FINAL QUALITY ASSURANCE PROJECT PLAN
Rainbow Creek HF183 Monitoring

Prepared for:

County of San Diego
DPW/Watershed Protection
5500 Overland Ave., Suite 310
San Diego, California 92123

Contract Number: 551462 TO67

Prepared by:

Weston Solutions, Inc.
5817 Dryden Place, Suite 101
Carlsbad, California 92008

November 2019
GROUP A ELEMENTS: PROJECT MANAGEMENT

1. TITLE AND APPROVAL SHEET

Final
Quality Assurance Project Plan
Rainbow Creek HF183 Monitoring

November 2019
## APPROVAL SIGNATURES

### COUNTY OF SAN DIEGO:

<table>
<thead>
<tr>
<th>Title</th>
<th>Name</th>
<th>Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contract Manager</td>
<td>Joanna Wisniewski</td>
<td></td>
<td>11/5/19</td>
</tr>
<tr>
<td>Project Manager</td>
<td>Ryan Jensen</td>
<td></td>
<td>11/5/19</td>
</tr>
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### WESTON SOLUTIONS, INC.:

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<th>Signature</th>
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<tr>
<td>Project Manager</td>
<td>Michelle Mattson</td>
<td></td>
<td>11/5/19</td>
</tr>
<tr>
<td>QA Officer</td>
<td>Satomi Yonemasu</td>
<td></td>
<td>11/5/19</td>
</tr>
<tr>
<td>Laboratory Director</td>
<td>Alexander Schriewer</td>
<td></td>
<td>11/5/19</td>
</tr>
<tr>
<td>Laboratory QA Officer</td>
<td>Melody McNay</td>
<td></td>
<td>11-5-2019</td>
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### EMA ANALYTICAL, INC.:

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<tr>
<td>Project Manager</td>
<td>Joseph Leonard</td>
<td></td>
<td>12/7/19</td>
</tr>
<tr>
<td>LAB DIRECTOR QA Officer</td>
<td>Jennifer Beyer</td>
<td></td>
<td>12/7/19</td>
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<th>Definition</th>
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<td>CA</td>
<td>California</td>
</tr>
<tr>
<td>CEDEN</td>
<td>California Environmental Data Exchange Network</td>
</tr>
<tr>
<td>COC</td>
<td>chain-of-custody</td>
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<tr>
<td>COLD</td>
<td>cold freshwater habitat</td>
</tr>
<tr>
<td>County</td>
<td>County of San Diego</td>
</tr>
<tr>
<td>ddPCR</td>
<td>droplet digital polymerase chain reaction</td>
</tr>
<tr>
<td>DNA</td>
<td>Deoxyribonucleic acid</td>
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<tr>
<td>EDD</td>
<td>electronic data deliverable</td>
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<tr>
<td>ELAP</td>
<td>Environmental Laboratory Accreditation Program</td>
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<tr>
<td>EMA</td>
<td>EnviroMatrix Analytical Inc.</td>
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<tr>
<td>HAS</td>
<td>hydrologic sub areas</td>
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<tr>
<td>IC</td>
<td>inhibition control</td>
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<tr>
<td>LCS</td>
<td>laboratory control sample</td>
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<tr>
<td>LOD</td>
<td>limit of detection</td>
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<tr>
<td>MQO</td>
<td>measurement quality objective</td>
</tr>
<tr>
<td>MPN</td>
<td>most probable number</td>
</tr>
<tr>
<td>MS</td>
<td>matrix spike</td>
</tr>
<tr>
<td>MSD</td>
<td>matrix spike duplicate</td>
</tr>
<tr>
<td>MST</td>
<td>microbial source tracking</td>
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<td>MS4</td>
<td>municipal separate storm sewer system</td>
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<tr>
<td>MUN</td>
<td>municipal supply</td>
</tr>
<tr>
<td>MWD</td>
<td>municipal water district</td>
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<tr>
<td>NA</td>
<td>not applicable</td>
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<tr>
<td>NTC</td>
<td>no template control</td>
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<tr>
<td>NGI</td>
<td>estimated illness rate</td>
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<tr>
<td>NPDES</td>
<td>National Pollutant Discharge Elimination System</td>
</tr>
<tr>
<td>PBS</td>
<td>phosphate-buffered saline</td>
</tr>
<tr>
<td>PCR</td>
<td>polymerase chain reaction</td>
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<tr>
<td>OWTS</td>
<td>onsite wastewater treatment system</td>
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<tr>
<td>QA</td>
<td>quality assurance</td>
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<td>QAPP</td>
<td>quality assurance project plan</td>
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<tr>
<td>QC</td>
<td>quality control</td>
</tr>
<tr>
<td>qPCR</td>
<td>quantitative polymerase chain reaction</td>
</tr>
<tr>
<td>RBC</td>
<td>Rainbow Creek</td>
</tr>
<tr>
<td>REC-1</td>
<td>contact water recreation</td>
</tr>
<tr>
<td>REC-2</td>
<td>non-contact water recreation</td>
</tr>
<tr>
<td>RW</td>
<td>receiving water</td>
</tr>
<tr>
<td>RPD</td>
<td>relative percent difference</td>
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<tr>
<td>San Diego Water Board</td>
<td>San Diego Regional Water Quality Control Board</td>
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<tr>
<td>SAP</td>
<td>sampling and analysis plan</td>
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<tr>
<td>SM</td>
<td>Standard Method</td>
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<tr>
<td>SOP</td>
<td>standard operating procedure</td>
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<td>SPC</td>
<td>sample processing control</td>
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<td>State Board</td>
<td>State Water Resources Control Board</td>
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<tr>
<td>STV</td>
<td>statistical threshold value</td>
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<tr>
<td>SWAMP</td>
<td>Surface Water Ambient Monitoring Program</td>
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<tr>
<td>TBD</td>
<td>to be determined</td>
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<tr>
<td>TMDL</td>
<td>total maximum daily load</td>
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USEPA United States Environmental Protection Agency
WARM warm freshwater habitat
WESTON® Weston Solutions, Inc.
WILD wildlife habitat

Units of Measure

°C degrees Celsius
CFU colony forming units
g gram(s)
mg/L milligram per liter
mL milliliters
MPN most probable number
oz ounce(s)
ppth Part per thousand
% percent
3. DISTRIBUTION LIST

Table 3-1 identifies those individuals who will oversee the implementation of the approved Quality Assurance Project Plan (QAPP). Copies of the QAPP will be submitted via electronic format to the key personnel listed in Table 3-1. These individuals will then be responsible for distributing this QAPP to their respective County of San Diego Department of Public Works Watershed Protection Program (County), Weston Solutions, Inc. (WESTON®) and EnviroMatrix Analytical, Inc. (EMA) staff.

Table 3-1. Quality Assurance Project Plan Distribution List

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<thead>
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<th>Title</th>
<th>Name (Affiliation)</th>
<th>Telephone No.</th>
<th>QAPP Version No.</th>
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<td>Contract Manager</td>
<td>Joanna Wisniewska (County)</td>
<td>(858) 694-2312</td>
<td>1.0</td>
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<tr>
<td>Project Manager</td>
<td>Ryan Jensen (County)</td>
<td>(858) 495-5636</td>
<td>1.0</td>
</tr>
<tr>
<td>Project Manager</td>
<td>Michelle Mattson (WESTON)</td>
<td>(760) 795-6984</td>
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<tr>
<td>QA Officer</td>
<td>Satomi Yonemasu (WESTON)</td>
<td>(760) 795-6907</td>
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<td>Field Sampling Lead</td>
<td>Kyle Clouthier (WESTON)</td>
<td>(760) 795-6903</td>
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<tr>
<td>Laboratory Director</td>
<td>Alexander Schriewer (WESTON)</td>
<td>(760) 795-6957</td>
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<tr>
<td>Laboratory QA Officer</td>
<td>Melody McNay (WESTON)</td>
<td>(760) 795-6913</td>
<td>1.0</td>
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<tr>
<td>Laboratory Project Manager</td>
<td>Joseph Leonard (EMA)</td>
<td>(858) 560-7717</td>
<td>1.0</td>
</tr>
<tr>
<td>Laboratory QA Officer</td>
<td>Jennifer Beyer (EMA)</td>
<td>(858) 560-7717</td>
<td>1.0</td>
</tr>
</tbody>
</table>
4. PROJECT/TASK ORGANIZATION

4.1 Involved Parties and Roles

This section of the QAPP describes individuals and their respective roles for this project.

Table 4-1 provides a summary of individuals, their key role, and contact information. Figure 4-1 is an organizational chart showing the roles and lines of communication between key individuals.

**County of San Diego Contract Manager:** Joanna Wisniewska will serve as the Contract Manager for the County. She will be responsible for oversight of the contract (no. 551462), including final approval of plans and reports.

**County of San Diego Project Manager:** Ryan Jensen will serve as the County’s Project Manager. He will be responsible for oversight of the monitoring program, coordination with WESTON on field activities and schedules, technical review of plans and reports, and approving invoices for payment.

**WESTON Project Manager:** Michelle Mattson will serve as WESTON’s Project Manager. She will be responsible for all aspects of implementing the Rainbow Creek HF183 Monitoring Program including scheduling and implementation of field monitoring activities, coordination with the laboratories involved in this project, overseeing budgetary expenses, and technical review of plans and reports.

**WESTON Field Sampling Lead:** Kyle Clouthier will serve as the WESTON Field Sampling Lead. He will be responsible for field team efforts and provide oversight for all field activities including developing field schedules, coordinating field staff, maintaining equipment utilized for sampling, conducting the sampling, ensuring samples are delivered to the laboratory with proper documentation and sample preservation, and maintaining field records associated with each monitoring task.

**WESTON Quality Assurance (QA) Officer:** Satomi Yonemasu will serve as the WESTON QA Officer. She will be responsible for guaranteeing the overall QA and quality control (QC) procedures and will ensure that data reported by WESTON have been generated in compliance with the appropriate protocols. Ms. Yonemasu will report all findings to the WESTON Project Manager, including all requests for corrective actions. If there is evidence of significant deviations from protocols stated in this QAPP or if there is evidence of systematic failure, Ms. Yonemasu has the authority to stop all activities until corrective actions can be documented and performed.

**WESTON Molecular Laboratory Director:** Alexander Schriewer will serve as the Laboratory Director for WESTON’s Molecular Laboratory. The Laboratory Director will be responsible for overseeing operations of laboratory staff, coordination with the WESTON Project Manager, and invoicing of laboratory charges.

**WESTON Molecular Laboratory QA Officer:** Melody McNay will serve as the Laboratory QA Officer for WESTON’s Molecular Laboratory. The Laboratory QA officer will be responsible for all analyses conducted by the molecular laboratory and will ensure that the QAPP guidelines are being met.
EMA Laboratory Project Manager: Joseph Leonard will serve as the EMA Laboratory Project Manager. The laboratory project manager will be responsible for coordination of laboratory staff to conduct analyses of fecal indicator bacteria, coordination with the WESTON Project Manager for scheduling, and invoicing of laboratory charges.

EMA Laboratory QA Officer: Jennifer Beyer will serve as the Laboratory QA Officer for EMA. The Laboratory QA Officer will be responsible for all analyses conducted by the laboratory and will ensure that the QAPP guidelines are being met.

Table 4-1. Personnel Responsibilities and Contact Information

<table>
<thead>
<tr>
<th>Name</th>
<th>Organizational Affiliation</th>
<th>Title</th>
<th>Contact Information (telephone number and email address)</th>
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<tr>
<td>Joanna Wisniewska</td>
<td>County of San Diego</td>
<td>Contract Manager</td>
<td>(858) 694-2312 <a href="mailto:Joanna.Wisniewska@sdcounty.ca.gov">Joanna.Wisniewska@sdcounty.ca.gov</a></td>
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<tr>
<td>Ryan Jensen</td>
<td>County of San Diego</td>
<td>Project Manager</td>
<td>(858) 495-5636 <a href="mailto:Ryan.Jensen@sdcounty.ca.gov">Ryan.Jensen@sdcounty.ca.gov</a></td>
</tr>
<tr>
<td>Michelle Mattson</td>
<td>Weston Solutions, Inc.</td>
<td>Project Manager</td>
<td>(760) 795-6984 <a href="mailto:Michelle.Mattson@westonsolutions.com">Michelle.Mattson@westonsolutions.com</a></td>
</tr>
<tr>
<td>Kyle Clouthier</td>
<td>Weston Solutions, Inc.</td>
<td>Field Sampling Lead</td>
<td>(760) 795-6903 <a href="mailto:Kyle.Clouthier@westonsolutions.com">Kyle.Clouthier@westonsolutions.com</a></td>
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<tr>
<td>Satomi Yonemasu</td>
<td>Weston Solutions, Inc.</td>
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<td>Melody McNay</td>
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<tr>
<td>Joseph Leonard</td>
<td>EnviroMatrix Analytical, Inc.</td>
<td>Project Manager</td>
<td>(858) 560-7717 <a href="mailto:Jleonard@enviromatrixinc.com">Jleonard@enviromatrixinc.com</a></td>
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<td>Jennifer Beyer</td>
<td>EnviroMatrix Analytical, Inc.</td>
<td>Laboratory QA Officer</td>
<td>(858) 560-7717 <a href="mailto:Jbeyer@enviromatrixinc.com">Jbeyer@enviromatrixinc.com</a></td>
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</tbody>
</table>
4.2 Quality Assurance Officer Role

The WESTON QA Officer will be responsible for maintaining the QAPP and ensuring that personnel listed in Element 3 have the most recent version of the QAPP. The QA Officer will ensure that project staff understand and perform all QA/QC procedures related to field sample collection, laboratory analysis, and data analysis according to QAPP requirements throughout the duration of this project.

4.3 Persons Responsible for QAPP Update and Maintenance

Changes and updates to this QAPP may be made after a review of the evidence for change by WESTON’s Project Manager and QA Officer with the concurrence of the County Contract Manager. WESTON’s Project Manager, with input from the QA Officer, will be responsible for making the changes, submitting drafts for review, preparing a final amended copy, and submitting the final version for signature.
5. **Problem Definition/Background**

5.1 **Problem Statement**

Rainbow Creek (Creek) was included on the Clean Water Act Section 303(d) list of water quality limited waterbodies in 1996 due to beneficial use impairments associated with elevated levels of nitrogen and phosphorus. Beneficial uses in Rainbow Creek include municipal supply (MUN), warm freshwater habitat (WARM), cold freshwater habitat (COLD), wildlife habitat (WILD), contact water recreation (REC-1), and non-contact water recreation (REC-2). These beneficial uses are threatened or impaired due to excessive levels of nutrients (San Diego Regional Water Quality Control Board [San Diego Water Board], 2005). In 2005 the San Diego Water Board adopted Resolution No. R9-2005-006 to amend the San Diego Water Quality Control Plan (Basin Plan) and incorporate the Total Maximum Daily Loads for Total Nitrogen and Total Phosphorus in Rainbow Creek Watershed (Nutrient TMDL).

The Nutrient TMDL identified the County, Caltrans, commercial nurseries, agricultural fields, orchards, parks, residential areas, and septic tank disposal systems as causing or permitting the discharge of nutrients to the Creek. The County developed and implemented the Sampling and Analysis Plan for Rainbow Creek Nutrient Reduction TMDL Implementation Water Quality Monitoring ([TMDL Monitoring Program], County, 2011) to monitor and assess water quality conditions, evaluate temporal trends for nutrients and assess progress toward TMDL attainment. In addition to the TMDL Monitoring Program, the County also implements a voluntary monitoring program to assess urban runoff contribution from the municipal separate storm sewer system (MS4) to the nutrient loading in the Creek (MS4 Monitoring Program).

Onsite wastewater treatment systems (OWTS) were identified by the Nutrient TMDL, as contributors of approximately 5 percent (%) of total nitrogen loading to the Creek. The Rainbow Valley Basin has a high ground water table, ground water surfaces in the Creek in Rainbow Valley and also in the lower reaches of the Creek beginning approximately 1 mile below I-15. There may also be localized mounding from septic fields and agricultural irrigation (Peterson 1989) in the valley. Since 1970, the County of San Diego has prohibited the installation of new or replacement OWTS in areas of Rainbow Valley that are impacted by a high groundwater table. Many of the existing OWTS have leach fields in close proximity or located within the groundwater table (San Diego Water Board, 2005).

This Monitoring Program will conduct screening of locations monitored under the TMDL and MS4 Monitoring Programs for fecal indicator bacteria and human-associated fecal marker HF183 in order to assess potential influence of septic systems on dry weather flows in the watershed. Sowah et al. (2017) found correlations between in-stream HF183 and proximity of OWTS. The study also found that HF183 levels were higher in watersheds with increased OWTS density. Data collected from the HF183 Monitoring Program will be used to identify areas with suspected septic system influence on dry weather flows and may be used to inform targeted studies or further investigation.
5.2 Decisions or Outcomes

Monitoring will be conducted in accordance with the Rainbow Creek HF183 Monitoring Plan ([HF183 Monitoring Plan], WESTON 2019). Data collected from this monitoring program will be used to address the following questions:

1. Is the human-associated fecal marker HF183 present in MS4 outfall and/or receiving water dry weather flows in the Rainbow Creek Watershed?

2. If present, the following sub-questions will be addressed:
   
   a) What is the spatial pattern of HF183 in the watershed?
   b) What is the magnitude and the rate of occurrence?
   c) Under what flow conditions is HF183 observed?
   d) Is there a correlation between HF183 marker and land use?
   e) Is there a correlation between HF183 spatial patterns and known septic tank locations?
   f) Is there a correlation between HF183 concentrations or frequency and nutrient levels?

These questions will be answered by analyses of collected samples for the human-associated fecal indicator marker HF183 as well as fecal indicator bacteria. It is anticipated that results from this study may be used to inform additional monitoring to target potential sources of HF183 in the watershed including failing septic systems.
5.3 Water Quality or Regulatory Criteria

The Nutrient TMDL identified septic systems as being responsible for 5% of the nutrient loading to the Creek. This Monitoring Program will conduct screening of receiving water and MS4 locations for fecal indicator bacteria and HF183 to assess potential influence of septic systems on dry weather flows in the watershed. There are currently no established thresholds or water quality objectives for HF183 in the San Diego region.

On August 7, 2018, the State Water Resources Control Board (State Water Board) adopted new statewide bacteria water quality objectives (Bacteria Provisions) to protect recreational beneficial uses. The Bacteria provisions became effective upon approval by the Office of Administrative Law, on February 4, 2019. The objectives were incorporated into Part 3 of the Water Quality Control Plan for the Inland Surface Waters, Enclosed Bays, and Estuaries of California (State Board, 2019). Additional discussion is provided in Section 7.2.
6. PROJECT/TASK DESCRIPTION

6.1 Work Statement and Produced Products

Screening of outfalls and receiving waters in the Rainbow Creek watershed will occur on a monthly basis during dry weather conditions. Samples will be collected at each site for the human-associated fecal marker HF183 and fecal indicator bacteria.

Monthly data deliverables will be provided to the County with results from the molecular analysis along with results from concurrent monitoring for the TMDL and MS4 Monitoring Programs. A report presenting the findings of the HF183 study will be presented to the County for review. Upon review by the County, comments will be incorporated and the report will be finalized for inclusion in the 2018-2019 Water Quality Improvement Plan Annual Report.

6.2 Constituents to be Monitored and Measurement Techniques

Samples will be analyzed for fecal indicator bacteria and human associated fecal marker HF183. EMA, an Environmental Laboratory Accreditation Program (ELAP)-certified laboratory (Certification No. 2564) will analyze samples for fecal coliform, *Enterococcus* and *E.coli*. Table 6-1 lists the monitored constituents and methods. Section 13 provides additional discussion of the analytical methods.

WESTON’s Molecular Laboratory will conduct analysis for the human-associated fecal marker HF183. Samples will be filtered within 6 hours in accordance with WESTON standard operating procedure (SOP) LAB074.01 (Filtration Protocol for Samples for Molecular Analysis). Deoxyribonucleic acid (DNA) will be extracted from the filters using the GeneRite DNA-EZ ST1 kit according to SOP LAB078.00 (GeneRite DNA-EZ Extraction (500/350)). The purified sample extracts will then be tested for HF183 via droplet digital polymerase chain reaction (ddPCR) on a BioRad QX200 ddPCR System.

<table>
<thead>
<tr>
<th>Laboratory</th>
<th>Parameters</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>EnviroMatrix Laboratory Inc.</td>
<td>Fecal coliform</td>
<td>SM9221E</td>
</tr>
<tr>
<td></td>
<td><em>E. coli</em></td>
<td>IDEXX</td>
</tr>
<tr>
<td></td>
<td><em>Enterococcus</em></td>
<td>SM 9230B</td>
</tr>
<tr>
<td>WESTON Molecular Laboratory</td>
<td>Filtration</td>
<td>SOP LAB074.01</td>
</tr>
<tr>
<td></td>
<td>DNA Extraction</td>
<td>SOP LAB078.00</td>
</tr>
<tr>
<td></td>
<td>HF183 (WESTON assay name: HF183 CAMan dd)</td>
<td>ddPCR</td>
</tr>
</tbody>
</table>
6.3 Project Schedule

Monitoring and Reporting Schedule
Table 6-2 details the project schedule for monitoring and reporting for the Rainbow Creek HF183 Monitoring Program, including initiation and completion dates for major tasks, required deliverables, and the deliverable’s due date. Monitoring will be conducted monthly from June 2019 through June 2020 in conjunction with the TMDL and MS4 Monitoring Programs.

Monthly data deliverables will be provided to the County in electronic format and will include a table of results, laboratory reports in portable document format (pdf), and electronic data deliverables (EDDs). A Draft Report will be submitted to the County on October 31, 2019. Assuming one round of comments from the County, and assuming that the County’s comments are received by November 14, 2019, a Final Report will be submitted to the County on November 29, 2019. Data included in the report will be submitted to the California Environmental Data Exchange Network (CEDEN) prior to January 31, 2020.

Data collected October 1, 2019 through June 2020 will be reported and submitted to CEDEN at a later date to be determined.

Table 6-2. Rainbow Creek HF183 Monitoring and Reporting Schedule

<table>
<thead>
<tr>
<th>Task</th>
<th>Anticipated Start Date</th>
<th>Anticipated End Date</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Project Planning</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitoring Plan</td>
<td>July 1, 2019</td>
<td>August 20, 2019</td>
</tr>
<tr>
<td>Quality Assurance Project Plan (QAPP)</td>
<td>July 1, 2019</td>
<td>August 20, 2019</td>
</tr>
<tr>
<td><strong>Monitoring Activities</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample Collection</td>
<td>June 1, 2019</td>
<td>June 30, 2020</td>
</tr>
<tr>
<td><strong>Data Deliverables &amp; Reporting Activities</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monthly Deliverables (Data Deliverable)</td>
<td>July 2019</td>
<td>June 2020</td>
</tr>
<tr>
<td>Draft Project Report</td>
<td>September 1, 2019</td>
<td>October 31, 2019</td>
</tr>
<tr>
<td>Final Project Report</td>
<td>November 14, 2019</td>
<td>November 29, 2019</td>
</tr>
<tr>
<td>Data Submittal to CEDEN</td>
<td>November 1, 2019</td>
<td>January 31, 2020</td>
</tr>
<tr>
<td>Data Report and CEDEN Submittal (data through June 2020)</td>
<td>TBD</td>
<td>TBD</td>
</tr>
</tbody>
</table>

TBD - to be determined
CEDEN – California Environmental Data Exchange Network
6.4 Geographical Setting

The Rainbow Creek Watershed is located within the Santa Margarita River Watershed Management Area in hydrologic sub areas (HSAs) 902.22 and 902.23 (Basin Plan). The Creek drains approximately 7,085 acres (San Diego Water Board, 2005), including 1,514-acres in Riverside County (Tetra Tech, 2016) (Figure 6-1).

![Figure 6-1. Rainbow Creek Watershed](image)

The Rainbow Creek watershed is primarily rural, with remaining land uses mainly classified as agricultural, residential, and urban. The most developed part of the watershed is the community of Rainbow that includes residential areas, commercial and private nurseries, and other agricultural operations (Figure 6-2).
Figure 6-2. Rainbow Creek Landuse in San Diego County
6.5 Constraints

Monthly dry weather monitoring will occur year round, including during the wet weather season. Dry weather sampling will occur when there is less than 0.1 inch of rainfall within the preceding 72 hours. Storm events are likely to occur in the wet weather season and may cause dry weather sampling events to be postponed. Depending upon the storm frequency and occurrence, it may not be possible to conduct dry weather sampling during a given month. If this occurs, sampling will be conducted on the next feasible date meeting the antecedent dry weather criteria. As a result, two sampling events may occur in a given month.

Throughout the year, conditions at each of the monitoring locations may be altered by natural or anthropogenic changes that may prevent physical or safe access. Such changes include overgrowth of vegetation, high flows, wildlife, or presence of transient populations. If field staff deem a site inaccessible for safety or physical constraints, the WESTON Project Manager will be notified, who will then notify the County Project Manager to determine the appropriate course of action. Potential actions include, but are not limited to, referral to the appropriate County agency for maintenance or revisiting the site.
7. Quality Objectives and Criteria for Measurement Data

7.1 Measurement Quality Indicators

Measurement quality indicators for laboratory analysis, including accuracy, precision, recovery, completeness, and representativeness, will be used to assess overall data quality for this monitoring program. These indicators and measurement quality objectives (MQOs) are used to determine the acceptable level of error in the data produced by the sampling program. Acceptance criteria will be based on the implementation of acceptable and recognized QA/QC procedures. Acceptable data must have been collected and analyzed using proper sample collection and handling methods, sample preparation and analytical procedures, holding times, stability issues, and QA protocols. The measurement quality indicators for laboratory analyses are summarized in Table 7-1 followed by a brief discussion of the objectives for each indicator.

<table>
<thead>
<tr>
<th>Measurement or Analysis Type</th>
<th>Applicable Data Quality Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory analyses: fecal indicator bacteria</td>
<td>Accuracy, Precision, Completeness</td>
</tr>
<tr>
<td>Laboratory analyses: human-associated fecal marker HF183</td>
<td>Accuracy, Precision, Completeness</td>
</tr>
</tbody>
</table>

**Accuracy**

Accuracy (bias) is a measure of how closely the analytical result represents the true quantity found in the sample. Evaluation of the accuracy of laboratory fecal indicator samples will be achieved using positive and negative controls and by field blanks or laboratory blanks.

Molecular analysis accuracy is measured by at least three blanks (field, filter, and extraction) for each batch for each assay. A field blank consists of sterile, molecular-grade water placed into a sample container during the field sampling process. A filtration blank consists of phosphate-buffered saline (PBS) filtered in the laboratory including all reagents added during the membrane filtration process. The PBS is the same used to rinse sample filters during membrane filtration. Filtration blanks are distributed throughout the sample filtration process to ensure the presence of at least one blank for each filtration batch. An extraction blank consists of a sterile filter through which at least 25 mL of sterile PBS solution is filtered prior to storage at -80°C, replacing a sample filter in the extraction process. Extraction blanks are distributed throughout the extraction process to ensure the presence of at least one blank for each extraction batch (17 samples).

In addition, molecular analysis accuracy is measured using several laboratory control samples including:

- Sample processing control (SPC) samples which involve the addition of salmon DNA (*Oncorhynchus keta*) to every sample during the extraction and quantified via the Sketa22 assay as a positive extraction control.
- Positive Control: PCR reactions set up with a known amount of target plasmid or genomic DNA. Lack of amplification of a positive control invalidates the PCR run, and the samples are re-analyzed with fresh reagents.
- Inhibition control (IC): Samples tested for inhibition use a matrix spike consisting of the target DNA added to the qPCR reaction containing the extracted sample DNA at full strength (undiluted) and extract diluted 1:5 by molecular-grade water. Sample DNA is considered inhibited if the cycle threshold between the undiluted and diluted extracts differ by more than one cycle (with results typically < 0.5 cycle) or the ddPCR analogue in concentration reduction. If results indicate inhibition, the sample DNA is diluted 1:5 and re-analyzed for target and for inhibition (e.g., using 1:5 dilutions of the already diluted DNA). Typically B. dorei genomic DNA (strain# DSM 17855, www.dsmz.de) is added and assessed by the HF183 assay. Sample results are corrected for the dilution required to overcome inhibition. Inhibited samples are flagged accordingly in laboratory reports.

- No Template Control (NTC): PCR reactions set up with molecular-grade water replacing sample DNA. NTCs are run at least in triplicate. Any positive reactions require re-analysis of the plate.

**Precision**

Precision is the measure of agreement among repeated measurements of the same property under identical or substantially similar conditions calculated as either the range or as the standard deviation. The precision of laboratory measurements will be controlled by comparison of the sample to a laboratory replicate. One laboratory replicate will be performed per 20 samples or one per analytical batch, whichever is more frequent. Precision of field sampling methods will be assessed through the use of field duplicate samples. Results of the duplicate (or replicate) analysis are evaluated per the Surface Water Ambient Monitoring Program (SWAMP) (QAPP) guidelines for indicator bacteria in freshwater. The results from the preceding 15 positive samples are used to assess precision as described below:

**Step 1:**
Record the results from duplicate analyses (D1 and D2).

**Step 2:**
Calculate the logarithm (L1 and L2) of each result.
Note: If either of the values D1 or D2 are less than 1, add 1 to both values before calculating the logarithms.

**Step 3:**
Calculate the range of logarithms (Rlog) for each pair of duplicates. Rlog is equal to the absolute value of the difference between the two numbers.

\[ R_{\text{log}} = |L_1 - L_2| \]

**Step 4:**
Calculate the mean of Rlog (\( \bar{R} \)) for the duplicates analyzed

\[ \bar{R} = \frac{\sum R_{\text{log}}}{n} \]

where:
\[ \Sigma = \text{the sum of the ranges of logarithms calculated for each pair of duplicates} \]
\[ n = \text{the number of pairs of duplicates (} n = 15 \) \]
Step 5:
Assess the precision of the duplicate analyses. In order for the laboratory to demonstrate an acceptable level of precision, the range of logarithms for a particular duplicate must be less than the mean of the range of logarithms multiplied by 3.27:

\[ R_{\log} \leq 3.27 \times \bar{R} \]

Molecular sample precision is measured with technical replicates: All samples and blanks are run in (at least) triplicate and the average and standard deviation is calculated.

\[
\text{Standard Deviation} (s) = \sqrt{\frac{\sum_{i=1}^{N} (x_i - \bar{x})^2}{n - 1}}
\]

where \(x_1, x_2, \ldots, x_N\) are the observed values of the sample items, \(\bar{x}\) is the mean value of these observations, and \(n\) is the number of observations in the sample.

Field duplicates are not a current SWAMP requirement for fecal indicator bacteria. Precision in field duplicates is evaluated using relative percent difference (RPD) as shown below:

\[
\text{RPD} = \frac{\text{abs} \left[ x_1 - x_2 \right]}{0.5 \times (x_1 + x_2)} \times 100
\]

where:
- \(x_1\) is the primary sample concentration; \(x_2\) is the duplicate sample concentration.

Completeness
Completeness is a measure of the percentage of sample results that are collected and analyzed and determined to be valid. Field personnel and the analytical laboratory will strive for 90% data completeness, which accounts for unexpected field conditions, equipment problems, and laboratory error.

The MQOs for laboratory measurements are provided in Table 7-2. One field duplicate and one field blank will be collected and analyzed for every 20 samples (5%).
### Table 7-2. Measurement Quality Objectives

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Accuracy</th>
<th>Precision</th>
<th>Target Reporting Limit</th>
<th>Completeness</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Enterococcus</strong></td>
<td>Field Blank: No growth on filter</td>
<td>Lab Replicate $R_{\text{rep}} \leq 3.27 \times R$</td>
<td>1 CFU/100 mL or 1 MPN/100 mL</td>
<td>90%</td>
</tr>
<tr>
<td>Laboratory Controls: Positive control and reference material = Growth on filter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative control = No growth on filter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fecal coliform</strong></td>
<td>Field Blank: No growth on filter</td>
<td>Lab Replicate $R_{\text{rep}} \leq 3.27 \times R$</td>
<td>2 CFU/100 mL or 2 MPN/100 mL</td>
<td>90%</td>
</tr>
<tr>
<td>Laboratory Controls: Positive control and reference material = Growth on filter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative control = No growth on filter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total coliform</strong></td>
<td>Field Blank: No growth on filter</td>
<td>Lab Replicate $R_{\text{rep}} \leq 3.27 \times R$</td>
<td>2 CFU/100 mL or 2 MPN/100 mL</td>
<td>90%</td>
</tr>
<tr>
<td>Laboratory Controls: Positive control and reference material = Growth on filter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative control = No growth on filter</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>HF183</strong></td>
<td>Field Blank, Filtration Blank, Extraction Blank and no-template controls: no amplification</td>
<td>Lab replicate $\leq 150% \text{ RSD}$</td>
<td>43 copies/100 mL (LOD)</td>
<td>90%</td>
</tr>
<tr>
<td>Positive controls: amplification</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RPD – relative percent difference  
LOD – limit of detection

### 7.2 Project Action Limits for Parameters of Interest

Results from FIB samples collected in receiving waters will be compared to Bacteria Provision objectives (see Section 5.3). The Bacteria Provisions provide statistical threshold values (STVs) for *E. coli* (320 colony forming units [CFU]/100 milliters [mL]) in freshwater and *Enterococcus* (110 CFU/100 mL) when salinity is greater than 1 part per thousand (ppth)\(^1\).

Sample results from MS4 locations will be compared to the non-stormwater action limits (NALs) provided in the MS4 Permit (San Diego Water Board Order No. R9-2013-0001 as amended by Order No. R9-2015-0001 and Order No. R9-2015-0100). The MS4 Permit includes instantaneous maximum NALs for fecal coliform (400 most probable number [MPN]/100mL) and *Enterococcus* (61 MPN/100mL).

A dry weather HF183 threshold has not yet been proposed for the San Diego Region.

---

\(^1\) *E. coli* objectives apply when salinity is equal to or less than 1 part per thousand (ppth) 95% or more of the time; *Enterococcus* objectives apply where salinity is greater than 1 ppth more than 5% of the time (State Board, 2018).
8. **SPECIAL TRAINING NEEDS/CERTIFICATION**

8.1 **Specialized Training or Certifications**

Field personnel will have current and relevant experience in the aspects of standard field monitoring, including use of relevant field monitoring equipment, experience in the collection and handling/storage of samples, and chain-of-custody (COC) procedures. Field staff will have training in clean hands technique (WESTON SOP FLD038.01, [Attachment A]). Prior to project initiation and training in techniques for proper field sampling and sample-handling will be reviewed, and only those staff with proficiency will be permitted to conduct field work.

All laboratory analysts will be proficient in the use of analytical equipment, conducting analytical protocols, and other general laboratory processes. The QA Officer is responsible for distributing the most up-to-date QAPP for this monitoring project to the respective laboratory staff and ensuring that the staff understand and follow all SOPs and the QAPP for the duration of this study.

8.2 **Training and Certification Documentation**

Personnel are responsible for complying with QA/QC requirements that pertain to their organizational/technical function. Technical staff members must have a combination of experience and education to adequately demonstrate a specific knowledge of their particular function and a general knowledge of laboratory operations, test methods, QA/QC procedures, and records management. Laboratory QA officers will ensure that all laboratory staff is proficient at analyses applicable to this project. Training and certification documents for laboratory staff will be maintained by the Laboratory QA officers, or their designee.

8.3 **Training Personnel**

The Project Manager and/or Field Sampling Lead will provide training for field personnel in proper field sampling techniques prior to work initiation to ensure consistent and appropriate sampling, sample handling/storage, and COC procedures. Training will include specialized training for the collection and handling of molecular samples. The laboratories’ QA officers will ensure that training is provided to the laboratories’ personnel for implementing standard laboratory procedures and maintaining proper documentation.
9. **DOCUMENTS AND RECORDS**

WESTON will document and track the aspects of the sample collection process at each site including COC forms for the samples collected. COC forms will accompany samples to each laboratory. Laboratories will document and track the aspects of receipt and storage, analyses, and reporting related to the samples.

WESTON will maintain a database of information collected during this project. The database will include field observations, data sheets, COC records, and analytical results. The original data sheets and reports produced will be housed in project-specific files maintained in file cabinets at the WESTON office after the report has been submitted. Electronic data will be stored in WESTON’s internal electronic file system. Data from outside contractors are kept exactly as received. Records will be maintained for at least five years or transferred according to agreement between the company and the client.

WESTON’s Project Manager (Ms. Mattson) will be responsible for maintaining records for this project. Ms. Mattson will oversee the operations of the project, will maintain the sample collection, sample transport, COC forms, and laboratory data. Ms. Mattson will also arbitrate any issues relative to records retention and any decisions to discard records.

Copies of this QAPP will be distributed to the parties identified previously in Element 3. Updates to this QAPP will be distributed in like manner, and previous versions will be discarded from the project file. WESTON’s Project Manager (Ms. Mattson) under the direction, supervision, and review of WESTON’s QA Officer (Ms. Yonemasu), will be responsible for distributing an updated version of the QAPP.

Copies of the final report, including laboratory results and field records, will be maintained for a minimum of five years after project completion.
GROUP B: DATA GENERATION AND ACQUISITION

10. SAMPLE PROCESS DESIGN

Monitoring will be conducted in conjunction with the TMDL and MS4 Monitoring Programs. Additional information can be found in the HF183 Monitoring Plan (WESTON, 2019).

10.1 Sample Locations

Monitoring will be conducted in conjunction with the TMDL and MS4 Monitoring Programs. Sample locations were selected for the TMDL and MS4 Monitoring Programs to characterize conditions in Rainbow Creek, tributaries, and MS4 outfalls with the potential to discharge to Rainbow Creek during dry weather.

The TMDL Monitoring Program includes sample locations in the main stem and tributaries of the Creek and two MS4 features (HST01 and HST02). The MS4 Monitoring Program includes 19 locations with the potential to discharge to the Creek during dry weather conditions. Descriptions of each site and coordinates are provided in Table 10-1. Sample locations are shown in Figure 10-1 and Figure 10-2.

Table 10-1. Monitoring Locations

<table>
<thead>
<tr>
<th>Location Name</th>
<th>Description</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Main Stem TMDL Sample Locations</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RBC01</td>
<td>Rainbow Creek @ Jubilee Way</td>
<td>33.4204</td>
<td>-117.1357</td>
</tr>
<tr>
<td>RBC02</td>
<td>Rainbow Creek @ Huffstatler Road</td>
<td>33.4154</td>
<td>-117.152</td>
</tr>
<tr>
<td>RBC04</td>
<td>Rainbow Creek @ Old Highway 395</td>
<td>33.4127</td>
<td>-117.1585</td>
</tr>
<tr>
<td>RBC10</td>
<td>Rainbow Creek @ MWD Crossing</td>
<td>33.407</td>
<td>-117.1834</td>
</tr>
<tr>
<td>SMG05</td>
<td>Rainbow Creek @ Willow Glen Road</td>
<td>33.4079</td>
<td>-117.201</td>
</tr>
<tr>
<td>SMG06</td>
<td>Rainbow Creek @ Stage Coach Lane</td>
<td>33.4106</td>
<td>-117.2148</td>
</tr>
<tr>
<td><strong>Tributary TMDL Sample Locations</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RVT02</td>
<td>Chica Tributary @ 1st Street</td>
<td>33.4213</td>
<td>-117.1498</td>
</tr>
<tr>
<td>RGT01</td>
<td>Rainbow Glen Tributary to Rainbow Creek</td>
<td>33.4111</td>
<td>-117.1857</td>
</tr>
<tr>
<td>MGT01</td>
<td>Margarita Glen Tributary to Rainbow Creek</td>
<td>33.4085</td>
<td>-117.1988</td>
</tr>
<tr>
<td>WGT01</td>
<td>Willow Glen Tributary @ Willow Glen Road</td>
<td>33.4078</td>
<td>-117.2031</td>
</tr>
<tr>
<td>VMT01</td>
<td>Via Milpas Tributary to Rainbow Creek</td>
<td>33.4096</td>
<td>-117.2137</td>
</tr>
<tr>
<td><strong>MS4 TMDL Sample Locations</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HST01</td>
<td>Brow Ditch to Rainbow Creek @ Huffstatler Road</td>
<td>33.4153</td>
<td>-117.152</td>
</tr>
<tr>
<td>HST02</td>
<td>Brow Ditch to Rainbow Creek @ Huffstatler Road</td>
<td>33.4117</td>
<td>-117.152</td>
</tr>
<tr>
<td><strong>MS4 Program Locations</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MS4-SMG-056</td>
<td>Outfall at Old Hwy. 395; 20’ south of 2nd Street</td>
<td>33.4174</td>
<td>-117.1558</td>
</tr>
<tr>
<td>MS4-SMG-057</td>
<td>Outfall at Old Hwy. 395; 1,160’ north of 2nd Street</td>
<td>33.4203</td>
<td>-117.1539</td>
</tr>
<tr>
<td>MS4-SMG-058</td>
<td>Outfall at Old Hwy. 395; 3,290’ north of 2nd Street</td>
<td>33.4253</td>
<td>-117.1502</td>
</tr>
<tr>
<td>MS4-SMG-061</td>
<td>Outfall at Rainbow Valley Blvd.; 1,025’ west of Old Hwy. 395</td>
<td>33.4296</td>
<td>-117.1448</td>
</tr>
</tbody>
</table>
### Table 10-1. Monitoring Locations

<table>
<thead>
<tr>
<th>Location Name</th>
<th>Description</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>MS4-SMG-063</td>
<td>Outfall at Rainbow Glen Rd.; 535’ west of Rainbow Hills Rd. (Under Bridge)</td>
<td>33.4093</td>
<td>-117.1656</td>
</tr>
<tr>
<td>MS4-SMG-086</td>
<td>Channel at 2526 Rainbow Valley Blvd.</td>
<td>33.4181</td>
<td>-117.1478</td>
</tr>
<tr>
<td>MS4-SMG-087</td>
<td>Channel at 2826 Rainbow Valley Blvd. (Old SMG19 Site)</td>
<td>33.4236</td>
<td>-117.1434</td>
</tr>
<tr>
<td>MS4-SMG-088</td>
<td>Channel at Huffstatler Street and 2nd Street</td>
<td>33.4177</td>
<td>-117.152</td>
</tr>
<tr>
<td>MS4-SMG-089</td>
<td>Channel across from HST01 at Huffstatler Street</td>
<td>33.4153</td>
<td>-117.1519</td>
</tr>
<tr>
<td>MS4-SMG-091</td>
<td>Outfall at Willow Glen Rd.; 125’ north of Red Mountain Heights Dr.</td>
<td>33.4034</td>
<td>-117.2041</td>
</tr>
<tr>
<td>MS4-SMG-092</td>
<td>Outfall in ceiling of west box culvert at Rainbow Glen Rd.; 200’ east of Oak Crest Rd.</td>
<td>33.4093</td>
<td>-117.1658</td>
</tr>
<tr>
<td>MS4-SMG-094</td>
<td>Outfall @ Old Hwy. 395, 700’ north of 2nd Street</td>
<td>33.4193</td>
<td>-117.1546</td>
</tr>
<tr>
<td>MS4-SMG-095</td>
<td>Outfall @ Old Hwy. 395, 1,800’ north of 2nd Street</td>
<td>33.422</td>
<td>-117.1528</td>
</tr>
<tr>
<td>MS4-SMG-096</td>
<td>Outfall at Old Hwy. 395, 2,000’ north of 2nd Street</td>
<td>33.4225</td>
<td>-117.1524</td>
</tr>
<tr>
<td>MS4-SMG-097</td>
<td>Outfall at Old Hwy. 395; 2,600’ north of 2nd Street</td>
<td>33.4238</td>
<td>-117.1515</td>
</tr>
<tr>
<td>MS4-SMG-098</td>
<td>Outfall at Old Hwy. 395; 1,350’ south of West Rainbow Valley Blvd.</td>
<td>33.4276</td>
<td>-117.1476</td>
</tr>
<tr>
<td>MS4-SMG-099</td>
<td>Outfall on hillside of Old Highway 395; 50’ south of West Rainbow Valley Blvd.</td>
<td>33.4293</td>
<td>-117.1447</td>
</tr>
<tr>
<td>MS4-SMG-100</td>
<td>Outfall on hillside at intersection of Old Highway 395 and West Rainbow Valley Blvd.</td>
<td>33.4296</td>
<td>-117.1446</td>
</tr>
<tr>
<td>MS4-SMG-101</td>
<td>Outfall at 2855 Rainbow Valley Blvd. (Rainbow Valley Nursery entrance)</td>
<td>33.4228</td>
<td>-117.144</td>
</tr>
</tbody>
</table>
Figure 10-1. Rainbow Creek Sampling Locations (TMDL Sites)
Figure 10-2. Rainbow Creek Sampling Locations (MS4 Program Sites)
10.2 Variability and Bias

Natural variability may occur within a given sampling location. Proper sampling procedures will help minimize variability. Field personnel will follow USEPA guidance for collecting grab samples in addition to WESTON SOP FLD038.01 (Appendix A) for the collection of molecular samples. Samples will be collected from the horizontal and vertical center of flow (when possible), bottom sediments will be avoided, and care will be taken to avoid collection of uncharacteristic floating debris. Field duplicates will also be collected to assess variability.

Bias is defined as the systematic or persistent distortion of a measurement process that causes errors in one direction. Bias, with regard to sample collection, will be controlled using best professional judgment to obtain representative samples that reflect field conditions. Field blanks will also be used to measure potential contamination introduced during sample collection and handling.
11. SAMPLING METHODS

Water samples will be collected following the clean hands technique, as outlined in WESTON SOP FLD038.01 (Attachment A). Sampling Methods are consistent with Standard Methods 9060 (“Collection and Preservation of Samples”) and the NPDES Storm Water Sampling Guidance Document (USEPA, 1992). Extreme care will be taken to avoid contamination and only personnel trained in proper molecular sampling techniques will conduct monitoring activities.

In order to avoid any potential contamination, scientists will wear clean, non-powdered, disposables gloves each time a sample is collected and new, disposable clean syringes will be used to collect water in low flow and ponded water situations. While one member of the field team collects the water sample, the other member of the field team will take notes on the designated field data sheet and will take photographs documenting conditions at each site.

Each field sample will be labeled and identified with the project title, site, date and time of sample collection, and preservation method. Upon collection, samples will be stored in coolers and on ice until delivery to EMA and WESTON’s Molecular laboratory. All samples will be delivered to the laboratories promptly in order to meet the required holding times. Sample containers and volumes are identified in Table 12-1.
12. SAMPLE HANDLING CUSTODY

12.1 Sample Collection

Samples will be uniquely identified with sample labels in indelible ink. All sample containers will be identified with the project title, sample identification number, date and time of sample collection, and preservation method. Upon collection, samples will be stored on ice until delivery to the appropriate laboratory for analysis within the required holding times (Table 12-1).

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Volume/Container</th>
<th>Holding Time</th>
<th>Preservation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fecal coliform</td>
<td>125 mL/HDPE</td>
<td>8 hours</td>
<td>Refrigerated ≤ 10°C</td>
</tr>
<tr>
<td><em>E. coli</em></td>
<td>125 mL/HDPE</td>
<td>8 hours</td>
<td>Refrigerated ≤ 10°C</td>
</tr>
<tr>
<td><em>Enterococcus</em></td>
<td>125 mL/HDPE</td>
<td>8 hours</td>
<td>Refrigerated ≤ 10°C</td>
</tr>
<tr>
<td>HF183</td>
<td>500 mL or 1000 mL/HDPE</td>
<td>6 hours</td>
<td>Refrigerated 4°C</td>
</tr>
</tbody>
</table>

Table 12-1. List of Analytes with Sample Volume, Container Type, Holding Time, and Preservation Method

HDPE – high density polyethylene

12.2 Chain-of-Custody Procedures

Samples will be considered to be in custody if they are retained as follows (1) in the custodian’s possession or view, (2) retained in a secured place (under lock) with restricted access, or (3) placed in a container and secured with an official seal such that the sample could not be reached without breaking the seal. The principal documents used to identify samples and to document possession will be chain-of-custody (COC) records (example COC form in Attachment B), field logbooks, and field tracking forms. COC procedures will be used for samples throughout the collection, transport, and analytical process.

COC procedures will be initiated during sample collection. A COC record will be provided with each sample or group of samples. Each person who will have custody of the samples will sign the form and ensure the samples will not be left unattended unless properly secured. Documentation of sample handling and custody includes the following:

- Sample identifier.
- Sample collection date and time.
- Any special notations on sample characteristics or analysis.
- Initials of the person collecting the sample.
- Date the sample was sent to the analytical laboratory.
- Shipping company and waybill information.

Completed COC forms will be placed in a plastic envelope and kept inside the cooler containing the samples. Once delivered to the analytical laboratory, the COC form will be signed by the person receiving the samples. The condition of the samples will be noted and recorded by the receiver. COC
records will be included in the final reports prepared by the laboratories and are considered an integral part of the report.

12.3 Sampling Transport, Shipping, and Storage Procedures

All samples collected in the field will be delivered on ice inside coolers to EMA and WESTON’s Molecular Laboratory for analysis. Transport of the samples will be coordinated by the Field Sampling Lead to insure that all samples are sent within appropriate laboratory holding times. Prior to transport, COC forms will be filled out and the original signed COC form will be inserted in a sealed plastic bag and placed inside the cooler. Laboratories will properly and safely dispose of the samples after the analyses are complete and analytical QA/QC procedures have been reviewed and accepted. Table 12-1 below contains the laboratory contact information.

Table 12-2. Analytical Laboratory Information and Point of Contact

<table>
<thead>
<tr>
<th>Laboratory</th>
<th>Analyses Performed</th>
<th>Point of Contact</th>
<th>Delivery Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>EnviroMatrix Analytical, Inc.</td>
<td>fecal coliform</td>
<td>Joseph Leonard</td>
<td>EnviroMatrix Analytical, Inc.</td>
</tr>
<tr>
<td></td>
<td><em>E. coli</em></td>
<td>(858) 560-7717</td>
<td>4340 Viewridge Ave. Ste. A</td>
</tr>
<tr>
<td></td>
<td><em>Enterococcus</em></td>
<td></td>
<td>San Diego, CA 92123</td>
</tr>
<tr>
<td>WESTON Molecular Laboratory</td>
<td>HF183 by ddPCR</td>
<td>Alexander Schriewer</td>
<td>Weston Solutions Inc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(760) 795-6957</td>
<td>5817 Dryden Place Suite 101</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Carlsbad, CA 92008</td>
</tr>
</tbody>
</table>
13. ANALYTICAL METHODS

EMA, an ELAP-certified laboratory (Certification No. 2564) will analyze samples for fecal coliform, *Enterococcus* and *E. coli*. Parameters, methods and target reporting limits are provided in Table 13-1.

WESTON’s Molecular Laboratory will conduct analysis for HF183. Samples will be filtered within 6 hours in accordance with SOP LAB074.01 (Filtration Protocol for Samples for Molecular Analysis). Deoxyribonucleic acid (DNA) will then be extracted from the filters using the GeneRite DNA-EZ ST1 kit according to SOP LAB078.00 (GeneRite DNA-EZ Extraction (500/350)). The purified sample extracts will then be tested for HF183 via droplet digital polymerase chain reaction (ddPCR) on a BioRad QX200 ddPCR System. Methods, primer and probe sequences and the target limit of detection (LOD) are provided in Table 13-1.

Table 13-1. Analytes, Analytical Methods, and Target Reporting Limits

<table>
<thead>
<tr>
<th>Laboratory</th>
<th>Parameters</th>
<th>Method</th>
<th>Primer and Probe Sequences (conc. in µM)</th>
<th>Target Reporting Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>EnviroMatrix Laboratory Inc.</td>
<td>Fecal coliform</td>
<td>SM 9221E</td>
<td>NA</td>
<td>2 MPN/100mL</td>
</tr>
<tr>
<td></td>
<td><em>E. coli</em></td>
<td>IDEXX</td>
<td>NA</td>
<td>1 MPN/100mL</td>
</tr>
<tr>
<td></td>
<td><em>Enterococcus</em></td>
<td>SM 9230B</td>
<td>NA</td>
<td>2 MPN/100mL</td>
</tr>
<tr>
<td>WESTON Molecular Laboratory</td>
<td>Filtration</td>
<td>SOP LAB074.01</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>DNA Extraction</td>
<td>SOP LAB078.00</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>HF183 CAMan dd1</td>
<td>ddPCR</td>
<td>HF183F: ATCATGAGTTCCATGTCCG (1) BacR287 - CTTCTCTCAGAACCCTATCC (1) BacP234MGB: 6FAM-CTAATGGAAACGCATCCC-MGB (0.08)</td>
<td>43 copies/100 mL (LOD)</td>
</tr>
</tbody>
</table>

1 - Master Mix and thermocycler conditions consist of ddPCR Supermix for Probes (BioRad) used on a BioRad. QX200 Droplet Digital PCR System. Reaction volumes are 20 µL with template volumes of 5 µL.

µM – micromole
mL – milliliter
MPN – most probable number
SM – standard method
SOP – Standard operating procedure
DNA – deoxyribonucleic acid
HF183 – human-associated fecal marker
ddPCR – droplet digital polymerase chain reaction
LOD – limit of detection
14. Quality Control

14.1 Water Sampling

Water samples will be collected in appropriate laboratory-certified containers, immediately placed on ice in coolers, along with completed COCs for transfer to the appropriate laboratory. The field crew will ensure that sampling containers are being filled properly and the requirement to avoid contamination of samples at all times is met. A field log will be completed at each site. Field duplicate and field blank samples will be collected programmatically to represent 5% of total samples.

14.2 Laboratory Analyses

Laboratory quality control of the collected samples will be performed under the guidelines of this QAPP and the laboratories SOPs (Attachments C and D). Quality control samples, frequency, and control limits specific to this project are discussed in Element 7 and listed in Table 7-1 and Table 7-2. Laboratory quality control checks may include the use of blanks, positive controls, and replicate samples. These checks are performed to identify possible contamination problem(s), and to facilitate the ability to duplicate results. If control limits are exceeded, the laboratory QA Officer will perform corrective actions to determine the cause of the exceedance. Analytical procedures based on laboratory SOPs will be reviewed with appropriate laboratory staff; and errors will be identified, documented, corrected, and reported. Samples will be re-analyzed, if available and within their respective holding times, and deemed necessary.
15. INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

15.1 Field Equipment

Prior to conducting field sampling, the Field Lead will be responsible for preparing sampling kits that include field logs, project-specific instructions, COC forms, sample labels, sampling containers, and monitoring equipment. Spare equipment, such as extra bottles, labels, etc., will be included in the field sampling kits in the event that the sampling equipment becomes lost, contaminated, or otherwise needs to be replaced or supplemented.

15.2 Analytical Laboratories

The laboratories (EMA and WESTON’s Molecular Laboratory) are responsible for maintaining their equipment in accordance with SOPs specified by equipment manufacturers and SOPs specified by the particular analytical method. Laboratory analysts are responsible for equipment testing, inspection, and maintenance. Corrective actions will be taken to repair equipment, document the issue, and reanalyze the sample if necessary. The Laboratory QA Officer will notify the WESTON Project Manager of any equipment deficiencies impacting sample results or timing or result availability.
16. INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

Laboratories are responsible for operating and calibrating laboratory equipment according to manufacturer recommendations as well as by criteria defined in individual SOPs. Operation and calibration will be performed by properly trained personnel. Documentation of calibration information will be recorded in appropriate logbooks. If calibration is unsuccessful, then the equipment will be cleaned and parts replaced until a successful calibration can occur. If the equipment fails to calibrate after several attempts, then WESTON’s Project Manager will be notified that analyses have stopped until functional equipment is available. Affected data will be flagged with appropriate qualifiers. Once equipment is functioning again, the samples will be reanalyzed. Issues with an instrument will be documented and corrective actions will be recorded by the laboratory.
17. **Inspection/Acceptance of Supplies and Consumables**

It is the duty of each staff member responsible for equipment ordering to inspect equipment and materials for quality and report any equipment or materials that do not meet acceptance criteria to the appropriate Laboratory Manager and/or QA Officer. Upon receipt of materials or equipment, a designated employee will receive and sign for the materials. The items will be reviewed to ensure the shipment is complete, then they will be delivered to the proper storage location. Chemicals will be dated upon receipt. Supplies will be stored appropriately and discarded on the expiration date. The equipment and supplies purchased for use in field sampling activities will be inspected for damage as they are received.

Sample containers will be provided by each of the laboratories (EMA and WESTON’s Molecular Laboratory). They will be shipped to and stored at WESTON’s Carlsbad facility prior to use in the field. Confirmation that sample bottles are laboratory-certified clean will be made when received from the laboratory. The Field Sampling Lead will oversee this element.
18. NON-DIRECT MEASUREMENTS

Precipitation data from sandiego.onerain.com will be used in performance of this monitoring program. Data will be reviewed prior to sampling events in order to ensure that antecedent dry weather requirements have been met prior to sampling.

Landuse data derived from San Diego Association of Governments (SANDAG) may also be used to identify patterns or correlations with HF183 detections (if any) as may data collected under the TMDL and MS4 Monitoring Pogroms.
19. **Data Management**

WESTON will document and track the aspects of the sample collection process, including generating field logs at each site and COC forms for the samples collected. COC forms will accompany samples to the laboratory for analysis.

The WESTON Molecular Laboratory and EMA will document and track sample receipt, storage, analyses, and reporting pertaining to respective laboratory analyses. Laboratory results for fecal indicator bacteria will be stored in a database system at EMAs office and will be provided to WESTON electronically in laboratory reports and CEDEN formatted EDDs. Laboratory results for HF183 will be stored in the WESTON’s Molecular Laboratory data management system and provided to the WESTON Project Manager electronically in laboratory reports and EDDs.

Further details of EMA’s data management protocols can be found in their Quality Assurance Manual (Attachment D).

WESTON’s Project Manager and QA officer will maintain and control the data and documents collected during this project. All data records, including field-generated data and laboratory data, will be accumulated into project-specific files that are maintained at WESTON’s Carlsbad, CA, office. Records will be maintained for at least five years or transferred according to agreement between WESTON and the County.
GROUP C: ASSESSMENT AND OVERSIGHT

20. ASSESSMENTS AND RESPONSE ACTIONS

Data collected and analyzed for this monitoring program need to be consistently assessed and documented throughout the project to determine whether the project objectives are being met. Field staff will review sampling procedures prior to conducting sampling to ensure that all methods of collection are understood and that equipment/instruments used for sample collection and analysis are functioning and ready for use. Field data sheets will be reviewed prior to leaving the sample location to ensure that all samples were collected and field observations were documented. If the field staff encounters any issues related to sample collection or equipment failure that cannot be immediately corrected at the sample site, they will notify the WESTON Project Manager. Either re-sampling will occur on another day or errors will be noted on field data sheets and reported in the project report.

Laboratory technicians are responsible for following laboratory procedures and operating analytical equipment, including conducting instrument maintenance, calibration of equipment/instruments, and performing laboratory QC sample analyses at the required frequency stated in this QAPP. The laboratory QA Officers are responsible for reviewing the associated QC results that are reported with all of the sample results to evaluate the analytical process performance, verifying that the performance criteria of this QAPP were met, recommending or approving proposed corrective actions, and verifying that corrective actions have been completed.

The need for corrective action comes from several sources, including equipment malfunction, failure of internal QA/QC checks, failure to follow-up on performance or system audit findings, and noncompliance with QA requirements. When measurement equipment or analytical methods fail QA/QC requirements, the problem(s) will be brought immediately to the attention of the laboratory supervisor and QA Officer. Corrective measures will depend entirely on the type of analysis, the extent of the error, and whether or not the error is determinant. Final approval of what the corrective measure will be is the responsibility of the Laboratory QA Officers. If failure is due to equipment malfunction, the equipment will not be used until repaired. Precision and accuracy will be reassessed, and the analysis will be rerun. Attempts will be made to reanalyze the affected parts of the analysis so that in the end, the product is not affected by failure of QC requirements. When a result in a performance audit is unacceptable, the laboratory will identify the problem(s) and implement corrective actions immediately. A step-by-step analysis and investigation to determine the cause of the problem will take place as part of the corrective action program. If the problem cannot be controlled, the laboratory will analyze the impact on data. The WESTON Project Manager will be notified if data are affected.
21. REPORTS TO MANAGEMENT

WESTON’s Project Manager is responsible for preparation and submittal of all project deliverables. Laboratory QA Officers are responsible for the preparation of all data packages and laboratory reports originating from their laboratory. The WESTON Project Manager will provide the County of San Diego Project Manager monthly deliverables in electronic format via email. The deliverables will include a table of results, laboratory report pdfs and laboratory EDDs.

A draft report will be developed for submittal to the County of San Diego by October 31, 2019 and will include data collected from June 2019 through September 2019. The final report will be completed by November 30, 2019, pending review by the County of San Diego. All data included in the report will be submitted to CEDEN by January 30, 2020.

Data collected October 1, 2019 through June 2020 will be reported and submitted to CEDEN at a later date to be determined. Table 21-1 presents the proposed schedule for management reporting.

Table 21-1. Management Report Schedule

<table>
<thead>
<tr>
<th>Type of Report</th>
<th>Frequency</th>
<th>Projected Delivery Dates(s)</th>
<th>Person(s) Responsible for Report Preparation</th>
<th>Report Recipients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitoring Plan</td>
<td>Once</td>
<td>7/12/2019</td>
<td>Project Manager (Michelle Mattson)</td>
<td>County of San Diego Contract (Joanna Wisniewska) and Project Manager (Ryan Jensen)</td>
</tr>
<tr>
<td>Quality Assurance Project Plan (QAPP)</td>
<td>Once</td>
<td>7/12/2019</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monthly Data Deliverables</td>
<td>Monthly</td>
<td>varies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Draft Project Report</td>
<td>Once</td>
<td>10/31/2019</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final Project Report</td>
<td>Once</td>
<td>11/30/2019</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Submittal of data to CEDEN*</td>
<td>Once</td>
<td>To be determined</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Submittal of data included in the report. Data collected from October 2019 through June 2020 will be submitted at a later date.
GROUP D: VALIDATION AND USABILITY

22. DATA REVIEW, VERIFICATION, AND VALIDATION REQUIREMENTS

All data generated by this project’s activities will be reviewed against the MQOs presented in Element 7 of this QAPP. The field and laboratory personnel, including QA Officers, will be responsible for verifying that the sample collection, handling, and analytical procedures were in accordance with the approved QAPP. The Field Sampling Lead will review all COC forms to ensure adherence to collection, transport to analytical laboratory, and receipt requirements are completed within appropriate holding times.

Laboratory technicians generating the data have the prime responsibility for the accuracy and completeness of data. The laboratory supervisors and QA Officers are responsible for reviewing laboratory data forms and sample logs to ensure that all requirements for sample preservation, sample integrity, data quality assessments, and equipment calibration have been met. Data that do not meet these requirements will be reanalyzed, not reported, or will be reported with qualifiers which provide adequate explanations for the data discrepancies. If data cannot be reported, WESTON’s Project Manager will be notified.
23. **Verification and Validation Methods**

After sampling, the field data sheets will be removed from the field logbooks, and sheets will be checked for completeness and accuracy (including sample location, sample date and time, and sample type) by WESTON’s Field Sampling Lead. Any field changes or discrepancies will be noted on the field sheets. It is the Field Sampling Leads responsibility to review all entries into Survey123, check for completeness and accuracy and upload the data files to the County database.

Copies of the COC forms with signatures from laboratory personnel showing that the laboratory has received the samples will be kept with field data sheets in a designated folder. If there are any questions, clarification from the Field Sampling Lead will be obtained as soon as possible.

Verification and validation of the laboratory data are the responsibility of the laboratory. All sample preparation and analytical activities will be documented in bound laboratory notebooks or on bench sheets. The laboratory technician generating the data has the prime responsibility for the accuracy and completeness of the data. Laboratory technicians and the laboratory QA Officers will review the analytical data to ensure that the sample description information, analysis information, instrument calibration, and analytical results are correct and documentation is complete, and that QC samples meet performance criteria. The Laboratory Director or Project Manager will maintain analytical reports and QA/QC documentation for this project in a database format. All corrective actions required during the analytical process that may affect sample results will be recorded by the laboratory’s QA Officer and reported to WESTON’s Project Manager and QA Officer.

In addition to the laboratory performing verification and validation of laboratory data, WESTON’s QA Officer will review all laboratory analytical reports and EDDs when they are received from the laboratory to ensure that the data provided are complete and MQOs in this QAPP have been met. Laboratory reports/EDDs that do not meet WESTON’s QC check will be returned to the laboratory with requests for correction.

WESTON’s Project Manager will be responsible for final review of data analysis, monthly data deliverables and reports prior to submission to the County of San Diego for their review.
24. RECONCILIATION WITH USER REQUIREMENTS

The goal of this monitoring program is to conduct screening of receiving waters and MS4 outfalls for HF183 and fecal indicator bacteria during dry weather. Data collected in this monitoring program will aid the County in addressing the management questions outlined in Element 5.2.

Question 1: Is the human-associated fecal marker HF183 present in MS4 outfall and/or receiving water dry weather flows in the Rainbow Creek Watershed?

In order to answer Question 1, water samples will be collected from the same locations that are monitored as part of the Rainbow Creek Nutrient TMDL and MS4 Monitoring programs. Results of these analyses will be used to assess if HF183 is present in detectable concentrations at locations within the watershed.

Question 2: If present, the following sub-questions will be addressed:

a) What is the spatial pattern of HF183 in the watershed?
b) What is the magnitude and the rate of occurrence?
c) Under what flow conditions is HF183 observed?
d) Is there a correlation between HF183 marker and land use?
e) Is there a correlation between HF183 spatial patterns and known septic tank locations?
f) Is there a correlation between HF183 concentrations or frequency and nutrient levels?

In order to answer Question 2, if applicable, results of water quality analyses will be assessed per the sub-questions with the final intent of potentially isolating drainage areas for further study.

The QA officer will review the data to determine if data quality objectives have been met. If data do not meet the project’s specifications, the QA officer will review the errors and determine if the problem is due to calibration/maintenance, sample techniques, or other factors and they will suggest corrective action. It is expected that the problem would be corrected by retraining, revision of techniques, or replacement of supplies/equipment. If not, then the measurement quality objectives will be reviewed for feasibility. If specific measurement quality objectives are not achievable, the QA officer will recommend appropriate modifications. Any revisions need approval by the WESTON Project Manager and the County of San Diego Project Manager.
REFERENCES


1.0 SCOPE

This document describes field methods for the proper collection, storage, and transport of samples for molecular analysis. Specifically, collection of water, sand, wrack, and eelgrass samples are described. Methods are consistent with Standard Methods 9060 (“Collection and Preservation of Samples”) and the NPDES Storm Water Sampling Guidance Manual (EPA, 1993).

2.0 HEALTH & SAFETY

2.1 Clothing

All participating personnel wear disposable gloves, close-toed shoes and any required safety gear for laboratory work or field sampling. Goggles and face masks are worn when appropriate or required. Gloves are changed as per the protocol being followed, after any spills, and when any possible contamination is suspected.

2.2 Practices

- Wear gloves during procedures involving bleach, DNA AWAY™, ethanol, and all environmental sampling. During procedures involving bleach, wear gloves, protective clothing, and protective eyewear. Change gloves after bleach application, taking care to not leave bleach on surfaces that others may contact with bare skin (e.g., phone, door knobs, etc.).
- Gloves contaminated or potentially contaminated should be removed with standard procedures for removing contaminated gloves, as follows:
  - Pull one glove near your wrist towards your fingertips until the glove folds over.
  - Carefully grab the fold and pull toward your fingertips, turning the glove inside out as you pull.
  - Remove your hand from the glove, continuing to hold it in the other, gloved hand.
  - Slide a finger from the glove-free hand under the remaining glove and remove the glove so that it turns inside out and encases the other glove. Place gloves in waste bag.
- Sanitize hands with soap and water and/or hand sanitizer after handling potentially contaminated environmental samples, particularly before ingesting food.

2.3 Personnel

Only properly trained technicians will perform the procedures described herein.

2.4 Equipment, Materials, and Conditions

All personnel are responsible to know how to safely utilize/handle all pertinent equipment and materials. DNA AWAY™ and bleach solutions can irritate eyes, skin, and mucous membranes. See MSDS for more information.
At no time will the sample collector risk personal health or safety in an attempt to collect a sample. When taking surface samples from a boat, or any samples from a stream, a pole from a fixed platform or bridge is used whenever possible. Stream banks and channel slopes are avoided. All personnel are aware of the potential dangers and proper use/handling of all equipment and materials.

3.0 EQUIPMENT AND SUPPLIES

3.1 Equipment

If applicable:
- sampling pole
- boat or kayak

3.2 Supplies

- 250 mL sterile, nuclease-free sample bottles (Thermo N_411-0250 HDPE sterile, nuclease free or equivalent)
- re-sealable plastic bags, small and large
- disposable laboratory gloves
- cooler or other insulated container*
- blue ice*
- nuclease-free water
- DNA AWAY™ (Cat#7010 Molecular Bio Products or equivalent)
- Kimwipes (large)
- water-proof, felt-tip markers
- garbage bags for discard
- Hand sanitizer
- 70% Ethanol
- 10% Bleach (see “Notes on Bleach” below)
- Hand sanitizer
- Sterile PBS for field blanks
- Sterile 50-mL conical tubes for sand collection, if applicable
- Sterile spoon or spatula for sand collection, if applicable
- Sterile whirlpack bag for collection of plant material such as eelgrass, kelp, or wrack, if applicable

*pre-cleaned with DNA AWAY™ or 10% Bleach
4.0 PROCEDURES

4.1 Laboratory Sample Bottle and Cooler Preparation

The following preparation step is to be performed by trained staff. A minimum of 24 hour notice for sample-bottle requests is required.

Notes on Bleach: When seen in an SOP, “10% Bleach” signifies a bleach solution with ~5,000 ppm free available chlorine (a 0.5% solution) that has not expired, or an equivalent purchased disinfection product. With 8.25% household bleach, add 1 part bleach: 15 parts water to make a “10% Bleach” solution. See SOP079.00 “Preparing Bleach Solutions” for complete details.

4.1.1 Prepare blue ice

- Spray blue ice with 10% bleach/70% ethanol rinse. Place blue ice in a clean garbage bag(s) and freeze.

4.1.2 Prepare Sample Bottles

- Spray laboratory surface with 10% bleach and allow to sit for 15 minutes. Change gloves. Spray bench top with 70% ethanol and wipe with Kimwipes to remove residual bleach (if hood surface is metal, rinse surface with sterile DI prior to ethanol to avoid corrosion).
- For ease of use in the field, remove and discard the plastic seal encasing the sampling bottle. If possible, bottles should be pre-labeled to ease field manipulation. Place bottle in a re-sealable plastic bag inside of another re-sealable plastic bag (in case of leaking this will provide an extra layer of protection to avoid cross-contamination).
- Place field blank bottle (nuclease-free water) in a re-sealable plastic bag.

4.1.3 Prepare coolers

Two coolers are used: one to carry fresh supplies and one containing blue ice to transport samples to the laboratory.

- Spray the interior of the coolers and the exterior lip used to open/close the cooler with 10% bleach. Allow to sit for 15 minutes. Spray with 70% ethanol and wipe with Kimwipes to remove residual bleach.
- Spray writing markers with DNA AWAY/70% ethanol rinse and place in re-sealable plastic bag.
- Load supply cooler with the following:
  - Bottles, double-bagged (needed plus a couple of extra)
4.2 **Field Sample Collection and Handling**

4.2.1 **Preparation and General Information**

- Tie discard bag onto handle of cooler with blue ice.
- Clean hands with hand sanitizer.
- Allow hands to dry and put on clean disposable gloves. Try to avoid touching fingers of gloves with bare hands, try to handle glove collar.
  - **It is important to avoid contamination of sample from human skin cells.** Do not touch skin with clean gloves (for example, wipe face with sleeve - not glove). In general, try to keep gloves clean prior to sampling.
  - For certain field situations (e.g., kayak sampling), it may be difficult to change gloves between sites. In such cases, wear multiple gloves discarding outer glove set between sample sites.
- Use water-proof permanent markers. Ensure that bottles are labeled with sample identification according to Chain of Custody (COC), date, and time of collection. Outer plastic bags can be labeled if it helps with organization in the field. Double check sample collection against sample plan/COC. Ensure that field blank is on the COC.
- All information pertinent to the sampling is recorded on field log-in sheets and chain of custody forms. Unique sample identifiers should be used (e.g., Event#-site or date-site instead of listing only the site).
Information needed includes name of sample event; sample identifier, date and time of sampling for each sample, sample matrix (e.g., fresh or salt water), storage conditions (e.g., “sterile plastic bottles”), transport conditions (e.g., “on ice”), preservation conditions if applicable (note: sodium thiosulfate should NOT be used in molecular samples).

Important field observations include type and number of animals, fecal deposits, diapers, decaying plant material, trash, etc. Other information may include suspected sample composition, including concentrations; number and volume of samples taken; description of sampling point; sampling method; producer of material being sampled and address, if different from location.

Verify with project manager the exact locations, definitions, and details of sampling. Typically, locations will have landmarks as well as environmental definitions. For example, “surf zone” sand is typically the sand routinely wetted by incoming waves, collected from the upper reaches of that zone (away from the water).

Optional: take photos to document field observations.

In particular for sand and wrack samples, take care not to walk through site prior to sample collection. Ideally stand downwind of site.

4.2.2 Sample Collection of Water, by Hand

Upon reaching the sampling location and wearing new gloves (section 4.2.1), remove bottle from plastic bag; ensure that bag does not blow away.

Carefully open sampling container, keeping lid face-down to avoid airborne contamination.

Use one hand for sampling, keeping the other hand clean and holding the cap face down. Fill bottle, keeping opening away from body. Collect on incoming wave or incoming stream flow.

Quickly recap using the clean hand, ensuring that cap is sealed tightly.

In the case of field duplicate collection or if bacteria and PCR samples are being sampled simultaneously, give caps to a partner to hold. If no partner is available, set caps on a clean area face-up. This poses some risk of air contamination, so work quickly. In addition, take extra care to not touch the inside surface of the lid or bottle during capping.
• Close containers securely. Shake or dry excess water with Kimwipe. Return sample bottle to resealable plastic bag. It helps to have a partner for this step, particularly if replicates are being collected.

• Check to make sure all sample containers are correctly labeled and sealed. Place sample in cooler. If replicate samples are taken from a site, place in a large plastic bag for organization.

• Discard gloves.

• Record time of sample collection in field sheets and ensure that field sampling sheet is complete.

• It is important to **avoid site cross-contamination**. Sanitize hands and wear fresh gloves prior to handling sample bottle(s) for the next site.

• Collect field blanks on site according to dictate of sample plan/Chain of Custody. Technique is similar to that used for collecting a fresh field sample except that the provided molecular-grade water is poured into the sample container.

### 4.2.3 Sample Collection of Water, by Pole

Use two trained technicians, if possible; one responsible for cleaning and holding pole.

• Wearing new gloves (section 4.2.1), spray pole with DNA AWAY™ or 10% bleach. Spray pole with 70% ethanol to rinse residual chemical. Allow pole to dry or wipe with Kimwipe. If pole gets contaminated (e.g., if it is set down), repeat decontamination procedure. Use fresh gloves and repeat decontamination prior to sampling a new site.

• Remove bottle from plastic bag, place bottle in the support clip, and close the clip. Remove cap of the bottle, holding it face down (easiest to hand cap to partner).

• Use plunge technique to take sample. Submerge the bottle below the water surface by plunging it open-end down (set hinge to allow this). Upon reaching desired depth, pole is scooped so that hinge turns bottle face-up and the bottle is allowed to fill. Samples are kept free from uncharacteristic floating debris.

• Cap bottle tightly and unclip.

• Place bottle in plastic bag, and place in cooler, as described for samples collected by hand.

• A field blank is performed using the same procedure as the collection of samples at the end of each set of samples using nuclease free water. Technicians should be facing the wind when performing the field blank.

• Use fresh gloves and repeat decontamination prior to sampling a new site.
4.2.4 Sample Collection of Sand

- Collect sand sample by scooping the top layer (to about ~1 inch deep) using a 50mL sterile conical tube. Scoop from multiple locations within a 0.5~1 meter diameter until tube is mostly full. Avoid collecting sand near bird feces. Repeat using a second tube; one sand sample consists of two (2) 50mL sterile conical tubes to ensure at least 100 grams of sand for the analytical laboratory.
- Pour off excess water.

4.2.5 Field Homogenization of Sand

In some cases, homogenization of sand will be necessary in the field (for example, if subsamples are to be delivered to different analytical laboratories). Verify with project manager.

- Put on new, clean gloves, as outlined in FLD038.01 Collection, Storage, and Transport of Water Samples for Molecular Analysis. Change gloves before handling samples from a new site.
- Layout autoclaved tinfoil in clean work space.
- Uncap sample tubes from site and pour sand onto tinfoil. Cap empty tubes and place to the side (also on tin foil).
- Use autoclaved metal spoon or sterile spatula to thoroughly mix sand for 1 minute (60 seconds).
- Transfer homogenized sand into original sample tubes. Securely re-cap tube and place samples on ice.

4.2.6 Field Collection of Wrack

- See Sections 4.1 and 4.2 of this document.
- Wearing clean gloves, collect ~75-100 g of wrack (~1 bag full).
- Minimize collection of root balls and other sea vegetation. Minimize the amount of contact with the sample. Avoid very fresh and highly decomposed wrack, unless otherwise directed by the project manager. Avoid collecting flies, bugs, sand, and feces as much as possible.
- Take photos of the wrack, if possible. Record species of the wrack on the field sheet, if possible (e.g., *Macrocystis* is large, brown, kelp versus eelgrass).
- Place samples into labeled whirl-pack bag, minimizing contact with sample. Close bag securely. Place in cooler on ice.
4.2.7 Field Collection of Fresh Eelgrass, On-Water Sampling

Below provides a brief description of collection of fresh eelgrass from an eelgrass bed in which boat operation is required. In addition to sections 4.1 and 4.2 of this document, see applicable protocols for boat operations and safety.

- Use sanitized equipment to collect eelgrass from mid-water level (e.g., stainless steel rake with a 10-foot extension attachment). Attempt to collect the sample from a stationary location. If no material is at the site, conduct short trawls (50-100 feet), as needed.
- Secure autoclaved aluminum foil to boat surface to place collected material.
- Collect ~75-100 g of blades of eelgrass wrack (~1 bag full). Minimize the amount of contact with the eelgrass. Minimize collection of root balls and sediment.
- Place eelgrass into whirl-pack bag (minimizing contact with sample). Close bag securely. Place in cooler on ice.

4.3 Sample Storage

- All samples are kept on gel ice packs or refrigerated from the time of sample collection until delivery to the analytical laboratory.
- Exposure to direct sunlight is avoided as much as possible, as ultra-violet rays are detrimental to bacterial DNA, resulting in unreliable analytical results. Samples are therefore covered or placed in an ice chest with a closed lid immediately following collection.
- Samples are stored away from all food, reagents, and other potentially contaminating sources.

4.4 Sample Delivery/Chain of Custody

- All samples are delivered to the analytical laboratory, and analysis is begun as quickly as possible, and always within the maximum holding time of twenty-four hours (e.g., 6 hours for enterococci analysis by EPA Method 1609).
- All samples are kept covered and on ice during transport.
- Chain-of-custody (COC) forms are filled out by the sampling team for all samples submitted to the analytical laboratory. COCs will include the sample identification, location, date and time of sampling, sample preservative type (if any), sample type, sampler’s name and signature, and any comments regarding the sample. Separate chains of custody should be filled out for samples for molecular analysis and for traditional bacteria sampling.
- Upon delivery to the laboratory, the laboratory supervisor or properly trained technician verifies that the time of sample collection is noted, and the samples are
stored at the appropriate temperature until analysis is begun. At this point the laboratory has become responsible for the sample custody. Make sure sample chain of custody (COC) is complete, including signatures. Leave original copies with lab. Take pink copy of the COC for yourself.

5.0 QUALITY CONTROL/ASSURANCE

- All participating personnel are fully trained in the aseptic technique of sample collection as well as the use of any specialized sampling equipment.
- Precautions are taken to avoid exposing samples to human, atmospheric, and other potential sources of contamination.
- Samples are collected upstream and upwind of sampling personnel to minimize introduction of contaminants.
- Disposable gloves are worn at all times when handling sample containers and sampling equipment. If gloved hands contact any surface that is suspected of being a contamination risk, the glove should be removed and replaced with a fresh, clean one.
- No material other than the sample water ever contacts the inner surface of a sample container, lid, or sampling tube. If any contact occurs, a new, sterile container is properly labeled and used and the old container discarded.
- No eating, drinking, or smoking is allowed while samples are being taken.

6.0 REFERENCE DOCUMENTS


Appendix B – Example Chain of Custody Form
Human-Associated HF183 Molecular Marker Analytical Methods
Weston follows the general approach outlined in the State Water Board’s Source Identification Protocol (Ca MST Manual, Griffith et al. 2013) for source tracking studies. Where the Ca MST Manual does not apply, e.g. ddPCR analytics or new source identification assays, the methodology is followed as much as possible and only modified when necessary according to best scientific knowledge.

Samples collected by WESTON for molecular analysis are filtered within 8 hours of sampling according to SOP LAB074.01 (Filtration Protocol for Samples for Molecular Analysis). Filters are stored at -80°C until DNA extraction with the GeneRite DNA-EZ ST1 kit according to LAB078.00 (GeneRite DNA-EZ Extraction (500/350)). Purified DNA is then stored at -80°C until polymerase chain reaction (PCR) analysis is conducted in case analysis does not occur immediately after extraction. Extracted DNA is analyzed by quantitative PCR (qPCR) or droplet digital PCR (ddPCR) for the human-associated microbial source tracking (MST) marker HF183 (Table 1). Purified sample extracts are tested for the human-associated microbial source tracking (MST) marker HF183 on a BioRad CFX96 Real-time PCR Detection System (qPCR) or a BioRad QX200 Droplet Digital PCR System (ddPCR) as described in Table 1 and related WESTON SOPs.

### Table 1. Assay Details Human-Associated HF183 Molecular Marker Analysis by Real-Time Quantitative PCR (qPCR) and droplet digital PCR (ddPCR)

<table>
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<tr>
<th>Target (Abbreviation)</th>
<th>Assay Name</th>
<th>Primer and Probe Sequences 5’-3’ (Final Conc, µM)</th>
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<td>Human Bacteroides (HF183) (qPCR)</td>
<td>HF183 CAMan</td>
<td>HF183F: ATCATGAGTTTACATGTCCG (1) BacR287 - CTTCCTCTCAGAACCCCTATCC (1) BacP234MGB: 6FAM-CTAATGAAACGATCCC-MGB (0.08)</td>
<td>50 °C, 2 min; 95 °C, 10 min; 40 cycles: 95 °C, 15 s; 60 °C, 1 min</td>
<td>Griffith et. al., 2013; Green et al., 2014</td>
</tr>
<tr>
<td>Human Bacteroides (HF183) (ddPCR)</td>
<td>HF183 CAMan dd</td>
<td>HF183F: ATCATGAGTTTACATGTCCG (1) BacR287 - CTTCCTCTCAGAACCCCTATCC (1) BacP234MGB: 6FAM-CTAATGAAACGATCCC-MGB (0.08)</td>
<td>50 °C, 2 min; 95 °C, 10 min; 40 cycles: 94 °C, 30 s; 60 °C, 1 min</td>
<td>Griffith et. al., 2013; Green et al., 2014; Manufacturers recommendation</td>
</tr>
</tbody>
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### Determination of Concentrations, Detection Limits, and Classification of Results for qPCR:
Concentrations of unknown samples are determined relative to a master standard curve measured with known concentrations. All qPCR assays use a master curve spanning at least five concentrations and a minimum of 50 data points obtained by a minimum of 3 separate runs. For each event and assay, laboratory reports provide the standard curve metrics (efficiency, standard curve regression [r²], y-intercept), the limit of detection (LOD), the lower limit of quantification (LLOQ), the standard deviation of the LLOQ and the non-detect (ND) substitution values in units of copies per reaction (cpr). Concentration calculations are based on the average Cp value compared to standard curve metrics. In addition, laboratory reports provide information regarding
the laboratory controls used for each assay/event. Laboratory controls include the following: (1)
laboratory blanks, (2) no-template controls, (3) positive controls, (4) inhibition controls, and (5)
sample processing controls, as defined below.

- **BDL:** Below Detection Limit (BDL) describes a sample result with a signal over the
  threshold (Cq > 0) but not above the LOD, as in BDL: 0 < Cq ≤ LOD. In case of frequent
  occurrence of BDL results in sample from the same location, an increase in process
  volumes is suggested to increase confidence in observed concentrations

- **DNQ:** Detected, Not Quantifiable (DNQ) describes a sample result above the LOD but not
  above the LLOQ, as in: LOD < Cq < LLOQ.

- **LOD:** The LOD is the lowest level at which an analyte is reliably detected (Armbruster
  and Pry, 2008); for example, the standard at which 95% of the replicates amplify (MIQE,
  2009). The minimum accepted amplification rate is 80%.

- **LLOQ:** The LLOQ is the lowest level at which 100% amplification was observed.

- **Range of Quantification:** The range of quantification (ROQ) is the linear dynamic range of
  the calibration curve with values above the LLOQ, as in: Cq > LLOQ. A sample result with
  a signal within the ROQ was considered to have been “detected.”

- **ND:** ND describes a sample that does not provide an amplification signal (Cq = 0) in any
  of the replicates analyzed per sample. The result is negative and may be reported as below
  a substitution value (NDsub).

- **NDsub:** The substitution value for nondetects (NDsub) is the quantification or threshold
  cycle (Cq) that would occur at the maximum number of cycles in the thermal cycle program
  (Boehm et al., 2013); for example, the Cq at 40 (depending on the assay) using the standard
  curve appropriate for that run.

**Determination of Concentrations, Detection Limits, and Classification of Results for ddPCR:**
The absolute quantification in the droplet digital PCR System relies on two elements, a) detection
of positive and negative fluorescence data from the sample droplets and b) data fitting to a Poisson
distribution. A calibration curve is not needed.

For each event and assay, laboratory reports provide, the limit of detection (LOD), the lower limit
of quantification (LLOQ), and the non-detect (ND) substitution values in units of copies per
reaction (cpr). In addition, laboratory reports provide information regarding the laboratory controls
used for each assay/event. Laboratory controls include the following: (1) laboratory blanks, (2)
no-template controls, (3) positive controls, (4) inhibition controls, and (5) sample processing
controls, as defined below.

- **LOD:** The LOD is the lowest level at which an analyte is reliably detected. For digital
droplet PCR this number is set to 3 copies per reaction (MIQE, 2009, digital MIQE 2013).

- **LLOQ:** Since reliable detection and quantification co-occur for ddPCR, the LOD equals
  the LLOQ.
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- **BDL**: Below Detection Limit (BDL) describes a sample result with a signal (i.e. positive droplet) but not above the LOD, as in BDL: $0 < \text{number of positive droplets} < \text{LOD}$. In case of frequent occurrence of BDL results in sample from the same location, an increase in process volumes is suggested to increase confidence in observed concentrations.

- **Range of Quantification**: The range of quantification (ROQ) is the range with enough positive droplets to compute positive concentrations with adequate statistical confidence. A sample result with a signal within the ROQ is considered to be “detected.”

- **ND**: ND describes a sample that does not provide an amplification signal (number of positive droplets = 0) in any of the replicates analyzed per sample. The result is negative and may be reported as below a substitution value (ND_{sub}).

- **ND_{sub}**: The substitution value for nondetects (ND_{sub}) is the minimum possible number of detectable copies (one) of the ddPCR instrument (analog rationale to qPCR, (Boehm et al., 2013)).

**Quality Control (qPCR and ddPCR):**

- **Blanks**: At least three blanks (field, method, or extraction) are run for each batch for each assay. A field blank consists of sterile, molecular-grade water placed into a sample container during the field sampling process. A filtration blank consists of PBS filtered in the laboratory including all reagents added during the membrane filtration process. The PBS is the same used to rinse sample filters during membrane filtration. Method blanks are distributed throughout the sample filtration process to ensure the presence of at least one blank for each extraction batch (17 samples). An extraction blank consists of a sterile filter through which at least 25 mL of sterile PBS solution is filtered prior to storage at -80°C, replacing a sample filter in the extraction process. Additional extraction blanks are added if the batch does not include Field Blanks and/or the sample set was not filtered by the WESTON Molecular Biology Laboratory. A positive blank will invalidate the samples associated with that set.

- **Sample Processing Control (SPC)**: Salmon DNA is added to every sample during the extraction and quantified via the Sketa22 assay as a positive extraction control. Additional positive filtration controls are optional and depend on the scope of the study.

- **Inhibition control (IC)**: Samples tested for inhibition use a matrix spike consisting of the target DNA added to the qPCR reaction containing the extracted sample DNA at full strength (undiluted) and extract diluted 1:5 by molecular-grade water. Sample DNA is considered inhibited if the C_\text{t} between the undiluted and diluted extracts differ by more than one cycle (with results typically < 0.5 cycle) or the ddPCR analogue in concentration reduction. If results indicate inhibition, the sample DNA is diluted 1:5 and re-analyzed for target and for inhibition (e.g., using 1:5 dilutions of the already diluted DNA). Typically *B. dorei* genomic DNA (DSM 17855, www.dsmz.de) is added and assessed by the HF183 assay (Table 1). Sample results are corrected for the dilution required to overcome inhibition. Inhibited samples are flagged accordingly in laboratory reports.

- **No Template Control (NTC)**: PCR reactions set up with molecular-grade water replacing sample DNA. NTCs are run at least in triplicate. Any positive reactions require re-analysis of the plate.
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- **Positive Control:** PCR reactions set up with a known amount of target plasmid or genomic DNA. Lack of amplification of a positive control invalidates the PCR run, and the samples are re-analyzed with fresh reagents.
- **Technical replicates:** Samples and blanks are run in (at least) triplicate.

References:


ENVIROMATRIX ANALYTICAL, INC.

QUALITY ASSURANCE PROGRAM MANUAL

This document has been prepared by EnviroMatrix Analytical, Inc. (EMA) and is approved by EMA Management. It will be reviewed on an annual basis and modified as necessary.

The material contained herein is not to be disclosed to or made available to any third party without the prior expressed written approval of the EMA Quality Assurance Director.
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1.0 Quality Assurance Policy

The entire EnviroMatrix Analytical, Inc. (EMA) staff is dedicated to providing reliable, superior quality analytical data to our clients. EMA management believes that Quality Assurance is not simply a management function, but that every individual in the laboratory is responsible for ensuring the quality of their analytical data. Therefore, each person within the laboratory is expected to understand the policies, objectives, and procedures that are described in this Quality Assurance Program Manual (QAPM) as it applies to their respective roles and responsibilities and ultimate commitment to quality.

1.1 Purpose

The purpose of the Quality Assurance Program is to ensure that all information, data, and resulting decisions compiled under a specific task are technically sound, statistically reliable, and properly documented.

The EMA Quality Assurance Program Manual communicates to employees, clients, and certification organizations EMA’s quality assurance policies and procedures.

The Quality Assurance Program Manual defines the purpose, organizational structure, and operating principles of the laboratory. The Quality Assurance Program Manual governs all activities and personnel of EMA including all aspects of administration, sample receipt, sample control, sample preparation, inorganic analysis, organic analysis, quality assurance, sample and waste disposal, data entry, and report production. Any deviation from this program must be approved by the Quality Assurance Director.

Quality Assurance is the structure within an organization which plans, designs, and monitors the frequency and methods of the checks, audits, and reviews necessary to identify problems and dictate corrective actions.

Quality Control is the mechanism or activities through which Quality Assurance achieves its goals. It is the methodical maintenance of strict quality through all activities from sample receipt through report generation; including standard preparation, instrument maintenance, calculation, recording of results, etc.

Quality Control is the function and responsibility of each individual within the laboratory.
1.2 General Description

EMA Quality Policy Statement

“The entire EMA staff is committed to consistently providing our clients with data which is statistically reliable, technically sound, and of the highest quality.”

The contents of this Quality Assurance Program Manual describe the activities which are utilized in order to ensure this commitment is maintained.

Written analytical procedures (Standard Operating Procedures – SOP) are used to ensure strict adherence to approved analytical methods throughout the laboratory. Bench-level quality control measures with established acceptance criteria are included in each analytical procedure employed by the laboratory. Laboratory records and quality control data are monitored by management on a regular basis.

This manual describes the Quality Assurance Program adhered to by EMA and has been written by EMA personnel and approved by Management. All EMA staff has received copies of this manual and is required to comply with the program’s stated goals, requirements, and responsibilities. The Quality Assurance Director has been designated to monitor the program and report program findings to the President and the Laboratory Director.

EMA is a State of California Department of Health Services fully accredited laboratory under the Environmental Laboratory Accreditation Program. EMA is evaluated by external audit under this program and certification is granted for a term of two years. Additional information as to the scope and expiration of this certification is presented in Appendix H.

1.3 Objective

The Quality Assurance Program is designed to provide EMA and its clients with accurate and reliable data.

The Quality Assurance Program ensures that EMA produces valid data for all analytical procedures. In order to accomplish this objective, the following criteria must be achieved:

1. All procedures and practices must be accepted by both the client and/or regulatory agency.

2. A program must be in place to monitor, document, and improve the performance of EMA.
3. There must be a mechanism for correcting problems which are determined by the Quality Assurance Program.

Specific objectives of our performance standards are:

1. Laboratory practices and methodologies are routinely updated and developed as new and improved methods and practices become available.
2. Only trained personnel having the appropriate expertise perform assigned tasks.
3. All data is reviewed prior to release to ensure validity, completeness, accuracy, and precision.

1.4 Intended Use of Data

This Quality Assurance Program Manual applies to the generation of analytical data for environmental monitoring and assessment programs. This Quality Assurance Program has been designed to meet the requirements of various federal and state regulatory agencies with which clients need to comply. The data generated under this Quality Assurance Program is provided in support of investigations or monitoring of sites that will have significant environmental impact on the public and private sector.

2.0 Laboratory Organization and Responsibility

EMA is a full-service environmental laboratory specializing in analytical services and is the sole laboratory operating under this quality management system. EMA maintains two locations that include the main facility and one auxiliary laboratory:

<table>
<thead>
<tr>
<th>Main Facility</th>
<th>Auxiliary Facility</th>
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<tbody>
<tr>
<td>4340 Viewridge Avenue, Suite A</td>
<td>4380 Viewridge Avenue, Suite B</td>
</tr>
<tr>
<td>San Diego, CA 92123</td>
<td>San Diego, CA 92123</td>
</tr>
<tr>
<td>858-560-7717</td>
<td>858-430-0379</td>
</tr>
</tbody>
</table>

EMA provides analytical testing services for the environmental industry. Services include:

- Classical chemistry (titrametric, gravimetric, colorimetric, infrared, etc.),
- Inorganic chemistry by Atomic Absorption (cold vapor), Inductively Coupled Plasma-Mass Spectrometry, and Inductively Coupled Plasma-Atomic Emission Spectrometry,
- Organic chemistry by Gas Chromatography (GC) and Gas Chromatography/Mass Spectrometry (GC/MS),
- Microbiology by Multiple Tube Fermentation, Presence/Absence Media, and Plate Count.

A list of analytical services and methods performed by EMA is presented in Appendix E.

A list of major instrumentation and equipment used by EMA is presented in Appendix F.
EMA has been operating as an analytical laboratory since 1974. EnviroMatrix Analytical, Inc. (EMA) was incorporated in the State of California on July 10, 1992.

The success of the quality assurance program is the responsibility of key laboratory personnel. All laboratory chemists and technicians are vested with the authority to stop work in response to quality related problems. Personnel notify their supervisor and the Quality Assurance Director immediately if any quality related problems or out-of-control events occur. In the temporary absence of their supervisor, lab personnel notify another member of laboratory management.

EnviroMatrix Analytical, Inc.
Organizational Chart

[Diagram of organizational chart with roles and titles]

Leland S. Pitt
President

Jennifer Beyer
Q.A. Director

Administrative Manager & Assistant

Joe Leonard
Laboratory Supervisor

Dan Verdon
Laboratory Director

Microbiologist
Glassware Preparation Technician
Wet Chemistry Chemist
Wet Chemistry Technician

Sample Control Technician
Field Chemist
Courier

Metals Chemist
Metals Extraction Technician

GC/MS Chemist
GC Chemist
Organic Extraction Technician
2.1  The President

The President of EMA approves overall policy, including the Quality Assurance policy and goals contained in this Quality Assurance Program. The president maintains the ultimate responsibility and authority for quality related matters.

2.2  Laboratory Director

The Laboratory Director is ultimately responsible for the timeliness and reliability of all analytical data.

The Laboratory Director's responsibilities with respect to the Quality Assurance Program are to:

- Supervises all department supervisors and chemistry laboratory personnel;
- Oversee and coordinate instrument, equipment, and facilities maintenance;
- Procurement of consumable materials;
- Review work procedures and daily laboratory practices to ensure reliable data;
- Training of laboratory personnel;
- Implement and develop new methodologies;
- Oversee the implementation of valid and reliable quality control procedures;
- Oversee the administration of quality control procedures;
- Oversee the implementation of corrective action(s);
- Oversee performance evaluation and auditing;
- Review analytical data and reporting to clients;
- Monitor standards of performance in Quality Assurance & Quality Control;
- Conducts annual management reviews.

If the Laboratory Director is absent for a period of time exceeding fifteen (15) consecutive calendar days, another full-time staff member meeting the below qualifications must be designated to perform the function. If this absence exceeds thirty-five (35) consecutive calendar days, the primary accreditation body must be notified in writing.

- Have a bachelor’s degree in the chemical, environmental, biological, or physical sciences, or engineering, with at least 24 college semester hours of chemistry.
- Have at least two years of experience in the environmental analysis of representative inorganic and organic analytes for which the laboratory is accredited.
- Other options are available and fully described in the standard (TNI 2009 V1M2, Sections 5.2.6.1)

2.3  Quality Assurance Director
The Quality Assurance Director is responsible for the monitoring performance, laboratory compliance, and maintaining the Quality Assurance Program activities.

Duties are to:

- Develop mechanisms to carry out quality objectives;
- Administrate quality control procedures;
- Implement corrective action(s);
- Manage a document control numbering system;
- Performance evaluation and auditing;
- Liaison with regulatory agencies;
- Propose Quality Assurance Program amendments, provide feedback, and conduct Quality Assurance training.
- Train and monitor chemists and technicians in implementation of Quality Assurance/Quality Control procedures;
- Maintain currency of Quality Manual;
- Manages all facets of the EMA safety program.

2.4 Laboratory Supervisor

The Laboratory Supervisors are responsible for the daily operation of the general lab area. Their duties as they relate to the Quality Assurance Program are to:

- Make recommendations for technical decisions to the Laboratory Director;
- Develop, review, and evaluate test procedures;
- Assist in the training and monitoring of chemists and technicians in implementation of Quality Assurance/Quality Control procedures;
- Ensure completion of analytical work within the requested turn-around time and prior to expiration of sample holding time;
- Initiate or respond to required corrective action(s);
- Monitor method detection limit and instrument detection limit studies on instruments used.

2.5 Project Managers/Project Coordinators

The Project Managers and Project Coordinators have responsibilities relating to the Quality Assurance Program. They are to:

- Respond promptly to client needs and inquiries;
- Track project reports to ensure they are delivered on time;
- Communicate any client inquiries or concerns promptly to the appropriate management person (i.e.: President, Vice-President/Laboratory Director, or other Project Manager);
• Ensure that all client inquiries are resolved by continued communication and follow-up;
• Act as client advocate;
• Determine any client project specific quality assurance or deliverable needs and communicate those needs to the laboratory through written and verbal notification;
• Define, document, and communicate work requirements for specific projects to the laboratory through written and verbal notification;
• Communicate changes in project requirements during the course of work to laboratory personnel through written and verbal notification.

2.6 Sample Control Technician (Sample Receiving Coordinator)

The Sample Control Technician is responsible for sample integrity, sample holding time adherence at receipt, proper container usage, proper sample storage, and sample custody.

Duties include to:

• Receives all client samples and enters project and samples into the EMA Laboratory Information Management System (LIMS);
• Labels all client samples and tracks the internal chain-of-custody;
• Prepares preserved sample containers and adds preservatives to incoming samples where indicated (includes documentation of pH for all metal samples);
• Document sample condition as received;
• Inform client, and/or Laboratory Director or chemists of any holding time considerations;
• Maintains internal chain-of-custody through sample control;
• Ensure and document proper sample container type;
• Control sample storage;
• Implement prescribed procedures for sample receipt and log-in;
• Document project-specific requirements or changes in project requirements during the course of work on the daily in-house aging report;
• Maintains logbook of daily verification of all laboratory balances (as well as refrigerator temperatures).

2.7 Laboratory Chemists and Technicians

The Chemist's duties as they relate to the Quality Assurance Program are to:

• Comply with Quality Assurance Program requirements and method specified Quality Control;
• Maintain a clean and safe working environment;
• Implement any prescribed corrective action(s);
• Utilize only methodologies as approved by EMA and follow EMA Standard Operating Procedures (SOPs);
• Keep accurate laboratory records;
• Routinely check expiration dates of reagents prior to initiating work, and make fresh reagents when necessary.

2.8 Purchasing Agent/Client Services Coordinator/Administrative Assistant

The Purchasing Agent's duties in relation to the Quality Assurance Program are to notify Laboratory Director immediately if incoming purchase requisitions request materials of a different quality or source (vendor) than prior orders. Purchase requisitions that request materials that vary from prior approved materials must have an indication that the Laboratory Director has approved such action.

The Client Services Coordinator duties in relation to the Quality Assurance Program are to:

• Ensure completion of report deliverable prior to due date;
• Files and maintains copies of all analytical reports and project information.
• Scans all incoming Chain-Of-Custody forms (COCs) into the EMA Server Files.

3.0 Facilities

EMA occupies one approximately 6,000 square foot building of which 90% is dedicated to the analytical laboratories. EMA maintains an additional auxiliary laboratory which includes approximately 1800 square foot building within the same business complex of which 65% is dedicated to the analytical laboratories. Separate laboratory areas are dedicated to volatile analyses, semi-volatile analyses, inorganic analyses, microbiological analyses, extraction for organic analyses, digestion for metals analyses, sample receiving/sample preparation, metals analyses, and glassware cleaning; facilitating measures to prevent cross contamination.
Facility Map of 4380 Viewridge Ave. Ste. B
4.0 Personnel Training

EMA provides all personnel with extensive training to assure all employees are provided with the necessary information to make educated, decisive and merited decisions. The guidelines set forth create parameters for all employees to follow that will aid in quality of all laboratory processes.

The intention of the training program is to provide a foundation of quality control in the designated specified tasks with the overall goal to ensure that all personnel have the skills to perform their work within the construct of the management system and have demonstrated competency to perform the tests, parts of tests or other functions for which they are responsible.

Each analyst must demonstrate capability for each test method used in the laboratory, prior to reporting samples using the method, and on an annual basis. Records of these demonstrations must be maintained.

4.1 Quality Commitment

EMA staff is committed to providing superior service and quality. EMA management believes that achieving excellence requires the dedication of all employees and has established training programs throughout the organization to foster employee involvement and growth. All employees sign a form, kept by the Q.A. Director and updated annually, which states they have read and understood the quality assurance principles and practices outlined in this manual.

4.2 Safety Training and Compliance

A formal safety program is established in accordance with local, state and federal requirements. Safety training is provided for all laboratory employees initially upon hire and thereafter on a routine basis. The safety program is maintained by the Q.A. Director with the help of the Laboratory Director and Laboratory Supervisor.

4.3 Qualifications of Laboratory Personnel

EMA is very proud of its highly qualified and professional staff and is committed to furthering the skills of employees at all levels.

Initial training is designed to provide personnel with the information required to perform their job in compliance with the overall management system.

Technical training is performed by management and qualified individuals to ensure method proficiency. The staff is updated as to current technical advances at an as-needed basis. All laboratory personnel are required to acknowledge through signature that they have read and understand the SOPs appropriate for their area. All training beyond acknowledgment of SOPs is documented. Continuing qualification of laboratory personnel is demonstrated through systems and performance audits conducted by the Quality Assurance Director. External courses and conferences
are attended when appropriate. The EMA staff further their expertise through present and past membership in professional organizations such as:

- San Diego Environmental Professionals (SDEP)
- American Council of Independent Laboratories (ACIL)
- Professional Environmental Marketing Association (PEMA)
- Association of Environmental Professionals (AEP)
- San Diego Dry Weather monitoring workgroup
- Stormwater Monitoring Coalition workgroup

All new employees receive a comprehensive orientation to quality assurance, quality control, and safety programs administered by management within approximately the first week of employment. Training for a new task includes reading and understanding all relevant documentation involved in the job description. Training is under the direct supervision of a qualified staff member during which time all pertaining logbooks, notebooks, and other associated laboratory worksheets are cosigned. Training effectiveness is evaluated initially through the observation of employee’s tasks through the evaluation of Initial Demonstrations of Capability. Continuing evaluations are made through review of quality control data, proficiency testing data, and internal audits.

Copies of all training records, including the results of Precision and Accuracy Studies and single- and double-blind performance evaluations, are maintained in the Quality Assurance program files. Appendix G presents professional profiles of key personnel.

5.0 Quality Assurance Objectives

The objectives of EMA are to supply precise, accurate data reports to clients which are representative of the sample supplied. All data reported are generated and calculated according to recognized standards of the environmental laboratory industry. Data reported by EMA are calculated and reported in units that are consistent with data produced by other organizations. EMA strives to present data reports that are complete and contain all data elements and supporting documentation for the type of deliverable requested by the client.

The precision and accuracy control limits utilized by EMA are based upon limits contained in the published methods. When warranted by EMA’s experience with a particular method, more restrictive control limits than those cited in the method are set.

Method performance characteristics are determined prior to method use for analytical methods. This is accomplished through Precision and Accuracy, Method Detection Limit, and Instrument Detection Limit Studies performed according to standard operating procedures. Additionally, Quality Control reference materials are analyzed to verify method performance characteristics. All method performance data is compiled by the individual analyst and is documented and maintained by the Quality Assurance Director in the Quality Assurance program files.

5.1 Data Quality Characteristics
There are five recognized characteristics of data quality. They are:

**Accuracy**
The degree of agreement of a measurement (or measurement average) with an accepted reference or true value. It is a measure of system bias. It is usually expressed as the difference of "measured" from "true" values, or as a percentage of the difference. The accuracy of laboratory analyses can be evaluated through the concurrent analyses of standard reference materials, if available.

**Precision**
A measure of agreement among individual measurements of the same property under similar conditions. It is expressed in terms of percent difference between replicates or in terms of the standard deviation.

**Completeness**
A measure of the amount of valid data obtained compared to the amount expected to be collected under normal conditions; it is usually expressed as a percentage. The completeness objective is calculated on those samples analyzed, not the remainder archived. Data from samples are considered to be complete if the samples have been properly collected, labeled, stored, prepared, and analyzed and the associated quality control criteria have been met.

**Representativeness**
Expresses the degree to which data accurately and precisely represents a characteristic of a data population, process condition, or a sample. The samples expected characterization would be compared to that obtained by laboratory analyses to evaluate the representativeness of the data to the expected data.

**Comparability**
Expresses the confidence with which one data set can be compared to another. To achieve comparability, the data generated will be reported using units specified in the Standard Operating Procedures as appropriate. Analytical results will be comparable to those produced from similar laboratories using the same instrumentation and methodology. This is accomplished through the following practices:

- Demonstrate traceability of standards to NIST or EPA sources.
- Use of standard and approved methodologies.
- Standardized units of measure.
- Standardized Quality Control Acceptance Criteria
- Analysis of Performance Evaluation (PE) samples to demonstrate laboratory performance.

5.2 Completeness, Representativeness, and Comparability

Prior to the results being disseminated, the report is reviewed and evaluated for completeness, representativeness, and comparability.
The report and associated data is evaluated to ensure that it is; sufficient for its intended use, representative of the matrix and conditions being measured, and representative of the method and instrument utilized.

The Laboratory Director will review and approve all EMA reports to clients. In cases whereby the Laboratory Director is unavailable (due to sickness, vacation, etc.), the Q.A Director, Laboratory Supervisor or other technical designee may review and approve reports.

6.0 Sample Custody

The Sample Control Technician is responsible for initiating and maintaining external and internal chain-of-custody, managing and tracking sample storage and distribution, ensuring proper containers, preservation, temperature requirements and adherence to holding time requirements. In the absence of the Sample Control Technician, only properly trained personnel may receive samples with all activities reviewed by the Sample Control Technician or Laboratory Management. All samples received are sent through an additional review process by a qualified employee to ensure the laboratory adheres to the client’s needs and representations.

Samples are physical evidence and are handled at EMA according to certain procedural safeguards. The strict adherence to chain-of-custody procedures is critical to legal proceedings and an integral part of a Quality Assurance Program. Chain-of-custody procedures are initiated during sampling events in the field and continued through laboratory analysis, and finally, the ultimate disposal or return of the sample.

EMA chain-of-custody procedures ensure traceability through proper sample handling, Quality Control procedures and internal chain-of-custody. The components of the chain-of-custody procedure include chain-of-custody documentation forms and unique sample identification numbers.

The National Enforcement Investigations Center of EPA defines custody of evidence in the following ways:

1. In a person’s physical possession,
2. In view of the person after possession has taken place,
3. Secured by that person so that the sample cannot be tampered with, or
4. Secured by that person in an area which is restricted to unauthorized personnel.

6.1 Laboratory Custody Procedures

EMA has implemented the following standard operating procedures with regard to laboratory internal chain-of-custody:

- Samples are stored in a secure area except when being analyzed or prepared.
Non-employee access to the laboratory is controlled through the use of limited access points at the facility. Outside personnel can access the building either through the front reception area or the sample receiving area.

The designated Sample Control Technician controls access to the sample storage area.

Samples remain in secured sample storage until removed for sample preparation or analysis.

Each sample container is assigned a unique identifier and this identifier is used to track the sample location and status throughout the analytical process, storage and disposal.

After the sample is assigned an identifier and logged in, sample tracking is utilized to trace the transfer of the sample from the sample storage area to the chemists.

Sample tracking is maintained through the internal chain-of-custody program in the EMA LIMS in order to document sample location and responsible party within the laboratory.

All samples are to be returned to the proper storage area and documented within the chain-of-custody program in the LIM system.

Any remaining samples are archived in locked storage areas, returned to the client, or disposed of properly as required by the client and federal and state regulations.

The Sample Control Technician is responsible for ensuring that all samples are maintained in a secure area while being logged-in.

Internal sample chain-of-custody is maintained through sample tracking program in the EMA LIMS. This program is used to log samples in and out of sample storage and indicate sample custody at all times. It is the responsibility of all personnel to document when a sample is in their custody.

Coolers containing samples are received through the sample receiving/sample management area. Upon sample receipt at the laboratory, samples are assigned a unique identification number and entered into the sample receipt logbook. All samples are entered into the EMA LIM system. Details include client name, laboratory identification number, parameters requested, date received, date and time sampled, date due and relinquishing parties.

For sample shipments that contain a temperature blank (i.e.: a separate water-filled container for verifying receipt temperature), the temperature of the water in the designated bottles will be obtained using an NIST calibrated thermometer. The thermometer will be inserted into the temperature blank as soon as possible after sample receipt; once equilibrium is reached the temperature will be recorded. In the event that there is no temperature blank present, the temperature of the samples are taken with an infrared thermometer which indicates the temperature of the sample bottles. The temperature or condition of the samples on receipt will be recorded on the associated chain-of-custody.
If samples are not received within the temperature requirements or if the samples are received outside of the protocol holding time requirements, the client will be contacted and notified of the discrepancy. In the event the client cannot be contacted, the samples will be processed on an as received basis. The discrepancy is noted on the chain-of-custody.

The samples are carefully removed from the shipping container. The condition of the samples will be noted on the associated chain-of-custody form (intact, broken, leaking, etc.). The client will be contacted immediately if there is evidence of damage. Broken/damaged sample bottles will be transferred to the EMA waste drums. The coolers containing the broken samples will be rinsed several times with water; the water will be transferred to the waste drums if necessary.

The Sample Control Technician will verify agreement between the labeled sample containers and the chain-of-custody. In the event of a discrepancy, the client will be contacted immediately.

The samples will be visually inspected to determine that adequate sample volume was collected for the parameters requested, correct sample containers were utilized, and proper preservation was indicated on the label. This will be documented on the chain-of-custody form. Any problems will warrant immediate client contact.

All liquid samples requiring any metals analysis must be verified to have a pH ≤ 2. All liquid samples requiring cyanide analysis must have pH verified ≥ 12. The Sample Control Technician will maintain a logbook which will contain pH upon receipt, amount of acid/base added (if necessary) and pH of sample after 24 hours (for metals analysis only).

If a problem is not resolved with the client during sample delivery, the client will be notified by telephone to clarify any discrepancies found during sample log-in and stipulate corrective actions. All samples that are affected by the problem are placed in the appropriate contaminant free refrigerator and maintained at 0-6°C until resolved. A record of the telephone call will be kept with the chain-of-custody information in the LIMS system.

If no problems are observed, the samples are placed in sample storage areas controlled by the Sample Control Technician until analysis. Maximum holding times for samples are observed and strict sample control is maintained by the Sample Control Technician.

In the absence of the Sample Control Technician, only personnel who have been trained in sample receipt and sample custody procedures have access to samples in the sample control area.

Controlled custody of digestates and extracts is maintained departmentally. Digestates and extracts are stored for thirty days after analysis, where applicable/storage permitting, and are promptly disposed of thereafter.

6.2 Chain-of-custody

To trace sample possession from the time of collection, a chain-of-custody record is completed and accompanies the sample(s).
The chain-of-custody contains the following information:

- Client sample identification number;
- Signature of the collector and any person who has had the sample in their possession;
- Date and time collected;
- Sample type;
- Client name and address,
- Inclusive date of possession;
- Analyses requested;
- Intact seals present on sample containers (if applicable);
- Sample condition when received (temperature, proper container, etc.);
- Samples properly preserved, as applicable;
- Time and date sample was received and by whom.

The chain-of-custody establishes the documentation and control necessary to identify and trace a sample from sample collection to final analysis. It includes sample labeling to ensure proper identification of each sample, secure custody, and provides the recorded support information for potential litigation.

Chain-of-custody forms are used to document the integrity of all samples. To maintain a record of sample collection, transfer between personnel, shipment and receipt by the laboratory, a chain-of-custody form will be filled out for each sample or batch of samples provided by the client.

Whenever the possessions of the samples are transferred, the individual relinquishing the sample(s) signs and records the date and time of sample transfer on the chain-of-custody document. The individual receiving the sample(s) repeats the procedure. This record represents the official documentation for all sample custody transfers until the samples have arrived at the laboratory.

A copy of the chain-of-custody is provided to the client when samples are logged in at the laboratory.

7.0 Sample Security, Storage, and Disposal

The Sample Control Technician is responsible for ensuring that samples are maintained in secured storage areas under the appropriate conditions and are properly disposed of once deemed suitable.

7.1 Sample Security

Samples are kept in secured storage areas except during laboratory analysis. All laboratory personnel who receive samples are responsible for the care and custody of samples from the time each sample is received into that person's possession until the sample is returned to the Sample Control Technician.
The following security measures are employed:

- Doors to the sample storage area are secured at all times.
- Authorized personnel escort all visitors and deliveries through the laboratory from the rear receiving area or the main reception area.
- Laboratory personnel are responsible for the control and maintenance of sample integrity while they have custody of samples.

Information provided by the client about samples, recorded on the chain-of-custody or project documents, is available to analysts and can prove useful guidance when analyzing samples. EMA policies prohibit disclosure of confidential client information to third parties. All laboratory personnel are instructed to maintain confidentiality of client project information.

7.2 Sample Storage

Once samples are logged into the sample tracking system, the Sample Control Technician is responsible for ensuring the following procedures:

- Water samples for volatile analyses are stored in a separate refrigerator reserved only for volatile samples to avoid contamination. Solid samples that are to be analyzed for volatile organic compounds are to be sub-sampled prior to any other analyses being performed on those samples.
- Samples for microbiological analyses are delivered to the analyst and processed immediately. These samples are not stored due to method recommendations.
- Samples are stored in a secured area.
- Samples are removed from the shipping container or cooler and stored in their original containers unless damaged.
- Damaged samples are documented and reported to the client and Project Manager.
- Sample storage areas are kept secured and tidy at all times.
- Samples are removed from storage only by authorized personnel trained in sample custody procedures.
- Standards are not stored with samples.

7.3 Sample and Waste Disposal

Upon completion of the analysis, any remaining sample will be placed into long-term storage, returned to the client, or disposed of in compliance with all applicable federal, state, and local laws. All samples disposed of are documented in the LIM system by the Sample Control Technician.

When sample analysis and all Quality Control checks have been completed and a final report has been issued, the unused sample will be stored for a period of no less than one week after the sample report was received (30 days maximum if storage space allows; longer archival available with nominal fee).
Any unused portions requested by the client shall be returned.

Laboratory waste is collected in individual laboratory areas in appropriate satellite containers labeled with water-proof labels. Labels identify the hazardous waste collected and all pertinent information from the Material Safety Data Sheets (MSDS). When filled, containers are taken to the Hazardous Waste Room and composited into larger containers for storage until transport to a designated disposal facility. The Safety Officer works with the waste transporters to obtain disposal of waste which meets regulatory standards.

Non-hazardous waters may be disposed of in sink drains as permitted by a wastewater permit granted from the City of San Diego Metropolitan Wastewater Department.

7.4 Sample Preservation and Holding Times

It is critical to sample integrity and data validity that EMA analyze samples within the method stated holding times. EMA follows regulatory guidelines for sample preservation and holding time requirements as specified by the method references. Sample holding time begins with the collection of the sample.

Appendix A contains the Sample Holding Times and Preservation Requirements which identifies holding time requirements by method and parameter for water and soil/wastes.

Adherence to holding time requirements is maintained through several laboratory policies:

- When a sample holding time is identified in terms of hours, the chain-of-custody must indicate the time of sampling.
- The Sample Control Technician verbally notifies the appropriate analyst immediately upon receipt of samples with holding times of 72 or less hours.
- All laboratory personnel shall generate a daily in-house aging report listing the status of requested analyses for current samples.
- All data is subject to supervisory review and audits in which adherence to holding time requirements are monitored.
- Time of analysis is reported with analytical results when requested.

Accurate sample preservation is critical for following procedural guidelines dictated by recognized standards of the environmental laboratory industry. Preservation of samples is noted in the LIM system and if contradictory to the standardized procedure noted within the chain-of-custody. All liquid samples to be analyzed for metals must be documented in a designated logbook, recording the pH of the sample upon arrival. Liquid samples for metals analysis must be at a pH of 2 or below. Additional acid may be needed to accomplish this requirement (with an adjustment period of 24 hours before analysis). Liquid samples requiring cyanide analysis must be received at a pH of 12 or higher. These samples are documented in pH logbook upon receipt and adjusted if necessary before analysis can begin. Occasionally samples will come in unpreserved whereupon the Sample Receiving Technician must sub-sample into correct containers pertaining to requested analyses.
8.0 Material Procurement and Control

Only chemicals and supplies of the quality specified in the appropriate method or Standard Operating Procedure shall be used for analyses. Purchase requisitions require review by the Laboratory Director for suitability prior to being issued. The Laboratory Director is responsible for ensuring that the materials being ordered are of the appropriate grade/quality for the methodologies.

It is the policy to only use products that do not negatively impact the quality of lab results. Should any product be found to negatively impact the quality of results, it will no longer be used or ordered.

The Purchasing Agent verifies that materials ordered are of the same grade/quality previously ordered and are requested from an approved vendor. If any deviations are noted the Purchasing Agent immediately notifies the Laboratory Director for approval/disapproval prior to placing order.

Upon receipt of orders, the purchase order is compared to the grade of material shipped to ensure that the correct quality/grade was received prior to acceptance by the laboratory.

8.1 Containers and Reagents

EMA provides required bottles, ultra-pure water (for use for trip blanks), coolers, sampling instructions, labels, ice packs, and chain-of-custody forms for sample collection. EMA utilizes EPA approved, pre-cleaned glassware for sample collection. Sample container preservatives are certified free from analytes of interest and contaminants. Compliance certificates that indicate freedom from contamination are maintained by the Sample Control Technician for each lot number of preservative and sample container.

Sample containers and preservatives are fully traceable to their sources and lot numbers through use of a logbook maintained by the Sample Control Technician. Containers provided to clients are labeled with the date the containers were prepared. All container and preservative lot numbers used for each day are recorded in a container preparation logbook along with the date that the preservative lot number was in use.

Upon request, EMA will provide trip blanks to clients.

8.2 Calibration Standards and Reagents

The chemicals and reagents used by EMA are selected with care. It is the policy to purchase standards from manufacturers which provide traceability to NIST standards. All chemicals and reagents are given a unique ID, through Promium® LIM system, and are recorded for every analytical batch processed. Analytical reagent grade is the minimum quality used within the laboratory. Ultra pure(trace metal free acids are employed for low detection limit metals analysis. Pesticide grade solvents are used for all organic extractions. The extraction solvents are treated to all steps of the sample preparation and analysis process.
The following acceptance criteria applies to solvents:

- No analyte present at concentrations equal to or greater than one-half the reported detection limit.
- No non-analyte peak present in the test chromatogram greater than 10% of the closest internal standard for GC/MS analysis or which would interfere with the identification and quantitation process for GC analysis.

Records showing the reagent lots employed are maintained for all analyses. The method blank serves as a continual verification of the quality of the reagents as well as the quality of the analytical laboratory environment.

8.3 Equipment Procurement

Only equipment and supplies of the quality specified in the appropriate method or Standard Operating Procedure shall be used for analyses. Purchase requisitions require review by the Laboratory Director for suitability prior to purchase orders being issued. The Laboratory Director is responsible for ensuring that the materials being ordered are of appropriate grade/quality for the methodologies.

Upon receipt of orders, the purchase order and requisition are compared to the grade of the material shipped to ensure that the correct quality/grade was received prior to acceptance by the laboratory. The Sample Control Technician is responsible for receiving products and is required to date and initial the invoice as verification of material acceptance.

9.0 Analytical Procedures

EMA utilizes methodologies from the following accepted standard references:

- California Code of Regulations, Title 22, Divisions 4 and 4.5.

Additional methods are taken from:

• American Society for Testing and Materials (ASTM).
• The United States Geological Survey (USGS).
• Association of Official Analytical Chemists (AOAC).
• NIOSH Analytical Manual.
• Air Resources Board Manual.

Additionally, EMA has developed proprietary in-house methods for some parameters.

Clients are notified by EMA Project Managers through written and/or verbal communication when non-standard or significantly modified methods are to be used. Written or documented verbal client approval is required prior to use of new, non-standard, or significantly modified methods for client sample analysis. In the absence of client direction, selection of a method to be used for analysis is determined by the Laboratory Director.

Each data report issued by EMA includes a reference to the exact method employed for the analysis. As new methods become promulgated and the laboratory demonstrates capability of performing new methods, SOPs are revised and updated accordingly to replace existing methods. Only the most recent revision for a method is used. Revised SOPs issued to personnel are accompanied by a form which personnel sign and date indication that they have read and understand the procedure.

Capability of performing an analytical method must be demonstrated prior to client sample analysis for all new and modified methods. This is accomplished through personnel training, QC Check sample analysis, Method Detection Limit, Instrument Detection Limit and Precision and Accuracy Studies.

Method capability data is maintained by the Quality Assurance Director in the Quality Assurance program files. The Quality Assurance Director is also responsible for ensuring that the laboratory staff is aware of the most current version for all methods.

10.0 Calibration Procedures

Calibration procedures are required in all areas of a laboratory setting. It is an essential component of quality control providing the correctness (or lack thereof) of laboratory procedures and instrumentation/equipment, to ensure that all aspects of data processing are of the utmost integrity.

10.1 Calibration Procedures and Frequencies

Instrument calibration is critical to generating accurate analytical data. EMA maintains strict controls on the calibration procedures for the various types of analytical equipment. Each instrument is calibrated prior to sample analysis in accordance with method criteria. The specific criteria for calibration can be found in each method SOP. Corrective action must be taken to remedy any out-of-control situations prior to analysis of any samples. Deviations from stated criteria are not acceptable.
Initial demonstration of capability for each instrument and analyst must be conducted before analysis of any samples. This includes performing instrument detection limit (IDL) and method detection limit (MDL) studies as well as having each analyst demonstrate proficiency to perform the method and obtain acceptable results for each analyte. MDL studies are updated according to each instrument SOP, occurring at minimum quarterly (ideally monthly) or when major changes to the instrumentation or new personnel are involved.

Instruments are calibrated in accordance with the appropriate analytical method and the manufacturer instructions. The analytical methods cite the appropriate calibration procedures and frequencies. In the event that the calibration specifications are not listed, a minimum correlation coefficient ($R^2$) of 0.99 or better is required.

Prior to the ongoing of analysis of samples, instruments are either calibrated or their calibrations verified. Calibration curves of signal versus concentration are generated on each analytical instrument. Calibration curves are established for each analyte of interest.

Most methods use either four or five (with a minimum of two) different calibration points for standardization. Current calibration curves are evaluated daily using one of the following; certified reference material (CRM, ICV, QCS), a continuing calibration curve verification standard (CCV), a laboratory control sample (LCS), or a laboratory blank spike (LBS).

It is EMA's policy to validate all new standards against existing standards prior to use. The new standard's response factor (RF) should be within 10% of the previous standard's RF.

Hardcopy records of all instrument calibrations are maintained in the individual laboratory areas. These records are reviewed and are included in internal audits.

When calibration acceptance criteria or guidelines are available in a method, those criteria, or that of which is more stringent, are utilized. In the absence of method-stated criteria or guidelines, calibration acceptance criteria or guidelines from a similar method are considered to be technically sound.

10.2 Laboratory Standards and Reagents

Analytical standards utilized for method calibration and preparation of quality control samples are traceable to standard reference materials, or a certificate of analyses provided by the manufacturer.

Standards are purchased from approved and reputable commercial vendors such as Aldrich, Fisher Scientific, Supelco, etc. for use in all laboratory analyses. Certificates of analysis and expiration date information are received with standards and are maintained by each department.

All standards and reagents are given unique ID’s, assigned through Promium® LIM system, either upon receipt or when newly opened. Information such as the manufacturer, lot number, expiration dates are recorded.
Standards and reagents are dated upon opening, and the date of expiration recorded (expiration dates are determined by the vendor or indicated in the individual method SOP). This procedure establishes the order of use and eliminates the possibility of exceeding shelf life. A stock or working standard will be assigned an expiration date of the component with the shortest time of expiration. Reference standards or materials shall not be used after their expiration date.

Standards are protected from degradation, deterioration and contaminations based upon storage requirements and are stored properly to ensure chemical compatibility and integrity.

Each analytical batch corresponds to a sample preparation log (i.e., bench sheet) where all applicable reagent and standard ID’s are recorded. Control check samples are analyzed with each analytical batch for all analytical procedures to ensure that the reagents used have not degraded or become contaminated.

Stock and working standard solutions are prepared fresh as required by their stability, and are checked regularly for signs of deterioration. Standards are labeled with a unique identifier and preparation date. Standards are traceable to analytical batches through the use of standard preparation logs and extraction/preparation logs (stand-alone logbooks or via LIMS).

The laboratory has established the following guidelines for the preparation of analytical standards:

1. Laboratory chemists who prepare standards are trained and experienced in calibration and the use of analytical measuring techniques.
2. Analytical reagent grade materials are utilized in preparation of standards.
3. Analytical measurement tools are calibrated to obtain accurate measurements.
4. All data generated are documented immediately in the appropriate standard preparation notebook.
5. Standards are properly labeled and referenced to standard preparation notebooks.

Laboratory contamination is minimized through implementation of a standard operation procedure (SOP) for glassware and lab-ware cleaning. The SOP is followed to ensure the removal of all traces of parameter(s) of interest and contaminants that could interfere with analysis.

Three grades of reagent water are used in the laboratory:

1. City water - The tap water used in the laboratory is supplied from the City of San Diego water supply. Its primary use is for the washing of glassware.
2. De-ionized water - This water is produced by passing tap water through a demineralization system. This water is used for some STLC preparations and as the final rinse for laboratory glassware.
3. Ultra-pure distilled water - This higher quality water is provided to the laboratory by an external supplier and meets specifications for Type I ASTM Reagent Water. This water is used for preparing inorganic and organic reagent blanks, reagent, solutions and standards.
Ultra-pure distilled waters are analyzed upon receipt of a new lot number to make sure that they meet pH and conductivity criteria for ASTM Type I and II Reagent Waters.

10.3 General Laboratory Equipment Calibration Requirements

Laboratory equipment requiring calibration, but not operational calibration, is checked on a routine basis for accuracy. These include; balances, ovens, refrigerators, freezers, automatic pipettes, and thermometers. Additionally, calibration is also performed and documented following maintenance and repair to show a return to control.

Each piece of support equipment is calibrated for every day of use. Calibration is documented in calibration logbooks for each piece of equipment. Acceptance criteria and correction factors observed are stated below or found in the support documents for individual pieces of support equipment. All out-of-control measurements and their resulting actions are documented on a corrective action form. The Laboratory Director and Quality Assurance Director are notified immediately of the out-of-control event. Non-compliant equipment is not used in the process of analyzing client samples. All out-of-compliance monitoring and corrective action measures are documented.

Equipment is calibrated against a standard traceable to NBS or other recognized physical or chemical constants. Calibration procedures are specified by the manufacturer, regulatory agency or method SOP. Procedures provide step-by-step detail for obtaining and documenting results. The data are kept on file in the laboratory and allow traceability to data generated under each equipment calibration. Calibration due dates are maintained by the Laboratory Supervisor to maintain proper calibration intervals.

**Balances**
The calibration of balances are verified before each use with standard Class-S calibration referenced weights to within 0.001 grams of "true weight," and are calibrated annually by a licensed specialist across the full weight range of the balance.

**Ovens/Furnace**
Oven temperatures will be recorded during each use. The required temperature tolerance is ± 2°C at the operating range of 60 - 300°C for ovens and 500 - 1500°C for furnaces. If the temperature is found to be out-of-control during analysis, the results of that analysis will not be reported and the analysis will be repeated after the oven has stabilized for 8 hours.

**Refrigerators/freezers**
The temperature in all the refrigerators shall be recorded each working day in the refrigerator logs and maintained at 0 - 6°C. In cases where temperatures are out of these limits, the temperature will be adjusted accordingly with the Lab Director's approval. Freezer control limits are -14°C ± 2°C.

**Thermometers**
Every thermometer must be checked annually against an NBS thermometer of equal or greater precision. The procedures of ASTM E77-92 for calibration are followed. Errors in temperature
indications of the thermometer should not exceed the scale errors as expressed in Table 1 of ASTM E1-83.

**Pipets**
All automatic pipets are given a unique identification marker and calibrated on a weekly and quarterly basis according to ASTM gravimetric methods and acceptance criteria.

**Syringes**
Calibration certificates from the manufacturer and frequent replacement of syringes ensure accuracy of measurements.

10.4 Sample Storage Temperature Monitoring

Maintaining appropriate temperature during sample storage is of critical importance in the task of attaining valid data. The following procedures must be followed in order to maintain and monitor appropriate sample storage temperatures.

Upon sample receipt, samples for analysis are transferred to the appropriate storage refrigerators. A daily temperature check is performed to verify refrigerator temperature and these temperature readings are recorded on a log sheet for that refrigerator. Each refrigerator has a unique identification number and a separate Daily Temperature Log is maintained for each refrigerator. The thermometer in each refrigerator is immersed in a liquid such as glycerin or water. If a daily temperature reading exceeds the $0-6^\circ\pm2^\circ$C acceptance criterion, all project samples will be transferred to another refrigerator that is documented to be within the acceptable temperature range. The problem will be corrected, and corrective actions will be documented for the faulty refrigerator.

11.0 Analytical Requirements

Analytical instruments are calibrated at regular intervals recommended by the manufacturer and as required by ASTM, EPA, or other standard methods. Calibration of all equipment used and documentation of the calibration will be performed by individual chemists/technicians as assigned by the Laboratory Director or by independent calibration firm.

11.1 GC/MS System Calibration

The gas chromatograph/mass spectrometer (GC/MS) systems are calibrated for mass and then tuned using specific instrument and method parameters. They are then calibrated for quantitation using the internal standard technique. Specific methods impose variations and/or different acceptance criteria on both the tuning and the calibration practices. These specific requirements are followed per the particular method Standard Operating Procedure.

**Mass Calibration and Tuning:**

The calibration of each instrument is verified at frequencies specified in the methods. Calibration and tuning the GC/MS systems is instrument specific and includes the following:
• GC/MS mass calibration using perfluorotributylamine (PFTBA);
• The tune of each system is checked using 4-bromofluorobenzene (BFB) for determinations of volatiles and with dacafluorotriphenylphosphine (DFTPP) for determination of semi-volatiles;
• The required ion abundance criteria must be met before determination of any analytes.

The background subtraction performed per the methodologies is straightforward and designed to eliminate column bleed or instrument background ions. Background subtraction actions resulting in spectral distortions for the sole purpose of meeting special requirements are contrary to the objectives of quality assurance and are unacceptable.

11.2 Gas Chromatography System Calibration

The gas chromatography systems are calibrated using either the external or internal standard techniques. The specific acceptance criterion varies for different methods and can be located in the method in question or the EMA Standard Operating Procedure.

**External Standard Calibration Procedure**

For each analyte, or group of analytes, five or more concentration levels of standard are prepared by adding aliquots of one or more stock standards to volumetric flasks. The standard solutions are then diluted to volume with the appropriate solvent for the method. The lowest concentration standard should be at the concentration of the method detection limit (MDL). The other concentrations should define the working range of the system.

Each of the calibration standards are injected into the GC system using the same technique employed for actual environmental sample extracts. (i.e., 1-5 ul liquid injections, purge & trap, etc.) A series of calibration factors (CFs) are calculated for each analyte, at each standard concentration. The calibration curve is a plot of the relative response vs. the amount injected.

The CF = amount injected/total response (area). Multi-response (multi-peak) compounds use the total area of all peaks for quantitation or the average concentration of several peaks.

Each of the calibration standards is injected into the GC system using the same technique as actual samples. A series of response factors (RFs) are calculated for each analyte, at each standard concentration for the mass peak of interest for each analyte. The linearity (%RSD) is to be determined and compared to the method requirement. If the criterion is not met, the standard analyses must be repeated if quantitation of unknown samples is desired.

If the quantitation criteria are not met, in certain cases, the documentation of the ability to detect the minimum detectable concentration is sufficient to determine the presence or absence of target compounds with "estimated only" concentrations provided or a qualitative determination only.
The working average calibration factor or calibration curve must be verified each working day by the injection of a continuing calibration curve verification standard (CCV). The frequency of verification is detector dependent and varies from once per day to an average of once every five samples. If the response of any analyte is outside the acceptable response for the specified method, a new calibration curve must be prepared for that analyte.

**Internal Standard Calibration Procedure:**

For each analyte, or group of analytes, five concentration levels of standards are prepared by adding aliquots of one or more stock standards to volumetric flasks. In addition, a known and constant amount of one or more internal standards (IS) is added to each volumetric flask and they are then diluted to volume with an appropriate solvent. The lowest concentration should be at the method detection limit. The other concentrations should define the working range of the system.

Each of the calibration standards is injected into the GC system using the same technique as actual samples. A series of response factors (RFs) are calculated for each analyte, at each standard concentration for the mass peak of interest for each analyte. The linearity (%RSD) is to be determined and compared to the method requirement. If the criterion is not met, the standard analyses must be repeated if quantitation of unknown samples is desired.

The working average response factor must be verified on each working day by the analysis of continuing calibration verification (CCV) standard. The frequency of verification is method specific.

If the response of any analyte is outside the acceptable response for the specified method, a corrective action must be taken before the analysis continues.

If the quantitation criterion is not met, in certain cases, the documentation of the ability to detect the minimum detectable concentration is sufficient to determine the presence or absence of target compounds with "estimated only" concentrations provided or a qualitative determination only.

11.3 **Inductively Coupled Plasma – Optical Emission Spectroscopy (ICP-OES) and ICP-Mass Spectroscopy Calibration**

The ICP-OES system is calibrated daily by an external standard calibration process. The ICP-MS is calibrated daily using an external and internal standard method calibration process. The calibration specifications may vary from method to method and can be found in the particular reference or EMA SOP for that method.

**Daily Standard Calibration Procedures:**

For each analyte, or group of analytes, a calibration curve is generated by preparing standards from one or more stock solutions according to the method outlined in the appropriate EMA SOP.
Continuing calibration standards, containing the same analyte(s) as the calibration standards are prepared in the same manner at an appropriate concentration within the calibration curve for the specified method.

Before the analysis and determination of elemental concentrations of interest can be determined, the instrument must be calibrated. This is done by creating a calibration curve from the measurement of emission for standard solutions and a blank. To ensure calibration correctness, an initial calibration verification solution (ICV) is analyzed immediately after calibration. The ICV must be prepared from a second source vendor, i.e.; source different from calibration stock standards. Continuation of calibration validation is monitored through the use of a continuing calibration verification (CCV) solution. The CCV standard is analyzed after every 10 samples. Laboratory control samples, matrix control samples, and duplicates are also used to verify calibration and method preparation techniques. Results are generally accepted if they have a percent relative deviation (%RSD) of ≤ 20. If this criterion is not met, the sample or standard analysis must be repeated.

Results from continuing calibration standards must fall within the method specified acceptance limits. If this criterion is not met, the standard analysis must be repeated. If upon reanalysis, the standard again fails to meet this criterion, a corrective action must be taken, and the entire standardization procedure must be repeated (after source of error is indicated and resolved).

12.0 Detection and Reporting Limits

Detection levels are determined to signify the smallest amount of an analyte that can be detected in a given procedure and within a stated confidence level. These levels (limits) are defined by their purpose, ranging from levels of instrument confidence, to method confidence.

12.1 Method Detection Limits

The method detection limit is the minimum concentration of a substance that can be measured with 99% confidence that the analyte concentration is greater than zero. A constituent is added to soil and water matrices to make a concentration near (within one to five times) the expected detection limit. Seven or more replicates of this sample are processed through the entire analytical method. The MDL is determined using the standard deviation of the replicates. EMA performs Method Detection Limit Studies (MDLs) accordingly, based on each individual method criteria and for all new or modified methods. The results of all MDL studies will be reviewed by the Laboratory Director for approval before client samples are analyzed. For all analysis, the MDLs may not be higher than the regulatory limits for that parameter of interest, (taking into consideration the instrument and method limitations). MDLs must be performed for new or modified analytical methods before the analysis of client samples. All MDL data and documentation are maintained by the QA Director in the QA program files. Experimentally derived MDLs are evaluated by the QA Director and checked against method specific MDL guidelines to ensure method performance comparable to that of peer laboratories.

12.2 Instrument Detection Limits
EMA performs Instrument Detection Limit Studies (IDLs), for initial setup and verification for an analytical instrument and any time there is a major change in or maintenance of instrumentation for a particular method. A standard with a concentration near (within one to three times) the expected instrument detection limit is made. Seven aliquots of this standard are analyzed each day on three non-consecutive days and the IDL is calculated using the pooled standard deviation. The IDL is the minimum concentration of a substance that can be identified by an instrument with 99% confidence that the analyte concentration is greater than zero.

12.3 Reporting Limits

Reporting limits take into account the sample size, matrix effects, and any dilution factors. The Reporting Limit is always greater than or equal to the MDL.

Reporting Limits are evaluated by the QA Director to verify that reporting limits are greater than or equal to the experimentally determined MDL and less than or equal to project-specific reporting limit requirements.

12.4 Practical Quantitation Limits

The practical quantitation limit (PQL) is the lower limit of concentration or amount of substance that must be present before a method is considered to provide quantitative results.

13.0 Analytical Quality Control

When a referenced method contains definitive acceptance criteria and performance criteria or guidelines for QC and calibration samples, those criteria, or more stringent criteria are required by the method SOP. Data is reviewed by the analyst to SOP criteria and accepted or rejected on that basis. When QC and calibration criteria are not listed in the method, criteria from similar methods are considered technically sound for that method.

Documenting that an approach is technically sound belongs to the analyst developing a method and is reviewed for technical merit by the Laboratory Director.

13.1 Quality Control Checks

Method blanks, laboratory control samples, and matrix spikes are required for every analytical batch. Additional QC and calibration checks may be required. The corresponding frequency and performance acceptance criteria are specified in each individual method’s SOP. In the absence of SOP instruction, the Laboratory Director is consulted.

The procedures used in the laboratory to ensure analytical data quality include:

Matrix Spike, Matrix Spike Duplicate, and Duplicates - are analyzed with every analytical batch or once in twenty samples, whichever is greater. Analytes stipulated by the method or applicable
regulations are spiked into the matrix spike and matrix spike duplicate sample. Selection of the sample to be spiked and/or split depends on the information required and the variety of conditions within a typical sample matrix. In some situations, requirements of the site being sampled may dictate that the person sampling select a sample to be spiked and/or split based on a pre-visit evaluation or on-site inspection. This does not preclude the laboratory's spiking a sample of its own selection. In most cases, the laboratory's selection is based on the attempt to determine the extent of matrix bias or interference on the analyte recovery and sample to sample precision.

**Trip Blanks** - Analysis of a sealed ultra-pure water sample which accompanied samples during transit, collection, and storage. The trip blank measures cumulative contamination derived from the travel blank source water, sample transit, the sample site, and the sample storage.

**Field Blank** - Similar to a trip blank; the field blank is opened during the sample collection process to measure the same contamination that the trip blank measures as well as the volatile airborne contaminants which may be present at the sample location that will not infiltrate the closed sample container.

**Rinse Blank** - Pure water which has been poured over field sampling equipment prior to sample collection to determine the possibility of equipment contamination. The rinse blank should be collected prior to use of equipment at each sampling point. It measures the possible combined contamination associated with field sampling equipment, rinse blank source water, sample transit, the sample site, and sample storage.

**Source Water Blank** - Analysis of the water used to prepare the rinse blanks which measure the background contaminants present in the water used for the rinse blanks.

**Laboratory Water Blank** - The water used to prepare trip blanks sent out by the laboratory (stored at the laboratory). They are analyzed only if the trip blank demonstrates contamination. The laboratory blank water measures contaminants derived from the laboratory pure water and laboratory sample storage facilities.

**Instrument Blank** - Laboratory pure water or other pure solvent analyzed at the initiation of an analytical run sequence by an instrument or between high level samples. It measures contamination which may be present in the instrument from carry-over following the analysis of a high level sample. If contamination is present, the chemist must perform maintenance on the instrument prior to analyzing client samples.

**Method Blank/Reagent Blank** - Laboratory pure water that has been processed exactly the same as sample as dictated by the method procedure. It contains all of the method reagents and measures combined contamination from the laboratory pure water, the instrument, the reagents, and the sample preparation steps. This type of blank is important in distinguishing between low level field contamination and lab contamination.

**Surrogates** – A pure compound added to a sample in the laboratory just before processing (according to the appropriate analytical methods) which provide information on the sample
extraction procedure and/or the purge efficiency. Surrogate spike recoveries should fall within the control limits set by the laboratory in accordance with the procedures specified in the method.

**Laboratory Control Spike and Laboratory Control Spike Duplicate** – A certified standard reference material that is spiked into a reagent blank. It is carried through all steps of sample preparation to demonstrate method performance inclusive of sample preparation steps.

**Reference Standards/Reference Samples** - Purchased reference standards and matrix standards are used routinely to evaluate method/analyst performance. These standards are purchased from reputable sources with certified true values.

**Calibration Blanks** - A standard prepared in the same manner as other standards except that it contains no analyte. Calibration blanks are used to verify a calibration curve at a low concentration.

**Calibration Verification Samples** – A standard used to determine the state of calibration of an instrument between periodic calibrations, or after every 10 samples of analysis, depending on method.

**Internal Standards** - An element or compound that is not an analyte which is added to a prepared sample and is used to quantitate analytes.

**Post Digestion Spikes** - Post digestion spikes are performed when a new matrix is analyzed. An analyte of interest is spiked into a sample after digestion and analyte recoveries are determined based on the analyte concentration observed.

**Interference Check Samples** - One or more standards with high concentrations of interfering analytes are analyzed to check compensation for interferences.

**Method of Standard Additions** - A sample is analyzed and then an aliquot is spiked with the analyte of interest and re-analyzed. The original sample concentration is derived based on the recovery of the standard addition sample. This practice allows for compensation for some matrix effects.

**Instrument Adjustment** - Requirements and procedures are instrument and method specific. Analytical instrumentation is tuned and aligned in accordance with requirements which are specific to the instrumentation procedures employed. Additionally, EMA has service contracts with instrument manufacturers. All adjustments are documented in the instrument logbook.

**Calibration** - Performed in accordance with the manufacturers' requirements and the procedures specified in the applicable method. All calibration procedures are documented.

**Gases** – Only ultra-high purity gases, filtered on line through a 5-micron molecular sieve are used. All carrier gases also flow through an oxygen removal system and a hydrocarbon trap.

**Analytical batches** - A unique analytical batch number is assigned to each and every set of samples and their corresponding QC Checks. These batch numbers are created by the individual chemist or
technician according to standard operating procedures and are documented in notebooks. The QC requirements and number of samples composing an analytical batch vary for each method and are specified in the individual method SOP. An analytical batch consists of a group of samples with similar matrices, which are analyzed together with the same preparation sequence and the same lots of reagents. They are prepared and analyzed within the same time period or in continuous sequential time periods. An analytical batch consists of no more than 20 samples.

Certified Reference Materials – When project requirements call for analysis of certified reference materials (CRMs), applicable CRMs are purchased through the National Institute for Standards & Technology (NIST) or other applicable vendor.

13.2 Control Chart Monitoring

Control charts are used to monitor real-time and long term assessment of data quality. Control charts for each analyte of control are prepared for both water and soil matrices. For organic analyses, the analytes which are charted are those analytes required to be present in the spiking solution based upon the current SW-846 methodology.

Each control chart consists of a center line, an upper and lower warning limit, and an upper and lower control limit. For each chart, a minimum of 20 points is included. Control charts are evaluated periodically to ensure quality control of analytical methods.

- The center line of the control chart is the mean of the time ordered points.
- The upper/lower control limit is defined as the mean plus/minus 3 times the standard deviation of the points.
- The upper/lower warning limits are defined as the mean plus/minus 2 times the standard deviation of the mean.

A laboratory method will be considered out of statistical control when the following are observed from the control charts:

- Any one point is outside the control limits.
- Any three consecutive points are outside the warning limits.
- Any eight consecutive points are on the same side of the centerline.
- Any six consecutive points are such that each point is larger or smaller than its immediate predecessor
- Any obvious cyclic pattern is seen in the points.

The Laboratory and Quality Assurance Directors generate the control charts using the EMA LIMS system. Out-of-control events will illicit the response of direct notification to the appropriate departmental supervisor whereby an investigation will occur. If it is determined to be an out-of-control event, and not a possible random error, corrective actions such as instrument recalibration and sample reanalysis will be taken. Corrective actions are determined on a case-by-case incidence. All corrective actions shall be documented and maintained in the QA program files.
14.0 Project Documentation

Guidelines set forth by the EPA and other regulatory bodies maintain that a comprehensive set of documentation pertaining to each sample must be thorough and complete. At EMA, Inc. our clients are ensured that all pertinent information, including project parameters scripted by the client, are included in our records for traceability and comparative reasons.

14.1 Recording Raw Data

Laboratory data can be generated in the following ways: instrument generation of electronic data files, local generation of data using instrument software and in-house spreadsheets, and manual recording of observed measurements. Reporting forms are completed by the individual analyst. Raw data is maintained in completed notebooks or data packages. Reduced raw data will be checked for error by peer review, Senior Chemists/Supervisors, and the Laboratory Director and subject to spot checks during internal audits by the QA Director.

14.2 Project Documentation Storage

There are two document categories associated with a project. The first is the project file. This file contains the following documents:

- Contracts, purchase orders, task orders, and other work authorization
- Correspondence and documentation of telephone conversations
- Project Plans and Project QA Plans (if provided)
- Project specific Statements of Work (SOWs), (if applicable)
- Project related internal laboratory correspondence

This file is under the custody of the Project Manager/Q.A. Director and available to all whom may need to retrieve the information. A majority of the information is stored in the EMA LIMS system for direct access.

The second category of document storage pertains to the analytical data gathered for the specific project. The files maintained for this sort of information include a copy of the final project report/QC report, copies of any bench sheets and raw data, as well as references to the file location of the original raw data. These files are kept throughout the lab and are under the custody of all those involved in the data process. The files will be stored in an accessible format for 5 years.

14.3 Communication of Project Requirements

Upon receipt of samples, the Sample Control Technician notes any project-specific requirements on the chain-of-custody and verbally notifies chemists and technicians of any requirements that differ from “standard” methods. These requirements are also documented on the daily in-house aging report issued to all personnel.
When project managers receive notice of changes to project requirements during the course of work, they communicate these changes verbally to the affected chemists or technicians and in a written communication log which is attached to the project documents. They also notify the Sample Control Technician, who documents the changes on the daily in-house aging report issued to all personnel.

15.0 Data Reduction, Validation and Reporting

Data reduction includes all processes that change either the form of expression (i.e.: units) or the quantity of the data values (rounding). Data reduction often involves statistical and mathematical analysis of data and usually results in a reduced subset of the original data set (i.e.: an average of three data points). Wherever employed, mathematical procedures will be verified for accuracy of computation.

All data are generated and reduced in accordance with the method SOPs. The data can be reduced by:

1. Manual computation directly found on an instrument/analysis logbook page or data sheet or
2. Computer processing of raw data via direct instrument linkage or manual entry.

The analyst who generates the data is directly responsible for ensuring that the computations are correct and complete and that all data reduction is documented appropriately for subsequent data review and validation. Any additional equations used in the data reduction process are required to be evident in the documentation. The computations are reviewed on a regular basis for accuracy by the Laboratory Director.

The analyst is responsible for verifying that the data reduction is correct for the project, sample numbers, calibration RFs and/or correlation coefficients, units, detection limits, dilution factors, volumes/weights used and moisture correction (when applicable).

15.1 Laboratory Data

All sample preparation activities are documented by the chemist or technician performing the work in laboratory notebooks or laboratory worksheets. These serve as the primary record for subsequent data reduction.

Laboratory data is generated in the following ways: instrument generation of electronic data files, local generation of data using instrument software and in-house spreadsheets, manual recording of observed measurements. Consistent data collection is achieved through the existence and use of SOPs.

Outputs from all instruments are monitored for readability and consistency. If clarity is less than desired, corrective actions are undertaken to rectify the output based on instrument manufacturers’ recommendations.
Laboratory forms, data sheets, logbooks, and reporting forms have a standard format to ensure that all pertinent information is recorded consistently. These forms are generated by the QA Director and are regularly monitored to ensure compliance with established requirements.

Analysts have control over and access to all data they have generated. Limited access policies, including password codes for computer generated data access, maintain security of data.

Data are checked for accuracy and precision by the chemist, Departmental Supervisor, the QA Director, and the Laboratory Director. The validity of data shall be supported by the maintenance and inspection of the following records:

- Description of calibration
- Documentation of traceability of standards
- Documentation of analytical methodologies (SOPs) and QC Methodology
- Method blank results to check for contamination and interference
- Laboratory Control Sample results will be inspected as to whether they fall inside the acceptable control limits.

15.2 Laboratory Data Validation and Reporting

Data validation is the systematic process of data evaluation for acceptance or rejection based upon a set of criteria. It is a systematic procedure of reviewing a body of data against a set of criteria to provide assurance of validity prior to its intended use.

Chemistry data validation is performed by the Chemist, Departmental Supervisor, the Laboratory Director, and the QA Director. Validation is accomplished through routine audits of the data collection and flow procedures and by monitoring of QC sample results.

Data validation includes dated and signed entries by chemists on the worksheets and laboratory notebooks used for all samples; the use of sample tracking and numbering systems to track the progress of the sample in the laboratory; and the use of quality control criteria to reject or accept specific data.

The raw data is compared with the report forms for agreement. The raw data and/or report forms are compared to the final LIMS generated report for agreement. This review is the final assessment of completeness and accuracy of the data. If there is a discrepancy of any type, the standard procedure for verification and confirmation is followed.

If raw data does not agree with the forms, the cause will be determined, the source of the problem will be corrected, and all incorrect data from the point of error will be corrected. A corrective action form may be completed to indicate the corrective action for the results and/or laboratory samples affected. Audit trails are maintained for data changes through analytical batch preparation records.
15. After all appropriate changes are made; another review of the data in question is performed. This will ensure that forms and raw data agree.

15.3 Data Collection and Flow Audits

Data collection and flow audits are performed routinely and include:

- Review of sample documents for completeness
- Daily review of test results
- Daily review of performance indicators and QC sample results
- Random calculation checks
- Review of all reports prior to and subsequent to data entry
- Review and approval of final report by Laboratory Director

15.4 Data Review

Data review is performed prior to release of the data to the client. It is performed as soon as possible after data acquisition in order to provide sufficient time for corrective action if required.

In the data review process, the data undergo a minimum of two separate reviews. The data are compared to information such as the expected characteristics of the sample, the sample preparation steps, and QC sample data to evaluate the validity of the results.

Corrective action is minimized through the development and implementation of routine internal system controls. Chemists are provided with specific criteria that must be met for each procedure, operation, or measurement system.

In order to prevent transcription errors, all stages of data deliverable preparation are subject to audit, peer review, and supervisory review.

Supporting material, such as chromatograms are compiled by the analyst and incorporated into the data deliverables by the data processor.

The final deliverable is reviewed for transcription and typographical errors by the Laboratory Director prior to release to the client.

15.5 Documentation

Upon completion of the project or job task, the final report will be compiled and includes a brief narrative discussion of the analyses, the analytical results, and the QC results. The final report is reviewed by the Laboratory Director and on occasion, when warranted, by the Q.A Director or Laboratory Supervisor.
A documentation control system assures that all documents for a given project are accountable and traceable. It includes chain-of-custody records, all logbooks, graphs, raw data, and other miscellaneous items.

15.6 Recordkeeping

Documentation in the laboratory is initiated by the Sample Control Technician who receives samples, assigns laboratory numbers and maintains laboratory custody logbooks which document sample movement in the laboratory.

Samples are processed together in a batch by the analysts. A batch consists of a number of samples carried through the entire analytical procedure, along with QC samples and blanks. All work performed on a sample batch is documented in laboratory logbooks which are described as follows:

Sample Receiving Logbook
This logbook lists samples as they are received into the laboratory and assigned unique sample identification numbers. This number corresponds to the LIMS generated numbering system.

Instrument Maintenance Logbook
A unique logbook is maintained for each system and used to record the maintenance and upkeep of analytical instruments.

Standards Logbook
Used for tracing all laboratory prepared or purchased standards back to certified standards or stock solutions. All standards are entered into the EMA LIMS from the vendor certified standard sheets. It indicates standard traceability. Documented in this logbook are all activities associated with the standard preparation process.

Data Notebook or Bench sheets
This is used to document all activities associated with the analytical process and recording raw data of every batch.

In some instances, analytical data recording and standards preparation may be included in a single notebook.

15.7 Rules Governing the Use of Logbooks

1. All logbooks are given unique identifiers. A master list of controlled documents is maintained by the Q.A. Director.
2. Bound notebooks are preferred record-keeping forms. Loose sheets, if used, are ultimately secured in notebooks.
3. All writing must be legible and in ink. All numbers are clear. Corrections are made by drawing one line through the incorrect entry, entering the correct information, initialing, and dating the entry.
4. Complete information should be entered so that in an examination, it can be determined what was done, when and what the results were.

5. If any data are determined to be invalid, reasons are indicated.

6. All relevant information is included (i.e.: the manufacturer and lot number of a chemical, the specific procedure reference, etc.).

7. When work is continued in another notebook or logbook, the number of the first notebook is written in the first page of the new notebook and vise-versa for easy reference.

15.8 Document Control

Document control is accomplished through the use of a centralized location of document inventories. Records, including raw data, supporting documentation, and electronic media are retained for a minimum of 5 years. After on-site storage for one full year, records may be transferred to a secured off-site storage facility. The QA Director maintains control of laboratory generated documents.

All appropriate documents are reviewed periodically and, where necessary, revised to ensure continuing suitability and compliance. Affected personnel are notified of changes, made as soon as practicable, at time of publication. The QAPM is reviewed and updated annually. Method SOPs are reviewed for technical purposes as part of the internal audit process (to ensure individual compliance to procedure) with analytical and quality review of methods not to exceed two years.

The EMA document control system, under the control of the QA Director, ensures that methods and procedures are followed in a consistent manner. Specific procedures for document management are outlined in EMA DCN 600.12.0001.

The document control system provides for the following:

- Managerial review and approval of documents prior to issue;
- A unique document control number for each document including the QA Program Manual, method SOPs, logbooks and other internal documents;
- A central location for all documents;
- A systematic method for distribution of all documents;
- A tracking system for existing documents;
- Identification of document revisions;
- A mechanism for periodic review of documents;
- Cataloging and archival of outdated materials in secured storage;
- Retrieval of raw data by authorized personnel only;
- A focal point for information exchange;
- Establishment of standardized methods and procedures;
- Organized review and revision of documents, including QA program documents.
- Internal systems audits confirm use of current SOPs
- All quality assurance program documents are revised by the QA Director; and,
- Current revisions of documents replace older versions.
15.9 Standard Operating Procedures

The laboratory maintains SOPs for each methodology or procedure used. SOPs are updated accordingly for any revisions made; i.e. when instruments or equipment change, an error is identified, improvements in technology and/or reagents need to be incorporated, or when references methods are revised or discontinued. Changes in documents reflect actual procedures being followed. Before any revision is made, documents are submitted to the Quality Assurance Director for approval of the proposed revision. Minor changes are those which do not affect the content or quality of the action being prescribed in the document.

The quality control protocols specified by the laboratory’s SOP shall be followed. The laboratory ensures that the essential standards outlined in the Technical Module of the Standards (TNI) or mandated methods or regulations (whichever are more stringent) are incorporated into the test method SOPs. When it is not apparent which is more stringent, EMA will default to the mandated method or regulations.

An addendum, subject to review and approval by the Quality Assurance Director, may be attached to a document to reflect policy and procedural changes which become effective between revisions. These changes are then incorporated into the body of the document at the time of the next revision.

All SOPs are considered proprietary and may only be released for review with written consent of managerial team or under regulation/accreditation purposes.

15.10 Verification of Software

All computer software used to acquire, process, or report data shall be verified upon initial use and re-verified after any modification. Manual calculations are performed to verify all computer calculations for at least one sample from every analytical batch.

Limited access policies for software and data maintain security and integrity of these systems.

EMA currently uses local and instrument software, and the Element Datasystem Laboratory Information Management Systems (LIMs). Data is backed up on a daily basis and the data storage tape removed off site daily. Additional software quality assurance requirements will be added as deemed necessary.

15.11 Control of Nonconforming Work

The laboratory has a policy and procedures that must be implemented when any aspect of work does not meet the acceptance criteria or requirements of its own procedure. Examples of places of non-conforming work could occur include quality control, instrument calibration, staff review, management review and internal or external audits.
The policy for control of non-conforming work is to identify the non-conformance, evaluate the significance, and immediate correction. Corrections are things done to continue working, report the data, and fix the immediate problem. Additional corrective actions may be necessary depending on level of non-conformance.

EMA follows drinking water protocols from State Water Resources Control Board Division of Drinking Water when handling microbiological notifications and nitrate MCL exceedances to clients.

The discovery of non-conformance for results that have already been reported to the client must be immediately evaluated for significance of the non-conformance, its acceptability to the client, and determination of the appropriate corrective action. If that data reported are affected adversely by the non-conformance, the client is notified in writing within 15 business days. Documentation of corrective actions taken to resolve the non-conformance shall be submitted to the client(s) in a timely and responsive manner.

The procedure for initiating and investigating associated corrective actions for non-conforming work is described in Section 20.0.

16.0 Quality Assurance Project Plans

Project specific Quality Assurance Project Plans (QAPjPs) may be developed to meet contract and agency requirements on a project specific basis. These plans discuss specific terms, policies, objectives and QA activities to achieve the data quality objectives of the project. QA Project Plans are generally written in accordance with the US EPA Document Guidelines and Specifications for Preparing Quality Assurance Project Plans.

The QAPjPs follow the format listed below as applicable (additional information is added, if required):

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<tr>
<th>Section</th>
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<tr>
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<td>QA Objectives for Measurement Data, in terms of precision, accuracy, completeness, comparability and representativeness</td>
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<tr>
<td>6.0</td>
<td>Sampling Requirements</td>
</tr>
<tr>
<td>7.0</td>
<td>Sample Custody</td>
</tr>
</tbody>
</table>
17.0 Performance and System Audits

The laboratory is subject to both internal and external audits, in order to monitor the capability and performance of the total measurement systems.

Performance and systems audits are conducted annually, at a minimum, by the QA Director and encompass all activities of the laboratory, to assess compliance with established methods, policies and procedures. These audits may be scheduled or unscheduled.

An audit is defined as a systematic check to determine the quality of the laboratory operation and activities. The following are definitions of audit types:

Performance Audit - determines the accuracy of the total measurement system, or portions. Test samples are analyzed and results evaluated.

System Audit - an evaluation of all components of the lab's measurement systems to determine their proper selection and use, including QC procedures.

A copy of audit findings and any proficiency test results obtained are summarized in quality assurance reports which are maintained by the Q.A. Director.

17.1 Performance Audit

A performance audit involves analysis of reference samples of concentrations unknown to laboratory personnel to evaluate analyst/method performance. Reference standards or matrix standards are purchased from reputable suppliers or prepared using traceable standards and submitted to the laboratory by the QA Director. The true values or reference values are available only to the QA Director.

Internal performance audits are accomplished by the laboratory through the use of blind check samples (when available), replicate measurement evaluations, and individual proficiency test samples. Results are compared to "true" values and evaluated for accuracy and/or precision. Records are maintained by the QA Director.
EMA is a participant in the EPA Water Pollution (WP), Water Supply (WS) and Soil Proficiency programs. Performance evaluation check samples are analyzed on an annual basis and are submitted to the California Department of Health Service, Environmental Laboratory Accreditation Program and EPA Region 9 for compliance under the State Certification. Please refer to Appendix H for a copy of our external certification.

17.2 Systems Audit

The laboratory systems audit is designed to verify that all QA/QC practices are being followed and that all procedures and protocols are fully understood and upheld by laboratory personnel. It also is used to find problems which may have entered the system or for which the QA/QC program is insufficient. General audit checklists which apply to all lab areas and procedures have been developed, and are used for documenting audit and surveillance findings.

Audits ensure that laboratory quality control criteria are adhered to and proper corrective action is implemented, when required. All inquires relative to data quality issues are reviewed and any corrective actions identified.

Additional audits performed by various regulatory agencies will be conducted periodically.

System audits are performed to provide an objective evaluation of compliance with established requirements, methods, and procedures. Audits also determine the adequacy of the QA program. Re-audits verify efficacy of corrective actions.

The audits include an evaluation of the work areas, activities, processes, review of documents and records, storage of standards and reagents, housekeeping, good laboratory practice, analytical procedures, and quality control.

The auditor uses a prepared audit checklist, documents the audit in writing, and signs the audit report. The audit report contains sufficient information to stand alone as a document.

Any deficiencies noted during the audit are discussed with the audited department within 5 days of the audit. All corrective actions are taken and a formal response submitted to the auditor following receipt of the audit report. The auditor re-audits the area to determine that the corrective action was implemented and the deficiency corrected.

System audits include an evaluation of the following:

1. Assessment of compliance with the QA Program
2. Verification of and adherence to written procedures
3. Data storage and record keeping
4. Analytical data review and validation procedures

17.3 External Audits
An on-site audit is performed every two years by the California Department of Health Service, Environmental Laboratory Accreditation Program to verify the laboratory has all equipment, documentation, personnel, and standard operation procedures needed for performance of EPA requirements. Other agencies with which EMA has contracts may perform site audits.

17.4 Subcontracted Services Audits

EMA occasionally sends selected analyses to a subcontract laboratory. The most common reason for utilization of a subcontractor facility is that EMA does not hold accreditation of analyte(s). Subcontracting of analyses is not conducted without client approval.

All subcontract laboratories utilized by EMA on a continuing basis are overseen by EMA Project Managers and require proper accreditation prior to use. The subcontractor and EMA agree on the specific quality control, analytical requirements, and acceptance limits to be performed prior to use.

Subcontract laboratories may receive an on-site systems audit by a representative of EMA' staff or be subjected to double-blind performance evaluations.

All data produced by another laboratory is identified.

18.0 Instrument Maintenance Procedures

Preventative maintenance is the program of defensive actions for averting failure of equipment and ensuring optimal performance of instrumentation. These actions may include specification checks, lubrication, cleaning, reconditioning, adjusting, etc.

A preventative maintenance program for the instrumentation ensures fewer interruptions of analyses, personnel efficiency, and lower repair costs. It eliminates premature replacement of parts, and reduces discrepancy among test results.

All EMA laboratory employees using the instrumentation are fully trained; having developed troubleshooting skills that enable them to recognize problems, their causes and appropriate corrective actions, quickly and accurately to reduce equipment failure. Service contracts are maintained for several pieces of equipment to guarantee expedient service and reduce analytical down-time.

Instrument maintenance is deemed necessary when an instrument is inoperable, is not performing acceptably or as expected, or a change in the performance characteristics of the instrument is noted.

EMA maintains maintenance logs and several service contracts for all major instrumentation. Major maintenance and repair of instrumentation is only performed by qualified analysts and manufacturer recommended service representatives.

Following major instrument maintenance and repair activities, a return to analytical control must be demonstrated and documented through performance according to typical QA/QC requirements.
Written equipment maintenance records are kept to document all maintenance and repair activities. Instrument performance criteria are established to determine the need to make adjustments to the instrument operating conditions.

The following are examples of general measures that are performed throughout the laboratory as a part of the preventative maintenance program.

**GC/MS Systems**
- Injection port liners and gold seals are replaced daily or as deemed necessary.
- Two to three inches of the front of the pre columns or capillary columns are removed as deemed necessary.
- Septa are inspected and replaced (if necessary) before each batch sequence.
- Ion source is cleaned as required.
- Mass Spectrometers are tuned every 12 hours of use.
- Compressed gas cylinders are checked daily.
- Autosampler wash bottles are changed at the beginning of each sequence.
- Gas filters on carrier lines are checked weekly.

**GC Systems**
- Septa are replaced before starting a new sequence run.
- Compressed gas cylinders are checked daily.
- Solvent blank is injected before starting a new sequence run to demonstrate the system is free of interfering artifacts.
- Flows are checked before starting sequence.
- Autosampler wash bottles are changed at the beginning of each new sequence run.
- Gas filters on carrier lines are checked weekly.

**ICP and ICP-MS**
- Nebulizer and spray chamber are cleaned as needed.
- Torch, sample cones, center tubes and other consumables are cleaned on a regular basis.
- Tubing is replaced daily or every other day depending on use.
- Filters for the ICP-OES are cleaned weekly.
- Waste containers are disposed of in the proper waste receptacle weekly.
- Lenses are cleaned as deemed necessary.

**pH Meters**
- Gel-type electrodes are inspected prior to use and cleaned with Alconox-type soap solution to remove oily residues.
- Meter is calibrated daily before use using a two point calibration and verifying with a third point for the slope check. If calibration or slope has deteriorated, the electrode is cleaned and treated with 1N HCL, then recalibrated.
- pH electrodes are stored in fresh pH 7.0 buffer solution when not in use.
Analytical Balances
- All balance surfaces are cleaned daily and covered when not in use.
- Analytical balances are calibrated and cleaned annually by manufacturer's representatives.
- Labels are attached to each balance indicating date of last calibration.
- The accuracy of each balance is checked against "S" Class weights prior to use.

Autoclave
- All interior and exterior surfaces are cleaned daily.
- Sterilization temperatures are monitored to be in control for every sterilization task.

Incubators and Water-baths
- All interior and exterior surfaces are cleaned daily.
- Incubator and water-bath temperatures are monitored two times per day at least four hours apart for temperature control.

19.0 Procedures for Assessing Precision, Accuracy and Completeness

Definitions according to *Standard Methods For The Examination of Water and Wastewater 20th Ed.*:
- **Precision**: Measure of the degree of agreement among replicate analyses of a sample, usually expressed as the standard deviation.
- **Accuracy**: Combination of bias and precision of an analytical procedure, which reflects the closeness of a measured value to a true value.
- **Bias**: Consistent deviation of measured values from the true value, caused by systematic errors in a procedure.

19.1 Precision

Reproducibility among duplicate samples provides a determination of precision in analytical testing. Precision is determined by splitting actual samples which cover a wide range of concentrations and a variety of commonly encountered interfering materials.

Duplicates and Duplicate Matrix Spiked Samples are run at a frequency of every 10 to every 20 samples analyzed as specified in the particular method or SOP. Acceptable RPD (relative percent difference) results are <20% or <30% depending upon the sample matrix type analyzed and specific analysis performed.

**Duplicate**

A duplicate is a regular sample which is split and carried through the entire sample preparation and analysis procedure with the sample set. Duplicate results provide information regarding the sample matrix effects, and the method efficiency. Duplicate samples are run at a frequency of one for every 20 samples analyzed, or at a minimum of one per analyzed batch and matrix, whichever is greater.
Matrix Spike

A matrix spike is a regular sample that is split into three sub-samples and two of the replicates are spiked with analyte solution at the same concentration. The two spiked replicates are defined as the matrix spike and the matrix spike duplicate. The matrix spike and the matrix spike duplicate samples are carried through the sample preparation and analysis procedure with the sample set. Matrix spikes are run at a frequency of every 10 to 20 samples analyzed, or at a minimum of once per analyzed batch and matrix, whichever is greater. The matrix spike and matrix spike duplicate results provide information regarding the precision of the matrix spike and matrix spike duplicate, the sample matrix effects, and the method efficiency.

The difference between the matrix spike and the matrix spike duplicate are reported as RPD as calculated below.

\[
\text{RPD} = \frac{\text{MS} - \text{MSD} \times 100}{(\text{MS} + \text{MSD})^2}
\]

\[
\text{RPD} = \text{relative percent difference}
\]

\[
\text{MS} = \text{Matrix Spike Result}
\]

\[
\text{MSD} = \text{Matrix Spike Duplicate Result}
\]

19.2 Accuracy

Accuracy is the degree of difference between observed and actual (known) values. Accuracy is determined by analyzing reference samples. Acceptable percent recoveries for matrix spikes are based upon statistical control limits. Control limits are equal to or narrower than the EPA published control limit ranges for each method.

Percent recovery calculations are determined through the following equation:

\[
\% \text{ Recovery} = \frac{(C_o - C_s) \times 100}{C}
\]

\[
C_o = \text{Concentration observed in analysis}
\]

\[
C = \text{True value of standard}
\]

\[
C_s = \text{Concentration observed in unspiked sample}
\]

Spike data can be indicative of matrix bias or interference on analyte recovery as well as sample preparation procedure performance. A spiked sample is a regular sample to which a known concentration of analyte is introduced. The sample is then carried through the entire workup or extraction and analysis procedure with the other samples in the sample set. The spike is reported as percent recovery.
20.0 Corrective Actions

The purpose of a formal corrective action process is to identify areas that require improvement and to ensure that long term corrective action is put in place to resolve the problem in a permanent manner.

Corrective actions are required any time project or method requirements are not met or as a result of audit deficiency findings. The laboratory Director and QA Director are notified immediately and the approach and time frame of the corrective action is discussed. The out-of-control situation is documented and the client is notified.

Whenever possible, a long term resolution to the occurrence is desirable. In some instances involving unusual circumstances, a long term corrective action may not be appropriate. This process is designed to handle both types of occurrences and to document the action that was taken. A fundamental goal of the corrective action process is to foster continual improvement in laboratory operations. Corrective actions are monitored to make certain that similar problems do not recur.

Daily quality control procedures are designed to identify the need for corrective action. Most corrective actions are performed by the chemists doing the analysis, and are usually as simple as recalibrating an instrument should the instrument check sample or CCV fall outside its acceptable range, or resulting because of a power failure. Most corrective actions are described in methods, standard operating procedures, and instrument manuals.

Corrective actions may also be initiated as a result of various quality assurance activities, including:

- Performance audits
- System audits
- Performance evaluation or check sample studies
- Program audits, and
- Review of raw data

Standard operating procedures for corrective actions are to:

- Define the problem
- Determine the cause(s) of the problem
- Determine possible solutions to the problem
- Implement corrective action
- Verify that the corrective action is effective, and
- Document the corrective action and its effectiveness

All employees must immediately bring to their supervisor's attention any problem or practice which they feel may affect data quality. If control parameters are outside acceptability criteria analysis must cease immediately and all affected samples must be reanalyzed when the system is corrected.
The need for corrective action may result from:

- Instrument malfunction
- Failure of internal QA/QC checks
- Failure to follow-up on performance or system audit findings
- And non-compliance with QA requirements

Corrective actions taken depend on the type of analyses and the extent of the error and are discussed with the Laboratory Supervisor and/or Laboratory Director. If the problem is indeterminate and cannot be controlled, the laboratory evaluates its impact on the data.

The QA Director and Laboratory Director shall determine that corrective actions proposed and agreed upon are actually implemented and successful. When corrective actions are implemented, evidence of their success shall be documented. Corrective action documents are to be signed and dated by the Chemist, and the Q.A. Director and/or Laboratory Director.

All corrective action documents are reviewed and maintained by the QA Director in the QA program files.

20.1 Client Concerns

The corrective action procedure is used to handle routine client inquiries concerning data reports. In some cases, an investigation regarding the concern may indicate that no problem was found. In other situations, the investigation may reveal a problem and the corrective action to prevent that occurrence in the future will be required.

The corrective action process involves the following actions:

- Client concerns are addressed accurately and in a timely fashion.
- The concern is properly identified and documented.
- Responsibility for investigation is assigned.
- The cause of the problem is investigated and determined.
- The appropriate long-term corrective action is determined and implemented.
- The complete corrective action process is documented.

If a new data report needs to be issued as a result of the investigation, the Laboratory Director is responsible for issuance of the revised report. All revised data are marked as such.

20.2 Criteria Used for Determining an Out-of-Control Event

Factors that affect data quality require investigation and corrective actions. All out-of-control events are investigated to determine whether the condition indicates a procedure that is truly out-of-control, or a possible random error. Any corrective actions taken are to be documented, whether
the analytical batch is repeated or the data was reviewed and released to the client (included in the
documentation is the rationale behind this decision).

20.3 Procedures for Stopping Analysis

Whenever an analytical system is out-of-control, investigative-corrective action is initiated. Once
corrective actions have been implemented, samples may be reanalyzed. If a sample batch reanalysis
is out-of-control following corrective actions, all analytical work for the method will cease
immediately. A detailed investigation shall be conducted to identify the source of the problem.
Sample security, integrity of standards, glassware preparation, reagents, notebooks, instrument
performance, and method adherence shall be included in this investigation.

All actions taken will be documented.

21.0 Timeliness of Data Reports

EMA recognizes the timeliness of data reports is assessed as an important part of the quality of our
services from the client's perspective. High quality data when received several weeks late is not
acceptable. In recognition of this, EMA tracks all projects from the time they are received to the
report completion and mailing (or facsimile transmission) of results. EMA's tracking procedure is
designed to monitor and maintain on-time report generation.

All staff queries for their respective analyses a daily basis. Project Managers track the status of all
samples as they are processed from the moment they are received through the final delivery of the
report. Weekly status meetings are held to assess the status of samples processed in the laboratory.

When problems arise, clients are notified well in advance.

EMA monitors our success in the timely delivery of reports to clients on a monthly basis. The date
clients are promised delivery is compared to the date actually mailed or faxed to the client. This
monitoring serves to identify service trends, helps to maintain timeliness, and ensures that
corrective action will be taken before problems occur.

22.0 Quality Assurance Program Revisions

Revisions to the EMA Quality Assurance Program Manual can be made upon written approval of
the Laboratory Director and the QA Director. Program revisions are to be presented to the
laboratory staff for implementation immediately following approval. Client-requested QC
procedures may be incorporated on a project basis provided the procedures are not in opposition to
the objectives of quality assurance and the EMA Quality Assurance Program. Revisions must be
documented and kept on file for review.
Appendix A
Sampling Guidelines
## EnviroMatrix Analytical, Inc.

### General Wet Chemistry Analyses

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<th>ANALYSIS/TEST</th>
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<th>PRESERVATIVE</th>
<th>TEMPERATURE</th>
<th>MINIMUM SAMPLE REQUIRED Water; Soil</th>
<th>HOLDING TIME</th>
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<td>Alkalinity</td>
<td>SMEWW 2320 B</td>
<td>250 ml poly; 4 oz. glass jar</td>
<td>UNPRESERVED</td>
<td>0 - 6°C</td>
<td>100 ml; 25 g</td>
<td>14 days</td>
</tr>
<tr>
<td>Ammonia</td>
<td>SMEWW 4500-NH3 B,C</td>
<td>250 ml poly; 4 oz. glass jar</td>
<td>UNPRESERVED</td>
<td>0 - 6°C</td>
<td>50 ml; 5 g</td>
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<tr>
<td>BOD</td>
<td>SMEWW 5210 A-B</td>
<td>1 L poly</td>
<td></td>
<td>0 - 6°C</td>
<td>1 L</td>
<td>48 hr</td>
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<td>Sulfate</td>
<td>SMEWW 4500 SO4 E</td>
<td>250 ml poly; 4 oz. glass jar</td>
<td>UNPRESERVED</td>
<td>0 - 6°C</td>
<td>100 ml; 25 g</td>
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<tr>
<td>Total Organic Carbon (TOC)</td>
<td>SMEWW 9060, SMEWW 5310 B</td>
<td>125 ml Amber; 4 oz. glass jar</td>
<td>H&lt;sub&gt;2&lt;/sub&gt;SO&lt;sub&gt;4&lt;/sub&gt; to pH &lt; 2</td>
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<td>Turbidity</td>
<td>SMEWW 2130 B</td>
<td>250 ml poly</td>
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<td>Total Solids</td>
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<td>0 - 6°C</td>
<td>100 ml</td>
<td>28 days</td>
</tr>
</tbody>
</table>

### Sampling Guidelines

* These analyses have short holding times. Please coordinate delivery time for these analyses.

** Recommended holding times for coliforms are 6 hours. Between 6 - 24 hours holding results become questionable. After 24 hours holding, results are considered unacceptable.

---

4340 Viewridge Ave., Suite A
San Diego, CA 92123

Phone/Fax: (858) 560-7717 / (858) 560-7763
### EnviroMatrix Analytical, Inc.

**Sampling Guidelines**

#### Organic Analyses

<table>
<thead>
<tr>
<th>ANALYSIS/TEST</th>
<th>SPECIFIC METHOD(S)</th>
<th>CONTAINER</th>
<th>PRESERVATIVE</th>
<th>TEMPERATURE</th>
<th>MINIMUM SAMPLE</th>
<th>HOLDING TIME</th>
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<tbody>
<tr>
<td>Oil &amp; Grease</td>
<td>EPA 1664A</td>
<td>1 L amber</td>
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<td>Oil &amp; Grease</td>
<td>EPA 413.2</td>
<td>500 ml amber; 4 oz. glass jar</td>
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<td>TRPH</td>
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<td>1 L; 30 g</td>
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<td>Organochlorine Pesticides and PCBs</td>
<td>EPA 608, EPA 8081, EPA 8082</td>
<td>1 Liter Amber; 8 oz. glass jar</td>
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<td>Organophosphorous Pesticides</td>
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<td>Volatile Organic Compounds (VOCs)</td>
<td>EPA 624, EPA 8260 B</td>
<td>(2) 40 ml VOA Vials; 4 oz. glass jar</td>
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<td>Semi Volatile Organics (SVOCs)</td>
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<td>Organotin Compounds - Tributyltin (TBT)</td>
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<td>Total Petroleum Hydrocarbons (TPH) - Gas</td>
<td>EPA 8015 B, DOHS LUFT Method (liquid), ASTM D2887 (solid)</td>
<td>(2) 40 ml VOA Vials; 4 oz. glass jar</td>
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<td>40 ml; 10 g</td>
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### Metals Analyses

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<th>PRESERVATIVE</th>
<th>TEMPERATURE</th>
<th>MINIMUM SAMPLE</th>
<th>HOLDING TIME</th>
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<td>Hexavalent Chrome (Cr+6)*</td>
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<td>Mercury</td>
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<td>Metals†</td>
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<td>Method Dependant</td>
</tr>
</tbody>
</table>

* This analysis has short holding time. Please coordinate delivery accordingly.
† Including but not limited to: A1, Ag, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mn, Mg, Mo, Na, Ni, Pb, Sb, Se, Sn, Ti, Tl, V, Zn
^ 7/40, 14/40 refers to hold time before extract/hold time after extract
28 January 2019

EnviroMatrix Analytical, Inc.          EMA Log #: 19A0196
Attn: Dan Verdon
4340 Viewridge Ave., Suite A
San Diego, CA 92123

Project Name: Sparkletts Testing
Project Desc./#: January 7, 2019

Enclosed are the results of analyses for samples received by the laboratory on 01/07/19 10:15. Samples were analyzed pursuant to client request utilizing EPA or other ELAP approved methodologies. I certify that this data is in compliance both technically and for completeness.

Dan Verdon
Laboratory Director

CA ELAP Certification #: 2564
### ANALYTICAL REPORT FOR SAMPLES

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Laboratory ID</th>
<th>Matrix</th>
<th>Date Sampled</th>
<th>Date Received</th>
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<td>Drinking Water</td>
<td>01/07/19 10:00</td>
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The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.
<table>
<thead>
<tr>
<th>Analyte</th>
<th>Result</th>
<th>MDL</th>
<th>Reporting Limit</th>
<th>Units</th>
<th>Dilution</th>
<th>Batch</th>
<th>Prepared</th>
<th>Analyzed</th>
<th>Method</th>
<th>Notes</th>
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<td>01/25/19</td>
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The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.
### Conventional Chemistry Parameters by Standard/EPA Methods

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<th>Analyte</th>
<th>Result</th>
<th>MDL</th>
<th>Reporting Limit</th>
<th>Units</th>
<th>Dilution</th>
<th>Batch</th>
<th>Prepared</th>
<th>Analyzed</th>
<th>Method</th>
<th>Notes</th>
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<tbody>
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<td>Specific Conductance (EC)</td>
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The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.
The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.
## Total Metals by EPA 200 Series Methods - Quality Control

### Batch 9012417

<table>
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<tr>
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<th>Spike Level</th>
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<th>%REC Limits</th>
<th>RPD Limit</th>
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## Total Metals by EPA 200 Series Methods - Quality Control

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Conventional Chemistry Parameters by Standard/EPA Methods - Quality Control

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EnviroMatrix Analytical, Inc.
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The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.
**Microbiological Parameters by Standard Methods - Quality Control**

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*The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.*
Notes and Definitions

J  Detected but below the Reporting Limit; therefore, result is an estimated concentration (CLP J-Flag).

HT-15  This sample was received outside of the EPA's recommended 15 minute holding time for this analysis. However, the sample was analyzed immediately upon receipt.

ND  Analyte NOT DETECTED at or above the reporting limit (or method detection limit when specified)

NR  Not Reported

dry  Sample results reported on a dry weight basis (if indicated in units column)

RPD  Relative Percent Difference

MDL  Method detection limit (indicated per client's request)
**CHAIN-OF-CUSTODY RECORD**

**EMA LOG #:**

Client: EMA

Attn: Dunn Verden

Samplers(s): Hansen Ewertz

Address:

Phone: Fax:

Email:

Billing Address:

Project ID: Monthly Sparklets Testing Jan. 2019

Project #: P0 #:

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**Requested Analysis**

- Oil & Gasoline
- Gasoline
- Diesel
- Full BTX
- MTBE
- Org. Nitrites
- Org. Pesticides
- Persistent and Bioactive Pesticides
- Polychlorinated Biphenyls
- PCBs
- Persistent and Bioactive Organics
- Organic Nitro Compounds
- Petroleum Hydrocarbons
- Alkanes
- Aromatic Hydrocarbons
- Chlorinated Compounds
- TPH
- Petroleum Hydrocarbons
- NAPL
- Total Petroleum Hydrocarbons
- Total Chlorinated Hydrocarbons
- Total Organic Chlorine
- Total Petroleum Chlorine
- Total Chlorine
- TPCH
- Total Petroleum Chlorine
- Total Chlorine
- TPCH
- Total Petroleum Chlorine
- Total Chlorine

RELINQUISHED BY: Hansen Ewertz

DATE/TIME: 06/17/19

RECEIVED BY: EMA

**Sample Integrity**

Correct Containers: Yes

Custody Seals Intact: Yes

Temp @ Receipt: 4°C

COC/Labels Agree: Yes

Sampled By: Client EMAS Autosampler

Additional notes:

1. Additional costs may apply. Please note there is a $35 minimum charge for all clients.

2. EMA reserves the right to return any samples that do not match our waste profile.

NOTE: By relinquishing samples to EMA, Inc., client agrees to pay for the services requested on this COC form and any additional analyses performed on this project. Payment for services is due within 30 days from date of invoice. Samples will be disposed of 7 days after report has been finalized unless otherwise noted. All work is subject to EMA's terms and conditions.
Appendix C
Chain-Of-Custody Form
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<td>Data 5</td>
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Table continued...
Appendix D
Corrective Action Form
CORRECTIVE ACTION FORM

ISSUED TO: 

RESPONSE REQUIRED BY: 

CORRECTIVE ACTION REQUESTED BY: 
DATE: 

________________________________________________________ 

(ISSUER) WILL PROVIDE A BRIEF DESCRIPTION OF HOW PROCEDURE WAS DETERMINED TO BE OUT-OF-CONTROL: 

OUT-OF-CONTROL PROCEDURE(s):

LIST SAMPLE I.D.(s) AFFECTED: 

DESCRIBE IMMEDIATE ACTION TAKEN TO REMEDY SITUATION: 

DESCRIBE FINAL PLANNED ACTION WHICH WILL CORRECT PROBLEM, EXPECTED DATE OF FINAL PLANNED ACTION, AND HOW YOU INTEND TO PREVENT RECURRENCE OF THE PROBLEM: 

______________________________________ 
SIGNATURE: ___________________________ DATE: _________________

___________________________________ 
REVIEWED BY: _________________________ DATE: _________________
Appendix E
List of Analytical Services and Methods
## Analytical Services and Methods

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<td>SM2540 D</td>
<td></td>
</tr>
<tr>
<td>Sulfate</td>
<td></td>
<td>SM4500-SO₄ E</td>
<td></td>
</tr>
<tr>
<td>Sulfide (Reactive)</td>
<td></td>
<td>SM4500-S D,F (Section 7.3 SW-846)</td>
<td>EPA 9034</td>
</tr>
<tr>
<td>Residue – Total/Filterable/Non-Filterable/Settleable</td>
<td></td>
<td>SM2540 B,C,D,F</td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td></td>
<td>SM2550 B</td>
<td></td>
</tr>
<tr>
<td>Total Organic Carbon (TOC) – Dissolved Organic Carbon (DOC)</td>
<td></td>
<td>SM5310 B *</td>
<td>EPA 9060 (TOC) *</td>
</tr>
<tr>
<td>Turbidity</td>
<td></td>
<td>SM2130 B</td>
<td></td>
</tr>
<tr>
<td>VSS, VDS</td>
<td></td>
<td>SM2540 E</td>
<td></td>
</tr>
</tbody>
</table>

* Currently Sub-Contracted and/or obsolete method.
Appendix F
List of Instrumentation and Equipment
**Instrumentation**

To meet our needs for accurate analytical results, EMA uses sophisticated instruments. Our instruments are calibrated to comply with regulatory detection limits in the parts per billion (ppb) and parts per million (ppm) detection ranges. Listed below are the key instruments that we use for inorganic and organic analyses.

### INORGANIC INSTRUMENTS

<table>
<thead>
<tr>
<th>#</th>
<th>Instrument Description</th>
<th>Make</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Inductively Coupled Argon Plasma-Mass Spectrometry (ICP-MS)</td>
<td>Agilent</td>
<td>7800</td>
</tr>
<tr>
<td>1</td>
<td>Inductively Coupled Argon Plasma-Atomic Emission Spectrometry (ICP-AES)</td>
<td>Perkin-Elmer</td>
<td>8300-DV</td>
</tr>
<tr>
<td>1</td>
<td>Automated Mercury Analyzer (Cold Vapor/Atomic Absorption Spectrophotometer)</td>
<td>Teledyne Leeman Labs</td>
<td>Hydra II AA</td>
</tr>
<tr>
<td>1</td>
<td>Segmented Flow Analyzer</td>
<td>SEAL Analytical</td>
<td>3 HR (AA3)</td>
</tr>
<tr>
<td>2</td>
<td>48-Well Block Digestor</td>
<td>CPI International</td>
<td>ModBlock</td>
</tr>
<tr>
<td>2</td>
<td>10-Position Distillation Block</td>
<td>Enviromental Express</td>
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</tr>
<tr>
<td>1</td>
<td>Block Digestion System</td>
<td>SEAL Analytical</td>
<td>BD50</td>
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</table>

### ORGANIC INSTRUMENTS

<table>
<thead>
<tr>
<th>#</th>
<th>Instrument Description</th>
<th>Make</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GC/MS</td>
<td>Agilent</td>
<td>5973N</td>
</tr>
<tr>
<td>1</td>
<td>GC/MS</td>
<td>Agilent</td>
<td>5973</td>
</tr>
<tr>
<td>1</td>
<td>GC/MS</td>
<td>Hewlett Packard</td>
<td>5970S</td>
</tr>
<tr>
<td>6</td>
<td>GC</td>
<td>Hewlett Packard</td>
<td>5890A</td>
</tr>
<tr>
<td>2</td>
<td>GC</td>
<td>Hewlett Packard</td>
<td>6890</td>
</tr>
<tr>
<td>1</td>
<td>GC</td>
<td>Perkin Elmer</td>
<td>Claris 600</td>
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</table>
Instrumentation (continued)

<table>
<thead>
<tr>
<th>#</th>
<th>ORGANIC INSTRUMENTS</th>
<th>MAKE</th>
<th>MODEL</th>
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<tbody>
<tr>
<td></td>
<td>Gas Chromatograph Detectors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Mass Spectrometer Detectors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Flame Ionization Detectors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Electron Capture Detectors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Photo Ionization Detectors</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Hall Detector (Electrolytic Conductivity)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Flame Photometric Detector</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Nitrogen-Phosphorus Detector</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sample Introduction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Purge and Trap</td>
<td>OI</td>
<td>4460</td>
</tr>
<tr>
<td>1</td>
<td>Purge and Trap</td>
<td>OI</td>
<td>MPM-16</td>
</tr>
<tr>
<td>1</td>
<td>Purge and Trap</td>
<td>OI</td>
<td>Eclipse/4560</td>
</tr>
<tr>
<td>3</td>
<td>VOC Autosampler</td>
<td>OI</td>
<td>4552</td>
</tr>
<tr>
<td></td>
<td>Spectrophotometers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Infrared Spectrophotometer</td>
<td>Buck Scientific</td>
<td>404</td>
</tr>
<tr>
<td>1</td>
<td>UV/Visible Spectrophotometer</td>
<td>HACH</td>
<td>DR3900</td>
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<tr>
<td></td>
<td>Miscellaneous</td>
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</tr>
<tr>
<td>1</td>
<td>Accelerated Solvent Extractor</td>
<td>Dionex</td>
<td>ASE 200</td>
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<tr>
<td>1</td>
<td>Accelerated Solvent Extractor</td>
<td>Dionex</td>
<td>ASE 300</td>
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<tr>
<td>1</td>
<td>GPC Cleanup System</td>
<td>Waters</td>
<td>717</td>
</tr>
<tr>
<td>1</td>
<td>Nitrogen Blowdown System</td>
<td>Zymark</td>
<td>TurboVap</td>
</tr>
</tbody>
</table>

In addition to the above listed organic chemistry and inorganic chemistry laboratory equipment, EMA maintains a full wet chemistry laboratory for performing spectrophotometric, titrimetric, and gravimetric analysis and a microbiology laboratory.
Appendix G
Professional Profiles of Key Personnel
Key Personnel

Leland Stanton Pitt, B.S., M.S.
President

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**Education:**

- **Master’s of Science in Chemistry, 1981**
  Delta State University, Cleveland, Mississippi

- **Bachelor of Science Degree in Biology and Physics, minor in Mathematics, 1969**
  University of New Mexico, Albuquerque, New Mexico

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**Professional Experience:**

**Certified Industrial Hygienist:** Southland Labs, Inc. #4303
**Certified Marine Chemist:** Pacific Chemical Labs, Inc. #654
**Certified Asbestos Consultant:** Southland Labs, Inc. #97-2209

**President**

EnviroMatrix Analytical, Inc., San Diego, CA
2002-Present
Responsibility includes overall business management, business development and strategic planning. As the President of EnviroMatrix Analytical, Inc., he is responsible for directing the activities of the business. He provides consultation and recommendation to various clients to determine the specifics of project requirements.

**President and Manager**

H.M. Pitt Labs, Inc., San Diego, CA
1986-Present

H.M. Pitt Labs, Inc. is an analytical lab specializing in environmental studies and industrial hygiene. Mr. Pitt is currently the consulting CIH for The Port of San Diego, Ninyo & Moore, an environmental and geotechnical science group, and Westair Technologies. As the consulting CIH, Mr. Pitt typically reviews and approves abatement plans (both asbestos and lead, as well as other programs), and is responsible for monitoring and inspections. H.M. Pitt Labs does the monitoring and abatement review for Pacific Ship Repair and Southwest Marine, which removes insulation and asbestos on Navy ships. As a Marine Chemist, he certifies Navy ships and land tanks in the San Diego area and elsewhere when requested. He was the primary Marine Chemist and CIH on the Exxon Valdez ship repair.
Chemist and Gas Free Engineer
Long Beach Naval Shipyard, Long Beach, CA
1983-1986
Program Manager responsible for certifying spaces and shipboard as safe for production work in shipbuilding and repair. Work required knowledge of general safety and health regulations of CFR 1910, 1915, and 1926, as well as the pertinent Federal, State and D.O.D. regulations. Responsible for technical supervision of 15-25 technicians.
Required knowledge of instrumentation associated with analytical chemistry. Civilian equivalent of this position is a Marine Chemist. Required to sample, identify, and quantify typical work place stressors associated with the industrial hygiene-monitoring program. Worked in the chemistry department at the shipyard doing analytical viscosity determinations, flashpoint, fire point, pH, water concentration, particle count, etc.
Performed environmental analysis of industrial hygiene samples, i.e., asbestos, lead, organic solvents, etc., utilizing gas chromatography (GC), atomic absorption spectrometry (AA), and infrared spectrophotometers (IR).

Chemist
Office of Safety and Health, Mare Island Naval Shipyard, Vallejo, CA
1981-1983
Responsibilities included monitoring ships and industrial areas for potentially hazardous environments, and enforcing federal safety regulations. Use of various detection equipment: gas chromatography, infrared spectrophotometer analysis (qualitative and quantitative), as well as other methods. Functioned as an assistant gas free engineer and was responsible for certifying confined spaces on ships, fuel tanks, cofferdams and other voids. Began work in industrial hygiene department assisting CIH, IH and IH technicians in survey work on various shipyard stressors: asbestos, lead, solvents, ventilation, noise, etc.

Research Biologist
Stauffer Chemical Company, Greenville, MS
1975-1981
Assigned to Stauffer’s experimental research station. Responsible for insecticide, fungicide, plant growth regulators, antidote and insect growth regulators.
Leland Stanton Pitt, B.S., M.S.
President (Continued)

AREAS OF SPECIALTY:

Effects of insecticide, fungicide, plant growth regulators, etc. on soybeans, milo, corn, with some work on barley and wheat. Soybean work has been centered on Verman and other related thiocarbamate herbicides. Corn research responsibilities included varietal testing with Stauffer’s proprietary herbicides Sutan, Eptam and Vernam. Also basic antidote work on experimental corn antidotes and herbicides were performed.

Small plot techniques for insecticide screening. These techniques for insecticide screening were developed in order to cope with small technical samples.

Cotton insecticide work with pesticide interaction in both the antidote and insecticide field program.

Research efforts with Imidan on cotton, vegetable crops and fruit trees.

Soybean fungicide work with Captan and other coded experimental biocides.

Paint biocide screening of coded materials for use in commercial paints. Interest in these tests is centered on fungal discoloration and chemical compatibility. Both weathered and new wood surfaces are used.

ADDITIONAL DUTIES:

Respirator coordinator, 1980-81. Solely responsible for Stauffer’s respirator program at the Mississippi field station. This included selecting the appropriate DOT and NIOSH certified respirators in accordance with federal regulations and Stauffer’s own respirator program.

In January 1981 I attended and graduated from the Occupational Health Services respirator course given by John Pritchard and was certified.

Safety coordinator at the Mississippi field station 1975-78. Responsibilities included respirator monitoring and insuring the compliance to Stauffer’s safety program (chemical exposures and handling machinery safety; EPA and OSHA regulations, etc.).

Head of Stauffer’s synergist program January 1973 to September 1975. Responsible for developing new and sophisticated bioassay techniques which opened new leads in search of broad spectrum (field crop) synergists beyond household use. Developed ovicide program in two diverse areas: insect growth regulators and formamidine insecticides.

Assigned to Stauffer’s Western Research Center Mt. View, Ca. Helped improve screening techniques, which lead to new classes of selective slow acting insecticides. Developed statistical interpretation of joint action.
Leland Stanton Pitt, B.S., M.S.
President (Continued)

Screened experimental compounds for insecticidal/miticidal activity, October 1969 to January 1973. Following this initial testing, more extensive testing was initiated on those leads which seemed both novel and potentially profitable.

Worked as a technician from 1968-1969 in rearing insects and functioned as a lab technician in the biochemistry lab.

RELATED EXPERIENCE:

Master’s Thesis work done in “Insecticidal Activity of several benzamides and nicotinamides on the Tobacco Budworm (Heliothis virescens).

Graduate work in Chemistry in synthesizing analogs of Dimilin to determine structure/activity relationships and possible new chemical properties of related ureides.

General laboratory experience including radioactive tracing techniques (TLC and liquid scintillation work).

UNITED STATES PATENTS:

#4,123,526
Patented October 31, 1978
THIONOPHOSPHATE INSECTICIDE ACTIVATORS
Assignors Stauffer Chemical Company
George B. Large and Leland S. Pitt

#4,096,251
Patented June 20, 1978
DIETHYL 2-PYRIDINE THIONOPHOSPHONATE AS AN INSECTICIDE ACTIVATOR
Assignors, Stauffer Chemical Company
Leland S. Pitt, George B. Large, Alan MacDonald

#4,083,970
Patented April 11, 1978
ACTIVATED INSECTICIDE COMPOSITION EMPLOYING A CERTAIN PHOSPHORODITHIOATE AND AN ACTIVATOR
Assignors Stauffer Chemical Company
George B. Large And Leland S. Pitt
Leland Stanton Pitt, B.S., M.S.
President (Continued)

#4,072,745
Patented July 12, 1977
SUBSTITUTED VINYL THIOPHOSPHATE ACTIVATORS
Assignors Stauffer Chemical Company
Leland S. Pitt and George B. Large

#4,035,490
Patented July 12, 1977
INSECTICIDAL PHTHALIMIDOTHIOPHOSPHATES ACTIVATED WITH CERTAIN
PHOSPHOROTHIONATES
Assignors Stauffer Chemical Company
George B. Large and Leland S. Pitt

#3,830,887
Patented August 20, 1974
O,) –DILOWERALKYL-O-(1-METHYL-2-PHENYL VINYL) THIOPHOSPHATES
Assignors Stauffer Chemical Company
George B. Large and Leland S. Pitt

PROFESSIONAL ORGANIZATIONS:
Marine Chemists Association
Industrial Hygiene Association
American Chemical Society
Daniel Verdon, B.S.  
Laboratory Director

Education:  
Bachelor of Science in Chemistry, minor in Computer Science, 1990  
Westmont College, Santa Barbara, California

Professional Experience:

**Laboratory Director**  
EnviroMatrix Analytical, Inc., San Diego, CA  
2003 – Present  
Responsible for overall management of analytical laboratory production. Selection, training, and directing activities of chemistry laboratory personnel including compensation and termination. Extensive experience with current state, local and federal regulations. Oversees laboratory operations to ensure quality data reduction and review, and ensures that project specifications are met. Holds weekly status meetings to discuss current project status, analyses schedule, and any potential problems or irregularities with laboratory operations.

**Senior Chemist**  
EnviroMatrix Analytical, Inc., San Diego, CA  
1993 - 2003  
Responsible for all volatile organic compound analyses by Gas Chromatography (GC) and Gas Chromatography Mass Spectrometry (GC/MS), following methods EPA 601, EPA 8010, EPA 624, EPA 8240 and EPA 8260. Performs all systems maintenance and method development. Responsible for data review and systems management. Ensures that all volatile GC and GC/MS work is performed in compliance with all local, state and federal regulations, and quality assurance program requirements. Additionally, responsible for method and procedure development, and training other analysts.

**Environmental Specialist**  
IT Corporation, Irvine, CA  
1992 - 1993  
Responsible for operation of mobile chemistry laboratory. Perform field Gas Chromatography analysis. Management and tracking of all CLP data validation projects. Performed CLP data validation (Levels C and D) for HAZWRAP and Comprehensive Long-Term Environmental Action Navy (CLEAN) projects.

**Field Analytical Specialist**  
IT Corporation, Irvine, CA  
1990 - 1992  
Responsible for sampling and monitoring of ground-water wells, soils, and air at potentially contaminated sites. Performed on-site physical and chemical analyses. Sampled and monitored ground-water wells, industrial discharge, and contaminated soils at various commercial and military facilities.
Consultant
G.V. Industries, Santa Barbara, CA
1990
   Development of hazardous waste conformance plan to meet local, state and federal regulations. Development and implementation of emergency response program for G.V. facilities that met local and state regulatory requirements.

Research Assistant
Chemistry Department at Westmont College, Santa Barbara, CA
1989
   Development and testing of microprocessor controlled pulse train generator and photon counter for application in optically detected magnetic resonance spectroscopy.

Laboratory Technician
Whittaker Corporation Research Laboratory, Colton, CA
1987 - 1988
   Development, testing and formulation of industrial coil coatings (paint) for new product lines.

Training and Certificates:
OSHA 40 Hour 29 CFR 1910.120, November 1990
OSHA 8 Hour 29 CFR 1910.120 Refresher, (Annually)
Jennifer Beyer, M.S.
Q.A. Director

Education:

- **Master of Science in Physical Chemistry, 2007**
  San Diego State University, San Diego, CA

- **Bachelor of Arts in Chemistry, 1997**
  University of Northern Iowa, Cedar Falls, IA

Professional Experience:

**Q.A. Director**
EnviroMatrix Analytical, Inc., San Diego, CA
2005 – Present
- Responsible for establishing and maintaining the laboratories working budget and approving all purchases and expenditures. Acts as liaison for all regulatory agencies. Responsible for maintaining and implementing the Quality Assurance Manual, QA/QC policies, Standard Operating Procedures, and corrective action documents. Performs data validation and review for adherence to QA requirements. Conducts internal quality audits. Reviews all project and/or contract specific QA requirements for laboratory implementation.

**Senior Metals Chemist-Department Supervisor**
EnviroMatrix Analytical, Inc., San Diego, CA
2003 - 2005
- Responsible for performing ICP and ICP-MS metals analyses following method EPA 6010/6020 and EPA 200.7/200.8 and atomic absorption spectrophotometric analysis using cold vapor generation on a variety of matrices using method EPA 245.1, EPA 7470, and EPA 7471 for mercury. Ensures that analytical data complies with Quality Assurance Program requirements. Performs all aspects of analysis including those relating to troubleshooting instrument problems, detecting analytical interferences due to complex sample matrices, performing system maintenance and method development. Supervises the metals digestion department and the metals extraction department.

**Independent Contractor**
SDSU/SPAWAR Systems Center, San Diego, CA
2002 – 2003
- Provided technical and analytical support in the field of materials science for the Film Implementation of a Neutron Detector (FIND) Project.

**Teachers Assistant (Masters Candidate)**
San Diego State University, San Diego, CA
2000-2002
- Organized and taught laboratory classes for SDSU Chemistry Department.
Jennifer Beyer, M.S.
Q.A. Director (Continued)

Organic Laboratory Technician
TestAmerica (NET, Inc.), Cedar Falls, IA
1997-1999
   Performed laboratory extractions and analyses of environmental contaminants in water and soil samples utilizing EPA test protocols. Performed daily quality control procedures.

Laboratory Technician
AG Processing, Inc., Manning, IA
1997
   Performed extensive work on NIR. Wet lab analyses included crude fiber determination, residual oil testing, urease activity, pH, moisture and volatiles testing.
Joe Leonard  
Laboratory Supervisor

Education:  **Bachelor of Arts in Chemistry, 2005**  
University of Connecticut, Storrs, CT

Professional Experience:

**Laboratory Supervisor**  
EnviroMatrix Analytical, Inc., San Diego, CA  
2016-Present  
Responsible for daily operation of laboratory activities. Maintains lab supplies, supervises Wet Chemistry Department as well as serves as client project manager.

**Senior Wet Chemistry Technician**  
EnviroMatrix Analytical, Inc., San Diego, CA  
2010-2016  
Conduct and report Wet Chemistry departmental lab analyses including but not limited to: Cyanide, Sulfide, Ammonia, Total Kjeldahl Nitrogen, and Nitrate. Also aids in various client inquiries pertaining to the Wet Chemistry department.

**Staff Scientist**  
D-Max Engineering Inc., San Diego, CA  
2009 – 2010  
Responsible for inspecting commercial and industrial businesses in several San Diego County cities for storm water pollution in accordance with respective city ordinances and the San Diego Regional Water Quality Control Board. Performed dry-weather field monitoring for San Diego County; consisting of sampling and testing of storm water conveyances.

**Research Associate**  
Gen-Probe Inc., San Diego, CA  
2008-2009  
Responsible for developing purity determination, identification, and sustainability analyses of raw materials and oligonucleotides using Dionex® and Waters® HPLC, MALDI-TOF Mass Spectrometer, UV/Vis, Karl Fischer, and FTIR instruments.

**Seafood Officer**  
Mississippi Department of Marine Resources, Biloxi, Mississippi  
2008  
Responsible for the inspection of seafood processing plants in Mississippi in accordance with GMP along with public outreach and education.
Wet Chemistry Technician
EnviroMatrix Analytical, Inc., San Diego, CA
2005-2008

Conduct and report Wet Chemistry departmental lab analyses including but not limited to: Cyanide, Sulfide, Ammonia, Total Kjeldahl Nitrogen, and Nitrate. Performed field sampling and testing for clients including seasonal cruise ships.
Appendix H
External Certification