel Alteration** | Channelization or dredging absent or minimal; stream with normal pattern. | Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present. | Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted. | Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely. |
| SCORE 17 | 20 19 18 (17) 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **7. Frequency of Riffles (or bends)** | Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important. | Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15. | Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25. | Generally all flat water or shallow riffles; poor habitat; distance botween riffles divided by the width of the stream is a ratio of >25. |
| SCORE 10 | 20 19 18 17 16 | 15 14 13 12 11 | (10) 9 8 7 6 | 5 4 3 2 1 0 |
| **8. Bank Stability (score each bank)** Note: determine left or right side by facing downstream. | Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected. | Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. | Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods. | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars. |
| SCORE 3 (LB) | Left Bank 10 9 | 8 7 6 | 5 4 (3) | 2 1 0 |
| SCORE 5 (RB) | Right Bank 10 9 | 8 7 6 | (5) 4 3 | 2 1 0 |
| **9. Vegetative Protection** (score each bank) | More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. | 70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. | 50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. | Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height. |
| SCORE 5 (LB) | Left Bank 10 9 | 8 7 6 | (5) 4 3 | 2 1 0 |
| SCORE 6 (RB) | Right Bank 10 9 | 8 7 (6) | 5 4 3 | 2 1 0 |
| **10. Riparian Vegetative Zone Width** (score each bank riparian zone) | Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone. | Width of riparian zone 12-18 meters; human activities have impacted zone only minimally. | Width of riparian zone 6-12 meters; human activities have impacted zone a great deal. | Width of riparian zone <6 meters: little or no riparian vegetation due to human activities. |
| SCORE 9 (LB) | Left Bank 10 (9) | 8 7 6 | 5 4 3 | 2 1 0 |
| SCORE 10 (RB) | Right Bank 10 (9) | 8 7 6 | 5 4 3 | 2 1 0 |

**Total Score** _____

# PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
## (FRONT)

| | |
|---|---|
| STREAM NAME White Run | LOCATION Farm N. of Ulysses Road |
| STATION # WR-2.5 RIVERMILE ____ | STREAM CLASS |
| LAT ____ LONG ____ | RIVER BASIN |
| STORET # | AGENCY FTN |
| INVESTIGATORS DMR/SEM | |
| FORM COMPLETED BY DMR | DATE 7-Mar-12 TIME 10:10 (AM) PM |
| REASON FOR SURVEY | |

**WEATHER CONDITIONS**

Now

- ☐ storm (heavy rain)
- ☐ rain (steady rain)
- ☐ showers (intermittent)
- 60 % ☒ %cloud cover
- ☐ clear/sunny

Past 24 Hours

- ☐
- ☐
- ☐
- ☐ ____ %
- ☒

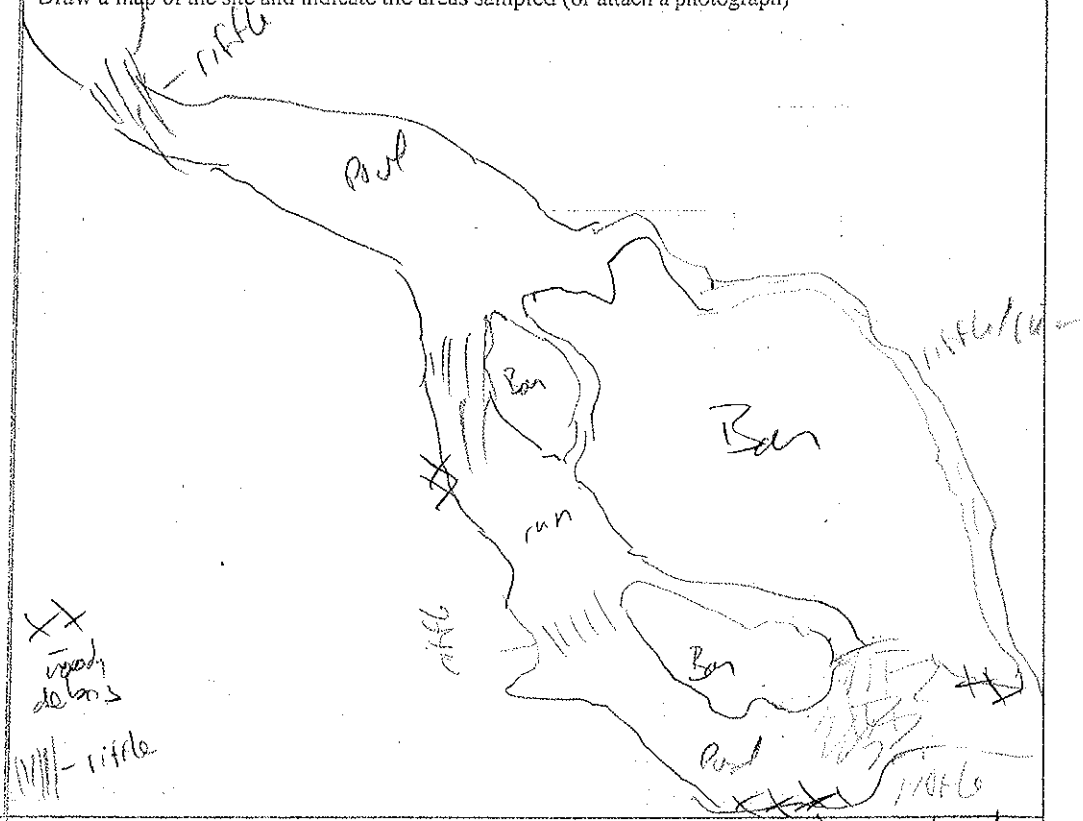
Has there been a heavy rain in the last 7 days? ☐ Yes ☒ No

Air Temperature 62 °F

Other ____

**SITE LOCATION/MAP**

Draw a map of the site and indicate the areas sampled (or attach a photograph)




**STREAM CHARACTERIZATION**

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☒ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Non-glacial montane ☒ Mixture of origins
☐ Swamp and bog ☐ Other ____

Catchment Area ____ km²

# PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

**WATERSHED FEATURES**

Predominant Surrounding Landuse
☐ Forest ☐ Commercial
☒ Field/Pasture ☐ Industrial
☐ Agricultural ☐ Other _____
☐ Residential

Local Watershed — cattle
☐ No evidence ☒ Some potential sources
☐ Obvious sources

Local Watershed Erosion
☐ None ☒ Moderate ☐ Heavy

**RIPARIAN VEGETATION (18 meter buffer)**

Indicate the dominant type and record the dominant species present
☒ Trees ☐ Shrubs ☐ Grasses ☐ Herbaceous
dominant species present River Birch / Silver leaf maple

**INSTREAM FEATURES**

Estimated Reach Length 250 m

Estimated Stream Width 12m/14m

Sampling Reach Area _____ $m^2$

Area in $km^2$ ($m^2$x1000) _____ $km^2$

Estimated Stream Depth 0.10 – 1.25 m

Surface Velocity (at thalweg) _____ m/sec

Canopy Cover
☒ Partly open ☐ Partly shaded ☐ Shaded

High Water Mark 4 m

Proportion of Reach Represented by Stream Morphology Types
☒ Riffle 25 % ☒ Run 30 %
☒ Pool 45 %

Channelized ☐ Yes ☒ No

Dam Present ☐ Yes ☒ No

**LARGE WOODY DEBRIS**

LWD 10 $m^2$

Density of LWD _____ $m^2/km^2$ (LWD/reach area)

**AQUATIC VEGETATION**

Indicate the dominant type and record the dominant species present
☐ Rooted emergent ☒ Rooted submergent ☐ Rooted Floating ☐ Free floating
☐ Floating Algae ☒ Attached Algae — small ant

dominant species present _____

Portion of the reach with aquatic vegetation 21 %

**WATER QUALITY**

Temperature _____ °C

Specific Conductance _____

Dissolved Oxygen _____

pH _____

Turbidity _____

WQ Instrument Used _____

Water Odors
☒ Normal/None ☐ Sewage
☐ Petroleum ☐ Chemical
☐ Fishy ☐ Other _____

Water Surface Oils
☐ Slick ☐ Sheen ☐ Globs ☐ Flecks
☒ None ☐ Other _____

Turbidity (if not measured)
☐ Clear ☒ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other _____

**SEDIMENT/ SUBSTRATE**

Odors
☒ Normal ☐ Sewage ☐ Petroleum
☐ Chemical ☐ Anaerobic ☐ None
☐ Other _____

Oils
☒ Absent ☐ Slight ☐ Moderate ☐ Profuse

Deposits
☐ Sludge ☐ Sawdust ☐ Paper fiber ☐ Sand
☐ Relict shells ☐ Other _____

Looking at stones which are not deeply embedded, are the undersides black in color?
☐ Yes ☒ No

| INORGANIC SUBSTRATE COMPONENTS (should add up to 100%) | | | ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%) | | |
|---|---|---|---|---|---|
| Substrate Type | Diameter | % Composition in Sampling Reach | Substrate Type | Characteristic | % Composition in Sampling Area |
| Bedrock | | 10 | Detritus | Sticks, wood, coarse plant materials (CPOM) | — |
| Boulder | > 256 mm (10") | 10 | | | |
| Cobble | 64-256 mm (2.5" – 10") | 60 | Muck-Mud | Black, very fine organic (FPOM) | — |
| Gravel | 2-64 mm (0.1" – 2.5") | 15 | | | |
| Sand | 0.06 – 2mm (gritty) | 5 | Marl | Grey, shell fragments | — |
| Silt | 0.004-0.06 mm | | | | |
| Clay | <0.004 mm (slick) | | | | |

## HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

| | | |
|---|---|---|
| STREAM NAME White River | LOCATION White River @ Farm | |
| STATION # WR-2.5 RIVERMILE | STREAM CLASS | |
| LAT _____ LONG _____ | RIVER BASIN | |
| STORET # | AGENCY DNR | |
| INVESTIGATORS DMR / SEM | | |
| FORM COMPLETED BY DMR | DATE 7-May-12<br>TIME 10:15 AM PM | REASON FOR SURVEY UAA |

Parameters to be evaluated in sampling reach

| Habitat Parameter | Condition Category | | | |
|---|---|---|---|---|
| | Optimal | Suboptimal | Marginal | Poor |
| **1. Epifaunal Substrate/ Available Cover** | Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient). | 40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale). | 20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed. | Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking. |
| SCORE 18 | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **2. Embeddedness** | Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. | Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment. | Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment. | Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment. |
| SCORE 18 | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **3. Velocity/Depth Regime** | All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.) | Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes). | Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low). | Dominated by 1 velocity/ depth regime (usually slow-deep). |
| SCORE 19 | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **4. Sediment Deposition** | Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition. | Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools. | Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent. | Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition. |
| SCORE 15 | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **5. Channel Flow Status** | Water reaches base of both lower banks, and minimal amount of channel substrate is exposed. | Water fills >75% of the available channel; or <25% of channel substrate is exposed. | Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed. | Very little water in channel and mostly present as standing pools. |
| SCORE 17 15 | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |

## HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

| Habitat Parameter | Condition Category | | | |
|---|---|---|---|---|
| | Optimal | Suboptimal | Marginal | Poor |
| **6. Channel Alteration** | Channelization or dredging absent or minimal; stream with normal pattern. | Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present. | Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted. | Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely. |
| SCORE 17 | 20 19 18 (17) 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **7. Frequency of Riffles (or bends)** | Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important. | Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15. | Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25. | Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25. |
| SCORE 16 | 20 19 18 17 (16) | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **8. Bank Stability (score each bank)** Note: determine left or right side by facing downstream. | Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected. | Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. | Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods. | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars. |
| SCORE 3 (LB) | Left Bank 10 9 | 8 7 6 | 5 4 (3) | 2 1 0 |
| SCORE 4 (RB) | Right Bank 10 9 | 8 7 6 | 5 (4) 3 | 2 1 0 |
| **9. Vegetative Protection** (score each bank) | More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. | 70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. | 50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. | Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height. |
| SCORE 4 (LB) | Left Bank 10 9 | 8 7 6 | (5) (4) 3 | 2 1 0 |
| SCORE 5 (RB) | Right Bank 10 9 | 8 7 6 | (5) 4 3 | 2 1 0 |
| **10. Riparian Vegetative Zone Width** (score each bank riparian zone) | Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone. | Width of riparian zone 12-18 meters; human activities have impacted zone only minimally. | Width of riparian zone 6-12 meters; human activities have impacted zone a great deal. | Width of riparian zone <6 meters: little or no riparian vegetation due to human activities. |
| SCORE 3 (LB) | Left Bank 10 9 | 8 7 6 | 5 4 (3) | 2 1 0 |
| SCORE 2 (RB) | Right Bank 10 9 | 8 7 6 | 5 4 3 | (2) 1 0 |

**Total Score** _____

# PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
## (FRONT)

| | |
|---|---|
| STREAM NAME Richland Creek | LOCATION Richland Cr. @ Co. Rd 79 Ruda |
| STATION # RC-02 RIVERMILE ____ | STREAM CLASS |
| LAT ____ LONG ____ | RIVER BASIN |
| STORET # | AGENCY FTN |
| INVESTIGATORS DMR/SEM | |
| FORM COMPLETED BY DMR | DATE 7-May-12 TIME 11:45 AM PM |
| REASON FOR SURVEY YAA | |

**WEATHER CONDITIONS**

Now

- ☐ storm (heavy rain)
- ☐ rain (steady rain)
- ☐ showers (intermittent)
- 80 % ☒ %cloud cover
- ☐ clear/sunny

Past 24 Hours

- ☐
- ☐
- ☐
- ☐ ____ %
- ☒

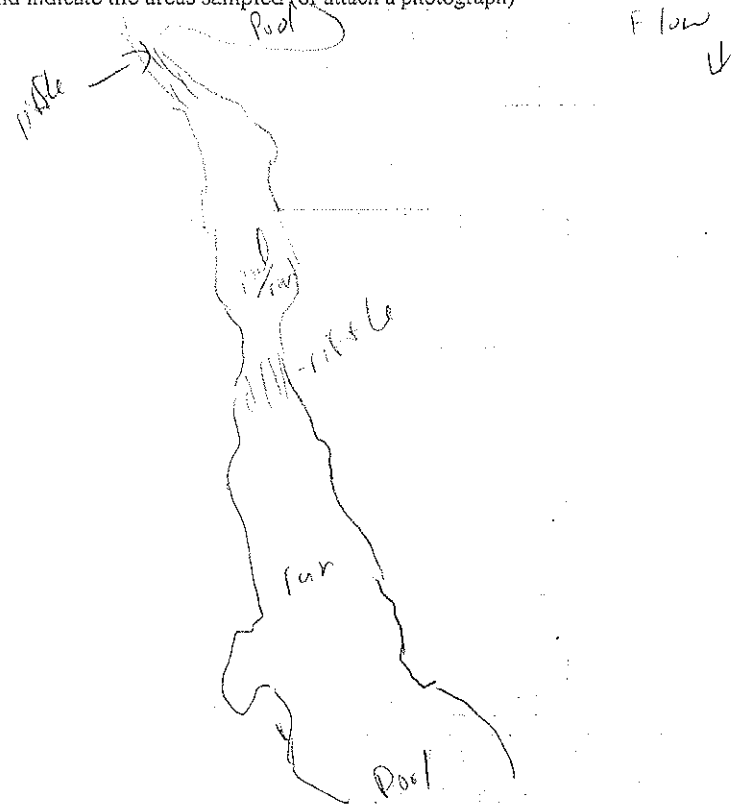
Has there been a heavy rain in the last 7 days? ☐ Yes ☒ No

Air Temperature 65 °C

Other ____

**SITE LOCATION/MAP**

Draw a map of the site and indicate the areas sampled (or attach a photograph)




**STREAM CHARACTERIZATION**

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☒ Non-glacial montane ☒ Mixture of origins
☐ Swamp and bog ☐ Other ____

Catchment Area ____ km²

# PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
## (BACK)

**WATERSHED FEATURES**

Predominant Surrounding Landuse
- ☐ Forest
- ☐ Commercial
- ☒ Field/Pasture
- ☐ Industrial
- ☐ Agricultural
- ☐ Other _____
- ☐ Residential

Local Watershed
- ☐ No evidence
- ☒ Some potential sources
- ☐ Obvious sources

Local Watershed Erosion
- ☐ None
- ☒ Moderate
- ☐ Heavy

**RIPARIAN VEGETATION (18 meter buffer)**

Indicate the dominant type and record the dominant species present
- ☒ Trees
- ☐ Shrubs
- ☐ Grasses
- ☐ Herbaceous

dominant species present Sycamore, Rim birch

**INSTREAM FEATURES**

Estimated Reach Length 250 m

Estimated Stream Width 6-10 m - varies

Sampling Reach Area _____ $m^2$

Area in $km^2$ ($m^2$x1000) _____ $km^2$

Estimated Stream Depth 0.25-0.75 m

Surface Velocity (at thalweg) _____ m/sec

Canopy Cover
- ☐ Partly open
- ☒ Partly shaded
- ☐ Shaded

High Water Mark 2 m

Proportion of Reach Represented by Stream Morphology Types
- ☒ Riffle 40 %
- ☒ Run 37 %
- ☒ Pool 30 %

Channelized ☐ Yes ☒ No

Dam Present ☐ Yes ☒ No

**LARGE WOODY DEBRIS**

LWD 5 $m^2$

Density of LWD _____ $m^2/km^2$ (LWD/reach area)

**AQUATIC VEGETATION**

Indicate the dominant type and record the dominant species present
- ☐ Rooted emergent
- ☐ Rooted submergent
- ☐ Rooted Floating
- ☐ Free floating
- ☐ Floating Algae
- ☒ Attached Algae –

dominant species present _____

Portion of the reach with aquatic vegetation < 1 %

**WATER QUALITY**

Temperature _____ °C

Specific Conductance _____

Dissolved Oxygen _____

pH _____

Turbidity _____

WQ Instrument Used _____

Water Odors
- ☐ Normal/None
- ☐ Sewage
- ☐ Petroleum
- ☐ Chemical
- ☐ Fishy
- ☐ Other _____

Water Surface Oils
- ☐ Slick
- ☐ Sheen
- ☐ Globs
- ☐ Flecks
- ☐ None
- ☐ Other _____

Turbidity (if not measured)
- ☐ Clear
- ☐ Slightly turbid
- ☐ Turbid
- ☐ Opaque
- ☐ Stained
- ☐ Other _____

**SEDIMENT/ SUBSTRATE**

Odors
- ☒ Normal
- ☐ Sewage
- ☐ Petroleum
- ☐ Chemical
- ☐ Anaerobic
- ☐ None
- ☐ Other _____

Oils
- ☒ Absent
- ☐ Slight
- ☐ Moderate
- ☐ Profuse

Deposits
- ☐ Sludge
- ☐ Sawdust
- ☐ Paper fiber
- ☐ Sand
- ☐ Relict shells
- ☐ Other _____

Looking at stones which are not deeply embedded, are the undersides black in color?
- ☐ Yes
- ☒ No

| INORGANIC SUBSTRATE COMPONENTS (should add up to 100%) | | | ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%) | | |
|---|---|---|---|---|---|
| Substrate Type | Diameter | % Composition in Sampling Reach | Substrate Type | Characteristic | % Composition in Sampling Area |
| Bedrock | | | Detritus | Sticks, wood, coarse plant materials (CPOM) | |
| Boulder | > 256 mm (10") | 10 | | | |
| Cobble | 64-256 mm (2.5" – 10") | 60 | Muck-Mud | Black, very fine organic (FPOM) | |
| Gravel | 2-64 mm (0.1" – 2.5") | 30 | | | |
| Sand | 0.06 – 2mm (gritty) | | Marl | Grey, shell fragments | |
| Silt | 0.004-0.06 mm | | | | |
| Clay | <0.004 mm (slick) | | | | |

## HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

| | | | |
|---|---|---|---|
| STREAM NAME Richland Creek | | LOCATION Richland Creek @ cnty. 79 bridge | |
| STATION # RC-02 | RIVERMILE | STREAM CLASS | |
| LAT | LONG | RIVER BASIN | |
| STORET # | | AGENCY FTN | |
| INVESTIGATORS DMR / SEar | | | |
| FORM COMPLETED BY DMR | DATE 7-May-12<br>TIME 1200 AM PM | REASON FOR SURVEY AMA | |

Parameters to be evaluated in sampling reach

| Habitat Parameter | Condition Category | | | |
|---|---|---|---|---|
| | Optimal | Suboptimal | Marginal | Poor |
| 1. Epifaunal Substrate/ Available Cover | Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient). | 40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale). | 20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed. | Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking. |
| SCORE 16 | 20 19 18 17 (16) | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| 2. Embeddedness | Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. | Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment. | Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment. | Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment. |
| SCORE 16 | 20 19 18 17 (16) | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| 3. Velocity/Depth Regime | All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.) | Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes). | Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low). | Dominated by 1 velocity/ depth regime (usually slow-deep). |
| SCORE 13 | 20 19 18 17 16 | 15 14 (13) 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| 4. Sediment Deposition | Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition. | Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools. | Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent. | Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition. |
| SCORE 16 | 20 19 18 17 (16) | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| 5. Channel Flow Status | Water reaches base of both lower banks, and minimal amount of channel substrate is exposed. | Water fills >75% of the available channel; or <25% of channel substrate is exposed. | Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed. | Very little water in channel and mostly present as standing pools. |
| SCORE 17 | 20 19 18 (17) 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |

## HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

| Habitat Parameter | Condition Category | | | |
|---|---|---|---|---|
| | **Optimal** | **Suboptimal** | **Marginal** | **Poor** |
| **6. Channel Alteration** | Channelization or dredging absent or minimal; stream with normal pattern. | Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present. | Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted. | Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely. |
| SCORE 14 | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **7. Frequency of Riffles (or bends)** | Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important. | Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15. | Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25. | Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25. |
| SCORE 11 | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **8. Bank Stability (score each bank)** Note: determine left or right side by facing downstream. | Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected. | Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. | Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods. | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars. |
| SCORE 7 (LB) | Left Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| SCORE 10 (RB) | Right Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| **9. Vegetative Protection** (score each bank) | More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. | 70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. | 50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. | Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height. |
| SCORE 5 (LB) | Left Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| SCORE 4 (RB) | Right Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| **10. Riparian Vegetative Zone Width** (score each bank riparian zone) | Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone. | Width of riparian zone 12-18 meters; human activities have impacted zone only minimally. | Width of riparian zone 6-12 meters; human activities have impacted zone a great deal. | Width of riparian zone <6 meters: little or no riparian vegetation due to human activities. |
| SCORE 9 (LB) | Left Bank 10 9 | 8 9 6 | 5 4 3 | 2 1 0 |
| SCORE 10 (RB) | Right Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |

**Total Score** _____

# PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (FRONT)

| | | |
|---|---|---|
| STREAM NAME RC of Richland Creek | LOCATION Richland Creek @ Hwy 45 Bridge | |
| STATION # RC-01 RIVERMILE ____ | STREAM CLASS | |
| LAT ____ LONG ____ | RIVER BASIN | |
| STORET # | AGENCY FTN | |
| INVESTIGATORS DMR/SEM | | |
| FORM COMPLETED BY DMR | DATE 7-May-12 TIME 1100 AM PM | REASON FOR SURVEY UAA |

**WEATHER CONDITIONS**

Now

- ☐ storm (heavy rain)
- ☐ rain (steady rain)
- ☐ showers (intermittent)
- 90 % ☒ %cloud cover
- ☐ clear/sunny

Past 24 Hours

- ☐
- ☐
- ☐
- ☐ ____ %
- ☒

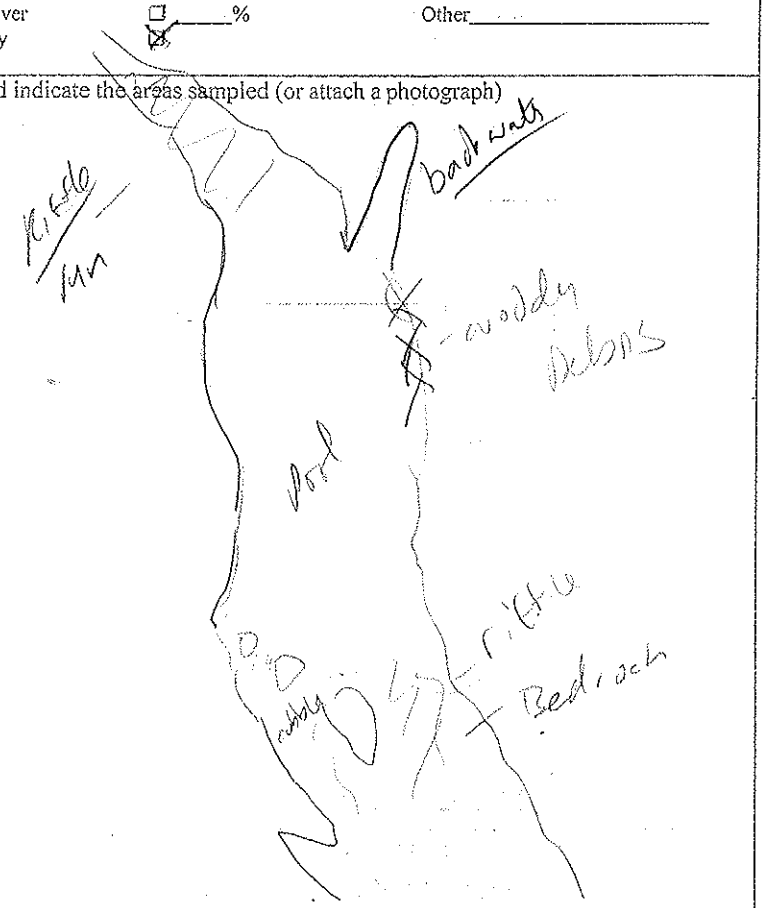
Has there been a heavy rain in the last 7 days? ☐ Yes ☒ No

Air Temperature 65 ☒ F ☐ C

Other ____

**SITE LOCATION/MAP**

Draw a map of the site and indicate the areas sampled (or attach a photograph)




**STREAM CHARACTERIZATION**

Stream Subsystem
☒ Perennial ☐ Intermittent ☐ Tidal

Stream Type
☐ Coldwater ☐ Warmwater

Stream Origin
☐ Glacial ☐ Spring-fed
☐ Non-glacial montane ☒ Mixture of origins
☐ Swamp and bog ☐ Other ____

Catchment Area ____ km²

# PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

**WATERSHED FEATURES**

Predominant Surrounding Landuse
- ☐ Forest
- ☒ Field/Pasture
- ☐ Agricultural
- ☐ Residential
- ☐ Commercial
- ☐ Industrial
- ☐ Other _____

Local Watershed
- ☐ No evidence
- ☒ Some potential sources
- ☐ Obvious sources

Local Watershed Erosion
- ☐ None
- ☒ Moderate
- ☐ Heavy

**RIPARIAN VEGETATION (18 meter buffer)**

Indicate the dominant type and record the dominant species present
- ☒ Trees
- ☒ Shrubs
- ☒ Grasses
- ☒ Herbaceous

dominant species present Silky willow, maple, cane, grasses

**INSTREAM FEATURES**

Estimated Reach Length 400 m

Estimated Stream Width ~~2 m~~ 15-20M

Sampling Reach Area _____ $m^2$

Area in $km^2$ ($m^2$x1000) _____ $km^2$

Estimated Stream Depth 0.1 – 0.8M

Surface Velocity (at thalweg) _____ m/sec

Canopy Cover
- ☐ Partly open
- ☒ Partly shaded
- ☐ Shaded

High Water Mark ~~1.2~~ m 2-3 m

Proportion of Reach Represented by Stream Morphology Types
- ☒ Riffle 25 %
- ☐ Run 20 %
- ☐ Pool 55 %

Channelized ☐ Yes ☒ No

Dam Present ☐ Yes ☒ No

**LARGE WOODY DEBRIS**

LWD 10 $m^2$

Density of LWD _____ $m^2/km^2$ (LWD/reach area)

**AQUATIC VEGETATION**

Indicate the dominant type and record the dominant species present
- ☐ Rooted emergent
- ☐ Rooted submergent
- ☐ Rooted Floating
- ☐ Free floating
- ☐ Floating Algae
- ☒ Attached Algae

dominant species present _____

Portion of the reach with aquatic vegetation 2 %

**WATER QUALITY**

Temperature _____ °C

Specific Conductance _____

Dissolved Oxygen _____

pH _____

Turbidity _____

WQ Instrument Used _____

Water Odors
- ☒ Normal/None
- ☐ Sewage
- ☐ Petroleum
- ☐ Chemical
- ☐ Fishy
- ☐ Other _____

Water Surface Oils
- ☐ Slick
- ☐ Sheen
- ☐ Globs
- ☐ Flecks
- ☒ None
- ☐ Other _____

Turbidity (if not measured)
- ☒ Clear
- ☐ Slightly turbid
- ☐ Turbid
- ☐ Opaque
- ☐ Stained
- ☐ Other

**SEDIMENT/ SUBSTRATE**

Odors
- ☒ Normal
- ☐ Sewage
- ☐ Petroleum
- ☐ Chemical
- ☐ Anaerobic
- ☐ None
- ☐ Other _____

Oils
- ☒ Absent
- ☐ Slight
- ☐ Moderate
- ☐ Profuse

Deposits
- ☐ Sludge
- ☐ Sawdust
- ☐ Paper fiber
- ☐ Sand
- ☐ Relict shells
- ☐ Other _____

Looking at stones which are not deeply embedded, are the undersides black in color?
- ☐ Yes
- ☒ No

| INORGANIC SUBSTRATE COMPONENTS (should add up to 100%) | | | ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%) | | |
|---|---|---|---|---|---|
| Substrate Type | Diameter | % Composition in Sampling Reach | Substrate Type | Characteristic | % Composition in Sampling Area |
| Bedrock | | 15 | Detritus | Sticks, wood, coarse plant materials (CPOM) | <5 |
| Boulder | > 256 mm (10") | <1 | | | |
| Cobble | 64-256 mm (2.5" – 10") | 20 | Muck-Mud | Black, very fine organic (FPOM) | — |
| Gravel | 2-64 mm (0.1" – 2.5") | 40 | | | |
| Sand | 0.06 – 2mm (gritty) | 10 | Marl | Grey, shell fragments | / |
| Silt | 0.004-0.06 mm | 14 | | | |
| Clay | <0.004 mm (slick) | | | | |

## HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

| | | |
|---|---|---|
| STREAM NAME Richland Creek | LOCATION Richland Cr. @ Hwy 45 bridge | |
| STATION # RC-1 RIVERMILE | STREAM CLASS | |
| LAT _____ LONG _____ | RIVER BASIN | |
| STORET # | AGENCY FTN | |
| INVESTIGATORS DMR/SRM | | |
| FORM COMPLETED BY DMR | DATE 2 May 12<br>TIME 1105 AM PM | REASON FOR SURVEY UAA |

Parameters to be evaluated in sampling reach

| Habitat Parameter | Condition Category | | | |
|---|---|---|---|---|
| | Optimal | Suboptimal | Marginal | Poor |
| **1. Epifaunal Substrate/ Available Cover** | Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient). | 40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale). | 20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed. | Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking. |
| SCORE 11 | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **2. Embeddedness** | Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space. | Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment. | Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment. | Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment. |
| SCORE 9 | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **3. Velocity/Depth Regime** | All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.) | Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes). | Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low). | Dominated by 1 velocity/ depth regime (usually slow-deep). |
| SCORE 14 | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **4. Sediment Deposition** | Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition. | Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools. DMR | Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent. | Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition. |
| SCORE 17 | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **5. Channel Flow Status** | Water reaches base of both lower banks, and minimal amount of channel substrate is exposed. | Water fills >75% of the available channel; or <25% of channel substrate is exposed. | Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed. | Very little water in channel and mostly present as standing pools. |
| SCORE 15 | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |

DMR

## HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

| Habitat Parameter | Condition Category | | | |
|---|---|---|---|---|
| | Optimal | Suboptimal | Marginal | Poor |
| **6. Channel Alteration** | Channelization or dredging absent or minimal; stream with normal pattern. | Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present. | Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted. | Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely. |
| SCORE 16 | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **7. Frequency of Riffles (or bends)** | Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important. | Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15. | Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25. | Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25. |
| SCORE 11 | 20 19 18 17 16 | 15 14 13 12 11 | 10 9 8 7 6 | 5 4 3 2 1 0 |
| **8. Bank Stability (score each bank)** Note: determine left or right side by facing downstream. | Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected. | Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion. | Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods. | Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars. |
| SCORE 7 (LB) | Left Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| SCORE 5 (RB) | Right Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| **9. Vegetative Protection** (score each bank) | More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally. | 70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining. | 50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining. | Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height. |
| SCORE 8 (LB) | Left Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| SCORE 4 (RB) | Right Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| **10. Riparian Vegetative Zone Width** (score each bank riparian zone) | Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone. | Width of riparian zone 12-18 meters; human activities have impacted zone only minimally. | Width of riparian zone 6-12 meters; human activities have impacted zone a great deal. | Width of riparian zone <6 meters: little or no riparian vegetation due to human activities. |
| SCORE 10 (LB) | Left Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |
| SCORE 4 (RB) | Right Bank 10 9 | 8 7 6 | 5 4 3 | 2 1 0 |

**Total Score** _____

WR-01 – Mid-reach, looking downstream

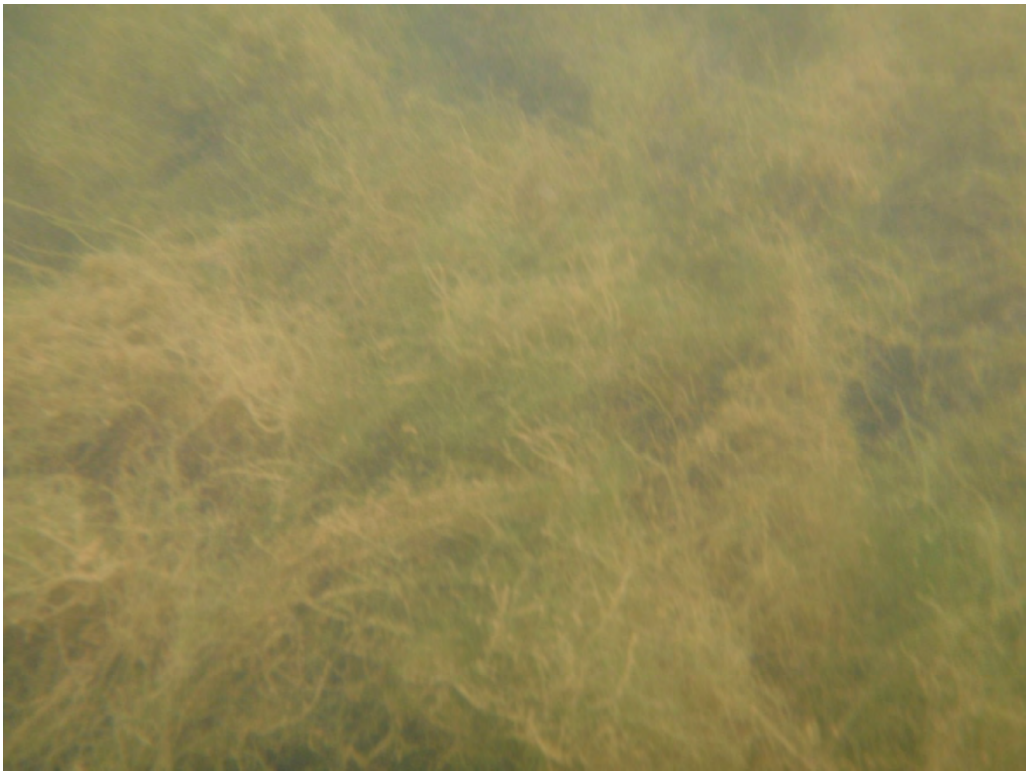
WR-01 – Mid-reach, looking upstream (riffle with open cobble substrate and lack of sand deposition)

WR-01 – Riffle (embeddedness and low flow)

WR-02 – Downstream block net; riffle/run habitat; relatively high flows

WR-02 – Upstream block net

WR-02 – Algal mats covering most of pool margins



WR-02 – Filamentous algae covering most of pool bottom

WR-2.5 – Upstream block net (shoreline free of sand deposition)

WR-2.5 – Mid-reach, looking downstream (lack of sand deposition)

WR-2.5 – Mid-reach, looking upstream

WR-2.5 – Downstream block net; algal mat on pool margin

WR-2.5 – Filamentous algae on pool bottom

RC-01 – Mid-reach, looking downstream

RC-01 – Mid-reach, looking upstream

RC-01 – Upstream end of reach

RC-01 – Upstream block net (sand deposition)

RC-01 – upstream portion of reach (sand deposition and braided channel)

RC-01 – Riffle with embedded cobble

RC-01 – Upstream portion of reach (sand deposition and embedded cobble)

RC-02 – Mid-reach looking upstream

RC-02 – Upstream block net

RC-02 – Downstream end of reach, looking upstream

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# Appendix C-5
# Benthic Macroinvertebrate Community Assessment – Summary Tables and Dataset

TABLE C-7

**Summary of Water Quality During Benthic Macroinvertebrate Community Assessments (Minerals Data)**

| | $Cl^-$ (mg/L) | | Sulfate (mg/L) | | TDS (mg/L) | |
|---|---|---|---|---|---|---|
| **Station ID** | **10/11/2011** | **3/7/2012** | **10/11/2011** | **3/7/2012** | **10/11/2011** | **3/7/2012** |
| RC-01 | 5.1 | 4.1 | 20.5 | 11.6 | 150 | 100 |
| RC-02 | 5.1 | 3.6 | 18.1 | 9.6 | 164 | 88 |
| WR-01 | 5.3 | 3.0 | 25.1 | 12.3 | 138 | 78 |
| WR-02 | 37.6 | 7.8 | 40.0 | 17.0 | 288 | 111 |
| WR-02.5 | 37.2 | 4.9 | 40.0 | 15.4 | 268 | 96 |

TABLE C-8

**Summary of Water Quality During Benthic Macroinvertebrate Community Assessments (In Situ Data)**

| | pH (SU) | | Temperature (˚C) | | Conductivity (µS/cm) | | DO (mg/L) | | Turbidity (NTU) | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Station ID** | **10/11/2011** | **3/7/2012** | **10/11/2011** | **3/7/2012** | **10/11/2011** | **3/7/2012** | **10/11/2011** | **3/7/2012** | **10/11/2011** | **3/7/2012** |
| RC-01 | 8.07 | 8.61 | 20.2 | 15.4 | 252 | 156 | 8.55 | 10.62 | 3.25 | 2.08 |
| RC-02 | 7.66 | 8.03 | 18.70 | 14.00 | 270 | 130 | 6.82 | 9.95 | 3.15 | 2.18 |
| WR-01 | 7.57 | 7.91 | 19.5 | 14.7 | 227 | 119 | 5.71 | 9.56 | 3.56 | 13.9 |
| WR-02 | 7.73 | 7.98 | 21.2 | 14.3 | 477 | 169 | 6.72 | 10.28 | 4.09 | 11.1 |
| WR-02.5 | 8.16 | 7.78 | 20.6 | 14 | 456 | 148 | 8.15 | 9.69 | 5.89 | 16.9 |

TABLE C-9

**Suggested Interpretation of Family and Hilsenhoff Biotic Indices**

| Hilsenhoff Biotic Index [a] | Family Biotic Index [b] | Water Quality | Degree of Organic Pollution |
|---|---|---|---|
| 0.00-3.50 | 0.00-3.75 | Excellent | Organic pollution unlikely |
| 3.51-4.50 | 3.76-4.25 | Very good | Possible slight organic pollution |
| 4.51-5.50 | 4.26-5.00 | Good | Some organic pollution probable |
| 5.51-6.50 | 5.01-5.75 | Fair | Fairly substantial pollution likely |
| 6.51-7.50 | 5.76-6.50 | Fairly poor | Substantial pollution likely |
| 7.51-8.50 | 6.51-7.25 | Poor | Very substantial pollution likely |
| 8.51-10.00 | 7.26-10.00 | Very poor | Severe organic pollution likely |

[a] Source: Hilsenhoff (1987)

[b] Source: Hilsenhoff (1988)

TABLE C-10

**Summary of Benthic Macroinvertebrate Community Sampled October 2011**

| Taxon | WR-01 | | WR-2 | | WR-2.5 | | RC-01 | | RC-02 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | % of Taxa | % of Individuals | % of Taxa | % of Individuals | % of Taxa | % of Individuals | % of Taxa | % of Individuals | % of Taxa | % of Individuals |
| Ephemeroptera (mayflies) | 16.3 | 31.2 | 16.7 | 34.7 | 20.0 | 45.8 | 14.3 | 15.6 | 33.3 | 79.9 |
| Plecoptera (stoneflies) | 0.0 | 0.0 | 0.0 | 0.0 | 4.0 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 |
| Trichoptera (caddisflies) | 11.6 | 7.4 | 4.2 | 3.0 | 16.0 | 25.5 | 14.3 | 41.6 | 0.0 | 0.0 |
| Coleoptera (beetles) | 9.3 | 10.4 | 25.0 | 26.7 | 4.0 | 5.7 | 2.9 | 1.2 | 5.6 | 1.4 |
| Odonata (dragonflies and damselflies) | 2.3 | 1.5 | 4.2 | 0.5 | 4.0 | 5.7 | 8.6 | 2.3 | 8.3 | 1.4 |
| Megaloptera (fishflies, dobsonflies, and alderflies) | 2.3 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.8 | 0.5 |
| Diptera (true flies), excluding Chironomidae | 7.0 | 2.5 | 4.2 | 0.5 | 0.0 | 0.0 | 2.9 | 0.6 | 0.0 | 0.0 |
| Chironomidae (non-biting or true midges) | 27.9 | 25.7 | 25.0 | 21.8 | 36.0 | 10.8 | 42.9 | 26.6 | 41.7 | 15.3 |
| Oligochaeta (aquatic worms) | 9.3 | 9.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.8 | 0.5 |
| Crustacea (shrimp, crabs, water fleas, sow bugs) | 2.3 | 1.5 | 4.2 | 2.0 | 8.0 | 1.4 | 2.9 | 0.6 | 0.0 | 0.0 |
| Mollusca (snails, clams, mussels) | 9.3 | 7.9 | 12.5 | 10.4 | 8.0 | 4.7 | 11.4 | 11.6 | 5.6 | 1.0 |
| Arachnoidea (water mites) | 2.3 | 1.5 | 4.2 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

TABLE C-11

**Summary of Benthic Macroinvertebrate Community Sampled March 2012**

| Taxon | WR-01 | | WR-2 | | WR-2.5 | | RC-01 | | RC-02 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | % of Taxa | % of Individuals | % of Taxa | % of Individuals | % of Taxa | % of Individuals | % of Taxa | % of Individuals | % of Taxa | % of Individuals |
| Ephemeroptera (mayflies) | 16.7 | 10.1 | 15.8 | 4.8 | 15.4 | 17.3 | 32.0 | 20.4 | 27.3 | 26.1 |
| Plecoptera (stoneflies) | 10.0 | 2.0 | 10.5 | 2.2 | 7.7 | 2.0 | 16.0 | 3.3 | 12.1 | 14.2 |
| Trichoptera (caddisflies) | 3.3 | 1.5 | 5.3 | 1.7 | 7.7 | 2.6 | 4.0 | 0.5 | 6.1 | 1.1 |
| Coleoptera (beetles) | 6.7 | 12.6 | 5.3 | 0.4 | 11.5 | 5.1 | 0.0 | 0.0 | 3.0 | 1.1 |
| Odonata (dragonflies and damselflies) | 3.3 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Megaloptera (fishflies, dobsonflies, and alderflies) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Diptera (true flies), excluding Chironomidae | 16.7 | 15.6 | 5.3 | 12.7 | 3.8 | 5.1 | 12.0 | 1.9 | 12.1 | 3.4 |
| Chironomidae (non-biting or true midges) | 36.7 | 52.8 | 47.4 | 76.9 | 38.5 | 64.8 | 28.0 | 73.0 | 33.3 | 50.0 |
| Oligochaeta (aquatic worms) | 0.0 | 0.0 | 5.3 | 0.4 | 0.0 | 0.0 | 4.0 | 0.5 | 0.0 | 0.0 |
| Crustacea (shrimp, crabs, water fleas, sow bugs) | 3.3 | 0.5 | 5.3 | 0.9 | 3.8 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 |
| Mollusca (snails, clams, mussels) | 3.3 | 4.5 | 0.0 | 0.0 | 7.7 | 2.0 | 4.0 | 0.5 | 3.0 | 3.4 |
| Heteroptera (true bugs) | 0.0 | 0.0 | 0.0 | 0.0 | 3.8 | 0.5 | 0.0 | 0.0 | 3.0 | 0.6 |

TABLE C-12

**Summary of Benthic Macroinvertebrate Community Metrics – Fall 2011**

| Metric | WR-01 | WR-02 | WR-2.5 | RC-01 | RC-02 |
|---|---|---|---|---|---|
| Number of Organisms | 202 | 202 | 212 | 173 | 209 |
| Number of Taxa | 43 | 24 | 25 | 35 | 36 |
| Hilsenhoff Biotic Index [a] | 6.76 (Fairly Poor) | 6.69 (Fairly Poor) | 5.58 (Fair) | 5.63 (Fair) | 5.75 (Fair) |
| Family Biotic index | 6.24 (Fairly Poor) | 5.68 (Fair) | 5.08 (Fair) | 4.81 (Good) | 5.51 (Fair) |
| EPT Taxa | 12 | 5 | 10 | 10 | 12 |
| Predator Taxa | 9 | 3 | 3 | 4 | 6 |
| Filterer Taxa | 3 | 1 | 5 | 5 | 2 |
| Scraper Taxa | 4 | 4 | 3 | 3 | 5 |
| Shredder Taxa | 4 | 4 | 2 | 6 | 4 |
| Clinger Taxa | 9 | 6 | 9 | 6 | 7 |
| Intolerant Taxa (<=3) | 5 | 1 | 2 | 2 | 4 |
| Tolerant Taxa (>=7) | 10 | 9 | 5 | 12 | 8 |
| % EPT | 39% | 38% | 72% | 57% | 80% |
| % Predator | 7% | 4% | 7% | 3% | 3% |
| % Filterer | 5% | 7% | 6% | 39% | 2% |
| % Scraper | 10% | 22% | 27% | 8% | 37% |
| % Shredder | 9% | 3% | 1% | 8% | 3% |
| % Clinger | 15% | 27% | 59% | 50% | 23% |
| % Intolerant | 6% | 2% | 2% | 21% | 2% |
| % Tolerant | 40% | 32% | 12% | 17% | 45% |
| Percent dominant Taxon | 16% | 28% | 24% | 19% | 37% |

EPT = Ephemoptera + Plecoptera + Trichoptera

[a] With regional modification, as allowed by Hilsenhoff (1987)

TABLE C-13

**Summary of Benthic Macroinvertebrate Community Metrics – Spring 2012**

| Metric | WR-01 | WR-02 | WR-2.5 | RC-01 | RC-02 |
|---|---|---|---|---|---|
| Number of Organisms | 199 | 229 | 196 | 211 | 176 |
| Number of Taxa | 30 | 19 | 26 | 25 | 33 |
| Hilsenhoff Biotic Index [a] | 5.98 (Fair) | 7.00 (Fairly Poor) | 6.42 (Fair) | 6.96 (Fairly Poor) | 5.82 (Fair) |
| Family Biotic index | 5.93 (Fairly Poor) | 5.97 (Fairly Poor) | 5.73 (Fair) | 5.79 (Fairly Poor) | 5.20 (Fair) |
| EPT Taxa | 9 | 6 | 8 | 13 | 15 |
| Predator Taxa | 5 | 2 | 2 | 3 | 4 |
| Filterer Taxa | 5 | 3 | 4 | 2 | 2 |
| Scraper Taxa | 5 | 1 | 5 | 4 | 5 |
| Shredder Taxa | 3 | 2 | 3 | 3 | 4 |
| Clinger Taxa | 9 | 6 | 8 | 5 | 14 |
| Intolerant Taxa (T.V. <=3) | 7 | 1 | 2 | 3 | 6 |
| Tolerant Taxa (T.V. >=7) | 5 | 5 | 6 | 6 | 7 |
| % EPT | 14% | 9% | 22% | 24% | 42% |
| % Predator | 6% | 2% | 3% | 2% | 9% |
| % Filterer | 22% | 14% | 10% | 1% | 2% |
| % Scraper | 14% | 3% | 9% | 4% | 19% |
| % Shredder | 9% | 7% | 17% | 3% | 12% |
| % Clinger | 32% | 20% | 17.4% | 4% | 19% |
| % Intolerant | 5% | 1% | 1% | 2% | 12% |
| % Tolerant Individuals | 23% | 64% | 30% | 66% | 40% |
| Percent dominant Taxon | 19% | 60% | 21% | 54% | 32% |

EPT = Ephemoptera + Plecoptera + Trichoptera

[a] With regional modification, as allowed by Hilsenhoff (1987)

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| SPECIES | WR-01 | WR-01-dup | WR-02 | WR-2.5 | RC-01 | RC-02 |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| **MOLLUSCA** | | | | | | |
| **Bivalvia** | | | | | | |
| **Veneroida** | | | | | | |
| Corbiculidae | | | | | | |
| *Corbicula fluminea* | 8 | 7 | 15 | 4 | 13 | |
| **Gastropoda** | | | | | | |
| **Mesogastropoda** | | | | | | |
| Pleuroceridae | | | | | | |
| *Elimia sp.* | | | | | | 1 |
| **Basommatophora** | | | | | | |
| Ancylidae | | | | | | |
| *Ferrissia sp.* | 1 | 4 | | | 1 | |
| Physidae | | | | | | |
| *Physella sp.* | 3 | | 3 | 6 | 1 | |
| Planorbidae | | | | | | |
| *Menetus dilatatus* | 4 | 3 | 3 | | 5 | 1 |
| **ANNELIDA** | | | | | | |
| **Oligochaeta** | | | | | | |
| **Tubificida** | | | | | | |
| Naididae | 14 | 1 | | | | |
| *Dero sp.* | 2 | | | | | |
| *Nais sp.* | 3 | | | | | 1 |
| Tubificidae w.h.c. | | | | | | |
| *Aulodrilus pigueti* | 1 | | | | | |
| **ARTHROPODA** | | | | | | |
| **Arachnoidea** | | | | | | |
| **Acariformes** | | | | | | |
| Lebertiidae | | | | | | |
| *Lebertia sp.* | 3 | | | | | |
| Pionidae | | | | | | |
| *Piona sp.* | | | 1 | | | |
| **Crustacea** | | | | | | |
| **Cladocera** | | | | | | |
| Chydoridae | | | | 2 | | |
| **Cyclopoida** | | | | 1 | | |
| **Ostracoda** | 3 | 1 | 4 | | 1 | |
| **Amphipoda** | | | | | | |
| Hyalellidae | | | | | | |
| *Hyalella azteca* | | 3 | | | | |
| **Decapoda** | | | | | | |
| Cambaridae | | | | | | |
| *Orconectes sp.* | | 1 | | | | |
| **Insecta** | | | | | | |
| **Ephemeroptera** | | | | | | |
| Baetidae | | 1 | | | 4 | |
| *Baetis intercalaris* | | 2 | 1 | 4 | | 2 |
| *Baetis sp.* | | | | | | 2 |
| *Diphetor hageni* | 1 | | | | | |
| *Plauditus sp.* | | | | | | 1 |
| Caenidae | | | | | | |
| *Brachycercus sp.* | 1 | 1 | | | | |
| *Caenis sp.* | 25 | 18 | 11 | 7 | 6 | 77 |

| SPECIES | WR-01 | WR-01-dup | WR-02 | WR-2.5 | RC-01 | RC-02 |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| Ephemeridae | | | | | | |
| *Hexagenia sp.* | | | | | 3 | 1 |
| Heptageniidae | | | 2 | | 11 | 34 |
| *Maccaffertium (Stenonema) sp.* | | 4 | | 40 | | 4 |
| *Stenonema femoratum* | 2 | 10 | | | | 37 |
| Isonychiidae | | | | | | |
| *Isonychia sp.* | 1 | | | 2 | 3 | 1 |
| Leptophlebiidae | 1 | 1 | | | | 2 |
| Potamanthidae | | | | | | |
| *Anthopotamus (Potamanthus) sp.* | | | | | | 1 |
| Tricorythidae | | | | | | |
| *Tricorythodes sp.* | 32 | 41 | 56 | 44 | | 5 |
| **Odonata** | | | | | | |
| Coenagrionidae | | 2 | | | 1 | 1 |
| *Argia sp.* | 3 | 4 | 1 | 12 | | 1 |
| *Enallagma sp.* | | | | | 2 | 1 |
| Gomphidae | | 1 | | | | |
| *Gomphus sp.* | | 1 | | | | |
| *Stylogomphus albistylus* | | 1 | | | | |
| Macromiinae | | | | | 1 | |
| **Plecoptera** | | | | | | |
| Perlidae | | | | | | |
| *Acroneuria sp.* | | 1 | | 1 | | |
| *Neoperla sp.* | | 1 | | | | |
| **Megaloptera** | | | | | | |
| Corydalidae | | | | | | |
| *Corydalus cornutus* | 1 | 4 | | | | 1 |
| **Trichoptera** | | | | | | |
| Hydropsychidae | | | | | 4 | |
| *Cheumatopsyche sp.* | 3 | 1 | 6 | 51 | 33 | |
| *Hydropsyche sp.* | | 1 | | 1 | | |
| Hydroptilidae | 4 | | | 1 | 1 | |
| *Hydroptila sp.* | | 2 | | | | |
| Leptoceridae | | 1 | | | 1 | |
| *Ceraclea sp.* | 2 | | | | | |
| *Nectopsyche sp.* | 5 | 2 | | | | |
| *Oecetis sp.* | 1 | 3 | | | | |
| Philopotamidae | | | | | | |
| *Chimarra sp.* | | 5 | | 1 | 33 | |
| **Coleoptera** | | | | | | |
| Elmidae | | | | | | |
| *Ancyronyx variegata* | | | 1 | | | |
| *Dubiraphia sp.* | 1 | 1 | 7 | | 2 | 1 |
| *Microcylloepus pusillus* | 4 | 4 | | | | |
| *Stenelmis sp.* | 14 | 20 | 36 | 12 | | |
| Hydrophilidae | | | | | | |
| *Berosus sp.* | 2 | 3 | 6 | | | |
| Haliplidae | | | | | | |
| *Peltodytes sp.* | | | 1 | | | |
| Psephenidae | | | | | | |
| *Psephenus herricki* | | | 3 | | | 2 |
| **Diptera** | | | | | | |

| SPECIES | WR-01 | WR-01-dup | WR-02 | WR-2.5 | RC-01 | RC-02 |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| Ceratopogonidae | 1 | | | | 1 | |
| *Dasyhelea sp.* | 3 | | 1 | | | |
| Chironomidae | | | | | | |
| Chironominae | | | | 1 | | |
| *Ablabesmyia mallochi* | 3 | 1 | | | 1 | |
| *Ablabesmyia sp.* | | 1 | | | | 1 |
| *Chironomus sp.* | | | 1 | | | |
| *Cladotanytarsus sp.* | | | | | 1 | |
| *Conchapelopia sp.* | | | | | | 1 |
| *Cricotopus absurdus* | | | | | | 3 |
| *Cricotopus sp.* | 1 | | 1 | 1 | 2 | |
| *Cricotopus bicinctus* | | | 2 | | | 1 |
| *Cryptochironomus sp.* | 1 | | | 1 | 1 | |
| *Dicrotendipes neomodestus* | 28 | 5 | 36 | 10 | 3 | 8 |
| *Dicrotendipes simpsoni* | | | | | 2 | |
| *Dicrotendipes sp.* | | | | | | 1 |
| *Endochironomus nigricans* | | | | | 1 | |
| *Glyptotendipes sp.* | | | | | 5 | |
| *Lipinella sp.* | | | | | 5 | |
| *Microtendipes pedellus gp.* | | | | | | 1 |
| *Nanocladius alternantherae* | | 1 | | | | |
| *Orthocladius sp.* | 1 | | | 2 | | |
| *Parakiefferiella sp.* | | | | | 1 | 2 |
| *Parametriocnemus sp.* | | 1 | | | | |
| *Paratanytarsus sp.* | | | | | | 2 |
| *Polypedilum flavum (convictum)* | 10 | 12 | | 1 | 4 | |
| *Polypedilum halterale gp.* | | | | | 1 | 1 |
| *Polypedilum illinoense* | 2 | | 2 | | 5 | 2 |
| *Polypedilum sp.* | | | | | 1 | |
| *Procladius sp.* | | 1 | | | | |
| *Pseudochironomus sp.* | 1 | 1 | 2 | | | 2 |
| *Rheotanytarsus sp.* | | | | 1 | | |
| *Rheotanytarsus exiguus gp.* | | | | 5 | 13 | |
| *Tanytarsus sp.* | 2 | | | | | 4 |
| *Tanypus sp.* | 1 | | | | | |
| *Thienemanniella lobapodema* | 1 | | | 1 | | |
| *Thienemannimyia gp.* | 1 | | | | | 1 |
| *Tribelos fusicorne* | | | | | | 2 |
| Simuliidae | | | | | | |
| *Simulium sp.* | 1 | 2 | | | | |
| Tabanidae | | | | | | |
| *Tabanus sp.* | | 1 | | | | |

| SPECIES | T.V. | F.F.G. | Habit | WR-01 | WR-02 | WR-2.5 | RC-01 |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| **MOLLUSCA** | | | | | | | |
| **Bivalvia** | | | | | | | |
| **Veneroida** | | | | | | | |
| Corbiculidae | | | | | | | |
| *Corbicula fluminea* | **6.3** | **Filterer** | | 9 | | 3 | |
| **Gastropoda** | | | | | | | |
| **Veneroida** | | | | | | | |
| Sphaeriidae | | **Filterer** | | | | | |
| **Basommatophora** | | | | | | | |
| Physidae | **8** | **Scraper** | | | | | |
| *Physella sp.* | **8** | **Scraper** | | | | 1 | 1 |
| **ANNELIDA** | | | | | | | |
| **Oligochaeta** | | | | | | | |
| **Tubificida** | | | | | | | |
| Lumbricidae | **9** | **Collector** | | | 1 | | |
| Naididae | **10** | **Collector** | | | | | |
| *Nais sp.* | | | | | | | 1 |
| Tubificidae w.o.h.c. | **10** | **Collector** | | | | | |
| *Limnodrilus hoffmeisteri* | **10** | **Collector** | | | | | |
| **Lumbriculida** | | | | | | | |
| Lumbriculidae | **4** | **Collector** | | | | | |
| **ARTHROPODA** | | | | | | | |
| **Crustacea** | | | | | | | |
| **Isopoda** | | | | | | | |
| Asellidae | | | | | | | |
| *Lirceus sp.* | **7.7** | **Collector** | | 1 | | | |
| **Amphipoda** | | | | | | | |
| Hyalellidae | | | | | | | |
| *Hyalella azteca* | **7.9** | **Collector** | | | 2 | | |
| **Decapoda** | | | | | | | |
| Cambaridae | **6** | **Collector** | | | | | |
| *Orconectes sp.* | **2.7** | **Collector** | | | | 1 | |
| **Insecta** | | | | | | | |
| **Ephemeroptera** | **4** | **Collector** | | | | | |
| Ameletidae | **2.1** | **Collector** | | | | | |
| *Ameletus sp.* | **2.1** | **Collector** | **Swimmer** | | | | 1 |
| Baetidae | **4** | **Collector** | | | | 1 | 13 |
| *Acentrella sp.* | **4** | **Collector** | **Swimmer** | 1 | | | |
| *Acerpenna sp.* | **4** | **Shredder** | **Swimmer** | | | | |
| *Plauditus sp.* | | | | | | | |
| Caenidae | **7** | **Collector** | | | | | |
| *Caenis sp.* | **7.6** | **Collector** | **Sprawler** | 8 | 2 | 3 | 19 |
| Heptageniidae | **4** | **Scraper** | | 1 | | | 2 |
| *Leucrocuta sp.* | **1** | **Scraper** | **Clinger** | | | | |
| *Maccaffertium (Stenonema) sp.* | **3.3** | **Scraper** | **Clinger** | | | | 1 |
| *Maccaffertium (Stenonema) mediopuncta* | **3.3** | **Scraper** | **Clinger** | | | | |
| *Stenonema femoratum* | **3.3** | **Scraper** | **Clinger** | 1 | 7 | 7 | 4 |
| Isonychiidae | | | | | | | |
| *Isonychia sp.* | **2** | **Collector** | **Swimmer** | | | | 2 |
| Leptophlebiidae | | **Collector** | | | | | |

| SPECIES | T.V. | F.F.G. | Habit | WR-01 | WR-02 | WR-2.5 | RC-01 |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| Tricorythidae | | **Collector** | | | | | |
| *Tricorythodes sp.* | **5.4** | **Collector** | **Sprawler** | 9 | 2 | 23 | 1 |
| **Odonata** | | | | | | | |
| Coenagrionidae | **9** | **Predator** | | | | | |
| *Argia sp.* | **5.1** | **Predator** | **Clinger** | 1 | | | |
| *Enallagma sp.* | **9** | **Predator** | **Climber** | | | | |
| Gomphidae | **1** | **Predator** | | | | | |
| *Lanthus sp.* | **6** | | **Burrower** | | | | |
| **Plecoptera** | | | | | | | |
| Chloroperlidae | | **Predator** | | | | | |
| Nemouridae | | **Shredder** | | | | | |
| *Amphinemura sp.* | **3.4** | **Shredder** | **Sprawler** | | | | 3 |
| *Shipsa rotunda* | | | **Sprawler** | | | | 1 |
| Perlidae | **1** | **Predator** | | | | | |
| *Neoperla sp.* | **1.6** | **Predator** | **Clinger** | 1 | | | |
| *Perlesta sp.* | | | | | | 3 | 2 |
| Perlodidae | **2** | **Predator** | | | | | |
| *Clioperla clio* | **4.8** | | **Clinger** | | | | |
| *Cultus sp.* | **1** | **Predator** | **Clinger** | | | | |
| *Hydroperla sp.* | | | | 1 | 2 | | |
| *Isoperla sp.* | **2** | **Predator** | **Clinger** | 2 | 3 | 1 | 1 |
| Taeniopterygidae | | | | | | | |
| *Strophopteryx sp.* | **2.5** | **Shredder** | **Sprawler** | | | | |
| **Heteroptera** | | | | | | | |
| Veliidae | | | | | | | |
| Microveliinae | | | | | | 1 | |
| *Microvelia sp.* | **6** | **Predator** | **Skater** | | | | |
| **Megaloptera** | | | | | | | |
| Corydalidae | | **Predator** | | | | | |
| *Corydalus cornutus* | **5.6** | **Predator** | **Clinger** | | | | |
| **Trichoptera** | | | | | | | |
| Helicopsychidae | | **Scraper** | | | | | |
| *Helicopsyche borealis* | **3** | **Scraper** | **Clinger** | | | | |
| Hydropsychidae | **4** | **Filterer** | | | | | |
| *Cheumatopsyche sp.* | **6.6** | **Collector** | **Clinger** | 3 | 4 | 4 | 1 |
| Hydroptilidae | **4** | | | | | | |
| *Hydroptila sp.* | **6.2** | **Scraper** | **Clinger** | | | 1 | |
| Philopotamidae | **3** | **Filterer** | | | | | |
| *Chimarra sp.* | **2.8** | **Filterer** | **Clinger** | | | | |
| **Coleoptera** | | | | | | | |
| Elmidae | **5** | **Collector** | | | | | |
| *Dubiraphia sp.* | **6.4** | **Collector** | **Clinger** | | 1 | 1 | |
| *Dubiraphia vittata* | **6.4** | **Collector** | | | | 1 | |
| *Stenelmis sp.* | **5.4** | **Scraper** | **Clinger** | 24 | | 8 | |
| Psephenidae | | **Scraper** | | | | | |
| *Psephenus herricki* | **2** | **Scraper** | **Clinger** | 1 | | | |
| **Diptera** | | | | | | | |
| Ceratopogonidae | **5.7** | **Predator** | **Sprawler** | | | | |
| Chironomidae | **6** | **Collector** | | | | | |
| *Cladotanytarsus sp.* | **7** | **Collector** | | | | | |

| SPECIES | T.V. | F.F.G. | Habit | WR-01 | WR-02 | WR-2.5 | RC-01 |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| *Conchapelopia sp.* | **6** | **Predator** | **Sprawler** | 4 | 1 | 4 | |
| *Cricotopus sp.* | **7** | **Shredder** | | | | 13 | 1 |
| *Cryptochironomus sp.* | **8** | **Predator** | | | | | 2 |
| *Diamesa sp.* | **5** | **Collector** | **Sprawler** | | | | 6 |
| *Dicrotendipes neomodestus* | **10** | **Collector** | **Burrower** | | 4 | 19 | |
| *Eukiefferiella brevicalcar* | **8** | **Collector** | **Sprawler** | 32 | 138 | 21 | 114 |
| *Hydrobaenus sp.* | **8** | **Scraper** | **Sprawler** | 1 | | 1 | |
| *Microtendipes pedellus gp.* | **6** | **Filterer** | **Clinger** | | | | |
| *Nanocladius distinctus* | **3** | **Collector** | **Sprawler** | 2 | | | |
| *Nilothauma sp.* | **2** | | | 1 | | | |
| *Orthocladius sp.* | **6** | **Collector** | **Sprawler** | 37 | 12 | 41 | 28 |
| *Orthocladius (Euorthocladius) sp.* | **6** | **Collector** | **Sprawler** | | 1 | | |
| *Parakiefferiella sp.* | **4** | **Collector** | **Sprawler** | 1 | | | |
| *Polypedilum aviceps* | **6** | **Shredder** | **Climber** | 2 | | | |
| *Polypedilum flavum (convictum)* | **6** | **Shredder** | **Climber** | 15 | 16 | 13 | 2 |
| *Polypedilum illinoense* | **6** | **Shredder** | **Climber** | | 1 | 8 | |
| *Pseudochironomus sp.* | | **Collector** | | | | | |
| *Rheotanytarsus exiguus gp.* | **6** | **Filterer** | **Clinger** | 7 | 1 | 2 | |
| *Sympotthastia sp.* | **2** | **Collector** | **Sprawler** | | | | |
| *Tanytarsus sp.* | **6** | **Filterer** | **Climber** | 3 | 2 | 5 | 1 |
| Empididae | **8.1** | **Predator** | **Sprawler** | | | | |
| *Hemerodromia sp.* | **6** | **Predator** | **Sprawler** | | | | |
| *Roederiodes sp.* | | | | 2 | | | 1 |
| Simuliidae | **7** | **Filterer** | | | | | |
| *Prosimulium sp.* | **2.6** | **Filterer** | **Climber** | 1 | | | |
| *Simulium sp.* | **4.4** | **Filterer** | **Clinger** | 24 | 29 | 10 | 1 |
| Tabanidae | **8** | **Predator** | | | | | |
| *Tabanus sp.* | **9.7** | **Predator** | **Sprawler** | 3 | | | 2 |
| Tanyderidae | | | | | | | |
| *Protoplasa fitchii* | | **Collector** | | | | | |
| Tipulidae | **3** | **Shredder** | | 1 | | | |
| *Hexatoma sp.* | **4.7** | **Predator** | **Burrower** | | | | |

| SPECIES | T.V. | F.F.G. | Habit | RC-01 Dup | RC-02 |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| **MOLLUSCA** | | | | | |
| **Bivalvia** | | | | | |
| **Veneroida** | | | | | |
| Corbiculidae | | | | | |
| *Corbicula fluminea* | **6.3** | **Filterer** | | | |
| **Gastropoda** | | | | | |
| **Veneroida** | | | | | |
| Sphaeriidae | | **Filterer** | | 1 | |
| **Basommatophora** | | | | | |
| Physidae | **8** | **Scraper** | | | |
| *Physella sp.* | **8** | **Scraper** | | 2 | 6 |
| **ANNELIDA** | | | | | |
| **Oligochaeta** | | | | | |
| **Tubificida** | | | | | |
| Lumbricidae | **9** | **Collector** | | 4 | |
| Naididae | **10** | **Collector** | | | |
| *Nais sp.* | | | | | |
| Tubificidae w.o.h.c. | **10** | **Collector** | | 1 | |
| *Limnodrilus hoffmeisteri* | **10** | **Collector** | | 3 | |
| **Lumbriculida** | | | | | |
| Lumbriculidae | **4** | **Collector** | | 2 | |
| **ARTHROPODA** | | | | | |
| **Crustacea** | | | | | |
| **Isopoda** | | | | | |
| Asellidae | | | | | |
| *Lirceus sp.* | **7.7** | **Collector** | | | |
| **Amphipoda** | | | | | |
| Hyalellidae | | | | | |
| *Hyalella azteca* | **7.9** | **Collector** | | | |
| **Decapoda** | | | | | |
| Cambaridae | **6** | **Collector** | | | |
| *Orconectes sp.* | **2.7** | **Collector** | | 1 | |
| **Insecta** | | | | | |
| **Ephemeroptera** | **4** | **Collector** | | | |
| Ameletidae | **2.1** | **Collector** | | | |
| *Ameletus sp.* | **2.1** | **Collector** | **Swimmer** | 2 | 2 |
| Baetidae | **4** | **Collector** | | 2 | 3 |
| *Acentrella sp.* | **4** | **Collector** | **Swimmer** | 9 | 3 |
| *Acerpenna sp.* | **4** | **Shredder** | **Swimmer** | | 3 |
| *Plauditus sp.* | | | | 2 | 5 |
| Caenidae | **7** | **Collector** | | | |
| *Caenis sp.* | **7.6** | **Collector** | **Sprawler** | 2 | 14 |
| Heptageniidae | **4** | **Scraper** | | 4 | |
| *Leucrocuta sp.* | **1** | **Scraper** | **Clinger** | 1 | |
| *Maccaffertium (Stenonema) sp.* | **3.3** | **Scraper** | **Clinger** | 1 | |
| *Maccaffertium (Stenonema) mediopuncta* | **3.3** | **Scraper** | **Clinger** | 1 | |
| *Stenonema femoratum* | **3.3** | **Scraper** | **Clinger** | 11 | 13 |
| Isonychiidae | | | | | |
| *Isonychia sp.* | **2** | **Collector** | **Swimmer** | 4 | 2 |
| Leptophlebiidae | | **Collector** | | 3 | 1 |

| SPECIES | T.V. | F.F.G. | Habit | RC-01 Dup | RC-02 |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| Tricorythidae | | **Collector** | | | |
| *Tricorythodes sp.* | **5.4** | **Collector** | **Sprawler** | | |
| **Odonata** | | | | | |
| Coenagrionidae | **9** | **Predator** | | | |
| *Argia sp.* | **5.1** | **Predator** | **Clinger** | | |
| *Enallagma sp.* | **9** | **Predator** | **Climber** | 1 | |
| Gomphidae | **1** | **Predator** | | | |
| *Lanthus sp.* | **6** | | **Burrower** | 1 | |
| **Plecoptera** | | | | | |
| Chloroperlidae | | **Predator** | | | 2 |
| Nemouridae | | **Shredder** | | | |
| *Amphinemura sp.* | **3.4** | **Shredder** | **Sprawler** | 14 | 10 |
| *Shipsa rotunda* | | | **Sprawler** | 2 | |
| Perlidae | **1** | **Predator** | | | |
| *Neoperla sp.* | **1.6** | **Predator** | **Clinger** | | |
| *Perlesta sp.* | | | | | |
| Perlodidae | **2** | **Predator** | | | |
| *Clioperla clio* | **4.8** | | **Clinger** | 1 | 2 |
| *Cultus sp.* | **1** | **Predator** | **Clinger** | 1 | |
| *Hydroperla sp.* | | | | | |
| *Isoperla sp.* | **2** | **Predator** | **Clinger** | 10 | 11 |
| Taeniopterygidae | | | | | |
| *Strophopteryx sp.* | **2.5** | **Shredder** | **Sprawler** | 2 | |
| **Heteroptera** | | | | | |
| Veliidae | | | | | |
| Microveliinae | | | | | |
| *Microvelia sp.* | **6** | **Predator** | **Skater** | | 1 |
| **Megaloptera** | | | | | |
| Corydalidae | | **Predator** | | | |
| *Corydalus cornutus* | **5.6** | **Predator** | **Clinger** | 1 | |
| **Trichoptera** | | | | | |
| Helicopsychidae | | **Scraper** | | | |
| *Helicopsyche borealis* | **3** | **Scraper** | **Clinger** | | 1 |
| Hydropsychidae | **4** | **Filterer** | | | |
| *Cheumatopsyche sp.* | **6.6** | **Collector** | **Clinger** | 2 | 1 |
| Hydroptilidae | **4** | | | | |
| *Hydroptila sp.* | **6.2** | **Scraper** | **Clinger** | | |
| Philopotamidae | **3** | **Filterer** | | | |
| *Chimarra sp.* | **2.8** | **Filterer** | **Clinger** | 1 | |
| **Coleoptera** | | | | | |
| Elmidae | **5** | **Collector** | | | |
| *Dubiraphia sp.* | **6.4** | **Collector** | **Clinger** | | |
| *Dubiraphia vittata* | **6.4** | **Collector** | | | |
| *Stenelmis sp.* | **5.4** | **Scraper** | **Clinger** | | 2 |
| Psephenidae | | **Scraper** | | | |
| *Psephenus herricki* | **2** | **Scraper** | **Clinger** | 1 | |
| **Diptera** | | | | | |
| Ceratopogonidae | **5.7** | **Predator** | **Sprawler** | 1 | |
| Chironomidae | **6** | **Collector** | | | 5 |
| *Cladotanytarsus sp.* | **7** | **Collector** | | | 3 |

| SPECIES | T.V. | F.F.G. | Habit | RC-01 Dup | RC-02 |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| *Conchapelopia sp.* | **6** | **Predator** | **Sprawler** | | |
| *Cricotopus sp.* | **7** | **Shredder** | | | 6 |
| *Cryptochironomus sp.* | **8** | **Predator** | | | |
| *Diamesa sp.* | **5** | **Collector** | **Sprawler** | | |
| *Dicrotendipes neomodestus* | **10** | **Collector** | **Burrower** | | 1 |
| *Eukiefferiella brevicalcar* | **8** | **Collector** | **Sprawler** | 66 | 41 |
| *Hydrobaenus sp.* | **8** | **Scraper** | **Sprawler** | | 12 |
| *Microtendipes pedellus gp.* | **6** | **Filterer** | **Clinger** | 1 | |
| *Nanocladius distinctus* | **3** | **Collector** | **Sprawler** | | |
| *Nilothauma sp.* | **2** | | | | |
| *Orthocladius sp.* | **6** | **Collector** | **Sprawler** | 7 | 8 |
| *Orthocladius (Euorthocladius) sp.* | **6** | **Collector** | **Sprawler** | | |
| *Parakiefferiella sp.* | **4** | **Collector** | **Sprawler** | | |
| *Polypedilum aviceps* | **6** | **Shredder** | **Climber** | | |
| *Polypedilum flavum (convictum)* | **6** | **Shredder** | **Climber** | 10 | |
| *Polypedilum illinoense* | **6** | **Shredder** | **Climber** | 14 | 2 |
| *Pseudochironomus sp.* | | **Collector** | | | 2 |
| *Rheotanytarsus exiguus gp.* | **6** | **Filterer** | **Clinger** | 3 | |
| *Sympotthastia sp.* | **2** | **Collector** | **Sprawler** | | 7 |
| *Tanytarsus sp.* | **6** | **Filterer** | **Climber** | | 1 |
| Empididae | **8.1** | **Predator** | **Sprawler** | | |
| *Hemerodromia sp.* | **6** | **Predator** | **Sprawler** | | 1 |
| *Roederiodes sp.* | | | | 2 | 1 |
| Simuliidae | **7** | **Filterer** | | | |
| *Prosimulium sp.* | **2.6** | **Filterer** | **Climber** | 1 | 3 |
| *Simulium sp.* | **4.4** | **Filterer** | **Clinger** | 4 | |
| Tabanidae | **8** | **Predator** | | | |
| *Tabanus sp.* | **9.7** | **Predator** | **Sprawler** | 2 | |
| Tanyderidae | | | | | |
| *Protoplasa fitchii* | | **Collector** | | | 1 |
| Tipulidae | **3** | **Shredder** | | | |
| *Hexatoma sp.* | **4.7** | **Predator** | **Burrower** | 1 | |

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# Appendix C-6
# Fish Community Assessment – Summary Tables and Dataset

TABLE C-14

**Summary of Water Quality During Fish Community Assessment (Minerals Data)**

| Station ID (Date) | $Cl^-$ (mg/L) | Sulfate (mg/L) | TDS (mg/L) |
|---|---|---|---|
| RC-01 (9/13/2011) | 4.7 | 13.7 | 134 |
| RC-02 (10/11/2011) | 5.1 | 18.1 | 164 |
| WR-01 (9/13/2011) | 5.1 | 16.6 | 130 |
| WR-02 (9/13/2011) | 51.0 | 48.6 | 342 |
| WR-02.5 (9/13/2011) | 46.3 | 44.5 | 287 |

Note: Station RC-02 sampled on 10/11/11; all other stations sampled 9/13/11

TABLE C-15

**Summary of Water Quality During Fish Community Assessment (In Situ Parameters)**

| Station ID (Date) | pH (SU) | Temperature (˚C) | Conductivity (µS/cm) | DO (mg/L) | Turbidity (NTU) |
|---|---|---|---|---|---|
| RC-01 (9/13/2011) | 7.99 | 22.3 | 227 | 7.29 | 9.04 |
| RC-02 (10/11/2011) | 7.66 | 18.7 | 270 | 6.82 | 3.15 |
| WR-01 (9/13/2011) | 7.95 | 22.5 | 216 | 6.88 | 8.14 |
| WR-02 (9/13/2011) | 6.74 | 23 | 553 | 5.75 | 2.74 |
| WR-02.5 (9/13/2011) | 8.51 | 23.4 | 493 | 10.05 | 9.35 |

Note: Station RC-02 sampled on 10/11/11; all other stations sampled on 9/13/11

TABLE C-16

**Summary of Fish Species Relative Abundance – Fall 2011[a]**

| Family | Common Name | Scientific Name | Relative Abundance (%) | | | | |
|---|---|---|---|---|---|---|---|
| | | | WR-01 | WR-02 | WR-2.5 | RC-01 | RC-02 |
| Clupeidae (shads) | American gizzard shad | *Dorosoma cepedianum* | 0.0 | 0.0 | 0.0 | 2.8 | 0.0 |
| Cyprinidae (minnows) | Largescale stoneroller | *Campostoma oligolepis* | 4.6 | 21.3 | 19.2 | 14.5 | 53.6 |
| | Steelcolor shiner | *Cyprinella whipplei* | 6.4 | 9.8 | 4.5 | 10.8 | 0.0 |
| | Bigeye chub | *Hybopsis amblops* | 0.0 | 0.2 | 0.0 | 0.5 | 3.8 |
| | Striped shiner | *Luxilus chrysocephalus* | 0.0 | 0.0 | 0.0 | 0.9 | 0.3 |
| | Duskystripe shiner [b] | *Luxilus pilsbryi* | 0.1 | 1.0 | 0.4 | 4.8 | 10.3 |
| | Hornyhead chub | *Nocomis biguttatus* | 0.0 | 0.0 | 0.1 | 0.0 | 0.5 |
| | Bigeye shiner | *Notropis boops* | 0.1 | 0.2 | 0.4 | 0.1 | 0.2 |
| | Ozark minnow [c] | *Notropis nubilus* | 0.3 | 1.3 | 3.9 | 6.0 | 8.3 |
| | Rosyface shiner | *Notropis rubellus* | 0.0 | 1.5 | 0.1 | 0.4 | 0.0 |
| | Bluntnose minnow | *Pimephales notatus* | 18.0 | 25.2 | 7.7 | 1.1 | 1.6 |
| Catostomidae (suckers) | Northern hogsucker [b] | *Hypentelium nigricans* | 0.0 | 0.5 | 0.1 | 0.1 | 0.0 |
| | River redhorse | *Moxostoma carinatum* | 0.0 | 0.0 | 0.0 | 1.1 | 0.9 |
| Ictaluridae (catfishes) | Yellow bullhead | *Ameiurus natalis* | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 |
| | Channel catfish | *Ictalurus punctatus* | 0.3 | 1.0 | 1.1 | 0.1 | 0.0 |
| | Ozark madtom [c] | *Noturus albater* | 0.0 | 0.2 | 0.4 | 0.0 | 0.0 |
| | Slender madtom [b] | *Noturus exilis* | 0.1 | 0.0 | 1.0 | 0.3 | 1.3 |
| | Flathead catfish | *Pylodictis olivaris* | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 |
| Fundulidae (topminnows) | Northern studfish | *Fundulus catenatus* | 0.0 | 0.0 | 0.0 | 0.5 | 0.3 |
| | Blackspotted topminnow | *Fundulus olivaceus* | 0.4 | 4.1 | 0.6 | 1.3 | 1.1 |
| Poeciliidae (livebearers) | Western mosquitofish | *Gambusia affinis* | 0.7 | 0.0 | 0.7 | 1.4 | 0.0 |
| Atherinidae (silversides) | Brook silverside | *Labidesthes sicculus* | 0.0 | 0.0 | 0.4 | 0.0 | 0.0 |
| Centrarchidae (sunfishes) | Green sunfish | *Lepomis cyanellus* | 3.4 | 2.6 | 9.7 | 2.4 | 0.0 |
| | Warmouth | *Lepomis gulosus* | 0.9 | 0.5 | 0.6 | 1.0 | 0.0 |
| | Bluegill | *Lepomis macrochirus* | 4.6 | 4.1 | 2.1 | 2.7 | 0.0 |
| | Longear sunfish | *Lepomis megalotis* | 38.1 | 11.4 | 25.6 | 34.3 | 8.9 |
| | Redear sunfish | *Lepomis microlophus* | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 |
| | Smallmouth bass [b] | *Micropterus dolomieu* | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Spotted bass | *Micropterus punctulatus* | 2.4 | 4.6 | 3.3 | 2.8 | 0.6 |
| | Largemouth bass | *Micropterus salmoides* | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 |
| | Black crappie | *Pomoxis nigromaculatus* | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 |
| Percidae (darters) | Greenside darter | *Etheostoma blennioides* | 4.6 | 1.1 | 0.6 | 0.6 | 0.6 |
| | Rainbow darter [b] | *Etheostoma caeruleum* | 6.7 | 2.3 | 6.9 | 5.2 | 6.9 |
| | Yoke darter | *Etheostoma juliae* | 1.3 | 2.1 | 7.7 | 0.0 | 0.0 |
| | Stippled darter | *Etheostoma punctulatum* | 0.0 | 0.0 | 0.0 | 0.1 | 0.3 |
| | Banded darter | *Etheostoma zonale* | 6.4 | 4.9 | 1.7 | 0.3 | 0.3 |
| | Logperch | *Percina caprodes* | 0.3 | 0.5 | 1.0 | 3.7 | 0.2 |

[a] RC-02 Sampled October 11, 2011; all other samples collected September 13-14, 2011

[b] Ozark Highlands key species

[c] Ozark Highlands indicator species

TABLE C-17

**Summary of Fish Community Family Composition – Fall 2011a**

| Family | WR-01 | | WR-2 | | WR-2.5 | | RC-01 | | RC-02 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | % of Taxa | % of Individuals | % of Taxa | % of Individuals | % of Taxa | % of Individuals | % of Taxa | % of Individuals | % of Taxa | % of Individuals |
| Clupeidae (shads) | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.2 | 2.8 | 0.0 | 0.0 |
| Cyprinidae (minnows) | 28.6 | 29.6 | 36.4 | 60.3 | 27.6 | 36.1 | 29.0 | 39.1 | 42.1 | 78.5 |
| Catostomidae (suckers) | 0.0 | 0.0 | 4.5 | 0.5 | 6.9 | 0.1 | 6.5 | 1.2 | 5.3 | 0.9 |
| Ictaluridae (catfishes) | 9.5 | 0.4 | 9.1 | 1.1 | 13.8 | 2.6 | 9.7 | 0.6 | 5.3 | 1.3 |
| Fundulidae (topminnows) | 4.8 | 0.4 | 4.5 | 4.1 | 3.4 | 0.6 | 6.5 | 1.8 | 10.5 | 1.4 |
| Poeciliidae (livebearers) | 4.8 | 0.7 | 0.0 | 0.0 | 3.4 | 0.7 | 3.2 | 1.4 | 0.0 | 0.0 |
| Atherinidae (silversides) | 0.0 | 0.0 | 0.0 | 0.0 | 3.4 | 0.4 | 3.2 | 0.0 | 0.0 | 0.0 |
| Centrarchidae (sunfishes) | 28.6 | 49.6 | 22.7 | 23.1 | 24.1 | 41.5 | 22.6 | 43.3 | 10.5 | 9.6 |
| Percidae (darters) | 23.8 | 19.3 | 22.7 | 10.9 | 17.2 | 18.0 | 16.1 | 9.8 | 26.3 | 8.3 |
| Total Species | 21 | | 22 | | 29 | | 31 | | 19 | |
| Total Individuals | 700 | | 615 | | 1385 | | 3124 | | 638 | |
| Catch per unit Effort | 170 | | 48 | | 108 | | 145 | | 119 | |

[a] RC-02 Sampled October 11, 2011; all other samples collected September 13-14, 2011

TABLE C-18

**ADEQ Index Scores for Fish Communities – Fall 2011[a]**

| | WR-01 | | WR-02 | | WR-2.5 | | RC-01 | | RC-02 | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Metric Category** | **Raw Score** | **Metric Score[b]** | **Raw Score** | **Metric Score[b]** | **Raw Score** | **Metric Score[b]** | **Raw Score** | **Metric Score[b]** | **Raw Score** | **Metric Score[b]** |
| % Sensitive Individuals | 26.0 | 3 | 23.6 | 3 | 23.8 | 3 | 24.7 | 3 | 25.4 | 3 |
| % Cyprinidae (Minnows) | 29.6 | 1 | 60.3 | 5 | 36.1 | 1 | 39.1 | 3 | 78.5 | 1 |
| % Ictaluridae (Catfishes)[c] | 0.4 | 1 | 1.1 | 3 | 2.6 | 5 | 0.6 | 1 | 1.3 | 3 |
| *% bullheads* | 0.0 | NA | 0.0 | NA | 0.0 | NA | 0.2 | NA | 0.0 | NA |
| % Centrarchidae (Sunfishes)[d] | 49.6 | 1 | 23.1 | 1 | 41.5 | 1 | 43.3 | 1 | 9.6 | 5 |
| *% green sunfish* | 3.4 | NA | 2.6 | NA | 9.7 | NA | 2.4 | NA | 0.0 | NA |
| % Percidae (Darters) | 19.3 | 5 | 10.9 | 3 | 18.0 | 5 | 9.8 | 3 | 8.3 | 3 |
| % Primary Feeders | 22.9 | 5 | 47.8 | 3 | 30.8 | 5 | 24.4 | 5 | 63.5 | 1 |
| % Key Individuals | 7.1 | 1 | 3.7 | 1 | 8.4 | 1 | 10.3 | 1 | 18.5 | 3 |
| Shannon-Weaver Diversity Index | 3.01 | 5 | 3.36 | 5 | 3.45 | 5 | 3.40 | 5 | 2.4 | 3 |
| Number of Species | 21 | 1 | 22 | 1 | 29 | 3 | 31 | 5 | 19 | 3 |
| **Total Metric Score** | **23** | | **25** | | **29** | | **27** | | **25** | |
| **Qualitative Category[e]** | **Somewhat Similar** | | **Generally Similar** | | **Generally Similar** | | **Generally Similar** | | **Generally Similar** | |

[a] RC-02 sampled October 11, 2011; all other samples collected September 13-14, 2011

[b] If a raw metric score is 0, score as "0", except for Primary Feeders (score as "1")

[c] Scores "1" if greater than 3 percent bullheads

[d] Scores "1" if greater than 2 percent green sunfish

[e] 37-45 = Mostly Similar; 25-36 = Generally Similar; 13-24 = Somewhat Similar; 0-12 –Not Similar

# White River UAA Report - Fish Community Assessment, Fall 2012

| | | | WR-1 | | | WR-2 | | | WR-2.5 | | | RC-1 | | | RC-2 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Family** | **Scientific name** | **Common name** | **Pass 1** | **Pass 2** | **Pass 1 & 2** | **Pass 1** | **Pass 2** | **Pass 1 & 2** | **Pass 1** | **Pass 2** | **Pass 1 & 2** | **Pass 1** | **Pass 2** | **Pass 1 & 2** | **Pass 1** | **Pass 2** | **Pass 1 & 2** |
| **Clupeidae** | | **Herrings** | | | | | | | | | | | | | | | |
| | *Dorosoma cepedianum* | gizzard shad | | | | | | | | | | 65 | 24 | 89 | | | |
| **Cyprinidae** | | **Minnows and Carps** | | | | | | | | | | | | | | | |
| | *Campostoma oligolepis* | largescale stoneroller | 20 | 12 | 32 | 97 | 34 | 131 | 153 | 113 | 266 | 311 | 141 | 452 | 257 | 85 | 342 |
| | *Cyprinella whipplei* | steelcolor shiner | 15 | 30 | 45 | 45 | 15 | 60 | 36 | 26 | 62 | 235 | 103 | 338 | | | |
| | *Hybopsis amblops* | bigeye chub | | | | 1 | | 1 | | | | 13 | 4 | 17 | 20 | 4 | 24 |
| | *Luxilus chrysocephalus* | stripped shiner | | | | | | | | | | 24 | 4 | 28 | 2 | | 2 |
| | *Luxilus pilsbryi* | duskystripe shiner | | 1 | 1 | 4 | 2 | 6 | 3 | 2 | 5 | 106 | 43 | 149 | 60 | 6 | 66 |
| | *Nocomis biguttatus* | hornyhead chub | | | | | | | 1 | | 1 | | | | 3 | | 3 |
| | *Notropis boops* | bigeye shiner | 1 | | 1 | | 1 | 1 | 3 | 2 | 5 | 3 | 1 | 4 | 1 | | 1 |
| | *Notropis nubilus* | Ozark minnow | | 2 | 2 | 8 | | 8 | 33 | 21 | 54 | 80 | 106 | 186 | 38 | 15 | 53 |
| | *Notropis rubellus* | rosyface shiner | | | | 7 | 2 | 9 | 1 | | 1 | 9 | 3 | 12 | | | |
| | *Pimephales notatus* | bluntnose minnow | 53 | 73 | 126 | 114 | 41 | 155 | 50 | 56 | 106 | 24 | 11 | 35 | 5 | 5 | 10 |
| **Catostomidae** | | **Suckers** | | | | | | | | | | | | | | | |
| | *Hypentelium nigricans* | northern hog sucker | | | | 1 | 2 | 3 | 1 | | 1 | | 2 | 2 | | | |
| | *Moxostoma carinatum* | river redhorse | | | | | | | | | | 23 | 12 | 35 | 3 | 3 | 6 |
| | *Ameiurus natalis* | yellow bullhead | | | | | | | | | | 2 | 3 | 5 | | | |
| | *Ictalurus punctatus* | channel catfish | 1 | 1 | 2 | 2 | 4 | 6 | 7 | 8 | 15 | 4 | | 4 | | | |
| | *Noturus albater* | Ozark madtom | | | | 1 | | 1 | 1 | 5 | 6 | | | | | | |
| | *Noturus exilis* | slender madtom | | 1 | 1 | | | | 6 | 8 | 14 | 5 | 4 | 9 | 5 | 3 | 8 |
| | *Pylodictis olivaris* | flathead catfish | | | | | | | 1 | | 1 | | | | | | |
| **Fundulidae** | | **Killifishes** | | | | | | | | | | | | | | | |
| | *Fundulus catenatus* | northern studfish | | | | | | | | | | 8 | 7 | 15 | | 2 | 2 |
| | *Fundulus olivaceus* | blackspotted topminnow | | 3 | 3 | 8 | 17 | 25 | 5 | 4 | 9 | 19 | 21 | 40 | 4 | 3 | 7 |
| **Poeciliidae** | | **Livebearers** | | | | | | | | | | | | | | | |
| | *Gambusia affinis* | mosquitofish | | 5 | 5 | | | | | 10 | 10 | 37 | 7 | 44 | | | |
| **Atherinidae** | | **Silversides** | | | | | | | | | | | | | | | |
| | *Labidesthes sicculus* | brook silverside | | | | | | | 2 | 3 | 5 | | 1 | 1 | | | |
| | *Menidia beryllina* | inland silverside | | | | | | | | | | | | | | | |
| **Centrarchidae** | | **Sunfishes** | | | | | | | | | | | | | | | |
| | *Lepomis cyanellus* | green sunfish | 5 | 19 | 24 | 7 | 9 | 16 | 75 | 60 | 135 | 47 | 28 | 75 | | | |
| | *Lepomis gulosus* | warmouth | 2 | 4 | 6 | 2 | 1 | 3 | 5 | 4 | 9 | 23 | 7 | 30 | | | |
| | *Lepomis macrochirus* | bluegill | 8 | 24 | 32 | 7 | 18 | 25 | 13 | 16 | 29 | 43 | 40 | 83 | | | |
| | *Lepomis megalotis* | longear sunfish | 99 | 168 | 267 | 28 | 42 | 70 | 190 | 164 | 354 | 845 | 227 | 1072 | 49 | 8 | 57 |
| | *Lepomis microlophus* | redear sunfish | | | | | | | | 1 | 1 | | 1 | 1 | | | |
| | *Micropterus dolomieu* | smallmouth bass | 1 | | 1 | | | | | | | | | | | | |
| | *Micropterus punctulatus* | spotted bass | 6 | 11 | 17 | 11 | 17 | 28 | 25 | 21 | 46 | 68 | 20 | 88 | 2 | 2 | 4 |
| | *Micropterus salmoides* | largemouth bass | | | | | | | 1 | | 1 | | | | | | |
| | *Pomoxis nigromaculatus* | black crappie | | | | | | | | | | 2 | 1 | 3 | | | |
| **Percidae** | | **Perches** | | | | | | | | | | | | | | | |
| | *Etheostoma blennioides* | greenside darter | 15 | 17 | 32 | 6 | 1 | 7 | 4 | 5 | 9 | 13 | 5 | 18 | 3 | 1 | 4 |
| | *Etheostoma caeruleum* | rainbow darter | 20 | 27 | 47 | 8 | 6 | 14 | 42 | 54 | 96 | 99 | 63 | 162 | 28 | 16 | 44 |
| | *Etheostoma juliae* | Yoke darter | 3 | 6 | 9 | 6 | 7 | 13 | 48 | 58 | 106 | | | | | | |
| | *Etheostoma punctulatum* | stippled darter | | | | | | | | | | 1 | 1 | 2 | 2 | | 2 |
| | *Etheostoma zonale* | banded darter | 25 | 20 | 45 | 17 | 13 | 30 | 10 | 14 | 24 | 7 | 1 | 8 | 1 | 1 | 2 |
| | *Percina caprodes* | logperch | | 2 | 2 | 2 | 1 | 3 | 10 | 4 | 14 | 63 | 54 | 117 | | 1 | 1 |
| | | | | | | | | | | | | | | | | | |
| | **Total** | | 274 | 426 | 700 | 382 | 233 | 615 | 726 | 659 | 1385 | 2179 | 945 | 3124 | 483 | 155 | 638 |
| | | | | | | | | | | | | | | | | | |
| | | Shock Time (sec) | 840 | 643 | 1483 | 2144 | 2473 | 4617 | 2360 | 2236 | 4596 | 4765 | 2967 | 7732 | 1745 | 1484 | 3229 |
| | | Reach Length (ft) | 800 | 800 | 800 | 1600 | 1600 | 1600 | 1200 | 1200 | 1200 | 1600 | 1600 | 1600 | 1000 | 1000 | 1000 |

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# Appendix C-7
# Whole Effluent Toxicity Assessment – Summary Tables, Methods, and Raw Data

Table A1. Reproduction (number of neonates) in each replicate on each day from the spiked effluent toxicity test using *Ceriodaphnia dubia.*

| Exposure | Replicate | Day of Test | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| Performance Control | 1 | 0 | 0 | 0 | 0 | 2 | 7 | 0 | 9 |
| | 2 | 0 | 0 | 0 | 4 | 0 | 7 | 12 | 23 |
| | 3 | 0 | 0 | 0 | 5 | 7 | 0 | 9 | 21 |
| | 4 | 0 | 0 | 0 | 0 | 0 | 7 | 10 | 17 |
| | 5 | 0 | 0 | 0 | 4 | 4 | 0 | 11 | 19 |
| | 6 | 0 | 0 | 0 | 2 | 0 | 3 | 8 | 13 |
| | 7 | 0 | 0 | 0 | 5 | 5 | 0 | 10 | 20 |
| | 8 | 0 | 0 | 0 | 3 | 0 | 7 | 10 | 20 |
| | 9 | 0 | 0 | 0 | 4 | 0 | 7 | 10 | 21 |
| | 10 | 0 | 0 | 0 | 5 | 0 | 9 | 11 | 25 |
| 1x (Unspiked effluent) | 1 | 0 | 0 | 0 | 4 | 6 | 0 | 11 | 21 |
| | 2 | 0 | 0 | 0 | 4 | 9 | 0 | 16 | 29 |
| | 3 | 0 | 0 | 0 | 4 | 5 | 0 | 15 | 24 |
| | 4 | 0 | 0 | 0 | 4 | 5 | 0 | 12 | 21 |
| | 5 | 0 | 0 | 0 | 5 | 0 | 12 | 16 | 33 |
| | 6 | 0 | 0 | 0 | 6 | 8 | 1 | 16 | 31 |
| | 7 | 0 | 0 | 0 | 0 | 4 | 10 | 14 | 28 |
| | 8 | 0 | 0 | 0 | 4 | 1 | 8 | 20 | 33 |
| | 9 | 0 | 0 | 0 | 4 | 0 | 13 | 14 | 31 |
| | 10 | 0 | 0 | 0 | 0 | 5 | 12 | 14 | 31 |
| 2.5x | 1 | 0 | 0 | 0 | 5 | 7 | 0 | 13 | 25 |
| | 2 | 0 | 0 | 0 | 6 | 9 | 0 | 16 | 31 |
| | 3 | 0 | 0 | 0 | 6 | 9 | 0 | 13 | 28 |
| | 4 | 0 | 0 | 0 | 5 | 8 | 0 | 13 | 26 |
| | 5 | 0 | 0 | 0 | 5 | 0 | 9 | 17 | 31 |
| | 6 | 0 | 0 | 0 | 4 | 8 | 0 | 16 | 28 |
| | 7 | 0 | 0 | 0 | 4 | 9 | 0 | 14 | 27 |
| | 8 | 0 | 0 | 0 | 5 | 10 | 0 | 16 | 31 |
| | 9 | 0 | 0 | 0 | 5 | 7 | 0 | 16 | 28 |
| | 10 | 0 | 0 | 0 | 4 | 0 | 8 | 14 | 26 |

Table A1. Continued

| Exposure | Replicate | Day of Test | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| | 1 | 0 | 0 | 0 | 5 | 6 | 1 | 14 | 26 |
| | 2 | 0 | 0 | 0 | 5 | 10 | 0 | 15 | 30 |
| | 3 | 0 | 0 | 0 | 5 | 0 | 8 | 14 | 27 |
| | 4 | 0 | 0 | 0 | 5 | 0 | 8 | 12 | 25 |
| | 5 | 0 | 0 | 0 | 5 | 1 | 0 | 15 | 21 |
| | 6 | 0 | 0 | 0 | 5 | 6 | 2 | 12 | 25 |
| | 7 | 0 | 0 | 0 | 6 | 8 | 0 | 14 | 28 |
| | 8 | 0 | 0 | 0 | 5 | 7 | 0 | 12 | 24 |
| | 9 | 0 | 0 | 0 | 6 | 0 | 10 | 17 | 33 |
| 3.4x | 10 | 0 | 0 | 0 | 6 | 0 | 8 | 15 | 29 |
| | 1 | 0 | 0 | 0 | 4 | 8 | 0 | 10 | 22 |
| | 2 | 0 | 0 | 0 | 6 | 10 | 0 | 12 | 28 |
| | 3 | 0 | 0 | 0 | 6 | 7 | 0 | 9 | 22 |
| | 4 | 0 | 0 | 0 | 6 | 8 | 1 | 10 | 25 |
| | 5 | 0 | 0 | 0 | 5 | 9 | 0 | 9 | 23 |
| | 6 | 0 | 0 | 0 | 5 | 8 | 0 | 10 | 23 |
| | 7 | 0 | 0 | 0 | 4 | 9 | 0 | 12 | 25 |
| | 8 | 0 | 0 | 0 | 6 | 6 | 0 | 12 | 24 |
| | 9 | 0 | 0 | 0 | 4 | 0 | 10 | 11 | 25 |
| 4.5x | 10 | 0 | 0 | 0 | 2 | 0 | 5 | 8 | 15 |
| | 1 | 0 | 0 | 0 | 3 | 5 | 0 | 5 | 13 |
| | 2 | 0 | 0 | 0 | 3 | 6 | 5 | 0 * | 14 |
| | 3 | 0 | 0 | 0 | 5 | 8 | 0 | 4 * | 13 |
| | 4 | 0 | 0 | 0 | 3 | 5 | 0 | 3 | 11 |
| | 5 | 0 | 0 | 0 | 5 | 6 | 2 | 7 | 20 |
| | 6 | 0 | 0 | 0 | 2 | 4 | 0 | 3 | 9 |
| | 7 | 0 | 0 | 0 | 5 | 7 | 0 | 9 | 21 |
| | 8 | 0 | 0 | 0 | 3 | 9 | 0 | 9 | 21 |
| | 9 | 0 | 0 | 0 | 5 | 1 | 0 | 0 | 6 |
| 6.0x | 10 | 0 | 0 | 0 | 4 | 0 | 3 | 8 | 15 |

* = dead

Table A1. Continued

| Exposure | Replicate | Day of Test | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 2 | 0 | 0 | 0 | 0 * | | | | 0 |
| | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 6 | 0 | 0 * | | | | | | 0 |
| | 7 | 0 | 0 | 0 | 0 * | | | | 0 |
| | 8 | 0 | 0 * | | | | | | 0 |
| | 9 | 0 | 0 * | | | | | | 0 |
| 8.0x | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

* = dead

Table B1. Compiled raw data for analytical testing associated with the spiked effluent toxicity test using *Ceriodaphnia dubia.*

| Test Exposure | Analayte | Date of Test (Date) | | | | | | | Mean | Min | Max |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 (4/27) | 2 (4/28) | 3 (4/29) | 4 (4/30) | 5 (5/1) | 6 (5/2) | 7 (5/3) | | | |
| | Total Alkalinity | 120 | | | | | | | 120 | NA | NA |
| | Measured TDS | 360 | | | | | | | 360 | NA | NA |
| | Ca | 45 | | | | | | | 45 | NA | NA |
| | Mg | 4.4 | | | | | | | 4.4 | NA | NA |
| | K | 13 | | | | | | | 13 | NA | NA |
| | Na | 61 | | | | | | | 61 | NA | NA |
| | Cl | 46 | | | | | | | 46 | NA | NA |
| | SO4 | 54 | | | | | | | 54 | NA | NA |
| | Test pH | 8.3 | 8.4 | 8.2 | 8.2 | 8.1 | 8.2 | 8.1 | 8.2 | 8.1 | 8.4 |
| | Calculated HCO3 | 72 | | | | | | | 72 | NA | NA |
| | Hardness | 130 | | | | | | | 130 | NA | NA |
| 1x | Calculated TDS | 295 | | | | | | | 295 | NA | NA |
| | Total Alkalinity | 300 | 300 | 310 | 280 | 240 | 320 | 290 | 291 | 240 | 320 |
| | Measured TDS | 1000 | 990 | 1000 | 1000 | 1000 | 990 | 990 | 996 | 990 | 1000 |
| | Ca | 34 | 32 | 38 | 38 | 37 | 35 | 33 | 35 | 32 | 38 |
| | Mg | 5.9 | 5.6 | 6.8 | 6.6 | 6.2 | 6.1 | 5.8 | 6.1 | 5.6 | 6.8 |
| | K | 19 | 18 | 22 | 21 | 21 | 20 | 19 | 20 | 18 | 22 |
| | Na | 380 | 360 | 370 | 350 | 400 | 360 | 440 | 380 | 350 | 440 |
| | Cl | 200 | 200 | 200 | 190 | 200 | 200 | 200 | 199 | 190 | 200 |
| | SO4 | 220 | 230 | 220 | 210 | 220 | 230 | 230 | 223 | 210 | 230 |
| | Test pH | 8.8 | 8.8 | 8.7 | 8.6 | 8.5 | 8.6 | 8.6 | 8.7 | 8.5 | 8.8 |
| | Calculated HCO3 | 173 | 172 | 181 | 164 | 142 | 187 | 171 | 170 | 142 | 187 |
| | Hardness | 109 | 103 | 123 | 122 | 118 | 113 | 106 | 113 | 103 | 123 |
| 2.5x | Calculated TDS | 1032 | 1017 | 1038 | 980 | 1026 | 1038 | 1098 | 1033 | 980 | 1098 |

Table B1. Continued

| Test Exposure | Analayte | Date of Test (Date) 1 (4/27) | 2 (4/28) | 3 (4/29) | 4 (4/30) | 5 (5/1) | 6 (5/2) | 7 (5/3) | Mean | Min | Max |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Alkalinity | 360 | 350 | 360 | 360 | 310 | 340 | 350 | 347 | 310 | 360 |
| | Measured TDS | 1200 | 1200 | 1200 | 1200 | 1200 | 1200 | 1200 | 1200 | 1200 | 1200 |
| | Ca | 32 | 30 | 36 | 38 | 32 | 30 | 32 | 33 | 30 | 38 |
| | Mg | 6.5 | 6.3 | 7.8 | 7.6 | 6.5 | 6.2 | 6.6 | 6.8 | 6.2 | 7.8 |
| | K | 21 | 21 | 25 | 24 | 22 | 21 | 22 | 22 | 21 | 25 |
| | Na | 460 | 470 | 470 | 470 | 460 | 490 | 520 | 477 | 460 | 520 |
| | Cl | 240 | 250 | 240 | 240 | 240 | 250 | 240 | 243 | 240 | 250 |
| | SO4 | 270 | 290 | 270 | 280 | 270 | 280 | 270 | 276 | 270 | 290 |
| | Test pH | 8.9 | 9.0 | 8.8 | 8.7 | 8.7 | 8.8 | 8.7 | 8.8 | 8.7 | 9.0 |
| | Calculated HCO3 | 205 | 194 | 208 | 209 | 181 | 196 | 204 | 200 | 181 | 209 |
| | Hardness | 107 | 101 | 122 | 126 | 107 | 100 | 107 | 110 | 100 | 126 |
| 3.4x | Calculated TDS | 1235 | 1262 | 1257 | 1268 | 1211 | 1273 | 1295 | 1257 | 1211 | 1295 |
| | Total Alkalinity | 420 | 430 | 430 | 430 | 370 | 420 | 410 | 416 | 370 | 430 |
| | Measured TDS | 1600 | 1600 | 1500 | 1600 | 1500 | 1500 | 1600 | 1557 | 1500 | 1600 |
| | Ca | 25 | 25 | 28 | 32 | 25 | 25 | 27 | 27 | 25 | 32 |
| | Mg | 6.6 | 6.9 | 7.9 | 8.2 | 6.8 | 6.9 | 7.1 | 7.2 | 6.6 | 8.2 |
| | K | 22 | 23 | 26 | 27 | 24 | 24 | 25 | 24 | 22 | 27 |
| | Na | 600 | 630 | 560 | 590 | 570 | 630 | 640 | 603 | 560 | 640 |
| | Cl | 300 | 300 | 310 | 310 | 300 | 310 | 310 | 306 | 300 | 310 |
| | SO4 | 340 | 340 | 350 | 360 | 340 | 350 | 350 | 347 | 340 | 360 |
| | Test pH | 9.0 | 9.0 | 8.9 | 8.8 | 8.8 | 8.8 | 8.8 | 8.9 | 8.8 | 9.0 |
| | Calculated HCO3 | 234 | 237 | 245 | 248 | 214 | 243 | 237 | 237 | 214 | 248 |
| | Hardness | 90 | 91 | 102 | 114 | 90 | 91 | 97 | 96 | 90 | 114 |
| 4.5x | Calculated TDS | 1528 | 1562 | 1527 | 1575 | 1480 | 1588 | 1596 | 1551 | 1480 | 1596 |

Table B1. Continued

| Test Exposure | Analayte | Date of Test (Date) 1 (4/27) | 2 (4/28) | 3 (4/29) | 4 (4/30) | 5 (5/1) | 6 (5/2) | 7 (5/3) | Mean | Min | Max |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total Alkalinity | 540 | 550 | 540 | 530 | 440 | 520 | 520 | 520 | 440 | 550 |
| | Measured TDS | 2000 | 1900 | 1900 | 1900 | 1900 | 2000 | 1900 | 1929 | 1900 | 2000 |
| | Ca | 23 | 19 | 23 | 27 | 19 | 21 | 22 | 22 | 19 | 27 |
| | Mg | 8.6 | 7.1 | 9.3 | 8.7 | 7.8 | 8.4 | 8.1 | 8.3 | 7.1 | 9.3 |
| | K | 30 | 25 | 31 | 29 | 28 | 30 | 29 | 29 | 25 | 31 |
| | Na | 750 | 810 | 770 | 710 | 760 | 870 | 820 | 784 | 710 | 870 |
| | Cl | 390 | 390 | 390 | 400 | 400 | 400 | 400 | 396 | 390 | 400 |
| | SO4 | 440 | 440 | 450 | 460 | 450 | 460 | 460 | 451 | 440 | 460 |
| | Test pH | 9.1 | 9.2 | 9.0 | 8.9 | 8.9 | 8.9 | 8.9 | 9.0 | 8.9 | 9.2 |
| | Calculated HCO3 | 295 | 289 | 304 | 301 | 251 | 293 | 294 | 290 | 251 | 304 |
| | Hardness | 93 | 77 | 96 | 103 | 80 | 87 | 88 | 89 | 77 | 103 |
| 6x | Calculated TDS | 1937 | 1980 | 1977 | 1935 | 1916 | 2083 | 2033 | 1980 | 1916 | 2083 |
| | Total Alkalinity | 690 | 680 | 660 | 670 | 570 | 610 | 620 | 643 | 570 | 690 |
| | Measured TDS | 2500 | 2400 | 2400 | 2400 | 2500 | 2400 | 2400 | 2429 | 2400 | 2500 |
| | Ca | 13 | 11 | 13 | 20 | 13 | 12 | 210* | 14 | 11 | 20 |
| | Mg | 8.7 | 8.2 | 10 | 11 | 9 | 8.8 | 13 | 9.8 | 8.2 | 13.0 |
| | K | 31 | 30 | 35 | 37 | 33 | 32 | 34 | 33 | 30 | 37 |
| | Na | 1000 | 960 | 960 | 990 | 1000 | 940 | 1100 | 993 | 940 | 1100 |
| | Cl | 530 | 530 | 530 | 530 | 520 | 540 | 550 | 533 | 520 | 550 |
| | SO4 | 590 | 600 | 590 | 600 | 570 | 600 | 620 | 596 | 570 | 620 |
| | Final Test pH | 9.2 | 9.2 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 | 9.1 | 9.0 | 9.2 |
| | Calculated HCO3 | 368 | 359 | 365 | 375 | 318 | 338 | 344 | 353 | 318 | 375 |
| | Hardness | 68 | 61 | 74 | 95 | 70 | 66 | 79 | 73 | 61 | 95 |
| 8x | Calculated TDS | 2541 | 2499 | 2503 | 2563 | 2463 | 2471 | 2671 | 2530 | 2463 | 2671 |

* Analytical outlier discarded

TOXSTAT 3.0 statistical output

ANOVA, NOEC, LOEC

```
Title:  Fville UAA spiked effluent
  File:      FVILLEUA.               Transform:             NO TRANSFORMATION

                         Chi-Square Test for Normality
  ------------------------------------------------------------------------------

                        Actual and Expected Frequencies

  INTERVAL     <-1.5     -1.5 to <-0.5     -0.5 to 0.5    >0.5 to 1.5    >1.5
               -----     -------------     -----------    -----------    -----
  EXPECTED    2.6800        9.6800          15.2800         9.6800     2.6800
  OBSERVED     4             9                13             13          1

  ------------------------------------------------------------------------------

       Chi-Square =   3.2299             (p-value = 0.5201)

       Critical Chi-Square   = 13.277  (alpha = 0.01 , df = 4)
                             =  9.488  (alpha = 0.05 , df = 4)

  ------------------------------------------------------------------------------

  Data PASS normality test (alpha = 0.01). Continue analysis.


  Title:  Fville UAA spiked effluent
  File:      FVILLEUA.               Transform:             NO TRANSFORMATION

                 Hartley's Test for Homogeneity of Variance
  ------------------------------------------------------------------------------

  Calculated H statistic (max Var/min Var) =  5.2138

                         Table H statistic =    9.90  (alpha = 0.01)
                                                6.31  (alpha = 0.05)

               Used  df =   9
               Based on R (# groups) =   4

  ------------------------------------------------------------------------------

  Data PASS homogeneity test (alpha = 0.01). Continue analysis.
```

Title: Fville UAA spiked effluent
File: FVILLEUA. Transform: NO TRANSFORMATION

Summary Statistics on Data TABLE 1 of 2

| GRP | IDENTIFICATION | N | MIN | MAX | MEAN |
|---|---|---|---|---|---|
| 1 | CONTROL | 10 | 21.0000 | 33.0000 | 28.2000 |
| 2 | 2.5x | 10 | 25.0000 | 31.0000 | 28.1000 |
| 3 | 3.4x | 10 | 21.0000 | 33.0000 | 26.8000 |
| 4 | 6x | 10 | 6.0000 | 21.0000 | 14.3000 |

Title: Fville UAA spiked effluent
File: FVILLEUA. Transform: NO TRANSFORMATION

Summary Statistics on Data TABLE 2 of 2

| GRP | IDENTIFICATION | VARIANCE | SD | SEM | C.V. % |
|---|---|---|---|---|---|
| 1 | CONTROL | 21.2889 | 4.6140 | 1.4591 | 16.3617 |
| 2 | 2.5x | 4.9889 | 2.2336 | 0.7063 | 7.9487 |
| 3 | 3.4x | 11.5111 | 3.3928 | 1.0729 | 12.6597 |
| 4 | 6x | 26.0111 | 5.1001 | 1.6128 | 35.6651 |

Title: Fville UAA spiked effluent
File: FVILLEUA. Transform: NO TRANSFORMATION

ANOVA Table

| SOURCE | DF | SS | MS | F |
|---|---|---|---|---|
| Between | 3 | 1358.9000 | 452.9667 | 28.3992 |
| Within (Error) | 36 | 574.2000 | 15.9500 | |
| Total | 39 | 1933.1000 | | |

(p-value = 0.0000)

Critical F = 4.3771 (alpha = 0.01, df = 3,36)
= 2.8663 (alpha = 0.05, df = 3,36)

Since F > Critical F REJECT Ho: All equal (alpha = 0.05)

Title: Fville UAA spiked effluent
File: FVILLEUA. Transform: NO TRANSFORMATION

Dunnett's Test - TABLE 1 OF 2 Ho:Control<Treatment

| GROUP | IDENTIFICATION | TRANSFORMED MEAN | MEAN CALCULATED IN ORIGINAL UNITS | T STAT | SIG 0.05 |
|---|---|---|---|---|---|
| 1 | CONTROL | 28.2000 | 28.2000 | | |
| 2 | 2.5x | 28.1000 | 28.1000 | 0.0560 | |
| 3 | 3.4x | 26.8000 | 26.8000 | 0.7838 | |
| 4 | 6x | 14.3000 | 14.3000 | 7.7825 | * |

Dunnett critical value = 2.1500 (1 Tailed, alpha = 0.05, df [used] = 3,30)
(Actual df = 3,36)

Title: Fville UAA spiked effluent
File: FVILLEUA. Transform: NO TRANSFORMATION

Dunnett's Test - TABLE 2 OF 2 Ho:Control<Treatment

| GROUP | IDENTIFICATION | NUM OF REPS | MIN SIG DIFF (IN ORIG. UNITS) | % OF CONTROL | DIFFERENCE FROM CONTROL |
|---|---|---|---|---|---|
| 1 | CONTROL | 10 | | | |
| 2 | 2.5x | 10 | 3.8400 | 13.6 | 0.1000 |
| 3 | 3.4x | 10 | 3.8400 | 13.6 | 1.4000 |
| 4 | 6x | 10 | 3.8400 | 13.6 | 13.9000 |

## IC25 Calculations

## Test Concentration

Title: Fville UAA spiked effluent
File: FVILLE .IN Transform: NO TRANSFORMATION

| GRP | IDENTIFICATION | MEAN | SMOOTHED MEAN | CONCENTRATION |
|---|---|---|---|---|
| 1 | Control | 28.2000 | 28.2000 | 0.0000 |
| 2 | 2.5 | 28.1000 | 28.1000 | 2.5000 |
| 3 | 3.4 | 26.8000 | 26.8000 | 3.4000 |
| 4 | 4.5 | 23.2000 | 23.2000 | 4.5000 |
| 5 | 6 | 14.3000 | 14.3000 | 6.0000 |
| 6 | 8 | 0.0000 | 0.0000 | 8.0000 |

ICp estimate with p = 25 is 4.8455

Bootstrap results using 480 iterations:

Mean = 4.7964 Standard Deviation = 0.2159
95% Confidence Interval: ( 4.2654 , 5.1528)

## IC25 Calculations

## Sulfate

Title: Fville UAA spiked effluent

File: FVSO4 . Transform: NO TRANSFORMATION

| GRP | IDENTIFICATION | MEAN | SMOOTHED MEAN | CONCENTRATION |
|---|---|---|---|---|
| 1 | Control | 28.2000 | 28.2000 | 0.0000 |
| 2 | 223 | 28.1000 | 28.1000 | 223.0000 |
| 3 | 276 | 26.8000 | 26.8000 | 276.0000 |
| 4 | 347 | 23.2000 | 23.2000 | 347.0000 |
| 5 | 451 | 14.3000 | 14.3000 | 451.0000 |
| 6 | 596 | 0.0000 | 0.0000 | 596.0000 |

ICp estimate with p = 25 is 370.9551

Bootstrap results using 480 iterations:

Mean = 366.3738 Standard Deviation = 15.3896
95% Confidence Interval: ( 333.9094 , 394.1089)

## IC25 Calculations

## TDS

```
Title:  Fville UAA spiked effluent
  File:      FVTDS   .               Transform:             NO TRANSFORMATION

     GRP         IDENTIFICATION        MEAN     SMOOTHED MEAN   CONCENTRATION
  ---------------------------------------------------------------------------
      1                  Control     28.2000       28.2000         0.0000
      2                      996     28.1000       28.1000       996.0000
      3                     1200     26.8000       26.8000      1200.0000
      4                     1557     23.2000       23.2000      1557.0000
      5                     1929     14.3000       14.3000      1929.0000
      6                     2429      0.0000        0.0000      2429.0000
  ---------------------------------------------------------------------------
  ICp estimate with p =   25 is  1642.6854

  Bootstrap results using 480 iterations:

             Mean  =  1627.6777    Standard Deviation   =    56.2823
             95% Confidence Interval: ( 1472.8500 ,  1724.1786)
```

## IC25 Calculations

## Chloride

```
  Title:  Fville UAA spiked effluent
  File:      FVCL    .IN             Transform:             NO TRANSFORMATION

     GRP         IDENTIFICATION        MEAN     SMOOTHED MEAN   CONCENTRATION
  ---------------------------------------------------------------------------
      1                  Control     28.2000       28.2000         0.0000
      2                      199     28.1000       28.1000       199.0000
      3                      243     26.8000       26.8000       243.0000
      4                      306     23.2000       23.2000       306.0000
      5                      396     14.3000       14.3000       396.0000
      6                      533      0.0000        0.0000       533.0000
  ---------------------------------------------------------------------------
  ICp estimate with p =   25 is   326.7303

  Bootstrap results using 480 iterations:

             Mean  =   324.9627    Standard Deviation   =    12.7695
             95% Confidence Interval: (  295.7143 ,   348.2165)
```

EcoTox
Ecotoxicology Research Facility

P.O. Box 847
State University, AR 72467
Tel. 870-972-2570
Fax 870-972-2577
http://ecotox.astate.edu/

ASU
ARKANSAS STATE UNIVERSITY
College of Sciences & Mathematics
www.astate.edu

June 14, 2012

Bruce Richart
OMI Fayetteville
1400 Fox Hunter Rd
Fayetteville, AR 72701

Dear Bruce,

Please find enclosed the results of the 7-day *Ceriodaphnia dubia* test performed beginning April 27th using Noland effluent and dissolved salts according to the protocol provided by FTN.

Concentrations tested included a 100% Noland effluent as the control concurrent with laboratory synthetic water (Moderately Hard Laboratory water). Dilutions included 8 times the TDS effluent value and a 75% dilution series from the 8X stock. This resulted in TDS values of 1X (effluent control), 2.5X, 3.4X, 4.5X, 6X and 8X. The statistical endpoints were then calculated using the unspiked Noland effluent (1X) as the control.

*Ceriodaphnia dubia* neonates were isolated in an 8-hr period and parentage blocking was used to initiate test.

Lethality after 7 days in the highest dilution (8X) was recorded as 50% of the test organisms and the LC50 was 7.85X the TDS value of the Noland effluent control. The LC50 is a calculated statistical endpoint that estimates the concentration in which 50% of the organisms would survive.

Sublethal tests (reproduction) was inhibited in the 6X and 8X test concentrations. This inhibition resulted in a calculated IC25 of 4.86X the TDS value of the Noland effluent control. IC25 is typically used to estimate the inhibitory effect of sublethal concentrations of a toxicant.

If further testing for TDS toxicity endpoints to *C. dubia* are needed, I would suggest using a TDS concentration greater than 8X, such as 10-12X. Compete (100%) mortality in the highest dilution and partial mortality (<80%) in at least one subsequent dilution will yield a more statistically robust endpoint than was measured in this present test.

Test conditions and acceptability criteria as suggested by our laboratory and the US EPA were met during these tests. If you have any questions regarding this test or want to discuss it further, please feel free to call.

Sincerely,

Jennifer L. Bouldin, PhD
Director, Ecotoxicology Research Facility
PO Box 847
Arkansas State University
State University, AR 72467

Arkansas State University Ecotoxicology Research Facility — Laboratory Report

**Facility Director and Contact:** Jennifer L. Bouldin (870) 972-2570

**Client:** OMI Fayetteville - TDS
1400 Fox Hunter Rd
Fayetteville, AR 72701

**Contact:** Bruce Richart
(479) 443-3292
(479) 443-5613 (f)

**NPDES Permit #:** AR0020010 **AFIN #:** 72-00102

**Effluent Sampling Point/Type:** Grab

**Samples Collected:**

| Grab Sample # | Sampling Times | Received | Arrival Temp |
|---|---|---|---|
| 1 | 4/23/2012 18:03 | 04/25/12 1000 | 5.0°C |
| 2 | 4/23/2012 23:45 | | |
| 3 | 4/24/2012 06:01 | | |
| 4 | 4/24/2012 11:58 | | |

**Test Methods:**
7-Day Chronic Toxicity, Static renewal, Cladoceran, EPA 821/R-02/013, Section 13

**Organisms:** *C. dubia* <24hrs **Culture Source:** ASU ERF

**Dilutions:** 100% effluent, 2.5X, 3.4X, 4.5X, 6X, 8X

**Statistical Method:** Toxcalc 5.0.25

| Results: | *C. dubia* |
|---|---|
| **Control Survival:** | 100% |
| **Control % CV Growth/Reproduction:** | 16.4 |
| **Mean # Neonates in Control:** | 28.2 |
| **Surival LC50:** | 7.85X |
| **Reproduction IC25:** | 4.86X |
| **MSDp Reproduction** | 0.1372 |

**Notes:**
To make stock solution, salts were added to the Noland effluent according to protocol and aerated for 24 hours.
The initial conductivity fell within the range specified.
Each day the spiked effluent was aerated before mixing the dilutions.
There appeared to be more precipitate in the stock solution each day of the test as dilutions were mixed.

**Results Summary:**
Nominal concentrations of TDS in the test series were up to 8X (8 times the initial TDS concentration of effluent from the Noland outfall).
Survival of the highest dilution (8X) at 7 days = 50% and Lethal Concentration 50 (LC50) was calculated as 7.85X.
Inhibitory Concentration 25 (IC25) was statistically calculated as 4.86X the initial TDS concentration of effluent from the Noland outfall.

Analytical data from the Noland effluent and dilution series were shipped to American Interplex, Little Rock, AR.

**QA/Reference Testing:** Data attached

**Reviewed By:**

Jennifer L. Bouldin, Director ASU Ecotoxicology Research Facility

| | | |
|---|---|---|
| Toxicity Test Performed: | 7-day *Ceriodaphnia dubia* Survival and Reproduction | |
| Effluent Sampling Point: | Fayetteville – Noland | |
| Date Test Started: | 04/27/12 | *C. dubia* |
| Time Test Started: | 1620 | *C. dubia* |
| Date Test Terminated: | 05/04/12 | *C. dubia* |
| Time Test Terminated: | 1545 | *C. dubia* |
| Laboratory Analyst: | Griffin | |

I. Test Methods

A. Physical and Chemical Testing - APHA, Standard Methods for the Examination of Water and Wastewater; Vol. 21, 2005.

| **Test** | **Method** |
|---|---|
| Alkalinity | 2320B |
| Conductivity | 2510B |
| Dissolved Oxygen (mg/L, DO) | 4500-O-G |
| Hardness (mg/L $CaCO_3$) | 2340C |
| pH | 4500-$H^+$B |
| Temperature ($^oC$) | 2550B |

B. Toxicity Testing – EPA 821/R-02/013: Short Term Methods for Estimating the Chronic Toxicity of Effluents to Freshwater Organisms

| **Test** | **Method** |
|---|---|
| Cladoceran Survival and Reproduction | Section 13 |

II. Test Organisms

A. Name: *Ceriodaphnia dubia* (Cladoceran)
Source: Laboratory Culture
Age: <24 hours
Life Stage: Neonate

III. External Factors

A. Incubator
Temperature ($^oC$)
Average: Average: 24.7
Range: 24.5 – 25.0

Light Cycle: 16 hours light/ 8 hours dark
Light Intensity: 100 footcandles
Control Water: Unspiked effluent

B. *Ceriodaphnia dubia*
Test Chambers: 30 ml Solo cups
Volume per Chamber: 15-20 ml
Number of Organisms per Chamber: 1
Number of Replicates per Concentration: 10
Acclimation: Laboratory control water was added to cultures until >50% of the culture water consisted of control water.
Food: Cladocera were fed *Selenastrum* (#ABS 031212) and yeast/cereal/trout chow mix (#YCT 041012-3) one hour prior to test setup and once daily thereafter.

IV. Quality Assurance

A. Standard Toxicant: Sodium Chloride

B. Organism: *Ceriodaphnia dubia*
Date and time of Reference Toxicant Test
Start: 04/12/12
Terminated: 04/19/12
Time of Reference Toxicant Test
Start: 1110
Terminated: 1140
Laboratory Analyst: Freyaldenhoven
Dilution Water Used: Moderately Hard Synthetic Water #862
Results: Survival and Reproduction within control limits

| Survival | Reproduction |
|---|---|
| LOEC: 1.82 g/L NaCl | LOEC: 1.82 g/L NaCl |
| EC50: 1.82 g/L NaCl | IC25: 1.54 g/L NaCl |

V. Physical and Chemical Data - See Attached

VI. Survival and Growth Data - See Attached

VII. Statistical Methods - See Attached

VIII. NPDES Permit Results - See Attached

**SUMMARY REPORTING FORM**
**WET Testing**
***Ceriodaphnia dubia* Survival and Reproduction**

Permittee: Fayetteville - Noland NPDES No.: AR0020010

| | | Time | Date |
|---|---|---|---|
| Grab 1: | Collected | 1803 | 04/23/12 |
| Grab 2: | Collected | 2345 | 04/23/12 |
| Grab 3: | Collected | 0601 | 04/24/12 |
| Grab 4: | Collected | 1158 | 04/24/12 |

Test Initiated: 1620 Date: 04/27/12
Time Terminated: 1545 Date: 05/04/12
Dilution $H_2O$: Unspiked effluent

**PERCENT SURVIVAL**
Percent Effluent

| Time of Reading | Effluent Control | 2.5X | 3.4X | 4.5X | 6X | 8X |
|---|---|---|---|---|---|---|
| 24h | 100 | 100 | 100 | 100 | 100 | 100 |
| 48h | 100 | 100 | 100 | 100 | 100 | 70 |
| 7 day | 100 | 100 | 100 | 100 | 80 | 50 |

**NUMBER OF YOUNG/FEMALE @ 7 DAYS**
Percent Effluent

| REP | 0% | 2.5X | 3.4X | 4.5X | 6X |
|---|---|---|---|---|---|
| **A** | 21 | 25 | 26 | 22 | 13 |
| **B** | 29 | 31 | 30 | 28 | X/14 |
| **C** | 24 | 28 | 27 | 22 | X/17 |
| **D** | 21 | 26 | 25 | 25 | 11 |
| **E** | 33 | 31 | 21 | 23 | 20 |
| **F** | 31 | 28 | 25 | 23 | 9 |
| **G** | 28 | 27 | 28 | 25 | 21 |
| **H** | 33 | 31 | 24 | 24 | 21 |
| **I** | 31 | 28 | 33 | 25 | 6 |
| **J** | 31 | 26 | 29 | 15 | 15 |
| **Mean** | **28.2** | **28.1** | **26.8** | **23.2** | **14.7** |
| **CV%** | **16.4** | **7.9** | **12.7** | **14.6** | **35.0** |

*Coefficient of Variation% = Standard Deviation x 100/Mean

## CHRONIC TOXICITY SUMMARY FORM

## WET Testing *Ceriodaphnia dubia* (Cladoceran)

## CHEMICAL PARAMETERS CHART

Permittee: Fayetteville - TDS
NPDES No.: AR0020010
Contact: Bruce Richart

Sample No. 1 Collected Ending Date: 04/23/12 Time: 1803
Sample No. 2 Collected Ending Date: 04/23/12 Time: 2345
Sample No. 3 Collected Ending Date: 04/24/12 Time: 0601
Sample No. 4 Collected Ending Date: 04/24/12 Time: 1158

Analyst: Griffin/Woodruff

Test Begin: Date: 04/27/12 Time: 1620 Test End: Date: 05/04/12 Time: 1545

| Initial Water Chemistry for Chronic Tests | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Project: Fayetteville TDS – *C. dubia* | | | | | | | | |
| Test day | | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| Date | | 4/27/2012 | 4/28/2012 | 4/29/2012 | 4/30/2012 | 5/1/2012 | 5/2/2012 | 5/3/2012 |
| $H_2O$ # | | MH 863 | MH 863 | MH 863 | MH 863 | MH 863 | MH 864 | MH 864 |
| Temp (°C) | ModHard Control | 23.2 | 23.2 | 23.5 | 23.0 | 22.9 | 24.0 | 24.0 |
| | Effluent control | 23.2 | 23.1 | 23.5 | 23.0 | 22.9 | 24.0 | 24.0 |
| | 2.5X | 23.0 | 23.2 | 23.5 | 23.0 | 23.0 | 24.0 | 23.9 |
| | 3.4X | 23.1 | 23.2 | 23.5 | 23.0 | 23.0 | 24.0 | 24.0 |
| | 4.5X | 23.1 | 23.2 | 23.5 | 23.0 | 23.1 | 24.0 | 23.9 |
| | 6X | 23.2 | 23.2 | 23.5 | 23.0 | 23.0 | 24.0 | 23.9 |
| | 8X | 23.2 | 23.2 | 23.5 | 23.0 | 23.0 | 24.0 | 24.0 |
| pH (Standard Units) | ModHard Control | 7.77 | 8.09 | 7.83 | 7.78 | 7.74 | 7.84 | 7.67 |
| | Effluent control | 7.76 | 7.58 | 8.17 | 8.13 | 7.87 | 7.94 | 7.97 |
| | 2.5X | 8.75 | 8.70 | 8.77 | 8.68 | 8.52 | 8.52 | 8.65 |
| | 3.4X | 8.83 | 8.79 | 8.84 | 8.73 | 8.60 | 8.64 | 8.73 |
| | 4.5X | 8.93 | 8.87 | 8.91 | 8.81 | 8.66 | 8.72 | 8.77 |
| | 6X | 9.02 | 8.96 | 8.97 | 8.89 | 8.74 | 8.77 | 8.89 |
| | 8X | 9.09 | 9.01 | 9.03 | 8.95 | 8.79 | 8.82 | 8.96 |
| DO (mg/L) | ModHard Control | 8.5 | 6.7 | 8.0 | 8.6 | 7.8 | 8.4 | 7.7 |
| | Effluent control | 8.8 | 8.3 | 7.5 | 7.9 | 7.2 | 7.8 | 8.4 |
| | 2.5X | 8.4 | 7.8 | 7.6 | 8.3 | 7.5 | 7.8 | 7.7 |
| | 3.4X | 7.5 | 7.4 | 7.2 | 8.3 | 7.3 | 7.8 | 7.6 |
| | 4.5X | 7.4 | 8.0 | 8.7 | 7.7 | 7.3 | 7.8 | 7.2 |
| | 6X | 7.5 | 8.4 | 9.0 | 8.3 | 7.8 | 8.4 | 7.9 |
| | 8X | 7.3 | 8.4 | 9.7 | 8.0 | 7.9 | 9.0 | 8.0 |
| Cond (µS/cm) | ModHard Control | 304 | 315 | 309 | 308 | 309 | 305 | 308 |
| | Effluent control | 603 | 601 | 600 | 600 | 624 | 594 | 592 |
| | 2.5X | 1737 | 1864 | 1840 | 1823 | 1792 | 1782 | 1797 |
| | 3.4X | 2090 | 2295 | 2235 | 2233 | 2194 | 2188 | 2179 |
| | 4.5X | 2568 | 2868 | 2800 | 2779 | 2771 | 2715 | 2705 |
| | 6X | 3210 | 3540 | 3530 | 3470 | 3360 | 3460 | 3360 |
| | 8X | 3970 | 4610 | 4480 | 4380 | 4220 | 4440 | 4240 |

## CHRONIC TOXICITY SUMMARY FORM

## WET Testing *Ceriodaphnia dubia* (Cladoceran)

## CHEMICAL PARAMETERS CHART

Permittee: Fayetteville - TDS
NPDES No.: AR0020010
Contact: Bruce Richart

Sample No. 1 Collected Ending Date: 04/23/12 Time: 1803
Sample No. 2 Collected Ending Date: 04/23/12 Time: 2345
Sample No. 3 Collected Ending Date: 04/24/12 Time: 0601
Sample No. 4 Collected Ending Date: 04/24/12 Time: 1158

Analyst: Griffin/Woodruff

Test Begin: Date: 04/27/12 Time: 1620 Test End: Date: 05/04/12 Time: 1545

| Final Water Chemistry for Chronic Tests | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Project: Fayetteville TDS – *C. dubia* | | | | | | | | |
| Test day | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Date | | 4/28/2012 | 4/29/2012 | 4/30/2012 | 5/1/2012 | 5/2/2012 | 5/3/2012 | 5/4/2012 |
| $H_2O$ # | | MH 863 | MH 863 | MH 863 | MH 863 | MH 863 | MH 864 | MH 864 |
| Temp (°C) | ModHard Control | 24.0 | 23.0 | 23.0 | 22.7 | 23.5 | 23.5 | 24.0 |
| | Effluent control | 23.0 | 23.0 | 23.0 | 22.7 | 23.5 | 23.5 | 24.0 |
| | 2.5X | 23.0 | 23.0 | 22.5 | 22.7 | 23.5 | 23.5 | 24.0 |
| | 3.4X | 23.0 | 23.0 | 22.7 | 22.8 | 23.5 | 23.6 | 23.9 |
| | 4.5X | 23.0 | 23.0 | 22.5 | 22.8 | 23.5 | 23.6 | 23.9 |
| | 6X | 23.0 | 23.0 | 22.2 | 22.7 | 23.5 | 23.7 | 24.0 |
| | 8X | 23.0 | 23.0 | 22.2 | 22.7 | 23.5 | 23.7 | 24.0 |
| pH (Standard Units) | ModHard Control | 8.15 | 7.91 | 7.79 | 8.00 | 7.60 | 7.76 | 7.53 |
| | Effluent control | 8.32 | 8.39 | 8.21 | 8.19 | 8.13 | 8.20 | 8.12 |
| | 2.5X | 8.76 | 8.83 | 8.68 | 8.63 | 8.54 | 8.64 | 8.58 |
| | 3.4X | 8.87 | 9.01 | 8.77 | 8.74 | 8.67 | 8.80 | 8.69 |
| | 4.5X | 8.99 | 9.04 | 8.87 | 8.78 | 8.75 | 8.77 | 8.78 |
| | 6X | 9.09 | 9.23 | 8.95 | 8.90 | 8.85 | 8.93 | 8.92 |
| | 8X | 9.18 | 9.21 | 9.04 | 8.97 | 8.99 | 9.02 | 9.02 |
| DO (mg/L) | ModHard Control | 7.7 | 7.5 | 7.6 | 8.7 | 6.9 | 8.6 | 7.1 |
| | Effluent control | 7.2 | 7.8 | 8.1 | 9.3 | 7.8 | 8.2 | 7.9 |
| | 2.5X | 7.2 | 8.3 | 8.2 | 8.8 | 8.2 | 8.3 | 7.7 |
| | 3.4X | 7.9 | 9.5 | 7.6 | 8.7 | 7.3 | 8.1 | 7.7 |
| | 4.5X | 7.1 | 8.9 | 8.4 | 8.3 | 7.4 | 7.8 | 8.1 |
| | 6X | 7.6 | 9.7 | 8.1 | 7.9 | 8.0 | 7.8 | 8.1 |
| | 8X | 8.4 | 8.7 | 8.3 | 8.4 | 7.4 | 8.1 | 7.4 |

## Ceriodaphnia Survival and Reproduction Test-7 Day Survival

| | | | | | |
|---|---|---|---|---|---|
| Start Date: | 4/27/2012 16:20 | Test ID: | Apr-12 | Sample ID: | NPDES Permit #AR0020010 |
| End Date: | 5/4/2012 15:45 | Lab ID: | ASU ERF | Sample Type: | |
| Sample Date: | | Protocol: | EPAF 02-EPA Freshwater | Test Species: | CD-Ceriodaphnia dubia |
| Comments: | | | | | |

| Conc-% | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| D-Control | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 2.5 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 3.4 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 4.5 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 6 | 1.0000 | 0.0000 | 0.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 | 1.0000 |
| 8 | 1.0000 | 0.0000 | 1.0000 | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.0000 |

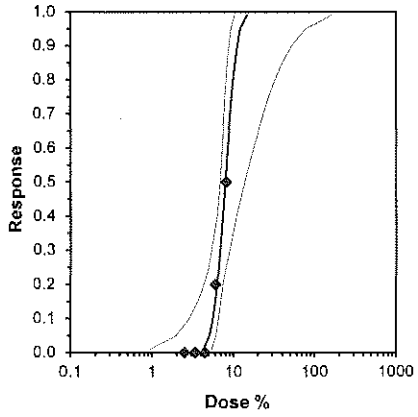
| Conc-% | Mean | N-Mean | Resp | Not Resp | Total | N | Fisher's Exact P | 1-Tailed Critical | Number Resp | Total Number |
|---|---|---|---|---|---|---|---|---|---|---|
| D-Control | 1.0000 | 1.0000 | 0 | 10 | 10 | 10 | | | 0 | 10 |
| 2.5 | 1.0000 | 1.0000 | 0 | 10 | 10 | 10 | 1.0000 | 0.0500 | 0 | 10 |
| 3.4 | 1.0000 | 1.0000 | 0 | 10 | 10 | 10 | 1.0000 | 0.0500 | 0 | 10 |
| 4.5 | 1.0000 | 1.0000 | 0 | 10 | 10 | 10 | 1.0000 | 0.0500 | 0 | 10 |
| 6 | 0.8000 | 0.8000 | 2 | 8 | 10 | 10 | 0.2368 | 0.0500 | 2 | 10 |
| *8 | 0.5000 | 0.5000 | 5 | 5 | 10 | 10 | 0.0163 | 0.0500 | 5 | 10 |

| Hypothesis Test (1-tail, 0.05) | NOEC | LOEC | ChV | TU |
|---|---|---|---|---|
| Fisher's Exact Test | 6 | 8 | 6.9282 | 16.6667 |

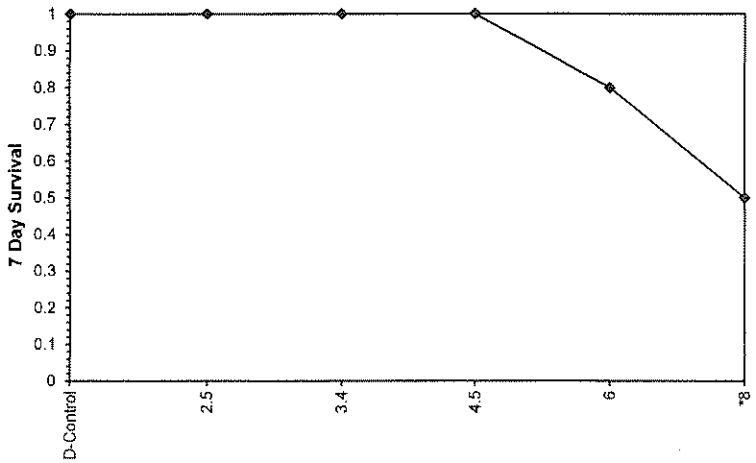
### Maximum Likelihood-Probit

| Parameter | Value | SE | 95% Fiducial Limits | | Control | Chi-Sq | Critical | P-value | Mu | Sigma | Iter |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Slope | 8.84065 | 3.43187 | 2.11419 | 15.5671 | 0 | 0.39323 | 7.81473 | 0.94 | 0.89493 | 0.11311 | 5 |
| Intercept | -2.91172 | 2.8738 | -8.54437 | 2.72092 | | | | | | | |
| TSCR | | | | | | | | | | | |

| Point | Probits | % | 95% Fiducial Limits | |
|---|---|---|---|---|
| EC01 | 2.674 | 4.28335 | 0.95059 | 5.39722 |
| EC05 | 3.355 | 5.11529 | 1.96158 | 6.07687 |
| EC10 | 3.718 | 5.62295 | 2.85438 | 6.54565 |
| EC15 | 3.964 | 5.99364 | 3.63365 | 6.96317 |
| EC20 | 4.158 | 6.3056 | 4.33944 | 7.41952 |
| EC25 | 4.326 | 6.58615 | 4.96312 | 7.97705 |
| EC40 | 4.747 | 7.34968 | 6.24548 | 10.6729 |
| EC50 | 5.000 | 7.85101 | 6.76389 | 13.4822 |
| EC60 | 5.253 | 8.38654 | 7.18589 | 17.3613 |
| EC75 | 5.674 | 9.35879 | 7.8046 | 26.9131 |
| EC80 | 5.842 | 9.77518 | 8.04 | 32.1252 |
| EC85 | 6.036 | 10.284 | 8.31311 | 39.5365 |
| EC90 | 6.282 | 10.9619 | 8.65861 | 51.4043 |
| EC95 | 6.645 | 12.0498 | 9.18112 | 75.9853 |
| EC99 | 7.326 | 14.3902 | 10.2148 | 158.678 |




### Dose-Response Plot



## Ceriodaphnia Survival and Reproduction Test-Reproduction

| | | | | | |
|---|---|---|---|---|---|
| Start Date: | 4/27/2012 16:20 | Test ID: | Apr-12 | Sample ID: | NPDES Permit #AR0020010 |
| End Date: | 5/4/2012 15:45 | Lab ID: | ASU ERF | Sample Type: | EFF1-POTW |
| Sample Date: | | Protocol: | EPAF 02-EPA Freshwater | Test Species: | CD-Ceriodaphnia dubia |
| Comments: | | | | | |

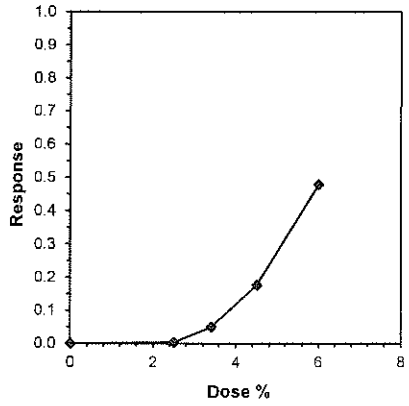
| Conc-% | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| D-Control | 21.000 | 29.000 | 24.000 | 21.000 | 33.000 | 31.000 | 28.000 | 33.000 | 31.000 | 31.000 |
| 2.5 | 25.000 | 31.000 | 28.000 | 26.000 | 31.000 | 28.000 | 27.000 | 31.000 | 28.000 | 26.000 |
| 3.4 | 26.000 | 30.000 | 27.000 | 25.000 | 21.000 | 25.000 | 28.000 | 24.000 | 33.000 | 29.000 |
| 4.5 | 22.000 | 28.000 | 22.000 | 25.000 | 23.000 | 23.000 | 25.000 | 24.000 | 25.000 | 15.000 |
| 6 | 13.000 | 14.000 | 17.000 | 11.000 | 20.000 | 9.000 | 21.000 | 21.000 | 6.000 | 15.000 |

| | | | Transform: Untransformed | | | | | 1-Tailed | | | Isotonic | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Conc-% | Mean | N-Mean | Mean | Min | Max | CV% | N | t-Stat | Critical | MSD | Mean | N-Mean |
| D-Control | 28.200 | 1.0000 | 28.200 | 21.000 | 33.000 | 16.362 | 10 | | | | 28.200 | 1.0000 |
| 2.5 | 28.100 | 0.9965 | 28.100 | 25.000 | 31.000 | 7.949 | 10 | 0.057 | 2.223 | 3.870 | 28.100 | 0.9965 |
| 3.4 | 26.800 | 0.9504 | 26.800 | 21.000 | 33.000 | 12.660 | 10 | 0.804 | 2.223 | 3.870 | 26.800 | 0.9504 |
| *4.5 | 23.200 | 0.8227 | 23.200 | 15.000 | 28.000 | 14.624 | 10 | 2.872 | 2.223 | 3.870 | 23.200 | 0.8227 |
| *6 | 14.700 | 0.5213 | 14.700 | 6.000 | 21.000 | 34.990 | 10 | 7.755 | 2.223 | 3.870 | 14.700 | 0.5213 |

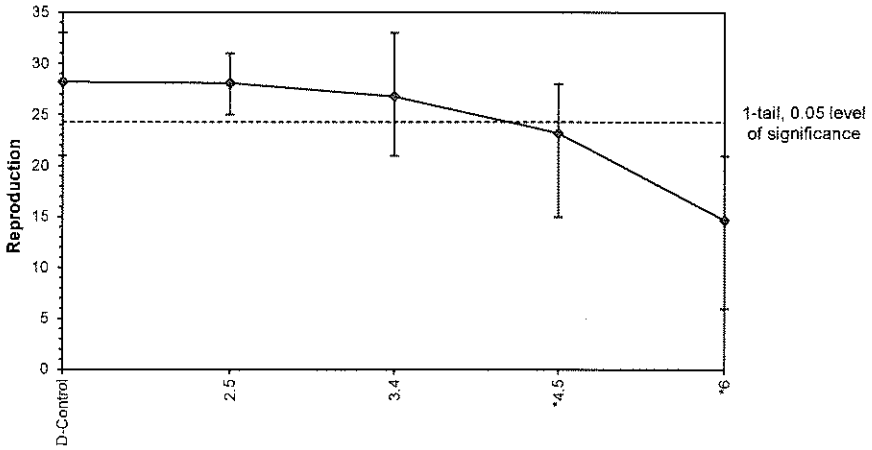
| Auxiliary Tests | | | | | Statistic | | Critical | | Skew | Kurt |
|---|---|---|---|---|---|---|---|---|---|---|
| Shapiro-Wilk's Test indicates normal distribution (p > 0.01) | | | | | 0.95646 | | 0.93 | | -0.45872 | -0.07877 |
| Bartlett's Test indicates equal variances (p = 0.16) | | | | | 6.57375 | | 13.2767 | | | |
| **Hypothesis Test (1-tail, 0.05)** | **NOEC** | **LOEC** | **ChV** | **TU** | **MSDu** | **MSDp** | **MSB** | **MSE** | **F-Prob** | **df** |
| Dunnett's Test | 3.4 | 4.5 | 3.91152 | 29.4118 | 3.87027 | 0.13724 | 323.05 | 15.1511 | 6.4E-10 | 4, 45 |

### Linear Interpolation (80 Resamples)

| Point | % | SD | 95% CL | | Skew |
|---|---|---|---|---|---|
| IC05 | 3.4031 | 0.7540 | 1.2970 | 3.8033 | -0.9070 |
| IC10 | 3.8339 | 0.4516 | 2.5895 | 4.3298 | -0.8849 |
| IC15 | 4.2647 | 0.3688 | 3.4262 | 4.6300 | -0.4691 |
| IC20 | 4.6129 | 0.2961 | 3.8982 | 4.9110 | -0.5804 |
| IC25 | 4.8618 | 0.2478 | 4.1797 | 5.1725 | -0.5941 |
| IC40 | 5.6082 | | | | |
| IC50 | >6 | | | | |




### Dose-Response Plot






ToxCalc v5.0

Reviewed by:

Arkansas State University
Ecotoxicology Research Facility

# CHRONIC TEST DATA SHEET

## *Ceriodaphnia dubia*

Project: Fayetteville TDS Beginning Date: 042712 Time: 1620 Test Species: *C. dubia*

Dilution $H_2O$: Moland effluent Ending Date: 050412 Time: 1545 Age: < 24h - middle & last

Test Type: ( * )Static Renewal ( ) Flowthrough Toxicant/Effluent: _____

| Conc. | Rep | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 | Neonates |
|---|---|---|---|---|---|---|---|---|---|
| MH Control | 1 | 0 | 0 | 0 | 0 | 2 | 7 | 0 | 9 |
| | 2 | | | | 4 | 0 | 7 | 12 | 23 |
| | 3 | | | | 5 | 7 | 0 | 9 | 21 |
| | 4 | | | | 0 | 0 | 7 | 10 | 17 |
| | 5 | | | | 4 | 4 | 0 | 11 | 19 |
| | 6 | | | | 2 | 0 | 3 | 8 | 13 |
| | 7 | | | | 5 | 5 | 0 | 10 | 20 |
| | 8 | | | | 3 | 0 | 7 | 10 | 20 |
| | 9 | | | | 4 | 0 | 7 | 10 | 21 |
| | 10 | | | | 5 | 0 | 9 | 11 | 25 |
| Effluent Control | 1 | 0 | 0 | 0 | 4 | 6 | 0 | 11 | 21 |
| | 2 | | | | 4 | 9 | 0 | 16 | ~~25~~ MG 29 |
| | 3 | | | | 4 | 5 | 0 | 15 | 24 |
| | 4 | | | | 4 | 5 | 0 | 12 | 21 |
| | 5 | | | | 5 | 0 | 12 | 16 | ~~32~~ MG 33 |
| | 6 | | | | 6 | 8 | 1 | 16 | ~~32~~ MG 31 |
| | 7 | | | | 0 | 4 | 10 | 14 | 28 |
| | 8 | | | | 4 | 1 | 8 | 20 | 33 |
| | 9 | | | | 4 | 0 | 13 | 14 | 31 |
| | 10 | | | | 0 | 5 | 12 | 14 | 31 |
| Date | | 042812 | 042912 | 043012 | 050112 | 050212 | 050312 | 050412 | 050412 |
| Initials | | MG | MG | MG | MG | MG | MG | MG | MG |

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# CHRONIC TEST DATA SHEET

## *Ceriodaphnia dubia*

Project: Fayetteville TDS  Beginning Date: 042712  Time: 1620  Test Species: *C. dubia*

Dilution $H_2O$: NoLand effluent  Ending Date: 050412  Time: 1545  Age: <24h  wisdom & Mook

Test Type: ( * )Static Renewal ( ) Flowthrough  Toxicant/Effluent: _____

| Conc. | Rep | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 | Neonates |
|---|---|---|---|---|---|---|---|---|---|
| 2.5 X | 1 | 0 | 0 | 0 | 5 | 7 | mort/0 | 13 | 25 |
| | 2 | | | | 6 | 9 | 0 | 16 | 31 |
| | 3 | | | | 6 | 9 | mort/0 | 13 | 28 |
| | 4 | | | | 5 | 8 | mort/0 | 13 | 26 |
| | 5 | | | | 5 | 0 | 9 | 17 | 31 |
| | 6 | | | | 4 | 8 | mort/0 | 16 | 28 |
| | 7 | | | | 4 | 9 | 0 | 14 | 27 |
| | 8 | | | | 5 | 10 | 0 | 16 | 31 |
| | 9 | | | | 5 | 7 | mort/0 | 16 | 28 |
| | 10 | ↓ | ↓ | ↓ | 4 | 0 | 8 | 14 | 26 |
| 3.4 X | 1 | 0 | 0 | 0 | 5 | 6 | mort/1 | 14 | 26 |
| | 2 | | | | 5 | 10 | 0 | 15 | 30 |
| | 3 | | | | 5 | 0 | 8 | 14 | 27 |
| | 4 | | | | 5 | 0 | mort/8 | 12 | 25 |
| | 5 | | | | 5 | 1 | mort/0 | 15 | 21 |
| | 6 | | | | 5 | 6 | mort/2 | 12 | 25 |
| | 7 | | | | 6 | 8 | 0 | 14 | 28 |
| | 8 | | | | 5 | 7 | 0 | 12 | 24 |
| | 9 | | | | 6 | 0 | 10 | 17 | 33 |
| | 10 | ↓ | ↓ | ↓ | 6 | 0 | 8 | 15 | 29 |
| Date | | 042912 | 042912 | 043012 | 050112 | 050212 | 050312 | 050412 | 050412 |
| Initials | | LMG | LMG | LMG | LMG | LMG | LMG | LMG | LMG |

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# CHRONIC TEST DATA SHEET

## *Ceriodaphnia dubia*

Project: Fayetteville TDS  Beginning Date: 042712  Time: 1620  Test Species: *C. dubia*

Dilution $H_2O$: Noland effluent  Ending Date: 050412  Time: 1545  Age: <24h within 8 hr clock

Test Type: ( * )Static Renewal ( ) Flowthrough  Toxicant/Effluent: _____

| Conc. | Rep | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 | Neonates |
|---|---|---|---|---|---|---|---|---|---|
| 4.5 X | 1 | 0 | 0 | 0 | 4 | 8 | 0 | 10 | 22 |
| | 2 | | | | 6 | 10 | 0 | 12 | 28 |
| | 3 | | | | 6 | 7 | 0 | 9 | 22 |
| | 4 | | | | 6 | 8 | 1 | 10 | 25 |
| | 5 | | | | 5 | 9 | 0 | 9 | 23 |
| | 6 | | | | 5 | 8 | 0 | 10 | ~~22~~ 23 LMG |
| | 7 | | | | 4 | 9 | 0 | 12 | 25 |
| | 8 | | | | 6 | 6 | 0 | 12 | 24 |
| | 9 | | | | 4 | 0 | 10 | 11 | 25 |
| | 10 | | | | 2 | 0 | 5 | 8 | 15 |
| 6 X | 1 | 0 | 0 | 0 | 3 | 5 | 0 | 5 | 13 |
| | 2 | | | | 3 | 6 | 5 | X/0 | X/14 |
| | 3 | | | | 5 | 8 | 0 | X/4 | X/17 |
| | 4 | | | | 3 | 5 | 0 | 3 | 11 |
| | 5 | | | | 5 | 6 | ~~4~~ 2 | 7 | 20 |
| | 6 | | | | 2 | 4 | 0 | 3 | 9 |
| | 7 | | | | 5 | 7 | 0 | 9 | 21 |
| | 8 | | | | 3 | 9 | 0 | 9 | 21 |
| | 9 | | | | 5 | 1 | 0 | 0 | 6 |
| | 10 | | | | 4 | 0 | 3 | 8 | 15 |
| Date | | 042812 | ~~042912~~ | 043012 | 050112 | 050212 | 050312 | 050412 | 050412 |
| Initials | | LMG | LMG | LMG | LMG | LMG | LMG | LMG | LMG |

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# CHRONIC TEST DATA SHEET

## *Ceriodaphnia dubia*

Project: Fayetteville TDS  Beginning Date: 042712  Time: 1620  Test Species: *C. dubia*

Dilution $H_2O$: Natural effluent  Ending Date: 050412  Time: 1545  Age: < 24h within 8 hr hatch

Test Type: ( * )Static Renewal ( ) Flowthrough  Toxicant/Effluent:

| Conc. | Rep | Day 1 | Day 2 | Day 3 | Day 4 | Day 5 | Day 6 | Day 7 | Neonates |
|---|---|---|---|---|---|---|---|---|---|
| 8 X | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 2 | | | | X/0 | — | — | — | — |
| | 3 | | | | 0 | 0 | 0 | 0 | 0 |
| | 4 | | | | 0 | 0 | 0 | 0 | 0 |
| | 5 | | ↓ | ↓ | 0 | 0 | 0 | 0 | 0 |
| | 6 | | X/0 | — | — | — | — | — | — |
| | 7 | | 0 | 0 | X/0 | — | — | — | — |
| | 8 | | X/0 | — | — | — | — | — | — |
| | 9 | | X/0 | — | — | — | — | — | — |
| | 10 | ↓ | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Date | | 042812 | 042912 | 043012 | 050112 | 050212 | 050312 | 050412 | 050412 |
| Initials | | LMS | LMG | LMG | LMG | LMG | LMG | LMS | LMG |

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## Initial Water Chemistry for Chronic Tests

Project: ~~ERIT~~ - *C. dubia*
Fayetteville

| | | Test Day: | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|---|
| | | Date: | 042712 | 042912 | 042912 | 043012 | 050112 | 050212 | 050312 |
| | | $H_2O$ Batch #: | MH863 | MH863 | MH863 | MH863 | MH863 | MH864 | MH864 |
| Temp. (°C) | Mod Hard Control | | 23.2 | 23.2 | 23.5 | 23.0 | 22.9 | 24.0 | 24.0 |
| | Effluent Control | | 23.2 | 23.1 | 23.5 | 23.0 | 22.9 | 24.0 | 24.0 |
| | 2.5 X | | 23.0 | 23.2 | 23.5 | 23.0 | 23.0 | 24.0 | 23.9 |
| | 3.4 X | | 23.1 | 23.2 | 23.5 | 23.0 | 23.0 | 24.0 | 24.0 |
| | 4.5 X | | 23.1 | 23.2 | 23.5 | 23.0 | 23.1 | 24.0 | 23.9 |
| | 6 X | | 23.2 | 23.2 | 23.5 | 23.0 | 23.0 | 24.0 | 23.9 |
| | 8 X | | 23.2 | 23.2 | 23.4 | 23.0 | 23.0 | 24.0 | 24.0 |
| pH | Mod Hard Control | | 7.77 | 8.09 | 7.83 | 7.78 | 7.74 | 7.84 | 7.67 |
| | Effluent Control | | 7.76 | 7.58 | 8.17 | 8.13 | 7.87 | 7.94 | 7.97 |
| | 2.5 X | | 8.75 | 8.70 | 8.77 | 8.68 | 8.52 | 8.52 | 8.65 |
| | 3.4 X | | 8.83 | 8.79 | 8.84 | 8.73 | 8.60 | 8.64 | 8.73 |
| | 4.5 X | | 8.93 | 8.87 | 8.91 | 8.81 | 8.66 | 8.72 | 8.77 |
| | 6 X | | 9.02 | 8.96 | 8.97 | 8.89 | 8.74 | 8.77 | 8.89 |
| | 8 X | | 9.09 | 9.01 | 9.03 | 8.95 | 8.79 | 8.82 | 8.96 |
| DO (mg/L) | Mod Hard Control | | 8.5 | 6.7 | 8.0 | 8.6 | 7.8 | 8.4 | 7.7 |
| | Effluent Control | | 8.8 | 8.3 | 7.5 | 7.9 | 7.2 | 7.8 | 8.4 |
| | 2.5 X | | 8.4 | 7.8 | 7.6 | 8.3 | 7.5 | 7.8 | 7.7 |
| | 3.4 X | | 7.5 | 7.4 | 7.2 | 8.3 | 7.3 | 7.8 | 7.6 |
| | 4.5 X | | 7.4 | 8.0 | 8.7 | 7.7 | 7.3 | 7.8 | 7.2 |
| | 6 X | | 7.5 | 8.4 | 9.0 | 8.3 | 7.8 | 8.4 | 7.9 |
| | 8 X | | 7.3 | 8.4 | 9.7 | 8.0 | 7.9 | 9.0 | 8.0 |
| Cond. (µS/cm) | Mod Hard Control | | 304 | ~~340~~ 315 | 309 | 308 | 309 | 305 | 308 |
| | Effluent Control | | 603 | 601 | 600 | 600 | 624 | 594 | 592 |
| | 2.5 X | | 1737 | 1864 | 1840 | 1823 | 1792 | 1782 | 1797 |
| | 3.4 X | | 2090 | 2295 | 2235 | 2233 | 2194 | 2188 | 2179 |
| | 4.5 X | | 2568 | 2868 | 2800 | 2779 | 2771 | 2715 | 2705 |
| | 6 X | | 3210 | 3540 | 3530 | ~~3490~~ | 3360 | 3460 | 3360 |
| | 8 X | | 3970 | 4610 | 4480 | 4380 | 4220 | 4440 | 4240 |
| Alk. (mg/L) | Control | | | | | | | | |
| | 17% | | | | | | | | |
| Hard. (mg/L) | Control | | | | | | | | |
| | 17% | | | | | | | | |
| Initials | | | TW MG | LRD LMC | MG/TW | MF MG | LMG | MF LMG TC | LMG |

Arkansas State University
Ecotoxicology Research Facility

# Final Water Chemistry for Chronic Tests

Project: ~~FRIT~~ - C. *dubia*
Fayetteville

| | | Test Day: | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|---|
| | | Date: | 042912 | 042912 | 043012 | 050112 | 050212 | 050212 | 050312 |
| | | $H_2O$ Batch #: | MH863 | MH863 | MH863 | MH863 | MH864 HF 3 | MH864 | MH864 |
| Temp. (°C) | Mod Hard Control | | 24.0 | 23.0 | 23.0 | 22.7 | 23.5 | 23.5 | 24.0 |
| | Effluent Control | | 23.0 | 23.0 | 23.0 | 22.7 | 23.5 | 23.5 | 24.0 |
| | 2.5 X | | 23.0 | 23.0 | 22.5 | 22.7 | 23.5 | 23.5 | 24.0 |
| | 3.4 X | | 23.0 | 23.0 | 22.7 | 22.8 | 23.5 | 23.6 | 23.9 |
| | 4.5 X | | 23.0 | 23.0 | 22.5 | 22.8 | 23.5 | 23.6 | 23.9 |
| | 6 X | | 23.0 | 23.0 | 22.2 | 22.7 | 23.5 | 23.7 | 24.0 |
| | 8 X | | 23.0 | 23.0 | 22.2 | 22.7 | 23.5 | 23.7 | 24.0 |
| pH | Mod Hard Control | | 8.15 | 7.91 | ~~7.78~~ 7.79 HF | 8.00 | 7.60 | 7.76 | 7.53 |
| | Effluent Control | | 8.32 | 8.39 | 8.21 | 8.19 | 8.13 | 8.20 | 8.12 |
| | 2.5 X | | 8.76 | 8.83 | 8.68 | 8.63 | 8.54 | 8.64 | 8.58 |
| | 3.4 X | | 8.87 | 9.01 | 8.77 | 8.74 | 8.67 | 8.80 | 8.69 |
| | 4.5 X | | 8.99 | 9.04 | 8.87 | 8.78 | 8.75 | 8.77 | 8.78 |
| | 6 X | | 9.09 | 9.23 | 8.95 | 8.90 | 8.85 | 8.93 | 8.92 |
| | 8 X | | 9.18 | 9.21 | 9.04 | 8.97 | 8.99 | 9.02 | 9.02 |
| DO (mg/L) | Mod Hard Control | | 7.7 | 7.5 | 7.6 | 8.7 | 6.9 | 8.6 | 7.1 |
| | Effluent Control | | 7.2 | 7.8 | 8.1 | 9.3 | 7.8 | 8.2 | 7.9 |
| | 2.5 X | | 7.2 | 8.3 | 8.2 | 8.8 | 8.2 | 8.3 | 7.7 |
| | 3.4 X | | 7.9 | 9.5 | 7.6 | 8.7 | 7.3 | 8.1 | 7.7 |
| | 4.5 X | | 7.1 | 8.9 | 8.4 | 8.3 | 7.4 | 7.8 | 8.1 |
| | 6 X | | 7.6 | 9.7 | 8.1 | 7.9 | 8.0 | 7.8 | 8.1 |
| | 8 X | | 8.4 | 8.7 | 8.3 | 8.4 | 7.4 | 8.1 | 7.4 |
| Initials | | | MG/CMS | MG | HF MG | MG | MG | MG | MG |

CH2M HILL
ATTN: Mr. Bruce Richart
1400 North Fox Hunter Road
Fayetteville, AR 72701

This report contains the analytical results and supporting information for samples submitted on May 1, 2012. Attached please find a copy of the Chain of Custody and/or other documents received. Note that any remaining sample will be discarded two weeks from the original report date unless other arrangements are made.

This report is intended for the sole use of the client listed above. Assessment of the data requires access to the entire document.

This report has been reviewed by the Laboratory Director or a qualified designee.

Steve Bradford
Deputy Laboratory Director

This document has been distributed to the following:

PDF cc: CH2M HILL
ATTN: Mr. Bruce Richart
robert.richart@ch2m.com

AMERICAN INTERPLEX CORPORATION LABORATORIES

40 1972 2012

CH2M HILL
1400 North Fox Hunter Road
Fayetteville, AR 72701

## SAMPLE INFORMATION

**Project Description:**
Twelve (12) water sample(s) received on May 1, 2012
Fayetteville (ASU)

**Receipt Details:**
A Chain of Custody was provided. The samples were delivered in one (1) ice chest.
Ice chest #1 was delivered with shipping documentation.

Each sample container was checked for proper labeling, including date and time sampled. Sample containers were reviewed for proper type, adequate volume, integrity, temperature, preservation, and holding times. Any exceptions are noted below:

**Sample Identification:**

| Laboratory ID | Client Sample ID | Sampled Date/Time | Notes |
|---|---|---|---|
| 157362-1 | Mod Hard Water 042712 | 27-Apr-2012 | 1 |
| 157362-2 | Effluent 042712 | 27-Apr-2012 | 1 |
| 157362-3 | 2.5X 042712 | 27-Apr-2012 | 1 |
| 157362-4 | 3.4X 042712 | 27-Apr-2012 | 1 |
| 157362-5 | 4.5X 042712 | 27-Apr-2012 | 1 |
| 157362-6 | 6X 042712 | 27-Apr-2012 | 1 |
| 157362-7 | 8X 042712 | 27-Apr-2012 | 1 |
| 157362-8 | 2.5X 042812 | 28-Apr-2012 | 1 |
| 157362-9 | 3.4X 042812 | 28-Apr-2012 | 1 |
| 157362-10 | 4.5X 042812 | 28-Apr-2012 | 1 |
| 157362-11 | 6X 042812 | 28-Apr-2012 | 1 |
| 157362-12 | 8X 042812 | 28-Apr-2012 | 1 |

Notes:
1. Sample label was incomplete in regard to date/time of sampling

**Qualifiers:**
D Result is from a secondary dilution factor
X Spiking level is invalid due to the high concentration of analyte in the spiked sample

**References:**
"Methods for Chemical Analysis of Water and Wastes", EPA/600/4-79-020 (Mar 1983) with updates and supplements EPA/600/5-91-010 (Jun 1991), EPA/600/R-92-129 (Aug 1992) and EPA/600/R-93-100 (Aug 1993).
"Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846)", Third Edition.
"Standard Methods for the Examination of Water and Wastewaters", 20th edition, 1998.
"American Society for Testing and Materials" (ASTM).
"Association of Analytical Chemists" (AOAC).

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## ANALYTICAL RESULTS

**AIC No.** 157362-1
**Sample Identification:** Mod Hard Water 042712

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **62** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 06-May-2012 1020 by 93 | | Batch: W39736 | |
| **Total Dissolved Solids** | | **180** | 10 | **mg/l** | |
| SM 2540C | Prep: 03-May-2012 1635 by 285 | Analyzed: 07-May-2012 1119 by 285 | | Batch: W39716 | |
| **Calcium** | | **16** | 0.1 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 03-May-2012 0410 by 297 | | Batch: S32344 | |
| **Magnesium** | | **11** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 03-May-2012 0410 by 297 | | Batch: S32344 | |
| **Potassium** | | **2.7** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 03-May-2012 0410 by 297 | | Batch: S32344 | |
| **Sodium** | | **27** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 03-May-2012 0410 by 297 | | Batch: S32344 | |
| **Chloride** | | **3.1** | 0.2 | **mg/l** | |
| EPA 300.0 | Prep: 01-May-2012 1130 by 07 | Analyzed: 01-May-2012 1813 by 07 | | Batch: S32337 | |
| **Sulfate** | | **86** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 01-May-2012 1130 by 07 | Analyzed: 01-May-2012 1738 by 07 | | Batch: S32337 | Dil: 10 |

**AIC No.** 157362-2
**Sample Identification:** Effluent 042712

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **120** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 06-May-2012 1020 by 93 | | Batch: W39736 | |
| **Total Dissolved Solids** | | **360** | 10 | **mg/l** | |
| SM 2540C | Prep: 03-May-2012 1635 by 285 | Analyzed: 07-May-2012 1119 by 285 | | Batch: W39716 | |
| **Calcium** | | **45** | 0.1 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 03-May-2012 0413 by 297 | | Batch: S32344 | |
| **Magnesium** | | **4.4** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 03-May-2012 0413 by 297 | | Batch: S32344 | |
| **Potassium** | | **13** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 03-May-2012 0413 by 297 | | Batch: S32344 | |
| **Sodium** | | **61** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 03-May-2012 0413 by 297 | | Batch: S32344 | |
| **Chloride** | | **46** | 0.2 | **mg/l** | |
| EPA 300.0 | Prep: 01-May-2012 1448 by 07 | Analyzed: 02-May-2012 0028 by 07 | | Batch: S32337 | |
| **Sulfate** | | **54** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 01-May-2012 1448 by 07 | Analyzed: 01-May-2012 1921 by 07 | | Batch: S32337 | Dil: 10 |

**AIC No.** 157362-3
**Sample Identification:** 2.5X 042712

| Analyte | Result | RL | Units | Qualifier |
|---|---|---|---|---|
| **Alkalinity as CaCO3** | **300** | 1 | **mg/l** | |
| SM 2320B | Analyzed: 06-May-2012 1020 by 93 | | Batch: W39736 | |

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## ANALYTICAL RESULTS

**AIC No.** 157362-3 (Continued)
**Sample Identification:** 2.5X 042712

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Total Dissolved Solids** | | **1000** | 20 | **mg/l** | |
| SM 2540C | Prep: 03-May-2012 1635 by 285 | Analyzed: 07-May-2012 1119 by 285 | | Batch: W39716 | |
| **Calcium** | | **34** | 0.1 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 03-May-2012 0417 by 297 | | Batch: S32344 | |
| **Magnesium** | | **5.9** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 03-May-2012 0417 by 297 | | Batch: S32344 | |
| **Potassium** | | **19** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 03-May-2012 0417 by 297 | | Batch: S32344 | |
| **Sodium** | | **380** | 10 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 07-May-2012 2151 by 297 | | Batch: S32344 | Dil: 10 |
| **Chloride** | | **200** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 01-May-2012 1448 by 07 | Analyzed: 02-May-2012 0311 by 07 | | Batch: S32337 | Dil: 10 |
| **Sulfate** | | **220** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 01-May-2012 1448 by 07 | Analyzed: 02-May-2012 0311 by 07 | | Batch: S32337 | Dil: 10 |

**AIC No.** 157362-4
**Sample Identification:** 3.4X 042712

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **360** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 06-May-2012 1020 by 93 | | Batch: W39736 | |
| **Total Dissolved Solids** | | **1200** | 20 | **mg/l** | |
| SM 2540C | Prep: 03-May-2012 1635 by 285 | Analyzed: 07-May-2012 1119 by 285 | | Batch: W39716 | |
| **Calcium** | | **32** | 0.1 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 03-May-2012 0420 by 297 | | Batch: S32344 | |
| **Magnesium** | | **6.5** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 03-May-2012 0420 by 297 | | Batch: S32344 | |
| **Potassium** | | **21** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 03-May-2012 0420 by 297 | | Batch: S32344 | |
| **Sodium** | | **460** | 10 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 07-May-2012 2153 by 297 | | Batch: S32344 | Dil: 10 |
| **Chloride** | | **240** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 01-May-2012 1448 by 07 | Analyzed: 02-May-2012 0337 by 07 | | Batch: S32337 | Dil: 10 |
| **Sulfate** | | **270** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 01-May-2012 1448 by 07 | Analyzed: 02-May-2012 0337 by 07 | | Batch: S32337 | Dil: 10 |

**AIC No.** 157362-5
**Sample Identification:** 4.5X 042712

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **420** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 06-May-2012 1020 by 93 | | Batch: W39736 | |

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## ANALYTICAL RESULTS

**AIC No.** 157362-5 (Continued)
**Sample Identification:** 4.5X 042712

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Total Dissolved Solids** | | **1600** | 20 | **mg/l** | |
| SM 2540C | Prep: 03-May-2012 1635 by 285 | Analyzed: 07-May-2012 1119 by 285 | | Batch: W39716 | |
| **Calcium** | | **25** | 0.1 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 03-May-2012 0424 by 297 | | Batch: S32344 | |
| **Magnesium** | | **6.6** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 03-May-2012 0424 by 297 | | Batch: S32344 | |
| **Potassium** | | **22** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 03-May-2012 0424 by 297 | | Batch: S32344 | |
| **Sodium** | | **600** | 10 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 07-May-2012 2155 by 297 | | Batch: S32344 | Dil: 10 |
| **Chloride** | | **300** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 01-May-2012 1448 by 07 | Analyzed: 02-May-2012 1826 by 07 | | Batch: S32337 | Dil: 10 |
| **Sulfate** | | **340** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 01-May-2012 1448 by 07 | Analyzed: 02-May-2012 1826 by 07 | | Batch: S32337 | Dil: 10 |

**AIC No.** 157362-6
**Sample Identification:** 6X 042712

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **540** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 06-May-2012 1020 by 93 | | Batch: W39736 | |
| **Total Dissolved Solids** | | **2000** | 20 | **mg/l** | |
| SM 2540C | Prep: 03-May-2012 1635 by 285 | Analyzed: 07-May-2012 1119 by 285 | | Batch: W39716 | |
| **Calcium** | | **23** | 0.1 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 03-May-2012 0427 by 297 | | Batch: S32344 | |
| **Magnesium** | | **8.6** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 03-May-2012 0427 by 297 | | Batch: S32344 | |
| **Potassium** | | **30** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 03-May-2012 0427 by 297 | | Batch: S32344 | |
| **Sodium** | | **750** | 10 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 07-May-2012 2157 by 297 | | Batch: S32344 | Dil: 10 |
| **Chloride** | | **390** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 01-May-2012 1448 by 07 | Analyzed: 02-May-2012 1852 by 07 | | Batch: S32337 | Dil: 10 |
| **Sulfate** | | **440** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 01-May-2012 1448 by 07 | Analyzed: 02-May-2012 1852 by 07 | | Batch: S32337 | Dil: 10 |

**AIC No.** 157362-7
**Sample Identification:** 8X 042712

| Analyte | Result | RL | Units | Qualifier |
|---|---|---|---|---|
| **Alkalinity as CaCO3** | **690** | 1 | **mg/l** | |
| SM 2320B | Analyzed: 06-May-2012 1020 by 93 | | Batch: W39736 | |

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## ANALYTICAL RESULTS

**AIC No.** 157362-7 (Continued)
**Sample Identification:** 8X 042712

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Total Dissolved Solids** | | **2500** | 40 | **mg/l** | |
| SM 2540C | Prep: 03-May-2012 1635 by 285 | Analyzed: 07-May-2012 1119 by 285 | | Batch: W39716 | |
| **Calcium** | | **13** | 0.1 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 03-May-2012 0430 by 297 | | Batch: S32344 | |
| **Magnesium** | | **8.7** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 03-May-2012 0430 by 297 | | Batch: S32344 | |
| **Potassium** | | **31** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 03-May-2012 0430 by 297 | | Batch: S32344 | |
| **Sodium** | | **1000** | 10 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 0916 by 100 | Analyzed: 07-May-2012 2159 by 297 | | Batch: S32344 | Dil: 10 |
| **Chloride** | | **530** | 20 | **mg/l** | D |
| EPA 300.0 | Prep: 01-May-2012 1448 by 07 | Analyzed: 02-May-2012 0455 by 07 | | Batch: S32337 | Dil: 100 |
| **Sulfate** | | **590** | 20 | **mg/l** | D |
| EPA 300.0 | Prep: 01-May-2012 1448 by 07 | Analyzed: 02-May-2012 0455 by 07 | | Batch: S32337 | Dil: 100 |

**AIC No.** 157362-8
**Sample Identification:** 2.5X 042812

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **300** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 06-May-2012 1020 by 93 | | Batch: W39736 | |
| **Total Dissolved Solids** | | **990** | 20 | **mg/l** | |
| SM 2540C | Prep: 04-May-2012 1533 by 285 | Analyzed: 07-May-2012 1317 by 285 | | Batch: W39728 | |
| **Calcium** | | **32** | 0.1 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 04-May-2012 0803 by 297 | | Batch: S32353 | |
| **Magnesium** | | **5.6** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 04-May-2012 0803 by 297 | | Batch: S32353 | |
| **Potassium** | | **18** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 04-May-2012 0803 by 297 | | Batch: S32353 | |
| **Sodium** | | **360** | 10 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 07-May-2012 2203 by 297 | | Batch: S32353 | Dil: 10 |
| **Chloride** | | **200** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 01-May-2012 1448 by 07 | Analyzed: 02-May-2012 0638 by 07 | | Batch: S32337 | Dil: 10 |
| **Sulfate** | | **230** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 01-May-2012 1448 by 07 | Analyzed: 02-May-2012 0638 by 07 | | Batch: S32337 | Dil: 10 |

**AIC No.** 157362-9
**Sample Identification:** 3.4X 042812

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **350** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 06-May-2012 1020 by 93 | | Batch: W39736 | |

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Fayetteville, AR 72701

## ANALYTICAL RESULTS

**AIC No.** 157362-9 (Continued)
**Sample Identification:** 3.4X 042812

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Total Dissolved Solids** | | **1200** | 20 | **mg/l** | |
| SM 2540C | Prep: 04-May-2012 1533 by 285 | Analyzed: 07-May-2012 1317 by 285 | | Batch: W39728 | |
| **Calcium** | | **30** | 0.1 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 04-May-2012 0807 by 297 | | Batch: S32353 | |
| **Magnesium** | | **6.3** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 04-May-2012 0807 by 297 | | Batch: S32353 | |
| **Potassium** | | **21** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 04-May-2012 0807 by 297 | | Batch: S32353 | |
| **Sodium** | | **470** | 10 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 07-May-2012 2205 by 297 | | Batch: S32353 | Dil: 10 |
| **Chloride** | | **250** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 01-May-2012 1448 by 07 | Analyzed: 02-May-2012 0704 by 07 | | Batch: S32337 | Dil: 10 |
| **Sulfate** | | **290** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 01-May-2012 1448 by 07 | Analyzed: 02-May-2012 0704 by 07 | | Batch: S32337 | Dil: 10 |

**AIC No.** 157362-10
**Sample Identification:** 4.5X 042812

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **430** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 06-May-2012 1020 by 93 | | Batch: W39736 | |
| **Total Dissolved Solids** | | **1600** | 20 | **mg/l** | |
| SM 2540C | Prep: 04-May-2012 1533 by 285 | Analyzed: 07-May-2012 1317 by 285 | | Batch: W39728 | |
| **Calcium** | | **25** | 0.1 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 04-May-2012 0811 by 297 | | Batch: S32353 | |
| **Magnesium** | | **6.9** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 04-May-2012 0811 by 297 | | Batch: S32353 | |
| **Potassium** | | **23** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 04-May-2012 0811 by 297 | | Batch: S32353 | |
| **Sodium** | | **630** | 10 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 07-May-2012 2207 by 297 | | Batch: S32353 | Dil: 10 |
| **Chloride** | | **300** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 01-May-2012 1448 by 07 | Analyzed: 02-May-2012 1918 by 07 | | Batch: S32337 | Dil: 10 |
| **Sulfate** | | **340** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 01-May-2012 1448 by 07 | Analyzed: 02-May-2012 1918 by 07 | | Batch: S32337 | Dil: 10 |

**AIC No.** 157362-11
**Sample Identification:** 6X 042812

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **550** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 06-May-2012 1020 by 93 | | Batch: W39736 | |

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Fayetteville, AR 72701

## ANALYTICAL RESULTS

**AIC No.** 157362-11 (Continued)
**Sample Identification:** 6X 042812

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Total Dissolved Solids** | | **1900** | 40 | **mg/l** | |
| SM 2540C | Prep: 04-May-2012 1533 by 285 | Analyzed: 07-May-2012 1317 by 285 | | Batch: W39728 | |
| **Calcium** | | **19** | 0.1 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 04-May-2012 0814 by 297 | | Batch: S32353 | |
| **Magnesium** | | **7.1** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 04-May-2012 0814 by 297 | | Batch: S32353 | |
| **Potassium** | | **25** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 04-May-2012 0814 by 297 | | Batch: S32353 | |
| **Sodium** | | **810** | 10 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 07-May-2012 2210 by 297 | | Batch: S32353 | Dil: 10 |
| **Chloride** | | **390** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 01-May-2012 1456 by 07 | Analyzed: 02-May-2012 1943 by 07 | | Batch: S32340 | Dil: 10 |
| **Sulfate** | | **440** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 01-May-2012 1456 by 07 | Analyzed: 02-May-2012 1943 by 07 | | Batch: S32340 | Dil: 10 |

**AIC No.** 157362-12
**Sample Identification:** 8X 042812

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **680** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 06-May-2012 1020 by 93 | | Batch: W39736 | |
| **Total Dissolved Solids** | | **2400** | 40 | **mg/l** | |
| SM 2540C | Prep: 04-May-2012 1533 by 285 | Analyzed: 07-May-2012 1317 by 285 | | Batch: W39728 | |
| **Calcium** | | **11** | 0.1 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 04-May-2012 0818 by 297 | | Batch: S32353 | |
| **Magnesium** | | **8.2** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 04-May-2012 0818 by 297 | | Batch: S32353 | |
| **Potassium** | | **30** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 04-May-2012 0818 by 297 | | Batch: S32353 | |
| **Sodium** | | **960** | 50 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1235 by 270 | | Batch: S32353 | Dil: 50 |
| **Chloride** | | **530** | 20 | **mg/l** | D |
| EPA 300.0 | Prep: 01-May-2012 1456 by 07 | Analyzed: 02-May-2012 0821 by 07 | | Batch: S32340 | Dil: 100 |
| **Sulfate** | | **600** | 20 | **mg/l** | D |
| EPA 300.0 | Prep: 01-May-2012 1456 by 07 | Analyzed: 02-May-2012 0821 by 07 | | Batch: S32340 | Dil: 100 |

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## DUPLICATE RESULTS

| Analyte | | AIC No. | Result | RPD | RPD Limit | Preparation Date | Analysis Date | Dil | Qual |
|---|---|---|---|---|---|---|---|---|---|
| Total Dissolved Solids | | 157409-1 | 5400 mg/l | | | 03May12 1635 by 285 | 04May12 1127 by 285 | | |
| | Batch: W39716 | Duplicate | 5400 mg/l | 0.369 | 10.0 | 03May12 1635 by 285 | 04May12 1127 by 285 | | |
| Total Dissolved Solids | | 157362-8 | 990 mg/l | | | 04May12 1533 by 285 | 07May12 1317 by 285 | | |
| | Batch: W39728 | Duplicate | 1000 mg/l | 2.09 | 10.0 | 04May12 1533 by 285 | 07May12 1317 by 285 | | |
| Total Dissolved Solids | | 157362-9 | 1200 mg/l | | | 04May12 1533 by 285 | 07May12 1317 by 285 | | |
| | Batch: W39728 | Duplicate | 1200 mg/l | 4.69 | 10.0 | 04May12 1533 by 285 | 07May12 1317 by 285 | | |
| Alkalinity as CaCO3 | | 157362-3 | 300 mg/l | | | | 06May12 1020 by 93 | | |
| | Batch: W39736 | Duplicate | 300 mg/l | 0.00 | 20.0 | | 06May12 1505 by 93 | | |

## LABORATORY CONTROL SAMPLE RESULTS

| Analyte | Spike Amount | % | Limits | RPD | Limit | Batch | Preparation Date | Analysis Date | Dil | Qual |
|---|---|---|---|---|---|---|---|---|---|---|
| Calcium | 10 mg/l | 109 | 85.0-115 | | | S32344 | 02May12 0916 by 100 | 02May12 1556 by 270 | | |
| Calcium | 10 mg/l | 96.7 | 85.0-115 | | | S32353 | 02May12 1621 by 100 | 04May12 0753 by 297 | | |
| Magnesium | 10 mg/l | 107 | 85.0-115 | | | S32344 | 02May12 0916 by 100 | 02May12 1556 by 270 | | |
| Magnesium | 10 mg/l | 96.4 | 85.0-115 | | | S32353 | 02May12 1621 by 100 | 04May12 0753 by 297 | | |
| Potassium | 10 mg/l | 98.0 | 85.0-115 | | | S32344 | 02May12 0916 by 100 | 02May12 2023 by 270 | | |
| Potassium | 10 mg/l | 97.7 | 85.0-115 | | | S32353 | 02May12 1621 by 100 | 04May12 0753 by 297 | | |
| Sodium | 10 mg/l | 108 | 85.0-115 | | | S32344 | 02May12 0916 by 100 | 02May12 1556 by 270 | | |
| Sodium | 10 mg/l | 103 | 85.0-115 | | | S32353 | 02May12 1621 by 100 | 04May12 0753 by 297 | | |
| Chloride | 20 mg/l | 100 | 90.0-110 | | | S32337 | 01May12 1130 by 07 | 01May12 1500 by 07 | | |
| Chloride | 20 mg/l | 103 | 90.0-110 | | | S32340 | 01May12 1456 by 07 | 02May12 0913 by 07 | | |
| Sulfate | 20 mg/l | 98.2 | 90.0-110 | | | S32337 | 01May12 1130 by 07 | 01May12 1500 by 07 | | |
| Sulfate | 20 mg/l | 99.7 | 90.0-110 | | | S32340 | 01May12 1456 by 07 | 02May12 0913 by 07 | | |

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## MATRIX SPIKE SAMPLE RESULTS

| Analyte | Sample | Spike Amount | % | Limits | Batch | Preparation Date | Analysis Date | Dil | Qual |
|---|---|---|---|---|---|---|---|---|---|
| Calcium | 157393-1 | 10 mg/l | 92.3 | 75.0-125 | S32344 | 02May12 0916 by 100 | 02May12 1559 by 270 | | |
| | 157393-1 | 10 mg/l | 91.4 | 75.0-125 | S32344 | 02May12 0916 by 100 | 02May12 1602 by 270 | | |
| | Relative Percent Difference: | | 0.587 | 20.0 | S32344 | | | | |
| Calcium | 157362-8 | 10 mg/l | 88.8 | 75.0-125 | S32353 | 02May12 1621 by 100 | 04May12 0756 by 297 | | |
| | 157362-8 | 10 mg/l | 97.1 | 75.0-125 | S32353 | 02May12 1621 by 100 | 04May12 0759 by 297 | | |
| | Relative Percent Difference: | | 2.11 | 20.0 | S32353 | | | | |
| Magnesium | 157393-1 | 10 mg/l | 95.5 | 75.0-125 | S32344 | 02May12 0916 by 100 | 02May12 1559 by 270 | | |
| | 157393-1 | 10 mg/l | 94.9 | 75.0-125 | S32344 | 02May12 0916 by 100 | 02May12 1602 by 270 | | |
| | Relative Percent Difference: | | 0.408 | 20.0 | S32344 | | | | |
| Magnesium | 157362-8 | 10 mg/l | 94.1 | 75.0-125 | S32353 | 02May12 1621 by 100 | 04May12 0756 by 297 | | |
| | 157362-8 | 10 mg/l | 95.4 | 75.0-125 | S32353 | 02May12 1621 by 100 | 04May12 0759 by 297 | | |
| | Relative Percent Difference: | | 0.919 | 20.0 | S32353 | | | | |
| Potassium | 157393-1 | 10 mg/l | 87.4 | 75.0-125 | S32344 | 02May12 0916 by 100 | 02May12 2025 by 270 | | |
| | 157393-1 | 10 mg/l | 95.4 | 75.0-125 | S32344 | 02May12 0916 by 100 | 02May12 2028 by 270 | | |
| | Relative Percent Difference: | | 6.72 | 20.0 | S32344 | | | | |
| Potassium | 157362-8 | 10 mg/l | 97.4 | 75.0-125 | S32353 | 02May12 1621 by 100 | 04May12 0756 by 297 | | |
| | 157362-8 | 10 mg/l | 101 | 75.0-125 | S32353 | 02May12 1621 by 100 | 04May12 0759 by 297 | | |
| | Relative Percent Difference: | | 1.41 | 20.0 | S32353 | | | | |
| Sodium | 157393-1 | 10 mg/l | 99.3 | 75.0-125 | S32344 | 02May12 0916 by 100 | 02May12 1559 by 270 | | |
| | 157393-1 | 10 mg/l | 98.0 | 75.0-125 | S32344 | 02May12 0916 by 100 | 02May12 1602 by 270 | | |
| | Relative Percent Difference: | | 0.953 | 20.0 | S32344 | | | | |
| Sodium | 157362-8 | 10 mg/l | - | 75.0-125 | S32353 | 02May12 1621 by 100 | 07May12 2219 by 297 | 10 | X |
| | 157362-8 | 10 mg/l | - | 75.0-125 | S32353 | 02May12 1621 by 100 | 07May12 2221 by 297 | 10 | X |
| | Relative Percent Difference: | | 4.63 | 20.0 | S32353 | | | | D |
| Chloride | 157362-1 | 20 mg/l | 96.4 | 80.0-120 | S32337 | 01May12 1130 by 07 | 01May12 1526 by 07 | | |
| | 157362-1 | 20 mg/l | 96.7 | 80.0-120 | S32337 | 01May12 1130 by 07 | 01May12 1704 by 07 | | |
| | Relative Percent Difference: | | 0.325 | 10.0 | S32337 | | | | |
| Chloride | 157367-10 | 20 mg/l | 102 | 80.0-120 | S32340 | 01May12 1456 by 07 | 02May12 0939 by 07 | | |
| | 157367-10 | 20 mg/l | 101 | 80.0-120 | S32340 | 01May12 1456 by 07 | 02May12 1005 by 07 | | |
| | Relative Percent Difference: | | 0.746 | 10.0 | S32340 | | | | |
| Sulfate | 157362-1 | 20 mg/l | 93.0 | 80.0-120 | S32337 | 01May12 1130 by 07 | 01May12 1526 by 07 | | |
| | 157362-1 | 20 mg/l | 93.4 | 80.0-120 | S32337 | 01May12 1130 by 07 | 01May12 1704 by 07 | | |
| | Relative Percent Difference: | | 0.254 | 10.0 | S32337 | | | | |
| Sulfate | 157367-10 | 20 mg/l | 101 | 80.0-120 | S32340 | 01May12 1456 by 07 | 02May12 0939 by 07 | | |
| | 157367-10 | 20 mg/l | 101 | 80.0-120 | S32340 | 01May12 1456 by 07 | 02May12 1005 by 07 | | |
| | Relative Percent Difference: | | 0.706 | 10.0 | S32340 | | | | |

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## LABORATORY BLANK RESULTS

| Analyte | Result | RL | PQL | QC Sample | Preparation Date | Analysis Date | Qual |
|---|---|---|---|---|---|---|---|
| Alkalinity as CaCO3 | < 1 mg/l | 1 | 1 | W39736-1 | | 06May12 1020 by 93 | |
| Total Dissolved Solids | < 10 mg/l | 10 | 10 | W39716-1 | 03May12 1635 by 285 | 04May12 1127 by 285 | |
| Total Dissolved Solids | < 10 mg/l | 10 | 10 | W39728-1 | 04May12 1533 by 285 | 07May12 1317 by 285 | |
| Calcium | < 0.1 mg/l | 0.1 | 0.1 | S32344-1 | 02May12 0916 by 100 | 02May12 1553 by 270 | |
| Magnesium | < 0.03 mg/l | 0.03 | 0.03 | S32344-1 | 02May12 0916 by 100 | 02May12 1553 by 270 | |
| Potassium | < 1 mg/l | 1 | 1 | S32344-1 | 02May12 0916 by 100 | 02May12 2020 by 270 | |
| Sodium | < 1 mg/l | 1 | 1 | S32344-1 | 02May12 0916 by 100 | 02May12 1553 by 270 | |
| Calcium | < 0.1 mg/l | 0.1 | 0.1 | S32353-1 | 02May12 1621 by 100 | 04May12 0750 by 297 | |
| Magnesium | < 0.03 mg/l | 0.03 | 0.03 | S32353-1 | 02May12 1621 by 100 | 04May12 0750 by 297 | |
| Potassium | < 1 mg/l | 1 | 1 | S32353-1 | 02May12 1621 by 100 | 04May12 0750 by 297 | |
| Sodium | < 1 mg/l | 1 | 1 | S32353-1 | 02May12 1621 by 100 | 04May12 0750 by 297 | |
| Chloride | < 0.2 mg/l | 0.2 | 0.2 | S32337-1 | 01May12 1130 by 07 | 01May12 1434 by 07 | |
| Sulfate | < 0.2 mg/l | 0.2 | 0.2 | S32337-1 | 01May12 1130 by 07 | 01May12 1434 by 07 | |
| Chloride | < 0.2 mg/l | 0.2 | 0.2 | S32340-1 | 01May12 1456 by 07 | 02May12 0847 by 07 | |
| Sulfate | < 0.2 mg/l | 0.2 | 0.2 | S32340-1 | 01May12 1456 by 07 | 02May12 0847 by 07 | |

AMERICAN INTERPLEX CORPORATION
LABORATORIES

# CHAIN OF CUSTODY / ANALYSIS REQUEST FORM

Client: Bruce Richart – ASU
Project Reference: Fayetteville
Project Manager:
Sampled By: MGriffin / TWoodruff / HF

PO No.

Sample Matrix: WATER, SOIL

| AIC No. | Sample Identification | Date/Time Collected | GRAB | COMP | WATER | SOIL | No of BOTTLES | Na+ | Ca++ | Mg++ | K+ | Cl- | SO4-2 | Total Alkalinity | TDS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ModHardWater | 042712 | X | | X | | 2 | | | | | | | | |
| 2 | Effluent | | X | | X | | 2 | | | | | | | | |
| 3 | 2.5X | | X | | X | | 2 | | | | | | | | |
| 4 | 3.4X | | X | | X | | 2 | | | | | | | | |
| 5 | 4.5X | | X | | X | | 2 | | | | | | | | |
| 6 | 6X | | X | | X | | 2 | | | | | | | | |
| 7 | 8X | | X | | X | | 2 | | | | | | | | |
| | | Container Type | | | | | | P | P | P | P | P | P | P | P |
| | | Preservative | | | | | | N | N | N | N | NO | NO | NO | NO |

G = Glass, P = Plastic, V = VOA vials, H = HCl to pH2, T = Sodium Thiosulfate
NO = none, S = Sulfuric acid pH2, N = Nitric acid pH2, B = NaOH to pH12, Z = Zinc acetate

AIC Control No: 157362
AIC Proposal No:
Carrier: Fed-X
Received Temperature °C: 2
Remarks:
Field pH calibration on _____ @ _____
Buffer:

Turnaround Time Requested: (Please circle)
NORMAL or EXPEDITED IN ____ DAYS
Expedited results requested by: _____
Who should AIC contact with questions: Jennifer Bouldin or Melanie Griffin
Phone: 870-972-2870 Fax: _____
Report Attention to: _____
Report Address to:

| Relinquished By: | Date/Time | Received By: | Date/Time |
|---|---|---|---|
| MGriffin | 043012 1530 | | |
| Relinquished By: | Date/Time | Received in Lab By: Cryza Hopton | Date/Time 5-1-12 0930 |

Comments: 8693 8533 6398

AMERICAN INTERPLEX CORPORATION
LABORATORIES

# CHAIN OF CUSTODY / ANALYSIS REQUEST FORM

Client: Bruce Richart - ASU
Project Reference: Fayetteville
Project Manager:
Sampled By: MGriffin/TWorley/HF

PO No.

Sample Matrix: WATER, SOIL

| AIC No. | Sample Identification | Date/Time Collected | GRAB | COMP | WATER | SOIL | No of BOTTLES | $Na^+$ | $Ca^{++}$ | $Mg^{++}$ | $K^+$ | $Cl^-$ | $SO_4^{-2}$ | Total Alkalinity | TDS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | 2.5X | 042812 | X | | X | | 2 | | | | | | | | |
| 9 | 3.4X | | X | | X | | 2 | | | | | | | | |
| 10 | 4.5X | | X | | X | | 2 | | | | | | | | |
| 11 | 6X | | X | | X | | 2 | | | | | | | | |
| 12 | 8X | ↓ | X | | X | | 2 | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | Container Type | | | | | | P | P | P | P | P | P | P | P |
| | | Preservative | | | | | | N | N | N | N | NO | NO | NO | NO |

Analyses Requested

AIC Control No:
AIC Proposal No:
Carrier: Fed-X
Received Temperature °C: 2
Remarks
Field pH calibration on _____ @ _____
Buffer:

G = Glass, P = Plastic, V = VOA vials, H = HCl to pH2, T = Sodium Thiosulfate
NO = none, S = Sulfuric acid pH2, N = Nitric acid pH2, B = NaOH to pH12, Z = Zinc acetate

Turnaround Time Requested: (Please circle)
NORMAL or EXPEDITED IN ____ DAYS
Expedited results requested by: _____
Who should AIC contact with questions: Jennifer Boulden or Melanie Griffin
Phone: 870-972-2570 Fax: _____
Report Attention to: _____
Report Address to:

| Relinquished By: | Date/Time | Received By: | Date/Time |
|---|---|---|---|
| Melanie Griffin | 042812 1530 | | |
| Relinquished By: | Date/Time | Received in Lab By: | Date/Time |
| | | Lugia Hopton | 5-1-12 0932 |

Comments:
8693 8533 6398

CH2M HILL
ATTN: Mr. Bruce Richart
1400 North Fox Hunter Road
Fayetteville, AR 72701

This report contains the analytical results and supporting information for samples submitted on May 2, 2012. Attached please find a copy of the Chain of Custody and/or other documents received. Note that any remaining sample will be discarded two weeks from the original report date unless other arrangements are made.

This report is intended for the sole use of the client listed above. Assessment of the data requires access to the entire document.

This report has been reviewed by the Laboratory Director or a qualified designee.

Steve Bradford
Deputy Laboratory Director

This document has been distributed to the following:

PDF cc: CH2M HILL
ATTN: Mr. Bruce Richart
robert.richart@ch2m.com

AMERICAN INTERPLEX CORPORATION LABORATORIES

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CH2M HILL
1400 North Fox Hunter Road
Fayetteville, AR 72701

## SAMPLE INFORMATION

**Project Description:**
Five (5) water sample(s) received on May 2, 2012
Fayetteville (ASU)

**Receipt Details:**
A Chain of Custody was provided. The samples were delivered in one (1) ice chest.
Ice chest #1 was delivered with shipping documentation.

Each sample container was checked for proper labeling, including date and time sampled. Sample containers were reviewed for proper type, adequate volume, integrity, temperature, preservation, and holding times. Any exceptions are noted below:

**Sample Identification:**

| Laboratory ID | Client Sample ID | Sampled Date/Time | Notes |
|---|---|---|---|
| 157398-1 | 2.5X 042912 | 29-Apr-2012 | 1 |
| 157398-2 | 3.4X 042912 | 29-Apr-2012 | 1 |
| 157398-3 | 4.5X 042912 | 29-Apr-2012 | 1 |
| 157398-4 | 6X 042912 | 29-Apr-2012 | 1 |
| 157398-5 | 8X 042912 | 29-Apr-2012 | 1 |

Notes:
1. Sample label was incomplete in regard to date/time of sampling

**Qualifiers:**
D Result is from a secondary dilution factor
X Spiking level is invalid due to the high concentration of analyte in the spiked sample

**References:**
"Methods for Chemical Analysis of Water and Wastes", EPA/600/4-79-020 (Mar 1983) with updates and supplements EPA/600/5-91-010 (Jun 1991), EPA/600/R-92-129 (Aug 1992) and EPA/600/R-93-100 (Aug 1993).
"Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846)", Third Edition.
"Standard Methods for the Examination of Water and Wastewaters", 20th edition, 1998.
"American Society for Testing and Materials" (ASTM).
"Association of Analytical Chemists" (AOAC).

AMERICAN INTERPLEX CORPORATION LABORATORIES

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1400 North Fox Hunter Road
Fayetteville, AR 72701

## ANALYTICAL RESULTS

**AIC No.** 157398-1
**Sample Identification:** 2.5X 042912

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **310** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 08-May-2012 1146 by 302 | | Batch: W39766 | |
| **Total Dissolved Solids** | | **1000** | 20 | **mg/l** | |
| SM 2540C | Prep: 04-May-2012 1533 by 285 | Analyzed: 07-May-2012 1317 by 285 | | Batch: W39728 | |
| **Calcium** | | **38** | 0.5 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1721 by 297 | | Batch: S32353 | Dil: 5 |
| **Magnesium** | | **6.8** | 0.2 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1721 by 297 | | Batch: S32353 | Dil: 5 |
| **Potassium** | | **22** | 5 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1721 by 297 | | Batch: S32353 | Dil: 5 |
| **Sodium** | | **370** | 5 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1721 by 297 | | Batch: S32353 | Dil: 5 |
| **Chloride** | | **200** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 03-May-2012 1256 by 07 | Analyzed: 03-May-2012 2322 by 07 | | Batch: S32357 | Dil: 10 |
| **Sulfate** | | **220** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 03-May-2012 1256 by 07 | Analyzed: 03-May-2012 2322 by 07 | | Batch: S32357 | Dil: 10 |

**AIC No.** 157398-2
**Sample Identification:** 3.4X 042912

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **360** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 08-May-2012 1146 by 302 | | Batch: W39766 | |
| **Total Dissolved Solids** | | **1200** | 20 | **mg/l** | |
| SM 2540C | Prep: 04-May-2012 1533 by 285 | Analyzed: 07-May-2012 1317 by 285 | | Batch: W39728 | |
| **Calcium** | | **36** | 0.5 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1723 by 297 | | Batch: S32353 | Dil: 5 |
| **Magnesium** | | **7.8** | 0.2 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1723 by 297 | | Batch: S32353 | Dil: 5 |
| **Potassium** | | **25** | 5 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1723 by 297 | | Batch: S32353 | Dil: 5 |
| **Sodium** | | **470** | 50 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1759 by 270 | | Batch: S32353 | Dil: 50 |
| **Chloride** | | **240** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 03-May-2012 1256 by 07 | Analyzed: 03-May-2012 2348 by 07 | | Batch: S32357 | Dil: 10 |
| **Sulfate** | | **270** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 03-May-2012 1256 by 07 | Analyzed: 03-May-2012 2348 by 07 | | Batch: S32357 | Dil: 10 |

**AIC No.** 157398-3
**Sample Identification:** 4.5X 042912

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **430** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 08-May-2012 1146 by 302 | | Batch: W39766 | |

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## ANALYTICAL RESULTS

**AIC No.** 157398-3 (Continued)
**Sample Identification:** 4.5X 042912

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Total Dissolved Solids** | | **1500** | 20 | **mg/l** | |
| SM 2540C | Prep: 04-May-2012 1533 by 285 | Analyzed: 07-May-2012 1317 by 285 | | Batch: W39728 | |
| **Calcium** | | **28** | 0.5 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1726 by 297 | | Batch: S32353 | Dil: 5 |
| **Magnesium** | | **7.9** | 0.2 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1726 by 297 | | Batch: S32353 | Dil: 5 |
| **Potassium** | | **26** | 5 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1726 by 297 | | Batch: S32353 | Dil: 5 |
| **Sodium** | | **560** | 50 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1802 by 270 | | Batch: S32353 | Dil: 50 |
| **Chloride** | | **310** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 03-May-2012 1256 by 07 | Analyzed: 04-May-2012 0014 by 07 | | Batch: S32357 | Dil: 10 |
| **Sulfate** | | **350** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 03-May-2012 1256 by 07 | Analyzed: 04-May-2012 0014 by 07 | | Batch: S32357 | Dil: 10 |

**AIC No.** 157398-4
**Sample Identification:** 6X 042912

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **540** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 08-May-2012 1146 by 302 | | Batch: W39766 | |
| **Total Dissolved Solids** | | **1900** | 10 | **mg/l** | |
| SM 2540C | Prep: 04-May-2012 1533 by 285 | Analyzed: 07-May-2012 1649 by 285 | | Batch: W39728 | |
| **Calcium** | | **23** | 0.5 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1729 by 297 | | Batch: S32353 | Dil: 5 |
| **Magnesium** | | **9.3** | 0.2 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1729 by 297 | | Batch: S32353 | Dil: 5 |
| **Potassium** | | **31** | 5 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1729 by 297 | | Batch: S32353 | Dil: 5 |
| **Sodium** | | **770** | 50 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1808 by 270 | | Batch: S32353 | Dil: 50 |
| **Chloride** | | **390** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 03-May-2012 1256 by 07 | Analyzed: 04-May-2012 0040 by 07 | | Batch: S32357 | Dil: 10 |
| **Sulfate** | | **450** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 03-May-2012 1256 by 07 | Analyzed: 04-May-2012 0040 by 07 | | Batch: S32357 | Dil: 10 |

**AIC No.** 157398-5
**Sample Identification:** 8X 042912

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **660** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 08-May-2012 1146 by 302 | | Batch: W39766 | |

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## ANALYTICAL RESULTS

**AIC No.** 157398-5 (Continued)
**Sample Identification:** 8X 042912

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Total Dissolved Solids** | | **2400** | 40 | **mg/l** | |
| SM 2540C | Prep: 04-May-2012 1533 by 285 | Analyzed: 07-May-2012 1317 by 285 | | Batch: W39728 | |
| **Calcium** | | **13** | 0.5 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1732 by 297 | | Batch: S32353 | Dil: 5 |
| **Magnesium** | | **10** | 0.2 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1732 by 297 | | Batch: S32353 | Dil: 5 |
| **Potassium** | | **35** | 5 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1732 by 297 | | Batch: S32353 | Dil: 5 |
| **Sodium** | | **960** | 50 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1810 by 270 | | Batch: S32353 | Dil: 50 |
| **Chloride** | | **530** | 20 | **mg/l** | D |
| EPA 300.0 | Prep: 03-May-2012 1256 by 07 | Analyzed: 04-May-2012 0106 by 07 | | Batch: S32357 | Dil: 100 |
| **Sulfate** | | **590** | 20 | **mg/l** | D |
| EPA 300.0 | Prep: 03-May-2012 1256 by 07 | Analyzed: 04-May-2012 0106 by 07 | | Batch: S32357 | Dil: 100 |

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## DUPLICATE RESULTS

| Analyte | | AIC No. | Result | RPD | RPD Limit | Preparation Date | Analysis Date | Dil | Qual |
|---|---|---|---|---|---|---|---|---|---|
| Total Dissolved Solids | | 157362-8 | 990 mg/l | | | 04May12 1533 by 285 | 07May12 1317 by 285 | | |
| | Batch: W39728 | Duplicate | 1000 mg/l | 2.09 | 10.0 | 04May12 1533 by 285 | 07May12 1317 by 285 | | |
| Total Dissolved Solids | | 157362-9 | 1200 mg/l | | | 04May12 1533 by 285 | 07May12 1317 by 285 | | |
| | Batch: W39728 | Duplicate | 1200 mg/l | 4.69 | 10.0 | 04May12 1533 by 285 | 07May12 1317 by 285 | | |
| Alkalinity as CaCO3 | | 157398-1 | 310 mg/l | | | | 08May12 1146 by 302 | | |
| | Batch: W39766 | Duplicate | 300 mg/l | 1.65 | 20.0 | | 09May12 1327 by 302 | | |

## LABORATORY CONTROL SAMPLE RESULTS

| Analyte | Spike Amount | % | Limits | RPD | Limit | Batch | Preparation Date | Analysis Date | Dil | Qual |
|---|---|---|---|---|---|---|---|---|---|---|
| Calcium | 10 mg/l | 96.7 | 85.0-115 | | | S32353 | 02May12 1621 by 100 | 04May12 0753 by 297 | | |
| Magnesium | 10 mg/l | 96.4 | 85.0-115 | | | S32353 | 02May12 1621 by 100 | 04May12 0753 by 297 | | |
| Potassium | 10 mg/l | 97.7 | 85.0-115 | | | S32353 | 02May12 1621 by 100 | 04May12 0753 by 297 | | |
| Sodium | 10 mg/l | 103 | 85.0-115 | | | S32353 | 02May12 1621 by 100 | 04May12 0753 by 297 | | |
| Chloride | 20 mg/l | 101 | 90.0-110 | | | S32357 | 03May12 1313 by 07 | 03May12 1747 by 07 | | |
| Sulfate | 20 mg/l | 97.7 | 90.0-110 | | | S32357 | 03May12 1313 by 07 | 03May12 1747 by 07 | | |

## MATRIX SPIKE SAMPLE RESULTS

| Analyte | Sample | Spike Amount | % | Limits | Batch | Preparation Date | Analysis Date | Dil | Qual |
|---|---|---|---|---|---|---|---|---|---|
| Calcium | 157362-8 | 10 mg/l | 88.8 | 75.0-125 | S32353 | 02May12 1621 by 100 | 04May12 0756 by 297 | | |
| | 157362-8 | 10 mg/l | 97.1 | 75.0-125 | S32353 | 02May12 1621 by 100 | 04May12 0759 by 297 | | |
| | Relative Percent Difference: | | 2.11 | 20.0 | S32353 | | | | |
| Magnesium | 157362-8 | 10 mg/l | 94.1 | 75.0-125 | S32353 | 02May12 1621 by 100 | 04May12 0756 by 297 | | |
| | 157362-8 | 10 mg/l | 95.4 | 75.0-125 | S32353 | 02May12 1621 by 100 | 04May12 0759 by 297 | | |
| | Relative Percent Difference: | | 0.919 | 20.0 | S32353 | | | | |
| Potassium | 157362-8 | 10 mg/l | 97.4 | 75.0-125 | S32353 | 02May12 1621 by 100 | 04May12 0756 by 297 | | |
| | 157362-8 | 10 mg/l | 101 | 75.0-125 | S32353 | 02May12 1621 by 100 | 04May12 0759 by 297 | | |
| | Relative Percent Difference: | | 1.41 | 20.0 | S32353 | | | | |
| Sodium | 157362-8 | 10 mg/l | - | 75.0-125 | S32353 | 02May12 1621 by 100 | 07May12 2219 by 297 | 10 | X |
| | 157362-8 | 10 mg/l | - | 75.0-125 | S32353 | 02May12 1621 by 100 | 07May12 2221 by 297 | 10 | X |
| | Relative Percent Difference: | | 4.63 | 20.0 | S32353 | | | | D |
| Chloride | 157391-1 | 20 mg/l | 88.2 | 80.0-120 | S32357 | 03May12 1313 by 07 | 03May12 1812 by 07 | | |
| | 157391-1 | 20 mg/l | 88.0 | 80.0-120 | S32357 | 03May12 1313 by 07 | 03May12 1838 by 07 | | |
| | Relative Percent Difference: | | 0.243 | 10.0 | S32357 | | | | |
| Sulfate | 157391-1 | 20 mg/l | 93.0 | 80.0-120 | S32357 | 03May12 1313 by 07 | 03May12 1812 by 07 | | |
| | 157391-1 | 20 mg/l | 92.6 | 80.0-120 | S32357 | 03May12 1313 by 07 | 03May12 1838 by 07 | | |
| | Relative Percent Difference: | | 0.351 | 10.0 | S32357 | | | | |

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## LABORATORY BLANK RESULTS

| Analyte | Result | RL | PQL | QC Sample | Preparation Date | Analysis Date | Qual |
|---|---|---|---|---|---|---|---|
| Alkalinity as CaCO3 | < 1 mg/l | 1 | 1 | W39766-1 | | 08May12 1147 by 93 | |
| Total Dissolved Solids | < 10 mg/l | 10 | 10 | W39728-1 | 04May12 1533 by 285 | 07May12 1317 by 285 | |
| Calcium | < 0.1 mg/l | 0.1 | 0.1 | S32353-1 | 02May12 1621 by 100 | 04May12 0750 by 297 | |
| Magnesium | < 0.03 mg/l | 0.03 | 0.03 | S32353-1 | 02May12 1621 by 100 | 04May12 0750 by 297 | |
| Potassium | < 1 mg/l | 1 | 1 | S32353-1 | 02May12 1621 by 100 | 04May12 0750 by 297 | |
| Sodium | < 1 mg/l | 1 | 1 | S32353-1 | 02May12 1621 by 100 | 04May12 0750 by 297 | |
| Chloride | < 0.2 mg/l | 0.2 | 0.2 | S32357-1 | 03May12 1313 by 07 | 03May12 1721 by 07 | |
| Sulfate | < 0.2 mg/l | 0.2 | 0.2 | S32357-1 | 03May12 1313 by 07 | 03May12 1721 by 07 | |

AMERICAN INTERPLEX CORPORATION
LABORATORIES

# CHAIN OF CUSTODY / ANALYSIS REQUEST FORM

Client: Bruce Richart (ASU)
Project Reference: Fayetteville
Project Manager:
Sampled By: MGriffin / TWoodruff

PO No.

Sample Matrix: WATER / SOIL

No of BOTTLES

Analyses Requested: $Na^+$, $Ca^{++}$, $Mg^{++}$, $K^+$, $Cl^-$, $SO_4^{-2}$, Total Alkalinity, TDS

AIC Control No: 157398
AIC Proposal No:
Carrier: Fed-Ex
Received Temperature °C: 2C

| AIC No. | Sample Identification | Date/Time Collected | GRAB | COMP | WATER | SOIL | BOTTLES | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1 | 2.5X | 042912 | X | | X | | 2 | |
| 2 | 3.4X | | X | | X | | | |
| 3 | 4.5X | | X | | X | | | |
| 4 | 6X | | X | | X | | | |
| 5 | 8X | | X | | X | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | Container Type | | | | | | |
| | | Preservative | | | | | | |

| | $Na^+$ | $Ca^{++}$ | $Mg^{++}$ | $K^+$ | $Cl^-$ | $SO_4^{-2}$ | Total Alkalinity | TDS |
|---|---|---|---|---|---|---|---|---|
| Container Type | P | P | P | P | P | P | P | P |
| Preservative | N | N | N | N | NO | NO | NO | NO |

Field pH calibration on _____ @ _____
Buffer:

G = Glass, P = Plastic, V = VOA vials, H = HCl to pH2, T = Sodium Thiosulfate
NO = none, S = Sulfuric acid pH2, N = Nitric acid pH2, B = NaOH to pH12, Z = Zinc acetate

Turnaround Time Requested: (Please circle)
NORMAL or EXPEDITED IN ____ DAYS
Expedited results requested by: _____
Who should AIC contact with questions: Jennifer Bonkin or Melanie Griffin
Phone: 870-972-2570 Fax: _____
Report Attention to: _____
Report Address to:

| Relinquished By: | Date/Time | Received By: | Date/Time |
|---|---|---|---|
| Melanie Griffin | 050112 1245 | | |
| Relinquished By: | Date/Time | Received in Lab By: | Date/Time |
| | | | 5-2-12 8:30am |

Comments:
8643 8533 6402

CH2M HILL
ATTN: Mr. Bruce Richart
1400 North Fox Hunter Road
Fayetteville, AR 72701

This report contains the analytical results and supporting information for samples submitted on May 2, 2012. Attached please find a copy of the Chain of Custody and/or other documents received. Note that any remaining sample will be discarded two weeks from the original report date unless other arrangements are made.

This report is intended for the sole use of the client listed above. Assessment of the data requires access to the entire document.

This report has been reviewed by the Laboratory Director or a qualified designee.

Steve Bradford
Deputy Laboratory Director

This document has been distributed to the following:

PDF cc: CH2M HILL
ATTN: Mr. Bruce Richart
robert.richart@ch2m.com

AMERICAN INTERPLEX CORPORATION LABORATORIES

40 1972 2012

CH2M HILL
1400 North Fox Hunter Road
Fayetteville, AR 72701

## SAMPLE INFORMATION

**Project Description:**
Five (5) water sample(s) received on May 2, 2012
Fayetteville (ASU)

**Receipt Details:**
A Chain of Custody was provided. The samples were delivered in one (1) ice chest.
Ice chest #1 was delivered with shipping documentation.

Each sample container was checked for proper labeling, including date and time sampled. Sample containers were reviewed for proper type, adequate volume, integrity, temperature, preservation, and holding times. Any exceptions are noted below:

**Sample Identification:**

| Laboratory ID | Client Sample ID | Sampled Date/Time | Notes |
|---|---|---|---|
| 157399-1 | 2.5X 043012 | 30-Apr-2012 | 1 |
| 157399-2 | 3.4X 043012 | 30-Apr-2012 | 1 |
| 157399-3 | 4.5X 043012 | 30-Apr-2012 | 1 |
| 157399-4 | 6X 043012 | 30-Apr-2012 | 1 |
| 157399-5 | 8X 043012 | 30-Apr-2012 | 1 |

Notes:
1. Sample label was incomplete in regard to date/time of sampling

**Qualifiers:**
D Result is from a secondary dilution factor
X Spiking level is invalid due to the high concentration of analyte in the spiked sample

**References:**
"Methods for Chemical Analysis of Water and Wastes", EPA/600/4-79-020 (Mar 1983) with updates and supplements EPA/600/5-91-010 (Jun 1991), EPA/600/R-92-129 (Aug 1992) and EPA/600/R-93-100 (Aug 1993).
"Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846)", Third Edition.
"Standard Methods for the Examination of Water and Wastewaters", 20th edition, 1998.
"American Society for Testing and Materials" (ASTM).
"Association of Analytical Chemists" (AOAC).

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## ANALYTICAL RESULTS

**AIC No.** 157399-1
**Sample Identification:** 2.5X 043012

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **280** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 08-May-2012 1146 by 302 | | Batch: W39766 | |
| **Total Dissolved Solids** | | **1000** | 20 | **mg/l** | |
| SM 2540C | Prep: 04-May-2012 1612 by 285 | Analyzed: 07-May-2012 1317 by 285 | | Batch: W39728 | |
| **Calcium** | | **38** | 0.5 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1734 by 270 | | Batch: S32353 | Dil: 5 |
| **Magnesium** | | **6.6** | 0.2 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1734 by 270 | | Batch: S32353 | Dil: 5 |
| **Potassium** | | **21** | 5 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1734 by 270 | | Batch: S32353 | Dil: 5 |
| **Sodium** | | **350** | 5 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1734 by 270 | | Batch: S32353 | Dil: 5 |
| **Chloride** | | **190** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 03-May-2012 1256 by 07 | Analyzed: 04-May-2012 0132 by 07 | | Batch: S32357 | Dil: 10 |
| **Sulfate** | | **210** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 03-May-2012 1256 by 07 | Analyzed: 04-May-2012 0132 by 07 | | Batch: S32357 | Dil: 10 |

**AIC No.** 157399-2
**Sample Identification:** 3.4X 043012

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **360** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 08-May-2012 1146 by 302 | | Batch: W39766 | |
| **Total Dissolved Solids** | | **1200** | 20 | **mg/l** | |
| SM 2540C | Prep: 04-May-2012 1612 by 285 | Analyzed: 07-May-2012 1317 by 285 | | Batch: W39728 | |
| **Calcium** | | **38** | 0.5 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1737 by 270 | | Batch: S32353 | Dil: 5 |
| **Magnesium** | | **7.6** | 0.2 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1737 by 270 | | Batch: S32353 | Dil: 5 |
| **Potassium** | | **24** | 5 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1737 by 270 | | Batch: S32353 | Dil: 5 |
| **Sodium** | | **470** | 50 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1813 by 270 | | Batch: S32353 | Dil: 50 |
| **Chloride** | | **240** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 03-May-2012 1256 by 07 | Analyzed: 04-May-2012 0157 by 07 | | Batch: S32357 | Dil: 10 |
| **Sulfate** | | **280** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 03-May-2012 1256 by 07 | Analyzed: 04-May-2012 0157 by 07 | | Batch: S32357 | Dil: 10 |

**AIC No.** 157399-3
**Sample Identification:** 4.5X 043012

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **430** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 08-May-2012 1146 by 302 | | Batch: W39766 | |

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## ANALYTICAL RESULTS

**AIC No.** 157399-3 (Continued)
**Sample Identification:** 4.5X 043012

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Total Dissolved Solids** | | **1600** | 20 | **mg/l** | |
| SM 2540C | Prep: 04-May-2012 1612 by 285 | Analyzed: 07-May-2012 1317 by 285 | | Batch: W39728 | |
| **Calcium** | | **32** | 0.5 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1740 by 270 | | Batch: S32353 | Dil: 5 |
| **Magnesium** | | **8.2** | 0.2 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1740 by 270 | | Batch: S32353 | Dil: 5 |
| **Potassium** | | **27** | 5 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1740 by 270 | | Batch: S32353 | Dil: 5 |
| **Sodium** | | **590** | 50 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1816 by 270 | | Batch: S32353 | Dil: 50 |
| **Chloride** | | **310** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 03-May-2012 1256 by 07 | Analyzed: 04-May-2012 0223 by 07 | | Batch: S32357 | Dil: 10 |
| **Sulfate** | | **360** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 03-May-2012 1256 by 07 | Analyzed: 04-May-2012 0223 by 07 | | Batch: S32357 | Dil: 10 |

**AIC No.** 157399-4
**Sample Identification:** 6X 043012

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **530** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 08-May-2012 1146 by 302 | | Batch: W39766 | |
| **Total Dissolved Solids** | | **1900** | 40 | **mg/l** | |
| SM 2540C | Prep: 04-May-2012 1612 by 285 | Analyzed: 07-May-2012 1317 by 285 | | Batch: W39728 | |
| **Calcium** | | **27** | 0.5 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1742 by 270 | | Batch: S32353 | Dil: 5 |
| **Magnesium** | | **8.7** | 0.2 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1742 by 270 | | Batch: S32353 | Dil: 5 |
| **Potassium** | | **29** | 5 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1742 by 270 | | Batch: S32353 | Dil: 5 |
| **Sodium** | | **710** | 50 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1818 by 270 | | Batch: S32353 | Dil: 50 |
| **Chloride** | | **400** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 03-May-2012 1256 by 07 | Analyzed: 04-May-2012 0249 by 07 | | Batch: S32357 | Dil: 10 |
| **Sulfate** | | **460** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 03-May-2012 1256 by 07 | Analyzed: 04-May-2012 0249 by 07 | | Batch: S32357 | Dil: 10 |

**AIC No.** 157399-5
**Sample Identification:** 8X 043012

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **670** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 08-May-2012 1146 by 302 | | Batch: W39766 | |

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## ANALYTICAL RESULTS

**AIC No.** 157399-5 (Continued)
**Sample Identification:** 8X 043012

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Total Dissolved Solids** | | **2400** | 40 | **mg/l** | |
| SM 2540C | Prep: 04-May-2012 1612 by 285 | Analyzed: 07-May-2012 1317 by 285 | | Batch: W39728 | |
| **Calcium** | | **20** | 0.5 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1745 by 270 | | Batch: S32353 | Dil: 5 |
| **Magnesium** | | **11** | 0.2 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1745 by 270 | | Batch: S32353 | Dil: 5 |
| **Potassium** | | **37** | 5 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1745 by 270 | | Batch: S32353 | Dil: 5 |
| **Sodium** | | **990** | 50 | **mg/l** | D |
| EPA 200.7 | Prep: 02-May-2012 1621 by 100 | Analyzed: 08-May-2012 1821 by 270 | | Batch: S32353 | Dil: 50 |
| **Chloride** | | **530** | 20 | **mg/l** | D |
| EPA 300.0 | Prep: 03-May-2012 1256 by 07 | Analyzed: 04-May-2012 0432 by 07 | | Batch: S32357 | Dil: 100 |
| **Sulfate** | | **600** | 20 | **mg/l** | D |
| EPA 300.0 | Prep: 03-May-2012 1256 by 07 | Analyzed: 04-May-2012 0432 by 07 | | Batch: S32357 | Dil: 100 |

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## DUPLICATE RESULTS

| Analyte | | AIC No. | Result | RPD | RPD Limit | Preparation Date | Analysis Date | Dil | Qual |
|---|---|---|---|---|---|---|---|---|---|
| Total Dissolved Solids | | 157362-8 | 990 mg/l | | | 04May12 1533 by 285 | 07May12 1317 by 285 | | |
| | Batch: W39728 | Duplicate | 1000 mg/l | 2.09 | 10.0 | 04May12 1533 by 285 | 07May12 1317 by 285 | | |
| Total Dissolved Solids | | 157362-9 | 1200 mg/l | | | 04May12 1533 by 285 | 07May12 1317 by 285 | | |
| | Batch: W39728 | Duplicate | 1200 mg/l | 4.69 | 10.0 | 04May12 1533 by 285 | 07May12 1317 by 285 | | |
| Alkalinity as CaCO3 | | 157398-1 | 310 mg/l | | | | 08May12 1146 by 302 | | |
| | Batch: W39766 | Duplicate | 300 mg/l | 1.65 | 20.0 | | 09May12 1327 by 302 | | |

## LABORATORY CONTROL SAMPLE RESULTS

| Analyte | Spike Amount | % | Limits | RPD | Limit | Batch | Preparation Date | Analysis Date | Dil | Qual |
|---|---|---|---|---|---|---|---|---|---|---|
| Calcium | 10 mg/l | 96.7 | 85.0-115 | | | S32353 | 02May12 1621 by 100 | 04May12 0753 by 297 | | |
| Magnesium | 10 mg/l | 96.4 | 85.0-115 | | | S32353 | 02May12 1621 by 100 | 04May12 0753 by 297 | | |
| Potassium | 10 mg/l | 97.7 | 85.0-115 | | | S32353 | 02May12 1621 by 100 | 04May12 0753 by 297 | | |
| Sodium | 10 mg/l | 103 | 85.0-115 | | | S32353 | 02May12 1621 by 100 | 04May12 0753 by 297 | | |
| Chloride | 20 mg/l | 101 | 90.0-110 | | | S32357 | 03May12 1313 by 07 | 03May12 1747 by 07 | | |
| Sulfate | 20 mg/l | 97.7 | 90.0-110 | | | S32357 | 03May12 1313 by 07 | 03May12 1747 by 07 | | |

## MATRIX SPIKE SAMPLE RESULTS

| Analyte | Sample | Spike Amount | % | Limits | Batch | Preparation Date | Analysis Date | Dil | Qual |
|---|---|---|---|---|---|---|---|---|---|
| Calcium | 157362-8 | 10 mg/l | 88.8 | 75.0-125 | S32353 | 02May12 1621 by 100 | 04May12 0756 by 297 | | |
| | 157362-8 | 10 mg/l | 97.1 | 75.0-125 | S32353 | 02May12 1621 by 100 | 04May12 0759 by 297 | | |
| | Relative Percent Difference: | | 2.11 | 20.0 | S32353 | | | | |
| Magnesium | 157362-8 | 10 mg/l | 94.1 | 75.0-125 | S32353 | 02May12 1621 by 100 | 04May12 0756 by 297 | | |
| | 157362-8 | 10 mg/l | 95.4 | 75.0-125 | S32353 | 02May12 1621 by 100 | 04May12 0759 by 297 | | |
| | Relative Percent Difference: | | 0.919 | 20.0 | S32353 | | | | |
| Potassium | 157362-8 | 10 mg/l | 97.4 | 75.0-125 | S32353 | 02May12 1621 by 100 | 04May12 0756 by 297 | | |
| | 157362-8 | 10 mg/l | 101 | 75.0-125 | S32353 | 02May12 1621 by 100 | 04May12 0759 by 297 | | |
| | Relative Percent Difference: | | 1.41 | 20.0 | S32353 | | | | |
| Sodium | 157362-8 | 10 mg/l | - | 75.0-125 | S32353 | 02May12 1621 by 100 | 07May12 2219 by 297 | 10 | X |
| | 157362-8 | 10 mg/l | - | 75.0-125 | S32353 | 02May12 1621 by 100 | 07May12 2221 by 297 | 10 | X |
| | Relative Percent Difference: | | 4.63 | 20.0 | S32353 | | | | D |
| Chloride | 157391-1 | 20 mg/l | 88.2 | 80.0-120 | S32357 | 03May12 1313 by 07 | 03May12 1812 by 07 | | |
| | 157391-1 | 20 mg/l | 88.0 | 80.0-120 | S32357 | 03May12 1313 by 07 | 03May12 1838 by 07 | | |
| | Relative Percent Difference: | | 0.243 | 10.0 | S32357 | | | | |
| Sulfate | 157391-1 | 20 mg/l | 93.0 | 80.0-120 | S32357 | 03May12 1313 by 07 | 03May12 1812 by 07 | | |
| | 157391-1 | 20 mg/l | 92.6 | 80.0-120 | S32357 | 03May12 1313 by 07 | 03May12 1838 by 07 | | |
| | Relative Percent Difference: | | 0.351 | 10.0 | S32357 | | | | |

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## LABORATORY BLANK RESULTS

| Analyte | Result | RL | PQL | QC Sample | Preparation Date | Analysis Date | Qual |
|---|---|---|---|---|---|---|---|
| Alkalinity as CaCO3 | < 1 mg/l | 1 | 1 | W39766-1 | | 08May12 1147 by 93 | |
| Total Dissolved Solids | < 10 mg/l | 10 | 10 | W39728-1 | 04May12 1533 by 285 | 07May12 1317 by 285 | |
| Calcium | < 0.1 mg/l | 0.1 | 0.1 | S32353-1 | 02May12 1621 by 100 | 04May12 0750 by 297 | |
| Magnesium | < 0.03 mg/l | 0.03 | 0.03 | S32353-1 | 02May12 1621 by 100 | 04May12 0750 by 297 | |
| Potassium | < 1 mg/l | 1 | 1 | S32353-1 | 02May12 1621 by 100 | 04May12 0750 by 297 | |
| Sodium | < 1 mg/l | 1 | 1 | S32353-1 | 02May12 1621 by 100 | 04May12 0750 by 297 | |
| Chloride | < 0.2 mg/l | 0.2 | 0.2 | S32357-1 | 03May12 1313 by 07 | 03May12 1721 by 07 | |
| Sulfate | < 0.2 mg/l | 0.2 | 0.2 | S32357-1 | 03May12 1313 by 07 | 03May12 1721 by 07 | |

AMERICAN INTERPLEX CORPORATION LABORATORIES

# CHAIN OF CUSTODY / ANALYSIS REQUEST FORM

Client: Bruce Richart (ASU)
Project Reference: Fayetteville
Project Manager:
Sampled By: MGriffin / TWoodruff

PO No.

AIC Control No: 157399
AIC Proposal No:
Carrier: fed-ex
Received Temperature °C: 2°C

| AIC No. | Sample Identification | Date/Time Collected | GRAB | COMP | Sample Matrix: WATER | Sample Matrix: SOIL | No of BOTTLES | Analyses Requested: $Na^+$ | $Ca^{++}$ | $Mg^{++}$ | $K^+$ | $Cl^-$ | $SO_4^{-2}$ | Total Alkalinity | TDS | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.5X | 043012 | X | | X | | 2 | | | | | | | | | |
| 2 | 3.4X | ↓ | ↓ | | ↓ | | 2 | | | | | | | | | |
| 3 | 4.5X | | | | | | 2 | | | | | | | | | |
| 4 | 6X | | | | | | 2 | | | | | | | | | |
| 5 | 8X | ↓ | ↓ | | ↓ | | 2 | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | Container Type | | | | | | P | P | P | P | P | P | P | P | |
| | | Preservative | | | | | | N | NO | N | N | N | NO | NO | NO | NO |

Field pH calibration on _____ @ _____ Buffer:

G = Glass, NO = none, P = Plastic, S = Sulfuric acid pH2, V = VOA vials, N = Nitric acid pH2, H = HCl to pH2, B = NaOH to pH12, T = Sodium Thiosulfate, Z = Zinc acetate

Turnaround Time Requested: (Please circle)
NORMAL or EXPEDITED IN ____ DAYS
Expedited results requested by: _____
Who should AIC contact with questions: _____
Phone: _____ Fax: _____
Report Attention to: _____
Report Address to:

| | | | |
|---|---|---|---|
| Relinquished By: Melanie Griffin | Date/Time 050112 1245 | Received By: | Date/Time |
| Relinquished By: | Date/Time | Received in Lab By: Dana Tuba | Date/Time 5-2-12 8:30 |

Comments: FedEx # 8693 8533 6402

CH2M HILL
ATTN: Mr. Bruce Richart
1400 North Fox Hunter Road
Fayetteville, AR 72701

This report contains the analytical results and supporting information for samples submitted on May 4, 2012. Attached please find a copy of the Chain of Custody and/or other documents received. Note that any remaining sample will be discarded two weeks from the original report date unless other arrangements are made.

This report is intended for the sole use of the client listed above. Assessment of the data requires access to the entire document.

This report has been reviewed by the Laboratory Director or a qualified designee.

Steve Bradford
Deputy Laboratory Director

This document has been distributed to the following:

PDF cc: CH2M HILL
ATTN: Mr. Bruce Richart
robert.richart@ch2m.com

AMERICAN INTERPLEX CORPORATION LABORATORIES

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1400 North Fox Hunter Road
Fayetteville, AR 72701

## SAMPLE INFORMATION

**Project Description:**
Five (5) water sample(s) received on May 4, 2012
Fayetteville - ASU

**Receipt Details:**
A Chain of Custody was provided. The samples were delivered in one (1) ice chest.
Ice chest #1 was delivered with shipping documentation.

Each sample container was checked for proper labeling, including date and time sampled. Sample containers were reviewed for proper type, adequate volume, integrity, temperature, preservation, and holding times. Any exceptions are noted below:

**Sample Identification:**

| Laboratory ID | Client Sample ID | Sampled Date/Time | Notes |
|---|---|---|---|
| 157476-1 | 2.5X 050112 | 01-May-2012 | 1 |
| 157476-2 | 3.4X 050112 | 01-May-2012 | 1 |
| 157476-3 | 4.5X 050112 | 01-May-2012 | 1 |
| 157476-4 | 6X 050112 | 01-May-2012 | 1 |
| 157476-5 | 8X 050112 | 01-May-2012 | 1 |

Notes:
1. Sample label was incomplete in regard to date/time of sampling

**Qualifiers:**
D Result is from a secondary dilution factor
X Spiking level is invalid due to the high concentration of analyte in the spiked sample

**References:**
"Methods for Chemical Analysis of Water and Wastes", EPA/600/4-79-020 (Mar 1983) with updates and supplements EPA/600/5-91-010 (Jun 1991), EPA/600/R-92-129 (Aug 1992) and EPA/600/R-93-100 (Aug 1993).
"Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846)", Third Edition.
"Standard Methods for the Examination of Water and Wastewaters", 20th edition, 1998.
"American Society for Testing and Materials" (ASTM).
"Association of Analytical Chemists" (AOAC).

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## ANALYTICAL RESULTS

**AIC No.** 157476-1
**Sample Identification:** 2.5X 050112

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **240** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 10-May-2012 1356 by 302 | | Batch: W39798 | |
| **Total Dissolved Solids** | | **1000** | 20 | **mg/l** | |
| SM 2540C | Prep: 07-May-2012 1334 by 285 | Analyzed: 08-May-2012 1146 by 285 | | Batch: W39749 | |
| **Calcium** | | **37** | 0.1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2216 by 297 | | Batch: S32367 | |
| **Magnesium** | | **6.2** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2216 by 297 | | Batch: S32367 | |
| **Potassium** | | **21** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2216 by 297 | | Batch: S32367 | |
| **Sodium** | | **400** | 10 | **mg/l** | D |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 07-May-2012 1311 by 297 | | Batch: S32367 | Dil: 10 |
| **Chloride** | | **200** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 05-May-2012 1831 by 07 | | Batch: S32373 | Dil: 10 |
| **Sulfate** | | **220** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 05-May-2012 1831 by 07 | | Batch: S32373 | Dil: 10 |

**AIC No.** 157476-2
**Sample Identification:** 3.4X 050112

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **310** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 10-May-2012 1356 by 302 | | Batch: W39798 | |
| **Total Dissolved Solids** | | **1200** | 20 | **mg/l** | |
| SM 2540C | Prep: 07-May-2012 1334 by 285 | Analyzed: 08-May-2012 1146 by 285 | | Batch: W39749 | |
| **Calcium** | | **32** | 0.1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2220 by 297 | | Batch: S32367 | |
| **Magnesium** | | **6.5** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2220 by 297 | | Batch: S32367 | |
| **Potassium** | | **22** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2220 by 297 | | Batch: S32367 | |
| **Sodium** | | **460** | 10 | **mg/l** | D |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 07-May-2012 1328 by 297 | | Batch: S32367 | Dil: 10 |
| **Chloride** | | **240** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 05-May-2012 1857 by 07 | | Batch: S32373 | Dil: 10 |
| **Sulfate** | | **270** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 05-May-2012 1857 by 07 | | Batch: S32373 | Dil: 10 |

**AIC No.** 157476-3
**Sample Identification:** 4.5X 050112

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **370** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 10-May-2012 1356 by 302 | | Batch: W39798 | |

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## ANALYTICAL RESULTS

**AIC No.** 157476-3 (Continued)
**Sample Identification:** 4.5X 050112

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Total Dissolved Solids** | | **1500** | 20 | **mg/l** | |
| SM 2540C | Prep: 07-May-2012 1334 by 285 | Analyzed: 08-May-2012 1146 by 285 | | Batch: W39749 | |
| **Calcium** | | **25** | 0.1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2225 by 297 | | Batch: S32367 | |
| **Magnesium** | | **6.8** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2225 by 297 | | Batch: S32367 | |
| **Potassium** | | **24** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2225 by 297 | | Batch: S32367 | |
| **Sodium** | | **570** | 10 | **mg/l** | D |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 07-May-2012 1331 by 297 | | Batch: S32367 | Dil: 10 |
| **Chloride** | | **300** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 05-May-2012 1923 by 07 | | Batch: S32373 | Dil: 10 |
| **Sulfate** | | **340** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 05-May-2012 1923 by 07 | | Batch: S32373 | Dil: 10 |

**AIC No.** 157476-4
**Sample Identification:** 6X 050112

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **440** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 10-May-2012 1356 by 302 | | Batch: W39798 | |
| **Total Dissolved Solids** | | **1900** | 40 | **mg/l** | |
| SM 2540C | Prep: 07-May-2012 1334 by 285 | Analyzed: 08-May-2012 1146 by 285 | | Batch: W39749 | |
| **Calcium** | | **19** | 0.1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2229 by 297 | | Batch: S32367 | |
| **Magnesium** | | **7.8** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2229 by 297 | | Batch: S32367 | |
| **Potassium** | | **28** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2229 by 297 | | Batch: S32367 | |
| **Sodium** | | **760** | 10 | **mg/l** | D |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 07-May-2012 1335 by 297 | | Batch: S32367 | Dil: 10 |
| **Chloride** | | **400** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 05-May-2012 1949 by 07 | | Batch: S32373 | Dil: 10 |
| **Sulfate** | | **450** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 05-May-2012 1949 by 07 | | Batch: S32373 | Dil: 10 |

**AIC No.** 157476-5
**Sample Identification:** 8X 050112

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **570** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 10-May-2012 1356 by 302 | | Batch: W39798 | |

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## ANALYTICAL RESULTS

**AIC No.** 157476-5 (Continued)
**Sample Identification:** 8X 050112

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Total Dissolved Solids** | | **2500** | 40 | **mg/l** | |
| SM 2540C | Prep: 07-May-2012 1334 by 285 | Analyzed: 08-May-2012 1146 by 285 | | Batch: W39749 | |
| **Calcium** | | **13** | 0.1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2233 by 297 | | Batch: S32367 | |
| **Magnesium** | | **9.0** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2233 by 297 | | Batch: S32367 | |
| **Potassium** | | **33** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2233 by 297 | | Batch: S32367 | |
| **Sodium** | | **1000** | 50 | **mg/l** | D |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 07-May-2012 1455 by 297 | | Batch: S32367 | Dil: 50 |
| **Chloride** | | **520** | 20 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 05-May-2012 2015 by 07 | | Batch: S32373 | Dil: 100 |
| **Sulfate** | | **570** | 20 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 05-May-2012 2015 by 07 | | Batch: S32373 | Dil: 100 |

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## DUPLICATE RESULTS

| Analyte | | AIC No. | Result | RPD | RPD Limit | Preparation Date | Analysis Date | Dil | Qual |
|---|---|---|---|---|---|---|---|---|---|
| Total Dissolved Solids | | 157391-1 | 990 mg/l | | | 07May12 1334 by 285 | 08May12 1146 by 285 | | |
| | Batch: W39749 | Duplicate | 1000 mg/l | 1.60 | 10.0 | 07May12 1334 by 285 | 08May12 1146 by 285 | | |
| Total Dissolved Solids | | 157391-3 | 980 mg/l | | | 07May12 1334 by 285 | 08May12 1146 by 285 | | |
| | Batch: W39749 | Duplicate | 970 mg/l | 1.23 | 10.0 | 07May12 1334 by 285 | 08May12 1146 by 285 | | |
| Alkalinity as CaCO3 | | 157476-1 | 240 mg/l | | | | 10May12 1356 by 302 | | |
| | Batch: W39798 | Duplicate | 240 mg/l | 0.00 | 20.0 | | 10May12 1356 by 302 | | |

## LABORATORY CONTROL SAMPLE RESULTS

| Analyte | Spike Amount | % | Limits | RPD | Limit | Batch | Preparation Date | Analysis Date | Dil | Qual |
|---|---|---|---|---|---|---|---|---|---|---|
| Calcium | 10 mg/l | 98.1 | 85.0-115 | | | S32367 | 04May12 1031 by 271 | 04May12 2141 by 297 | | |
| Magnesium | 10 mg/l | 96.6 | 85.0-115 | | | S32367 | 04May12 1031 by 271 | 04May12 2141 by 297 | | |
| Potassium | 10 mg/l | 97.2 | 85.0-115 | | | S32367 | 04May12 1031 by 271 | 04May12 2141 by 297 | | |
| Sodium | 10 mg/l | 99.2 | 85.0-115 | | | S32367 | 04May12 1031 by 271 | 04May12 2141 by 297 | | |
| Chloride | 20 mg/l | 99.8 | 90.0-110 | | | S32373 | 05May12 1154 by 07 | 05May12 1648 by 07 | | |
| Sulfate | 20 mg/l | 96.3 | 90.0-110 | | | S32373 | 05May12 1154 by 07 | 05May12 1648 by 07 | | |

## MATRIX SPIKE SAMPLE RESULTS

| Analyte | Sample | Spike Amount | % | Limits | Batch | Preparation Date | Analysis Date | Dil | Qual |
|---|---|---|---|---|---|---|---|---|---|
| Calcium | 157469-1 | 10 mg/l | 108 | 75.0-125 | S32367 | 04May12 1031 by 271 | 04May12 2144 by 297 | | |
| | 157469-1 | 10 mg/l | 105 | 75.0-125 | S32367 | 04May12 1031 by 271 | 04May12 2148 by 297 | | |
| | Relative Percent Difference: | | 1.35 | 20.0 | S32367 | | | | |
| Magnesium | 157469-1 | 10 mg/l | - | 75.0-125 | S32367 | 04May12 1031 by 271 | 07May12 1301 by 297 | 10 | X |
| | 157469-1 | 10 mg/l | - | 75.0-125 | S32367 | 04May12 1031 by 271 | 07May12 1303 by 297 | 10 | X |
| | Relative Percent Difference: | | 4.22 | 20.0 | S32367 | | | | D |
| Potassium | 157469-1 | 10 mg/l | 123 | 75.0-125 | S32367 | 04May12 1031 by 271 | 04May12 2144 by 297 | | |
| | 157469-1 | 10 mg/l | 122 | 75.0-125 | S32367 | 04May12 1031 by 271 | 04May12 2148 by 297 | | |
| | Relative Percent Difference: | | 0.141 | 20.0 | S32367 | | | | |
| Sodium | 157469-1 | 10 mg/l | - | 75.0-125 | S32367 | 04May12 1031 by 271 | 07May12 1301 by 297 | 10 | X |
| | 157469-1 | 10 mg/l | - | 75.0-125 | S32367 | 04May12 1031 by 271 | 07May12 1303 by 297 | 10 | X |
| | Relative Percent Difference: | | 4.14 | 20.0 | S32367 | | | | D |
| Chloride | 157476-1 | 20 mg/l | 95.7 | 80.0-120 | S32373 | 05May12 1154 by 07 | 05May12 1714 by 07 | | |
| | 157476-1 | 20 mg/l | 96.3 | 80.0-120 | S32373 | 05May12 1154 by 07 | 05May12 1740 by 07 | | |
| | Relative Percent Difference: | | 0.510 | 10.0 | S32373 | | | | |
| Sulfate | 157476-1 | 20 mg/l | 95.0 | 80.0-120 | S32373 | 05May12 1154 by 07 | 05May12 1714 by 07 | | |
| | 157476-1 | 20 mg/l | 95.4 | 80.0-120 | S32373 | 05May12 1154 by 07 | 05May12 1740 by 07 | | |
| | Relative Percent Difference: | | 0.394 | 10.0 | S32373 | | | | |

AMERICAN INTERPLEX CORPORATION LABORATORIES

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1400 North Fox Hunter Road
Fayetteville, AR 72701

## LABORATORY BLANK RESULTS

| Analyte | Result | RL | PQL | QC Sample | Preparation Date | Analysis Date | Qual |
|---|---|---|---|---|---|---|---|
| Alkalinity as CaCO3 | < 1 mg/l | 1 | 1 | W39798-1 | | 10May12 1356 by 302 | |
| Total Dissolved Solids | < 10 mg/l | 10 | 10 | W39749-1 | 07May12 1334 by 285 | 08May12 1146 by 285 | |
| Calcium | < 0.1 mg/l | 0.1 | 0.1 | S32367-1 | 04May12 1031 by 271 | 04May12 2138 by 297 | |
| Magnesium | < 0.03 mg/l | 0.03 | 0.03 | S32367-1 | 04May12 1031 by 271 | 04May12 2138 by 297 | |
| Potassium | < 1 mg/l | 1 | 1 | S32367-1 | 04May12 1031 by 271 | 04May12 2138 by 297 | |
| Sodium | < 1 mg/l | 1 | 1 | S32367-1 | 04May12 1031 by 271 | 04May12 2138 by 297 | |
| Chloride | < 0.2 mg/l | 0.2 | 0.2 | S32373-1 | 05May12 1154 by 07 | 05May12 1622 by 07 | |
| Sulfate | < 0.2 mg/l | 0.2 | 0.2 | S32373-1 | 05May12 1154 by 07 | 05May12 1622 by 07 | |

AMERICAN INTERPLEX CORPORATION
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# CHAIN OF CUSTODY / ANALYSIS REQUEST FORM

Client: Bruce Richart - ASU
Project Reference: Fayetteville
Project Manager:
Sampled By: MG TW

PO No.

Sample Matrix: WATER / SOIL

No of BOTTLES

Analyses Requested: $Na^+$, $Ca^{++}$, $Mg^{++}$, $K^+$, $Cl^-$, $SO_4^{-2}$, Total Alkalinity, TDS

AIC Control No: 157476
AIC Proposal No:
Carrier: Fed-X
Received Temperature °C: 2

| AIC No. | Sample Identification | Date/Time Collected | GRAB | COMP | WATER | SOIL | BOTTLES | Remarks |
|---|---|---|---|---|---|---|---|---|
| 1 | 2.5x | 050112 | X | | X | | 2 | |
| 2 | 3.4x | ↓ | X | | X | | 2 | |
| 3 | 4.5x | | X | | X | | 2 | |
| 4 | 6x | | X | | X | | 2 | |
| 5 | 8x | | X | | X | | 2 | |
| | | | | | | | | |
| | | | | | | | | |
| | | Container Type | | | | | P → | |
| | | Preservative | | | | | N N N N NO NO NO NO | |

Field pH calibration
on _____ @ _____
Buffer:

G = Glass P = Plastic V = VOA vials H = HCl to pH2 T = Sodium Thiosulfate
NO = none S = Sulfuric acid pH2 N = Nitric acid pH2 B = NaOH to pH12 Z = Zinc acetate

Turnaround Time Requested: (Please circle)
NORMAL or EXPEDITED IN ____ DAYS
Expedited results requested by: _____
Who should AIC contact with questions: Jennifer Bouldin or Melanie Griffin
Phone: _____ Fax: _____
Report Attention to: _____
Report Address to:

| Relinquished By: | Date/Time | Received By: | Date/Time |
|---|---|---|---|
| Melanie Griffin | 050312 1200 | | |
| Relinquished By: | Date/Time | Received in Lab By: | Date/Time |
| | | Logan Hopton | 5-4-12 0845 |

Comments:
8693 85336571

AMERICAN INTERPLEX CORPORATION LABORATORIES

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CH2M HILL
ATTN: Mr. Bruce Richart
1400 North Fox Hunter Road
Fayetteville, AR 72701

This report contains the analytical results and supporting information for samples submitted on May 4, 2012. Attached please find a copy of the Chain of Custody and/or other documents received. Note that any remaining sample will be discarded two weeks from the original report date unless other arrangements are made.

This report is intended for the sole use of the client listed above. Assessment of the data requires access to the entire document.

This report has been reviewed by the Laboratory Director or a qualified designee.

Steve Bradford
Deputy Laboratory Director

This document has been distributed to the following:

PDF cc: CH2M HILL
ATTN: Mr. Bruce Richart
robert.richart@ch2m.com

AMERICAN INTERPLEX CORPORATION LABORATORIES

40 1972 2012

CH2M HILL
1400 North Fox Hunter Road
Fayetteville, AR 72701

## SAMPLE INFORMATION

**Project Description:**
Five (5) water sample(s) received on May 4, 2012
Fayetteville - ASU

**Receipt Details:**
A Chain of Custody was provided. The samples were delivered in one (1) ice chest.
Ice chest #1 was delivered with shipping documentation.

Each sample container was checked for proper labeling, including date and time sampled. Sample containers were reviewed for proper type, adequate volume, integrity, temperature, preservation, and holding times. Any exceptions are noted below:

**Sample Identification:**

| Laboratory ID | Client Sample ID | Sampled Date/Time | Notes |
|---|---|---|---|
| 157477-1 | 2.5X 050212 | 02-May-2012 | 1 |
| 157477-2 | 3.4X 050212 | 02-May-2012 | 1 |
| 157477-3 | 4.5X 050212 | 02-May-2012 | 1 |
| 157477-4 | 6X 050212 | 02-May-2012 | 1 |
| 157477-5 | 8X 050212 | 02-May-2012 | 1 |

Notes:
1. Sample label was incomplete in regard to date/time of sampling

**Qualifiers:**
D Result is from a secondary dilution factor
X Spiking level is invalid due to the high concentration of analyte in the spiked sample

**References:**
"Methods for Chemical Analysis of Water and Wastes", EPA/600/4-79-020 (Mar 1983) with updates and supplements EPA/600/5-91-010 (Jun 1991), EPA/600/R-92-129 (Aug 1992) and EPA/600/R-93-100 (Aug 1993).
"Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846)", Third Edition.
"Standard Methods for the Examination of Water and Wastewaters", 20th edition, 1998.
"American Society for Testing and Materials" (ASTM).
"Association of Analytical Chemists" (AOAC).

AMERICAN INTERPLEX CORPORATION LABORATORIES

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1400 North Fox Hunter Road
Fayetteville, AR 72701

## ANALYTICAL RESULTS

**AIC No.** 157477-1
**Sample Identification:** 2.5X 050212

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **320** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 10-May-2012 1356 by 302 | | Batch: W39798 | |
| **Total Dissolved Solids** | | **990** | 20 | **mg/l** | |
| SM 2540C | Prep: 08-May-2012 1214 by 285 | Analyzed: 09-May-2012 1028 by 285 | | Batch: W39767 | |
| **Calcium** | | **35** | 0.1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2237 by 297 | | Batch: S32367 | |
| **Magnesium** | | **6.1** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2237 by 297 | | Batch: S32367 | |
| **Potassium** | | **20** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2237 by 297 | | Batch: S32367 | |
| **Sodium** | | **360** | 10 | **mg/l** | D |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 07-May-2012 1340 by 297 | | Batch: S32367 | Dil: 10 |
| **Chloride** | | **200** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 05-May-2012 2158 by 07 | | Batch: S32373 | Dil: 10 |
| **Sulfate** | | **230** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 05-May-2012 2158 by 07 | | Batch: S32373 | Dil: 10 |

**AIC No.** 157477-2
**Sample Identification:** 3.4X 050212

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **340** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 10-May-2012 1356 by 302 | | Batch: W39798 | |
| **Total Dissolved Solids** | | **1200** | 20 | **mg/l** | |
| SM 2540C | Prep: 08-May-2012 1214 by 285 | Analyzed: 09-May-2012 1028 by 285 | | Batch: W39767 | |
| **Calcium** | | **30** | 0.1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2241 by 297 | | Batch: S32367 | |
| **Magnesium** | | **6.2** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2241 by 297 | | Batch: S32367 | |
| **Potassium** | | **21** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2241 by 297 | | Batch: S32367 | |
| **Sodium** | | **490** | 10 | **mg/l** | D |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 07-May-2012 1343 by 297 | | Batch: S32367 | Dil: 10 |
| **Chloride** | | **250** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 05-May-2012 2224 by 07 | | Batch: S32373 | Dil: 10 |
| **Sulfate** | | **280** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 05-May-2012 2224 by 07 | | Batch: S32373 | Dil: 10 |

**AIC No.** 157477-3
**Sample Identification:** 4.5X 050212

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **420** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 10-May-2012 1356 by 302 | | Batch: W39798 | |

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## ANALYTICAL RESULTS

**AIC No.** 157477-3 (Continued)
**Sample Identification:** 4.5X 050212

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Total Dissolved Solids** | | **1500** | 20 | **mg/l** | |
| SM 2540C | Prep: 08-May-2012 1214 by 285 | Analyzed: 09-May-2012 1028 by 285 | | Batch: W39767 | |
| **Calcium** | | **25** | 0.1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2245 by 297 | | Batch: S32367 | |
| **Magnesium** | | **6.9** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2245 by 297 | | Batch: S32367 | |
| **Potassium** | | **24** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2245 by 297 | | Batch: S32367 | |
| **Sodium** | | **630** | 10 | **mg/l** | D |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 07-May-2012 1346 by 297 | | Batch: S32367 | Dil: 10 |
| **Chloride** | | **310** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 05-May-2012 2250 by 07 | | Batch: S32373 | Dil: 10 |
| **Sulfate** | | **350** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 05-May-2012 2250 by 07 | | Batch: S32373 | Dil: 10 |

**AIC No.** 157477-4
**Sample Identification:** 6X 050212

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **520** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 10-May-2012 1356 by 302 | | Batch: W39798 | |
| **Total Dissolved Solids** | | **2000** | 40 | **mg/l** | |
| SM 2540C | Prep: 08-May-2012 1214 by 285 | Analyzed: 09-May-2012 1028 by 285 | | Batch: W39767 | |
| **Calcium** | | **21** | 0.1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2249 by 297 | | Batch: S32367 | |
| **Magnesium** | | **8.4** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2249 by 297 | | Batch: S32367 | |
| **Potassium** | | **30** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2249 by 297 | | Batch: S32367 | |
| **Sodium** | | **870** | 10 | **mg/l** | D |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 07-May-2012 1349 by 297 | | Batch: S32367 | Dil: 10 |
| **Chloride** | | **400** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 05-May-2012 2316 by 07 | | Batch: S32373 | Dil: 10 |
| **Sulfate** | | **460** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 05-May-2012 2316 by 07 | | Batch: S32373 | Dil: 10 |

**AIC No.** 157477-5
**Sample Identification:** 8X 050212

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **610** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 10-May-2012 1356 by 302 | | Batch: W39798 | |

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## ANALYTICAL RESULTS

**AIC No.** 157477-5 (Continued)
**Sample Identification:** 8X 050212

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Total Dissolved Solids** | | **2400** | 40 | **mg/l** | |
| SM 2540C | Prep: 08-May-2012 1214 by 285 | Analyzed: 09-May-2012 1028 by 285 | | Batch: W39767 | |
| **Calcium** | | **12** | 0.1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2310 by 297 | | Batch: S32367 | |
| **Magnesium** | | **8.8** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2310 by 297 | | Batch: S32367 | |
| **Potassium** | | **32** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2310 by 297 | | Batch: S32367 | |
| **Sodium** | | **940** | 50 | **mg/l** | D |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 07-May-2012 1458 by 297 | | Batch: S32367 | Dil: 50 |
| **Chloride** | | **540** | 20 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 05-May-2012 2341 by 07 | | Batch: S32373 | Dil: 100 |
| **Sulfate** | | **600** | 20 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 05-May-2012 2341 by 07 | | Batch: S32373 | Dil: 100 |

AMERICAN INTERPLEX CORPORATION LABORATORIES

CH2M HILL
1400 North Fox Hunter Road
Fayetteville, AR 72701

## DUPLICATE RESULTS

| Analyte | | AIC No. | Result | RPD | RPD Limit | Preparation Date | Analysis Date | Dil | Qual |
|---|---|---|---|---|---|---|---|---|---|
| Total Dissolved Solids | | 157477-1 | 990 mg/l | | | 08May12 1214 by 285 | 09May12 1028 by 285 | | |
| | Batch: W39767 | Duplicate | 990 mg/l | 0.808 | 10.0 | 08May12 1214 by 285 | 09May12 1028 by 285 | | |
| Total Dissolved Solids | | 157477-2 | 1200 mg/l | | | 08May12 1214 by 285 | 09May12 1028 by 285 | | |
| | Batch: W39767 | Duplicate | 1200 mg/l | 0.160 | 10.0 | 08May12 1214 by 285 | 09May12 1028 by 285 | | |
| Alkalinity as CaCO3 | | 157476-1 | 240 mg/l | | | | 10May12 1356 by 302 | | |
| | Batch: W39798 | Duplicate | 240 mg/l | 0.00 | 20.0 | | 10May12 1356 by 302 | | |

## LABORATORY CONTROL SAMPLE RESULTS

| Analyte | Spike Amount | % | Limits | RPD | Limit | Batch | Preparation Date | Analysis Date | Dil | Qual |
|---|---|---|---|---|---|---|---|---|---|---|
| Calcium | 10 mg/l | 98.1 | 85.0-115 | | | S32367 | 04May12 1031 by 271 | 04May12 2141 by 297 | | |
| Magnesium | 10 mg/l | 96.6 | 85.0-115 | | | S32367 | 04May12 1031 by 271 | 04May12 2141 by 297 | | |
| Potassium | 10 mg/l | 97.2 | 85.0-115 | | | S32367 | 04May12 1031 by 271 | 04May12 2141 by 297 | | |
| Sodium | 10 mg/l | 99.2 | 85.0-115 | | | S32367 | 04May12 1031 by 271 | 04May12 2141 by 297 | | |
| Chloride | 20 mg/l | 99.8 | 90.0-110 | | | S32373 | 05May12 1154 by 07 | 05May12 1648 by 07 | | |
| Sulfate | 20 mg/l | 96.3 | 90.0-110 | | | S32373 | 05May12 1154 by 07 | 05May12 1648 by 07 | | |

## MATRIX SPIKE SAMPLE RESULTS

| Analyte | Sample | Spike Amount | % | Limits | Batch | Preparation Date | Analysis Date | Dil | Qual |
|---|---|---|---|---|---|---|---|---|---|
| Calcium | 157469-1 | 10 mg/l | 108 | 75.0-125 | S32367 | 04May12 1031 by 271 | 04May12 2144 by 297 | | |
| | 157469-1 | 10 mg/l | 105 | 75.0-125 | S32367 | 04May12 1031 by 271 | 04May12 2148 by 297 | | |
| | Relative Percent Difference: | | 1.35 | 20.0 | S32367 | | | | |
| Magnesium | 157469-1 | 10 mg/l | - | 75.0-125 | S32367 | 04May12 1031 by 271 | 07May12 1301 by 297 | 10 | X |
| | 157469-1 | 10 mg/l | - | 75.0-125 | S32367 | 04May12 1031 by 271 | 07May12 1303 by 297 | 10 | X |
| | Relative Percent Difference: | | 4.22 | 20.0 | S32367 | | | | D |
| Potassium | 157469-1 | 10 mg/l | 123 | 75.0-125 | S32367 | 04May12 1031 by 271 | 04May12 2144 by 297 | | |
| | 157469-1 | 10 mg/l | 122 | 75.0-125 | S32367 | 04May12 1031 by 271 | 04May12 2148 by 297 | | |
| | Relative Percent Difference: | | 0.141 | 20.0 | S32367 | | | | |
| Sodium | 157469-1 | 10 mg/l | - | 75.0-125 | S32367 | 04May12 1031 by 271 | 07May12 1301 by 297 | 10 | X |
| | 157469-1 | 10 mg/l | - | 75.0-125 | S32367 | 04May12 1031 by 271 | 07May12 1303 by 297 | 10 | X |
| | Relative Percent Difference: | | 4.14 | 20.0 | S32367 | | | | D |
| Chloride | 157476-1 | 20 mg/l | 95.7 | 80.0-120 | S32373 | 05May12 1154 by 07 | 05May12 1714 by 07 | | |
| | 157476-1 | 20 mg/l | 96.3 | 80.0-120 | S32373 | 05May12 1154 by 07 | 05May12 1740 by 07 | | |
| | Relative Percent Difference: | | 0.510 | 10.0 | S32373 | | | | |
| Sulfate | 157476-1 | 20 mg/l | 95.0 | 80.0-120 | S32373 | 05May12 1154 by 07 | 05May12 1714 by 07 | | |
| | 157476-1 | 20 mg/l | 95.4 | 80.0-120 | S32373 | 05May12 1154 by 07 | 05May12 1740 by 07 | | |
| | Relative Percent Difference: | | 0.394 | 10.0 | S32373 | | | | |

AMERICAN INTERPLEX CORPORATION LABORATORIES

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1400 North Fox Hunter Road
Fayetteville, AR 72701

## LABORATORY BLANK RESULTS

| Analyte | Result | RL | PQL | QC Sample | Preparation Date | Analysis Date | Qual |
|---|---|---|---|---|---|---|---|
| Alkalinity as CaCO3 | < 1 mg/l | 1 | 1 | W39798-1 | | 10May12 1356 by 302 | |
| Total Dissolved Solids | < 10 mg/l | 10 | 10 | W39767-1 | 08May12 1214 by 285 | 09May12 1028 by 285 | |
| Calcium | < 0.1 mg/l | 0.1 | 0.1 | S32367-1 | 04May12 1031 by 271 | 04May12 2138 by 297 | |
| Magnesium | < 0.03 mg/l | 0.03 | 0.03 | S32367-1 | 04May12 1031 by 271 | 04May12 2138 by 297 | |
| Potassium | < 1 mg/l | 1 | 1 | S32367-1 | 04May12 1031 by 271 | 04May12 2138 by 297 | |
| Sodium | < 1 mg/l | 1 | 1 | S32367-1 | 04May12 1031 by 271 | 04May12 2138 by 297 | |
| Chloride | < 0.2 mg/l | 0.2 | 0.2 | S32373-1 | 05May12 1154 by 07 | 05May12 1622 by 07 | |
| Sulfate | < 0.2 mg/l | 0.2 | 0.2 | S32373-1 | 05May12 1154 by 07 | 05May12 1622 by 07 | |

AMERICAN INTERPLEX CORPORATION LABORATORIES

# CHAIN OF CUSTODY / ANALYSIS REQUEST FORM

Client: Bruce Richart - ASU
Project Reference: Fayetteville
Project Manager:
Sampled By:

PO No.

AIC Control No: 157477
AIC Proposal No:
Carrier: Fed-X
Received Temperature °C: 2
Remarks

| AIC No. | Sample Identification | Date/Time Collected | GRAB | COMP | Sample Matrix: WATER | Sample Matrix: SOIL | No of BOTTLES | Analyses Requested: $Na^+$ | $Ca^{++}$ | $Mg^{++}$ | $K^+$ | $Cl^-$ | $SO_4^{-2}$ | Total Alkalinity | TDS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.5X | 050212 | X | | X | | 2 | | | | | | | | |
| 2 | 3.4X | ↓ | X | | X | | 2 | | | | | | | | |
| 3 | 4.5X | | X | | X | | 2 | | | | | | | | |
| 4 | 6X | | X | | X | | 2 | | | | | | | | |
| 5 | 8X | ↓ | X | | X | | 2 | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | Container Type | | | | | | P | → | | | | | | |
| | | Preservative | | | | | | N | N | N | N | NO | NO | NO | NO |

Field pH calibration on _____ @ _____
Buffer:

G = Glass, P = Plastic, V = VOA vials, H = HCl to pH2, T = Sodium Thiosulfate
NO = none, S = Sulfuric acid pH2, N = Nitric acid pH2, B = NaOH to pH12, Z = Zinc acetate

Turnaround Time Requested: (Please circle)
NORMAL or EXPEDITED IN ____ DAYS
Expedited results requested by: _____
Who should AIC contact with questions: _____
Phone: _____ Fax: _____
Report Attention to: _____
Report Address to:

| Relinquished By: | Date/Time | Received By: | Date/Time |
|---|---|---|---|
| Melanie Ruffin | 050312 1700 | | |
| Relinquished By: | Date/Time | Received in Lab By: Logan Hopton | Date/Time 5-4-12 0845 |

Comments:
8693 8533 6571

CH2M HILL
ATTN: Mr. Bruce Richart
1400 North Fox Hunter Road
Fayetteville, AR 72701

This report contains the analytical results and supporting information for samples submitted on May 4, 2012. Attached please find a copy of the Chain of Custody and/or other documents received. Note that any remaining sample will be discarded two weeks from the original report date unless other arrangements are made.

This report is intended for the sole use of the client listed above. Assessment of the data requires access to the entire document.

This report has been reviewed by the Laboratory Director or a qualified designee.

Steve Bradford
Deputy Laboratory Director

This document has been distributed to the following:

PDF cc: CH2M HILL
ATTN: Mr. Bruce Richart
robert.richart@ch2m.com

CH2M HILL
1400 North Fox Hunter Road
Fayetteville, AR 72701

## SAMPLE INFORMATION

**Project Description:**
Five (5) water sample(s) received on May 4, 2012
Fayetteville - ASU

**Receipt Details:**
A Chain of Custody was provided. The samples were delivered in one (1) ice chest.
Ice chest #1 was delivered with shipping documentation.

Each sample container was checked for proper labeling, including date and time sampled. Sample containers were reviewed for proper type, adequate volume, integrity, temperature, preservation, and holding times. Any exceptions are noted below:

**Sample Identification:**

| Laboratory ID | Client Sample ID | Sampled Date/Time | Notes |
|---|---|---|---|
| 157479-1 | 2.5X 050312 | 03-May-2012 | 1 |
| 157479-2 | 3.4X 050312 | 03-May-2012 | 1 |
| 157479-3 | 4.5X 050312 | 03-May-2012 | 1 |
| 157479-4 | 6X 050312 | 03-May-2012 | 1 |
| 157479-5 | 8X 050312 | 03-May-2012 | 1 |

Notes:
1. Sample label was incomplete in regard to date/time of sampling

**Qualifiers:**
D Result is from a secondary dilution factor
X Spiking level is invalid due to the high concentration of analyte in the spiked sample

**References:**
"Methods for Chemical Analysis of Water and Wastes", EPA/600/4-79-020 (Mar 1983) with updates and supplements EPA/600/5-91-010 (Jun 1991), EPA/600/R-92-129 (Aug 1992) and EPA/600/R-93-100 (Aug 1993).
"Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846)", Third Edition.
"Standard Methods for the Examination of Water and Wastewaters", 20th edition, 1998.
"American Society for Testing and Materials" (ASTM).
"Association of Analytical Chemists" (AOAC).

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## ANALYTICAL RESULTS

**AIC No.** 157479-1
**Sample Identification:** 2.5X 050312

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **290** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 10-May-2012 1356 by 302 | | Batch: W39798 | |
| **Total Dissolved Solids** | | **990** | 20 | **mg/l** | |
| SM 2540C | Prep: 08-May-2012 1214 by 285 | Analyzed: 09-May-2012 1028 by 285 | | Batch: W39767 | |
| **Calcium** | | **33** | 0.1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2314 by 297 | | Batch: S32367 | |
| **Magnesium** | | **5.8** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2314 by 297 | | Batch: S32367 | |
| **Potassium** | | **19** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2314 by 297 | | Batch: S32367 | |
| **Sodium** | | **440** | 10 | **mg/l** | D |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 07-May-2012 1355 by 297 | | Batch: S32367 | Dil: 10 |
| **Chloride** | | **200** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 06-May-2012 0007 by 07 | | Batch: S32373 | Dil: 10 |
| **Sulfate** | | **230** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 06-May-2012 0007 by 07 | | Batch: S32373 | Dil: 10 |

**AIC No.** 157479-2
**Sample Identification:** 3.4X 050312

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **350** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 10-May-2012 1356 by 302 | | Batch: W39798 | |
| **Total Dissolved Solids** | | **1200** | 20 | **mg/l** | |
| SM 2540C | Prep: 08-May-2012 1214 by 285 | Analyzed: 09-May-2012 1028 by 285 | | Batch: W39767 | |
| **Calcium** | | **32** | 0.1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2318 by 297 | | Batch: S32367 | |
| **Magnesium** | | **6.6** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2318 by 297 | | Batch: S32367 | |
| **Potassium** | | **22** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2318 by 297 | | Batch: S32367 | |
| **Sodium** | | **520** | 10 | **mg/l** | D |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 07-May-2012 1358 by 297 | | Batch: S32367 | Dil: 10 |
| **Chloride** | | **240** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 06-May-2012 0033 by 07 | | Batch: S32373 | Dil: 10 |
| **Sulfate** | | **270** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 06-May-2012 0033 by 07 | | Batch: S32373 | Dil: 10 |

**AIC No.** 157479-3
**Sample Identification:** 4.5X 050312

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **410** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 10-May-2012 1356 by 302 | | Batch: W39798 | |

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## ANALYTICAL RESULTS

**AIC No.** 157479-3 (Continued)
**Sample Identification:** 4.5X 050312

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Total Dissolved Solids** | | **1600** | 20 | **mg/l** | |
| SM 2540C | Prep: 08-May-2012 1214 by 285 | Analyzed: 09-May-2012 1028 by 285 | | Batch: W39767 | |
| **Calcium** | | **27** | 0.1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2322 by 297 | | Batch: S32367 | |
| **Magnesium** | | **7.1** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2322 by 297 | | Batch: S32367 | |
| **Potassium** | | **25** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2322 by 297 | | Batch: S32367 | |
| **Sodium** | | **640** | 10 | **mg/l** | D |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 07-May-2012 1402 by 297 | | Batch: S32367 | Dil: 10 |
| **Chloride** | | **310** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 06-May-2012 0059 by 07 | | Batch: S32373 | Dil: 10 |
| **Sulfate** | | **350** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 06-May-2012 0059 by 07 | | Batch: S32373 | Dil: 10 |

**AIC No.** 157479-4
**Sample Identification:** 6X 050312

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **520** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 10-May-2012 1356 by 302 | | Batch: W39798 | |
| **Total Dissolved Solids** | | **1900** | 40 | **mg/l** | |
| SM 2540C | Prep: 08-May-2012 1214 by 285 | Analyzed: 09-May-2012 1028 by 285 | | Batch: W39767 | |
| **Calcium** | | **22** | 0.1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2326 by 297 | | Batch: S32367 | |
| **Magnesium** | | **8.1** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2326 by 297 | | Batch: S32367 | |
| **Potassium** | | **29** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2326 by 297 | | Batch: S32367 | |
| **Sodium** | | **820** | 10 | **mg/l** | D |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 07-May-2012 1405 by 297 | | Batch: S32367 | Dil: 10 |
| **Chloride** | | **400** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 06-May-2012 0125 by 07 | | Batch: S32373 | Dil: 10 |
| **Sulfate** | | **460** | 2 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 06-May-2012 0125 by 07 | | Batch: S32373 | Dil: 10 |

**AIC No.** 157479-5
**Sample Identification:** 8X 050312

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Alkalinity as CaCO3** | | **620** | 1 | **mg/l** | |
| SM 2320B | | Analyzed: 10-May-2012 1356 by 302 | | Batch: W39798 | |

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## ANALYTICAL RESULTS

**AIC No.** 157479-5 (Continued)
**Sample Identification:** 8X 050312

| Analyte | | Result | RL | Units | Qualifier |
|---|---|---|---|---|---|
| **Total Dissolved Solids** | | **2400** | 40 | **mg/l** | |
| SM 2540C | Prep: 08-May-2012 1214 by 285 | Analyzed: 09-May-2012 1028 by 285 | | Batch: W39767 | |
| **Calcium** | | **210** | 1 | **mg/l** | D |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 07-May-2012 1419 by 297 | | Batch: S32367 | Dil: 10 |
| **Magnesium** | | **13** | 0.03 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2330 by 297 | | Batch: S32367 | |
| **Potassium** | | **34** | 1 | **mg/l** | |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 04-May-2012 2330 by 297 | | Batch: S32367 | |
| **Sodium** | | **1100** | 50 | **mg/l** | D |
| EPA 200.7 | Prep: 04-May-2012 1031 by 271 | Analyzed: 07-May-2012 1501 by 297 | | Batch: S32367 | Dil: 50 |
| **Chloride** | | **550** | 20 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 06-May-2012 0150 by 07 | | Batch: S32373 | Dil: 100 |
| **Sulfate** | | **620** | 20 | **mg/l** | D |
| EPA 300.0 | Prep: 05-May-2012 1150 by 07 | Analyzed: 06-May-2012 0150 by 07 | | Batch: S32373 | Dil: 100 |

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## DUPLICATE RESULTS

| Analyte | | AIC No. | Result | RPD | RPD Limit | Preparation Date | Analysis Date | Dil | Qual |
|---|---|---|---|---|---|---|---|---|---|
| Total Dissolved Solids | | 157477-1 | 990 mg/l | | | 08May12 1214 by 285 | 09May12 1028 by 285 | | |
| | Batch: W39767 | Duplicate | 990 mg/l | 0.808 | 10.0 | 08May12 1214 by 285 | 09May12 1028 by 285 | | |
| Total Dissolved Solids | | 157477-2 | 1200 mg/l | | | 08May12 1214 by 285 | 09May12 1028 by 285 | | |
| | Batch: W39767 | Duplicate | 1200 mg/l | 0.160 | 10.0 | 08May12 1214 by 285 | 09May12 1028 by 285 | | |
| Alkalinity as CaCO3 | | 157476-1 | 240 mg/l | | | | 10May12 1356 by 302 | | |
| | Batch: W39798 | Duplicate | 240 mg/l | 0.00 | 20.0 | | 10May12 1356 by 302 | | |

## LABORATORY CONTROL SAMPLE RESULTS

| Analyte | Spike Amount | % | Limits | RPD | Limit | Batch | Preparation Date | Analysis Date | Dil | Qual |
|---|---|---|---|---|---|---|---|---|---|---|
| Calcium | 10 mg/l | 98.1 | 85.0-115 | | | S32367 | 04May12 1031 by 271 | 04May12 2141 by 297 | | |
| Magnesium | 10 mg/l | 96.6 | 85.0-115 | | | S32367 | 04May12 1031 by 271 | 04May12 2141 by 297 | | |
| Potassium | 10 mg/l | 97.2 | 85.0-115 | | | S32367 | 04May12 1031 by 271 | 04May12 2141 by 297 | | |
| Sodium | 10 mg/l | 99.2 | 85.0-115 | | | S32367 | 04May12 1031 by 271 | 04May12 2141 by 297 | | |
| Chloride | 20 mg/l | 99.8 | 90.0-110 | | | S32373 | 05May12 1154 by 07 | 05May12 1648 by 07 | | |
| Sulfate | 20 mg/l | 96.3 | 90.0-110 | | | S32373 | 05May12 1154 by 07 | 05May12 1648 by 07 | | |

## MATRIX SPIKE SAMPLE RESULTS

| Analyte | Sample | Spike Amount | % | Limits | Batch | Preparation Date | Analysis Date | Dil | Qual |
|---|---|---|---|---|---|---|---|---|---|
| Calcium | 157469-1 | 10 mg/l | 108 | 75.0-125 | S32367 | 04May12 1031 by 271 | 04May12 2144 by 297 | | |
| | 157469-1 | 10 mg/l | 105 | 75.0-125 | S32367 | 04May12 1031 by 271 | 04May12 2148 by 297 | | |
| | Relative Percent Difference: | | 1.35 | 20.0 | S32367 | | | | |
| Magnesium | 157469-1 | 10 mg/l | - | 75.0-125 | S32367 | 04May12 1031 by 271 | 07May12 1301 by 297 | 10 | X |
| | 157469-1 | 10 mg/l | - | 75.0-125 | S32367 | 04May12 1031 by 271 | 07May12 1303 by 297 | 10 | X |
| | Relative Percent Difference: | | 4.22 | 20.0 | S32367 | | | | D |
| Potassium | 157469-1 | 10 mg/l | 123 | 75.0-125 | S32367 | 04May12 1031 by 271 | 04May12 2144 by 297 | | |
| | 157469-1 | 10 mg/l | 122 | 75.0-125 | S32367 | 04May12 1031 by 271 | 04May12 2148 by 297 | | |
| | Relative Percent Difference: | | 0.141 | 20.0 | S32367 | | | | |
| Sodium | 157469-1 | 10 mg/l | - | 75.0-125 | S32367 | 04May12 1031 by 271 | 07May12 1301 by 297 | 10 | X |
| | 157469-1 | 10 mg/l | - | 75.0-125 | S32367 | 04May12 1031 by 271 | 07May12 1303 by 297 | 10 | X |
| | Relative Percent Difference: | | 4.14 | 20.0 | S32367 | | | | D |
| Chloride | 157476-1 | 20 mg/l | 95.7 | 80.0-120 | S32373 | 05May12 1154 by 07 | 05May12 1714 by 07 | | |
| | 157476-1 | 20 mg/l | 96.3 | 80.0-120 | S32373 | 05May12 1154 by 07 | 05May12 1740 by 07 | | |
| | Relative Percent Difference: | | 0.510 | 10.0 | S32373 | | | | |
| Sulfate | 157476-1 | 20 mg/l | 95.0 | 80.0-120 | S32373 | 05May12 1154 by 07 | 05May12 1714 by 07 | | |
| | 157476-1 | 20 mg/l | 95.4 | 80.0-120 | S32373 | 05May12 1154 by 07 | 05May12 1740 by 07 | | |
| | Relative Percent Difference: | | 0.394 | 10.0 | S32373 | | | | |

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## LABORATORY BLANK RESULTS

| Analyte | Result | RL | PQL | QC Sample | Preparation Date | Analysis Date | Qual |
|---|---|---|---|---|---|---|---|
| Alkalinity as CaCO3 | < 1 mg/l | 1 | 1 | W39798-1 | | 10May12 1356 by 302 | |
| Total Dissolved Solids | < 10 mg/l | 10 | 10 | W39767-1 | 08May12 1214 by 285 | 09May12 1028 by 285 | |
| Calcium | < 0.1 mg/l | 0.1 | 0.1 | S32367-1 | 04May12 1031 by 271 | 04May12 2138 by 297 | |
| Magnesium | < 0.03 mg/l | 0.03 | 0.03 | S32367-1 | 04May12 1031 by 271 | 04May12 2138 by 297 | |
| Potassium | < 1 mg/l | 1 | 1 | S32367-1 | 04May12 1031 by 271 | 04May12 2138 by 297 | |
| Sodium | < 1 mg/l | 1 | 1 | S32367-1 | 04May12 1031 by 271 | 04May12 2138 by 297 | |
| Chloride | < 0.2 mg/l | 0.2 | 0.2 | S32373-1 | 05May12 1154 by 07 | 05May12 1622 by 07 | |
| Sulfate | < 0.2 mg/l | 0.2 | 0.2 | S32373-1 | 05May12 1154 by 07 | 05May12 1622 by 07 | |

AMERICAN INTERPLEX CORPORATION
LABORATORIES

# CHAIN OF CUSTODY / ANALYSIS REQUEST FORM

Client: Bruce Richart - ASU
Project Reference: Fayetteville
Project Manager:
Sampled By:

PO No.

Sample Matrix: WATER / SOIL

No of BOTTLES

Analyses Requested: $Na^+$, $Ca^{++}$, $Mg^{++}$, $K^+$, $Cl^-$, $SO_4^{-2}$, Total Alkalinity, TDS

AIC Control No: 157479
AIC Proposal No:
Carrier: Fed-X
Received Temperature °C: 2
Remarks

| AIC No. | Sample Identification | Date/Time Collected | GRAB | COMP | WATER | SOIL | BOTTLES |
|---|---|---|---|---|---|---|---|
| 1 | 2.5x | 050312 | X | | X | | 2 |
| 2 | 3.4x | ↓ | X | | X | | 2 |
| 3 | 4.5x | | X | | X | | 2 |
| 4 | 6x | | X | | X | | 2 |
| 5 | 8x | | X | | X | | 2 |
| | | | | | | | |
| | | | | | | | |
| | | Container Type | | | | | |
| | | Preservative | | | | | |

Container Type: P
Preservative: N N N N NO NO NO NO

Field pH calibration on _____ @ _____
Buffer:

G = Glass, P = Plastic, V = VOA vials, H = HCl to pH2, T = Sodium Thiosulfate
NO = none, S = Sulfuric acid pH2, N = Nitric acid pH2, B = NaOH to pH12, Z = Zinc acetate

Turnaround Time Requested: (Please circle)
NORMAL or EXPEDITED IN ____ DAYS
Expedited results requested by: _____
Who should AIC contact with questions: _____
Phone: _____ Fax: _____
Report Attention to: _____
Report Address to:

| Relinquished By: | Date/Time | Received By: | Date/Time |
|---|---|---|---|
| Melanie Griffin | 050312 1200 | | |
| Relinquished By: | Date/Time | Received in Lab By: Tyra Hopton | Date/Time 5-4-12 0845 |

Comments: 8693 8533 6582

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TABLE C-19
**Summary of % Survival (n = 10) on each Day of the Spiked Effluent Test**

| | Day of Test | | | | | | |
|---|---|---|---|---|---|---|---|
| **Test Exposure** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| Laboratory Control | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1x (Unspiked Effluent) | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 2.5x | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 3.4x | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 4.5x | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 6.0x | 100 | 100 | 100 | 100 | 100 | 100 | 80 |
| 8.0x | 100 | 70 | 70 | 50 | 50 | 50 | 50 [a] |

[a] Statistically less than unspiked effluent control (P < 0.05)

TABLE C-20
**Summary of Reproduction (Average Number of Neonates per Female) on each Day of the Spiked Effluent Test**

| | Day of Test | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Test Exposure** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **Total** |
| Laboratory Control | 0 | 0 | 0 | 3.2 | 1.8 | 4.7 | 9.1 | 18.8 |
| 1x (Unspiked Effluent) | 0 | 0 | 0 | 3.5 | 4.3 | 5.6 | 14.8 | 28.2 |
| 2.5x | 0 | 0 | 0 | 4.9 | 6.7 | 1.7 | 14.8 | 28.1 |
| 3.4x | 0 | 0 | 0 | 5.3 | 3.8 | 3.7 | 14 | 26.8 |
| 4.5x | 0 | 0 | 0 | 4.8 | 6.5 | 1.6 | 10.3 | 23.2 |
| 6.0x | 0 | 0 | 0 | 3.8 | 5.1 | 1 | 4.8 | 14.7 [a] |
| 8.0x | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 [a] |

[a] Statistically less than unspiked effluent control (P < 0.05)

TABLE C-21
**Summary of Average Measured Ion Concentrations for each Test Exposure**

| | Exposure | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **1x** | **2.5x** | **3.4x** | **4.5x** | **6x** | **8x** |
| Total Alkalinity | 120 (NA) | 291 (28) | 347 (14) | 416 (14) | 520 (21) | 643 (19) |
| TDS | 360 (NA) | 996 (1.0) | 1200 (0.0) | 1557 (6.4) | 1929 (5.2) | 2429 (4.1) |
| Calculated TDS | 295 (NA) | 1033 (12) | 1257 (6.6) | 1551 (7.5) | 1980 (8.4) | 2559 (8.2) |
| $Ca^{+2}$ | 45 (NA) | 35 (17) | 33 (24) | 27 (26) | 22 (36) | 14 (66) |
| $Mg^{+2}$ | 4.4 (NA) | 6.1 (20) | 6.8 (24) | 7.2 (22) | 8.3 (27) | 9.8 (49) |
| $K^{+}$ | 13 (NA) | 20 (20) | 22 (18) | 24 (21) | 29 (21) | 33 (21) |

TABLE C-21
**Summary of Average Measured Ion Concentrations for each Test Exposure**

| Parameter | Exposure | | | | | |
|---|---|---|---|---|---|---|
| | **1x** | **2.5x** | **3.4x** | **4.5x** | **6x** | **8x** |
| $Na^+$ | 61<br>(NA) | 380<br>(24) | 477<br>(13) | 603<br>(13) | 784<br>(20) | 993<br>(16) |
| $Cl^-$ | 46<br>(NA) | 199<br>(5.0) | 243<br>(4.1) | 306<br>(3.3) | 396<br>(2.5) | 533<br>(5.6) |
| $SO_4^{-2}$ | 54<br>(NA) | 223<br>(9.0) | 276<br>(7.3) | 347<br>(5.8) | 451<br>(4.4) | 596<br>(8.4) |
| Test pH | 8.2<br>(3.3) | 8.7<br>(3.3) | 8.8<br>(3.9) | 8.9<br>(3.3) | 9.0<br>(4.2) | 9.1<br>(2.6) |
| Calculated $HCO_3^-$ | 72<br>(NA) | 170<br>(27) | 200<br>(14) | 237<br>(14) | 290<br>(18) | 353<br>(16) |
| Hardness | 130<br>(NA) | 113<br>(18) | 110<br>(23) | 96<br>(25) | 89<br>(30) | 73<br>(8.2) |

Values in parentheses are the maximum minus the minimum values expressed as a percentage of the mean.

NA = not applicable (unspiked effluent analyzed only once)

TABLE C-22
**Summary of Test Endpoints**

| Endpoint | | Test Parameter | | | |
|---|---|---|---|---|---|
| | | **Test Concentration** | **TDS (mg/L)** | **Sulfate (mg/L)** | **$Cl^-$ (mg/L)** |
| Survival | NOEC | 6.0x | 1,929 | 451 | 396 |
| | LOEC | 8.0x | 2,429 | 596 | 533 |
| Reproduction | NOEC | 4.5x | 1,557 | 347 | 306 |
| | LOEC | 6.0x | 1,929 | 451 | 396 |
| IC25<br>(95% Confidence interval) | | 4.8x<br>(4.3 – 5.2) | 1,643<br>(1,473 – 1,724) | 371<br>(334 -394) | 327<br>(296 – 348) |

# Appendix D
# Comments and Responses Related to White River UAA

Formal comments and responses related to this report will be inserted here.

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