MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

Public Notice of Intent to Initiate Triennial Review of Missouri Water Quality Standards

PUBLIC COMMENTS

Public Notice
May 5 – June 15, 2014

Missouri Department of Natural Resources
Water Protection Program
PO Box 176
Jefferson City, MO 65102-0176
800-361-4827 / 573-751-1300

In accordance with Section 303(c)(1) of the federal Clean Water Act, the Missouri Department of Natural Resources gave notice of its intent to initiate a review of Missouri's Water Quality Standards ("WQS"). This review is being conducted to evaluate the need to update or revise state WQS in order to remain consistent with state and federal law. The review will also ensure Missouri's WQS continue to reflect the best available science and support sound water quality management policies that improve and protect the unique and diverse water resources of the state.

With this notice the department solicited comments from interested parties and members of the public on any aspect of the WQS that the department should consider for potential revision.

Comments were received from the following groups or individuals:

AquaLaw
City of Blue Springs (Geosyntec)
City of Jackson (Geosyntec)
City of Monett (Geosyntec)
Dan Sherburne
Missouri Stream Team Watershed Coalition
Missouri Public Utility Alliance
Newman Comley Ruth
Duckett Creek Sanitary District (AquaLaw)
Copper Development Association, International Copper Association (GEI Consultants)

Blue Springs, Missouri
Public Works Department

June 15, 2014

RECEIVED
JUN 16 2014
WATER PROTECTION PROGRAM

Mr. John Hoke
Water Protection Program
Missouri Department of Natural Resources
P.O. Box 176
Jefferson City, MO 65102

Subject: Request to Revise 10 CSR 20-7.031, Table K to Reflect Permanent Site-Specific Dissolved Oxygen Criteria for Sni-A-Bar Creek

Mr. Hoke,

With this letter, the City of Blue Springs (City) respectfully requests that the Missouri Department of Natural Resources (MDNR or Department) revise the existing site-specific dissolved oxygen criteria (SSDOC) for Sni-A-Bar Creek during the upcoming water quality standards triennial review. As you know, the existing SSDOC for Sni-A-Bar Creek published in Table K of 10 CSR 20-7.031 are time-limited and will expire on October 31, 2014. The City requests that these SSDOC be made permanent going forward. Justification for making the SSDOC permanent is summarized below. In the near future, the City will be submitting a complete, more detailed data report to further support the City's request.

Issue History

In 2011, the US Environmental Protection Agency (EPA) approved the current Table K daily average and daily minimum SSDOC of 4.4 milligrams per liter (mg/L) and 4.0 mg/L, respectively. Those criteria apply to the 5.0 mile reach of Sni-A-Bar Creek below the City's wastewater treatment facility (WWTF) discharge. The criteria were developed from a 2005 stream assessment which investigated the highest attainable water quality conditions and beneficial aquatic life uses that could be supported in the stream. The study showed that low DO conditions were prevalent in the region and were primarily caused by naturally high levels of sediment oxygen demand (SOD) and low reaeration, caused by to low stream velocity. The study also showed that even if the City implemented the highest level of wastewater treatment affordable, the statewide DO criterion of 5.0 mg/L could not be achieved in Sni-A-Bar Creek downstream from the facility. The final, time-limited criteria were consensus-based targets that were derived from Sni-A-Bar Creek water quality modeling efforts and monitoring data collected from East Fork Crooked River, a biocriteria reference stream in the ecoregion.

In their approval, EPA noted that the SSDOC were time-limited, and to extend them additional investigations would be needed to "provide further confirmation that the site-specific criteria protect the designated use." EPA stated that these investigations should "... provide additional information about the aquatic community in Sni-A-Bar Creek and demonstrate that the level of sediment oxygen demand observed in Sni-A-Bar Creek does indeed represent a naturally occurring condition." The expansion of

the City of Blue Springs Wastewater Treatment Facility (MO-0028886) was completed on March 20, 2014. In 2013, the City collected additional data as requested by EPA in their approval notification. Results of these efforts are outlined in the following section.

2013 Data Summary

In 2013, the City contracted Geosyntec Consultants (Geosyntec) to collect the additional data requested by EPA. Between July and October 2013, Geosyntec collected continuous DO, SOD, physical habitat, and aquatic community (macroinvertebrate and fish) data in Sni-A-Bar Creek and East Fork Crooked River, a biocriteria reference stream. The biocriteria reference stream was included because it was monitored in 2005 and it reflects the best available representation of natural conditions (with respect to water quality and aquatic life) expected to occur in the region[1]. Four sites, one upstream and three downstream of the City's outfall, were monitored on Sni-A-Bar Creek; one site was monitored on East Fork Crooked River. Monitoring results are summarized below.

- **Dissolved Oxygen Results** – Data sondes were deployed at the monitoring sites for between 4 and 12 weeks. Approximately 27,000 individual DO records, representing about 300 data days, were collected during the monitoring period. Results indicate that the time-limited SSDOC were attained during baseflow conditions in Sni-A-Bar Creek both up and downstream from the City's outfall. The data also show that DO concentrations in Sni-A-Bar Creek were higher than those measured in East Fork Crooked River, the biocriteria reference stream.

- **Sediment Oxygen Demand Results** – SOD estimates were developed by directly measuring SOD at the monitoring sites using one open and three closed chambers. Each chamber was filled with site water and continuously mixed while DO was being measured with a data sonde. SOD was then calculated from the oxygen depletion curves measured in the open and closed containers[2]. In the biocriteria reference stream, SOD was estimated to be 1.0 grams of oxygen per square meter per day ($g/m^2/d$). SOD in Sni-A-Bar Creek was comparable to the reference stream; SOD was estimated to be 1.5 $g/m^2/d$ and 0.8 $g/m^2/d$ upstream and downstream of the WWTF outfall, respectively. Because the reference stream reflects the best available representation of natural conditions in the region, and SOD conditions in Sni-A-Bar Creek are comparable to the reference stream, these results confirm that SOD levels in Sni-A-Bar Creek represent a naturally-occurring condition.

- **Macroinvertebrate Sampling Results** – Macroinvertebrate communities were measured during fall 2013 using MDNR's macroinvertebrate sampling protocol[3]. At each site, macroinvertebrate samples were collected from three distinct habitat types (non-flowing, large woody debris, and rootmat) if the habitats were present. Samples were then preserved, identified, and analyzed to calculate a Missouri Stream Condition Index (MSCI) score. The Department uses MSCI scores because they represent a standardized method of evaluating macroinvertebrate data to determine whether or not aquatic life uses are being attained; MSCI scores greater than or equal to 16

[1] 10 CSR 20-7.031(1)(W)

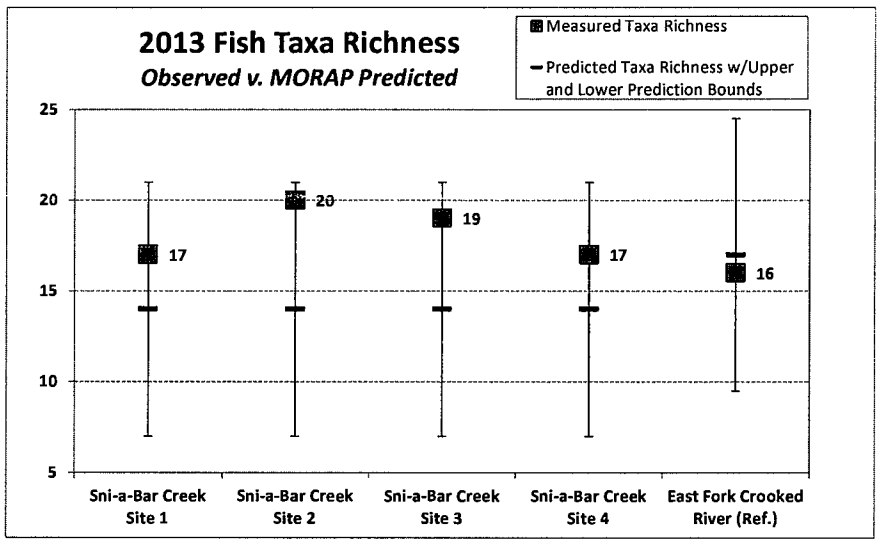
[2] Todd, M., G. Vellidis, R. Lowrance, and C. Pringle. 2009. High sediment oxygen demand within an instream swamp in Southern Georgia: implications for low dissolved oxygen levels in coastal blackwater streams. JAWRA. 45(9).

[3] MDNR. 2003. Semi-Quantitative Macroinvertebrate Stream Bioasessment Project Procedure. Jefferson City, Missouri.

indicate that aquatic life uses are met. MSCI results from the 2013 study show that all sites on Sni-A-Bar Creek and East Fork Crooked River were greater than or equal to 16. Therefore, the aquatic life use was fully supported.

Fall 2013 Macroinvertebrate Sampling Results					
Stream	**East Fork Crooked River**	**Sni-A-Bar Creek**			
Site Location	**Site 1 Reference**	**Site 1 Upstream**	**Site 2 Downstream**	**Site 3 Downstream**	**Site 4 Downstream**
MSCI Score	18	16	20	18	20
MSCI Interpretation	Fully Attains Aquatic Life Use	Fully Attaining Aquatic Life Use	Fully Attaining Aquatic Life Use	Fully Attaining Aquatic Life Use	Fully Attaining Aquatic Life Use

- **Fish Sampling Results** – Fish data were collected during summer 2013 using Missouri Department of Conservation's Resource Assessment and Monitoring (RAM) procedures[4]. A representative reach with the most representative habitat was selected near each monitoring site, blocked upstream and downstream, and sampled using electrofishing and seining techniques. Because fish biocriteria have not yet been developed for the region, fish sampling data were evaluated using the Missouri Resource Assessment Partnership's (MORAP) predictive fish distribution model for species richness[5]. This model is a GIS-based tool that allows the user to query the number and type of fish species expected to occur in a given stream reach. The model predicted that 14 and 17 species would be present in Sni-A-Bar Creek and East Fork Crooked River, respectively. It should be noted that the MORAP model predictions are accurate to approximately plus or minus 50% of the true species richness. Observed taxa richness at all sites on Sni-A-Bar Creek were greater than both the MORAP predictions and the observed taxa richness in East Fork Crooked River, the biocriteria reference stream. These results indicate that Sni-A-Bar Creek supports a representative fish community.



[4] Fischer, S. and M. combes. 2003. Resource Assessment and Monitoring Program: Standard Operating Procedures – Fish Sampling. Resource Science Division. Jefferson City, Missouri.

[5] Sowa, S. P., D. D. Diamond, R. Abbitt, G. Annis, T. Gordon, M. E. Morey, G. R. Sorensen, and D. True. 2005. A Gap Analysis for Riverine Ecosystems of Missouri. Final Report, submitted to the USGS National Gap Analysis Program. 1675 pp.

Summary and SSDOC Request

Data collected by the City in 2013 confirm that the time-limited SSDOC are protective of aquatic life beneficial uses in Sni-A-Bar Creek. This conclusion is supported by the data which show that DO criteria targets were attained, SOD levels in Sni-A-Bar Creek reflect a naturally-occurring condition, and aquatic community data meet or exceed expected metric thresholds. For these reasons, the City requests that the existing, time-limited SSDOC for Sni-A-Bar Creek be made permanent going forward.

Thank you for your consideration of this very important request by the City of Blue Springs. As mentioned previously, we will be submitting a more complete study report to supplement the information presented above in the near future. If you should have any questions or comments, please let me know. We also would appreciate notification as to whether our request was approved for the rulemaking process.

Sincerely,

Christopher G. Sandie
Director of Public Works

City of Jackson

June 13, 2014

Mr. John Hoke
Water Protection Program
Missouri Department of Natural Resources
P.O. Box 176
Jefferson City, MO 65102

Subject: Request to Revise 10 CSR 20-7.031 to Include Site-Specific Copper Criteria for Goose Creek in Upcoming Rule Revision

Mr. Hoke,

With this letter, the City of Jackson (City) respectfully requests that the Missouri Department of Natural Resources (MDNR) process a revision of 10 CSR 20-7.031 to reflect site-specific copper criteria for Goose Creek, downstream from the City's wastewater plant discharge. The requested site-specific copper criteria are based on a 2012 Water Effect Ratio (WER) Study (Study) conducted for the City by Geosyntec Consultants (Geosyntec). The summary report of the Study is attached for reference and provides further details on the Study and findings (Attachment A).

Background

The City is the continuing authority of the Jackson Municipal Wastewater Treatment Plant (WWTP) (MO-0022853). The WWTP design average flow is 2.4 million gallons per day (mgd). Treated effluent from the WWTP is discharged to Goose Creek (Attachment A, Figure 2.1).

Final Effluent Limitations (FEL's) for several heavy metals were issued by MDNR as part of the 2009 permit renewal. These FELs are based on revised, in-stream water quality criteria adopted into rule at 10 CSR 20-7.031 in 2005. The new FELs were significantly less than criteria previously applied by MDNR and were new to the Jackson permit. The Department included a 3-year compliance schedule for achieving FELs in the Jackson permit (effective July 10, 2012), but the City continues to be challenged with meeting the revised copper effluent limitations. Geosyntec concluded that 97% of the copper loading to the WWTP originated from the municipal water supply and cannot be treated affordably (see Attachment A for more detailed information).

2012 Water Effect Ratio Study

In 2012, the City retained the services of Geosyntec Consultants, Inc. (Geosyntec) to conduct a Water Effect Ratio Study to evaluate the actual toxicity of copper in the WWTP discharge matrix. The Study methodology followed US Environmental Protection Agency (EPA) guidance and was conducted under an MDNR approved Quality Assurance Project Plan. Based on the results of the Study, Geosyntec proposed

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site-specific acute and chronic copper criteria of 87 ug/L and 54 ug/L, respectively. Copper concentrations in the Jackson WWTP effluent would not have a "Reasonable Potential to Exceed" these site-specific criteria. The MDNR Water Quality Monitoring Assessment Section has reviewed but not commented on the findings of the Study.

Request for Adoption of Site-specific Copper Criteria

It is the City's understanding that MDNR cannot modify the Jackson discharge permit to reflect the findings of the WER Study until approval of a site-specific copper criteria is granted by the Missouri Clean Water Commission through a rule change or variance. Until the permit is modified, the City faces potential enforcement liability for copper FEL violations, even though the Study has demonstrated that the current FEL's are overprotective. The City therefore requests that the adoption of site-specific copper criteria be included in the next rule revision, so that the City's permit may be modified in a timely manner.

Thank you for your consideration of this very important request by the City of Jackson. We are available to provide additional information as needed during the upcoming rule change process. We also would appreciate notification as to whether our request was approved for the rulemaking process. I can be reached at the following phone number and e-mail address: (573) 243-4290, kpeetz@jacksonmo.org.

Sincerely,

Kent Peetz

Kent Peetz, PE
Director of Wastewater Utilities

Attachment A

Water Effect Ratio Study Report for the Jackson Municipal Wastewater Treatment

Prepared for

City of Jackson
101 Court Street
Jackson, Missouri 63755

REGULATORY COPPER INVESTIGATIONS AT THE JACKSON MUNICIPAL WASTEWATER TREATMENT PLANT

Project Report

Prepared by

Geosyntec consultants

engineers | scientists | innovators

1123 Wilkes Blvd., Ste. 400
Columbia, Missouri 65201

September 2012

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APPENDICES

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1. BACKGROUND

The City of Jackson, Missouri (City) is the continuing authority of a mechanical oxidation ditch wastewater treatment plant (WWTP) having a dry weather design average flow of 2.4 million gallons per day (mgd). The Jackson WWTP has a single outfall (# 001) permitted under NPDES operating permit number MO-0022853 (permit). Treated effluent is discharged from the WWTP into Goose Creek, a Class C (i.e., intermittent) water of the state.

Final Effluent Limitations (FELs) for several heavy metals (**Table 1.1**) were issued by the Missouri Department of Natural Resources (MDNR or Department) as part of the 2009 permit renewal. These FELs are based on revised in-stream water quality criteria adopted into rule at 10 CSR 20-7.031 in 2005. New FELs are significantly less than criteria previously applied by MDNR and were new to the Jackson permit. The Department included a 3-year compliance schedule for achieving FELs in the Jackson permit. Quarterly effluent sampling conducted by the City indicates that achieving new FELs for total recoverable copper will be challenging (**Figure 1.1**). Consequently, the City has periodically discussed with MDNR approaches to comply with existing or modified copper FELs. In April 2012, the City retained Geosyntec Consultants (Geosyntec) to review available copper management information at the WWTP and assist in determining potential compliance options.

Table 1.1. Final Effluent Limits for Total Recoverable Metals at the Jackson Wastewater Treatment Plant.

Effluent Parameter	Unit	Daily Maximum Limit	Monthly Average Limit
Copper	µg/L	22.9	8.5
Lead	µg/L	14.3	4.6
Nickel	µg/L	135.4	61.3
Silver	µg/L	8.7	4.3
Zinc	µg/L	183.9	76.4

Geosyntec and the City met with the Department on 06/05/2012 to discuss preliminary copper management conclusions and identify appropriate regulatory pathways. During this meeting, the following information was summarized in a Microsoft PowerPoint presentation:

- Data collected from 2009 through 2012 infers the potable water distribution system is the primary contributor of copper to the WWTP;
- Dosing of the distribution system with zinc orthophosphate at the drinking water plant appears to have reduced copper effluent concentrations;
- The City is presently cleaning and coating over 9,000 feet of tuberculated water lines at a cost of approximately $500,000 that is expected to reduce distributed copper loading; and
- Preliminary receiving stream evaluations suggest that copper is less bioavailable and toxic than assumed by effluent limits.

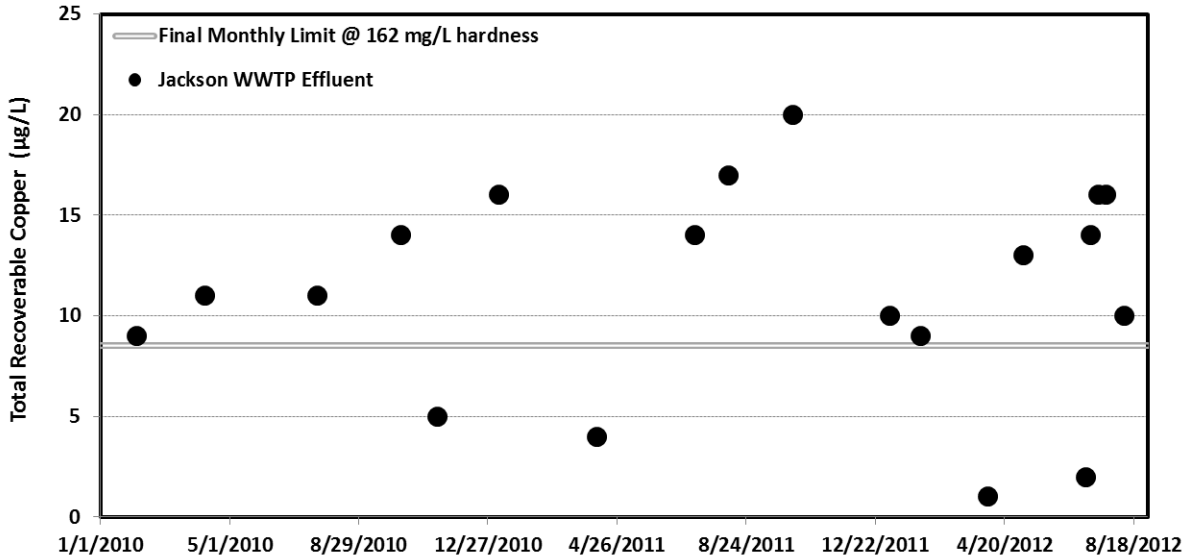

Figure 1.1. Effluent Concentrations of Total Recoverable Copper at the Jackson Wastewater Treatment Plant.

Action items identified during this meeting included development of a revised compliance schedule (schedule). The City subsequently provided a schedule to the Department as a letter request on July 10, 2012. The revised compliance schedule specified a copper management report (report) be submitted to the Department by September 21, 2012. The purpose of this report is to fulfill the report requirement included in the schedule. This report provides additional data and documentation of informational items presented during the 06/05/2012 meeting.

2. COPPER SOURCE EVALUATION

The majority of copper loading to the Jackson WWTP (**Figure 2.1**) likely originates from the potable water distribution system. Identification of the distribution system as the primary source is supported by a mass-balance calculation from aggregated flow and copper concentration data (**Table 2.1**). Presently, two Significant Industrial Users (SIUs) contribute approximately 1.5 % (0.01 lbs/day) of the annual copper load to the Jackson WWTP. These SIUs include the Rubbermaid Corporation (median copper load = 0.01 lbs/day, n=33) and Farrow Fabricating (median copper load = 0.0003 lbs/day, n=11). In addition, tap water concentration data (median total copper = 42 µg/L) collected at five residential locations during July 2012 underscores the role of the drinking water distribution system in contributing to influent copper loads. Source evaluation data are listed in **Appendix A**.

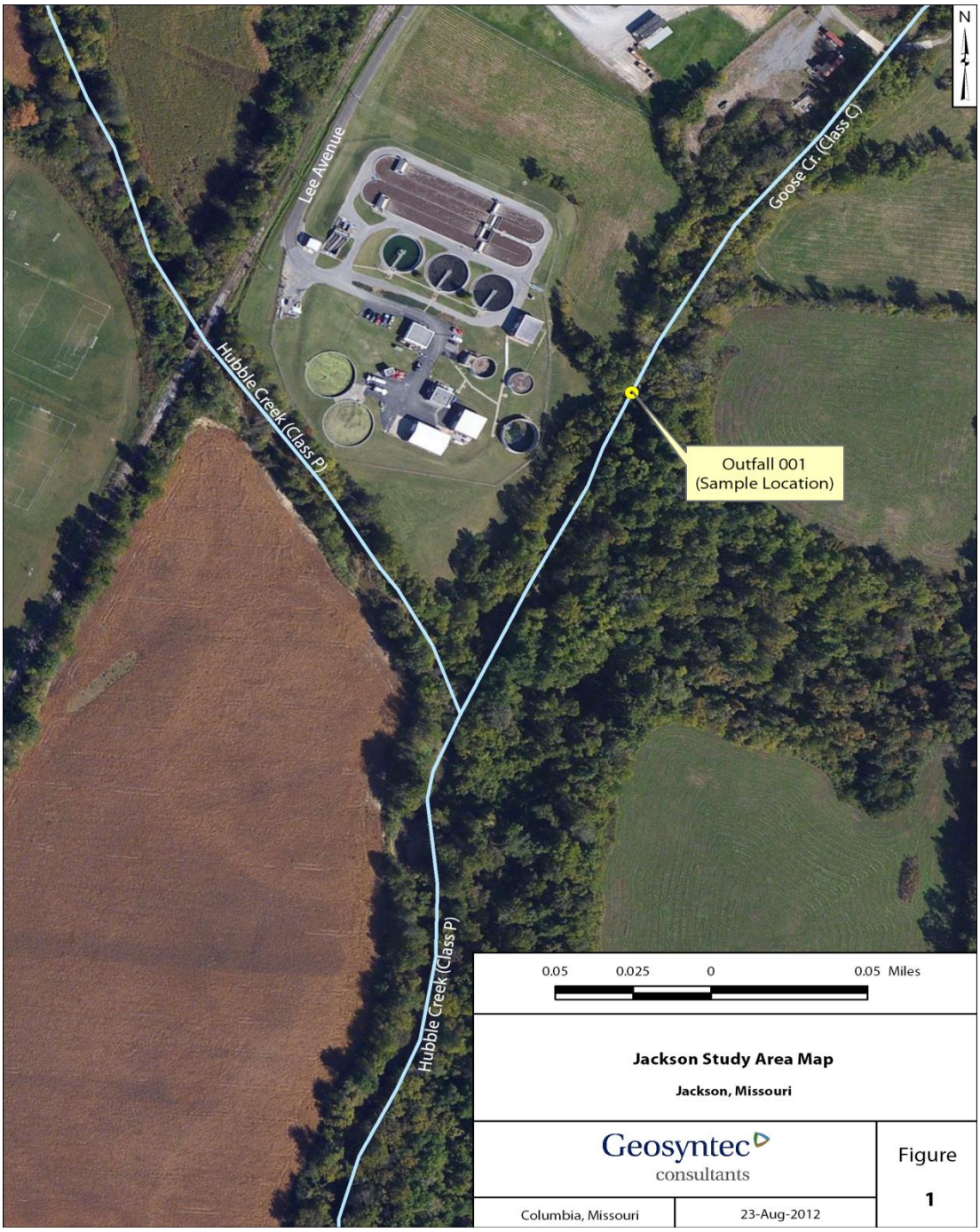

Figure 2.1. Project Study Area

Table 2.1. Estimated Sources of Copper Loading to the Jackson WWTP.

Budget Component (narrative)	Symbol (ID)	Total Copper (lbs/day, median)	Percent Influent Load (%)	Comments (narrative)
Influent	**'Cu_{in}'**	0.68	-----	n=8, 2012 to 2009
Rubbermaid	**'Cu_{s1}'**	0.01	1.5%	n=33, 2011 to 2009
Farrow Fab	**'Cu_{s2}'**	0.00	0.04%	n=11, 2011 to 2009
Wells	**'Cu_{sw}'**	0.01*	1.7%	n=9, 2012, 8 of 9 are ND
Distribution System	**'Cu_{sDWS}'**	0.65	96.8%	Residual Calc, DWS = In-s1-s2-sw

*assumes that non-detect values (<2 µg/L) equal 0.99 µg/L

3. ZINC PHOSPHATE TRIALS

Zinc orthophosphate is a common corrosion inhibitor developed for potable drinking water systems. The City has been dosing drinking water at a rate of 10 gallons per 1 million gallons produced since December 2011. Discharge Monitoring Report (DMR) data collected before and after addition of corrosion inhibitors suggests a reduction (approximately 30%) in effluent copper levels (**Figure 3.1**). Consistently achieving the FEL (8.5 µg/L) appears unlikely despite noticeable improvements in copper effluent concentrations due to zinc phosphate addition. Study data used in this analysis are listed in **Appendix B.**

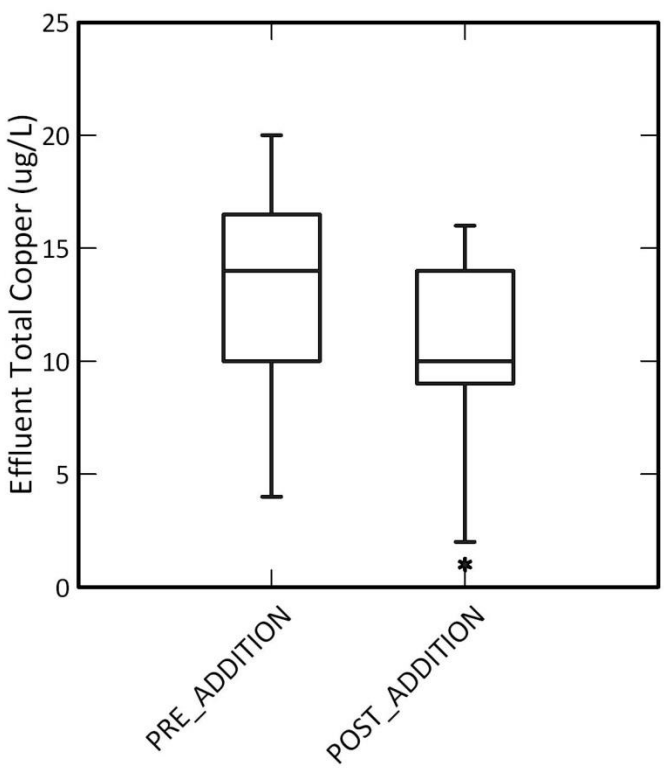

Figure 3.1. Boxplot of Effluent Copper Concentrations Before (n=11) and After (n=9) Zinc Phosphate Addition. Note differences between pre and post median concentrations are not significantly different at alpha = 0.05.

4. WASTEWATER TREATMENT PERFORMANCE

Paired influent and effluent samples for the period of 2009 to 2012 indicate the Jackson WWTP is removing approximately 83% (median) of the incoming copper load (**Table 4.1.**). Removal efficiencies for metals included in table below are comparable to or better than values reported in the literature (Tchobanoglous and Burton, 1991; Isaac et al., 1997). As wastewater treatment processes are performing well, it can be concluded that operation and maintenance of the Jackson WWTP is not contributing to effluent copper concentrations above the FEL.

Table 4.1. Removal Efficiencies for Total Recoverable Copper at the Jackson WWTP.

Sample Dates (M/D/Y)	Reported Flow (MGD)	Influent Copper (TR, µg/L)	Effluent Copper (TR, µg/L)	Percent Removal (%)
08/06/09	1.7	56	6	89%
10/08/09	1.5	51	12	76%
12/03/09	2.3	33	17	48%
11/10/10	1.8	74	5	93%
01/06/11	1.6	67	16	76%
04/07/11	1.7	50	4	92%
7/5/2012	1.2	62	2	97%
8/9/2012	1.2	44	10	77%
			Median =	83%

In addition to acceptable treatment performance, the Jackson WWTP has successfully passed acute Whole Effluent Toxicity (WET) tests (2009 to 2011, n=3). It can therefore be assumed that effluent copper concentrations are not causing acute toxicity to sensitive aquatic biota.

5. RECEIVING WATER ANALYSES

Three receiving water studies were conducted to evaluate the relative bioavailability or toxicity of copper within treated effluent at the Jackson WWTP: (1) characterization of hardness concentrations, (2) Streamlined Water Effect Ratio (WER) for copper, and (3) preliminary dissolved to total recoverable translator. Each of these studies are described and summarized in this section. Studies for other permitted metals including total recoverable zinc may be pursued in the future following coordination with the Department and as part of the drinking water planning process.

5.1 Adjusting for Critical Flows

The sampling location for receiving water studies is the point where treated wastewater effluent enters Goose Creek (see **Figure 2.1**). This location was selected as it best coincided with the intent of WER guidance (US EPA, 2001) and Missouri's mixing zone allowances (i.e., no mixing allowed for streams with 7Q10 < 0.0 cfs). The location of sampling points is further discussed as follows.

Missouri Water Quality Standards (WQS) stipulate that wasteload allocations (WLA) and permit limits be based on critical low-flow conditions (e.g., 7Q10). However, water quality studies used to support permit limits are rarely conducted during statistical low-flow conditions.
Rather, WLA and modeling studies are typically conducted at steady baseflow conditions. Differences in flow conditions (i.e., actual vs. critical) must therefore be accounted for. For example, WLA data to support calibration of a DO model is typically collected during warm-weather baseflow conditions. However, for the purpose of developing a WLA, the calibrated DO model is re-run at critical low-flow conditions. Because the WER, translator, and hardness regime are data driven and do not include transport processes, differences in flow (i.e., observed vs. critical) are accounted for during the sampling event. Guidance developed by the US Environmental Protection Agency (US EPA, 2001) recommends mixing effluent and upstream water at the design low-flow dilution to create a simulated downstream sample (page 1, first paragraph under Synopsis of the Streamlined Water Effect Ratio Procedure, US EPA 2001). In the case of the Jackson WWTP, the receiving stream (Goose Creek) has a 7Q10 critical low-flow value of 0 cubic feet per second (cfs). Therefore, study samples were collected near the Jackson WWTP outfall and consisted of 100% effluent. Such an approach is also consistent with MDNR's WET test guidance, which calls for a 100% effluent sample where the 7Q10 is zero.

5.2 Hardness Regime

Greater concentrations of polyvalent cations, specifically Mg^{2+} and Ca^{2+}, reduce the absorption of heavy metals by aquatic organisms. Consequently, Missouri's copper criteria are hardness-dependent. According to the City's operating permit fact sheet, the Department assumed a default hardness concentration of 162 mg/L. The most recent 20 hardness samples (minimum regulatory sample size) from the Jackson WWTP (see **Figure 2.1** for sampling location) are equal to or greater than the default value of 162 mg/L. Per 10 CSR 20-7.031(1)(Y), the 25th percentile of measured hardness values may be used to recalculate metals criteria. As provided in **Appendix B**, the 25th percentile of hardness data is 232 mg/L. Alternative permit limits are provided in Section 6 that incorporates site-specific hardness data.

5.3 Streamlined Water Effect Ratio

The toxicity of copper to aquatic organisms can be influenced by several environmental factors including the concentrations of hardness, organic carbon, pH, and suspended solids. Many of these factors exhibit a reduced influence in the laboratory setting (e.g., clean water) used to derive national default water quality criteria. A procedure developed by US EPA to account for differences in toxicity due to these factors is termed a Water Effect Ratio.

The Streamlined Water Effect Ratio (US EPA, 2001) requires two sampling events to be conducted one month apart at design flow dilution and under representative conditions using a single test organism. To comply with these requirements, Geosyntec conducted two WER sampling events on 05/08/2012 and 07/16/2012 using the test organism *Ceriodaphnia dubia*. Sampling events were performed during normal plant operating conditions during dry weather conditions. Grab samples were collected from near the Jackson WWTP outfall, placed on ice and hand-carried to the WET testing laboratory performing the analyses.

At the laboratory, Geosyntec personnel adjusted laboratory reconstituted water to similar hardness, alkalinity, and pH of the site water and prepared the appropriate test dilutions by spiking with copper nitrate [$CuNO_3)_2$ *2.5 H_2O] to establish a range of concentrations bracketing the expected EC_{50} for both the site water and reconstituted tests. Tests were conducted under representative conditions such that total suspended solids were less than 4 mg/L during each event and calculated BOD_5 less than 10 mg/L. Results from WER tests are depicted in **Table 5.1**. Additional WER study details are included in **Appendix C.** Alternative permit limits are provided in Section 6 that incorporates a Final Total Recoverable WER of 2.8. Additional copper WER studies that may be pursued by the City in the future could modify this proposed final WER.

Table 5.1. Streamlined Water Effect Ratio Results for the Jackson WWTP

Test Date	Water Source	Parameter	Unit	Value	Comments
5/8/2012	Site Water	Native EC_{50}	µg/L	125.0	US EPA Toxcalc Software
5/8/2012	Site Water	Hardness Normalized EC_{50}	µg/L	106.4	EPA Procedure, Page 13. Normalized to 232 mg/L
5/8/2012	Site Water	SMAV at Site Hardness	µg/L	53.0	EPA Procedure, Page 17. Normalized to 232 mg/L
5/8/2012	Laboratory Water	Native EC_{50}	µg/L	< 33	Enhanced sensitivity in laboratory water
5/8/2012	Laboratory Water	Hardness Normalized EC_{50}	µg/L	12.5	Calculation Assumed 0.5* Response Threshold
5/8/2012	-----	Sample WER Criterion 1	-----	6.4	Site EC_{50}/Lab EC_{50} at Normalized Hardness
5/8/2012	-----	Sample WER Criterion 2	-----	2.0	Site EC_{50}/SMAV at Normalized Hardness
5/8/2012	-----	**Sample WER for Test #1**	-----	**2.0**	Lesser of Criteria 1 and 2
7/16/2012	Site Water	Native EC_{50}	µg/L	241.6	US EPA Toxcalc Software
7/16/2012	Site Water	Hardness Normalized EC_{50}	µg/L	205.6	EPA Procedure, Page 13. Normalized to 232 mg/L
7/16/2012	Site Water	SMAV at Site Hardness	µg/L	53.0	EPA Procedure, Page 17. Normalized to 232 mg/L
7/16/2012	Laboratory Water	Native EC_{50}	µg/L	53.0	Enhanced sensitivity in lab water
7/16/2012	Laboratory Water	Hardness Normalized EC_{50}	µg/L	12.5	EPA Procedure, Page 13
7/16/2012	-----	Sample WER Criterion 1	-----	16.4	Site EC_{50}/Lab EC_{50} at Normalized Hardness
7/16/2012	-----	Sample WER Criterion 2	-----	3.9	Site EC_{50}/SMAV at Normalized Hardness
7/16/2012	-----	**Sample WER for Test #2**	-----	**3.9**	Lesser of Criteria 1 and 2
			Final WER for Study	**2.8**	Geometric Mean of Sample WERs , Page 14

Notable WER results include the following observations:

- Sample WERs differed by a factor of approximately 2. Such a difference is explained by the greater Dissolved Organic Carbon (DOC) concentration in the second test (DOC=5.0 mg/L) as compared to the first test (DOC=2.6 mg/L). In addition, the relatively high default Standard Deviation (SD) of WERs (SD=0.5 log units, or 3.2 native WER units) listed in Table C-1 of US EPA (2001) suggests that differences between tests may not be significantly different or anomalous. That is, differences between sample WERs were less than one 'default' standard deviation.

- Test organisms in the reconstituted (recon) water used by the EAS laboratory appear to have been more sensitive as the EC_{50} in the reconstituted water (<33 µg/L) was substantively less than the expected Species Mean Acute Value (SMAV) of approximately 69.7 µg/L (normalized to recon hardness of 310 mg/L). In comparison, the recon water EC_{50} from Pace Analytical (53 µg/L) was much closer to the expected SMAV of 59 µg/L (normalized to recon hardness of 260 mg/L). Ultimately, the potential sensitivity of EAS test organisms did not inflate the sample WER value as Calculation Criterion 2 (see **Table 5.1**) minimized the WER from the first test (WER=2.0).

5.4 Total to Dissolved Metals Translator

A preliminary translator value of f_D = 0.75 was determined from two sampling events (geometric mean) and is approximately 22% lower than the default value of f_D = 0.96 in Missouri's Water Quality Standards. According to US EPA guidance (US EPA 1996), at least ten sampling events are needed to develop an alternative translator value. While additional sampling is needed to develop a final translator, it should be noted that a 22% reduction in the default translator represents a margin of safety with respect to implementing other site-specific modifications such as hardness and WER. Preliminary translator data are listed in **Appendix D**.

6. PROPOSED EFFLUENT LIMIT MODIFICATIONS

Use of site-specific hardness and WER data increase applicable copper criteria and therefore copper water quality-based limits. Alternative permit limits proposed for the Jackson WWTP (**Table 6.1.**) are derived according to US EPA guidance (1991) and utilize the 25th percentile hardness value (**Appendix B**) and Final WER (=2.8, see Section 5.3). As presented in the table below, we note the Jackson WWTP may not have 'reasonable potential' (see US EPA 1991) to exceed the adjusted copper criteria. Therefore, the Department should consider replacing numeric copper effluent limits with 'monitoring only' requirements.

Table 6.1. Adjusted Copper Effluent Limits for the Jackson WWTP

Receiving Stream: Goose Creek, Class C, 7Q10 = 0.0 cfs

Parameter	Unit	Value	Comments
Hardness	mg/L	232	25th Percentile of n=20 DMR records
Coefficient of Variation	-----	0.46	See Appendix B
Existing Acute Copper Criterion	µg/L as Total Recoverable	30.9	at 232 mg/L hardness and no conversion factor
Existing Chronic Copper Criterion	µg/L as Total Recoverable	19.1	at 232 mg/L hardness and no conversion factor
Final Water Effect Ratio	------	2.8	See Section 5.3
Adjusted Acute Copper Criteria	µg/L as Total Recoverable	**87**	=existing total recoverable criterion* total recoverable WER
Adjusted Chronic Copper Criteria	µg/L as Total Recoverable	**54**	=existing total recoverable criterion* total recoverable WER
Acute Wasteload Allocation	µg/L as Total Recoverable	87	=adjusted acute criterion, 7Q10=0.0 cfs
Chronic Wasteload Allocation	µg/L as Total Recoverable	54	=adjusted chronic criterion, 7Q10=0.0 cfs
Acute Long-Term Average	µg/L as Total Recoverable	34.2	see EPA (1991). Note chronic LTA is limiting
Chronic Long-Term Average	µg/L as Total Recoverable	32.3	see EPA (1991). Note chronic LTA is limiting
Adjusted Maximum Daily Limit	µg/L as Total Recoverable	**81.4**	see EPA (1991).
Adjusted Monthly Average Limit	µg/L as Total Recoverable	**45.7**	see EPA (1991). Note n=4 per permit Fact Sheet
Maximum Effluent Concentration	µg/L as Total Recoverable	20	Measured on 10/6/2011
Reasonable Potential Multiplier	-----	2.0	RPM, see page 54 of EPA (1991). N=20, CV=0.46
Expected Maximum Receiving Water Concentration	MRWC, µg/L as Total Recoverable	40	=Maximum Effluent Concentration*RPM. Per MDNR method of using 99% Probability RPM
Reasonable Potential to Exceed	----	**No**	MRWC< Adjusted Acute or Chronic Criteria

7. SUMMARY AND CONCLUSION

The City is the continuing authority of a mechanical oxidation ditch WWTP having a dry weather design average flow of 2.4 mgd. Final effluent limits for copper issued by the Department as part of the 2009 permit renewal (effective as of July 2012) are likely to be exceeded based on monitoring data collected since 2009. Despite ongoing treatment measures to the water distribution system (i.e., zinc orthophosphate addition, cleaning and coating) and above average process performance (i.e, percent removal approximately 80-85%), influent copper loads are likely to result in periodic excursions of the existing average monthly copper limit of 8.5 µg/L prescribed by the Department.

As the existing copper FELs were developed according to default and potentially conservative assumptions (i.e., hardness concentrations, default bioavailability), the City requested Geosyntec investigate the relative toxicity of copper for the Jackson WWTP discharge scenario. Incorporation of site-specific hardness and WER data from receiving water investigations into the permit limit derivation process support an upward adjustment of copper effluent limits. In addition, issuance of 'monitoring only' requirements for copper may be justified based on a 'reasonable potential analysis' using US EPA (1991) procedures. Therefore, the City should request the Department reconsider the FELs, and compliance schedule, in the existing operating permit to account for site-specific toxicity data and the distributed nature of the primary copper source (i.e., drinking water distribution system).

8. REFERENCES

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United States Environmental Protection Agency (US EPA), 1996. The Metals Translator: Guidance for Calculating a Total Recoverable Permit Limit from a Dissolved Criterion. EPA 823-B-96-007.

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APPENDIX A. SOURCE LOADING DATA

Jackson WWTP Influent

Sample Dates (M/D/Y)	Reported Flow (MGD)	Influent Copper (TR, µg/L)	Influent Copper (TR, lbs/day)
08/06/09	1.7	56	0.80
10/08/09	1.5	51	0.64
12/03/09	2.3	33	0.63
11/10/10	1.8	74	1.11
01/06/11	1.6	67	0.90
04/07/11	1.7	50	0.71
7/5/2012	1.2	62	0.62
8/9/2012	1.2	44	0.44
		53.5 median	**0.68 median 'Cu$_{in}$'**

Farrow Fabrication Effluent

Sample Dates (M/D/Y)	Average Water Use (MGD)	Effluent Copper (TR, mg/L)	Effluent Copper (TR, lbs/day)
3/6/2009	0.00198	0.0400	0.0007
6/3/2009	0.00198	0.0010	0.0000
9/17/2009	0.00198	0.0160	0.0003
12/4/2009	0.00198	0.0100	0.0002
2/18/2010	0.00198	0.0330	0.0005
5/6/2010	0.00198	0.0140	0.0002
8/10/2010	0.00198	0.0200	0.0003
11/9/2010	0.00198	0.0070	0.0001
2/3/2011	0.00198	0.0270	0.0004
5/12/2011	0.00198	0.0160	0.0003
8/11/2011	0.00198	0.0260	0.0004
		0.0160 median	**0.0003 median 'Cu$_{s2}$'**

Drinking Water Well Data

Sample Dates (M/D/Y)	Well ID (#)	Source Water Copper (TR, µg/L)
5/8/2012	7	44*
5/8/2012	6	< 2**
5/8/2012	5	< 2**
5/8/2012	4	< 2**
7/5/2012	7	< 2**
7/5/2012	6	< 2**
7/5/2012	5	< 2**
7/5/2012	3	< 2**
7/5/2012	2	< 2**

*assumed to be contamination anomaly

*assumed equal to 0.99 µg/L for load calculations

2011 Annual Mean Pumping Rate = 1.41 MGD

Estimated Well Loading

Cu$_{sw}$ = (0.99/1000)*(5.395)*(1.41*1.55)=**0.012 lbs/day**

APPENDIX A. SOURCE LOADING DATA (continued)

Rubbermaid Effluent

Sample Dates (M/D/Y)	Average Water Use (MGD)	Effluent Copper (TR, mg/L)	Effluent Copper (TR, lbs/day)
02/18/09	0.010	0.019	0.0016
05/20/09	0.010	0.052	0.0045
08/18/09	0.010	0.251	0.0216
11/24/09	0.010	0.25	0.0215
02/16/10	0.010	0.054	0.0047
05/04/10	0.010	0.158	0.0136
06/21/10	0.010	0.67	0.0577
08/12/10	0.010	0.182	0.0157
11/09/10	0.010	0.073	0.0063
01/10/11	0.010	0.206	0.0177
01/18/11	0.010	0.077	0.0066
02/07/11	0.010	0.044	0.0038
02/21/11	0.010	0.037	0.0032
03/07/11	0.010	0.088	0.0076
03/14/11	0.010	0.209	0.0180
04/04/11	0.010	0.284	0.0245
04/28/11	0.010	0.346	0.0298
05/09/11	0.010	0.439	0.0378
05/16/11	0.010	0.831	0.0716
06/07/11	0.010	0.182	0.0157
06/20/11	0.010	0.171	0.0147
07/07/11	0.010	0.071	0.0061
07/18/11	0.010	0.123	0.0106
08/01/11	0.010	0.093	0.0080
08/15/11	0.010	0.067	0.0058
09/06/11	0.010	0.146	0.0126
09/19/11	0.010	0.044	0.0038
10/03/11	0.010	0.114	0.0098
10/17/11	0.010	0.081	0.0070
11/07/11	0.010	0.078	0.0067
11/21/11	0.010	0.087	0.0075
12/05/11	0.010	0.063	0.0054
12/14/11	0.010	0.131	0.0113
		0.114	**0.010**
		median	**median**
			'Cu_{s1}'

APPENDIX B. Jackson WWTP Effluent Data

Based on guidance from the Missouri Department of Natural Resources, the most recent 20 samples were used in determining hardness assumptions and effluent statistical properties.

Sample Dates (M/D/Y)	Effluent Copper (TR, µg/L)	Effluent Hardness (mg/L)
12/3/2009	17	172
2/4/2010	9	207
4/8/2010	11	206
7/22/2010	11	162
10/7/2010	14	213
11/10/2010	5	238
1/6/2011	16	238
4/7/2011	4	329
7/7/2011	14	300
8/8/2011	17	276
10/6/2011	20	338
1/5/2012	10	375
2/2/2012	9	310
4/5/2012	0.99	338
5/8/2012*	13	280
7/5/2012	2	323
7/9/2012	14	340
7/16/2012*	16	287
7/23/2012	16	323
8/9/2012	10	355

*Samples collected by Geosyntec for receiving stream study purposes

Copper Descriptive Statistics	
Mean	11.4
Standard Error	1.2
Median	12
Mode	14
Coefficient of Variation	0.46
Standard Deviation	5.3
Sample Variance	28.0
Kurtosis	-0.4
Skewness	-0.6
Range	19.0
Minimum	0.99
Maximum	20
Sum	228.99
Count	20
Conf. Interval (95.0%)	2.5

Hardness Descriptive Statistics	
Mean	280.5
Standard Error	14.2
Median	293.7
25th Percentile	232
Mode	238
Standard Deviation	63.6
Sample Variance	4045
Kurtosis	-1.0
Skewness	-0.5
Range	213
Minimum	162
Maximum	375
Sum	5611
Count	20
Conf. Interval (95.0%)	29.8

APPENDIX C. Water Effect Ratio Data and Information

Sample (ID for **05/08/2012**)	Water Source (Description)	Copper (µg/L, as Total)	Sample Hardness (mg/L)	*C. dubia* Response (% Mortality)
WE-12812-UNSPIKED	Site Water	14	275	10
WE-12812-35	Site Water	42	275	15
WE-12812-50	Site Water	54	275	25
WE-12812-75	Site Water	75	275	30
WE-12812-100	Site Water	95	275	30
WE-12812-150	Site Water	160	275	45
WE-12812-250	Site Water	240	275	90
WE-12812-400	Site Water	360	275	100
WE-12812-700	Site Water	590	275	100
WE-12812-1500	Site Water	1300	275	100
WC-12812-(Control)	Laboratory Control Water	1.4	60	0
WR-12812-UNSPIKED	Reconstituted Laboratory Water	1.4	310	0
WR-12812-25	Reconstituted Laboratory Water	33	310	100
WR-12812-35	Reconstituted Laboratory Water	38	310	100
WR-12812-50	Reconstituted Laboratory Water	46	310	100
WR-12812-75	Reconstituted Laboratory Water	74	310	100
WR-12812-100	Reconstituted Laboratory Water	93	310	100
WR-12812-150	Reconstituted Laboratory Water	130	310	100
WR-12812-250	Reconstituted Laboratory Water	230	310	100
WR-12812-400	Reconstituted Laboratory Water	350	310	100

Sample (ID for **07/16/2012**)	Water Source (Description)	Copper (µg/L, as Total)	Sample Hardness (mg/L)	*C. dubia* Response (% Mortality)
WE-19812-10 (UNSPIKED)	Site Water	17	275	0
WE-19812-25	Site Water	35	275	0
WE-19812-35	Site Water	48	275	0
WE-19812-50	Site Water	35	275	0
WE-19812-75	Site Water	76	275	0
WE-19812-100	Site Water	120	275	0
WE-19812-150	Site Water	190	275	0
WE-19812-250	Site Water	260	275	75
WE-19812-400	Site Water	370	275	100
WE-19812-700	Site Water	630	275	100
WC-19812-0 (Control)	Laboratory Control Water	2.1	72	0
WR-19812-0 (UNSPIKED)	Reconstituted Laboratory Water	2.1	260	0
WR-19812-10	Reconstituted Laboratory Water	16	260	0
WR-19812-25	Reconstituted Laboratory Water	30	260	0
WR-19812-35	Reconstituted Laboratory Water	62	260	55
WR-19812-50	Reconstituted Laboratory Water	75	260	100
WR-19812-75	Reconstituted Laboratory Water	96	260	100
WR-19812-100	Reconstituted Laboratory Water	110	260	100
WR-19812-150	Reconstituted Laboratory Water	160	260	100
WR-19812-250	Reconstituted Laboratory Water	270	260	100

Note: Water Effect Ratio testing on 05/08/2012 conducted by Environmental Analysis South (EAS) Laboratories Inc. located Jackson, Missouri. The WER test conducted on 07/16/2012 was performed by Pace Analytical located in Lenexa, Kansas. Different laboratories for each test were used because of analytical capacity limitations at the EAS Laboratory.

Note: Reagent grade copper nitrate hydrate [$Cu(NO_3)_2$ * 2.5 H_2O] was used to prepare working stock solutions of site water and reconstituted laboratory water by adding 0.0915 g copper nitrate to 1 >L of each. Stock solutions were used to prepare 1 L of each dilution for WET and analytical testing.

APPENDIX C. Water Effect Ratio Data and Information (continued)

Site Water Characteristics - 05/08/2012

Parameter	Unit	Value
Dissolved Oxygen	mg/L	7.91
Water Temperature	^{o}C	20.98
pH	SU	7.69
Specific Conductivity	uS/cm	936
Chloride	mg/L	100
Sulfate	mg/L	36
Alkalinity	mg/L	170
Hardness	mg $CaCO_3$/L	280
Dissolved Organic Carbon	mg/L	2.6
Total Organic Carbon	mg/L	2.8
Cadmium, Dissolved	mg/L	<0.000030
Chromium, Dissolved	mg/L	0.0026
Copper, Dissolved	mg/L	0.0089
Lead, Dissolved	mg/L	0.00015
Nickel, Dissolved	mg/L	0.018
Zinc, Dissolved	mg/L	0.13
Cadmium, Total	mg/L	0.00036
Calcium, Total	mg/L	66
Chromium , Total	mg/L	0.0028
Copper, Total	mg/L	0.013
Lead, Total	mg/L	0.00064
Magnesium, Total	mg/L	28
Nickel, Total	mg/L	0.017
Potassium	mg/L	16
Sodium	mg/L	69
Zinc, Total	mg/L	0.14
Total Suspended Solids	mg/L	< 4.0

Site Water Characteristics - 07/16/2012

Parameter	Unit	Value
Dissolved Oxygen	mg/L	7.33
Water Temperature	^{o}C	26.23
pH	SU	7.71
Specific Conductivity	uS/cm	969
Chloride	mg/L	120
Sulfate	mg/L	30
Alkalinity	mg/L	140
Hardness	mg $CaCO_3$/L	287
Dissolved Organic Carbon	mg/L	5.0
Total Organic Carbon	mg/L	4.9
Cadmium, Dissolved	mg/L	0.000037
Chromium, Dissolved	mg/L	0.0042
Copper, Dissolved	mg/L	0.013
Lead, Dissolved	mg/L	0.00011
Nickel, Dissolved	mg/L	0.015
Zinc, Dissolved	mg/L	0.09
Cadmium, Total	mg/L	0.000038
Calcium, Total	mg/L	64
Chromium , Total	mg/L	0.0029
Copper, Total	mg/L	0.016
Lead, Total	mg/L	0.00013
Magnesium, Total	mg/L	31
Nickel, Total	mg/L	0.014
Potassium	mg/L	18
Sodium	mg/L	75
Zinc, Total	mg/L	0.091
Total Suspended Solids	mg/L	< 4.0

Note: Field analyses conducted by Geosyntec Consultants. Laboratory analyses performed by PDC Laboratories, Peoria, Illinois.

APPENDIX C. Water Effect Ratio Data and Information (continued)

Environmental Analysis South Results of WET Testing

APPENDIX C. Water Effect Ratio Data and Information (continued)

Pace Analytical Laboratories Results of WET Testing

Appendix C. Water Effect Ratio Data and Information (continued)

Water Effect Ration Reporting Requirements
(see Page 14 and 15 in Procedures)

Parameter	Response
Identity of the investigators	Section 1. Background
Identify of laboratories	Appendix C. WER Data and Information
Name, location, and description of the discharger	Section 1. Background
Description of receiving stream	Section 1. Background
Effluent flow	Section 1. Background
Receiving water flow	Section 5. Receiving Water Analyses
Prior meteorological conditions potentially effecting flow and water quality	Section 5.3 Streamlined Water Effect Ratio
Dilution ratio used in mixing effluent and upstream water to prepare site water	Not applicable
Downstream design hardness expected to be used for the permit derivation	Proposed Effluent Limit Modifications Table 6.1

Parameter	Response
Value of proposed site-specific criterion	Proposed Effluent Modifications Table 6.1
Identification of each sampling location	Section 5. Receiving Water Analyses
Procedures to obtain, transport, and store samples	Section 5.3 Streamlined Water Effect Ratio
Any pretreatment of the sample such as filtration of the site or laboratory dilution water	Section 5.3 Streamlined Water Effect Ratio
Description of laboratory dilution water including source and preparation	Appendix C. WER Data and Information
Results of all chemical and physical measurements on upstream, effluent, and simulated downstream water including hardness, alkalinity, pH, concentrations of total recoverable and dissolved metals, TSS, and DOC	Appendix C. WER Data and Information
Description of experimental design, test chambers, volume of solution in chambers, numbers of organisms and chambers per treatment. Source and grade of the copper salt, and how stock solution was prepared.	Appendix C. WER Data and Information
Species and source of the test organisms, age, and holding and acclimation procedures.	Appendix C. WER Data and Information
Average and range of the temperature, pH, hardness, alkalinity, and the concentration of dissolved oxygen during acclimation.	Appendix C. WER Data and Information

APPENDIX D. Preliminary Translator Calculation

Date	Parameter	Unit	Value	f_D
5/8/2012	Copper, Dissolved	ug/L	8.9	-----
5/8/2012	Copper, Total	ug/L	13	0.68
7/16/2012	Copper, Dissolved	ug/L	13	-----
7/16/2012	Copper, Total	ug/L	16	0.81
			Geomean f_D=	0.75

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WATER PROTECTION PROGRAM

City of Monett

217 5th Street
Monett, MO 65708

TEL (417) 235-3300
FAX (417) 235-4635

June 13, 2014

Mr. John Hoke
Water Protection Program
Missouri Department of Natural Resources
P.O. Box 176
Jefferson City, MO 65102

Subject: Request to Revise 10 CSR 20-7.031 to Include Site-Specific Copper Criteria for Clear Creek in Upcoming Rule Revision

Mr. Hoke,

With this letter, the City of Monett (City) respectfully requests that the Missouri Department of Natural Resources (MDNR) process a revision of 10 CSR 20-7.031 to reflect site-specific copper criteria for Clear Creek, downstream from the City's wastewater plant discharge. The requested site-specific copper criteria are based on a 2012 water effect ratio (WER) Study (Study) conducted for the City by Geosyntec Consultants (Geosyntec). The summary report of the Study is attached for reference and provides further details on the Study and findings (Attachment A).

Background

The City is the continuing authority of the Monett Municipal Wastewater Treatment Facility (WWTF) (MO-0021440). The WWTF design average flow is 6.0 million gallons per day (mgd). Treated effluent from the WWTF is discharged to a recently classified segment of Clear Creek (Attachment A, Figure 1.1).

Final Effluent Limitations (FEL's) for several heavy metals were issued by MDNR as part of the 2008 permit renewal. These FELs are based on revised, in-stream water quality criteria adopted into rule at 10 CSR 20-7.031 in 2005. The new FELs were significantly less than criteria previously applied by MDNR and were new to the Monett permit. The Department included a 3-year compliance schedule for achieving FELs in the Monett permit (effective August 22, 2011), but the City continues to be challenged with meeting the revised copper effluent limitations. A study conducted for the City by Allgeier, Martin and Associates, Inc. concluded that less than 20% of the copper loading to the WWTF originated from industrial sources. The remaining copper loading is attributed to the potable water supply and cannot be treated affordably (see Attachment A for more detailed information).

2012 Water Effect Ratio Study

In 2012, the City retained the services of Geosyntec Consultants, Inc. (Geosyntec) to conduct a Water Effect Ratio Study to evaluate the actual toxicity of copper in the WWTF discharge matrix. The Study methodology followed US Environmental Protection Agency (EPA) guidance and was conducted under an MDNR approved Quality Assurance Project Plan (QAPP). Based on the results of the Study, Geosyntec proposed site-specific acute and chronic copper criteria of 180 ug/L and 114 ug/L, respectively. Copper concentrations in the Monett WWTF effluent would not have a "Reasonable Potential to Exceed" these site-specific criteria. The MDNR Water Quality Monitoring Assessment Section has reviewed and approved the findings of the Study.

Request for Adoption of Site-specific Copper Criteria

It is the City's understanding that MDNR cannot modify the Monett discharge permit to reflect the findings of the WER Study until approval of a site-specific copper criteria is granted by the Missouri Clean Water Commission through a rule change or variance. Until the permit is modified, the City faces potential enforcement liability for copper FEL violations, even though the Study has demonstrated that the current FEL's are overprotective. The City therefore requests that the adoption of site-specific copper criteria be included in the next rule revision, so that the City's permit may be modified in a timely manner.

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Thank you for your consideration of this very important request by the City of Monett. We are available to provide additional information as needed during the upcoming rule change process. We also would appreciate notification as to whether our request was approved for the rulemaking process. I can be reached at the following phone number and e-mail address: (417) 235-3300, skipschaller@cityofmonett.com.

Sincerely,

Skip Schaller
General Manager-Utilities

"United We Stand"

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JUN 16 2014

WATER PROTECTION PROGRAM

Attachment A

Water Effect Ratio Study Report for the Monett Municipal Wastewater Treatment

"United We Stand"

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JUN 16 2014

WATER PROTECTION PROGRAM

Prepared for

City of Monett
217 5th Street
Monett, Missouri 65708

REGULATORY COPPER INVESTIGATIONS AT THE MONETT MUNICIPAL WASTEWATER TREATMENT FACILITY

Project Report

Prepared by

Geosyntec consultants

engineers | scientists | innovators

1123 Wilkes Blvd., Ste. 400
Columbia, Missouri 65201

March 2013

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APPENDICES

Appendix A. Source Data Evaluation
Appendix B. Monett WWTF Effluent Data
Appendix C. Water Effect Ratio Data and Information

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1. BACKGROUND

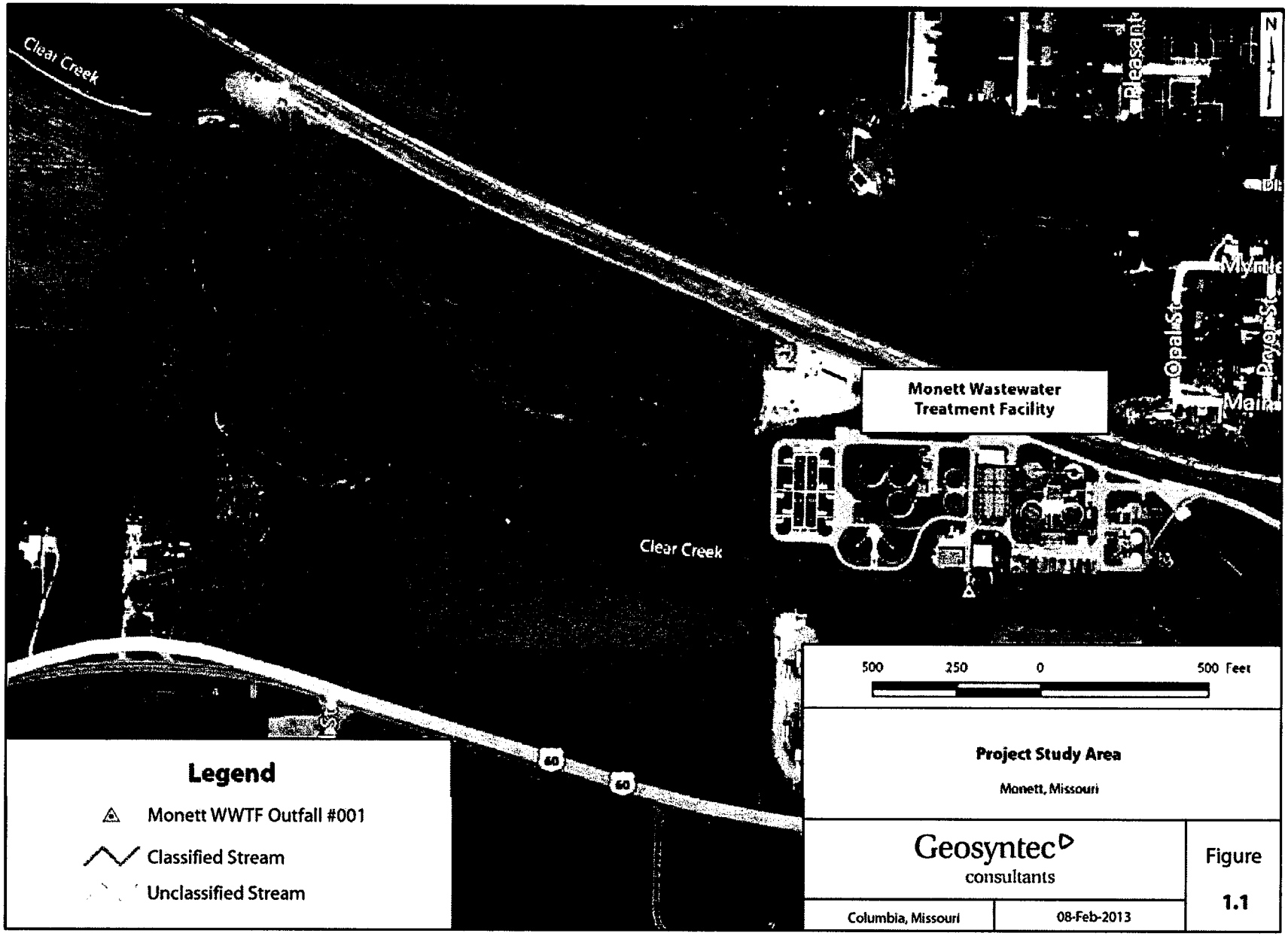
The City of Monett, Missouri (City) is the continuing authority of a mechanical oxidation ditch wastewater treatment facility (WWTF) having a dry weather design average flow of 6.0 million gallons per day (mgd). Outfall #001 serves as the primary outfall for the Monett WWTF under NPDES operating permit number MO-0021440 (permit). Treated effluent from the WWTF is discharged to an unclassified segment of Clear Creek (**Figure 1.1**).

Final Effluent Limitations (FELs) for several heavy metals (**Table 1.1**) were issued by the Missouri Department of Natural Resources (MDNR or Department) as part of the 2008 permit renewal. These FELs are based on revised in-stream water quality criteria adopted into rule at 10 CSR 20-7.031 in 2005. New FELs are significantly less than criteria previously applied by MDNR and were new to the Monett permit. The Department included a 3-year compliance schedule for achieving FELs in the Monett permit (effective August 22, 2011), but the City continues to be challenged with meeting the revised copper effluent limitations (**Figure 1.2**). Based on consultation with the City's engineers (i.e., Allgeier, Martin and Associates), this issue cannot likely be resolved through any reasonable level of wastewater technology or any other means, including distributed controls.

Table 1.1. Final Effluent Limits for Total Recoverable Copper at the Monett Wastewater Treatment Facility.

Effluent Parameter	Unit	Daily Maximum Limit	Monthly Average Limit
Copper	µg/L	15.6	7.8
Zinc	µg/L	146	73

In 2012, the City retained Geosyntec Consultants (Geosyntec) to conduct receiving stream assessments to assess the toxicity of copper in Clear Creek. Geosyntec subsequently developed a Quality Assurance Project Plan (QAPP) for a streamlined Water Effect Ratio evaluation (EPA 822-R-01-005) to guide sampling and analysis activities. The study was conducted on September 18, 2012 and October 25, 2012. Results and recommendations from the study are provided in this report.


Clear Creek
Clear Creek
Pleasant
Myrtle
Opal St
Pryor St
Main
Monett Wastewater Treatment Facility
60
60
N
500 250 0 500 Feet
Legend
Monett WWTF Outfall #001
Classified Stream
Unclassified Stream
Project Study Area
Monett, Missouri
Geosyntec consultants
Columbia, Missouri
08-Feb-2013
Figure
1.1

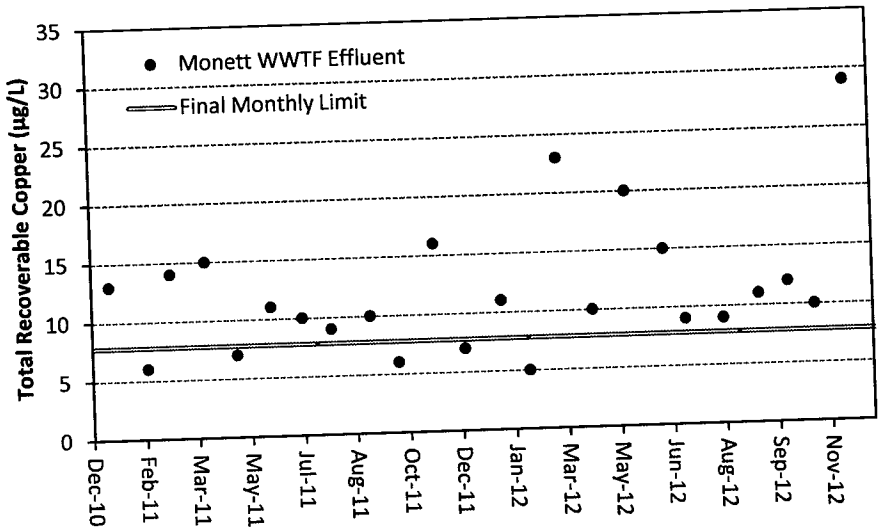


Figure 1.2. Effluent Concentrations of Total Recoverable Copper at the Monett Wastewater Treatment Facility.

2. COPPER SOURCE EVALUATION

Allgeier, Martin and Associates (Allgeier Martin) recently prepared a document entitled "Plan for Meeting Final Effluent Limits – City of Monett, Missouri" (hereinafter referred to as the "planning document"). The planning document concluded that the City will routinely exceed copper FELs, unless effluent limits are relaxed. Influent copper concentrations to the WWTF average 43 µg/L. According to the planning document, the City's potable water supply and industry account for approximately 11 µg/L and 8 µg/L, respectively; the remainder likely coming from the drinking water distribution system. The existing wastewater treatment system removes approximately 70 percent of the influent copper loading. Therefore, even if industrial copper loadings were reduced to zero, the City could not consistently achieve its monthly average copper limits of 7.8 µg/L. Allgeier Martin estimates that an approximate 90 percent removal rate would be required to consistently achieve the copper FEL, which is not possible with any reasonable or affordable level of wastewater technology. The planning document is included in **Appendix A**.

3. RECEIVING WATER ANALYSES

Two receiving water studies were conducted to evaluate the relative bioavailability or toxicity of copper within treated effluent at the Monett WWTF: (1) characterization of hardness concentrations, and (2) Streamlined Water Effect Ratio (WER) for copper. Each of these studies are described and summarized in this section. Studies for other permitted metals including total recoverable zinc may be pursued in the future following coordination with the Department.

3.1 Adjusting for Critical Flows

The sampling location for receiving water studies is the point where treated wastewater effluent enters Clear Creek. This location was selected as it best coincided with the intent of WER guidance (US EPA, 2001) and Missouri's mixing zone allowances (i.e., no mixing allowed for streams with 7Q10 < 0.0 cfs). Location of sampling points is further discussed as follows.

Missouri Water Quality Standards (WQS) stipulate that wasteload allocations (WLA) and permit limits be based on critical low-flow conditions (e.g., 7Q10). However, water quality studies used to support permit limits are rarely conducted during statistical low-flow conditions. Rather, WLA and modeling studies are typically conducted at steady baseflow conditions. Differences in flow conditions (i.e., actual vs. critical) must therefore be accounted for. For example, WLA data to support calibration of a DO model is typically collected during warm-weather baseflow conditions. However, for the purpose of developing a WLA, the calibrated DO model is re-run at critical low-flow conditions. Because the WER and hardness regime are data driven and do not include transport processes, differences in flow (i.e., observed vs. critical) are accounted for during the sampling event. Guidance developed by the US Environmental Protection Agency (USEPA, 2001) recommends mixing effluent and upstream water at the design low-flow dilution to create a simulated downstream sample (page 1, first paragraph under Synopsis of the Streamlined Water Effect Ratio Procedure, USEPA 2001). In the case of the Monett WWTF, the receiving stream (Clear Creek) has a 7Q10 critical low-flow value of 0 cubic feet per second (cfs). Therefore, study samples were collected near the Monett WWTF outfall and consisted of 100% effluent. Such an approach is also consistent with MDNR's WET test guidance, which calls for a 100% effluent sample where the 7Q10 is zero.

3.2 Hardness Regime

Greater concentrations of polyvalent cations, specifically Mg^{2+} and Ca^{2+}, reduce the absorption of heavy metals by aquatic organisms. Consequently, Missouri's copper criteria are hardness-dependent. According to the City's operating permit fact sheet, the Department assumed a hardness concentration of 140 mg/L. Weekly hardness samples (n=106) collected from the Monett WWTF are greater than the assumed hardness value of 140 mg/L. Per 10 CSR 20-7.031(1)(Y), the 25th percentile of measured hardness values may be used to recalculate metals criteria. As provided in **Appendix B**, the 25th percentile of hardness data is 172 mg/L. Alternative permit limits are provided in Section 4 that incorporates site-specific hardness data.

3.3 Streamlined Water Effect Ratio

The toxicity of copper to aquatic organisms can be influenced by several environmental factors including the concentrations or levels of hardness, organic carbon, pH, and suspended solids. Many of these factors exhibit a reduced influence in the laboratory setting (e.g., clean water) used to derive national default water quality criteria. A procedure developed by US EPA to account for differences in toxicity due to these factors is termed a Water Effect Ratio.

The Streamlined Water Effect Ratio (US EPA, 2001) requires two sampling events to be conducted one month apart at design flow dilution and under representative conditions using a single test organism. To comply with these requirements, Geosyntec conducted two WER

sampling events on 09/18/2012 and 10/25/2012 using the test organism *Ceriodaphnia dubia*. The WER sampling events were conducted under a Quality Assurance Project Plan (QAPP) and were performed during normal plant operating conditions during dry weather conditions. Grab samples were collected from the Monett WWTF outfall, placed on ice and hand-carried to the WET testing laboratory performing the analyses.

At the laboratory, Geosyntec personnel adjusted laboratory reconstituted water to similar hardness, alkalinity, and pH of the site water and prepared the appropriate test dilutions by spiking with copper nitrate [$(CuNO_3)_2$ *2.5 H_2O] to establish a range of concentrations bracketing the expected EC_{50} for both the site water and reconstituted tests. Tests were conducted under representative conditions such that total suspended solids were less than 4 mg/L during each event and calculated BOD_5 less than 10 mg/L. Results from WER tests are depicted in **Table 3.1**. Additional WER study details are included in **Appendix C.** Alternative permit limits proposed for the Monett WWTF are provided in Section 4. Proposed alternative limits incorporate a Final Total Recoverable WER of 8.0.

Table 3.1. Streamlined Water Effect Ratio Results for the Monett WWTF.

Test Date	Water Source	Parameter	Unit	Value	Comments
9/18/2012	Site Water	Native EC_{50}	µg/L	245	Spearman-Karber method
9/18/2012	Site Water	Hardness Normalized EC_{50}	µg/L	244	EPA Procedure, Page 13. Normalized to 172 mg/L
9/18/2012	Site Water	SMAV at Site Hardness	µg/L	40.0	EPA Procedure, Page 17. Normalized to 172 mg/L
9/18/2012	Laboratory Water	Native EC_{50}	µg/L	14.1	Spearman-Karber method
9/18/2012	Laboratory Water	Hardness Normalized EC_{50}	µg/L	14.7	EPA Procedure, Page 13. Normalized to 172 mg/L
9/18/2012	-----	Sample WER Criterion 1	-----	16.6	Site EC_{50}/Lab EC_{50} at Normalized Hardness
9/18/2012	-----	Sample WER Criterion 2	-----	6.1	Site EC_{50}/SMAV at Normalized Hardness
9/18/2012	-----	**Sample WER for Test #1**	-----	**6.1**	Lesser of Criteria 1 and 2
10/25/2012	Site Water	Native EC_{50}	µg/L	346	Spearman-Karber method
10/25/2012	Site Water	Hardness Normalized EC_{50}	µg/L	422.9	EPA Procedure, Page 13. Normalized to 172 mg/L
10/25/2012	Site Water	SMAV at Site Hardness	µg/L	40.0	EPA Procedure, Page 17. Normalized to 172 mg/L
10/25/2012	Laboratory Water	Native EC_{50}	µg/L	26.7	Spearman-Karber method
10/25/2012	Laboratory Water	Hardness Normalized EC_{50}	µg/L	32.9	EPA Procedure, Page 13. Normalized to 172 mg/L
10/25/2012	-----	Sample WER Criterion 1	-----	12.9	Site EC_{50}/Lab EC_{50} at Normalized Hardness
10/25/2012	-----	Sample WER Criterion 2	-----	10.6	Site EC_{50}/SMAV at Normalized Hardness
10/25/2012	-----	**Sample WER for Test #2**	-----	**10.6**	Lesser of Criteria 1 and 2
			Final WER for Study	**8.0**	Geometric Mean of Sample WERs , Page 14

Notable WER results include the following observations:

- Sample WERs differed by approximately 70%. The relatively high default Standard Deviation (SD) of WERs (SD=0.5 log units, or 3.2 native WER units) listed in Table C-1 of USEPA (2001) suggests that differences between tests may not be significantly different or anomalous. That is, the observed differences were within 3.2 native WER units. Additionally, the final WER is calculated as the geometric mean, which reduces the effect of very high or low values.

- Test organisms in the reconstituted (recon) water from the 9/18/2012 sample event appear to have been more sensitive as the EC_{50} in the reconstituted water (14.7 µg/L)

was substantively less than the expected Species Mean Acute Value (SMAV) of approximately 40.0 µg/L (normalized to recon hardness of 172 mg/L). In comparison, the recon water EC_{50} from the 10/25/2012 sample event (32.9 µg/L) was much closer to the expected SMAV of 40.0 µg/L (normalized to recon hardness of 172 mg/L). Ultimately, the potential sensitivity of the test organisms from 9/18/2012 did not inflate the sample WER value as Calculation Criterion 2 (see **Table 3.1**) minimized the WER from the first test (WER=6.1).

4. PROPOSED EFFLUENT LIMIT MODIFICATIONS

Use of site-specific hardness and WER data increase applicable copper criteria and therefore copper water quality-based limits. After adjusting for the WER (=8.0, see Section 3.3), the site-specific acute and chronic copper criteria are 114 µg/L and 180 µg/L, respectively (**Table 4.1**). As presented in the table below, we note that the Monett WWTF may not have 'reasonable potential' (see US EPA 1991) to exceed the adjusted copper criteria. However, given potential antibacksliding issues and as an added safety factor, the City is proposing to retain their previous copper limits of 43 µg/L as daily and monthly averages.

Table 4.1. Proposed Copper Effluent Limit Modifications for the Monett WWTF.

Receiving Stream: Unnamed Tributary to Clear Creek, Unclassified, 7Q10 = 0.0 cfs

Parameter	Unit	Value	Comments
Hardness	mg/L	172	25th Percentile of n=20 DMR records
Coefficient of Variation	-----	0.47	See Appendix B
Existing Acute Copper Criterion	µg/L as Total Recoverable	22.4	at 172 mg/L hardness and no conversion factor
Existing Chronic Copper Criterion	µg/L as Total Recoverable	14.2	at 172 mg/L hardness and no conversion factor
Final Water Effect Ratio	------	8.0	See Section 3.3
Adjusted Acute Copper Criteria	µg/L as Total Recoverable	**180**	=existing total recoverable criterion* total recoverable WER
Adjusted Chronic Copper Criteria	µg/L as Total Recoverable	**114**	=existing total recoverable criterion* total recoverable WER
Acute Wasteload Allocation	µg/L as Total Recoverable	180	=adjusted acute criterion, 7Q10=0.0 cfs
Chronic Wasteload Allocation	µg/L as Total Recoverable	114	=adjusted chronic criterion, 7Q10=0.0 cfs
Acute Long-Term Average	µg/L as Total Recoverable	60.1	see EPA (1991). Note acute LTA is limiting
Chronic Long-Term Average	µg/L as Total Recoverable	62.8	see EPA (1991). Note acute LTA is limiting
Adjusted Maximum Daily Limit	µg/L as Total Recoverable	**187**	see EPA (1991).
Adjusted Monthly Average Limit	µg/L as Total Recoverable	**93**	see EPA (1991). Note n=4 per permit Fact Sheet
Maximum Effluent Concentration	µg/L as Total Recoverable	29	Measured on 12/4/2012
Reasonable Potential Multiplier	-----	1.8	*RPM, see page 54 of EPA (1991). N=X, CV=XX*
Expected Maximum Receiving Water Concentration	MRWC, µg/L as Total Recoverable	52.2	=Maximum Effluent Concentration*RPM. Per MDNR method of using 99% Probability RPM
Reasonable Potential to Exceed	----	**No**	MRWC< Adjusted Acute or Chronic Criteria
Proposed Maximum Daily Limit	µg/L as Total Recoverable	**43**	Previous copper limits for MO-0021440
Proposed Monthly Average Limit	µg/L as Total Recoverable	**43**	Previous copper limits for MO-0021440

5. SUMMARY AND CONCLUSION

The City is the continuing authority of a mechanical oxidation ditch WWTF having a dry weather design average flow of 6.0 mgd. Final effluent limits (FEL) for copper issued by the Department as part of the 2008 permit renewal (effective as of August 22, 2011) was reduced from 43 µg/L to 7.8 µg/L as a monthly average limit. The City is currently unable to achieve the revised FEL

on a consistent basis due to copper loadings primarily generated from the drinking water distribution system and source water. Additionally, no reasonable level of technology is capable of achieving the required removal efficiencies (i.e., approximately 90 percent). Therefore, the City requested Geosyntec investigate the relative toxicity of copper for the Monett WWTF discharge scenario.

As the existing copper FELs were developed according to default and potentially conservative assumptions (i.e., hardness concentrations, default bioavailability), Geosyntec investigated the relative toxicity of copper for the Monett WWTF discharge scenario. Incorporation of site-specific hardness and WER data from receiving water investigations into the permit limit derivation process support an upward adjustment of copper effluent limits. Therefore, the City should request the Department reconsider the FELs in the existing operating permit to account for site-specific toxicity data and the distributed nature of the primary copper source (i.e., drinking water distribution system).

6. REFERENCES

United States Environmental Protection Agency (US EPA), 2001. Streamlined Water Effect Ratio Procedures for Discharges of Copper. EPA-822-R-01-005.

United States Environmental Protection Agency (US EPA), 1991. Technical Support Document for Water Quality-Based Toxics Control. EPA/505/2-90-001.

APPENDIX A. SOURCE DATA EVALUATION

Plan for Meeting Final Effluent Limits – City of Monett, Missouri

Plan For Meeting Final Effluent Limits

City of Monett, Missouri

Introduction

The City of Monett operates wastewater treatment facilities under Missouri State Operating Permit Number MO-0021440. When issued in 2008, the permit established new "Final Effluent Limits" for ammonia, copper, and zinc that were significantly more restrictive than previous limits. Recognizing that the new effluent limits might not be attainable with the existing wastewater treatment facilities, the permit contained a Schedule of Compliance that established a timeframe for submission of a plan for meeting the new limits.

The following report summarizes available data relative to ammonia, copper, and zinc, and evaluates what steps might be needed to insure compliance with the final limits.

Compliance With Ammonia Limit

The Monett operating permit establishes the Final Effluent Limitations for ammonia as follows:

	Daily Maximum	Monthly Average
Ammonia as N (total)		
(May 1 – Oct. 31)	3.4 mg/l	1.3 mg/l
(Nov. 1 – April 30)	6.2 mg/l	2.4 mg/l

A review of the operating records for the City's WWTP reveals that the facilities are able to consistently comply with the final ammonia limits, and there is no need to upgrade the treatment plant as a result of the newly imposed ammonia limit.

Compliance With Zinc Limit

The Monett operating permit establishes the Final Effluent Limitations for zinc as follows:

	Daily Maximum	Monthly Average
Zinc, Total Recoverable	146 ug/l	73 ug/l

A review of the operating records for the City WWTP indicates that since December 2007, the current facilities have discharged effluents containing an average zinc concentration of 32 ug/l. At no time did the effluent zinc concentration exceed the daily maximum limit of 146 ug/l, and on only one occasion did the effluent contain a zinc concentration above the 73 ug/l monthly average limit. A tabulation of the concentration of zinc in the City's raw sewage and treated effluent is provided in Appendix A.

The WWTP typically removes approximately 75 percent of the zinc contained in the raw sewage. Over the last four years the raw sewage contained an average of 119 ug/l of zinc, which amounts to approximately 3.5 lbs of zinc per weekday at a flow of 3.5 mgd.

Of the zinc received at the WWTP, approximately 28 ug/l, or 0.8 lbs, is attributed to the potable water drawn from the City's twelve deep wells. A summary of the zinc and copper concentrations of water drawn from each of the City's deep wells is provided in Appendix B. An estimated 0.4 lb of zinc originates from industrial sources, and the remaining 2.3 lbs of zinc is attributed to leaching from pipes, fittings, valves, and equipment that are a part of the overall City water system.

Of the six significant industrial users, Efco and DFA show no measurable contribution of zinc to the wastewater. The average contribution of zinc from Tyson's, IDF's, and Hydro's (Wells) wastewater is less than 50 ug/l. Miracle Recreation is the only industry contributing any significant concentration of zinc to the wastewater system, however their water usage averages only 8,000 gallons on a typical workday, and their contribution of zinc is therefore quite small. A summary of the zinc contributions from industrial sources is shown in Appendix C.

The Monett WWTP appears capable of remaining compliant with the final zinc limits so long as industrial contributions of zinc remain in line with current levels. There appears to be no need to upgrade the treatment plant as a result of the newly imposed zinc limit.

Compliance With Copper Limit

The Monett operating permit establishes the Final Effluent Limitations for copper as follows:

	Daily Maximum	Monthly Average
Copper, Total Recoverable	15.6 ug/l	7.8 ug/l

A review of the operating records for the City WWTP for the period since December 2007 reveals routine exceedances of the final copper limit that takes effect on August 22, 2011. As shown in Appendix A, the average effluent copper concentration over this four-year period has been 13.7 ug/l, and a peak reading of 26 ug/l has been noted.

In an effort to identify sources of copper that might be removed from the wastewater at their source, industrial users were investigated. A summary of the concentrations of copper in the wastewater from each industry is provided in Appendix D. Industries discharge a weighted average of 19 ug/l copper to the City sewers. Of this amount, the background copper in the City's potable water, as shown in Appendix B, accounts for approximately 11 ug/l. In effect, industry "creates" an estimated 8 ug/l of the copper being discharged to the City sewers. This equates to about 0.144 lbs. copper on a typical workday. It is apparent that the exceedances of the City's final copper limit are not the result of industrial dischargers.

The City has undertaken lead and copper testing of its public water system in compliance with federal and state requirements, and the results of the testing for copper are summarized in Appendix E. By its very nature the testing attempts to locate potentially high levels of copper in the water distribution system, therefore the results do not represent true averages of overall water characteristics. The results do, however, reveal the potential impact that the leaching of small amounts of copper from the piping in private residences can have on the City's wastewater flows. The testing of twenty residential water samples in each of five years resulted in an average copper concentration of 82 ug/l. Obviously this is well below the "action level" of 1300 ug/l established by the EPA for domestic water consumption, but well in excess of the established wastewater effluent limit of 7.8 ug/l.

The author is not aware of any reasonable level of technology that could be employed at the WWTP to improve copper removal to the point that the 7.8 ug/l effluent limit could be consistently met. The wastewater treatment process currently removes approximately 70 percent of the copper that reaches the WWTP, however closer to 90 percent removal would be required.

Discharge from the Monett WWTP represents the entire flow of Clear Creek at the plant outfall therefore there is no stream dilution available to allow for a relaxation of effluent limits for copper. The City finds itself faced with what appears to be an unrealistically restrictive effluent limit for copper that cannot be

consistently met with current technology. (For comparative purposes, the concentration of copper in drinking water supplies can reach 167 times the Monett WWTP effluent limit of 7.8 ug/l before an "action level" is reached.)

Proposed Resolution of Copper Issue

It appears that the City will need to pursue a relaxation of current effluent limits for copper through a determination of site specific water quality based effluent limits. It is recommended that a translator study be undertaken to more accurately define the copper waste load allocation (WLA). In the event that the translator study does not result in an adequate relaxation of the copper limit, it will be necessary to model the bioavailability of copper based on water chemistry measurement utilizing the Biotic Ligand Model (BLM). Depending on the outcome of the BLM study, it may be necessary to undertake a detailed evaluation of the composition of aquatic species in the receiving stream as compared with those used in deriving the copper criterion.

In summary, the current effluent limits for copper do not appear to be consistently attainable, and the City will need to pursue a relaxation of the limits as set forth in 10CSR 20-7.031 (4) (R) - Site – Specific Criteria Development for the Protection of Aquatic Life.

Appendix A

Monett WWTP Copper and Zinc Concentrations

Appendix A
Monett WWTP Copper and Zinc Concentrations

	Copper (ug/l)		Zinc (ug/l)	
Date	Effluent	Influent	Effluent	Influent
12-06-07	.01	.03	.03	.07
01-08-08	.02	.04	.04	.11
02-08-08	.01	.02	.03	.13
03-05-08	.01	.05	.03	.10
04-15-08	.015	.04	.024	.131
05- -08	.008	.058	.02	.096
06-03-08	.005	.033	.027	.095
07-10-08	.010	.023	.043	.077
08-12-08	.016	.046	.029	.147
09-04-08	.008	.076	.025	.232
10-01-08	.010		.033	
11-06-08	.019		.068	
12-15-08	.015		.030	
01-06-09	.018		.041	
02-04-09	.023	.067	.026	.113
03-03-09	.021		.026	
04-03-09	.016		.027	
05- -09	.026		.026	
06-09-09	.024	.049	.025	.129
07-02-09	.010		.040	
08-07-09	.014		.028	
09-08-09	.022		.026	
10- -09	.014		.055	
11- -09	.009		.028	
12-09-09	.013		.043	
01-11-10	.010		.036	
02-10-10	.019		.028	
03-09-10	.017		.033	
04- -10	.009		.023	
05-14-10	.013		.029	
06-10-10	.015		.034	
07-01-10	.015		.016	
08-06-10	.012		.022	
09-09-10	.016		.033	
10-07-10	.013		.015	
11- -10	.010		.013	
12-02-10	.010		.046	

Date	Copper (ug/l) Effluent	Copper (ug/l) Influent	Zinc (ug/l) Effluent	Zinc (ug/l) Influent
01-06-11	.013		.028	
02-11-11	.006		.032	
03- -11	.014		.080	
04-05-11	.015		.037	
05-04-11	.007		.039	
07-06-11	.010		.019	
Average	.0137	.0443	.0322	.119

Average on Days When Influent Tested	.0132	.0288

Percentage Removal of Cu = 70%
Percentage Removal of Zn = 75%

Current Effluent Limits
Cu 0.043 ug/l
Zn 1.505 ug/l

Final Effluent Limits
Cu 0.0078 ug/l
Zn 0.073 ug/l

Appendix B

Zinc And Copper Concentration At City's Potable Wells

Monett Wells
Zinc Concentration At Wells

Well No.	Zinc Concentration (ug/l) IOC '04	IOC '07	IOC '10	Avg. Conc.	% System Flow
1	3.51	22.1	23.4	16.3	0.4
4	11.8	34.1	32.9	26.3	1.4
5	10.0	2.04	22.8	11.6	9.1
9	15.3	17.9	19.9	17.7	22.4
11	2.65	7.13	10.5	6.76	1.3
12	32.0	--	--	32.0	27.0
13	6.10	273	31.7	103.6	2.3
15	31.9	17.3	8.28	19.2	6.3
16	27.8	63.3	23.3	38.1	3.1
17	70.8	38.4	--	54.6	7.0
18	4.15	1.54	340	115	5.5
20	1.44	1.00	--	1.22	14.2
21	--	21.3	--	21.3	0

Weighted Average Zinc Concentration = 27.6 ug/l

Monett Wells
Copper Concentration At Wells

Well No.	Copper Concentration (ug/l) IOC '04	IOC '07	IOC '10	Avg. Conc.	% System Flow
1	3.34	20.4	8.84	10.9	0.4
4	4.98	61.7	82.8	49.8	1.4
5	20.3	28.7	22.0	23.7	9.1
9	6.16	7.29	5.08	6.18	22.4
11	1.68	4.73	2.23	2.88	1.3
12	10.0	--	--	10.0	27.0
13	1.34	10.1	22.6	11.3	2.3
15	2.80	5.01	11.9	6.57	6.3
16	3.01	1.88	2.66	2.52	3.1
17	14.3	4.68	--	9.49	7.0
18	8.99	4.17	119	44.1	5.5
20	1.19	1.76	--	1.48	14.2
21	--	1.55	--	1.55	0

Weighted Average Copper Concentration = 11.1 ug/l

Appendix C

Zinc From Industrial Sources

Appendix C

	Zinc. From Industrial Sources (mg/l)					
	Tyson	Efco	Hydro	IDF	DFA	Miracle
11/06	.01	<.01	<.01	<.01	<.01	.01
12/06	.04	<.01	.04	.06	.02	.07
01/07	.05	<.01	.03	.04	.01	.11
02/07	.04	<.01	.11	.02	.02	<.05
03/07	.05	--	--	--		.03
04/07	.03	<.01	.03	--	.02	.09
05/07	.04	<.01	.07	.10	.02	.28
06/07	.06	<.05M	.05	.05	.03	.10
07/07	.10	.01	.03	.03	.02	.20
08/07	.03	.01	.03	.02	.02	.17
09/07	.03	.02	.03	.02	.02	.12
10/07	.04	<.01	.03	.02	.02	.03
11/07	.09	<.01	.07	.03	.03	.21
12/07	.05	<.01	.05	.06	.02	.23
01/08	.04	<.01	.02	.02	.02	10.3
02/08	.04	.02	.02	.06	.01	1.33
03/08	.04	<.01	.02	.03	.05	.33
04/08	.04	.01	.03	.08	.02	.03
05/08	.05	.01	.03	.05	.02	.05
06/08	.04	<.01	.47M	.03	.03	.03
07/08	.05	.01	.05	.14	.02	.11
08/08	.07	.02	.06	.03	.03	.11
09/08	.04	.01	.05	.12	.02	.14
10/08	.04	.02	.03	.21	.03	.04
11/08	.03	.01	.04	.03	.02	.11
12/08	.09	<.01	.02	.02	.02	2.64
03/09	.08	.01	.05	.01	.01	.13
06/09	.08	<.01	.03	.04	.02	.01
09/09	.07	<.01	.02	.04	.01	<.02
12/09	.06	<.01	.04	.10	.02	<.02
03/10	.06	<.01	.02	<.01	.02	.02
06/10	.03	.02	.04	.02	.03	.01
09/10	.06	<.01	.06	.01	.03	6.75
12/10	.04	.01	.12	.01	.03	.59

Zinc From Industrial Sources

Industry (Current Pretreatment Limit Max)	Avg. Workday Water Usage (gpd)	Avg. Zn Conc. (mg/l)	Max Zn Conc. (mg/l)	Avg. Zn (lb/d)	Max Zn (lb/d)
Tyson (.23)	1,508,000	.050	.10	.649	1.298
Efco (.28)	154,000	<.011	.02	<.016	.029
Hydro (1.25)	74,000	.041	.12	.026	.077
IDF (1.14)	402,000	.046	.14	.130	.395
DFA (.42)	284,000	.021	.05	.054	.129
Miracle (1.90)	8,000	.429	6.75	.036	.563
TOTAL	2,430,000			.911	2.491

Average WWTP Influent Zn Conc. = .121 mg/l
At 3.5 mgd = 3.53 lb Zn/d

Maximum WWTP Influent Zn. Conc. = .232 mg/l
At 3.5 mgd = 6.77 lb Zn/d

Typical Zn Removal Thru WWTP = 75%

Typical WWTP Effl. Zn. Conc. = .0322 mg/l
At 3.5 mgd = 0.94 lb Zn/d

Average Industrial Zn. Conc. = 0.0444 mg/l
This is less than the new WWTP effluent limit.

The only industry with a zinc issue is Miracle. It would appear that some controls might be appropriate, however industry is not a problem overall.

Industries discharge an average of 0.0444 mg/l zinc to City sewers. Of this amount, the zinc in the City's potable water accounts for approximately 0.0276 mg/l based on testing at the City wells. In effect, industries "create" about 0.0168 mg/l of the zinc being discharged to the City. This equates to about 0.345 lb Zn on a typical workday.

Appendix D

Copper From Industrial Sources

Appendix D

	Copper From Industrial Sources (mg/l)					
	Tyson	Efco	Hydro	IDF	DFA	Miracle
11/06	.01	.01	.02	.01	<.01	.01
12/06	.02	.01	.02	.01	<.01	.01
01/07	.01	<.01	.02	.02	.01	.28
02/07	.02	<.01	.03	.01	<.01	.03
03/07	.02	.01	.02	.01	<.01	.01
04/07	.01	<.01	.01	--	.01	.13
05/07	.02	.01	.01	.02	.01	<.05
06/07	.01	<.05M	.01	.01	.01	.02
07/07	.02	.02	.01	.01	.01	.04
08/07	.02	.01	.01	.01	.01	.06
09/07	.01	.01	.01	.01	<.01	.13
10/07	.02	.02	.02	.02	.01	.01
11/07	.04	.02	.03	.02	.02	.01
12/07	.02	<.01	.02	.02	<.01	.03
01/08	.01	.01	.02	<.01	<.01	.01
02/08	.04	.02	.01	.01	<.01	.09
03/08	.01	.01	.01	<.01	<.01	.20
04/08	.02	.02	.01	.01	<.01	.01
05/08	.02	.02	.01	.01	.01	.02
06/08	.01	<.01	.07M	.01	.02	.01
07/08	.03	.02	<.01	<.01	.01	<.01
08/08	.03	.01	.01	.01	.01	.02
09/08	.02	.02	.03	.02	.01	.08
10/08	.05	<.01	.01	.01	<.01	<.01
11/08	.01	.01	.01	.01	.02	<.01
12/08	.03	.01	.02	.01	.01	.01
03/09	.04	.02	.03	.01	.01	.01
06/09	.03	.01	.01	.02	<.01	.01
09/09	.04	.01	.01	.01	.01	.02
12/09	.03	.01	.02	.01	.01	<.02
03/10	.02	.01	.01	.01	.01	.04
06/10	.01	.01	.02	<.01	<.01	.02
09/10	.016	<.01	.07	.01	<.01	.17
12/10	.02	.01	.27	.01	.01	.04

Monett WWTP
Copper From Industrial Sources

Industry (Current Pretreatment Limit Max)		Avg. Workday Water Usage (gpd)	Avg. Cu Conc. (mg/l)	Max Cu Conc. (mg/l)	Avg. Cu. (lb/d)	Max Cu. (lb/d)
Tyson	(.12)	1,508,000	.022	.05	.276	.629
Efco	(.10)	154,000	<.012	.02	<.015	.026
Wells	(.10)	74,000	.025	.27	.015	.166
IDF	(.11)	402,000	<.012	.02	.040	.114
DFA	(.06)	284,000	<.011	.02	.026	.066
Miracle	(.26)	8,000	.048	.28	.003	.019
TOTAL		2,430,000			.375	1.020

Average WWTP Influent Cu Conc. = .0432 mg/l
At 3.5 mgd = 1.26 lb Cu/d

Maximum WWTP Influent Cu. Conc. = .076 mg/l
At 3.5 mgd = 2.22 lb Cu/d

Typical Cu Removal Thru WWTP = 70%
Typical WWTP Effluent Cu. Conc. = .0137 mg/l
At 3.5 mgd = 0.40 lb Cu/d

If industrial copper was reduced to zero, typical WWTP influent would be 1.26 lb Cu/d less .375 lb Cn/d = 0.885 lb Cu/d.

At 70% removal of Cu, typical effluent = 0.266 lb/d.

At 3.5 mgd, 0.266 lb Cu/d = 0.0091 mg/l Cu.

This still exceeds the new permit limit of 0.0078 mg/l.

Appendix E

Copper At Residential Services

Appendix E

Copper At Residential Services

The following is a summary of the results of lead and copper surveys of residential customers most likely to have high readings.

Year	No. Customers Sampled	Max. Cu. (mg/l)	Min Cu. (mg/l)	Avg. Cu. (mg/l)
1998	20	.353	.016	.075
2001	20	.172	.015	.066
2004	20	.0267	.027	.097
2007	20	.366	.008	.106
2009	20	.181	.011	.068
				.082 Avg.

Well below "action level" of 1.3 mg/l for Copper.

APPENDIX B. MONETT WWTF EFFLUENT DATA

Sample Dates	Effluent Hardness (mg/L)	Effluent Copper (TR, µg/L)
1/3/2011	181	--
1/4/2011	--	13
1/10/2011	180.6	--
1/17/2011	181.2	--
1/25/2011	181.6	--
1/30/2011	183.6	--
2/7/2011	194.8	--
2/8/2011	--	6
2/14/2011	191.2	--
2/22/2011	189.6	--
3/3/2011	--	14
3/7/2011	180.6	--
3/13/2011	174.4	--
3/21/2011	173.6	--
3/28/2011	177.6	--
4/3/2011	181.2	--
4/5/2011	--	15
4/11/2011	174.4	--
4/18/2011	177.6	--
4/20/2011	172	--
4/25/2011	171.6	--
5/2/2011	181.6	--
5/4/2011	--	7
5/10/2011	179.6	--
5/16/2011	180	--
5/23/2011	179.8	--
5/31/2011	186.4	--
6/6/2011	179.8	11
6/13/2011	167.8	--
6/19/2011	167.2	--
6/28/2011	166.4	--
7/4/2011	160.0	--
7/5/2011	--	10
7/12/2011	158.4	--
7/18/2011	159.6	--
7/25/2011	158.0	--
8/2/2011	177.2	9
8/8/2011	173.6	--
8/15/2011	176.0	--
8/22/2011	177.6	--
8/28/2011	168.6	--
9/7/2011	176.6	--
9/8/2011	--	10
9/13/2011	179.4	--
9/19/2011	178.4	--

Descriptive Statistics		
	Hardness (mg/L)	Copper (TR, µg/L)
Count	106	24
Minimum	152	5
Maximum	195	29
Average	176	12
25th Percentile	172	9

Sample Dates	Effluent Hardness (mg/L)	Effluent Copper (TR, µg/L)
9/26/2011	179.6	--
10/3/2011	188.8	--
10/4/2011	--	6
10/9/2011	171.6	--
10/17/2011	172.0	--
10/24/2011	162.8	--
10/31/2011	175.0	--
11/7/2011	167.4	--
11/8/2011	--	16
11/14/2011	163.6	--
11/20/2011	159.6	--
11/28/2011	168.8	--
12/5/2011	164.2	--
12/6/2011	--	7
12/11/2011	165.2	--
12/19/2011	180.6	--
12/27/2011	172.2	--
1/1/2012	160.0	--
1/9/2012	180.6	--
1/10/2012	--	11
1/17/2012	177.4	--
1/23/2012	181.2	--
1/30/2012	180.2	--
2/5/2012	--	5
2/7/2012	179.8	--
2/13/2012	180.4	--
2/20/2012	182.8	--
2/27/2012	177.4	--
2/29/2012	168.6	--
3/5/2012	171.6	23
3/12/2012	161.8	--
3/20/2012	175.6	--
3/26/2012	176.4	--
4/3/2012	180.6	--
4/5/2012	--	10
4/10/2012	177.2	--
4/16/2012	180.2	--
4/23/2012	175.2	--
4/30/2012	158.6	--
5/8/2012	168.8	20
5/14/2012	177.6	--
5/21/2012	178.2	--
5/28/2012	177.8	--
6/5/2012	180.0	--
6/11/2012	180.6	--
6/12/2012	--	15
6/19/2012	177.4	--
6/25/2012	182.0	--

Descriptive Statistics		
	Hardness (mg/L)	Copper (TR, µg/L)
Count	106	24
Minimum	152	5
Maximum	195	29
Average	176	12
25th Percentile	172	9

Sample Dates	Effluent Hardness (mg/L)	Effluent Copper (TR, µg/L)
7/2/2012	--	9
7/5/2012	166.4	--
7/9/2012	177.6	--
7/16/2012	179.6	--
7/23/2012	180.2	--
7/30/2012	177.4	--
8/6/2012	180.4	--
8/7/2012	--	9
8/13/2012	179.6	--
8/20/2012	177.6	--
8/28/2012	180.6	--
9/4/2012	183.6	--
9/10/2012	181.8	11
9/17/2012	173.2	--
9/24/2012	176.8	--
10/1/2012	194.6	--
10/8/2012	179.4	12
10/15/2012	152.4	--
10/22/2012	172.8	--
10/31/2012	177.8	--
11/2/2012	--	10
11/5/2012	183.4	--
11/12/2012	177.4	--
11/19/2012	177.4	--
11/26/2012	182.4	--
12/3/2012	180.2	--
12/4/2012	--	29
12/10/2012	183.4	--
12/17/2012	176.6	--
12/23/2012	176.2	--
12/31/2012	180.6	--

Descriptive Statistics		
	Hardness (mg/L)	Copper (TR, µg/L)
Count	106	24
Minimum	152	5
Maximum	195	29
Average	176	12
25th Percentile	172	9

APPENDIX C. WATER EFFECT RATIO DATA AND INFORMATION

Sample (ID for **09/18/2012**)	Water Source (Description)	Copper (µg/L, as Total)	Sample Hardness (mg/L)	*C. dubia* Response (% Mortality)
WE-60212-10 (Unspiked)	Site Water	15	173	0
WE-26212-25	Site Water	37	173	0
WE-26212-35	Site Water	54	173	0
WE-26212-50	Site Water	57	173	0
WE-26212-75	Site Water	87	173	0
WE-26212-100	Site Water	110	173	0
WE-26212-150	Site Water	140	173	0
WE-26212-250	Site Water	240	173	40
WE-26212-400	Site Water	370	173	100
WE-26212-700	Site Water	690	173	100
WC-26212-0 (Control)	Laboratory Control Water	0.97	74	0
WR-26212-0	Reconstituted Laboratory Water	0.86	167	0
WR-26212-10	Reconstituted Laboratory Water	13	--	40
WR-26212-25	Reconstituted Laboratory Water	21	--	100
WR-26212-35	Reconstituted Laboratory Water	41	--	100
WR-26212-50	Reconstituted Laboratory Water	48	--	100
WR-26212-75	Reconstituted Laboratory Water	59	--	100
WR-26212-100	Reconstituted Laboratory Water	93	--	100
WR-26212-150	Reconstituted Laboratory Water	140	--	100
WR-26212-250	Reconstituted Laboratory Water	250	163	100

Sample (ID for **10/25/2012**)	Water Source (Description)	Copper (µg/L, as Total)	Sample Hardness (mg/L)	*C. dubia* Response (% Mortality)
WE-29712-10 (Unspiked)	Site Water	5.9	139	0
WE-29712-25	Site Water	20	139	0
WE-29712-35	Site Water	30	139	0
WE-29712-50	Site Water	45	139	0
WE-29712-75	Site Water	63	139	0
WE-29712-100	Site Water	86	139	0
WE-29712-150	Site Water	130	139	0
WE-29712-250	Site Water	220	139	0
WE-29712-400	Site Water	370	139	65
WE-29712-700	Site Water	660	139	100
WC-29712-0 (Control)	Laboratory Control Water	0.64	69	0
WR-29712-0 (Unspiked)	Reconstituted Laboratory Water	0.62	141	0
WR-29712-10	Reconstituted Laboratory Water	15	--	0
WR-29712-25	Reconstituted Laboratory Water	19	--	0
WR-29712-35	Reconstituted Laboratory Water	30	--	75
WR-29712-50	Reconstituted Laboratory Water	46	--	100
WR-29712-75	Reconstituted Laboratory Water	70	--	100
WR-29712-100	Reconstituted Laboratory Water	100	--	100
WR-29712-150	Reconstituted Laboratory Water	140	--	100
WR-29712-250	Reconstituted Laboratory Water	250	134	100

Note: Reagent grade copper nitrate hydrate [$Cu(NO_3)_2$ * 2.5 H_2O] was used to prepare working stock solutions of site water and reconstituted laboratory water by adding 0.0915 g copper nitrate to 1 >L of each. Stock solutions were used to prepare 1 L of each dilution for WET and analytical testing.

APPENDIX C. WATER EFFECT RATIO DATA AND INFORMATION (CONTINUED)

Site Water Characteristics - 09/18/2012

Parameter	Unit	Value
Dissolved Oxygen	mg/L	7.39
Water Temperature	°C	24.19
pH	SU	7.66
Specific Conductivity	uS/cm	1,566
Chloride	mg/L	130
Sulfate	mg/L	270
Alkalinity	mg/L	210
Hardness	mg $CaCO_3$/L	173
Dissolved Organic Carbon	mg/L	4.2
Total Organic Carbon	mg/L	4.4
Copper, Dissolved	mg/L	0.0069
Calcium, Total	mg/L	51
Copper, Total	mg/L	0.0065
Magnesium, Total	mg/L	11
Potassium	mg/L	37
Sodium	mg/L	230
Ammonia-N	mg/L	<0.10
BOD_5	mg/L	<4.0
Total Suspended Solids	mg/L	<4.0

Site Water Characteristics - 10/25/2012

Parameter	Unit	Value
Dissolved Oxygen	mg/L	7.17
Water Temperature	°C	22.7
pH	SU	7.9
Specific Conductivity	uS/cm	1,343
Chloride	mg/L	120
Sulfate	mg/L	220
Alkalinity	mg/L	210
Hardness	mg $CaCO_3$/L	139
Dissolved Organic Carbon	mg/L	2.4
Total Organic Carbon	mg/L	2.5
Copper, Dissolved	mg/L	0.0042
Calcium, Total	mg/L	41
Copper, Total	mg/L	0.0045
Magnesium, Total	mg/L	8.8
Potassium	mg/L	29
Sodium	mg/L	180
Ammonia-N	mg/L	<0.10
BOD_5	mg/L	<4.0
Total Suspended Solids	mg/L	<4.0

Note: Field analyses conducted by Geosyntec Consultants. Laboratory analyses performed by PDC Laboratories, Peoria, Illinois.

APPENDIX C. WATER EFFECT RATIO DATA AND INFORMATION (CONTINUED)

Pace Analytical Laboratories Results of WET Testing

Pace Analytical
www.pacelabs.com

Pace Analytical Services, Inc.
9608 Loiret Blvd.
Lenexa, KS 66219
(913)599-5665

September 28, 2012

Randy Crawford
Geosyntec Consultants
1123 Wilkes Blvd., Suite 400
Columbia, MO 65201

RE: Project: CITY OF MONETT METALS INVESTIG
Pace Project No.: 60129565

Dear Randy Crawford:
Enclosed are the analytical results for sample(s) received by the laboratory on September 18, 2012. The results relate only to the samples included in this report. Results reported herein conform to the most current TNI standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Sherri Rosenstangle

Sherri Rosenstangle

sherri.rosenstangle@pacelabs.com
Project Manager

Enclosures

cc: Cody Luebbering, Geosyntec Consultants

REPORT OF LABORATORY ANALYSIS

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9608 Loiret Blvd.
Lenexa, KS 66219
(913)599-5665

CERTIFICATIONS

Project: CITY OF MONETT METALS INVESTIG
Pace Project No.: 60129565

Kansas Certification IDs
9608 Loiret Boulevard, Lenexa, KS 66219
A2LA Certification #: 2456.01
Arkansas Certification #: 12-019-0
Illinois Certification #: 002885
Iowa Certification #: 118
Kansas/NELAP Certification #: E-10116
Louisiana Certification #: 03055
Nevada Certification #: KS000212008A
Oklahoma Certification #: 9205/9935
Texas Certification #: T104704407-12-3
Utah Certification #: KS000212012-2

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Lenexa, KS 66219
(913)599-5665

SAMPLE SUMMARY

Project: CITY OF MONETT METALS INVESTIG
Pace Project No.: 60129565

Lab ID	Sample ID	Matrix	Date Collected	Date Received
60129565010	**WE-26212-700**	Water	09/18/12 11:20	09/18/12 16:50
60129565020	**WR-26212-250**	Water	09/18/12 14:30	09/18/12 16:50

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Lenexa, KS 66219
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SAMPLE ANALYTE COUNT

Project: CITY OF MONETT METALS INVESTIG
Pace Project No.: 60129565

Lab ID	Sample ID	Method	Analysts	Analytes Reported
60129565010	WE-26212-700	EPA 821/R-02/012	TDH	1
60129565020	WR-26212-250	EPA 821/R-02/012	TDH	1

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ANALYTICAL RESULTS

Project: CITY OF MONETT METALS INVESTIG
Pace Project No.: 60129565

Sample: WE-26212-700 **Lab ID: 60129565010** Collected: 09/18/12 11:20 Received: 09/18/12 16:50 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Acute Toxicity	Analytical Method: EPA 821/R-02/012							
Toxicity, Acute	**Complete**		1.0	1		09/20/12 16:30		

REPORT OF LABORATORY ANALYSIS

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Lenexa, KS 66219
(913)599-5665

ANALYTICAL RESULTS

Project: CITY OF MONETT METALS INVESTIG
Pace Project No.: 60129565

Sample: WR-26212-250 **Lab ID: 60129565020** Collected: 09/18/12 14:30 Received: 09/18/12 16:50 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Acute Toxicity	Analytical Method: EPA 821/R-02/012							
Toxicity, Acute	**Complete**		1.0	1		09/20/12 16:30		

REPORT OF LABORATORY ANALYSIS

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Lenexa, KS 66219
(913)599-5665

QUALIFIERS

Project: CITY OF MONETT METALS INVESTIG
Pace Project No.: 60129565

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to changes in sample preparation, dilution of the sample aliquot, or moisture content.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PRL - Pace Reporting Limit.

RL - Reporting Limit.

S - Surrogate

1,2-Diphenylhydrazine (8270 listed analyte) decomposes to Azobenzene.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

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Pace Analytical Services, Inc.
9608 Loiret Blvd.
Lenexa, KS 66219
(913)599-5665

QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: CITY OF MONETT METALS INVESTIG
Pace Project No.: 60129565

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
60129565010	**WE-26212-700**	EPA 821/R-02/012	BIO/1564		
60129565020	**WR-26212-250**	EPA 821/R-02/012	BIO/1564		

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Pace Analytical Services, Inc.
9608 Loiret Blvd.
Lenexa, KS 66219
Phone: 913.599.5665
Fax: 913.599.1759

September 24, 2012

Randy Crawford
Geosyntec
1123 Wilkes Blvd. Ste. 400
Columbia, MO 65201

Re: Lab Project Number: 60129565-010
Client Project ID: Wet Test

Dear:

Enclosed are the analytical results for sample(s) received by the laboratory. The results relate only to the samples included in this report. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report.

If you have any question concerning this report, please feel free to contact me.

Sincerely,

Tim Harrell
Tim.Harrell@pacelabs.com
Technical Director

Kansas/ NELAP Certification Number E-10116
Utah Certification Number 9135995665
Texas Certification Number T104704407-08-TX
Oklahoma Certification Number 9205/9935
Louisiana Certification Number 03055
Arkansas Certification Number 05-008-0

Enclosures

REPORT OF LABORATORY ANALYSIS

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Lenexa, KS 66219
Phone: 913.599.5665
Fax: 913.599.1759

Pace Analytical Services, Inc.

808 West McKay, Frontenac, KS 66763

LABORATORY REPORT:

CLIENT: Randy Crawford Geosyntec 1123 Wilkes Blvd. Ste. 400 Columbia, MO 65201 573-443-4100	**Date Reported:** 9-24-12 **Date Initiated:** 9-18-12 **Time Used:** 17:00 **Date Terminated:** 9-20-12

BIOMONITORING STUDY

ACUTE TOXICITY

FINDING AND CONCLUSIONS:

Acute toxicity testing was performed on duplicate samples of the Geosyntec WE-26212 solution. **Acute toxicity**, as defined by significant mortality for at least one of two aquatic test species during a 48 hour period of exposure, only Ceriodaphnia was used in this testing. **The LC50 for the Ceriodaphnia was 265.1 ug/L.** The test species utilized in this test were the water flea, Ceriodaphnia dubia. Detailed results of the toxicity testing are provided in the Acute Toxicity Reports. In addition to the acute toxicity testing, water temperature, pH, dissolved oxygen, total hardness, total alkalinity, conductivity, and chlorine determinations were performed on the sample and control samples.

SAMPLING PROCEDURES:

Geosyntec personnel collected a sample and modified it at Pace Analytical.

REPORT OF LABORATORY ANALYSIS

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Pace Analytical Services, Inc.
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Lenexa, KS 66219
Phone: 913.599.5665
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INTRODUCTION:

The purpose of this test was to determine the acute toxicity of the Geosyntec WE-26212 sample on the freshwater invertebrate, Ceriodaphnia dubia. This test was conducted at Pace Analytical Services, Inc., Frontenac, KS.

TEST ORGANISMS:

Ceriodaphnia dubia - The genetic stock of Ceriodaphnia dubia used in this acute toxicity Test were originally obtained from a private breeder. Ceriodaphnia are cultured in house at Pace Analytical Services, Inc. Culture methods of Ceriodaphnia were obtained from EPA821-C-02-006 November 2002.

MATERIALS AND METHODS:

Procedures used in the acute toxicity tests are described in Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms (USEPA, 2002).

Geosyntec personnel collected the sample tested and modified it calling it Geosyntec WE-26212 sample. Testing was performed using a 700 ug/L sample, a series of dilution, and a synthetic control. **The toxicity test was initiated within 36 hours of sample collection.**

Sample and synthetic control test solutions were not aerated during the testing period.

Ceriodaphnia *ACUTE METHODS:*

This static test was ran using 40 ml glass vials containing 25 ml of test solution. Food was administered before the test Five Ceriodaphnia neonates (<24 hr old) were randomly selected and placed in each of 4 replicates of test solution. A total of 20 organisms per concentration were tested. Observations of mortality were made at 24 and 48 hours of exposure.

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WATER QUALITY METHODS:

Prior to test initiation, temperature, dissolved oxygen, pH, total alkalinity, total hardness, and total residual chlorine were measured in the effluent and in the controls. At 24 and 48 hours of exposure, temperature, dissolved oxygen, pH, and conductance were measured in the sample and the controls.

DATA ANALYSIS:

Statistically significant ($p \leq 0.05$) mortality is determined by Dunnet's procedure using average percent survival of each test concentration versus the average survival of the controls. If significant mortality occurs, median lethal concentrations (LC50) are calculated using effluent concentrations and their corresponding percent mortality data. The LC50's and the 95% confidence intervals are calculated where appropriate by the Spearman-Karber method. Statistical analysis is accomplished by following steps in EPA/600/4-90/027F, August 1993 and by use of Toxstat version 3.4.

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RESULTS:

THE Ceriodaphnia MORTALITY RESULTS - There was significant mortality observed of the freshwater invertebrate, Ceriodaphnia dubia, during the 48 hour exposure period to the 700 ug/L effluent concentrations. There was no significant mortality in the synthetic control. The LC50 value of the sample to Ceriodaphnia is approximately 265.1 ug/l.

Ceriodaphnia MORTALITY DATA

 # ALIVE

CONC.	REP #	0 HOURS	24 HOURS	48 HOURS	% MORT.
SYNTHETIC	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
10	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
25	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
35	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
50	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
75	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
100	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
150	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
250	1	5	4	3	40
"	2	5	5	4	20
"	3	5	5	3	40
"	4	5	4	2	60

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CONC.	REP #	O HOURS	24 HOURS	48 HOURS	% MORT.
400	1	5	0	0	100
"	2	5	0	0	100
"	3	5	0	0	100
"	4	5	0	0	100
700	1	5	0	0	100
"	2	5	0	0	100
"	3	5	0	0	100
"	4	5	0	0	100

AVG. MORTALITY (700ug/l sample) =100%

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WATER CHEMISTRY RESULTS:

Total residual chlorine (Cl2) - The sample from the Geosyntec WE-26212 had <0.1 mg/l detectable level of total residual chlorine upon receipt in the laboratory.

Dissolved Oxygen (D.O.) - Dissolved oxygen reading of the 700 ug/L sample was 8.20 mg/l after being raised to the test temperature of 25° C. At termination D.O. was 7.80 mg/l in the 700 ug/L sample, which falls into acceptable limits. Aeration was not required in this test.

pH - The pH of the 700 ug/L sample was 7.89 upon receipt in the laboratory and the synthetic control had a 7.61. At termination the pH measurement in the 700 ug/L sample was 8.59.

Conductance - The conductance of the 700 ug/L sample was 1465 umhos and the synthetic control was 300 umhos.

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INITIAL WATER QUALITY:

Initial Measurements Synthetic Water

pH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
7.61	8.40	300	<0.2	<0.1	25	94	60

Initial Measurements 10

PH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
7.82	8.10	1403	N/A	<0.1	25	198	228

Initial Measurements 700

PH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
7.89	8.20	1465	N/A	<0.1	25	224	222

TEST WATER QUALITY:

24-hour Water Quality Measurements

CONC	PH	D.O. (mg/l)	TEMP (C)	COND. (umhos)
Synthetic	7.87	7.80	25	441
10	8.54	8.10	25	1525
25	8.54	8.10	25	1540
35	8.53	8.10	25	1543
50	8.53	8.10	25	1545
75	8.53	8.10	25	1545
100	8.53	8.20	25	1546
150	8.53	8.20	25	1546
250	8.53	8.20	25	1548
400	8.52	8.20	25	1549
700	8.52	8.20	25	1549

48-hour Water Quality Measurements

CONC	PH	D.O. (mg/l)	TEMP (C)	COND. (umhos)
Synthetic	7.63	7.60	25	460
10	8.45	7.70	25	1395
25	8.50	7.70	25	1470
35	8.54	7.70	25	1510
50	8.56	7.70	25	1525
75	8.57	7.80	25	1525
100	8.57	7.80	25	1538
150	8.58	7.80	25	1540
250	8.59	7.80	25	1580
400	8.59	7.80	25	1580
700	8.59	7.80	25	1583

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QUALITY ASSURANCE:

The absence of control mortality during this test indicated the health of the organisms and indicated that any significant mortality in the test concentrations is not due to contaminants or variations in test conditions. Reference toxicity tests are routinely performed by staff members of our Toxicology Department.

REFERENCE TOXICANT (NaCl)
Ceriodaphnia
 # OF LIVE ORGANISMS

CONC OF TOXICANT	TEST INITIATION	24 HOUR EXPOSURE	48 HOUR EXPOSURE
3.0 g/l	20	1	0
2.5 g/l	20	14	9
2.0 g/l	20	19	19
1.5 g/l	20	20	20
1.0 g/l	20	20	20

LC50 = 2.45 g/l NaCl

REFERENCE TOXICANT (NaCl)
Pimephales
 # OF LIVE ORGANISMS

CONC OF TOXICANT	TEST INITIATION	24 HOUR EXPOSURE	48 HOUR EXPOSURE
10.0 g/l	40	9	0
8.0 g/l	40	31	26
6.0 g/l	40	39	38
4.0 g/l	40	40	40
2.0 g/l	40	40	40

LC50 = 8.32 g/l NaCl

Submitted By: Tim Harrell
Timothy Harrell
Technical Director

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SPECIES TYPE	TEST CHEMICAL	SOLVENT	DATE
Dubia	Geo WE-26212		9/24/12

CONC.	NUMBER EXPOSED	NUMBER DEAD	PERCENT DEAD	BINOMIAL PROB. (PERCENT)
700	20	20	100	LESS THAN 0.001
400	20	20	100	LESS THAN 0.001
250	20	8	40	25.17222
150	20	0	0	LESS THAN 0.001
100	20	0	0	LESS THAN 0.001
75	20	0	0	LESS THAN 0.001
50	20	0	0	LESS THAN 0.001
35	20	0	0	LESS THAN 0.001
25	20	0	0	LESS THAN 0.001
10	20	0	0	LESS THAN 0.001

THE BINOMIAL TEST SHOWS THAT 150 AND 400 CAN BE USED AS STATISTICALLY SOUND CONSERVATIVE 95 PERCENT CONFIDENCE LIMITS BECAUSE THE ACTUAL CONFIDENCE LEVEL ASSOCIATED WITH THESE LIMITS IS GREATER THAN 95 PERCENT

AN APPROXIMATE LC50 OF 265.0501 IS OBTAINED BY NONLINEAR INTERPOLATION BETWEEN 250 AND 400

WHEN THERE ARE LESS THAN TWO CONCENTRATIONS AT WHICH THE PERCENT DEAD IS BETWEEN 0 AND 100, NEITHER THE MOVING AVERAGE METHOD NOR THE PROBIT METHOD CAN GIVE ANY STATISTICALLY SOUND RESULTS!

COMPARE RESULTS WITH ORIGINAL DATA TO SEE IF THEY ARE REASONABLE.

Geosyntec consultants

Geosyntec Consultants
1123 Wilkes Blvd., Ste. 400
Columbia, MO 65201
Phone: (573)443-4100 Fax: (573)443-4140

FIELD SHEET AND CHAIN OF CUSTODY RECORDS

Project Name: CITY OF MONETT METALS INVESTIGATION

Number of Samples: 14

Number of Containers: 14

Collector's Name and Affiliation (Please Print): Cody Luebbering GEOSYNTEC CONSULTANTS

Sample Number	Site Name / Sample Location	Collected Date	Collected Time	BOD5	COD	TN	TSS	VSS	NO_2+NO_3	NH3-N	TP	SRP	Cl	Acute WET Test *Ceriodaphnia dubia*	Comp	Grab	Comments
WE-26212 -10	Monett Effluent	9/18/2012	1120											X			
WE- 26212 -25	Monett Effluent	9/18/2012												X			
WE- 26212 -35	Monett Effluent	9/18/2012												X			
WE- 26212 -50	Monett Effluent	9/18/2012												X			
WE- 26212 -75	Monett Effluent	9/18/2012												X			
WE- 26212 -100	Monett Effluent	9/18/2012												X			
WE- 26212 -150	Monett Effluent	9/18/2012												X			
WE- 26212 -250	Monett Effluent	9/18/2012												X			
WE- 26212 -400	Monett Effluent	9/18/2012												X			
WE- 26212 -700	Monett Effluent	9/18/2012												X			
WC- 26212 -0	Culture Water	9/18/2012	1430											X			
WR- 26212 -0	Reconstituted Water	9/18/2012												X			
WR- 26212 -10	Reconstituted Water	9/18/2012												X			
WR- 26212 -25	Reconstituted Water	9/18/2012												X			

CHAIN OF CUSTODY RECORD

Relinquished By:	Received By:	Date/Time	IF SHIPPED	DELIVERED Date	DELIVERED Time	PICKED UP Date	PICKED UP Time
Cody Luebbering ☐ Sealed ☐ Shipped	Jason Howell ☐ Sealed	9/18/12 1630	Carrier				
☐ Sealed ☐ Shipped	☐ Sealed		Carrier				
☐ Sealed ☐ Shipped	☐ Sealed		Carrier				
☐ Sealed ☐ Shipped	☐ Sealed		Carrier				

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September 24, 2012

Randy Crawford
Geosyntec
1123 Wilkes Blvd. Ste. 400
Columbia, MO 65201

Re: Lab Project Number: 60129565-020
Client Project ID: Wet Test

Dear:

Enclosed are the analytical results for sample(s) received by the laboratory. The results relate only to the samples included in this report. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report.

If you have any question concerning this report, please feel free to contact me.

Sincerely,

Tim Harrell
Tim.Harrell@pacelabs.com
Technical Director

Kansas/ NELAP Certification Number E-10116
Utah Certification Number 9135995665
Texas Certification Number T104704407-08-TX
Oklahoma Certification Number 9205/9935
Louisiana Certification Number 03055
Arkansas Certification Number 05-008-0

Enclosures

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Pace Analytical Services, Inc.

808 West McKay, Frontenac, KS 66763

LABORATORY REPORT:

CLIENT: Randy Crawford Geosyntec 1123 Wilkes Blvd. Ste. 400 Columbia, MO 65201 573-443-4100	**Date Reported:** 9-24-12 **Date Initiated:** 9-18-12 **Time Used:** 17:00 **Date Terminated:** 9-20-12

BIOMONITORING STUDY

ACUTE TOXICITY

FINDING AND CONCLUSIONS:

Acute toxicity testing was performed on duplicate samples of the Geosyntec WR-26212 solution. **Acute toxicity**, as defined by significant mortality for at least one of two aquatic test species during a 48 hour period of exposure, only Ceriodaphnia was used in this testing. **The LC50 for the Ceriodaphnia was 11.2 ug/L.** The test species utilized in this test were the water flea, Ceriodaphnia dubia. Detailed results of the toxicity testing are provided in the Acute Toxicity Reports. In addition to the acute toxicity testing, water temperature, pH, dissolved oxygen, total hardness, total alkalinity, conductivity, and chlorine determinations were performed on the sample and control samples.

SAMPLING PROCEDURES:

Geosyntec personnel collected a sample and modified it at Pace Analytical.

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INTRODUCTION:

The purpose of this test was to determine the acute toxicity of the Geosyntec WR-26212 sample on the freshwater invertebrate, Ceriodaphnia dubia. This test was conducted at Pace Analytical Services, Inc., Frontenac, KS.

TEST ORGANISMS:

Ceriodaphnia dubia - The genetic stock of Ceriodaphnia dubia used in this acute toxicity Test were originally obtained from a private breeder. Ceriodaphnia are cultured in house at Pace Analytical Services, Inc. Culture methods of Ceriodaphnia were obtained from EPA821-C-02-006 November 2002.

MATERIALS AND METHODS:

Procedures used in the acute toxicity tests are described in Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms (USEPA, 2002).

Geosyntec personnel collected the sample tested and modified it calling it Geosyntec WR-26212 sample. Testing was performed using a 250 ug/L sample, a series of dilution, and a synthetic control. **The toxicity test was initiated within 36 hours of sample collection.**

Sample and synthetic control test solutions were not aerated during the testing period.

Ceriodaphnia *ACUTE METHODS:*

This static test was ran using 40 ml glass vials containing 25 ml of test solution. Food was administered before the test. Five Ceriodaphnia neonates (<24 hr old) were randomly selected and placed in each of 4 replicates of test solution. A total of 20 organisms per concentration were tested. Observations of mortality were made at 24 and 48 hours of exposure.

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WATER QUALITY METHODS:

Prior to test initiation, temperature, dissolved oxygen, pH, total alkalinity, total hardness, and total residual chlorine were measured in the effluent and in the controls. At 24 and 48 hours of exposure, temperature, dissolved oxygen, pH, and conductance were measured in the sample and the controls.

DATA ANALYSIS:

Statistically significant ($p<0.05$) mortality is determined by Dunnet's procedure using average percent survival of each test concentration versus the average survival of the controls. If significant mortality occurs, median lethal concentrations (LC50) are calculated using effluent concentrations and their corresponding percent mortality data. The LC50's and the 95% confidence intervals are calculated where appropriate by the Spearman-Karber method. Statistical analysis is accomplished by following steps in EPA/600/4-90/027F, August 1993 and by use of Toxstat version 3.4.

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RESULTS:

THE Ceriodaphnia MORTALITY RESULTS - There was significant mortality observed of the freshwater invertebrate, Ceriodaphnia dubia, during the 48 hour exposure period to the 250 ug/L effluent concentrations. There was no significant mortality in the synthetic control. The LC50 value of the sample to Ceriodaphnia is approximately 11.2 ug/l.

Ceriodaphnia MORTALITY DATA

 # ALIVE

CONC.	REP #	O HOURS	24 HOURS	48 HOURS	% MORT.
SYNTHETIC	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
WC-0	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
WR-0	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
10	1	5	5	4	20
"	2	5	5	3	40
"	3	5	4	3	40
"	4	5	4	2	60
25	1	5	5	0	100
"	2	5	4	0	100
"	3	5	3	0	100
"	4	5	3	0	100
35	1	5	3	0	100
"	2	5	2	0	100
"	3	5	1	0	100
"	4	5	2	0	100
50	1	5	1	0	100
"	2	5	2	0	100
"	3	5	0	0	100
"	4	5	1	0	100
100	1	5	0	0	100
"	2	5	0	0	100
"	3	5	0	0	100
"	4	5	0	0	100
150	1	5	0	0	100
"	2	5	0	0	100
"	3	5	0	0	100
"	4	5	0	0	100

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CONC.	REP #	O HOURS	24 HOURS	48 HOURS	% MORT.
250	1	5	0	0	100
"	2	5	0	0	100
"	3	5	0	0	100
"	4	5	0	0	100

AVG. MORTALITY (250 ug/l sample) =100%

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WATER CHEMISTRY RESULTS:

Total residual chlorine (Cl2) - The sample from the Geosyntec WR-26212 had <0.1 mg/l detectable level of total residual chlorine upon receipt in the laboratory.

Dissolved Oxygen (D.O.) - Dissolved oxygen reading of the 250 ug/L sample was 8.40 mg/l after being raised to the test temperature of 25° C. At termination D.O. was 8.00 mg/l in the 250 ug/L sample, which falls into acceptable limits. Aeration was not required in this test.

pH - The pH of the 250 ug/L sample was 7.89 upon receipt in the laboratory and the synthetic control had a 7.61. At termination the pH measurement in the 250 ug/L sample was 8.13.

Conductance - The conductance of the 250 ug/L sample was 486 umhos and the synthetic control was 300 umhos.

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INITIAL WATER QUALITY:

Initial Measurements Synthetic Water

pH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
7.61	8.40	300	<0.2	<0.1	25	94	60

Initial Measurements WC-0

PH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
7.95	8.50	330	N/A	<0.1	25	96	66

Initial Measurements WR-0

PH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
7.88	8.40	483	N/A	<0.1	25	190	58

Initial Measurements 250

PH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
7.89	8.40	486	N/A	<0.1	25	186	60

TEST WATER QUALITY:

24-hour Water Quality Measurements

CONC	PH	D.O. (mg/l)	TEMP (C)	COND. (umhos)
Synthetic	7.87	7.80	25	441
WC-0	8.22	8.00	25	404
WR-0	8.12	8.20	25	481
10	8.12	8.20	25	480
25	8.12	8.20	25	480
35	8.12	8.30	25	480
50	8.12	8.30	25	479
100	8.13	8.30	25	479
150	8.13	8.30	25	479
250	8.13	8.30	25	477

48-hour Water Quality Measurements

CONC	PH	D.O. (mg/l)	TEMP (C)	COND. (umhos)
Synthetic	7.63	7.60	25	460
WC-0	8.28	7.80	25	425
WR-0	8.20	7.90	25	506
10	8.18	7.90	25	507
25	8.18	7.90	25	507
35	8.18	7.90	25	507
50	8.17	7.90	25	508
100	8.17	8.00	25	508
150	8.15	8.00	25	507
250	8.13	8.00	25	509

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Pace Analytical Services, Inc.
9608 Loiret Blvd.
Lenexa, KS 66219
Phone: 913.599.5665
Fax: 913.599.1759

QUALITY ASSURANCE:

The absence of control mortality during this test indicated the health of the organisms and indicated that any significant mortality in the test concentrations is not due to contaminants or variations in test conditions. Reference toxicity tests are routinely performed by staff members of our Toxicology Department.

REFERENCE TOXICANT (NaCl)
Ceriodaphnia
OF LIVE ORGANISMS

CONC OF TOXICANT	TEST INITIATION	24 HOUR EXPOSURE	48 HOUR EXPOSURE
3.0 g/l	20	1	0
2.5 g/l	20	14	9
2.0 g/l	20	19	19
1.5 g/l	20	20	20
1.0 g/l	20	20	20

LC50 = 2.45 g/l NaCl

REFERENCE TOXICANT (NaCl)
Pimephales
OF LIVE ORGANISMS

CONC OF TOXICANT	TEST INITIATION	24 HOUR EXPOSURE	48 HOUR EXPOSURE
10.0 g/l	40	9	0
8.0 g/l	40	31	26
6.0 g/l	40	39	38
4.0 g/l	40	40	40
2.0 g/l	40	40	40

LC50 = 8.32 g/l NaCl

Submitted By: Tim Harrell
Timothy Harrell
Technical Director

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SPECIES TYPE	TEST CHEMICAL	SOLVENT	DATE
Dubia	Geo WR-26212		9/24/12

CONC.	NUMBER EXPOSED	NUMBER DEAD	PERCENT DEAD	BINOMIAL PROB.(PERCENT)
250	20	20	100	LESS THAN 0.001
150	20	20	100	LESS THAN 0.001
100	20	20	100	LESS THAN 0.001
75	20	20	100	LESS THAN 0.001
50	20	20	100	LESS THAN 0.001
35	20	20	100	LESS THAN 0.001
25	20	20	100	LESS THAN 0.001
10	20	8	40	25.17222

AT A CONFIDENCE LEVEL OF 95 PERCENT, THE BINOMIAL TEST
SHOWS THAT THE LC50 IS ABOVE 25

THE USEFULNESS OF ANY LC50 CALCULATED FROM THIS SET OF DATA
IS QUESTIONABLE BECAUSE A CONCENTRATION-EFFECT RELATIONSHIP
HAS NOT BEEN DEMONSTRATED OVER A REASONABLE RANGE (e.g.
<37 TO>63 OF PERCENT DEAD

AN APPROXIMATE LC50 OF 11.20714 IS OBTAINED BY
NONLINEAR INTERPOLATION BETWEEN 10 AND 25

WHEN THERE ARE LESS THAN TWO CONCENTRATIONS AT WHICH THE
PERCENT DEAD IS BETWEEN 0 AND 100, NEITHER THE MOVING
AVERAGE METHOD NOR THE PROBIT METHOD CAN GIVE ANY
STATISTICALLY SOUND RESULTS!

COMPARE RESULTS WITH ORIGINAL DATA TO SEE IF THEY ARE
REASONABLE.

Geosyntec consultants

Geosyntec Consultants
1123 Wilkes Blvd., Ste. 400
Columbia, MO 65201
Phone: (573)443-4100 Fax: (573)443-4140

FIELD SHEET AND CHAIN OF CUSTODY RECORDS

Project Name: CITY OF MONETT METALS INVESTIGATION

Number of Samples: 6

Collector's Name and Affiliation (Please Print): Cody Lubbering — GEOSYNTEC CONSULTANTS

Number of Containers: 6

Sample Number	Site Name / Sample Location	Collected Date	Collected Time	BOD5	COD	TN	TSS	VSS	NO_2+NO_3	NH3-N	TP	SRP	Cl	Acute WET Test *Ceriodaphnia dubia*	Comp	Grab	Comments
WR- 26212 -35	Reconstituted Water	9/18/2012	1430											X			
WR- 26212 -50	Reconstituted Water	9/18/2012												X			
WR- 26212 -75	Reconstituted Water	9/18/2012												X			
WR- 26212 -100	Reconstituted Water	9/18/2012												X			
WR- 26212 -150	Reconstituted Water	9/18/2012												X			
WR- 26212 -250	Reconstituted Water	9/18/2012												X			

CHAIN OF CUSTODY RECORD			IF SHIPPED	DELIVERED		PICKED UP	
Relinquished By:	Received By:	Date/Time		Date	Time	Date	Time
☐ Sealed ☐ Shipped	☐ Sealed	9/18/12 1650	Carrier				
☐ Sealed ☐ Shipped	☐ Sealed		Carrier				

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November 06, 2012

Randy Crawford
Geosyntec Consultants
1123 Wilkes Blvd., Suite 400
Columbia, MO 65201

RE: Project: CITY OF MONETT METALS INVESTIG
Pace Project No.: 60132196

Dear Randy Crawford:
Enclosed are the analytical results for sample(s) received by the laboratory on October 25, 2012. The results relate only to the samples included in this report. Results reported herein conform to the most current TNI standards and the laboratory's Quality Assurance Manual, where applicable, unless otherwise noted in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Sherri Rosenstangle

Sherri Rosenstangle

sherri.rosenstangle@pacelabs.com
Project Manager

Enclosures

cc: Cody Luebbering, Geosyntec Consultants

Pace Analytical Services, Inc.
9608 Loiret Blvd.
Lenexa, KS 66219
(913)599-5665

CERTIFICATIONS

Project: CITY OF MONETT METALS INVESTIG
Pace Project No.: 60132196

Kansas Certification IDs
9608 Loiret Boulevard, Lenexa, KS 66219
A2LA Certification #: 2456.01
Arkansas Certification #: 12-019-0
Illinois Certification #: 002885
Iowa Certification #: 118
Kansas/NELAP Certification #: E-10116
Louisiana Certification #: 03055
Nevada Certification #: KS000212008A
Oklahoma Certification #: 9205/9935
Texas Certification #: T104704407-12-3
Utah Certification #: KS000212012-2

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SAMPLE SUMMARY

Project: CITY OF MONETT METALS INVESTIG
Pace Project No.: 60132196

Lab ID	Sample ID	Matrix	Date Collected	Date Received
60132196001	**WE- 29712 -700**	Water	10/25/12 10:05	10/25/12 15:00
60132196002	**WR- 29712 -250**	Water	10/25/12 13:00	10/25/12 15:00

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SAMPLE ANALYTE COUNT

Project: CITY OF MONETT METALS INVESTIG
Pace Project No.: 60132196

Lab ID	Sample ID	Method	Analysts	Analytes Reported
60132196001	**WE- 29712 -700**	EPA 821/R-02/012	TDH	1
60132196002	**WR- 29712 -250**	EPA 821/R-02/012	TDH	1

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ANALYTICAL RESULTS

Project: CITY OF MONETT METALS INVESTIG
Pace Project No.: 60132196

Sample: WE- 29712 -700 **Lab ID: 60132196001** Collected: 10/25/12 10:05 Received: 10/25/12 15:00 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Acute Toxicity	Analytical Method: EPA 821/R-02/012							
Toxicity, Acute	**Complete**		1.0	1		10/27/12 15:00		

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ANALYTICAL RESULTS

Project: CITY OF MONETT METALS INVESTIG
Pace Project No.: 60132196

Sample: WR- 29712 -250 **Lab ID: 60132196002** Collected: 10/25/12 13:00 Received: 10/25/12 15:00 Matrix: Water

Parameters	Results	Units	Report Limit	DF	Prepared	Analyzed	CAS No.	Qual
Acute Toxicity	Analytical Method: EPA 821/R-02/012							
Toxicity, Acute	**Complete**		1.0	1		10/27/12 15:00		

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QUALIFIERS

Project: CITY OF MONETT METALS INVESTIG
Pace Project No.: 60132196

DEFINITIONS

DF - Dilution Factor, if reported, represents the factor applied to the reported data due to changes in sample preparation, dilution of the sample aliquot, or moisture content.

ND - Not Detected at or above adjusted reporting limit.

J - Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit.

MDL - Adjusted Method Detection Limit.

PRL - Pace Reporting Limit.

RL - Reporting Limit.

S - Surrogate

1,2-Diphenylhydrazine (8270 listed analyte) decomposes to Azobenzene.

Consistent with EPA guidelines, unrounded data are displayed and have been used to calculate % recovery and RPD values.

LCS(D) - Laboratory Control Sample (Duplicate)

MS(D) - Matrix Spike (Duplicate)

DUP - Sample Duplicate

RPD - Relative Percent Difference

NC - Not Calculable.

SG - Silica Gel - Clean-Up

U - Indicates the compound was analyzed for, but not detected.

N-Nitrosodiphenylamine decomposes and cannot be separated from Diphenylamine using Method 8270. The result reported for each analyte is a combined concentration.

Pace Analytical is TNI accredited. Contact your Pace PM for the current list of accredited analytes.

TNI - The NELAC Institute.

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QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: CITY OF MONETT METALS INVESTIG
Pace Project No.: 60132196

Lab ID	Sample ID	QC Batch Method	QC Batch	Analytical Method	Analytical Batch
60132196001	**WE- 29712 -700**	EPA 821/R-02/012	BIO/1575		
60132196002	**WR- 29712 -250**	EPA 821/R-02/012	BIO/1575		

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PACE # 60132196-001

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Fax: 913.599.1759

October 29, 2012

Randy Crawford
Geosyntec
1123 Wilkes Blvd. Ste. 400
Columbia, MO 65201

Re: Lab Project Number: 60132196-001
Client Project ID: Wet Test

Dear:

Enclosed are the analytical results for sample(s) received by the laboratory. The results relate only to the samples included in this report. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report.

If you have any question concerning this report, please feel free to contact me.

Sincerely,

Tim Harrell
Tim.Harrell@pacelabs.com
Technical Director

Kansas/ NELAP Certification Number E-10116
Utah Certification Number 9135995665
Texas Certification Number T104704407-08-TX
Oklahoma Certification Number 9205/9935
Louisiana Certification Number 03055
Arkansas Certification Number 05-008-0

Enclosures

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Pace Analytical Services, Inc.

808 West McKay, Frontenac, KS 66763

LABORATORY REPORT:

CLIENT: Randy Crawford Geosyntec 1123 Wilkes Blvd. Ste. 400 Columbia, MO 65201 573-443-4100	**Date Reported: 10-29-12** **Date Initiated: 10-25-12** **Time Used: 16:00** **Date Terminated: 10-27-12**

BIOMONITORING STUDY

ACUTE TOXICITY

FINDING AND CONCLUSIONS:

Acute toxicity testing was performed on duplicate samples of the Geosyntec WE-29712 solution. **Acute toxicity**, as defined by significant mortality for at least one of two aquatic test species during a 48 hour period of exposure, only Ceriodaphnia was used in this testing. **The LC50 for the Ceriodaphnia was 268.1 ug/L.** The test species utilized in this test were the water flea, Ceriodaphnia dubia. Detailed results of the toxicity testing are provided in the Acute Toxicity Reports. In addition to the acute toxicity testing, water temperature, pH, dissolved oxygen, total hardness, total alkalinity, conductivity, and chlorine determinations were performed on the sample and control samples.

SAMPLING PROCEDURES:

Geosyntec personnel collected a sample and modified it at Pace Analytical.

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INTRODUCTION:

The purpose of this test was to determine the acute toxicity of the Geosyntec WE-29712 sample on the freshwater invertebrate, Ceriodaphnia dubia. This test was conducted at Pace Analytical Services, Inc., Frontenac, KS.

TEST ORGANISMS:

Ceriodaphnia dubia - The genetic stock of Ceriodaphnia dubia used in this acute toxicity Test were originally obtained from a private breeder. Ceriodaphnia are cultured in house at Pace Analytical Services, Inc. Culture methods of Ceriodaphnia were obtained from EPA821-C-02-006 November 2002.

MATERIALS AND METHODS:

Procedures used in the acute toxicity tests are described in Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms (USEPA, 2002).

Geosyntec personnel collected the sample tested and modified it calling it Geosyntec WE-29712 sample. Testing was performed using a 700 ug/L sample, a series of dilution, and a synthetic control. **The toxicity test was initiated within 36 hours of sample collection.**

Sample and synthetic control test solutions were not aerated during the testing period.

Ceriodaphnia *ACUTE METHODS:*

This static test was ran using 40 ml glass vials containing 25 ml of test solution. Food was administered before the test. Five Ceriodaphnia neonates (<24 hr old) were randomly selected and placed in each of 4 replicates of test solution. A total of 20 organisms per concentration were tested. Observations of mortality were made at 24 and 48 hours of exposure.

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WATER QUALITY METHODS:

Prior to test initiation, temperature, dissolved oxygen, pH, total alkalinity, total hardness, and total residual chlorine were measured in the effluent and in the controls. At 24 and 48 hours of exposure, temperature, dissolved oxygen, pH, and conductance were measured in the sample and the controls.

DATA ANALYSIS:

Statistically significant ($p<0.05$) mortality is determined by Dunnet's procedure using average percent survival of each test concentration versus the average survival of the controls. If significant mortality occurs, median lethal concentrations (LC50) are calculated using effluent concentrations and their corresponding percent mortality data. The LC50's and the 95% confidence intervals are calculated where appropriate by the Spearman-Karber method. Statistical analysis is accomplished by following steps in EPA/600/4-90/027F, August 1993 and by use of Toxstat version 3.4.

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RESULTS:

THE Ceriodaphnia MORTALITY RESULTS - There was significant mortality observed of the freshwater invertebrate, Ceriodaphnia dubia, during the 48 hour exposure period to the 700 ug/L effluent concentrations. There was no significant mortality in the synthetic control. The LC50 value of the sample to Ceriodaphnia is approximately 368.1 ug/l.

Ceriodaphnia MORTALITY DATA

 # ALIVE

CONC.	REP #	O HOURS	24 HOURS	48 HOURS	% MORT.
SYNTHETIC	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
10	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
25	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
35	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
50	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
75	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
100	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
150	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
250	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0

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CONC.	REP #	O HOURS	24 HOURS	48 HOURS	% MORT.
400	1	5	3	1	80
"	2	5	2	2	60
"	3	5	3	3	40
"	4	5	3	1	80
700	1	5	0	0	100
"	2	5	0	0	100
"	3	5	0	0	100
"	4	5	0	0	100

AVG. MORTALITY (700ug/l sample) =100%

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WATER CHEMISTRY RESULTS:

Total residual chlorine (Cl2) - The sample from the Geosyntec WE-29712 had <0.1 mg/l detectable level of total residual chlorine upon receipt in the laboratory.

Dissolved Oxygen (D.O.) - Dissolved oxygen reading of the 700 ug/L sample was 8.40 mg/l after being raised to the test temperature of 25° C. At termination D.O. was 7.80 mg/l in the 700 ug/L sample, which falls into acceptable limits. Aeration was not required in this test.

pH - The pH of the 700 ug/L sample was 7.73 upon receipt in the laboratory and the synthetic control had a 7.69. At termination the pH measurement in the 700 ug/L sample was 8.59.

Conductance - The conductance of the 700 ug/L sample was 1363 umhos and the synthetic control was 335 umhos.

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INITIAL WATER QUALITY:

Initial Measurements Synthetic Water

pH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
7.69	8.60	335	<0.2	<0.1	25	104	58

Initial Measurements 10

PH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
7.74	8.40	1350	N/A	<0.1	25	186	208

Initial Measurements 700

PH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
7.73	8.40	1363	N/A	<0.1	25	180	210

TEST WATER QUALITY:

24-hour Water Quality Measurements

CONC	PH	D.O. (mg/l)	TEMP (C)	COND. (umhos)
Synthetic	7.92	8.10	25	350
10	8.42	8.30	25	1480
25	8.43	8.20	25	1510
35	8.46	8.20	25	1560
50	8.48	8.20	25	1562
75	8.48	8.20	25	1560
100	8.47	8.20	25	1565
150	8.47	8.10	25	1570
250	8.47	8.10	25	1570
400	8.48	8.10	25	1575
700	8.50	8.10	25	1590

48-hour Water Quality Measurements

CONC	PH	D.O. (mg/l)	TEMP (C)	COND. (umhos)
Synthetic	7.84	7.80	25	400
10	8.55	7.80	25	1560
25	8.55	7.80	25	1590
35	8.54	7.80	25	1605
50	8.53	7.80	25	1620
75	8.53	7.80	25	1640
100	8.54	7.80	25	1649
150	8.54	7.90	25	1652
250	8.53	7.80	25	1660
400	8.55	7.80	25	1660
700	8.59	7.80	25	1670

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QUALITY ASSURANCE:

The absence of control mortality during this test indicated the health of the organisms and indicated that any significant mortality in the test concentrations is not due to contaminants or variations in test conditions. Reference toxicity tests are routinely performed by staff members of our Toxicology Department.

REFERENCE TOXICANT (NaCl)
Ceriodaphnia
 # OF LIVE ORGANISMS

CONC OF TOXICANT	TEST INITIATION	24 HOUR EXPOSURE	48 HOUR EXPOSURE
3.0 g/l	20	2	0
2.5 g/l	20	16	9
2.0 g/l	20	20	20
1.5 g/l	20	20	20
1.0 g/l	20	20	20

LC50 = 2.46 g/l NaCl

REFERENCE TOXICANT (NaCl)
Pimephales
 # OF LIVE ORGANISMS

CONC OF TOXICANT	TEST INITIATION	24 HOUR EXPOSURE	48 HOUR EXPOSURE
10.0 g/l	40	12	0
8.0 g/l	40	35	27
6.0 g/l	40	39	39
4.0 g/l	40	40	40
2.0 g/l	40	40	39

LC50 = 8.36 g/l NaCl

Submitted By: Tim Harrell
Timothy Harrell
Technical Director

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SPECIES TYPE	TEST CHEMICAL	SOLVENT	DATE
Ceriodaphnia	Geo Syn WE2972		10/12

CONC.	NUMBER EXPOSED	NUMBER DEAD	PERCENT DEAD	BINOMIAL PROB. (PERCENT)
700	20	20	100	LESS THAN 0.001
400	20	13	65	LESS THAN 0.001
250	20	0	0	LESS THAN 0.001
150	20	0	0	LESS THAN 0.001
100	20	0	0	LESS THAN 0.001
75	20	0	0	LESS THAN 0.001
50	20	0	0	LESS THAN 0.001
35	20	0	0	LESS THAN 0.001
25	20	0	0	LESS THAN 0.001
10	20	0	0	LESS THAN 0.001

THE BINOMIAL TEST SHOWS THAT 250 AND 400 CAN BE USED AS STATISTICALLY SOUND CONSERVATIVE 95 PERCENT CONFIDENCE LIMITS BECAUSE THE ACTUAL CONFIDENCE LEVEL ASSOCIATED WITH THESE LIMITS IS GREATER THAN 95 PERCENT

AN APPROXIMATE LC50 OF 368.1045 IS OBTAINED BY NONLINEAR INTERPOLATION BETWEEN 250 AND 400

WHEN THERE ARE LESS THAN TWO CONCENTRATIONS AT WHICH THE PERCENT DEAD IS BETWEEN 0 AND 100, NEITHER THE MOVING AVERAGE METHOD NOR THE PROBIT METHOD CAN GIVE ANY STATISTICALLY SOUND RESULTS!

COMPARE RESULTS WITH ORIGINAL DATA TO SEE IF THEY ARE REASONABLE.

Geosyntec consultants

Geosyntec Consultants
1123 Wilkes Blvd., Ste. 400
Columbia, MO 65201
Phone: (573)443-4100 Fax: (573)443-4140

FIELD SHEET AND CHAIN OF CUSTODY RECORDS

Project Name: CITY OF MONETT METALS INVESTIGATION

Number of Samples: 14

Collector's Name and Affiliation (Please Print): Cody Luebbering — GEOSYNTEC CONSULTANTS

Number of Containers: 14

60132196

Sample Number	Site Name / Sample Location	Collected Date	Collected Time	BOD5	COD	TN	TSS	VSS	NO_2+NO_3	NH3-N	TP	SRP	Cl	Acute WET Test *Ceriodaphnia dubia*	Comp	Grab	Comments
WE-29712 -10	Monett Effluent	10/23/2012 CLS	1005											x			
WE- 29712 -25	Monett Effluent	10/23/2012 CLS	1005											x			
WE- 29712 -35	Monett Effluent	10/23/2012 CLS	1005											x			
WE- 29712 -50	Monett Effluent	10/23/2012 CLS	1005											x			
WE- 29712 -75	Monett Effluent	10/23/2012 CLS	1005											x			
WE- 29712 -100	Monett Effluent	10/23/2012 CLS	1005											x			
WE- 29712 -150	Monett Effluent	10/23/2012 CLS	1005											x			
WE- 29712 -250	Monett Effluent	10/23/2012 CLS	1005											x			
WE- 29712 -400	Monett Effluent	10/23/2012 CLS	1005											x			
WE- 29712 -700	Monett Effluent	10/23/2012 CLS	1005											x			001
WC- 29712 -0	Culture Water	10/23/2012 CLS	1300											x			
WR- 29712 -0	Reconstituted Water	10/23/2012 CLS	1300											x			
WR- 29712 -10	Reconstituted Water	10/23/2012 CLS	1300											x			
WR- 29712 -25	Reconstituted Water	10/23/2012 CLS	1300											x			

CHAIN OF CUSTODY RECORD

Relinquished By:	Received By:	Date/Time	IF SHIPPED	DELIVERED Date	DELIVERED Time	PICKED UP Date	PICKED UP Time
[signature] ☐ Sealed ☐ Shipped	[signature] ☐ Sealed	10/25/12 1500	Carrier				
☐ Sealed ☐ Shipped	☐ Sealed		Carrier				
☐ Sealed ☐ Shipped	☐ Sealed		Carrier				
☐ Sealed ☐ Shipped	☐ Sealed		Carrier				

Geosyntec consultants

Geosyntec Consultants
1123 Wilkes Blvd., Ste. 400
Columbia, MO 65201
Phone: (573)443-4100 Fax: (573)443-4140

FIELD SHEET AND CHAIN OF CUSTODY RECORDS

Project Name: CITY OF MONETT METALS INVESTIGATION

Number of Samples: 6

Collector's Name and Affiliation (Please Print): Cody Lubbering — GEOSYNTEC CONSULTANTS

Number of Containers: 6

Sample Number	Site Name / Sample Location	Collected Date	Collected Time	BOD5	COD	TN	TSS	VSS	NO_2+NO_3	NH3-N	TP	SRP	Cl	Acute WET Test *Ceriodaphnia dubia*	Comp	Grab	Comments
WR- 29712 -35	Reconstituted Water	10/23/2012 CLS	1300											X			
WR- 29712 -50	Reconstituted Water	10/23/2012 CLS	1300											X			
WR- 29712 -75	Reconstituted Water	10/23/2012 CLS	1300											X			
WR- 29712 -100	Reconstituted Water	10/23/2012 CLS	1300											X			
WR- 29712 -150	Reconstituted Water	10/23/2012 CLS	1300											X			
WR- 29712 -250	Reconstituted Water	10/23/2012 CLS	1300											X			002

CHAIN OF CUSTODY RECORD

Relinquished By:	Received By:	Date/Time	IF SHIPPED	DELIVERED Date	DELIVERED Time	PICKED UP Date	PICKED UP Time
Cody Lubbering ☐ Sealed ☐ Shipped	Jim Hewell ☐ Sealed	10/25/12 1500	Carrier				
☐ Sealed ☐ Shipped	☐ Sealed		Carrier				

WO#: 60132196

60132196

Sample Condition Upon Receipt

Client Name: Geosyntec

Courier: [ ] Fed Ex [ ] UPS [ ] USPS [X] Client [ ] Commercial [ ] Pace [ ] Other _____

Tracking #: _____ Pace Shipping Label Used? [ ] Yes [ ] No

Custody Seal on Cooler/Box Present: [ ] Yes [X] No Seals intact: [ ] Yes [X] No

Optional
Proj. Due Date:
Proj. Name:

Packing Material: Bubble Wrap [ ] Bubble Bags [ ] Foam [ ] None [X] Other _____

Thermometer Used: T-193 Type of Ice: Wet Blue None [ ] Samples on ice, cooling process has begun

Cooler Temperature: In house

Temperature should be above freezing to 6°C

Date and Initials of person examining contents: TH 10/25/12 15:00

		Comments:
Chain of Custody present	[X] Yes [ ] No [ ] N/A	1.
Chain of Custody filled out	[X] Yes [ ] No [ ] N/A	2.
Chain of Custody relinquished	[X] Yes [ ] No [ ] N/A	3.
Sampler name & signature on COC	[X] Yes [ ] No [ ] N/A	4.
Samples arrived within holding time	[X] Yes [ ] No [ ] N/A	5.
Short Hold Time analyses (<72hr):	[X] Yes [ ] No [ ] N/A	6.
Rush Turn Around Time requested:	[ ] Yes [X] No [ ] N/A	7.
Sufficient volume	[X] Yes [ ] No [ ] N/A	8.
Correct containers used	[X] Yes [ ] No [ ] N/A	9.
Pace containers used	[X] Yes [ ] No [ ] N/A	
Containers intact	[X] Yes [ ] No [ ] N/A	10.
Unpreserved 5035A soils frozen w/in 48hrs?	[ ] Yes [ ] No [X] N/A	11.
Filtered volume received for dissolved tests	[ ] Yes [X] No [ ] N/A	12.
Sample labels match COC	[X] Yes [ ] No [ ] N/A	13.
Includes date/time/ID/analyses Matrix:		
All containers needing preservation have been checked	[ ] Yes [ ] No [X] N/A	14.
All containers needing preservation are found to be in compliance with EPA recommendation	[ ] Yes [ ] No [X] N/A	
Exceptions: VOA, coliform, TOC, O&G, WI-DRO (water), phenols	[ ] Yes [ ] No	Initial when completed ____ Lot # of added preservative ____
Trip Blank present	[ ] Yes [ ] No [X] N/A	15.
Pace Trip Blank lot # (if purchased) ____		
Headspace in VOA vials (>6mm)	[ ] Yes [ ] No [X] N/A	16.
Project sampled in USDA Regulated Area	[ ] Yes [ ] No [X] N/A	17. List State ____

SAG

Client Notification/ Resolution: Copy COC to Client? (Y) / N Field Data Required? Y / (N)

Person Contacted _____ Date/Time _____

Comments/ Resolution _____

Project Manager Review: [signature] Date: 10.25.12

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DEHNR Certification Office (i.e. out of hold, incorrect preservative, out of temp, incorrect containers)

Pace Analytical Services, Inc.
9608 Loiret Blvd.
Lenexa, KS 66219
Phone: 913.599.5665
Fax: 913.599.1759

October 29, 2012

Randy Crawford
Geosyntec
1123 Wilkes Blvd. Ste. 400
Columbia, MO 65201

Re: Lab Project Number: 60132196-002
Client Project ID: Wet Test

Dear:

Enclosed are the analytical results for sample(s) received by the laboratory. The results relate only to the samples included in this report. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report.

If you have any question concerning this report, please feel free to contact me.

Sincerely,

Tim Harrell

Tim Harrell
Tim.Harrell@pacelabs.com
Technical Director

Kansas/ NELAP Certification Number E-10116
Utah Certification Number 9135995665
Texas Certification Number T104704407-08-TX
Oklahoma Certification Number 9205/9935
Louisiana Certification Number 03055
Arkansas Certification Number 05-008-0

Enclosures

REPORT OF LABORATORY ANALYSIS

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Pace Analytical Services, Inc.

808 West McKay, Frontenac, KS 66763

LABORATORY REPORT:

CLIENT: Randy Crawford Geosyntec 1123 Wilkes Blvd. Ste. 400 Columbia, MO 65201 573-443-4100	**Date Reported: 10-29-12** **Date Initiated: 10-25-12** **Time Used: 16:00** **Date Terminated: 10-27-12**

BIOMONITORING STUDY

ACUTE TOXICITY

FINDING AND CONCLUSIONS:

Acute toxicity testing was performed on duplicate samples of the Geosyntec WR-29712 solution. **Acute toxicity**, as defined by significant mortality for at least one of two aquatic test species during a 48 hour period of exposure, only Ceriodaphnia was used in this testing. **The LC50 for the Ceriodaphnia was 31.97 ug/L.** The test species utilized in this test were the water flea, Ceriodaphnia dubia. Detailed results of the toxicity testing are provided in the Acute Toxicity Reports. In addition to the acute toxicity testing, water temperature, pH, dissolved oxygen, total hardness, total alkalinity, conductivity, and chlorine determinations were performed on the sample and control samples.

SAMPLING PROCEDURES:

Geosyntec personnel collected a sample and modified it at Pace Analytical.

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INTRODUCTION:

The purpose of this test was to determine the acute toxicity of the Geosyntec WR-29712 sample on the freshwater invertebrate, Ceriodaphnia dubia. This test was conducted at Pace Analytical Services, Inc., Frontenac, KS.

TEST ORGANISMS:

Ceriodaphnia dubia - The genetic stock of Ceriodaphnia dubia used in this acute toxicity Test were originally obtained from a private breeder. Ceriodaphnia are cultured in house at Pace Analytical Services, Inc. Culture methods of Ceriodaphnia were obtained from EPA821-C-02-006 November 2002.

MATERIALS AND METHODS:

Procedures used in the acute toxicity tests are described in Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms (USEPA, 2002).

Geosyntec personnel collected the sample tested and modified it calling it Geosyntec WR-29712 sample. Testing was performed using a 250 ug/L sample, a series of dilution, and a synthetic control. **The toxicity test was initiated within 36 hours of sample collection.**

Sample and synthetic control test solutions were not aerated during the testing period.

Ceriodaphnia *ACUTE METHODS:*

This static test was ran using 40 ml glass vials containing 25 ml of test solution. Food was administered before the test. Five Ceriodaphnia neonates (<24 hr old) were randomly selected and placed in each of 4 replicates of test solution. A total of 20 organisms per concentration were tested. Observations of mortality were made at 24 and 48 hours of exposure.

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WATER QUALITY METHODS:

Prior to test initiation, temperature, dissolved oxygen, pH, total alkalinity, total hardness, and total residual chlorine were measured in the effluent and in the controls. At 24 and 48 hours of exposure, temperature, dissolved oxygen, pH, and conductance were measured in the sample and the controls.

DATA ANALYSIS:

Statistically significant ($p<0.05$) mortality is determined by Dunnet's procedure using average percent survival of each test concentration versus the average survival of the controls. If significant mortality occurs, median lethal concentrations (LC50) are calculated using effluent concentrations and their corresponding percent mortality data. The LC50's and the 95% confidence intervals are calculated where appropriate by the Spearman-Karber method. Statistical analysis is accomplished by following steps in EPA/600/4-90/027F, August 1993 and by use of Toxstat version 3.4.

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RESULTS:

THE Ceriodaphnia MORTALITY RESULTS - There was significant mortality observed of the freshwater invertebrate, Ceriodaphnia dubia, during the 48 hour exposure period to the 250 ug/L effluent concentrations. There was no significant mortality in the synthetic control. The LC50 value of the sample to Ceriodaphnia is approximately 31.97 ug/l.

Ceriodaphnia MORTALITY DATA

 # ALIVE

CONC.	REP #	O HOURS	24 HOURS	48 HOURS	% MORT.
SYNTHETIC	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
WC-0	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
WR-0	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
10	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
25	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
35	1	5	2	1	80
"	2	5	2	1	80
"	3	5	2	1	80
"	4	5	4	2	60
50	1	5	0	0	100
"	2	5	0	0	100
"	3	5	0	0	100
"	4	5	0	0	100
100	1	5	0	0	100
"	2	5	0	0	100
"	3	5	0	0	100
"	4	5	0	0	100
150	1	5	0	0	100
"	2	5	0	0	100
"	3	5	0	0	100
"	4	5	0	0	100

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CONC.	REP #	O HOURS	24 HOURS	48 HOURS	% MORT.
250	1	5	0	0	100
"	2	5	0	0	100
"	3	5	0	0	100
"	4	5	0	0	100

AVG. MORTALITY (250 ug/l sample) =100%

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WATER CHEMISTRY RESULTS:

Total residual chlorine (Cl2) - The sample from the Geosyntec WR-29712 had <0.1 mg/l detectable level of total residual chlorine upon receipt in the laboratory.

Dissolved Oxygen (D.O.) - Dissolved oxygen reading of the 250 ug/L sample was 8.80 mg/l after being raised to the test temperature of 25° C. At termination D.O. was 8.00 mg/l in the 250 ug/L sample, which falls into acceptable limits. Aeration was not required in this test.

pH - The pH of the 250 ug/L sample was 7.49 upon receipt in the laboratory and the synthetic control had a 7.69. At termination the pH measurement in the 250 ug/L sample was 8.19.

Conductance - The conductance of the 250 ug/L sample was 475 umhos and the synthetic control was 335 umhos.

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INITIAL WATER QUALITY:

Initial Measurements Synthetic Water

pH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
7.69	8.60	335	<0.2	<0.1	25	104	58

Initial Measurements WC-0

PH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
7.32	8.80	335	N/A	<0.1	25	98	60

Initial Measurements WR-0

PH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
7.45	8.80	460	N/A	<0.1	25	178	60

Initial Measurements 250

PH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
7.49	8.80	475	N/A	<0.1	25	200	64

TEST WATER QUALITY:

24-hour Water Quality Measurements

CONC	PH	D.O. (mg/l)	TEMP (C)	COND. (umhos)
Synthetic	7.92	8.10	25	350
WC-0	8.14	8.10	25	395
WR-0	8.13	8.10	25	535
10	8.13	8.10	25	528
25	8.12	8.10	25	529
35	8.11	8.10	25	529
50	8.13	8.10	25	530
75	8.13	8.10	25	530
100	8.12	8.10	25	530
150	8.12	8.10	25	535
250	8.13	8.10	25	550

48-hour Water Quality Measurements

CONC	PH	D.O. (mg/l)	TEMP (C)	COND. (umhos)
Synthetic	7.84	7.80	25	400
WC-0	8.19	7.70	25	465
WR-0	8.25	7.70	25	618
10	8.21	7.70	25	629
25	8.20	7.70	25	638
35	8.19	7.70	25	645
50	8.19	7.70	25	650
75	8.20	7.70	25	665
100	8.20	7.70	25	685
150	8.19	7.60	25	692
250	8.19	7.60	25	700

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QUALITY ASSURANCE:

The absence of control mortality during this test indicated the health of the organisms and indicated that any significant mortality in the test concentrations is not due to contaminants or variations in test conditions. Reference toxicity tests are routinely performed by staff members of our Toxicology Department.

REFERENCE TOXICANT (NaCl)
Ceriodaphnia
 # OF LIVE ORGANISMS

CONC OF TOXICANT	TEST INITIATION	24 HOUR EXPOSURE	48 HOUR EXPOSURE
3.0 g/l	20	2	0
2.5 g/l	20	16	9
2.0 g/l	20	20	20
1.5 g/l	20	20	20
1.0 g/l	20	20	20

LC50 = 2.46 g/l NaCl

REFERENCE TOXICANT (NaCl)
Pimephales
 # OF LIVE ORGANISMS

CONC OF TOXICANT	TEST INITIATION	24 HOUR EXPOSURE	48 HOUR EXPOSURE
10.0 g/l	40	12	0
8.0 g/l	40	35	27
6.0 g/l	40	39	39
4.0 g/l	40	40	40
2.0 g/l	40	40	39

LC50 = 8.36 g/l NaCl

Submitted By: Tim Harrell
Timothy Harrell
Technical Director

REPORT OF LABORATORY ANALYSIS

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SPECIES TYPE	TEST CHEMICAL	SOLVENT	DATE
Ceriodaphnia	Geo Syn WR29712		10/12

CONC.	NUMBER EXPOSED	NUMBER DEAD	PERCENT DEAD	BINOMIAL PROB. (PERCENT)
250	20	20	100	LESS THAN 0.001
150	20	20	100	LESS THAN 0.001
100	20	20	100	LESS THAN 0.001
75	20	20	100	LESS THAN 0.001
50	20	20	100	LESS THAN 0.001
35	20	15	75	LESS THAN 0.001
25	20	0	0	LESS THAN 0.001
10	20	0	0	LESS THAN 0.001

THE BINOMIAL TEST SHOWS THAT 25 AND 35 CAN BE USED AS STATISTICALLY SOUND CONSERVATIVE 95 PERCENT CONFIDENCE LIMITS BECAUSE THE ACTUAL CONFIDENCE LEVEL ASSOCIATED WITH THESE LIMITS IS GREATER THAN 95 PERCENT

AN APPROXIMATE LC50 OF 31.97112 IS OBTAINED BY NONLINEAR INTERPOLATION BETWEEN 25 AND 35

WHEN THERE ARE LESS THAN TWO CONCENTRATIONS AT WHICH THE PERCENT DEAD IS BETWEEN 0 AND 100, NEITHER THE MOVING AVERAGE METHOD NOR THE PROBIT METHOD CAN GIVE ANY STATISTICALLY SOUND RESULTS!

COMPARE RESULTS WITH ORIGINAL DATA TO SEE IF THEY ARE REASONABLE.

Geosyntec consultants

Geosyntec Consultants
1123 Wilkes Blvd., Ste. 400
Columbia, MO 65201
Phone: (573)443-4100 Fax: (573)443-4140

FIELD SHEET AND CHAIN OF CUSTODY RECORDS

Project Name: CITY OF MONETT METALS INVESTIGATION

Number of Samples: 14

Collector's Name and Affiliation (Please Print): Cody Luebbering — GEOSYNTEC CONSULTANTS

Number of Containers: 14

60132196

Sample Number	Site Name / Sample Location	Collected Date	Collected Time	BOD5	COD	TN	TSS	VSS	NO_2+NO_3	NH3-N	TP	SRP	Cl	Acute WET Test *Ceriodaphnia dubia*	Comp	Grab	Comments
WE-29712 -10	Monett Effluent	10/23/2012 CLS	1005											x			
WE- 29712 -25	Monett Effluent	10/23/2012 CLS	1005											x			
WE- 29712 -35	Monett Effluent	10/23/2012 CLS	1005											x			
WE- 29712 -50	Monett Effluent	10/23/2012 CLS	1005											x			
WE- 29712 -75	Monett Effluent	10/23/2012 CLS	1005											x			
WE- 29712 -100	Monett Effluent	10/23/2012 CLS	1005											x			
WE- 29712 -150	Monett Effluent	10/23/2012 CLS	1005											x			
WE- 29712 -250	Monett Effluent	10/23/2012 CLS	1005											x			
WE- 29712 -400	Monett Effluent	10/23/2012 CLS	1005											x			
WE- 29712 -700	Monett Effluent	10/23/2012 CLS	1005											x			001
WC- 29712 -0	Culture Water	10/23/2012 CLS	1300											x			
WR- 29712 -0	Reconstituted Water	10/23/2012 CLS	1300											x			
WR- 29712 -10	Reconstituted Water	10/23/2012 CLS	1300											x			
WR- 29712 -25	Reconstituted Water	10/23/2012 CLS	1300											x			

CHAIN OF CUSTODY RECORD

Relinquished By:	Received By:	Date/Time	IF SHIPPED	DELIVERED Date	DELIVERED Time	PICKED UP Date	PICKED UP Time
Cody Luebbering ☐ Sealed ☐ Shipped	Jim Howell ☐ Sealed	10/25/12 1500	Carrier				
☐ Sealed ☐ Shipped	☐ Sealed		Carrier				
☐ Sealed ☐ Shipped	☐ Sealed		Carrier				
☐ Sealed ☐ Shipped	☐ Sealed		Carrier				

Geosyntec consultants

Geosyntec Consultants
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Columbia, MO 65201
Phone: (573)443-4100 Fax: (573)443-4140

FIELD SHEET AND CHAIN OF CUSTODY RECORDS

Project Name: CITY OF MONETT METALS INVESTIGATION

Number of Samples: 6

Collector's Name and Affiliation (Please Print): Cody Luebbering — GEOSYNTEC CONSULTANTS

Number of Containers: 6

Sample Number	Site Name / Sample Location	Collected Date	Collected Time	BOD5	COD	TN	TSS	VSS	NO_2+NO_3	NH3-N	TP	SRP	Cl	Acute WET Test *Ceriodaphnia dubia*	Comp	Grab	Comments
WR- 29712 -35	Reconstituted Water	10/23/2012 CLS	1300											X			
WR- 29712 -50	Reconstituted Water	10/23/2012 CLS	1300											X			
WR- 29712 -75	Reconstituted Water	10/23/2012 CLS	1300											X			
WR- 29712 -100	Reconstituted Water	10/23/2012 CLS	1300											X			
WR- 29712 -150	Reconstituted Water	10/23/2012 CLS	1300											X			
WR- 29712 -250	Reconstituted Water	10/23/2012 CLS	1300											X			002

CHAIN OF CUSTODY RECORD			IF SHIPPED	DELIVERED		PICKED UP	
Relinquished By: Cody Luebbering ☐ Sealed ☐ Shipped	Received By: Jim Hewitt ☐ Sealed	Date/Time 10/23/12 1500	Carrier	Date	Time	Date	Time
☐ Sealed ☐ Shipped	☐ Sealed		Carrier				

WO#: 60132196

60132196

Sample Condition Upon Receipt

Client Name: Geosyntec

Courier: [ ] Fed Ex [ ] UPS [ ] USPS [X] Client [ ] Commercial [ ] Pace [ ] Other _____

Tracking #: _____ Pace Shipping Label Used? [ ] Yes [ ] No

Optional
Proj. Due Date:
Proj. Name:

Custody Seal on Cooler/Box Present: [ ] Yes [X] No Seals intact: [ ] Yes [X] No

Packing Material: [ ] Bubble Wrap [ ] Bubble Bags [ ] Foam [ ] None [X] Other _____

Thermometer Used: T-193 Type of Ice: Wet Blue None [ ] Samples on ice, cooling process has begun

Cooler Temperature: In house

Temperature should be above freezing to 6°C

Date and Initials of person examining contents: TH 10/25/12 15:00

		Comments:
Chain of Custody present	[X] Yes [ ] No [ ] N/A	1.
Chain of Custody filled out	[X] Yes [ ] No [ ] N/A	2.
Chain of Custody relinquished	[X] Yes [ ] No [ ] N/A	3.
Sampler name & signature on COC	[X] Yes [ ] No [ ] N/A	4.
Samples arrived within holding time	[X] Yes [ ] No [ ] N/A	5.
Short Hold Time analyses (<72hr):	[X] Yes [ ] No [ ] N/A	6.
Rush Turn Around Time requested:	[ ] Yes [X] No [ ] N/A	7.
Sufficient volume	[X] Yes [ ] No [ ] N/A	8.
Correct containers used	[X] Yes [ ] No [ ] N/A	9.
Pace containers used	[X] Yes [ ] No [ ] N/A	
Containers intact	[X] Yes [ ] No [ ] N/A	10.
Unpreserved 5035A soils frozen w/in 48hrs?	[ ] Yes [ ] No [X] N/A	11.
Filtered volume received for dissolved tests	[ ] Yes [X] No [ ] N/A	12.
Sample labels match COC	[X] Yes [ ] No [ ] N/A	13.
-Includes date/time/ID/analyses Matrix _____		
All containers needing preservation have been checked	[ ] Yes [ ] No [X] N/A	14.
All containers needing preservation are found to be in compliance with EPA recommendation	[ ] Yes [ ] No [X] N/A	
Exceptions: VOA, coliform, TOC, O&G, WI-DRO (water), phenolics	[ ] Yes [ ] No	Initial when completed _____ Lot # of added preservative _____
Trip Blank present	[ ] Yes [ ] No [X] N/A	15.
Pace Trip Blank lot # (if purchased) _____		
Headspace in VOA vials (>6mm)	[ ] Yes [ ] No [X] N/A	16.
Project sampled in USDA Regulated Area	[ ] Yes [ ] No [X] N/A	17. List State _____

SAG

Client Notification/ Resolution: Copy COC to Client? (Y) / N Field Data Required? Y / (N)

Person Contacted _____ Date/Time _____

Comments/ Resolution _____

Project Manager Review: JR Date: 10.29.12

Note: Whenever there is a discrepancy affecting North Carolina compliance samples, a copy of this form will be sent to the North Carolina DENR Certification Office (i.e. out of hold, incorrect preservative, out of temp, incorrect containers)

Appendix C. WATER EFFECT RATIO DATA AND INFORMATION (CONTINUED)

Water Effect Ration Reporting Requirements
(see Page 14 and 15 in Procedures)

Requirement	Response
Identity of the investigators	Section 1. Background
Identify of laboratories	Appendix C. WER Data and Information
Name, location, and description of the discharger	Section 1. Background
Description of receiving stream	Section 1. Background
Effluent flow	Section 1. Background
Receiving water flow	Section 3. Receiving Water Analyses
Prior meteorological conditions potentially effecting flow and water quality	Section 3.3 Streamlined Water Effect Ratio
Dilution ratio used in mixing effluent and upstream water to prepare site water	Not applicable
Downstream design hardness expected to be used for the permit derivation	Proposed Effluent Limit Modifications Table 4.1
Value of proposed site-specific criterion	Proposed Effluent Modifications Table 4.1
Identification of each sampling location	Section 3. Receiving Water Analyses
Procedures to obtain, transport, and store samples	Section 3.3 Streamlined Water Effect Ratio
Any pretreatment of the sample such as filtration of the site or laboratory dilution water	Section 3.3 Streamlined Water Effect Ratio
Description of laboratory dilution water including source and preparation	Appendix C. WER Data and Information
Results of all chemical and physical measurements on upstream, effluent, and simulated downstream water including hardness, alkalinity, pH, concentrations of total recoverable and dissolved metals, TSS, and DOC	Appendix C. WER Data and Information
Description of experimental design, test chambers, volume of solution in chambers, numbers of organisms and chambers per treatment. Source and grade of the copper salt, and how stock solution was prepared.	Appendix C. WER Data and Information
Species and source of the test organisms, age, and holding and acclimation procedures.	Appendix C. WER Data and Information
Average and range of the temperature, pH, hardness, alkalinity, and the concentration of dissolved oxygen during acclimation.	Appendix C. WER Data and Information

June 15, 2014

John Hoke, Chief
Watershed Protection Section
Water Protection Program
Department of Natural Resources
P.O. Box 176
Jefferson City, MO 65102-0176

Dear Mr. Hoke:

I appreciate the opportunity to submit comments on and suggestions for the next triennial review of Missouri water quality standards.

The department, in its "Public Notice of Intent to Initiate Review of Missouri Water Quality Standards" (NOI), has presented a number of topics for discussion and potential inclusion in the next triennial review package. While all have merit, several are particularly significant in bringing state WQS into compliance with Clean Water Act requirements and with federal guidance on pollutant criteria: nutrient criteria for lakes and streams, wetlands water quality criteria, bacteria criteria, ammonia criteria, sulfate and chloride criteria, and use attainability analysis protocols that actually embody and enforce the intent of the CWA to presume and protect fishable/swimmable uses. All of these should be included in the coming triennial review.

One topic, glaring by its absence, was not present in the NOI: the extension of fishable/swimmable uses designations and protections to all waters of the United States in Missouri. The state has been out of compliance with this most fundamental of CWA goals for over thirty years, yet the 2014 WQS rule added these uses to only a fraction of Missouri's waters, leaving a substantial majority of stream miles and lakes (and all of its wetlands) unprotected.[1] Even if EPA approves that quite limited extension of uses in its review of the 2014 rule, Missouri will still, for at least three more years, be out of compliance with the CWA.

I strongly suggest, therefore, that the department take up this issue in the coming triennial review and commit to bringing fishable/swimmable protections to all of the state's waters in the next rule. If the limited extension of uses in the 2014 rule was, as some have characterized it, a step toward default protections for all waters, let us take that step now. There is no need or basis for further delay. It would be unconscionable to subject children (and adults) who play in these waters, as well as the aquatic life that depends on them for their existence, to unprotected conditions for another six—or more—years.

Again, thank you for the opportunity to offer these brief comments.

Sincerely,
Dan Sherburne

---

[1] It is well-known by stream ecologists and aquatic biologists, and supported by numerous studies, that the streams shown on the USGS 1:100,000 map, on which the 2014 rule is based, and even the more detailed USGS 1:24,000 map, omit much of the stream length that can be verified on the ground. One particularly robust study (Roy et al 2009), done in the Midwest, found that the 1:100,000 map left out 85% of the length of sampled streams (all waters of the U.S.). See http://www.bioone.org/doi/full/10.1899/08-178.1

Hoke, John

From: Madras, John
Sent: Tuesday, June 24, 2014 5:39 PM
To: Hoke, John; Wieberg, Chris
Cc: Tippett Mosby, Leanne
Subject: AMCA input

Here is some material from Paul in support of the changes AMCA requests.

From: Calamita, Paul [mailto:paul@aqualaw.com]
Sent: Tuesday, June 24, 2014 3:12 PM
To: Madras, John
Subject:

John,

Good to talk with you today.

Regarding statewide variances, see the Wisconsin effort here: https://docs.legis.wisconsin.gov/2013/related/proposals/sb547

Also, here is a good summary about variances, including statewide variances (of which there have been many, especially for mercury, PCBs, etc) http://www.waterquality.utah.gov/WQS/docs/2012/09Sep/WQSMA_handout_Variance_statements_2012-03-09.pdf

We have done TN and TP and DO variances for the chesapeake bay, including a sexy sounding "restoration variance" for all dischargers to part of Maryland's Bay.

See the Duckett Creek comment below on the justification for returning the pH range criterion to "6 to 9".

Paul

Comment by Duckett Creek:
John,

Rick Higgins
Duckett Creek Sanitary District
636-441-1244

Comment to the current water quality standards

Regarding 10 CSR 20-7.031 sect. 5. (E) pH. Water contaminants shall not cause pH to be outside of the range of 6.5 to 9.0 standard pH units.

The 6.5 pH should be moved to 6.0. A complete reading of the technical basis for this rule (Red Book p. 373, and Gold Book p. 230) shows that a pH of 6.0 is “unlikely to be harmful to fish unless free carbon dioxide is present in excess of 100 ppm”. That carbon dioxide level is extremely unlikely and becomes less likely all of the time as WWTP’s fully nitrify, receive discharge oxygen requirements and many other advances in permitting. What does happen however, is that plants that discharge low ammonia levels by nitrifying tend to have lower discharge pH’s.

Also worth noting, we personally have measured stream background levels below 6.5 and even below 6.0. We have never measured plant discharge with CO_2's exceeding 100 ppm.

There is no federal requirement to regulate to the 6.5 to 9.0 range rather than the 6.0 to 9.0 range. Rather, this comes from Recommend Water Quality Standard, not from a promulgated rule.

Paul Calamita
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June 13th, 2014

Geotechnical
Environmental
Water Resources
Ecological

John Hoke
Missouri Department of Natural Resources
Watershed Protection Section
P.O. Box 176
Jefferson City, MO 65102

Re: Proposal to Support the State-wide Use of Biotic Ligand Model for Copper Aquatic Life Criteria in Missouri

Dear Mr. Hoke,

Thank you for the opportunity to provide these comments as part of the Missouri Department of Natural Resources (MDNR) triennial review of surface water quality standards on behalf of our client, the International Copper Association and Copper Development Association (ICA/CDA). ICA/CDA played a significant role in sponsoring scientific research used in development of the freshwater Biotic Ligand Model (BLM) for copper, which was adopted by the United States Environmental Protection Agency (USEPA) in its latest national ambient water quality criteria (USEPA 2007). ICA/CDA is now interested in encouraging efforts by states and tribes to incorporate these latest recommended USEPA national criteria for copper into their water quality standards programs. While Missouri currently allows use of the BLM to derive site-specific water quality standards, we recommend taking the next step to consider full state-wide implementation of BLM-based criteria without having to go through the expensive and time-consuming regulatory steps required to develop and approve a site-specific water quality criterion.

It is our understanding that the MDNR is currently conducting its Triennial Review of water quality standards and is accepting stakeholder comments until June 15, 2014. The purpose of this letter is to urge the MDNR to consider updating its state-wide aquatic life criteria for copper to use the BLM as currently recommended by USEPA.

While the BLM is a currently acceptable approach to deriving site-specific standards in Missouri, the current state-wide aquatic life criteria used to derive copper standards, like most states' criteria, still only take into account hardness as a factor that modifies toxicity. Therefore, we suggest MDNR consider using the BLM as the basis of their state-wide copper criteria, and not just use the BLM for site-specific criteria. Using only hardness as a modifying factor for metals criteria is an outdated approach that excludes a substantial body of peer-reviewed scientific literature demonstrating that additional modifying factors can and should be incorporated into regulatory benchmarks or standards, while providing the same levels of aquatic life protection required under the Clean Water Act (USEPA 1985,

GEI Consultants, Inc.
4601 DTC Boulevard, Suite 900, Denver, CO 80237
303.662.0100 fax: 303.662.8757

1994, 2001, 2007). Like most metals, copper toxicity is a function of its bioavailability, which in addition to being controlled by hardness, is also strongly related to other important factors such as dissolved organic carbon (DOC), alkalinity, pH, and temperature. The key strength of the BLM is that it accounts for multiple factors—in addition to hardness—that mitigate or exacerbate copper's toxic effect on aquatic life.

Utilizing the BLM only as per 10 CSR 20-7.031, Subsection (5)(S), requires that the regulated party to go through a hearing process in order to get state and EPA approval of a site-specific criterion. ICA/CDA suggests that it would instead be far simpler to allow any stakeholder with sufficient water quality data to use BLM-based copper criteria in development or revision of their NPDES permit rather than the existing hardness-based criteria. This approach is currently in place in South Carolina, and is currently under consideration by the Virginia Water Control Board. This option would eliminate the need for a rulemaking hearing each time the BLM is used to derive copper criteria, saving time and resources for both regulatory and regulated communities.

With respect to changes to CSR, we suggest the following additions:

- Add a new subsection (3) under 10 CSR 20-7.031, Subsection (5)(B)(6) that would state: A. Alternate Copper Criteria in Freshwater: The freshwater criteria for copper can also be calculated using the EPA 2007 Biotic Ligand Model. If an individual permittee wants to use the BLM to calculate criteria for copper applicable to the receiving stream, the permittee will be responsible for generating the needed data for the ten water parameters needed to run the BLM model. Without the needed data for these ten parameters, the current hardness-based criteria in Table A for copper will continue to be applicable."

- Add a new footnote to the acute and chronic copper aquatic life criteria entries in Table A – Criteria for Designated Uses under 10 CSR 20-7.031, Table A that would state: "Alternate Copper Criteria in Freshwater: The freshwater criteria for copper can also be calculated using the EPA 2007 Biotic Ligand Model. If an individual permittee wants to use the BLM to calculate criteria for copper applicable to the receiving stream, the permittee will be responsible for generating the needed data for the ten water parameters needed to run the BLM model. Without the needed data for these ten parameters, the current hardness-based criteria in Table A for copper will continue to be applicable."

Similar to copper, BLMs have been developed, validated, and are available for regulatory use for several other metals, including zinc, lead, nickel, and cadmium. While USEPA has yet to develop formal recommended national ambient water quality criteria using BLMs for these other metals, the models are widely available

and are being applied in regulatory programs in several European countries and Canada. ICA/CDA fully supports and shares their desire to move towards bioavailability models such as the BLM as being the current state of both scientific and regulatory practice.

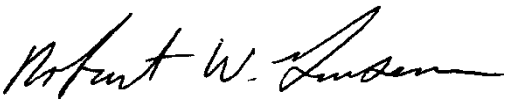
There also are practical advantages for using the BLM; it is a cost effective regulatory tool compared to other site-specific toxicity test procedures (e.g., water-effect ratios), and the BLM software is publicly available, sanctioned by USEPA, and requires only brief training to generate rapid and useable output. Therefore, BLM-based criteria provide a practical means of deriving demonstrably more accurate levels of aquatic life protection across a broad range of water quality conditions.

Please let us know if we can provide assistance regarding use of the BLM. GEI or ICA/CDA could help in a variety of ways, including providing thoughts or guidance on application of the BLM to water quality criteria, and how one might summarize surface water quality data to derive protective criteria using the BLM. ICA/CDA has also sponsored BLM training sessions over the past several years, and they have been well-attended by both regulators and the regulated community. If desired, it may be possible to provide this course or related education materials if you would find that helpful.

We appreciate the opportunity to provide you with these comments. Let us know if you have any questions. We look forward to discussing this with you further.

Sincerely,

GEI CONSULTANTS, INC.



Robert W. Gensemer, Ph.D.
Senior Ecotoxicologist

RWG

cc: Joe Gorsuch, CDA
Steven Canton, GEI
Stephanie Baker, GEI
David DeForest, Windward Environmental
Eric Van Genderen, International Zinc Association

References

U.S. Environmental Protection Agency (USEPA). 1985. Guidelines for deriving numerical national water quality criteria for the protection of the aquatic

organisms and their uses. PB85-227049, U.S. Environmental Protection Agency, Washington, DC.

U.S. Environmental Protection Agency (USEPA). 1994. Interim guidance on determination and use of water-effect ratios for metals. EPA-823-B-94-001, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency (USEPA). 2001. Streamlined water-effect ratio procedure for discharges of copper. EPA-822-R001-005, U.S. Environmental Protection Agency, Washington, D.C.

U.S. Environmental Protection Agency (USEPA). 2007. Aquatic Life Ambient Freshwater Quality Criteria – Copper. EPA-822-R-07-001. U.S. Environmental Protection Agency, Washington, D.C.

Missouri Stream Team Watershed Coalition
PO Box 575
Point Lookout, MO 65726-0575
Phone: 417-827-4864
www.mstwc.org

LINKING STREAM TEAMS FOR HEALTHY WATERSHEDS

May 29, 2014

Missouri Department of Natural Resources
P.O. Box 176
Jefferson City, MO 65102-0176

RE: Designation of Headwater Section of LaBarque Creek as an Outstanding State Resource Water

The Missouri Stream Team Watershed Coalition would like to request the 1.6 mile headwater section of LaBarque Creek that runs adjacent to the MDC LaBarque Conservation Area be designated as an Outstanding State Resource Water.

State agencies describe the creek as high quality and residents and visitors alike appreciate the watershed for its high aesthetic value. In addition, this waterway and its watershed are used for a variety of scientific research and has geological features that are unique to this region of the state.

According to the State of Missouri C.S.R. 20-7.031(8), Outstanding State Resource Water must meet the following criteria:
(A) Have a high level of aesthetic or scientific value:
(B) Have an undeveloped watershed; and
(C) Be located on or pass through lands which are state or federally owned, or which are leased or held in perpetual easement for conservation purposes by a state, federal, or private conservation agency or organization.

The LaBarque Creek watershed has a high level of aquatic and terrestrial biodiversity. The Missouri Department of Conservation has designated the LaBarque Creek watershed a Conservation Opportunity Area (COA) (http://mdc.mo.gov/sites/default/files/resources/2010/10/17990.pdf) and also an Aquatic COA. This designation notes that the area's underlying sandstone geology results in an unusual and dramatic landscape of deep canyons and ravines that contain several state-listed plants occurring in only a few other places in the state. Because of its unique features and proximity to the St. Louis Metro area, the department has also created the LaBarque Creek Watershed Land Stewardship Initiative to encourage further protection of this unique state resource (http://mdc.mo.gov/sites/default/files/resources/2010/10/17990.pdf).

In addition, the LaBarque Creek and its watershed is currently the site for several research projects. The watershed has provided a valuable resource for Dr. Brian Allan, Department of Entomology at University of Illinois who studies the ecology of tick-borne diseases in the Saint Louis, MO, metropolitan area. As one of the largest contiguous tracts of natural habitat in the St. Louis region, the watershed provides a potential "baseline" of tick-borne disease risk to compare to areas experiencing more intensive human development. Further, the study of the watershed in this context over time will also provide the opportunity to understand what may be the public health consequences of development within the watershed. Therefore, the watershed provides an essential scientific resource for studies of this nature in the St. Louis, MO, region.

Dr. Jason Knouff at St. Louis University utilizes LaBarque Creek for research related to fish biodiversity and distributions as it relates to habitat diversity, and has received a career award from the National Science Foundation. Recent publications include:

Michel, M. J. and Knouft, J. H. 2014. Spatial structure and the temporal transferability of trait-environment relationships. Landscape Ecology 29:467-477.

Michel, M. J. and Knouft J. H. 2012. Niche variability and its consequences for species distribution modeling. PLoS ONE 7:e44932.

Knouft, J. H., Caruso, N. M., Dupre, P. J., Anderson, K. A., Trumbo, D. R., and Puccinelli, J. 2011. Using fine-scale GIS data to assess the relationship between intra-annual environmental niche variability and population density in a local stream fish assemblage. Methods in Ecology and Evolution 2:303-311.

Other research within the watershed include: Dr. Tiffany Knight of Washington University and Dr. Jean Burns of the University of California at Davis investigated pollination ecology of native and invasive plants and John Stanton Geddes of University of Vermont studied the plant Chamaecrista fasiculata and its reproductive behavior.

According to the Watershed Conservation Plan developed for the area, of the 8,365 acres in the watershed, over 86% is forested and the watershed contained approximately 1,300 residents in 2000. The population is concentrated on only 20% of the watershed land with impervious surfaces estimated at four percent of the watershed.

Furthermore, a significant amount of land within the watershed is set aside for public and institutional lands. The Young Conservation Area (CA) and the LaBarque Creek CA together encompass over 1,700 acres. Don Robinson deeded over 800 acres of properties to the Missouri Department of Natural Resources for the Don Robinson State Park. Institutional lands include over 270 acres owned by the College School, St. Joseph Hill, and Washington University. (http://www.friendsoflabarquecreek.org/LBQ_Land_Use_3.1_Oct_2012.pdf)

LaBarque Creek appears to meet all the criteria to be classified as an Outstanding State Resource Water. It has high aesthetic value, it is a valuable scientific resource for several institutions of higher education, the population is concentrated on only 20% of the watershed and over 86% is forested, and there are large holdings of public lands in the watershed. We hope the Missouri

Clean Water Commission will consider designation of the headwater section of LaBarque Creek as an Outstanding State Resource Water to further the protection of this valuable resource.

Respectfully,

Holly Neill, M.S.
Executive Director

ROBERT J. BRUNDAGE
EDWARD C. CLAUSEN
MARK W. COMLEY
SHARIE L. HAHN
JOSHUA L. HILL
CATHLEEN A. MARTIN

NEWMAN COMLEY RUTH

STEPHEN G. NEWMAN
JOHN A. RUTH
THOMAS C. SMITH
NICOLE L. SUBLETT
ALICIA EMBLEY TURNER

June 13, 2014

VIA EMAIL ONLY

John Hoke
Chief, Watershed Protection Section
Water Protection Program
Missouri Department of Natural Resources
P.O. Box 176
Jefferson City, MO 65102-0176
john.hoke@dnr.mo.gov

RE: Public Notice – Triennial Review

Dear Mr. Hoke:

I am writing in response to the *Public Notice of Intent to Initiate Triennial Review of the Missouri Water Quality Standards*. I reviewed the list of topics relative to water quality standards listed in the public notice. I agree with the Departments recommendation to move forward with proposed revisions to the sulfate and chloride criteria. In addition, it should be a high priority to adopt regional dissolved oxygen criteria and also use attainability analysis. It is also important to revise the flawed and partially disapproved nutrient criteria for lakes.

Two proposed changes to the water quality standards not listed in this public notice are changes to the cadmium and lead criteria. On December 6, 2012, I delivered to you a letter and memorandum setting forth in detail proposed changes to the lead water quality criteria and supporting information and justification. I also provided to you a letter dated July 10, 2012 requesting changes to the cadmium criteria. My letter was accompanied by a memorandum supporting changes to the cadmium water quality criteria including data that support revisions.

To date, the Department of Natural Resources has not responded to or brought these proposed changes to the Water Protection Forum or to the Clean Water Commission. My clients strongly support these proposed changes and I would ask that you add them to the list of criteria that the Department and the Commission will address in the upcoming triennial review.

I also recommend you include in the criteria proposed changes to the mixing zone regulations concerning bacteria. Mixing zone regulations should also take into account mixing when ditches or water bodies that are not waters of the state empty into larger water bodies. Mixing zones should also take into account and acknowledge the flexibility afforded by different flow tiers.

For example, a permit could include a flow tier for no flow and flow tiers when the receiving water body actually has flow in it.

I also suggest the Department consider changes to the temperature water quality criteria to clarify the size of the stream to which the criteria apply and under what flow conditions.

Sincerely,

By: Robert J. Brundage

Robert J. Brundage
rbrundage@ncrpc.com

RJB:la

RECEIVED

JUN 18 2014

WATER PROTECTION PROGRAM

MPUA
Missouri Public Utility Alliance

June 13, 2014

Water Protection Program
c/o: John Hoke
Missouri Department of Natural Resources
P.O. Box 176
Jefferson City, MO 65102

Re: 2014 Missouri Water Quality Standards Review

Dear Mr. Hoke:

The Missouri Public Utility Alliance (MPUA) is a non-profit association of municipal governments that provides advocacy to its members. MPUA appreciates the opportunity to respond to the Department of Natural Resources' (Department) *Public Notice of Intent to Initiate Triennial Review of Missouri Water Quality Standards.*

We prefaced the composition of this letter with our submission of MPUA's "Top Ten List" as requested by the Chairman of the Clean Water Commission earlier this year. Our desired outcomes were also presented orally at various Clean Water Commission meetings.

1. We agree with the United States Environmental Protection Agency's (USEPA) assessment that the Department should focus, first and foremost, on items that have been previously "partially or fully disapproved" in past rule-makings. First, this would include nutrient criteria for lakes. Please understand that when MPUA states "lake nutrient criteria" it does NOT mean "lake's watershed nutrient criteria". The Department's desire to extend lake nutrient criteria into the upper-most watersheds of lake areas (i.e., streams) is not appropriate.

2. Secondly, we suggest that the sulfate and chloride criteria should be forwarded for discussion and approval.

1808 I-70 Dr. SW
Columbia, MO 65203
Phone: 573-445-3279
Fax: 573-445-0680
www.mpua.org

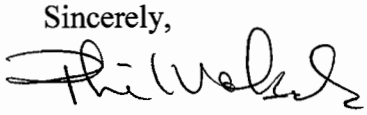
3. MPUA believes that significant efforts have been expended to reach consensus on the use/practice of Use Attainability Analyses. We support continuing this effort; forwarding the discussion; and advancing this topic for approval.

MPUA believes that other, newly-released Federal criteria are not yet ripe for adoption or consideration in Missouri. As the Department knows, MPUA is emphatically advancing an environmental improvement message for Missouri we call "Pipes before Plants". Supported by the 2004 and the 2008 USEPA Clean Watershed Needs Assessments (with final release dates of 2006 and 2010), and the Governor-commissioned Missouri 604(b) Report it is clear that Missouri lags well behind other States in addressing its collection system pipe networks needs. We rank 50th out of 50 in the 2010-released national needs assessment in the collection system piping needs category.

With the historic passage of the 2013 Missouri Water Quality Standards Rulemaking package, we believe that this $1.25 Billion rulemaking must be given time to run its course. Many public utilities and private purveyors of sewer services will be required to make significant and expensive upgrades to their wastewater treatment plants and dramatically reduce the concentrations of certain constituents in their effluent. Immediately, adding another layer of costs, with little holistic environmental benefits is not a prudent expenditure of public funds and resources.

The Missouri Public Utility Alliance appreciates the opportunity to engage with the Department on these very important and economically challenging issues. If you have any questions or concerns, please feel free to contact Phil Walsack or Floyd Gilzow at (573) 445-3279.

Sincerely,



Philip Walsack
Manager of Environmental Services