CITY OF BOZEMAN
Bozeman, Montana
Department of Public Works

March 3, 2015

John Collins
Montana Department of Environmental Quality
Solid Waste Program
PO Box 200901
Helena, MT 59620-0901

Dear Mr. Collins:

Please find attached City's responses to your December 18, 2014 Notice of Deficiency on the draft Corrective Measures Assessment. Please contact me if you have any questions. We're looking forward to your final decision on our recommended remediation alternative.

Sincerely,

Craig Woolard, Ph.D., P.E.
Director of Public Works

Enclosure

**TETRA TECH**

March 3, 2015

Mr. John Collins
Environmental Science Specialist
Montana Department of Environmental Quality
PO Box 200901
Helena, Montana 59620

Subject: Response to DEQ Letter dated December 8, 2014

Dear Mr. Collins:

We have prepared responses to DEQ's letter dated December 8, 2014, submitted to the City of Bozeman asking for clarification on several issues related to the City's landfill CMA. DEQ's requests are listed below and are numbered. The City's responses follow each request and are *italicized*.

1. The SWP notes that the additional groundwater investigation efforts proposed in the October 2, 2014, addendum to the work plan have not been completed. The SWP approved the addendum to the work plan that included the installation of two additional monitoring wells. The well installations must be completed before the SWP completes the review of the proposed corrective measures; the Administrative Rules of Montana (ARM) section 17.50.1307(7)(a)(i), requires the characterization of "the nature and extent of the release by installing additional monitoring wells as necessary". The proposed installation of PMW-28 is very important in determining the extent of VOCs upgradient of MW-17. The data from this well will also be critical in verifying whether or not the main component of the source of contamination is landfill gas, as the City asserts. Proposed well PMW-27 is also equally important in defining the downgradient extent of the VOC plume south and west of the unlined closed cell. As has been stated in previous correspondence, if analytical results from either of these wells exceed the current Circular DEQ-7 "Montana Numeric Water Quality Standards", additional investigation may be necessary. Please proceed with your effort to obtain access to those properties identified in the work plan for the additional monitoring well installations.

*Response: The City pursued access agreements with adjacent landowners for the purpose of installing new groundwater monitoring wells PMW-27 and PMW-28 (see attached figure). Access agreements were completed that allowed installation of PMW-27. However, the City has not been successful (as yet) in obtaining access for installation of PMW-28. The City will continue to pursue access for installation of PMW-28, however the results from an upgradient well would not change our selection of Alternative F.*

*Groundwater monitoring well PMW-27 was installed on January 14, 2015, and samples from the well were taken and analyzed. The groundwater monitoring results were previously submitted to DEQ and are also attached to this letter. Evaluation of the results indicate that perchloroethylene (PCE) was detected at a concentration of 1.2 µg/L, which is below the 5 µg/L Montana Groundwater Protection Standard (GWPS).*

2. In the analysis of the effectiveness of Alternative F, the City's preferred alternative, there are qualitative statements made about the short-term and long-term effectiveness of the remedial technologies that this preferred alternative combines. Please provide examples of other sites, with similar geology and contaminants of concern, where this type of technology has been implemented. The summary should include, at a minimum, an executive summary of the sites and the timeframe of effectiveness and/or contaminant reduction rates. These examples will provide support for the degree of certainty that the proposed chosen remedy will prove effective.

*Response: In addition to providing the requested examples below, the City would like to elaborate on the rationale behind the Alternative F technologies. Soil Vapor Extraction (SVE), like Landfill Gas Extraction (LFG), is a well-established technology for in-situ source removal and controlling soil gas migration. The US Army Corps of Engineers (2002) notes that SVE has been used for landfill gas control and petroleum cleanup since the 1970s and has been used to successfully clean up solvents at a number of Superfund sites since the 1980s. According to the EPA Superfund Remedy Report of November 2013, SVE has been one of the top selected remedies for in-situ source treatment on Superfund sites since 2005, being selected at 61% of the sites in 2011 (the latest year reported). SVE is specifically intended for volatile compounds, such as the Bozeman Landfill Contaminants of Concern (COCs), and works well in fine sand to gravel deposits, which are present at this site. The Vadose Zone Air Injection (VZAI) component of Alternative F is intended to accelerate the movement of air and COCs through the subsurface, and provides an additional pressure gradient barrier to any lateral gas migration that might occur. Therefore, VZAI is not a stand-alone technology, but an enhancement to SVE.*

*Finally the Air Sparging (AS) component of Alternative F is intended to treat groundwater already impacted by partitioning from landfill gas, and if necessary, will accelerate the decline in groundwater concentrations that would result from SVE alone. AS, like SVE, is a well-established technology that targets volatile organic compounds and works best in fine sand to gravel deposits such as exists at the Bozeman landfill. EPA 2013 identified that AS is a component of 6% of remedies selected at Superfund sites in 2011. In addition to the specific references to documents in this letter, there are additional general references on the technologies attached to this letter.*

*Three projects where similar technology has been used have been selected as examples. Synopses of each of the projects are included below, and a comparison of these projects to the Bozeman Landfill follows the synopses.*

*<u>South Chollas Landfill, City of San Diego, California</u>*

*The South Chollas landfill in the City of San Diego is an unlined landfill located above permeable cobble conglomerate and sand deposits. Monitoring data indicated the presence of low concentrations of chlorinated VOCs in shallow soils, surface water, and groundwater due to both LFG and leachate migration. In areas that had groundwater wells that indicated impacts, surface drainage and cover conditions were improved on the landfill upgradient from those wells. The existing LFG collection and control system was optimized, including expanded LFG extraction and air injection in the unsaturated zone. These actions led to reduced VOC concentrations in groundwater within two years (Geo-Logic, 2014).*

*Harrison Landfill Project Summary*

*Harrison Landfill in Tucson, Arizona is an unlined landfill that was operated from 1972 to 1997. The site is located above colluvial and alluvial sands, silts and gravels, with groundwater depths over 250 ft. below ground surface. Groundwater contamination was determined to be the result of migrating VOCs in the vapor phase. A LFG extraction system was installed within the former landfill cell and in 1999 a soil vapor extraction (SVE) system with air injection (AI) was installed around the perimeter of the former cell. The intent of the SVE/AI system was to remove VOCs in the vadose zone beneath the landfill before they came in contact with groundwater, thereby containing the source of the VOCs and preventing further transfer of VOCs into groundwater. The SVE/AI system operated from 1999 until 2002 and again from 2005 to 2006 (due to PCE rebound). The SVE/AI system removed and treated an estimated 18,034 pounds of total VOCs from below the landfill including 1,590 pounds of PCE. The PCE and overall VOC concentrations in vapor monitoring wells decreased significantly within a year of the SVE system startup at the Harrison Landfill. Groundwater concentrations of TCE declined from a peak of 15 µg/l in 1999 to less than the 5 µg/l MCL in 2002 and PCE concentrations declined from a peak of 35 µg/l to 6 µg/l in 2003 then finally to less than the 5 µg/l MCL in 2006 (City of Tucson, 2011).*

*Webster Parish Landfill, Louisiana*

*Landfill gas migration from the closed and unlined cell at the Webster Parish Landfill site was causing chlorinated VOC concentrations in groundwater to increase along the eastern property boundary. The site soils are fine sand and silt alluvium in both the unsaturated and saturated intervals beneath the landfill. Corrective measures consisting of LFG control of the gas-to-groundwater pathway were approved by the Louisiana Department of Environmental Quality (LDEQ). An SVE system including 10 SVE wells on 75-foot centers was installed outside the waste mass along the eastern boundary in the alluvium, with screen total depths set a few feet above the saturated sand. The system began operation in 2007 and groundwater cleanup standards were achieved within approximately five years of system operation (Hydrex Environmental, 2012).*

*Example Projects Comparison to Bozeman Landfill*

*Based on the similarity of COCs and soils with good air permeability in the examples discussed above, rapid declines in soil gas VOCs can also be expected at Bozeman Landfill. Alternative F will reduce VOC concentrations in groundwater by increasing the volume of VOCs that are captured within the landfill cell through optimization of the Landfill Gas System. VOCs in landfill gas that migrate out of the unlined cell will be captured by the SVE/AS/VZAI system, thereby further reducing the contact of VOCs with groundwater. Alternative F is expected to reduce concentrations of VOCs in groundwater within similar time frames as the examples above.*

3. The City's chosen alternative (Alternative F) relies mainly on the hypothesis that the main contaminant transport mechanism is the partitioning and transfer of the non-methane organic compounds in the landfill gas into the vadose zone and groundwater. Please provide executive summaries of several studies or several examples of this similar scenario at other landfills. This again will help provide support for the degree of certainty that the proposed chosen remedy will prove effective.

*The requested examples are provided above. In addition, groundwater monitoring data indicate that the original Story Mill Landfill CMA remedy (landfill gas extraction and capping) has reduced COC concentrations in groundwater over time and virtually eliminated off-site exceedances of Montana GWPS at previous monitoring well locations. This performance substantiates the original CMA premise that groundwater impacts were principally due to partitioning of VOCs from landfill gas to groundwater and possibly leaching from refuse in the landfill cell, since significant sources within the saturated zone would not have responded to either of the technologies.*

*The recent off-site exceedances observed at MW-20 (which was installed in March 2014) are less than an order of magnitude above the groundwater standard, and GWPS exceedances are not observed in MW-27. These relatively low concentrations and the limited extent of migration are consistent with a localized source zone where landfill gas has partitioned to the groundwater surface. Because vertical dispersions of COCs below the water table is low (the diffusivity of chlorinated compounds in water is about 10,000 times less than in air), the resultant groundwater plume would be expected to be thin with limited COC mass, resulting in more rapid attenuation with distance than groundwater plumes with saturated zone sources.*

*Therefore, the 2014 CMA remedy is intended to enhance the effectiveness of gas extraction technologies that have already been demonstrated to work at the Bozeman Landfill. SVE is a more targeted version of LFG technologies and more suitable to boundary control in natural deposits outside of the landfill material. SVE in the landfill area upgradient of MW-20 (i.e., near MW-17) will capture COCs in landfill gas before they contact groundwater, and also control lateral migration of gasses off of the landfill property to the extent this is occurring. Elevated soil gas concentrations south of the landfill property may also be explained by partitioning of COCs from groundwater back into soil vapor once beyond the landfill gas extraction zone of influence. The example sites discussed above support this conclusion.*

*The primary transport mechanism at the Bozeman Landfill is believed to be VOC migration through the vadose zone (Tetra Tech, 2014b, page 12). However, some transport may also be taking place through leachate migration to the groundwater. During a recent groundwater monitoring event (August, 2014), chloride, total hardness, and total dissolved solids were found at elevated levels around the margin of the unlined portion of the landfill. These constituents are common in landfill leachate. Also, during a recent investigation of landfill gas (LFG) wells, liquid was found in the casings of most of the LFG wells (Tetra Tech, 2014c). Liquid in two of the wells (GW-7 and GW-19) was sampled and analyzed. No PCE was detected in either sample. While it is possible this liquid could migrate to the underlying groundwater, the absence of PCE in the liquid indicates it is not the source of PCE contamination detected in groundwater at off-site monitoring wells MW-20 and LF-3.*

*In summary, recent data suggest there may be some leachate reaching the groundwater, however, like the other sites discussed above, the primary transport mechanism is believed to be through landfill gas migration in the vadose zone. Regardless of the transport mechanism, the selected Alternative F will effectively remove the COCs from both the vadose zone and groundwater.*

4. ARM 17.50.1309(3)(vii) and (viii) requires facilities assess the "long term reliability of the engineering and institutional controls; and potential for replacement of the remedy" when selecting the preferred corrective measures remedy. In light of this requirement, the SWP

requests that the City identify the possible additional alternative, essentially the backup plan, if Alternative F does not prove effective.

*Response: Alternative F was selected as the preferred remedy because it already provides a contingent remedy in the event that landfill gas control and SVE are not sufficient to control off-site impacts to groundwater. AS of the groundwater will prevent continued off-site migration of VOCs above GWPS.*

*The City also recommends that the remedy be implemented in phases, beginning with enhanced LFG, so that appropriate monitoring of the performance of each phase can enhance our understanding of the contribution of each technology to remediation and the role of both soil gas and groundwater transport mechanisms.*

*In the event that monitoring indicated inadequate control of VOCs in soil gas, additional SVE or VZAI wells could easily be added to the proposed system or the blowers and compressors supplying vacuum and compressed air to the wells could be adjusted to create greater removal. In the event that monitoring determines that VOCs are migrating through the groundwater following implementation of Alternative F as currently designed, additional AS wells can be added to the system or the compressor supplying air to the wells can be adjusted to supply additional air, thereby inducing additional VOC removal from the groundwater.*

*Finally, it is Tetra Tech's experience that the first and best backup plan is not to implement another remediation technology but rather to optimize, adjust and supplement the selected alternative with additional wells, higher air flow rates, or both.*

If you should have any questions regarding these responses, I would be pleased to discuss them with you.

Sincerely,

Larry Cawlfield, P.E., P.H.

Larry Cawlfield, P.E., P.H.
Engineer/Hydrologist

Attached: Site Map
MW-27 Laboratory Report
References

References:

EPA Superfund Remedy Report, Fourteenth Edition, www.epa.gove/superfund/remedytech/srr, November 2013

City of Tucson, 2011. Harrison Road Landfill: Remedial System Status Memorandum from Ms. Molly Collins to Ms. Nancy Petersen. City of Tucson Environmental Services. April 22, 2011

Geo-Logic Associates, 2014. Annual Groundwater Monitoring Report (October 2013 through September 2014) South Chollas Landfill for City of San Diego. October, 2014

Hydrex Environmental, Inc., 2012, 2nd 2012 Semi-Annual Report on Groundwater Sampling and Analysis; Webster Parish Landfill. December 10, 2012

Tetra Tech, 2014b. Draft Revised Corrective Measures Assessment, Bozeman Landfill, Gallatin County. Tetra Tech Inc., Helena, MT. September 4, 2014.

Tetra Tech, 2014c. Memorandum regarding Downhole Monitoring of LFG Extraction Wells, from Mark F. Pearson and Larry Cawlfield (Tetra Tech) to Rick Hixson (City of Bozeman). Tetra Tech, Helena, MT. October 9, 2014.

Partial Bibliography Related to Soil Vapor Extraction and Air Injection Effectiveness

*Air Sparging Guidance*. Leeson, A., Johnson, P.C., Johnson, R. L., Vogel, C.M., Robert H.E., McWhorter, D.B. et al. From http://clu-in.org/download/contaminantfocus/dnapl/Treatment_Technologies/Air_Sparg_paradigmpdf

*Air Sparging Guidance*. Miller, R.R..
From https://clu-in.org/download/toolkit/Sparge_o.pdf

Bentley and Smith, 2007. Systematic Remedial Methodology for Chlorinated VOC Contamination of Soils and Groundwater Underlying Desert Landfills. Bentley, Harold and Smith, Stewart. Desert Remedial Action Technologies Workshop. Phoenix, AZ. October 2-4, 2007.

*Dense Non-Aqueous Phase Liquids (DNAPLs) Treatment Technologies*. Federal Remediation Technologies Roundtable, 1988. From http://nepis.epa.gov/exe/Zynet.exe

In-Situ Air Sparging, EM 1110-1-405. U.S. Army Corps of Engineers. January 31, 2008. Washington, D.C.

*Proposed Solution to Landfill Gas Contamination of Groundwater*. Prosser, R. and Waineo, D.. G.C. Environmental. 1999.

*U.S. Army Corps of Engineers Official Publication EM-200-1-19*. From http://www.publications.usace.army.mil/Portals/76/publications/EngineerManuals/EM200-19-1.pdf


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Methane Monitoring Well

Groundwater Monitoring Well

Landfill Gas Extraction Well

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January 23, 2015

Mark Pearson
Tetra Tech, Inc. - MT
851 Bridger Dr. Suite 6
Bozeman, MT 59715

RE: Project: 114-710303A.700 Bozeman LF
Pace Project No.: 10294384

Dear Mark Pearson:

Enclosed are the analytical results for sample(s) received by the laboratory on January 17, 2015. 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,

Kang Khang
kang.khang@pacelabs.com
Project Manager

Enclosures

**Pace Analytical Services, Inc.**
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## CERTIFICATIONS

Project: 114-710303A.700 Bozeman LF
Pace Project No.: 10294384

**Minnesota Certification IDs**

1700 Elm Street SE Suite 200, Minneapolis, MN 55414
A2LA Certification #: 2926.01
Alaska Certification #: UST-078
Alaska Certification #MN00064
Alabama Certification #40770
Arizona Certification #: AZ-0014
Arkansas Certification #: 88-0680
California Certification #: 01155CA
Colorado Certification #Pace
Connecticut Certification #: PH-0256
EPA Region 8 Certification #: 8TMS-L
Florida/NELAP Certification #: E87605
Guam Certification #:14-008r
Georgia Certification #: 959
Georgia EPD #: Pace
Idaho Certification #: MN00064
Hawaii Certification #MN00064
Illinois Certification #: 200011
Indiana Certification#C-MN-01
Iowa Certification #: 368
Kansas Certification #: E-10167
Kentucky Dept of Envi. Protection - DW #90062
Kentucky Dept of Envi. Protection - WW #:90062
Louisiana DEQ Certification #: 3086
Louisiana DHH #: LA140001
Maine Certification #: 2013011
Maryland Certification #: 322
Michigan DEPH Certification #: 9909
Minnesota Certification #: 027-053-137
Mississippi Certification #: Pace
Montana Certification #: MT0092
Nevada Certification #: MN_00064
Nebraska Certification #: Pace
New Jersey Certification #: MN-002
New York Certification #: 11647
North Carolina Certification #: 530
North Carolina State Public Health #: 27700
North Dakota Certification #: R-036
Ohio EPA #: 4150
Ohio VAP Certification #: CL101
Oklahoma Certification #: 9507
Oregon Certification #: MN200001
Oregon Certification #: MN300001
Pennsylvania Certification #: 68-00563
Puerto Rico Certification
Saipan (CNMI) #:MP0003
South Carolina #:74003001
Texas Certification #: T104704192
Tennessee Certification #: 02818
Utah Certification #: MN000642013-4
Virginia DGS Certification #: 251
Virginia/VELAP Certification #: Pace
Washington Certification #: C486
West Virginia Certification #: 382
West Virginia DHHR #:9952C
Wisconsin Certification #: 999407970

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## SAMPLE SUMMARY

Project: 114-710303A.700 Bozeman LF
Pace Project No.: 10294384

| Lab ID | Sample ID | Matrix | Date Collected | Date Received |
|---|---|---|---|---|
| **10294384001** | **MW-27** | Water | 01/16/15 12:00 | 01/17/15 10:40 |
| **10294384002** | **TRIP BLANK** | Water | | 01/17/15 10:40 |

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## SAMPLE ANALYTE COUNT

Project: 114-710303A.700 Bozeman LF
Pace Project No.: 10294384

| Lab ID | Sample ID | Method | Analysts | Analytes Reported | Laboratory |
|---|---|---|---|---|---|
| **10294384001** | **MW-27** | EPA 8260B | SH2 | 61 | PASI-M |
| **10294384002** | **TRIP BLANK** | EPA 8260B | SH2 | 61 | PASI-M |

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## PROJECT NARRATIVE

Project: 114-710303A.700 Bozeman LF
Pace Project No.: 10294384

**Method:** **EPA 8260B**
**Description:** 8260B MSV Low Level
**Client:** Tetra Tech, Inc. - MT
**Date:** January 23, 2015

**General Information:**
2 samples were analyzed for EPA 8260B. All samples were received in acceptable condition with any exceptions noted below.

L2: Analyte recovery in the laboratory control sample (LCS) was below QC limits. Results may be biased low.
- MW-27 (Lab ID: 10294384001)
- TRIP BLANK (Lab ID: 10294384002)

**Hold Time:**
The samples were analyzed within the method required hold times with any exceptions noted below.

**Initial Calibrations (including MS Tune as applicable):**
All criteria were within method requirements with any exceptions noted below.

**Continuing Calibration:**
All criteria were within method requirements with any exceptions noted below.

**Internal Standards:**
All internal standards were within QC limits with any exceptions noted below.

**Surrogates:**
All surrogates were within QC limits with any exceptions noted below.

**Method Blank:**
All analytes were below the report limit in the method blank, where applicable, with any exceptions noted below.

**Laboratory Control Spike:**
All laboratory control spike compounds were within QC limits with any exceptions noted below.

QC Batch: MSV/30161

L0: Analyte recovery in the laboratory control sample (LCS) was outside QC limits.
- LCS (Lab ID: 1884863)
  - 2-Hexanone
  - Iodomethane

**Matrix Spikes:**
All percent recoveries and relative percent differences (RPDs) were within acceptance criteria with any exceptions noted below.

QC Batch: MSV/30161

A matrix spike and/or matrix spike duplicate (MS/MSD) were performed on the following sample(s): 10293854003

M0: Matrix spike recovery and/or matrix spike duplicate recovery was outside laboratory control limits.
- MS (Lab ID: 1884864)
  - Iodomethane
- MSD (Lab ID: 1884865)
  - Iodomethane

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## PROJECT NARRATIVE

Project: 114-710303A.700 Bozeman LF
Pace Project No.: 10294384

**Method:** **EPA 8260B**
**Description:** 8260B MSV Low Level
**Client:** Tetra Tech, Inc. - MT
**Date:** January 23, 2015

QC Batch: MSV/30161

A matrix spike and/or matrix spike duplicate (MS/MSD) were performed on the following sample(s): 10293854003

M1: Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery.

- MS (Lab ID: 1884864)
  - Bromomethane
- MSD (Lab ID: 1884865)
  - Acetone
  - Tetrahydrofuran
  - cis-1,2-Dichloroethene
  - n-Hexane

**Additional Comments:**

This data package has been reviewed for quality and completeness and is approved for release.

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## ANALYTICAL RESULTS

Project: 114-710303A.700 Bozeman LF
Pace Project No.: 10294384

**Sample: MW-27** **Lab ID: 10294384001** Collected: 01/16/15 12:00 Received: 01/17/15 10:40 Matrix: Water

| Parameters | Results | Units | PQL | MDL | DF | Prepared | Analyzed | CAS No. | Qual |
|---|---|---|---|---|---|---|---|---|---|
| **8260B MSV Low Level** | Analytical Method: EPA 8260B | | | | | | | | |
| Acetone | **<10.0** | ug/L | 20.0 | 10.0 | 1 | | 01/21/15 16:09 | 67-64-1 | |
| Acrylonitrile | **<1.0** | ug/L | 10.0 | 1.0 | 1 | | 01/21/15 16:09 | 107-13-1 | |
| Benzene | **0.083J** | ug/L | 0.50 | 0.073 | 1 | | 01/21/15 16:09 | 71-43-2 | |
| Bromochloromethane | **<0.16** | ug/L | 1.0 | 0.16 | 1 | | 01/21/15 16:09 | 74-97-5 | |
| Bromodichloromethane | **<0.11** | ug/L | 0.50 | 0.11 | 1 | | 01/21/15 16:09 | 75-27-4 | |
| Bromoform | **<2.0** | ug/L | 4.0 | 2.0 | 1 | | 01/21/15 16:09 | 75-25-2 | |
| Bromomethane | **<2.0** | ug/L | 4.0 | 2.0 | 1 | | 01/21/15 16:09 | 74-83-9 | |
| 2-Butanone (MEK) | **<2.5** | ug/L | 5.0 | 2.5 | 1 | | 01/21/15 16:09 | 78-93-3 | |
| Carbon disulfide | **<0.18** | ug/L | 1.0 | 0.18 | 1 | | 01/21/15 16:09 | 75-15-0 | |
| Carbon tetrachloride | **<0.17** | ug/L | 1.0 | 0.17 | 1 | | 01/21/15 16:09 | 56-23-5 | |
| Chlorobenzene | **<0.066** | ug/L | 0.50 | 0.066 | 1 | | 01/21/15 16:09 | 108-90-7 | |
| Chloroethane | **<0.27** | ug/L | 1.0 | 0.27 | 1 | | 01/21/15 16:09 | 75-00-3 | |
| Chloroform | **<0.20** | ug/L | 0.50 | 0.20 | 1 | | 01/21/15 16:09 | 67-66-3 | |
| Chloromethane | **<0.34** | ug/L | 4.0 | 0.34 | 1 | | 01/21/15 16:09 | 74-87-3 | |
| Cyclohexane | **<2.5** | ug/L | 5.0 | 2.5 | 1 | | 01/21/15 16:09 | 110-82-7 | |
| 1,2-Dibromo-3-chloropropane | **<2.0** | ug/L | 4.0 | 2.0 | 1 | | 01/21/15 16:09 | 96-12-8 | |
| Dibromochloromethane | **<0.086** | ug/L | 0.50 | 0.086 | 1 | | 01/21/15 16:09 | 124-48-1 | |
| 1,2-Dibromoethane (EDB) | **<0.097** | ug/L | 0.50 | 0.097 | 1 | | 01/21/15 16:09 | 106-93-4 | |
| Dibromomethane | **<0.18** | ug/L | 0.50 | 0.18 | 1 | | 01/21/15 16:09 | 74-95-3 | |
| 1,2-Dichlorobenzene | **<0.082** | ug/L | 0.50 | 0.082 | 1 | | 01/21/15 16:09 | 95-50-1 | |
| 1,4-Dichlorobenzene | **<0.25** | ug/L | 0.50 | 0.25 | 1 | | 01/21/15 16:09 | 106-46-7 | |
| trans-1,4-Dichloro-2-butene | **<0.37** | ug/L | 10.0 | 0.37 | 1 | | 01/21/15 16:09 | 110-57-6 | |
| Dichlorodifluoromethane | **<0.50** | ug/L | 1.0 | 0.50 | 1 | | 01/21/15 16:09 | 75-71-8 | |
| 1,1-Dichloroethane | **<0.087** | ug/L | 0.50 | 0.087 | 1 | | 01/21/15 16:09 | 75-34-3 | |
| 1,2-Dichloroethane | **<0.10** | ug/L | 0.50 | 0.10 | 1 | | 01/21/15 16:09 | 107-06-2 | |
| 1,1-Dichloroethene | **<0.17** | ug/L | 0.50 | 0.17 | 1 | | 01/21/15 16:09 | 75-35-4 | |
| cis-1,2-Dichloroethene | **<0.11** | ug/L | 0.50 | 0.11 | 1 | | 01/21/15 16:09 | 156-59-2 | |
| trans-1,2-Dichloroethene | **<0.15** | ug/L | 0.50 | 0.15 | 1 | | 01/21/15 16:09 | 156-60-5 | |
| 1,2-Dichloropropane | **<0.10** | ug/L | 4.0 | 0.10 | 1 | | 01/21/15 16:09 | 78-87-5 | |
| cis-1,3-Dichloropropene | **<0.093** | ug/L | 0.50 | 0.093 | 1 | | 01/21/15 16:09 | 10061-01-5 | |
| trans-1,3-Dichloropropene | **<0.11** | ug/L | 0.50 | 0.11 | 1 | | 01/21/15 16:09 | 10061-02-6 | |
| 1,4-Dioxane (p-Dioxane) | **<28.7** | ug/L | 200 | 28.7 | 1 | | 01/21/15 16:09 | 123-91-1 | |
| Ethylbenzene | **<0.096** | ug/L | 0.50 | 0.096 | 1 | | 01/21/15 16:09 | 100-41-4 | |
| n-Hexane | **<5.0** | ug/L | 10.0 | 5.0 | 1 | | 01/21/15 16:09 | 110-54-3 | |
| 2-Hexanone | **<2.5** | ug/L | 5.0 | 2.5 | 1 | | 01/21/15 16:09 | 591-78-6 | L2 |
| Iodomethane | **<2.0** | ug/L | 10.0 | 2.0 | 1 | | 01/21/15 16:09 | 74-88-4 | L3 |
| Isopropylbenzene (Cumene) | **<0.087** | ug/L | 1.0 | 0.087 | 1 | | 01/21/15 16:09 | 98-82-8 | |
| Methylene Chloride | **<2.0** | ug/L | 4.0 | 2.0 | 1 | | 01/21/15 16:09 | 75-09-2 | |
| 4-Methyl-2-pentanone (MIBK) | **<2.5** | ug/L | 5.0 | 2.5 | 1 | | 01/21/15 16:09 | 108-10-1 | |
| Methyl-tert-butyl ether | **<0.12** | ug/L | 0.50 | 0.12 | 1 | | 01/21/15 16:09 | 1634-04-4 | |
| 2-Propanol | **<50.0** | ug/L | 100 | 50.0 | 1 | | 01/21/15 16:09 | 67-63-0 | |
| n-Propylbenzene | **<0.077** | ug/L | 0.50 | 0.077 | 1 | | 01/21/15 16:09 | 103-65-1 | |
| Styrene | **<0.069** | ug/L | 4.0 | 0.069 | 1 | | 01/21/15 16:09 | 100-42-5 | |
| 1,1,1,2-Tetrachloroethane | **<0.10** | ug/L | 0.50 | 0.10 | 1 | | 01/21/15 16:09 | 630-20-6 | |
| 1,1,2,2-Tetrachloroethane | **<0.086** | ug/L | 0.50 | 0.086 | 1 | | 01/21/15 16:09 | 79-34-5 | |
| Tetrachloroethene | **1.2** | ug/L | 0.50 | 0.12 | 1 | | 01/21/15 16:09 | 127-18-4 | |

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## ANALYTICAL RESULTS

Project: 114-710303A.700 Bozeman LF
Pace Project No.: 10294384

**Sample: MW-27** **Lab ID: 10294384001** Collected: 01/16/15 12:00 Received: 01/17/15 10:40 Matrix: Water

| Parameters | Results | Units | PQL | MDL | DF | Prepared | Analyzed | CAS No. | Qual |
|---|---|---|---|---|---|---|---|---|---|
| **8260B MSV Low Level** | Analytical Method: EPA 8260B | | | | | | | | |
| Tetrahydrofuran | **<0.98** | ug/L | 10.0 | 0.98 | 1 | | 01/21/15 16:09 | 109-99-9 | |
| Toluene | **<0.11** | ug/L | 0.50 | 0.11 | 1 | | 01/21/15 16:09 | 108-88-3 | |
| 1,1,1-Trichloroethane | **<0.17** | ug/L | 0.50 | 0.17 | 1 | | 01/21/15 16:09 | 71-55-6 | |
| 1,1,2-Trichloroethane | **<0.14** | ug/L | 0.50 | 0.14 | 1 | | 01/21/15 16:09 | 79-00-5 | |
| Trichloroethene | **<0.084** | ug/L | 0.40 | 0.084 | 1 | | 01/21/15 16:09 | 79-01-6 | |
| Trichlorofluoromethane | **<0.12** | ug/L | 0.50 | 0.12 | 1 | | 01/21/15 16:09 | 75-69-4 | |
| 1,2,3-Trichloropropane | **<1.2** | ug/L | 4.0 | 1.2 | 1 | | 01/21/15 16:09 | 96-18-4 | |
| 1,1,2-Trichlorotrifluoroethane | **<0.16** | ug/L | 1.0 | 0.16 | 1 | | 01/21/15 16:09 | 76-13-1 | |
| 1,2,4-Trimethylbenzene | **<0.25** | ug/L | 1.0 | 0.25 | 1 | | 01/21/15 16:09 | 95-63-6 | |
| Vinyl acetate | **<0.13** | ug/L | 10.0 | 0.13 | 1 | | 01/21/15 16:09 | 108-05-4 | |
| Vinyl chloride | **<0.082** | ug/L | 0.20 | 0.082 | 1 | | 01/21/15 16:09 | 75-01-4 | |
| Xylene (Total) | **<0.21** | ug/L | 1.5 | 0.21 | 1 | | 01/21/15 16:09 | 1330-20-7 | |
| ***Surrogates*** | | | | | | | | | |
| 1,2-Dichloroethane-d4 (S) | 91 | %. | 75-125 | | 1 | | 01/21/15 16:09 | 17060-07-0 | |
| Toluene-d8 (S) | 99 | %. | 75-125 | | 1 | | 01/21/15 16:09 | 2037-26-5 | |
| 4-Bromofluorobenzene (S) | 104 | %. | 75-125 | | 1 | | 01/21/15 16:09 | 460-00-4 | |

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## ANALYTICAL RESULTS

Project: 114-710303A.700 Bozeman LF
Pace Project No.: 10294384

**Sample: TRIP BLANK** **Lab ID: 10294384002** Collected: Received: 01/17/15 10:40 Matrix: Water

| Parameters | Results | Units | PQL | MDL | DF | Prepared | Analyzed | CAS No. | Qual |
|---|---|---|---|---|---|---|---|---|---|
| **8260B MSV Low Level** | Analytical Method: EPA 8260B | | | | | | | | |
| Acetone | **<10.0** | ug/L | 20.0 | 10.0 | 1 | | 01/21/15 15:45 | 67-64-1 | |
| Acrylonitrile | **<1.0** | ug/L | 10.0 | 1.0 | 1 | | 01/21/15 15:45 | 107-13-1 | |
| Benzene | **<0.073** | ug/L | 0.50 | 0.073 | 1 | | 01/21/15 15:45 | 71-43-2 | |
| Bromochloromethane | **<0.16** | ug/L | 1.0 | 0.16 | 1 | | 01/21/15 15:45 | 74-97-5 | |
| Bromodichloromethane | **<0.11** | ug/L | 0.50 | 0.11 | 1 | | 01/21/15 15:45 | 75-27-4 | |
| Bromoform | **<2.0** | ug/L | 4.0 | 2.0 | 1 | | 01/21/15 15:45 | 75-25-2 | |
| Bromomethane | **<2.0** | ug/L | 4.0 | 2.0 | 1 | | 01/21/15 15:45 | 74-83-9 | |
| 2-Butanone (MEK) | **<2.5** | ug/L | 5.0 | 2.5 | 1 | | 01/21/15 15:45 | 78-93-3 | |
| Carbon disulfide | **<0.18** | ug/L | 1.0 | 0.18 | 1 | | 01/21/15 15:45 | 75-15-0 | |
| Carbon tetrachloride | **<0.17** | ug/L | 1.0 | 0.17 | 1 | | 01/21/15 15:45 | 56-23-5 | |
| Chlorobenzene | **<0.066** | ug/L | 0.50 | 0.066 | 1 | | 01/21/15 15:45 | 108-90-7 | |
| Chloroethane | **<0.27** | ug/L | 1.0 | 0.27 | 1 | | 01/21/15 15:45 | 75-00-3 | |
| Chloroform | **<0.20** | ug/L | 0.50 | 0.20 | 1 | | 01/21/15 15:45 | 67-66-3 | |
| Chloromethane | **<0.34** | ug/L | 4.0 | 0.34 | 1 | | 01/21/15 15:45 | 74-87-3 | |
| Cyclohexane | **<2.5** | ug/L | 5.0 | 2.5 | 1 | | 01/21/15 15:45 | 110-82-7 | |
| 1,2-Dibromo-3-chloropropane | **<2.0** | ug/L | 4.0 | 2.0 | 1 | | 01/21/15 15:45 | 96-12-8 | |
| Dibromochloromethane | **<0.086** | ug/L | 0.50 | 0.086 | 1 | | 01/21/15 15:45 | 124-48-1 | |
| 1,2-Dibromoethane (EDB) | **<0.097** | ug/L | 0.50 | 0.097 | 1 | | 01/21/15 15:45 | 106-93-4 | |
| Dibromomethane | **<0.18** | ug/L | 0.50 | 0.18 | 1 | | 01/21/15 15:45 | 74-95-3 | |
| 1,2-Dichlorobenzene | **<0.082** | ug/L | 0.50 | 0.082 | 1 | | 01/21/15 15:45 | 95-50-1 | |
| 1,4-Dichlorobenzene | **<0.25** | ug/L | 0.50 | 0.25 | 1 | | 01/21/15 15:45 | 106-46-7 | |
| trans-1,4-Dichloro-2-butene | **<0.37** | ug/L | 10.0 | 0.37 | 1 | | 01/21/15 15:45 | 110-57-6 | |
| Dichlorodifluoromethane | **<0.50** | ug/L | 1.0 | 0.50 | 1 | | 01/21/15 15:45 | 75-71-8 | |
| 1,1-Dichloroethane | **<0.087** | ug/L | 0.50 | 0.087 | 1 | | 01/21/15 15:45 | 75-34-3 | |
| 1,2-Dichloroethane | **<0.10** | ug/L | 0.50 | 0.10 | 1 | | 01/21/15 15:45 | 107-06-2 | |
| 1,1-Dichloroethene | **<0.17** | ug/L | 0.50 | 0.17 | 1 | | 01/21/15 15:45 | 75-35-4 | |
| cis-1,2-Dichloroethene | **<0.11** | ug/L | 0.50 | 0.11 | 1 | | 01/21/15 15:45 | 156-59-2 | |
| trans-1,2-Dichloroethene | **<0.15** | ug/L | 0.50 | 0.15 | 1 | | 01/21/15 15:45 | 156-60-5 | |
| 1,2-Dichloropropane | **<0.10** | ug/L | 4.0 | 0.10 | 1 | | 01/21/15 15:45 | 78-87-5 | |
| cis-1,3-Dichloropropene | **<0.093** | ug/L | 0.50 | 0.093 | 1 | | 01/21/15 15:45 | 10061-01-5 | |
| trans-1,3-Dichloropropene | **<0.11** | ug/L | 0.50 | 0.11 | 1 | | 01/21/15 15:45 | 10061-02-6 | |
| 1,4-Dioxane (p-Dioxane) | **<28.7** | ug/L | 200 | 28.7 | 1 | | 01/21/15 15:45 | 123-91-1 | |
| Ethylbenzene | **<0.096** | ug/L | 0.50 | 0.096 | 1 | | 01/21/15 15:45 | 100-41-4 | |
| n-Hexane | **<5.0** | ug/L | 10.0 | 5.0 | 1 | | 01/21/15 15:45 | 110-54-3 | |
| 2-Hexanone | **<2.5** | ug/L | 5.0 | 2.5 | 1 | | 01/21/15 15:45 | 591-78-6 | L2 |
| Iodomethane | **<2.0** | ug/L | 10.0 | 2.0 | 1 | | 01/21/15 15:45 | 74-88-4 | L3 |
| Isopropylbenzene (Cumene) | **<0.087** | ug/L | 1.0 | 0.087 | 1 | | 01/21/15 15:45 | 98-82-8 | |
| Methylene Chloride | **<2.0** | ug/L | 4.0 | 2.0 | 1 | | 01/21/15 15:45 | 75-09-2 | |
| 4-Methyl-2-pentanone (MIBK) | **<2.5** | ug/L | 5.0 | 2.5 | 1 | | 01/21/15 15:45 | 108-10-1 | |
| Methyl-tert-butyl ether | **<0.12** | ug/L | 0.50 | 0.12 | 1 | | 01/21/15 15:45 | 1634-04-4 | |
| 2-Propanol | **<50.0** | ug/L | 100 | 50.0 | 1 | | 01/21/15 15:45 | 67-63-0 | |
| n-Propylbenzene | **<0.077** | ug/L | 0.50 | 0.077 | 1 | | 01/21/15 15:45 | 103-65-1 | |
| Styrene | **<0.069** | ug/L | 4.0 | 0.069 | 1 | | 01/21/15 15:45 | 100-42-5 | |
| 1,1,1,2-Tetrachloroethane | **<0.10** | ug/L | 0.50 | 0.10 | 1 | | 01/21/15 15:45 | 630-20-6 | |
| 1,1,2,2-Tetrachloroethane | **<0.086** | ug/L | 0.50 | 0.086 | 1 | | 01/21/15 15:45 | 79-34-5 | |
| Tetrachloroethene | **<0.12** | ug/L | 0.50 | 0.12 | 1 | | 01/21/15 15:45 | 127-18-4 | |

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# ANALYTICAL RESULTS

Project: 114-710303A.700 Bozeman LF
Pace Project No.: 10294384

**Sample: TRIP BLANK** **Lab ID: 10294384002** Collected: Received: 01/17/15 10:40 Matrix: Water

| Parameters | Results | Units | PQL | MDL | DF | Prepared | Analyzed | CAS No. | Qual |
|---|---|---|---|---|---|---|---|---|---|
| **8260B MSV Low Level** | Analytical Method: EPA 8260B | | | | | | | | |
| Tetrahydrofuran | **<0.98** | ug/L | 10.0 | 0.98 | 1 | | 01/21/15 15:45 | 109-99-9 | |
| Toluene | **<0.11** | ug/L | 0.50 | 0.11 | 1 | | 01/21/15 15:45 | 108-88-3 | |
| 1,1,1-Trichloroethane | **<0.17** | ug/L | 0.50 | 0.17 | 1 | | 01/21/15 15:45 | 71-55-6 | |
| 1,1,2-Trichloroethane | **<0.14** | ug/L | 0.50 | 0.14 | 1 | | 01/21/15 15:45 | 79-00-5 | |
| Trichloroethene | **<0.084** | ug/L | 0.40 | 0.084 | 1 | | 01/21/15 15:45 | 79-01-6 | |
| Trichlorofluoromethane | **<0.12** | ug/L | 0.50 | 0.12 | 1 | | 01/21/15 15:45 | 75-69-4 | |
| 1,2,3-Trichloropropane | **<1.2** | ug/L | 4.0 | 1.2 | 1 | | 01/21/15 15:45 | 96-18-4 | |
| 1,1,2-Trichlorotrifluoroethane | **<0.16** | ug/L | 1.0 | 0.16 | 1 | | 01/21/15 15:45 | 76-13-1 | |
| 1,2,4-Trimethylbenzene | **<0.25** | ug/L | 1.0 | 0.25 | 1 | | 01/21/15 15:45 | 95-63-6 | |
| Vinyl acetate | **<0.13** | ug/L | 10.0 | 0.13 | 1 | | 01/21/15 15:45 | 108-05-4 | |
| Vinyl chloride | **<0.082** | ug/L | 0.20 | 0.082 | 1 | | 01/21/15 15:45 | 75-01-4 | |
| Xylene (Total) | **<0.21** | ug/L | 1.5 | 0.21 | 1 | | 01/21/15 15:45 | 1330-20-7 | |
| ***Surrogates*** | | | | | | | | | |
| 1,2-Dichloroethane-d4 (S) | 89 | %. | 75-125 | | 1 | | 01/21/15 15:45 | 17060-07-0 | |
| Toluene-d8 (S) | 100 | %. | 75-125 | | 1 | | 01/21/15 15:45 | 2037-26-5 | |
| 4-Bromofluorobenzene (S) | 103 | %. | 75-125 | | 1 | | 01/21/15 15:45 | 460-00-4 | |

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## QUALITY CONTROL DATA

Project: 114-710303A.700 Bozeman LF
Pace Project No.: 10294384

QC Batch: MSV/30161 Analysis Method: EPA 8260B
QC Batch Method: EPA 8260B Analysis Description: 8260 MSV LL Water
Associated Lab Samples: 10294384001, 10294384002

METHOD BLANK: 1884862 Matrix: Water
Associated Lab Samples: 10294384001, 10294384002

| Parameter | Units | Blank Result | Reporting Limit | Analyzed | Qualifiers |
|---|---|---|---|---|---|
| 1,1,1,2-Tetrachloroethane | ug/L | <0.10 | 0.50 | 01/21/15 12:13 | |
| 1,1,1-Trichloroethane | ug/L | <0.17 | 0.50 | 01/21/15 12:13 | |
| 1,1,2,2-Tetrachloroethane | ug/L | <0.086 | 0.50 | 01/21/15 12:13 | |
| 1,1,2-Trichloroethane | ug/L | <0.14 | 0.50 | 01/21/15 12:13 | |
| 1,1,2-Trichlorotrifluoroethane | ug/L | <0.16 | 1.0 | 01/21/15 12:13 | |
| 1,1-Dichloroethane | ug/L | <0.087 | 0.50 | 01/21/15 12:13 | |
| 1,1-Dichloroethene | ug/L | <0.17 | 0.50 | 01/21/15 12:13 | |
| 1,2,3-Trichloropropane | ug/L | <1.2 | 4.0 | 01/21/15 12:13 | |
| 1,2,4-Trimethylbenzene | ug/L | <0.25 | 1.0 | 01/21/15 12:13 | |
| 1,2-Dibromo-3-chloropropane | ug/L | <2.0 | 4.0 | 01/21/15 12:13 | |
| 1,2-Dibromoethane (EDB) | ug/L | <0.097 | 0.50 | 01/21/15 12:13 | |
| 1,2-Dichlorobenzene | ug/L | <0.082 | 0.50 | 01/21/15 12:13 | |
| 1,2-Dichloroethane | ug/L | <0.10 | 0.50 | 01/21/15 12:13 | |
| 1,2-Dichloropropane | ug/L | <0.10 | 4.0 | 01/21/15 12:13 | |
| 1,4-Dichlorobenzene | ug/L | <0.25 | 0.50 | 01/21/15 12:13 | |
| 1,4-Dioxane (p-Dioxane) | ug/L | <28.7 | 200 | 01/21/15 12:13 | |
| 2-Butanone (MEK) | ug/L | <2.5 | 5.0 | 01/21/15 12:13 | |
| 2-Hexanone | ug/L | <2.5 | 5.0 | 01/21/15 12:13 | |
| 2-Propanol | ug/L | <50.0 | 100 | 01/21/15 12:13 | |
| 4-Methyl-2-pentanone (MIBK) | ug/L | <2.5 | 5.0 | 01/21/15 12:13 | |
| Acetone | ug/L | <10.0 | 20.0 | 01/21/15 12:13 | |
| Acrylonitrile | ug/L | <1.0 | 10.0 | 01/21/15 12:13 | |
| Benzene | ug/L | <0.073 | 0.50 | 01/21/15 12:13 | |
| Bromochloromethane | ug/L | <0.16 | 1.0 | 01/21/15 12:13 | |
| Bromodichloromethane | ug/L | <0.11 | 0.50 | 01/21/15 12:13 | |
| Bromoform | ug/L | <2.0 | 4.0 | 01/21/15 12:13 | |
| Bromomethane | ug/L | <2.0 | 4.0 | 01/21/15 12:13 | |
| Carbon disulfide | ug/L | <0.18 | 1.0 | 01/21/15 12:13 | |
| Carbon tetrachloride | ug/L | <0.17 | 1.0 | 01/21/15 12:13 | |
| Chlorobenzene | ug/L | <0.066 | 0.50 | 01/21/15 12:13 | |
| Chloroethane | ug/L | <0.27 | 1.0 | 01/21/15 12:13 | |
| Chloroform | ug/L | <0.20 | 0.50 | 01/21/15 12:13 | |
| Chloromethane | ug/L | <0.34 | 4.0 | 01/21/15 12:13 | |
| cis-1,2-Dichloroethene | ug/L | <0.11 | 0.50 | 01/21/15 12:13 | |
| cis-1,3-Dichloropropene | ug/L | <0.093 | 0.50 | 01/21/15 12:13 | |
| Cyclohexane | ug/L | <2.5 | 5.0 | 01/21/15 12:13 | |
| Dibromochloromethane | ug/L | <0.086 | 0.50 | 01/21/15 12:13 | |
| Dibromomethane | ug/L | <0.18 | 0.50 | 01/21/15 12:13 | |
| Dichlorodifluoromethane | ug/L | <0.50 | 1.0 | 01/21/15 12:13 | |
| Ethylbenzene | ug/L | <0.096 | 0.50 | 01/21/15 12:13 | |
| Iodomethane | ug/L | <2.0 | 10.0 | 01/21/15 12:13 | |

**Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.**

## REPORT OF LABORATORY ANALYSIS

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## QUALITY CONTROL DATA

Project: 114-710303A.700 Bozeman LF
Pace Project No.: 10294384

METHOD BLANK: 1884862 Matrix: Water
Associated Lab Samples: 10294384001, 10294384002

| Parameter | Units | Blank Result | Reporting Limit | Analyzed | Qualifiers |
|---|---|---|---|---|---|
| Isopropylbenzene (Cumene) | ug/L | <0.087 | 1.0 | 01/21/15 12:13 | |
| Methyl-tert-butyl ether | ug/L | <0.12 | 0.50 | 01/21/15 12:13 | |
| Methylene Chloride | ug/L | <2.0 | 4.0 | 01/21/15 12:13 | |
| n-Hexane | ug/L | <5.0 | 10.0 | 01/21/15 12:13 | |
| n-Propylbenzene | ug/L | <0.077 | 0.50 | 01/21/15 12:13 | |
| Styrene | ug/L | <0.069 | 4.0 | 01/21/15 12:13 | |
| Tetrachloroethene | ug/L | <0.12 | 0.50 | 01/21/15 12:13 | |
| Tetrahydrofuran | ug/L | <0.98 | 10.0 | 01/21/15 12:13 | |
| Toluene | ug/L | <0.11 | 0.50 | 01/21/15 12:13 | |
| trans-1,2-Dichloroethene | ug/L | <0.15 | 0.50 | 01/21/15 12:13 | |
| trans-1,3-Dichloropropene | ug/L | <0.11 | 0.50 | 01/21/15 12:13 | |
| trans-1,4-Dichloro-2-butene | ug/L | <0.37 | 10.0 | 01/21/15 12:13 | |
| Trichloroethene | ug/L | <0.084 | 0.40 | 01/21/15 12:13 | |
| Trichlorofluoromethane | ug/L | <0.12 | 0.50 | 01/21/15 12:13 | |
| Vinyl acetate | ug/L | <0.13 | 10.0 | 01/21/15 12:13 | |
| Vinyl chloride | ug/L | <0.082 | 0.20 | 01/21/15 12:13 | |
| Xylene (Total) | ug/L | <0.21 | 1.5 | 01/21/15 12:13 | |
| 1,2-Dichloroethane-d4 (S) | %. | 91 | 75-125 | 01/21/15 12:13 | |
| 4-Bromofluorobenzene (S) | %. | 106 | 75-125 | 01/21/15 12:13 | |
| Toluene-d8 (S) | %. | 99 | 75-125 | 01/21/15 12:13 | |

LABORATORY CONTROL SAMPLE: 1884863

| Parameter | Units | Spike Conc. | LCS Result | LCS % Rec | % Rec Limits | Qualifiers |
|---|---|---|---|---|---|---|
| 1,1,1,2-Tetrachloroethane | ug/L | 20 | 20.4 | 102 | 75-125 | |
| 1,1,1-Trichloroethane | ug/L | 20 | 18.6 | 93 | 75-125 | |
| 1,1,2,2-Tetrachloroethane | ug/L | 20 | 16.5 | 82 | 75-125 | |
| 1,1,2-Trichloroethane | ug/L | 20 | 19.4 | 97 | 75-125 | |
| 1,1,2-Trichlorotrifluoroethane | ug/L | 20 | 19.2 | 96 | 60-135 | |
| 1,1-Dichloroethane | ug/L | 20 | 17.5 | 87 | 69-125 | |
| 1,1-Dichloroethene | ug/L | 20 | 19.1 | 96 | 68-125 | |
| 1,2,3-Trichloropropane | ug/L | 20 | 16.8 | 84 | 75-125 | |
| 1,2,4-Trimethylbenzene | ug/L | 20 | 18.4 | 92 | 75-125 | |
| 1,2-Dibromo-3-chloropropane | ug/L | 50 | 40.6 | 81 | 65-145 | |
| 1,2-Dibromoethane (EDB) | ug/L | 20 | 20.2 | 101 | 75-125 | |
| 1,2-Dichlorobenzene | ug/L | 20 | 19.5 | 98 | 75-125 | |
| 1,2-Dichloroethane | ug/L | 20 | 16.7 | 83 | 73-125 | |
| 1,2-Dichloropropane | ug/L | 20 | 19.0 | 95 | 75-125 | |
| 1,4-Dichlorobenzene | ug/L | 20 | 18.3 | 91 | 75-125 | |
| 1,4-Dioxane (p-Dioxane) | ug/L | 400 | 439 | 110 | 75-125 | |
| 2-Butanone (MEK) | ug/L | 100 | 64.9 | 65 | 63-130 | |
| 2-Hexanone | ug/L | 100 | 68.1 | 68 | 69-133 | L0 |
| 2-Propanol | ug/L | 200 | 177 | 89 | 64-125 | |
| 4-Methyl-2-pentanone (MIBK) | ug/L | 100 | 73.4 | 73 | 71-126 | |

**Results presented on this page are in the units indicated by the "Units" column except where an alternate unit is presented to the right of the result.**

## REPORT OF LABORATORY ANALYSIS

Pace Analytical
www.pacelabs.com

Pace Analytical Services, Inc.
150 N Ninth Street
Billings, MT 59101
(406)254-7226

# QUALITY CONTROL DATA

Project: 114-710303A.700 Bozeman LF
Pace Project No.: 10294384

LABORATORY CONTROL SAMPLE: 1884863

| Parameter | Units | Spike Conc. | LCS Result | LCS % Rec | % Rec Limits | Qualifiers |
|---|---|---|---|---|---|---|
| Acetone | ug/L | 100 | 114 | 114 | 69-131 | |
| Acrylonitrile | ug/L | 200 | 156 | 78 | 66-125 | |
| Benzene | ug/L | 20 | 19.7 | 99 | 42-143 | |
| Bromochloromethane | ug/L | 20 | 21.8 | 109 | 75-125 | |
| Bromodichloromethane | ug/L | 20 | 20.4 | 102 | 75-125 | |
| Bromoform | ug/L | 20 | 19.2 | 96 | 70-125 | |
| Bromomethane | ug/L | 20 | 27.6 | 138 | 30-150 | |
| Carbon disulfide | ug/L | 20 | 19.9 | 99 | 55-132 | |
| Carbon tetrachloride | ug/L | 20 | 20.8 | 104 | 75-126 | |
| Chlorobenzene | ug/L | 20 | 21.4 | 107 | 75-125 | |
| Chloroethane | ug/L | 20 | 17.6 | 88 | 65-134 | |
| Chloroform | ug/L | 20 | 19.9 | 100 | 75-125 | |
| Chloromethane | ug/L | 20 | 18.0 | 90 | 35-150 | |
| cis-1,2-Dichloroethene | ug/L | 20 | 20.2 | 101 | 72-125 | |
| cis-1,3-Dichloropropene | ug/L | 20 | 18.8 | 94 | 75-125 | |
| Cyclohexane | ug/L | 100 | 95.7 | 96 | 63-131 | |
| Dibromochloromethane | ug/L | 20 | 19.9 | 99 | 75-125 | |
| Dibromomethane | ug/L | 20 | 20.2 | 101 | 75-125 | |
| Dichlorodifluoromethane | ug/L | 20 | 15.3 | 76 | 50-134 | |
| Ethylbenzene | ug/L | 20 | 18.9 | 95 | 75-125 | |
| Iodomethane | ug/L | 20 | 30.6 | 153 | 32-137 | L0 |
| Isopropylbenzene (Cumene) | ug/L | 20 | 18.5 | 93 | 75-125 | |
| Methyl-tert-butyl ether | ug/L | 20 | 17.9 | 89 | 73-125 | |
| Methylene Chloride | ug/L | 20 | 19.4 | 97 | 73-125 | |
| n-Hexane | ug/L | 50 | 65.6 | 131 | 37-157 | |
| n-Propylbenzene | ug/L | 20 | 19.5 | 98 | 72-126 | |
| Styrene | ug/L | 20 | 17.7 | 89 | 75-125 | |
| Tetrachloroethene | ug/L | 20 | 20.4 | 102 | 74-125 | |
| Tetrahydrofuran | ug/L | 200 | 232 | 116 | 62-133 | |
| Toluene | ug/L | 20 | 21.2 | 106 | 74-125 | |
| trans-1,2-Dichloroethene | ug/L | 20 | 19.2 | 96 | 69-125 | |
| trans-1,3-Dichloropropene | ug/L | 20 | 19.0 | 95 | 75-125 | |
| trans-1,4-Dichloro-2-butene | ug/L | 50 | 41.5 | 83 | 62-133 | |
| Trichloroethene | ug/L | 20 | 20.4 | 102 | 75-125 | |
| Trichlorofluoromethane | ug/L | 20 | 16.6 | 83 | 74-127 | |
| Vinyl acetate | ug/L | 20 | 16.5 | 82 | 59-127 | |
| Vinyl chloride | ug/L | 20 | 15.4 | 77 | 66-132 | |
| Xylene (Total) | ug/L | 60 | 56.0 | 93 | 75-125 | |
| 1,2-Dichloroethane-d4 (S) | %. | | | 90 | 75-125 | |
| 4-Bromofluorobenzene (S) | %. | | | 98 | 75-125 | |
| Toluene-d8 (S) | %. | | | 98 | 75-125 | |

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## QUALITY CONTROL DATA

Project: 114-710303A.700 Bozeman LF
Pace Project No.: 10294384

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1884864 1884865

| Parameter | Units | 10293854003 Result | MS Spike Conc. | MSD Spike Conc. | MS Result | MSD Result | MS % Rec | MSD % Rec | % Rec Limits | RPD | Max RPD | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1,1,1,2-Tetrachloroethane | ug/L | ND | 50 | 50 | 59.2 | 62.2 | 118 | 124 | 68-141 | 5 | 30 | |
| 1,1,1-Trichloroethane | ug/L | ND | 50 | 50 | 56.4 | 59.9 | 113 | 120 | 52-150 | 6 | 30 | |
| 1,1,2,2-Tetrachloroethane | ug/L | ND | 50 | 50 | 45.7 | 51.5 | 91 | 103 | 61-143 | 12 | 30 | |
| 1,1,2-Trichloroethane | ug/L | ND | 50 | 50 | 56.9 | 60.4 | 114 | 121 | 65-140 | 6 | 30 | |
| 1,1,2-Trichlorotrifluoroethane | ug/L | ND | 50 | 50 | 50.2 | 57.6 | 100 | 115 | 51-150 | 14 | 30 | |
| 1,1-Dichloroethane | ug/L | 124 | 50 | 50 | 174 | 174 | 100 | 100 | 49-150 | 0 | 30 | |
| 1,1-Dichloroethene | ug/L | 32.6 | 50 | 50 | 90.6 | 87.4 | 116 | 110 | 40-150 | 4 | 30 | |
| 1,2,3-Trichloropropane | ug/L | ND | 50 | 50 | 48.4 | 52.5 | 97 | 105 | 65-141 | 8 | 30 | |
| 1,2,4-Trimethylbenzene | ug/L | ND | 50 | 50 | 44.5 | 52.0 | 89 | 104 | 47-149 | 16 | 30 | |
| 1,2-Dibromo-3-chloropropane | ug/L | ND | 125 | 125 | 107 | 111 | 86 | 89 | 53-150 | 4 | 30 | |
| 1,2-Dibromoethane (EDB) | ug/L | ND | 50 | 50 | 54.2 | 58.0 | 108 | 116 | 65-137 | 7 | 30 | |
| 1,2-Dichlorobenzene | ug/L | ND | 50 | 50 | 48.8 | 56.2 | 98 | 112 | 66-133 | 14 | 30 | |
| 1,2-Dichloroethane | ug/L | ND | 50 | 50 | 50.3 | 54.5 | 101 | 109 | 54-138 | 8 | 30 | |
| 1,2-Dichloropropane | ug/L | ND | 50 | 50 | 55.4 | 59.3 | 111 | 119 | 59-142 | 7 | 30 | |
| 1,4-Dichlorobenzene | ug/L | ND | 50 | 50 | 45.9 | 54.1 | 92 | 108 | 65-129 | 16 | 30 | |
| 1,4-Dioxane (p-Dioxane) | ug/L | ND | 1000 | 1000 | 1230 | 1240 | 123 | 124 | 64-131 | 1 | 30 | |
| 2-Butanone (MEK) | ug/L | ND | 250 | 250 | 173 | 183 | 69 | 73 | 39-150 | 6 | 30 | |
| 2-Hexanone | ug/L | ND | 250 | 250 | 191 | 205 | 77 | 82 | 62-145 | 7 | 30 | |
| 2-Propanol | ug/L | ND | 500 | 500 | 443J | 568 | 89 | 114 | 30-150 | | 30 | |
| 4-Methyl-2-pentanone (MIBK) | ug/L | ND | 250 | 250 | 201 | 221 | 80 | 88 | 59-143 | 9 | 30 | |
| Acetone | ug/L | ND | 250 | 250 | 302 | 377 | 121 | 151 | 52-150 | 22 | 30 | M1 |
| Acrylonitrile | ug/L | ND | 500 | 500 | 438 | 454 | 88 | 91 | 63-126 | 4 | 30 | |
| Benzene | ug/L | ND | 50 | 50 | 52.7 | 55.3 | 105 | 110 | 30-150 | 5 | 30 | |
| Bromochloromethane | ug/L | ND | 50 | 50 | 63.7 | 68.0 | 127 | 136 | 62-140 | 7 | 30 | |
| Bromodichloromethane | ug/L | ND | 50 | 50 | 55.5 | 57.6 | 111 | 115 | 62-143 | 4 | 30 | |
| Bromoform | ug/L | ND | 50 | 50 | 49.1 | 56.8 | 98 | 114 | 59-136 | 15 | 30 | |
| Bromomethane | ug/L | ND | 100 | 100 | 164 | 145 | 164 | 145 | 30-150 | 12 | 30 | M1 |
| Carbon disulfide | ug/L | ND | 50 | 50 | 57.6 | 60.3 | 115 | 121 | 35-150 | 5 | 30 | |
| Carbon tetrachloride | ug/L | ND | 50 | 50 | 59.0 | 62.3 | 118 | 125 | 51-150 | 5 | 30 | |
| Chlorobenzene | ug/L | ND | 50 | 50 | 58.0 | 64.8 | 116 | 130 | 65-133 | 11 | 30 | |
| Chloroethane | ug/L | 16.2 | 100 | 100 | 126 | 101 | 110 | 85 | 48-150 | 22 | 30 | |
| Chloroform | ug/L | ND | 50 | 50 | 57.0 | 59.2 | 114 | 118 | 54-149 | 4 | 30 | |
| Chloromethane | ug/L | ND | 100 | 100 | 98.8 | 78.0 | 99 | 78 | 30-150 | 24 | 30 | |
| cis-1,2-Dichloroethene | ug/L | 672 | 50 | 50 | 710 | 682 | 76 | 20 | 49-150 | 4 | 30 | M1 |
| cis-1,3-Dichloropropene | ug/L | ND | 50 | 50 | 53.3 | 57.1 | 107 | 114 | 64-130 | 7 | 30 | |
| Cyclohexane | ug/L | ND | 250 | 250 | 238 | 260 | 95 | 104 | 50-150 | 9 | 30 | |
| Dibromochloromethane | ug/L | ND | 50 | 50 | 56.3 | 60.9 | 113 | 122 | 68-138 | 8 | 30 | |
| Dibromomethane | ug/L | ND | 50 | 50 | 59.9 | 64.6 | 120 | 129 | 67-134 | 8 | 30 | |
| Dichlorodifluoromethane | ug/L | ND | 100 | 100 | 79.5 | 68.2 | 79 | 68 | 39-150 | 15 | 30 | |
| Ethylbenzene | ug/L | ND | 50 | 50 | 52.5 | 59.9 | 105 | 120 | 55-139 | 13 | 30 | |
| Iodomethane | ug/L | ND | 50 | 50 | 110 | 110 | 220 | 221 | 32-135 | 1 | 30 | M0 |
| Isopropylbenzene (Cumene) | ug/L | ND | 50 | 50 | 48.4 | 52.1 | 97 | 104 | 61-146 | 7 | 30 | |
| Methyl-tert-butyl ether | ug/L | ND | 50 | 50 | 48.7 | 53.7 | 97 | 107 | 50-144 | 10 | 30 | |
| Methylene Chloride | ug/L | ND | 50 | 50 | 57.4 | 61.2 | 115 | 122 | 54-136 | 6 | 30 | |

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## QUALITY CONTROL DATA

Project: 114-710303A.700 Bozeman LF
Pace Project No.: 10294384

MATRIX SPIKE & MATRIX SPIKE DUPLICATE: 1884864 1884865

| Parameter | Units | 10293854003 Result | MS Spike Conc. | MSD Spike Conc. | MS Result | MSD Result | MS % Rec | MSD % Rec | % Rec Limits | RPD | Max RPD | Qual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| n-Hexane | ug/L | ND | 125 | 125 | 171 | 216 | 137 | 173 | 30-150 | 23 | 30 | M1 |
| n-Propylbenzene | ug/L | ND | 50 | 50 | 49.5 | 56.7 | 99 | 113 | 59-142 | 14 | 30 | |
| Styrene | ug/L | ND | 50 | 50 | 47.0 | 53.6 | 94 | 107 | 68-134 | 13 | 30 | |
| Tetrachloroethene | ug/L | ND | 50 | 50 | 53.7 | 62.5 | 107 | 125 | 44-150 | 15 | 30 | |
| Tetrahydrofuran | ug/L | ND | 500 | 500 | 705 | 769 | 141 | 154 | 59-145 | 9 | 30 | M1 |
| Toluene | ug/L | ND | 50 | 50 | 58.9 | 64.5 | 117 | 128 | 52-148 | 9 | 30 | |
| trans-1,2-Dichloroethene | ug/L | 18.6 | 50 | 50 | 74.9 | 76.8 | 113 | 116 | 45-150 | 2 | 30 | |
| trans-1,3-Dichloropropene | ug/L | ND | 50 | 50 | 53.3 | 56.2 | 107 | 112 | 68-132 | 5 | 30 | |
| trans-1,4-Dichloro-2-butene | ug/L | ND | 125 | 125 | 107 | 118 | 86 | 95 | 49-135 | 10 | 30 | |
| Trichloroethene | ug/L | ND | 50 | 50 | 61.6 | 65.0 | 123 | 130 | 52-150 | 5 | 30 | |
| Trichlorofluoromethane | ug/L | ND | 100 | 100 | 95.7 | 80.0 | 96 | 80 | 50-150 | 18 | 30 | |
| Vinyl acetate | ug/L | ND | 50 | 50 | 44.4J | 46.4J | 89 | 93 | 41-130 | | 30 | |
| Vinyl chloride | ug/L | 2.9 | 100 | 100 | 100 | 79.2 | 97 | 76 | 43-150 | 24 | 30 | |
| Xylene (Total) | ug/L | ND | 150 | 150 | 153 | 167 | 102 | 111 | 54-144 | 9 | 30 | |
| 1,2-Dichloroethane-d4 (S) | %. | | | | | | 87 | 87 | 75-125 | | | |
| 4-Bromofluorobenzene (S) | %. | | | | | | 97 | 95 | 75-125 | | | |
| Toluene-d8 (S) | %. | | | | | | 99 | 100 | 75-125 | | | |

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# QUALIFIERS

Project: 114-710303A.700 Bozeman LF
Pace Project No.: 10294384

## 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.

PQL - Practical Quantitation 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.

## LABORATORIES

PASI-M Pace Analytical Services - Minneapolis

## ANALYTE QUALIFIERS

| | |
|---|---|
| L0 | Analyte recovery in the laboratory control sample (LCS) was outside QC limits. |
| L2 | Analyte recovery in the laboratory control sample (LCS) was below QC limits. Results may be biased low. |
| L3 | Analyte recovery in the laboratory control sample (LCS) exceeded QC limits. Analyte presence below reporting limits in associated samples. Results unaffected by high bias. |
| M0 | Matrix spike recovery and/or matrix spike duplicate recovery was outside laboratory control limits. |
| M1 | Matrix spike recovery exceeded QC limits. Batch accepted based on laboratory control sample (LCS) recovery. |

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## QUALITY CONTROL DATA CROSS REFERENCE TABLE

Project: 114-710303A.700 Bozeman LF
Pace Project No.: 10294384

| Lab ID | Sample ID | QC Batch Method | QC Batch | Analytical Method | Analytical Batch |
|---|---|---|---|---|---|
| **10294384001** | **MW-27** | EPA 8260B | MSV/30161 | | |
| **10294384002** | **TRIP BLANK** | EPA 8260B | MSV/30161 | | |