Quality Assurance/Quality Control Manual
Municipal Separate Stormwater Sewer System
Stormwater Monitoring
August 2020

In support of
Arizona Department of Transportation
Municipal Separate Stormwater Sewer System
Permit No. AZS000018 – 2015

Submitted To:
ADOT Environmental Planning
Water Resources
1221 South Second Avenue
Tucson, Arizona 85713

Submitted By:
Engineering and Environmental Consultants, Inc.
7740 N. 16th Street, #135
Phoenix, AZ 85020
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ABBREVIATIONS
A.A.C. Arizona Administrative Code
ADEQ Arizona Department of Environmental Quality
ADHS Arizona Department of Health Services
ADOT Arizona Department of Transportation
A.R.S. Arizona Revised Statutes
BMP Best Management Practices
BOD Biochemical Oxygen Demand
COC Chain of Custody
COD Chemical Oxygen Demand
CRM Certified Reference Material
E. coli Escherichia coli
EPA United States Environmental Protection Agency
HPLC High Performance Liquid Chromatography
LCS Laboratory Control Sample
LOQ Limit of Quantitation
MDL Method Detection Limit
mg/L Milligrams per Liter
MQO Measurement Quality Objective
MPN Most Probable Number
MS/MSD Matrix Spike/Matrix Spike Duplicate
MS4 Municipal Separate Storm Water Sewer System
NTU Nephelometric Turbidity Units
OAW Outstanding Arizona Waters
PAH Polycyclic Aromatic Hydrocarbons
PQLs Practical Quantitation Limits
QAM Quality Assurance Manual
QAP Quality Assurance Plan
QA/QC Quality Assurance/Quality Control
SOP Standard Operating Procedure
TDS Total Dissolved Solids
TSS Total Suspended Solids
VOC Volatile Organic Compound
WLA Wasteload Allocation
μg/L Micrograms per Liter
1.0 PROJECT MANAGEMENT

1.1 INTRODUCTION
This Quality Assurance/Quality Control Manual has been prepared for the Arizona Department of Transportation (ADOT) and their contractors to assist in meeting stormwater monitoring requirements as identified within Section 12 of Arizona Pollutant Discharge Elimination System Municipal Separate Storm Sewer System Permit No. AZS000018 (Permit). This Permit is implemented under Arizona Department of Environmental Quality (ADEQ) Arizona Pollutant Discharge Elimination System (AZPDES) and authorizes ADOT to discharge stormwater to Waters of the United States in Arizona within its Municipal Separate Storm Sewer System (MS4) and select maintenance facilities.

Quality assurance (QA) is defined as methods designed to implement the data quality objectives throughout the sampling and analytical procedure. Quality control (QC) is defined as the methods to measure how effectively the quality assurance methodologies have been applied.

1.2 DATA QUALITY OBJECTIVES
The data quality objectives of this manual are to provide a standard working tool for ADOT personnel and designated contractors in determining the type, quantity and quality of data needed to reach defensible decisions or make credible estimates in meeting Permit conditions as described in Part 12 of the ADOT’s MS4 Permit. This regulatory target requires data qualifiers of precision, accuracy and representativeness that governs the data quality objectives of the program.

1.2.1 Precision
Precision refers to the closeness of two or more measurements to each other. Measurements of concentration in sampled stormwater gathered by this program will be compared to Arizona surface water quality standards (A.A.C. Title 18, Chapter 11, Article 1) applicable to receiving waters of the MS4, qualitatively used to evaluate narrative standards to impaired and unique waters. The precision of numeric water quality standards varies but is the most exact of these three uses. Therefore, the precision of any data should be comparable to applicable surface water quality standards of the specific receiving waters.

1.2.2 Accuracy
Accuracy refers to the closeness of a measured value to a standard or known value. For environmental samples the true value is never known, even for a specific aliquot. Therefore, data accuracy can only be determined by intra-laboratory methods. Acceptable levels for accuracy of regulatory data where enforcement actions are possible are quite high and these have been specified by the Arizona Department of Health Services (ADHS) Office of Laboratory Licensure and Certification. All samples collected for monitoring are analyzed by a laboratory licensed by the ADHS and accuracy determined by internal programs of those labs. See Section 3.3 – Acceptance Criteria for further discussion.
1.2.3 Representativeness
For environmental samples, representativeness is the closeness of the measured value of a random sample to that obtained from the entire population. Obviously, for water samples variability is continuous, therefore site characterization standards suggest that the physical nature of the water sample be the best criteria for representativeness. For stormwater samples, these criteria include location relative to the source of pollution and receiving water, flow discharge and the nature of the rainstorm has specified the locations, sample timing, characteristic rainfall amounts and other qualifiers for the sampling program.

1.2.4 Level of Data Quality
The MS4 permit has assumed a level of data quality needed for compliance by requiring that ADHS certified laboratories are used, by stipulating the sampling locations, frequency and antecedent rainfall conditions and by requiring that the data be compared to applicable surface water quality standards of the specific receiving waters and calculated pollutant loads of impaired waters. This level of data quality will be maintained during the implementation of the monitoring.

1.3 ROLES, RESPONSIBILITIES, AND QUALIFICATIONS
The monitoring project structure is given by an organization chart, which is provided in Appendix A and will be updated as needed. The ADOT assigned project manager (ADOT PM) is responsible for compliance with the MS4 Permit. Sampling, monitoring and interpretive support will be assigned to the ADOT Contractor, who will maintain the project database. Data and narrative interpretation will be delivered to the ADOT PM for inclusion in the MS4 Permit Annual Report.

1.4 SAMPLE PARAMETERS AND FREQUENCY
Permit section 12.4.2.4(b) identifies parameters and sampling frequency. This table is provided below as Table 1 to assist users of this manual in preparing sampling activities.
### Table 1. Analytes, Sample Types, and Matrices

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Sample Type</th>
<th>Sample Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow</td>
<td>Field Measurement</td>
<td>Each time an outfall is sampled, for each aliquot</td>
</tr>
<tr>
<td>pH</td>
<td>Field Measurement</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Temperature</td>
<td>Field Measurement</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Total Dissolved Solids</td>
<td>Flow Weighted Composite</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Total Suspended Solids</td>
<td>Flow Weighted Composite</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Turbidity</td>
<td>Flow Weighted Composite</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Biochemical Oxygen Demand</td>
<td>Flow Weighted Composite</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Chemical Oxygen Demand</td>
<td>Flow Weighted Composite</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Sulfates</td>
<td>Flow Weighted Composite</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Nitrate</td>
<td>Flow Weighted Composite</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Nitrite</td>
<td>Flow Weighted Composite</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Sodium</td>
<td>Flow Weighted Composite</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Calcium</td>
<td>Flow Weighted Composite</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Chloride</td>
<td>Flow Weighted Composite</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Ammonia</td>
<td>Discrete Manual</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Chlorine</td>
<td>Discrete Manual</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>Discrete Manual</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Fecal Coliform</td>
<td>Flow Weighted Composite</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Arsenic</td>
<td>Flow Weighted Composite</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Barium</td>
<td>Flow Weighted Composite</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Cadmium</td>
<td>Flow Weighted Composite</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Chromium</td>
<td>Flow Weighted Composite</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Copper</td>
<td>Flow Weighted Composite</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Lead</td>
<td>Flow Weighted Composite</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Mercury</td>
<td>Flow Weighted Composite</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Nickel</td>
<td>Flow Weighted Composite</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Selenium</td>
<td>Flow Weighted Composite</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Silver</td>
<td>Flow Weighted Composite</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Zinc</td>
<td>Flow Weighted Composite</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Dissolved Copper</td>
<td>Discrete Manual</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Hardness</td>
<td>Discrete Manual</td>
<td>Once each wet season for each year in the</td>
</tr>
<tr>
<td>Polycyclic Aromatic</td>
<td>Discrete Manual</td>
<td>Once each wet season for each year in the</td>
</tr>
</tbody>
</table>

### 1.5 REGULATORY LIMITS

Analytical results will be compared to their applicable Arizona numeric water quality standards for surface water (A.A.C. Title 18, Chapter 11, Article 1) applicable to the MS4 receiving waters. Current surface water quality standards are available at the following link:

2.0 SAMPLE COLLECTION PROCEDURES

2.1 SAMPLING EQUIPMENT
Monitoring equipment will be gathered ahead of time because opportunities to sample during rainfall events often come with little advanced notice. Stormwater monitoring generally requires the following equipment:

- Field forms
- Waterproof pens
- Permanent markers
- Powder-free nitrile gloves
- Clear glass jar for visual examinations
- Sample containers
- Sample preservatives
- Sample container labels
- Chain of Custody (COC) forms
- COC seals
- Ice chest(s)
- Ice
- Foul-weather gear

A MS4 Stormwater Sampling Equipment List is provided in Appendix B to assist sampling technicians in preparing for field activities.

2.2 SAMPLE LOCATIONS

2.2.1 Maintenance Facilities Monitoring Locations
ADOT will conduct stormwater monitoring at its maintenance facilities located within a quarter mile of an impaired water or OAW, including, but not limited to:

- **Nogales Maintenance Yard** - 1340 N. Hohokam Drive, Nogales (31° 21’ 22.97” N; 110° 55’ 38.96” W)
- **Roosevelt Maintenance Yard** – SR 188 Milepost 242.8, Roosevelt (33° 39’ 45.67” N; 111° 08’ 03.16” W)
- **Spring Creek Maintenance Yard** – No listed address 34°48’00.50” N; 111° 55’ 20.43 W
- **Superior Maintenance Yard** - 951 Main Street, Superior (33° 17’ 14.14” N; 111° 06’ 40.31” W)
- **Superior Storage and Fuel Yard** - 952 Main Street, Superior (33° 17’ 17.12” N; 111° 06’ 43.49” W)

*Maintenance Facility Sampling Parameters*  
ADOT will collect a minimum of one sample per facility from each representative outfall between June 1 and October 31 (summer season) and one sample between November 1 and May 31 (winter season). Samples will be collected utilizing in-ground passive collection bottles installed within protective mounting tubes and retrieved after a storm event.
Maintenance Facility Field Measurements
Field measurements at each maintenance location will consist of the following:

- pH
- Temperature
- Residual chlorine (Nogales Yard only)

Field measurements will be recorded in the site location logbook.

2.2.2 Wet Weather (MS4) Monitoring Locations
ADOT will conduct stormwater monitoring at the following five established MS4 locations:

- **Flagstaff 2 MS4** - S. Beulah Blvd. along north side of street between I-40 overpass and south bound I-17 exit ramp (35°10’20.23”N; 111°39’56.18”W)
- **Nogales MS4** - Morley Road at Intersection of State Route 82 (31° 21’ 02.12”N; 110° 55’ 24.52”W)
- **Phoenix MS4** - East of State Route 101 on north bank of Skunk Creek (33° 37’ 19.86”N; 112° 14’ 21.65”W)
- **Sedona MS4** - Below western abutment of State Route 179 bridge over Oak Creek (34° 51’43.95’N; 111° 45’ 42.72”W)
- **Tucson MS4** - West of Interstate 10 north of Grant Road within ADOT Yard (32° 15’ 17.21”N; 110° 59’ 49.43”W)

A map showing the MS4 sampling locations is provided in Appendix C.

**MS4 Sampling Parameters**
ADOT will collect stormwater samples from the first representative storm event of each wet season (June 1 - October 31 and November 1 - May 31) and subsequent representative storm events as necessary to collect at least one stormwater sample for each wet season from each outfall or monitoring location. Sampling will be conducted over the first 3 hours of the discharge or for the entire discharge period, if the discharge lasts less than 3 hours. Sampling efforts should include the “first flush” (first 30 minutes of stormwater discharge) whenever possible. A representative storm event is defined in the ADOT Permit as a storm event of greater than 0.1 inches of rainfall and that occurs at least 72 hours after the previously measurable (greater than 0.1 inch of rainfall) storm event.

**MS4 Field Measurements**
Field measurements at each MS4 location will consist of the following:

- pH
- Temperature
- Flow

Field measurements will be recorded in the site location logbook.
**MS4 Grab Samples**
A minimum of one grab sample will be collected from a discharge resulting from a measurable storm event at each MS4 location and analyzed for the following:

- Escherichia coli (E. coli)
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Residual chlorine (Nogales MS4 only)

Grab sampling information for E. Coli and PAHs will be recorded on the COC. Information for residual chlorine (Nogales MS4 only) will be recorded in the site location logbook.

**MS4 Flow-Weighted Composite Samples**
Flow-weighted composite samples will be collected at each MS4 location utilizing an ISCO automated stormwater sampler. Sampling will be conducted over the first three hours of the discharge or for the entire discharge period if the discharge is less than three hours. A list of analyses required for flow-weighted sampling is provided in Table 1 (see page 3 of this document).

**2.2.3 Impaired Water Monitoring**
ADOT will conduct stormwater monitoring at the following locations within one-quarter mile of an impaired waterway:

- Queen Creek, Superior, AZ for dissolved copper
- State Route 85 bridge over Gila River for total selenium

**Impaired Water Sampling Parameters**
Samples will be collected utilizing in-ground passive collection bottles installed within protective mounting tubes and retrieved after a storm event.

**2.3 QUALITY ASSURANCE/QUALITY CONTROL SAMPLING**
The Quality Assurance/Quality Control (QA/QC) program ensures that samples collected are of the highest quality and the laboratory analyzing the samples is producing reliable results. In order to be certified by ADHS, an analytical laboratory is required to have a Quality Assurance Plan (QAP) or Quality Assurance Manual (QAM) that contains a set of QA/QC procedures covering all aspects of laboratory operations. The contracted laboratory will be required to provide a copy of its QAP and maintained on file by ADOT or their contractor.

Contamination can be introduced to a sample at any point during equipment preparation, sample collection, transport, or analysis steps and is referred to as sample bias. Standardized procedures for field and laboratory activities minimize the likelihood of contamination of samples or sample bias. Different types of blank samples can be used to determine if contamination has been introduced during any of the steps. The different types of blanks are described in the remainder of this section.

Section 4 of this document outlines required correction procedures in the event of surface water quality standard exceedance.
**Trip Blanks**
A trip blank sample shall be analyzed every fifth sampling event to estimate sample bias in volatile organic compound (VOC) analyses and analyzed for VOCs during every sampling event. Trip blank samples will be provided by the laboratory and will remain with the sample containers throughout the sampling and shipping process.

**Equipment Blanks**
Equipment blanks shall be collected by pouring analyte-free water over the decontaminated field equipment before collecting samples from a site. One equipment blank sample will be collected during seasonal maintenance activity (winter and summer). The equipment blank will be submitted to the laboratory and analyzed for the same parameters as the site sample(s).

**Matrix Spikes and Matrix Spike Duplicates**
Matrix spikes and matrix spike duplicates (MS/MSD) are collected at the same location as the original samples and the laboratory adds (spikes) the sample with a known concentration of analyte to a sample. The samples are then analyzed to determine the concentration of the sample plus the spike. Deviation from 100 percent in the spike recoveries indicates matrix interference. One MS/MSD will be collected for every ten VOC.

**Method Blanks**
A method blank is used to determine if any contamination is being introduced by laboratory reagents or glassware. For each batch of samples, method blanks will be run by the laboratory and the results of the method blank analysis reported with the sample results as percent recovery. Method blanks are conducted by the laboratory and no action on the part of the field sampling personnel is required.

**Laboratory Duplicates**
A laboratory duplicate is a sample that is split into two aliquot samples and then analyzed separately to determine the reproducibility of the laboratory analytical methods. Results of the laboratory duplicate analysis is reported with the sample results. At least one laboratory duplicate sample should be collected once a year from the five MS4 sampling locations. Laboratory duplicates are conducted by the laboratory and no action on the part of the field sampling personnel is required.

### 2.4 PRESERVATIVES AND HOLDING TIMES
Water sample preservation procedure is based on the particular type of analysis methodology.

- Bottle sets are typically shipped from the contract laboratory with preservatives contained in the bottle but may include separately-contained preservative vials for special circumstances.
- The type of preservative used for the analysis to be performed is typically identified by a colored dot or sticker on the pre-preserved bottle, which may also include a written notation of the added preservative.
- Sample bottles should be shipped for each sampling event on a per event/request basis.
- Bottles shall be new and contain the pre-measured amount of the preservative, except as noted above.
• Any pre-preserved bottle that is discolored around the cap, lost its preservative label, or appears to lack sufficient preservative shall be discarded.
• A crucial requirement for sample preservation is to extract the sample within established hold times for the specific analysis.

A list of analysis methods, bottle requirements, preservatives and hold times for the required analysis is listed in Table 2 and in accordance with EPA SW-846 requirements.

**Table 2. Preservatives and Holding Times**

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Method</th>
<th>Preservative</th>
<th>Container</th>
<th>Volume Required</th>
<th>Hold Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonia</td>
<td>SM4500NH3 D</td>
<td>Sulfuric Acid</td>
<td>Plastic 500 mL - Wide - H2SO4</td>
<td>100 mL</td>
<td>28 Days</td>
</tr>
<tr>
<td>Anions, Ion Chromatography</td>
<td>300 ORGFMS</td>
<td>None</td>
<td>Plastic 500 mL - Wide - unpreserved</td>
<td>30 mL</td>
<td>48 Hours</td>
</tr>
<tr>
<td>BOD, 5-Day</td>
<td>SM5210B Calc</td>
<td>None</td>
<td>Plastic 500 mL - Wide - unpreserved</td>
<td>400 mL</td>
<td>48 Hours</td>
</tr>
<tr>
<td>COD</td>
<td>5220D</td>
<td>Sulfuric Acid</td>
<td>Plastic 500 mL - Wide - H2SO4</td>
<td>100 mL</td>
<td>28 Days</td>
</tr>
<tr>
<td>Coliforms, Fecal (Colilert - Quanti Tray)</td>
<td>9223B ColiQT FC</td>
<td>Sodium Thiosulfate</td>
<td>Bacti Bottle - Idexx 125 mL w/thio</td>
<td>100 mL</td>
<td>8 Hours</td>
</tr>
<tr>
<td>E. Coli</td>
<td>9221F</td>
<td>None</td>
<td>Bacti Bottle - Idexx 125 mL</td>
<td>125 mL</td>
<td>8 Hours</td>
</tr>
<tr>
<td>Mercury (CVAA)</td>
<td>245.1 CWA</td>
<td>Nitric Acid</td>
<td>Plastic 500 mL - Wide - HNO3</td>
<td>100 mL</td>
<td>28 Days</td>
</tr>
<tr>
<td>Metals (ICP)</td>
<td>200.7 CWA</td>
<td>Nitric Acid</td>
<td>Plastic 500 mL - Wide - HNO3</td>
<td>100 mL</td>
<td>180 Days</td>
</tr>
<tr>
<td>Metals (ICP/MS)</td>
<td>200.8 CWA LL</td>
<td>Nitric Acid</td>
<td>Plastic 500 mL - Wide - HNO3</td>
<td>100 mL</td>
<td>180 Days</td>
</tr>
<tr>
<td>PAHs (HPLC)</td>
<td>8310</td>
<td>None</td>
<td>Amber Glass 1 liter Wide - unpreserved</td>
<td>2000 mL</td>
<td>7 Days</td>
</tr>
<tr>
<td>Solids, Total Dissolved (TDS)</td>
<td>2540C CalcD</td>
<td>None</td>
<td>Plastic 500 mL - Wide- unpreserved</td>
<td>200 mL</td>
<td>7 Days</td>
</tr>
<tr>
<td>Solids, Total Suspended (TSS)</td>
<td>2540D</td>
<td>None</td>
<td>Plastic 500 mL - Wide- unpreserved</td>
<td>200 mL</td>
<td>7 Days</td>
</tr>
<tr>
<td>Turbidity, Nephelometric</td>
<td>180.1</td>
<td>None</td>
<td>Plastic 500 mL - Wide- unpreserved</td>
<td>100 mL</td>
<td>48 Hours</td>
</tr>
<tr>
<td>Chlorine</td>
<td>SM4500Cl-G</td>
<td>None</td>
<td>Plastic or Glass 250 mL brown poly</td>
<td>100 mL</td>
<td>15 Minutes</td>
</tr>
</tbody>
</table>
2.5 SAMPLE NOMENCLATURE
A consistent system for naming samples ensures that sample data are readily identifiable as to
time and location and avoids confusion when samples are collected regularly at the same
location over a long period of time. All samples should be named according to the following
two-part labeling system:

Part 1 - Location Code
- FLAG2 - Flagstaff MS4
- NOGMS4 - Nogales MS4
- PHX - Phoenix MS4
- SED - Sedona MS4
- TUC - Tucson MS4
- NOGYARD - Nogales Maintenance Yard
- ROSVLT - Roosevelt Yard
- SPRCRK - Spring Creek Yard
- SUPYARD - Superior Maintenance Yard
- SUPFUEL - Superior Storage and Fuel Yard

Part 2 - Date Code
Include the date in the following format: YYMMDD. An example sample from the Tucson MS4
sampling location collected on November 15, 2016 would be labeled:

TUC161115

An example of a completed COC is provided in Appendix D of this document.

Laboratory Selection
Laboratories selected for analyses of stormwater samples may include any ADHS certified
laboratory. Currently, the following labs have been providing service to ADOT for stormwater
analyses:

- Pace Analytical
- Turner Laboratories, Inc.
- Xenco Laboratories

The sampling technician will also document field measurements and observations in the Water
Sampling Data Form provided in Appendix E or within the site logbook.
3.0 APPROVED ANALYTICAL METHODS

3.1 ANALYTICAL METHODS

ADOT MS4 Permit Section 12.2.1.2 specifies the process for selecting analytical methods for stormwater sample analysis. The recommended analytical methods, limits of quantification (LOQs) and method detection limits (MDLs) for specific analytes are provided in Table 3 below and are in accordance with EPA SW-846 requirements.

The analytical method will be specified on the COC form. In addition to these requirements, the Permit requires the selected analytical method to have a LOQ less than the applicable numeric surface water quality standard. If all methods have LOQs higher than applicable numeric surface water quality criteria, ADOT must use the approved analytical method with the lowest LOQ. The laboratory contracted for ADOT stormwater sample analysis must also use a standard calibration where the lowest standard point is equal to or less than the LOQ. This will be verified through review of laboratory data in comparison of the LOQ to surface water quality standards.

Table 3. Analytical Methods

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Method</th>
<th>LOQ</th>
<th>MDL</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonia</td>
<td>SM 4500 NH3 D</td>
<td>0.5</td>
<td>0.383</td>
<td>mg/L</td>
</tr>
<tr>
<td>Biochemical Oxygen Demand</td>
<td>SM 5210B</td>
<td>5.0</td>
<td>5.00</td>
<td>mg/L</td>
</tr>
<tr>
<td>Chemical Oxygen Demand</td>
<td>SM 5220D</td>
<td>20.0</td>
<td>4.53</td>
<td>mg/L</td>
</tr>
<tr>
<td>Chlorine, Residual</td>
<td>SM 4500 Cl G</td>
<td>0.05</td>
<td>0.0096</td>
<td>mg/L</td>
</tr>
<tr>
<td>Nitrate as N</td>
<td>300.0</td>
<td>0.1</td>
<td>0.0509</td>
<td>mg/L</td>
</tr>
<tr>
<td>Nitrite as N</td>
<td>300.0</td>
<td>0.1</td>
<td>0.0329</td>
<td>mg/L</td>
</tr>
<tr>
<td>Chloride</td>
<td>300.0</td>
<td>2.0</td>
<td>0.291</td>
<td>mg/L</td>
</tr>
<tr>
<td>Sulfate</td>
<td>300.0</td>
<td>2.0</td>
<td>0.214</td>
<td>mg/L</td>
</tr>
<tr>
<td>Calcium</td>
<td>200.7 Rev 4.4</td>
<td>2.0</td>
<td>0.0139</td>
<td>mg/L</td>
</tr>
<tr>
<td>Sodium</td>
<td>200.7 Rev 4.4</td>
<td>0.5</td>
<td>0.154</td>
<td>mg/L</td>
</tr>
<tr>
<td>Arsenic</td>
<td>200.8 LL</td>
<td>0.5</td>
<td>0.247</td>
<td>µg/L</td>
</tr>
<tr>
<td>Barium</td>
<td>200.8 LL</td>
<td>0.5</td>
<td>0.259</td>
<td>µg/L</td>
</tr>
<tr>
<td>Cadmium</td>
<td>200.8 LL</td>
<td>0.1</td>
<td>0.0231</td>
<td>µg/L</td>
</tr>
<tr>
<td>Chromium</td>
<td>200.8 LL</td>
<td>0.5</td>
<td>0.433</td>
<td>µg/L</td>
</tr>
<tr>
<td>Copper</td>
<td>200.8 LL</td>
<td>0.5</td>
<td>0.332</td>
<td>µg/L</td>
</tr>
<tr>
<td>Lead</td>
<td>200.8 LL</td>
<td>0.5</td>
<td>0.220</td>
<td>µg/L</td>
</tr>
<tr>
<td>Nickel</td>
<td>200.8 LL</td>
<td>0.5</td>
<td>0.344</td>
<td>µg/L</td>
</tr>
<tr>
<td>Selenium</td>
<td>200.8 LL</td>
<td>0.5</td>
<td>0.0743</td>
<td>µg/L</td>
</tr>
<tr>
<td>Silver</td>
<td>200.8 LL</td>
<td>0.1</td>
<td>0.0121</td>
<td>µg/L</td>
</tr>
<tr>
<td>Zinc</td>
<td>200.8 LL</td>
<td>12.5</td>
<td>3.12</td>
<td>µg/L</td>
</tr>
<tr>
<td>Hardness</td>
<td>SM 2340B</td>
<td>3.3</td>
<td>0.07</td>
<td>mg/L</td>
</tr>
<tr>
<td>Mercury</td>
<td>245.1</td>
<td>0.0002</td>
<td>0.00007</td>
<td>mg/L</td>
</tr>
<tr>
<td>Total Dissolved Solids</td>
<td>SM 2540C</td>
<td>20.0</td>
<td>20</td>
<td>mg/L</td>
</tr>
</tbody>
</table>
3.2 QUALITY CONTROL RESULTS

The subcontracted laboratory will provide the standard Level II data package with the analytical results. This will provide the QA/QC data necessary to evaluate the laboratory results. The standard Level 2 data package will reports include all of the elements of a Level 1 report (the sample analytical results) and also include surrogates and batch QC results. This allows for review of the reliability of the sample data provided.

3.3 ACCEPTANCE CRITERIA

The process of acceptance criteria for laboratory data is important to ensure quality and reliability of the sample results. This process will be conducted by ADOT and/or their designated contractor and may include one or more of the following elements:

- Percent recovery of the laboratory control sample
- Percent recovery of the matrix spike
- Percent difference of the matrix spike duplicate
- Laboratory duplicates and field duplicates
- Replicate analyses

If the sample doesn't completely comply with the criteria it must be rejected and new sample collected and analyzed.

---

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Method</th>
<th>LOQ</th>
<th>MDL</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Suspended Solids</td>
<td>SM 2540D</td>
<td>10.0</td>
<td>10</td>
<td>mg/L</td>
</tr>
<tr>
<td>Turbidity</td>
<td>180.1</td>
<td>0.2</td>
<td>0.2</td>
<td>NTU</td>
</tr>
<tr>
<td>Acenaphthene</td>
<td>8310</td>
<td>1.0</td>
<td>0.312</td>
<td>µg/L</td>
</tr>
<tr>
<td>Acenaphthylene</td>
<td>8310</td>
<td>1.0</td>
<td>0.689</td>
<td>µg/L</td>
</tr>
<tr>
<td>Anthracene</td>
<td>8310</td>
<td>0.05</td>
<td>0.0341</td>
<td>µg/L</td>
</tr>
<tr>
<td>Benzo[a]anthracene</td>
<td>8310</td>
<td>0.2</td>
<td>0.0308</td>
<td>µg/L</td>
</tr>
<tr>
<td>Benzo[a]pyrene</td>
<td>8310</td>
<td>0.05</td>
<td>0.0173</td>
<td>µg/L</td>
</tr>
<tr>
<td>Benzo[b]fluoranthene</td>
<td>8310</td>
<td>0.1</td>
<td>0.0272</td>
<td>µg/L</td>
</tr>
<tr>
<td>Benzo[g,h,i]perylene</td>
<td>8310</td>
<td>0.1</td>
<td>0.0299</td>
<td>µg/L</td>
</tr>
<tr>
<td>Benzo[k]fluoranthene</td>
<td>8310</td>
<td>0.05</td>
<td>0.0197</td>
<td>µg/L</td>
</tr>
<tr>
<td>Chrysene</td>
<td>8310</td>
<td>0.1</td>
<td>0.0162</td>
<td>µg/L</td>
</tr>
<tr>
<td>Dibenz(a,h)anthracene</td>
<td>8310</td>
<td>0.1</td>
<td>0.0417</td>
<td>µg/L</td>
</tr>
<tr>
<td>Fluoranthene</td>
<td>8310</td>
<td>0.1</td>
<td>0.0831</td>
<td>µg/L</td>
</tr>
<tr>
<td>Fluorene</td>
<td>8310</td>
<td>0.1</td>
<td>0.092</td>
<td>µg/L</td>
</tr>
<tr>
<td>Indeno[1,2,3-cd]pyrene</td>
<td>8310</td>
<td>0.1</td>
<td>0.025</td>
<td>µg/L</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>8310</td>
<td>0.5</td>
<td>0.468</td>
<td>µg/L</td>
</tr>
<tr>
<td>Phenanthrene</td>
<td>8310</td>
<td>0.1</td>
<td>0.0988</td>
<td>µg/L</td>
</tr>
<tr>
<td>Pyrene</td>
<td>8310</td>
<td>0.1</td>
<td>0.0473</td>
<td>µg/L</td>
</tr>
<tr>
<td><em>Escherichia coli</em></td>
<td>SM 9221F</td>
<td>1.8</td>
<td>1.8</td>
<td>MPN/100 mL</td>
</tr>
<tr>
<td><em>Coliform, Fecal</em></td>
<td>SM 9223B</td>
<td>1.0</td>
<td>1.0</td>
<td>MPN/100 mL</td>
</tr>
</tbody>
</table>
4.0 CORRECTIVE ACTION
Corrective action is required in response to administrative or technical failures. Any corrective action required will be implemented and documented accordingly. Once the corrective action is identified, ADOT personnel or their designated contractor will initiate activities and provide appropriate documentation of actions taken. A copy of the corrective action will be maintained with this QAM and kept on file for a minimum of five years past the date of the expired permit.

4.1 Laboratory Corrective Action
Failures in laboratory measurement systems include, but are not limited to: instrument malfunction, calibration failure, sample container breakage, contamination, and QC sample failure. If the failure can be corrected, the analyst documents the issue and resolution in the laboratory records and completes the analyses. If the failure is not resolved, it is conveyed to the respective supervisor who will determine if the analytical failure compromised associated results. The nature and disposition of the problem must be documented in the data report sent to the ADOT Project Manager.

4.2 Field Corrective Action
The field technician team is responsible for responding to failures in their sampling and field measurement systems. These failures may include equipment or technical failures as presented below:

- **Equipment Failures** - If monitoring equipment fails, personnel are to record the issue accordingly. Failing equipment must be replaced or repaired prior to subsequent sampling events.

- **Technical Failures** - Technical failures may include dropped or broken sample containers during collection due to site conditions (rain, low visibility, slick surfaces, etc.). If such an event occurs the sampling technician will document the occurrence in the site logbook.

It is the combined responsibility of all members of the field sampling team to determine if requirements of the specific sampling method have been met. The field sampling team will also determine if additional sampling is required and analyses is required.

5.0 DATA REVIEW
The initial data review is conducted by the laboratory to verify holding times, proper COC procedures, preservation, sample data, QC sample data, and laboratory QC data. Any deviations from the requirements are noted by the laboratory and reported with the analytical results.

5.1 REVIEW PROCESS
The laboratory will provide a standard Level II data package and standard turnaround time for analytical results. Standard turnaround times for laboratory data of two to three weeks for electronic data are generally satisfactory for stormwater samples. Receiving the electronic data more quickly allows an early data review to identify any problems that may be corrected.
through re-extraction or re-analysis of leftover sample still at the laboratory (unless notified to
do otherwise, the laboratory only keeps leftover samples for 30 days). The data package should
be delivered as electronic.

The data package will include a narrative identifying any problems, corrections, anomalies, and
conclusions, as well as completed COC documentation. The standard Level II data package will
include:

- Sample extraction and analysis dates
- Results of method blanks
- Summary of analytical accuracy (matrix spike, duplicate compound recoveries, and lab
  control samples)
- Summary of analytical precision (comparison of laboratory control samples, matrix
duplicate, and matrix spike duplicate results)
- Summary of organic method performance (surrogate spike compound recoveries)
- Practical Quantitation Limits (PQLs) and MDLs

The field sampling sheets and analytical data package will be reviewed for unacceptable
procedures in the field or laboratory. Analytical data will be reviewed as soon as it is received
from the laboratory.

5.2 REPORTING RESULTS
The Permit requires sampling results from the field sampling data forms and the laboratory to
be included in the Annual Report. This reporting is the responsibility of the ADOT Water
Resources Group.

5.3 RESOLVING DATA QUALITY ISSUES
A Data Quality Assurance Worksheet as provided in Appendix F will be completed upon receipt
of laboratory reports to assist in validity of the data. The purpose of this review is not to reject
that data, but rather assist in improving the data collection process. In general, given the time
constraints involved in stormwater sampling, exceeded hold times on analyses for E. coli and
fecal coliform will not automatically trigger resampling. These data will be flagged as necessary
for reporting purposes.

5.4 DATA USE LIMITATIONS
Data use limitations may also be identified in the Data Quality Assurance Worksheet as
provided in Attachment F. Data that do not meet the measurement performance criteria
specified in this QAM will be identified and the impact on the project quality objectives
documented. Specific actions for data that do not meet the measurement performance criteria
depend on the use of the data and may require additional samples be collected or the use of
the data restricted. Determination of the overall data quality for a specific sampling event
program will be conducted upon receipt of final laboratory report.

5.5 DATA RETENTION
Data will be retained by ADOT for a period of 5 year past the expired/termination date of the
permit.
Appendix A: Project Organization Chart
Appendix B: MS4 Stormwater Sampling Equipment List
# MS4 Stormwater Sampling Equipment List
*(all equipment may not be required)*

## Documentation
- [ ] **field log book or**
- [ ] **laminated field book**
- [ ] **camera (if required)**
- [ ] **GPS (if required)**

## Sample Collection
- [ ] **disp. bailers** >qty.
- [ ] **disp. filters** >qty.
- [ ] **disp. gloves**
- [ ] **pH/temp/SC/Eh meter**
- [ ] **peristaltic pump**
- [ ] **geo-pump tubing**
- [ ] **calibration standards**
- [ ] **200’ garden hose**
- [ ] **350’ rope for bailing**
- [ ] **electric wire pigtails**
- [ ] **controller for ready-flow II**
- [ ] **QED Pump controller**
- [ ] **QED compressor**
- [ ] **solinist**
- [ ] **long solinist**
- [ ] **1/4” poly tubing**
- [ ] **discharge hose**
- [ ] **4 water pales & lids**
- [ ] **decon tube for pump**
- [ ] **Hand Radios**
- [ ] **Keck**

## Access/Maintenance
- [ ] **tool box**
- [ ] **3/8” socket set**
- [ ] **shovel**
- [ ] **decon soap**
- [ ] **sponges**
- [ ] **deionized water**
- [ ] **loppers**
- [ ] **machete**
- [ ] **bow saw**
- [ ] **J-plugs**

## Sample Shipping
- [ ] **shipping tape/dispenser**
- [ ] **coolers** >qty.
- [ ] **custody seals**
- [ ] **shipping labels**

## Health and Safety
- [ ] **first aid kit**
- [ ] **fire extinguisher**
- [ ] **local phone book**
- [ ] **mobile phone**
- [ ] **shade umbrella**
- [ ] **water igloo container**
- [ ] **truck flags**

## Personal Gear
- [ ] **hard hat**
- [ ] **respirator**
- [ ] **coveralls**
- [ ] **rain gear**
- [ ] **hard toed boots**
- [ ] **safety glasses**
- [ ] **personal cooler**
Appendix C: ADOT MS4 Sampling Locations
Flagstaff MS4
Sedona MS4
Phoenix MS4
Tucson MS4
Nogales MS4

ADOT MS4 Sampling Locations
Appendix D: Example Chain-of-Custody Form
**CHAIN-OF-CUSTODY / Analytical Request Document**

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields must be completed accurately.

### Section A
**Required Client Information:**
- **Company:** 
- **Address:** 7740 N. 16th St., #135, Phoenix, AZ 85020
- **Phone:** 602-248-7702
- **Email To:** jburton@eeccorp.com
- **Requested Due Date/TAT:** Phoenix MS4

### Section B
**Required Project Information:**
- **Project Name:**
- **Project Number:**
- **Company Name:** EEC
- **Purchase Order No.:**
- **Project Manager:**
- **Pace Project No./ Lab I.D.:**

### Section C
**Invoice Information:**
- **Accounts Payable**
- **REGULATORY AGENCY**
  - NPDES
  - GROUND WATER
  - DRINKING WATER
  - UST
  - RCRA
  - OTHER

### Section D
**Required Client Information**

<table>
<thead>
<tr>
<th>SAMPLE ID</th>
<th>MATRIX CODE</th>
<th>DATE</th>
<th>TIME</th>
<th>COMPOSITE START</th>
<th>COMPOSITE END/GRAB</th>
<th>SAMPLE TEMP AT COLLECTION</th>
<th># OF CONTAINERS</th>
<th>Preservatives</th>
<th>Analysis Test</th>
<th>Sample Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHX200715</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Additional Comments**
- **RELINQUISHED BY / AFFILIATION**
- **DATE**
- **TIME**
- **ACCEPTED BY / AFFILIATION**
- **DATE**
- **TIME**
- **SAMPLE CONDITIONS**

**Sampler Name and Signature**
- **PRINT Name of SAMPLER:**
- **DATE Signed (MM/DD/YY):**

---

*Important Note: By signing this form you are accepting Pace's NET 30 day payment terms and agreeing to late charges of 1.5% per month for any invoices not paid within 30 days.*

F-ALL-G-020rev.07, 15-May-2007
Instructions for completing Chain of Custody (COC)

1. **Section A and B:** Complete all Client information at top of sheet: company name, address, phone, fax, contact (the person to contact if there are questions, and who will receive the final report.), e-mail address (if available), PO#, Project Name and/or Project Number as you would like to see it appear on the report.

2. **Section C:** Invoice Information: Billing information is included in this section. This information should include the name and address of the person receiving the invoice.

3. Quote Reference should be completed if a quotation was provided by Pace Analytical. The Project Manager, and Profile No. will be completed by Pace Analytical Services.

4. **Site Location:** A separate COC must be filled out for each day of sample collection. Record the two letter postal code for the US state in which the samples were collected.

5. **Regulatory Agency:** List the program that is guiding the work to ensure proper regulations are followed.

6. **Section D:** Complete a Sample Description in the ‘SAMPLE ID’ section as you would like it to appear on the laboratory report. The following information should also be included: the sample matrix, sample type (G (grab) or C (composite). When collecting a composite, the start time and end time should be documented in the respective boxes. The collection time for a grab (G) sample should be entered in the boxes marked ‘Composite End/Grab’), Sample temp at collection (if required by state), the total number of containers, and preservative used.

7. Mark if the sample was filtered in the field by marking Y or N in ‘Filtered’ row by the Analysis requested.

8. **Requested Analysis:** List the required analysis and methods on the lines provided and place a check in the column for the samples requiring the analysis. Additional comments should be referenced in the bottom left hand corner or include attachments for extended lists of parameters.

9. The sampler should print their name in the space provided and sign their name followed by the date of the sampling event at the bottom of the COC in the spaces designated for ‘SAMPLER NAME AND SIGNATURE’.

10. When relinquishing custody of the samples to a representative of the laboratory or other organization, indicate the Item Numbers of those samples being transferred; sign relinquished by, date and time, and include your affiliation.

**Important Note:**

*Standard Turnaround Time is 2 Weeks/10 business days.* Results will be delivered by end of business on the date due unless other arrangements have been made with your project manager.

**Special Project Requirements** such as Low Level Detection Limits or level of QC reported must be included on the chain of custody in the Additional Comments section.
Appendix E: Stormwater Sampling Data Form
MS4 Stormwater Sampling

Record the following information in the site logbook and take a photo:

Sample ID: ___________________________  Sample Date: ________________

Sampler Name(s): ______________________  Time (24 hr time): ________________

Sampling Event: Summer / Winter

<table>
<thead>
<tr>
<th>Site Parameter</th>
<th>Reading</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow (gpm)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH (SU)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature (°C)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: Site parameter readings are not required for Yard Sites

CURRENT WEATHER:

Temperature: ________________

Humidity: ________________

Cloud Cover: ________________

Wind/Direction: ________________

FLOW CALCULATION:

Signature: ___________________________
Appendix F: Data Quality Assurance Worksheet
# Data Quality Assurance Worksheet

Monitoring Site: _______________________

Sample Date: ___________ Sample Time: ______

Sample Type (underline):  Regular   Duplicate   Split

Analytical Laboratory: _______________________

<table>
<thead>
<tr>
<th></th>
<th>YES (✔)</th>
<th>NO (✔)</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did the laboratory analyze all parameters requested on the chain of custody?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were the samples analyzed with the analytical methods specified in the monitoring plan?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were all holding times met by both the monitoring personnel and the laboratory?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were the reported values at or below the reporting limits specified in the monitoring plan?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>YES (✔)</th>
<th>NO (✔)</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>For duplicate samples: Does sample duplicate precision meet the specified criteria?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For split samples: Does sample duplicate precision meet the criteria specified in the monitoring plan?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If not, did the laboratories use the same analytical methods?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>