QUALITY ASSURANCE FOR MUNICIPAL STORMWATER PROGRAMS

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EXECUTIVE SUMMARY

This document has been prepared for the technical and managerial staff of cities and counties that must implement a comprehensive water quality protection program under the Phase II stormwater regulations or otherwise want to implement local water quality improvement programs. The information in this document provides an overview of the various strategies that must be considered to ensure that all information and data generated under a stormwater protection program are useable, defensible and effective.

The intended audience for this document is staff and management persons of a city or county that have little to no experience with: water quality standards, creating and operating a water quality inspection and enforcement program, or the importance of data quality. While there are a number of checklist items in the document that can be used in creating quality assurance plans and inspection programs, this is not a complete guidance on preparing these. Rather, the intent is to introduce the beginning staff person to the importance of data quality and to provide direction and resources for developing local data quality and inspection programs.

Cities having industrial pretreatment programs or "major" POTWs will have the greatest advantage as they will already have staff who are familiar with data collection, laboratory and field testing, documenting and reporting results to meet discharge permit requirements, negotiating with responsible parties of potential pollutant sources, and addressing technical questions from citizens, managers, councils, vendors, consultants and regulatory agencies. However, most Phase II municipalities do not have pretreatment programs, and their stormwater staff are floodplain managers, building inspectors and city planners, all with limited knowledge of water quality data issues.

This document should enable a municipal stormwater manager to decide upon what types of data quality strategies are needed and what resources are available to achieve a successful QA program. Agencies such as ACOG, INCOG, EPA and ODEQ should be contacted for assistance and information about establishing an effective data quality program. This guidance is intended to be a planning tool in developing a reliable quality assurance program for stormwater.

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I. INTRODUCTION

As Phase II stormwater programs begin in Oklahoma, many activities of cities and counties will require consideration of the "ruggedness" of the data and of the procedures that will be employed to collect, analyze, store and report information. Defensibility of data and information is frequently overlooked, and development and deployment of a good quality assurance (QA) program is time-consuming and expensive. QA works "behind the scenes" of a data-rich program, and it is essential for a data program to function efficiently. There are several levels of data collection and data management that require different QA attention.

This QA guidance will help Phase II stormwater permittees establish an effective program and provide basic QA information. Cities already employ QA procedures, mostly in the testing and operation of their water and wastewater treatment plants. All Oklahoma Pollutant Discharge Elimination System (OPDES) discharge permits require certain types of records to be kept and certain types of approved analytical tests to be performed by a certified laboratory. A city's water and wastewater treatment plants are periodically audited by the Permitting Authority (PA) which in Oklahoma is the Oklahoma Department of Environmental Quality (ODEQ). All of these considerations are part of the city's existing QA program. The Phase II stormwater program is yet another OPDES permit, one that requires collection of a wide variety of data for purposes ranging from simply recording the number of brochures distributed to chemical sampling data to be used for justifying enforcement actions and assessing penalties through administration or court.

EPA has established guidance for understanding, developing and using data quality objectives (DQOs), quality assurance project plans (QAPPs), quality management plans (QMPs), and standard operating procedures (SOPs). These documents are required of any organization that performs environmental data collection using Federal water quality grant funds. In such cases, EPA and ODEQ formally review and approve each QMP and QAPP document. However, for non-Federal funded environmental programs, the guidance is nonetheless valuable to establish a QA program having the same QA oversight and effectiveness. Challenges to data quality are defended by having a good "quality system".

EPA receives many requests to review and approve QAPPs and QMPs, but they can only approve those related to EPA water quality funded projects. Therefore, the QA procedures for Phase II stormwater programs cannot be formally approved by EPA. The QA procedures described in this INCOG guidance are intended to cover the full range of QA development, from implementing a simple, informal QA program to preparation of formal QA documents based upon EPA guidance. Each stormwater permittee should select the level of QA that is appropriate to the data quality objectives.

II. WHAT IS QUALITY ASSURANCE / WHY IS QA NEEDED

EPA QA/R-2 QMP guidance states that "a structured system that describes the policies and procedures for ensuring that work processes, products, or services satisfy stated expectations or specifications is called a quality system. …Organizations must ensure that data collected for the characterization of environmental processes and conditions are of the appropriate type and quality for their intended use and that environmental technologies are designed, constructed, and operated according to defined expectations."

EPA QA/R-5 QAPP guidance describes Quality Assurance (QA) as "a tool for project managers and planners to document the type and quality of data needed for environmental decisions and to describe the methods for collecting and assessing those data."

QA is a set of processes and procedures used during data and information collection, analysis, storing and reporting that enhances the quality of the data and information to suit its intended purpose(s). For example, if a city collects stream water samples, takes photographs, records visual observations onto a field form, takes notes during interviews with facility employees, uses field test kits and fills bottles for lab analysis of potential polluted runoff from a facility under investigation, the quality of that data must be considered in the context of its expected and intended use.

Will the city need to present the data in a court as evidence? Will the data be mailed to the facility manager / owner as evidence of potential city enforcement? Will the data be shown to the facility operator at the time of collection with a request to stop illicit discharges? If the data are not convincing, then a defense attorney will request that the case be dismissed due to lack of sufficient and convincing evidence. A facility manager has a right to question the adequacy of any data generated by the city. What will ensure successful data usefulness will be the "defensibility" of the data, and the QA program will be the means to meet the city's data quality objectives.

III. TO WHAT DOES QA APPLY

For the stormwater permit program under ODEQ's general permit for small MS4s (OKR04), there are many activities to which having an established QA process would be of benefit. QA does not only apply to field sampling, but also encompasses how data are analyzed, stored and reported. For a typical Phase II stormwater program, the following are examples of types of data and information that should fall under some type of QA program:

III.1 Field Data:

1. Dry Weather Field Screen (DWFS) visual inspection field notes *(e.g. flow, color, odor, sediment stains, debris in creek, etc.);*
2. DWFS location field data *(e.g. photographs, map location, GPS measurement, surrounding land uses, descriptions of adjacent structures and activities, weather conditions, etc.);*
3. DWFS field chemical test kit data *(e.g. pH, dissolved oxygen, chlorine residual, etc.);*
4. Source Tracking Inspection (STI) visual inspection field notes;
5. STI location field data;
6. STI field chemical test kit data;
7. STI lab sampling information *(e.g. types of bottles filled, date, time, location, sampler's name, preservative, parameter(s) for lab analysis, etc.);* and

8. Methods for conducting inspections *(e.g., DWFS, source tracking, facilities and construction sites).*
9. Analytical laboratory methods and requirements *(e.g., 40 CFR Part 136 methods, lab certification from ODEQ, other EPA and ODEQ methods, detection limits, significant figures, lab QA/QC sample results, etc.);*
10. Field Data Collection Methods *(e.g., sample bottles, labels, field forms, collection methods, preservation methods, sample transport, collection devices, test kits, notes and comments, photos, GPS, etc.).*

III.2 Facility Inspection Data:

1. Facility information *(e.g. facility name, owner/manager name, address, type of business, map location, etc.);*
2. Initial complaint / observations that triggered the facility inspection;
3. Date, time of facility inspection and general description of how inspection was conducted;
4. Facility location notes and data *(e.g. photographs, map location, GPS measurement, surrounding land uses, descriptions of adjacent structures and activities, facility activities, directions of flow to MS4 and streams, etc.);*
5. Visual inspection field notes of discharges *(e.g. flow, color, odor, stains, oils, grease, solvents, leaking storage containers, extent of runoff into MS4, impacts in creek, etc.);*
6. Results of field test kits;
7. Lab sampling information *(e.g. types of bottles filled, date, time, location, sampler's name, preservative, parameter(s) for lab analysis, etc.);*
8. Field records of conversations / interviews *(e.g., with facility owners, managers, supervisors and employers, etc.);*
9. Records of conversations with adjacent land owners, if any;
10. Facility Data Collection Methods *(e.g., records of interviews, sample bottles, labels, field forms, collection methods, preservation methods, sample transport, collection devices, test kits, notes and comments, photos, GPS, etc.).*

III.3 Construction Site Inspections:

1. Routine site visual inspection *(e.g., any evidence of sediment or chemical pollutant runoff, BMP placement and effectiveness, etc.);*
2. Field measurements and notes of pollutant runoff *(e.g., turbidity field tests, photos, visual observation notes, GPS readings, descriptions of observations, locations, date, time, etc.);*
3. Summaries of conversations *(e.g., with site operator, adjacent land owners, site employees, and decisions made).*

III.4 Data and QA Program Management:

1. How data are stored *(e.g., types of paper and computer filing systems, locations of files, how computer data are backed up, etc.);*
2. How data are analyzed *(e.g., computer statistical software, hand calculators, table summaries, graphs, etc.);*
3. How data manipulation is checked and verified *(e.g., second employee review, self-checking of all or a percentage of data entry, comparing to other data, etc.);*
4. How data are reported and to whom *(e.g., individual and groups of citizens, city staff and supervisors, managers and Mayors, City Councils and Commissions, State and Federal agencies, consultants, vendors, the Permitting Authority ODEQ or EPA, etc.);*
5. Restrictions on data access *(e.g., designating a contact for data inquiries, creating a process for data reproduction and distribution, distribution record-keeping, etc.);*
6. Chain of custody of important data *(e.g., samples collected in the field and sent to the lab, records and documents that are taken from the office on loan, etc.);*
7. Storage of records of employee training, certifications, awards, etc.
8. Storage of records of regulatory audits and inspections and corrective actions taken;
9. Standard Operating Procedures (SOPs) for field, facility and construction inspections and monitoring *(e.g., visual inspection methods, chemical sampling methods, use of field test kits, sample labeling and transport, field safety, forms, equipment maintenance, etc.);*
10. Process for receiving information from the public *(e.g., designated city contact, forms, information collected, city response status, city actions taken, etc.);*
11. Chain of command for staff and management decision-making *(e.g., management and supervisory flow-chart, who is responsible for QA authority, who is designated Quality Assurance Officer (QAO), who decides adequacy of data and makes data reporting decisions, etc.).*

III.5 Maintenance and Storage of Equipment:

1. Field gear storage: *(e.g., waders, field test kits, sample bottles, calibration standards, deionized water, repair and replacement supplies, field safety equipment, etc.);*
2. Papers for field and lab *(e.g., field visual inspection forms, sample bottle labels, chain of custody forms, etc.);*
3. Field test kit records: *(e.g., records of calibration of test kits, written history of purchases and repairs, Material Safety Data Sheets, etc.).*

IV. WHAT QA DOES OKR04 REQUIRE

There is only one direct reference to "quality assurance" in OKR04, in Part VI. However, the OKR04 section on "monitoring" and "recordkeeping", while not specifically mentioning QA, nonetheless provides data quality guidance. Verbatim OKR04 text is pasted below in *blue italicized text* with underlines added.

PART VI. STANDARD PERMIT CONDITIONS

PART VI.J PROPER OPERATION AND MAINTANENCE

You must at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by you to achieve compliance with the conditions of this permit and with the conditions of your storm water management program. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. Proper operation and maintenance requires the operation of backup or auxiliary facilities or similar systems, installed by you only when the operation is necessary to achieve compliance with the conditions of the permit.

PART V. MONITORING, RECORD KEEPING, AND REPORTING

PART V.A MONITORING

1. Designing Your Monitoring Program

You must evaluate program compliance, the appropriateness of identified best management practices, and progress toward achieving identified measurable goals. If you discharge to a water of the state for which a TMDL has been approved, you may have additional monitoring requirements under PART III of this permit.

2. Conducting Monitoring

If you plan to conduct monitoring, you are required to comply with the following:

a. Representative monitoring

Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.

b. Laboratory Methods

If laboratory analysis is conducted it must be conducted according to test procedures approved under 40 CFR part 136.

3. Records Of Monitoring information

Monitoring records must include:

a. The date, exact place, and time of sampling or measurements;

b. The name(s) of the individual(s) who performed the sampling or measurements;

c. The date(s) analysis were performed;

d. The names of the individuals who performed the analyses;

e. The analytical techniques or methods used; and

f. The results or observations of such analyses.

4. Discharge Monitoring Report

The reporting of monitoring results may be required, by the Executive Director, to be submitted on a Discharge Monitoring Report (DMR).

PART V.B RECORD KEEPING

1. Retain Records Of All Monitoring Information

Include all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, copies of Discharge Monitoring Reports (DMRs), a copy of the OPDES permit, and records of all data used to complete the NOI for this permit, for a period of at least three years from the date of the sample, measurement, report or application, or for the term of this permit, whichever is longer. This period may be extended by request of the Director at any time.

2. Submit Your Records

Mail your completed DMR reports, if required, to the DEQ along with your annual report. You must retain a description of the Storm Water Management Program required by this permit (including a copy of the permit language) at a location accessible to the Director. You must make your records, including the NOI and the description of the storm water management program, available to the public.

OKR04 also contains a special provision in Part VIII for cities that elect to use the optional construction site provisions for municipally controlled projects. Part VIII requires a Stormwater Pollution Prevention Plan (SWP3) to be written, a portion of which has specific requirements for site inspections. These are presented verbatim below:

PART VIII.B REQUIREMENTS FOR SMALL MS4s THAT ELECT TO ADOPT THE OPTIONAL PERMIT REQUIREMENTS FOR MUNICIPAL CONSTRUCTION ACTIVITIES

13. Contents of Plan

d. Inspections

Qualified personnel (provided or approved by the permittee) shall inspect disturbed areas of the construction site that have not been finally stabilized, areas used for storage of materials that are exposed to precipitation, structural control measures, and locations where vehicles enter or exit the site, at least once every fourteen (14) calendar days and within 24 hours of the end of a storm event of 0.5 inches or greater.

Where sites have been finally or temporarily stabilized, runoff is unlikely due to winter conditions (e.g., site is covered with snow, ice, or frozen ground exists), or during seasonal arid periods in arid areas (areas with an average annual rainfall of 0 to 10 inches) and semi-arid areas (areas with an average annual rainfall of 10 to 20 inches) such inspections shall be conducted at least once every month.

Inspections should at a minimum consist of the following items:

(1) Disturbed areas and areas used for storage of materials that are exposed to precipitation shall be inspected for evidence of, or the potential for, pollutants entering the drainage system. Sediment and erosion control measures identified in the SWP3 shall be observed to ensure that they are operating correctly. Where discharge locations or points are accessible, they shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Where discharge locations are inaccessible, nearby downstream locations shall be inspected to the extent that such inspections are practicable. Locations where vehicles enter or exit the site shall be inspected for evidence of off-site sediment tracking.

(2) Based on the results of the inspection, the SWP3 shall be modified as necessary (e.g., show additional controls on required maps and revise description of required controls to include additional or modified BMPs designed to correct problems identified. Revisions to the SWP3 shall be completed within 7 calendar days following the inspection. If existing BMPs need to be modified or if additional BMPs are necessary, implementation shall be completed before the next anticipated storm event. If implementation before the next anticipated storm event is impracticable, they shall be implemented as soon as practicable.

(3) A report summarizing the scope of the inspection, name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, and major observations relating to the implementation of the SWP3 shall be made and retained as part of the SWP3 for at least three years from the date that the site is finally stabilized. Major observations should include: the location(s) of discharges of sediment or other pollutants from the site; location(s) of BMPs that need to be maintained; location(s) of BMPs that failed to operate as designed or proved inadequate for a particular location; and location(s) where additional BMPs are needed that did not exist at the time of inspection. Reports of actions taken as a result of an inspection shall be retained as part of the Storm Water Pollution Prevention Plan for at least three years from the date that the site is finally stabilized. Such reports shall identify any incidents of non-compliance. Where a report does not identify any incidents of non-compliance, the report shall contain a certification that the facility is in compliance with the Storm Water Pollution Prevention Plan and this permit.

V. LEVELS OF QUALITY ASSURANCE

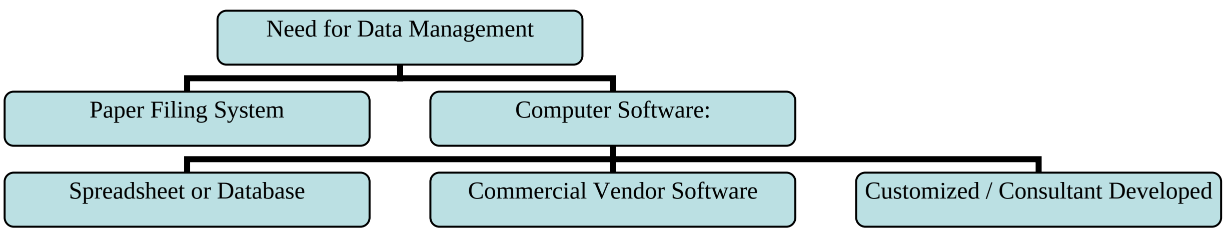
EPA QA/R-2 QMP guidance states that “Implementation of the EPA Quality System is based on the principle of a graded approach. This principle recognizes that a ‘one size fits all’ approach to quality requirements will not work in a [diverse] organization … so managerial controls are applied according to the scope of the program and/or the intended use of the outputs from a process [where] … the purpose or intended use of the data are different. Applying a graded approach means that quality systems for different organizations and programs will vary according to the specific objectives and needs of the organization.”

Judgment is required to determine the best quality assurance procedures most suitable for the various components of the stormwater program. For example, basic public education activities of distributing brochures will not require any QA procedures regarding sampling. A comprehensive QA program will have several levels of QA procedures.

V.1 Basic Written QA Procedures:

While distributing education material may not seem suitable for any QA procedures, it will be beneficial nonetheless to think through how such education data [1] will be processed and identify a specific data management process for compiling education data as well as all data collected under the stormwater program. Several options can be used for compiling stormwater program data:

1. Purchasing commercial software from private vendors designed specifically for stormwater program management and data processing,
2. Creating customized software developed by consultant,
3. Using PC-based spreadsheets or databases, or
4. Simply organizing a paper filing system in an efficient manner.



Consistency is important in order to not lose track of data, and having a staff person dedicated to its upkeep will also prevent data loss. Having written procedures for stormwater data management will be most useful in the event staff are replaced allowing new staff to assume responsibility for a well defined data program.

Other types of stormwater activities that do not need formal QA procedures but would still benefit from having consistent written data management procedures are:

1. Collecting information from the public (e.g. complaints and reports of possible pollution);
2. Tracking employee education and training, including their certifications and licenses;
3. Tracking data concerning public education activities (e.g. Blue Thumb school education events, stream monitoring events and community cleanup events);
4. Employing consistent procedures for dealing with vendors and consultants;
5. Creating standardized reports for staff, management, councils and citizens;

[1] *"Education data" in the case of brochures will consist of the number of brochures distributed, type(s) of brochures, where distributed, and by whom; these will have to be reported in the city's Annual Report, so a consistent means of collecting, summarizing and reporting these data are an important part of the city's QA program.*

6. Defining minimum criteria for requests for proposals and contracts with laboratories, consultants and vendors;
7. Creating and updating Standard Operating Procedures (SOPs) for field work.

V.2 Standard Operating Procedures (SOPs):

Many actions employed in stormwater field work are repeated consistently with every event. For example, the collection of samples for lab analysis should be performed consistently in the same manner every time samples are collected. Field chemical test kits should be used with the same procedures. Having written Standard Operating Procedures (SOPs) for repeatable activities ensures consistency and adds greatly to the defensibility of the data generated by SOP use.

EPA's QA/G-6 SOP Guidance states that: "A Standard Operating Procedure (SOP) is a set of written instructions that document a routine or repetitive activity followed by an organization. The development and use of SOPs are an integral part of a successful quality system as it provides individuals with the information to perform a job properly, and facilitates consistency in the quality and integrity of a product or end result."

The EPA guidance further states that "SOPs detail the work processes that are to be conducted or followed within an organization. They document the way activities are to be performed to facilitate consistent conformance to technical and quality system requirements and to support data quality. SOPs are intended to be specific to the organization or facility whose activities are described and assist that organization to maintain their quality control and quality assurance processes and ensure compliance with governmental regulations. If not written correctly, SOPs are of limited value. In addition, the best written SOPs will fail if they are not followed. Therefore, the use of SOPs needs to be reviewed and re-enforced by management, preferably the direct supervisor. Current copies of the SOPs also need to be readily accessible for reference in the work areas of those individuals actually performing the activity, either in hard copy or electronic format, otherwise SOPs serve little purpose."

The EPA guidance continues with "The development and use of SOPs promotes quality through consistent implementation of a process or procedure within the organization, even if there are temporary or permanent personnel changes. SOPs can be used as a part of a personnel training program, since they should provide detailed work instructions. It minimizes opportunities for miscommunication. When historical data are being evaluated for current use, SOPs can also be valuable for reconstructing project activities when no other references are available. In addition, SOPs are frequently used as checklists by inspectors when auditing procedures. Ultimately, the benefits of a valid SOP are reduced work effort, along with improved data comparability, credibility, and legal defensibility."

The city's finished SOP document will be a collection of many individual SOPs, one for each activity. It is not necessary to follow the EPA guidance to the letter (or any other guidance). In fact, SOPs are usually customized to suit the particular intended uses and for the convenience of the preparer. The EPA QA/G-6 SOP guidance recommends the following general format for preparing SOPs and is presented here as but one of many ways SOPs can be prepared.

An internet search will provide numerous examples of SOPs for most routine stormwater related activities. Appendix A to this guidance is copied from EPA's QA/G-6 SOP guidance as but one example of how a SOP can be prepared. Many SOPs are simpler and still very effective. The following are general SOP content recommendations from EPA QA/G-6:

<u>SOP GENERAL FORMAT</u>
SOPs should be organized to ensure ease and efficiency in use and to be specific to the organization which develops it. There is no one "correct" format; and internal formatting will vary with each organization and with the type of SOP being written. A generalized format is discussed next.

<u>Title Page</u>
The first page or cover page of each SOP should contain the following information: a title that clearly identifies the activity or procedure, a SOP identification (ID) number, date of issue and/or revision, the name of the applicable agency, division, and/or branch to which this SOP applies, and the signatures and signature dates of those individuals who prepared and approved the SOP. Electronic signatures are acceptable for SOPs maintained on a computerized database.

<u>Table of Contents</u>
A Table of Contents is needed for quick reference for locating information and to denote changes or revisions made only to certain sections of a SOP.

<u>Text</u>
Well-written SOPs should first briefly describe the purpose of the work or process, including any regulatory information or standards that are appropriate to the SOP process. Define any specialized or unusual terms either in a separate definition section or in the appropriate discussion section. Then denote the sequential procedures to be followed, divided into significant sections; e.g., equipment needed, personnel qualifications, and safety considerations. Describe next all appropriate QA and quality control (QC) activities for that procedure, and list any cited or significant references.

As noted above, SOPs should be clearly worded so as to be readily understandable by a person knowledgeable with the general concept of the procedure, and the procedures should be written in a format that clearly describes the steps in order. Use of diagrams and flow charts help to break up long sections of text and to briefly summarize a series of steps for the reader. Attach any appropriate information; e.g., a SOP may reference other SOPs. In such a case, the following should be included:

1. Cite the other SOP and attach a copy, or reference where it may be easily located.
2. If the referenced SOP is not to be followed exactly, the required modification should be specified in the SOP at the section where the other SOP is cited.

V.3 Data Quality Objectives (DQOs):

Probably the most important consideration of all stormwater data management is to anticipate and plan for how all of the data will be used. This planning, in effect, sets objectives for and identifies the level of data quality needed for each type of data collection activity. The Data Quality Objectives (DQOs) discussed below are formally established procedures for all environmental data collection and analysis activities. DQOs are especially useful when preparing formal Quality Assurance Project Plans (QAPPs). However, even when QAPPs are not needed, following some type of DQO process in the beginning of a data-rich program (such as the municipal stormwater permit) will help establish an efficient program and identify early on what types of software or other data management systems will be needed to meet program needs.

The DQO process will also help identify what types of training and experience will be needed by data collectors and data managers, what types of reports will be needed, how data will be analyzed and used, and identify data end-users (e.g. consultants, citizens, council members, city managers, State and Federal agencies, supervisors, city technical staff, and for use in audits performed by ODEQ and EPA).

The EPA QA/G-4 DQO guidance recommends a seven step process that leads to a Decision Rule which defines how certain types of environmental data will be used. An example of a stormwater related Decision Rule would be the following: whether or not the sampling data collected by city crews confirms that an illicit discharge has occurred requiring enforcement action. However, most of the data collected under a municipal stormwater program will not have a Decision Rule applicability (e.g., how many school education events were conducted in 2008 or how many brochures were distributed about home fertilizer use).

For most stormwater program activities, the EPA QA/G-4 DQO guidance should be consulted as a general reference as the seven step Decision Rule process will not apply to simply collecting data on quantities that do not result in a decision (e.g., number of employees trained, number of brochures on septic tanks distributed, number of citizen reports taken and acted upon, etc.).

The data collection under the OKR04 permit compliance must serve many purposes:

1. <u>Internal staff and crew reports</u> (e.g., processing of a pollution report should be systematic and thorough; date and time, location, observations, inspection results, cleanup status, etc.);
2. <u>Periodic reports to supervisors and city management</u> (e.g., monthly or quarterly summaries of stormwater staff activities, status of budget expenditures and income, safety issues, man-hours expended in reporting period, inspection results, etc.);
3. <u>Reports to City Councils and Commissions</u> (e.g., summary of stormwater program, how funds were spent, progress in meeting permit requirements, types of activities and actions taken during reporting period, etc.);
4. <u>Data reports to third parties</u> (e.g., requests for technical data and information from citizens, vendors, consultants and agencies);
5. <u>Site-specific data reports for local pollution abatement</u> (e.g., results of inspections sent to a local industry to demonstrate illicit discharge with request for cleanup, submitting data to local business' legal staff to justify why enforcement actions were taken, etc.);
6. <u>Evidence in court proceedings</u> (e.g., provide technical evidence justifying court action against local facility for pollution event that could not be resolved with civil penalties);

7. Stormwater Annual Report to ODEQ (e.g., detailed summary of all actions taken and all data collected during the year, evaluation of BMPs and meeting measurable goals, and what actions will change in the forthcoming year);
8. Producing data during an EPA or ODEQ audit (e.g., details of all activities, measurable goals, quantities of all actions, how and where all records are kept and processed, etc.); and,
9. Data requested by ODEQ under OKR04 city noncompliance (e.g., in the event the city is in noncompliance with its OKR04 permit, the ODEQ may request a variety of program data to re-establish compliance or to assess penalties).

Having an efficient system for compiling and reporting many types of data for various purposes will be enhanced if the end uses of the data (many of which are cited above) are taken into account early in the data collection process. Data management issues and options to consider are:

1. PC software (e.g., spreadsheet, database, GIS-based data systems, etc.);
2. Commercial software packages for stormwater programs;
3. Proprietary, custom-built software;
4. Paper files and filing systems;
5. Developing written directions and procedures for data management activities;
6. Training and skills of data collectors and handlers.

An example of a DQO concept is selecting the type of chemical sampling that will be done in the field. The intended use of the data will drive the choice of test method, collection procedures, sample processing, skills and training of staff, and method of data reporting. For example, an initial Dry Weather Field Screen (DWFS) inspection may initiate the need to use a simple field test kit for chlorine residual as a quick check. Lab analysis will not be required, and the test kit can be rather simple and inexpensive, with simple documentation. Written procedures (preferably in the form of a SOP) will still be beneficial, but if it is determined that the data won't be used in enforcement or court, there is no need to go to a "higher level' of Quality Assurance to increase data defensibility.

Contrast this with a sampling event that must be done for chlorine residual to collect evidence for enforcement against a chronic or recalcitrant polluter. Simple field test kit results taken by minimally skilled staff with no formal training and poor documentation of field activities will not be useable in enforcement proceedings. A preferable level of QA for such cases would be to have field test kits supported by concurrent sample collections for lab analysis, samples processed by a formal Chain of Custody form, consistent field notes and inspection documentation, proper sample preservation and transport, documented and adequate training and experience of field crews, documented data management procedures and a thorough and consistent system for processing data used in enforcement actions.

Both situations will be faced by stormwater cities. Each situation creates its own objective for data quality, dependant upon the intended use of the data. In either case, having written procedures, employee training and data management procedures increases data defensibility and brings credibility to the municipal stormwater program.

V.4 Quality Assurance Project Plan (QAPP):

There will be some types of data collection activities that may be suitable for placing within the context of a Quality Assurance Project Plan (QAPP). While QAPPs are not specifically required for the Phase II program in either the EPA regulations or OKR04, a generic QAPP may be desirable for data collection and management activities that require a high level of defensibility. A QAPP would be particularly suitable for data used in tough enforcement actions that are challenged by technical consultants or submitted in court as evidence.

EPA has developed QAPP guidance (QA/R-5) and also periodically offers certified training for those wishing to prepare QAPPs. While the QAPP cannot be formally approved by EPA or any State agency, having a written QAPP nonetheless provides considerable backbone to data collection efforts. QAPPs should be reviewed and updated every year to keep relevant. The following is background taken from the EPA QA/R-5 guidance.

EPA QA/R-5 guidance states that: "The QA Project Plan [QAPP] integrates all technical and quality aspects of a project, including planning, implementation, and assessment. The purpose of the QA Project Plan is to document planning results for environmental data operations and to provide a project-specific "blueprint" for obtaining the type and quality of environmental data needed for a specific decision or use. The QA Project Plan documents how quality assurance … [procedures] are applied to an environmental data operation to assure that the results obtained are of the type and quality needed and expected. The ultimate success of an environmental program or project depends on the quality of the environmental data collected and used in decision-making, and this may depend significantly on the adequacy of the QA Project Plan and its effective implementation."

The EPA QA/R-5 guidance further describes a "generic QAPP" which will be more appropriate for municipal stormwater programs: "While most QA Project Plans will describe project- or task-specific activities, there may be occasions when a *generic* QA Project Plan may be more appropriate. A generic QA Project Plan addresses the general, common activities of a program that are to be conducted at multiple locations or over a long period of time; for example, it may be useful for a large monitoring program that uses the same methodology at different locations. A generic QA Project Plan describes, in a single document, the information that is not site or time-specific but applies throughout the program. Application-specific information is then added to the approved QA Project Plan as that information becomes known or completely defined."

The EPA QA/R-5 guidance describes the QAPP contents as: "The QA Project Plan must provide sufficient detail to demonstrate that:

- the project technical and quality objectives are identified and agreed upon;
- the intended measurements, data generation, or data acquisition methods are appropriate for achieving project objectives;
- assessment procedures are sufficient for confirming that data of the type and quality needed and expected are obtained; and

- any limitations on the use of the data can be identified and documented.

When planning a data program's QA efforts, the QA activities applied to a project should start with defining:

- the purpose of the environmental data operation (e.g., dry weather field screening, source tracking inspections, baseline monitoring, enforcement, etc.),
- the type of work to be done (e.g., baseline pollutant sampling in streams, sampling outfalls from specific sources for potential enforcement actions,), and
- the intended use of the results (e.g., compliance with local illicit discharge ordinances, documenting existing water quality conditions in local streams,)."

The EPA QA/R-5 guidance provides content details of a formal QAPP. Refer to the guidance for how to address these. A QAPP has four sections or "Groups":

- Project Management (Group A)
- Data Generation and Acquisition (Group B)
- Assessment and Oversight (Group C)
- Data Validation and Usability (Group D)

Each of the four Groups of a QAPP is further divided [2]:

Group A: Project Management

This group of QAPP elements covers the general areas of project management, project history and objectives, and roles and responsibilities of the participants. The following 9 elements ensure that the project's goals are clearly stated, that all participants understand the goals and the approach to be used, and that project planning is documented:

A1 Title and Approval Sheet
A2 Table of Contents and Document Control Format
A3 Distribution List
A4 Project/Task Organization and Schedule
A5 Problem Definition/Background
A6 Project/Task Description
A7 Quality Objectives and Criteria for Measurement Data
A8 Special Training Requirements/Certification
A9 Documentation and Records

- date of event,

[2] *Taken from: "The Technology Acceptance Reciprocity Partnership (TARP) Protocol for Stormwater Best Management Practice Demonstrations" Endorsed by California, Massachusetts, Maryland, New Jersey, Pennsylvania, and Virginia. Final Protocol 8/01, Updated: 7/03.*

- time and duration of the storm event,
- size of the storm event,
- inches of rain and intensity,
- number of days since preceding storm event,
- total volume of runoff treated and volume bypassed,
- time into event and conditions when BMP was bypassed,
- condition of the drainage area prior to and during the event,
- activities being conducted,
- chemicals, materials, equipment, or vehicles stored or handled in drainage area,
- good housekeeping measures implemented prior to event,
- upset, spills, or leaks in drainage area, including the material or chemical,
- construction or maintenance activities in the drainage area, and
- any other information needed to adequately characterize the contributing areas to the BMP.)

Group B: Measurement/Data Acquisition
This group of QAPP elements covers all of the aspects of measurement system design and implementation, ensuring that appropriate methods for sampling, analysis, data handling, and QC are employed and will be thoroughly documented:

B1 Sampling Process Design (Experimental Design)
B2 Sampling Methods Requirements
B3 Sample Handling and Custody Requirements
B4 Analytical Methods Requirements
B5 Quality Control Requirements
B6 Instrument/Equipment Testing, Inspection, and Maintenance Requirements
B7 Instrument Calibration and Frequency
B8 Inspection/Acceptance Requirements for Supplies and Consumables
B9 Data Acquisition Requirements (Non-Direct Measurements)
B10 Data Management

Group C: Assessment/Oversight

The purpose of assessment is to ensure that the QAPP is implemented as prescribed. This group of QAPP elements addresses the activities for assessing the effectiveness of the implementation of the project and the associated QA/QC activities:

C1 Assessments and Response Actions
C2 Reports to Management

Group D: Data Validation and Usability
Implementation of Group D elements ensures that the individual data elements conform to the specified criteria, thus enabling reconciliation with the project's objectives. This group of elements covers the QA activities that occur after the data collection phase of the project has been completed:

D1 Data Review, Validation, and Verification Requirements
D2 Validation and Verification Methods
D3 Reconciliation with Data Quality Objectives

V.5 Quality Management Plan (QMP):

For those wishing to implement the highest level of Quality Assurance, particularly to have an active QAPP, it is recommended that the city prepare a Quality Management Plan (QMP). The QMP documents all of the management activities of the city and staff relating to stormwater data collecting and processing. Like the QAPP, the QMP should be reviewed and amended annually to maintain relevancy to program objectives and actions.

EPA has developed QMP guidance (QA/R-2) and also periodically offers certified training for those wishing to prepare QMPs. While the QMP cannot be formally approved by EPA or any State agency, having a written QMP nonetheless provides considerable backbone to data collection efforts for which a QAPP has been prepared. Passages of QA/R-2 describing the basics of a QMP are presented below.

EPA QA/R-2 guidance states that "a Quality Management Plan documents how an organization structures its quality system and describes its quality policies and procedures, criteria for and areas of application, and roles, responsibilities, and authorities. It also describes an organization's policies and procedures for implementing and assessing the effectiveness of the quality system. … The Quality Management Plan may be viewed as the 'umbrella' document under which individual projects are conducted. The Quality Management Plan is then supported by project specific QA Project Plans."

"A QA Project Plan is the 'blueprint' by which individual projects involving environmental data are implemented and assessed and how specific quality assurance (QA) and quality control (QC) activities will be applied during a particular project. … In some cases, a QA Project Plan and a Quality Management Plan may be combined into a single document that contains both organizational and project-specific elements. … A Quality Management Plan is a management tool that documents an organization's quality system for planning, implementing, documenting, and assessing the effectiveness of activities supporting environmental data operations and other environmental programs."

"The Quality Management Plan must be sufficiently inclusive, explicit, and readable to enable both management and staff to understand the priority which management places on QA and QC activities, the established quality policies and procedures, and their respective quality related roles and responsibilities."

"An organization's senior manager is responsible for assuring the preparation of a Quality Management Plan to cover all environmental programs supported or undertaken by the organization. Senior management, i.e., the executives and managers who are responsible and accountable for mission accomplishment and overall operations of the organization, is responsible for ensuring that the Quality Management Plan is prepared…"

"Each organization shall review its Quality Management Plan at least annually to reconfirm the suitability and effectiveness of the approved quality management practices. The process of developing, annually reviewing, and revising (as needed) the Quality Management Plan provides an opportunity for management and staff to clarify roles and responsibilities, address problem areas, and institutionalize improvements. Having an accurate Quality Management Plan at all times is an essential element in every quality system, thus changes in QA policy and procedures shall be documented in the Quality Management Plan in a timely fashion."

"The Quality Management Plan documents management practices, including QA and QC activities, used to ensure that the results of technical work are of the type and quality needed for their intended use. Accordingly, the Quality Management Plan documents:

- the mission and quality policy of the organization;
- the specific roles, authorities, and responsibilities of management and staff with respect to QA and QC activities;
- the means by which effective communications with personnel actually performing the work are assured;
- the processes used to plan, implement, and assess the work performed;
- the process by which measures of effectiveness for QA and QC activities will be established and how frequently effectiveness will be measured; and
- the continual improvement based on lessons learned from previous experience."

"The Quality Management Plan reflects the organization's commitment to quality management principles and practices, tailored, when appropriate, by senior management to meet the organization's needs."

"The elements to be addressed in a Quality Management Plan include:

- management and organization;
- quality system description;
- personnel qualifications and training;
- procurement of items and services;
- documentation and records;
- computer hardware and software;
- planning;
- implementation of work processes;
- assessment and response; and
- quality improvement."

VI. EMPLOYEE TRAINING / SAFETY

OKR04 requires employee training for several different topics, including proper handling and disposal of chemicals at city facilities, hazards associated with illicit discharges, and prevention and reduction of stormwater pollution from MS4 activities. However, these topics do not specifically address data management, quality assurance, inspections and other data collection activities. Over the next few years, training in Oklahoma will likely be available from private vendors, INCOG, ACOG, ODEQ and other cities.

As discussed in the Section V.3 Formal DQOs, there will likely be different levels of employee training needed, depending upon the stormwater program activity and intended use of the data. It is important to receive documentation of all formal training attained by employees. This will include certificates of attendance, continuing education credits, professional development hours, course completion certificates, and awards and acknowledgements. It is advisable to keep such records in a central location and to keep an overall tracking record with periodic renewals required so that training won't lapse.

VI.1 Employee Training:

For the first few years of the stormwater program, there will be great interest in the following employee training topics:

1. How to conduct visual screening and source tracking inspections;
2. How to collect and process field samples for lab analysis;
3. What types of field equipment will be needed for screening and enforcement inspections;
4. What are the safety considerations and training for use of field chemical test kits;
5. What to look for to identify illicit discharges;
6. State and Federal regulations and local codes regarding private property access;
7. Water quality impacts of illicit discharges;
8. How to develop and use field data and field QA forms;
9. How to identify potentially dangerous field conditions;
10. What types of safety gear and practices need to be deployed and for what circumstances;
11. How to conduct interviews of citizens and facility managers and personnel;
12. What kinds of city documentation and credentials should be taken to the field;
13. How to inspect construction sites;
14. How to inspect commercial and industrial facilities;
15. How to negotiate with owners of pollution sources prior to taking enforcement action;
16. When to transition from initial screening inspection to enforcement investigation;
17. When to notify supervisors from the field that third party inspectors and investigators should be deployed; and
18. When to contact local or regional HAZMAT units for hazardous materials cleanup.

VI.2 Field Safety:

Field safety is paramount, and it is essential that not only proper training be provided to all field crews, but that documentation of the training be maintained. Safety equipment will need to be purchased. Each municipal permittee will judge the types of safety gear and practices needed for field crews, but some common items to consider are:

1. Eye goggles and latex or nitrile disposable gloves;
2. Protective clothing such as long sleeve shirts, blue jeans and work boots;
3. Hip or chest waders for deep water;
4. Employee hiring requirements for a high level of physical fitness;
5. Vehicle traffic cones, flashing lights and road flagging;
6. Personal orange vests;
7. Eye wash kit and emergency first aid kit;
8. Bottle of water, soap and towels for emergency washing;
9. Proper maintenance of field gear and supplies;
10. Adequate training of equipment use, updated periodically;
11. Sufficient city identification for field crews to clearly establish authority;

VII. QUALITY ASSURANCE ADMINISTRATION

Like any other municipal program involving a variety of activities by many employees, adequate program management ensures efficiency and minimizes costs. For more formal QA programs, it is advisable to appoint one employee who will be responsible for QA decision-making. This person is called a Quality Assurance Officer (QAO). For stormwater programs not requiring a high level of QA management (e.g., where a QAPP or QMP is not required), it is still beneficial to have a staff person designated as a QAO to help implement QA procedures across different activities and departments.

VII.1 Role of the Quality Assurance Officer:

The QAO will have specific authority to make decisions affecting the collection, transfer, analysis, storage and reporting of stormwater data. This responsibility will usually reach across more than one city department. For example, the QAO may place requirements on the actions of field personnel within a public works department as well as data entry staff within an engineering department. The QA Officer's role is not to act as a staff manager or supervisor, but rather to have the authority over certain actions of personnel within different municipal departments regarding specific stormwater related tasks. Formal QAPPs require that a staff person be designated as the QAO for all activities within the context of the QAPP.

VII.2 Lab Services:

It is essential that all lab services be performed by a laboratory certified by ODEQ for the parameters requested, and that the lab use methods in 40 CFR Part 136 or otherwise acceptable by ODEQ in their lab certification program. Appendix B contains a list of laboratories certified by ODEQ as of 2006 .

There are three types of laboratory services: commercial (private) labs, city labs, and government agency labs. Private labs can be found with searches on the internet, from customer recommendations or advertisements, and searching telephone directories. Every city that operates its own water and/or wastewater treatment plant has at least some level of laboratory or testing capability ranging from field test kits to certified lab facilities in buildings performing a variety of lab tests. Government agency labs are fewer, but in Oklahoma they are very reliable.

Part of the DQO process is to identify parameters that will require a high degree of analytical performance that cannot be achieved by field test kits thus requiring laboratory analysis. Once the lab parameters have been identified, a stormwater city should seek lab services that will provide the level of testing at the most reasonable cost and effort.

Many samples have very short "holding times", i.e., the time from initial collection to lab analysis that cannot be exceeded by a specified number of hours, days or months. 40 CFR Part 136 methods used by ODEQ certified labs (Appendix B) provide requirements for collection bottle types, preservatives, and holding times. Lab selection should consider the effort needed to meet holding times regarding travel time from the field to the lab delivery.

Most labs now provide properly cleaned sampling bottles and field preservatives. However, when soliciting lab services, it is essential that the stormwater city specify clearly the sample and analytical requirements of their program.

VII.3 Lab Contracts:

When soliciting laboratory services, consider using a written agreement that contains specific project information and technical requirements such as the following:

1. Responsible parties in the agreement (city and lab names);
2. Purpose of the study or sampling program;
3. Start and end dates of the sampling program and lab services agreement;
4. Parameters to be analyzed;
5. Types of sample containers for each parameter;
6. Volumes of sample required by the lab for each test;
7. Approximate numbers of samples of each parameter expected to be collected during the agreement period;
8. Unit cost of each parameter;
9. Expectations of reporting of the internal QA samples analyzed by lab (e.g., lab duplicates, lab spikes, lab blanks, lab performance audits);
10. Copy of the laboratory's certifications from ODEQ for contract parameters;
11. Lab methods to be used for each parameter;
12. Which party will supply bottles, preservatives and transport containers;
13. Reporting of results to at least two significant figures;

14. The units expected for each parameter (e.g., micrograms per liter, ug/L);
15. How lab errors, lost samples or other analytical problems will be reported to the city and resolved;
16. Time from initial sample delivery to final report of analytical results;
17. Payment method and invoice processing timeframe; and
18. How the lab contract can be extended or modified by mutual written agreement.

Even if a formal contract agreement is not required, the city should consider the above conditions in obtaining successful laboratory services and lab data.

VIII. FIELD MEASUREMENTS AND TEST KITS

The OKR04 General Permit for small MS4 stormwater dischargers does not specify types of field test kits to use, nor any types of field measurements to make when performing dry weather field screening (DWFS) or source tracking inspections (STIs). Each city will develop an inspection program to suit its own unique circumstances and conditions. The following are examples of the more common methods for field testing and measurements. These are provided as examples, and others may also be used. Once a stormwater city has decided upon the field testing and measurement methods, SOPs should be developed for each procedure, and employee training on use and safety considerations should be performed and updated as needed.

The field test kits and field measuring devices most easy to use often have the least accuracy and sensitivity. They are the least expensive, but usefulness of the data are usually limited to "spot-checking" to indicate when more rigorous sampling will be required. "Screening" tests from these simple and inexpensive field test kits are an important part of an illicit detection program. However, the data are usually insufficient for more rigorous use, such as in justifying costly enforcement actions or for use as evidence in court proceedings or other legal challenges to data quality.

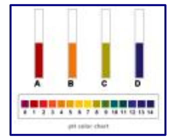
VIII.1 Field Test Kits:

Field test kits are portable supplies housed in a small container (e.g., a plastic box) having all items necessary to perform the test. For example, a field test kit for chlorine residual will contain the glassware, chemicals and instructions for performing the test with enough chemical reagents to perform 50 to 100 tests. There are also multi-parameter kits available, and several of the leading suppliers will custom-build a multi-parameter kit. This would be especially desirable for a regional program coordinated by one entity between adjacent cities so that all cities use the same test kit for the same parameters. EPA publishes examples of field test kits for stormwater, and there are a number of commercial or nonprofit organizations that also recommend one or more field tests that will benefit DWFS and STI inspection programs.

Field test kits come in several different forms, such as:

1. Comparator test kits with glassware, chemicals and devices to analyze color changes by mixing powders or liquids into the water sample and comparing

a color change to a chart or "color wheel", usually with a darker color indicating a higher concentration;



2. Bottles of test strips (small pieces of plastic or paper impregnated with a dry chemical that changes color in the presence of a specific parameter such as lead);
3. Titration devices that require the water sample to be mixed with chemicals then a final chemical is added from a special device (titrator) that delivers a specific amount of chemical until a color change is observed);

4. Colorimeters that require a water sample to be mixed with chemicals and then placed into the chamber of a device that shines a specific wavelength of light through the sample to read the absorbance of the sample, with a stronger absorbance indicating a greater concentration of pollutant being tested; and

5. Turbidimeters in which a water sample is placed inside a clean tube which is placed into the device that measures the amount of light reflected by suspended particles in the water, with the greater reflection indicating greater turbidity.

EPA regulations for Phase I cities require specific tests to be performed for their DWFS program, however, the Phase II regulations do not require specific tests. The following are examples of field tests that rely on chemical reactions to reveal parameter concentrations which in turn can provide insight into potential illicit discharges of pollutants:

- chlorine residual
- total phenols
- ammonia nitrogen
- color
- BTEX (benzene, toluene, ethylbenzene and xylene – associated with petroleum)
- TPH (total petroleum hydrocarbons)
- copper
- lead
- zinc
- total nitrogen
- total phosphorus
- MBAS (Methylene blue-activated substances – a test for presence of detergents)
- cyanide
- hardness

VIII.2 Field Measurements:

Field measurements are made with devices or other procedures that read the parameter concentration directly without the need for chemical reactions. Many devices can be purchased that will meet 40 CFR Part 136 methods (e.g., for pH, dissolved oxygen and conductivity) or are otherwise of sufficient reliability to produce data for enforcement. There are several types of field measurement systems that can be used, with the more sophisticated being the most costly but also providing the greatest data defensibility. Other devices are so simple that they are only useable as a simple screening tool.

1. Test pens – simple devices that have a probe on one end with a digital readout on the other, useful as a screening test (e.g., pH, conductivity);

2. Single-parameter meters – devices with a digital readout screen and a small probe attached via a short cable, useful for quick reading of a single parameter (e.g., dissolved oxygen, pH, conductivity) with the more costly producing very reliable data;

3. Multi-parameter meters – devices that have a digital readout with a "multi-probe" (often called a "sonde" – pronounced like "pond") attached via cable and capable of reading several parameters simultaneously (e.g., temperature, dissolved oxygen, pH, conductivity). These devices are more costly and provide very reliable data.

4. Field fluorometers – devices that cause a water sample to give off a certain color of light (fluoresce) when illuminated in a chamber, with the greater fluorescence being caused by higher concentrations of the chemical tested for (e.g., optical brighteners, algal chlorophyll, etc.);

5. Turbidimeters – Devices that measure the scattering of light from a water sample placed in a chamber, turbidity being a measure of the amount of particles in the water, usually from sediment runoff;

6. Flow meters – Devices that measure the velocity of water past the probe, normally either a ring of spinning cups or a magnetic probe shaped like an egg. When combined with measurements of width and depth, discharge can be calculated (cubic feet / second). Knowing discharge and concentration, mass loads (as lbs/day) can be calculated.

Parameters that are usually measured directly by these devices are:

- pH (single or multi-probe meter)
- Dissolved oxygen (single or multi-probe meter)
- Temperature (single or multi-probe meter)
- Conductivity (single or multi-probe meter, with many devices reading also as total dissolved solids – TDS and/or salinity)
- Turbidity (turbidimeters)

- Optical brighteners from detergents (portable fluorometer)
- Velocity (flow meter or timed float of an object, used to calculate discharge)

VIII.3 Field Observations:

An integral part of a field inspection program is recording visual observations of site conditions. EPA has developed guidance as have many other agencies and organizations. Field observations are easily recorded on a 1-2 page field form, and the data can be entered later into a computer database or spreadsheet for analysis and reporting.

Portable electronic devices such as personal data assistants (PDAs), laptops and tablet PCs can be used directly in the field to enter data electronically without the need for paper forms. However, many of these devices are not designed for rugged field use, and the rugged ones cost considerably more to purchase. Special field data collection programs can be purchased or written that use drop down text boxes or other tools for easy and consistent data entry (e.g., "water color" would have choices such as: no color, tan, green, brown, red, black, etc.).

Typical field observations useful in a stormwater inspection are:

- Water velocity (estimated by timing a floating object);
- Width and depth of a cross-section of stream or pool of water;
- Color of water;
- Color of stream banks especially stains or discolorations;
- Odors of the water;
- Odors within the vicinity;
- Excessive algae growth;
- Dead or dying vegetation by stream channel or next to a potential source;
- Trash or debris (floating small items as well as large objects);
- Dead animals;
- Lawn clippings or other yard materials (e.g., bags of leaves);
- Car batteries, appliances, other identifiable home items;
- Unidentifiable barrels or other containers with indeterminate markings;
- Oily sheen on water surface;
- Excess buildup of silt, sediment, dirt or other fine particles;
- Opacity of water (turbidity due to suspended particulates such as silt);
- Foam or suds;
- Types and descriptions of adjacent land uses;
- Descriptions of adjacent and upstream facilities, residences or other potential sources of pollution;
- Interviews and comments from neighbors and adjacent landowners and facility staff;

IX. SAMPLE COLLECTION AND PROCESSING

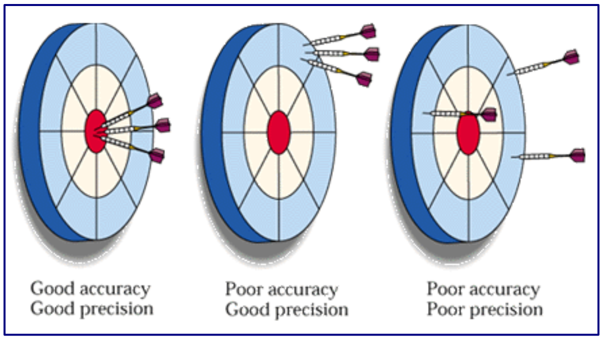
When laboratory analyses are required, samples must be collected from the field and transported to the lab in a manner that ensures parameter integrity and no contamination. Lab analyses are very sensitive (i.e., they can detect the parameter at very low concentrations), so the slightest contamination during collection or transport will be measured at the lab as a false positive result. There are a number of precautions that must be taken to minimize sample contamination. Since lab analyses will normally be performed only when needed for enforcement actions or for evidence in court proceedings, the city's desire for data integrity will be very high.

IX.1 Sample Integrity:

Knowing what, when and where to sample require as much consideration and planning as does knowing how to sample. Samples must be collected in a planned and consistent manner so that the resulting data are useable. The following concepts apply to sampling. Precision and accuracy are not the same thing. A lab can have good precision but be inaccurate at the same time. Precision measures how close multiple readings are to each other, while accuracy measures how close a single reading is to the true value.

Precision

Precision is a measure of how close together are multiple readings of the same sample (analysis of replicates). If two or more readings from a field instrument, or two or more chemical tests are performed, on the same sample then precision can be determined. If the readings or measurements are very far apart, then it indicates that the measurement process likely has error and the data are not reliable. There are formal statistical tests to quantify precision, but best judgment is also reliable when collecting data in the field. Laboratories employ rigid statistical procedures to track precision of all analytical tests. In more formal analytical and monitoring programs, especially where data integrity requirements are high, poor precision may lead to rejection of analytical and measurement results.



Accuracy

Accuracy refers to how close a single measurement, or an average of multiple measurements, is to the true value. Since environmental samples have no known concentrations of the measured parameter, accuracy cannot be determined from "unknown samples". Rather, tests for accuracy are performed on specially prepared "control samples" from EPA or other sources that provide "known samples" for testing of accuracy. Many field and lab instruments can be "calibrated", that is, adjustments to the internal reading processes can be made, so that the instrument reading a "calibration standard" will measure the true concentration. An example is calibrating a pH meter using calibration standards of 7.0 and 10.0 pH units. Calibration of instruments is an important means to frequently modify the instrument so that it will perform with greater accuracy. Laboratories also measure known samples periodically and use the results to determine if the regular samples are acceptable.

Representativeness
Samples should be collected in a time and location that represents the conditions to which the data will be applied. For example, sampling downstream of a potential industrial pollution source will be ineffective if the sampling location is too far downstream and thus also includes runoff from other sources, or if the sample is collected the day after the runoff event has ceased. The sample must represent the purpose for which it is intended.

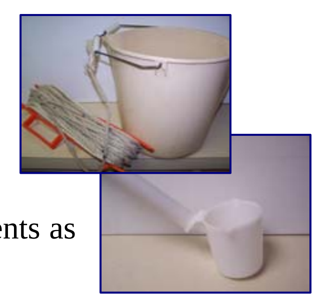
Completeness
Completeness refers to the number of successful samples collected and measurements made with respect to the numbers desired and attempted. For example, if monthly sampling of a site is designated necessary but only three samples were collected, then the sampling set is incomplete. A formal QA program will set "percent completeness" goals for various sampling activities. For example, a dry weather field screen program may require 20 locations per year to be inspected. If only 17 of the 20 were inspected, then completeness was 17/20 = 85%. If the completeness goal was 90%, then the city did not meet the goal. Either the goal needs to be modified for future sampling, or additional samples must be collected in the future.

Comparability
Comparability refers to how well the data can be used (i.e., compared) to data from the same stream between different sampling locations, or between different periods of time, or to other streams for the purpose of comparing and contrasting similar or different conditions. Comparability requires the use of standardized field and analytical methods, reporting of units, site selection, and many other QA considerations. For example, it is inappropriate to compare ammonia test results between a simple field test strip and a laboratory analysis of ammonia.

IX.2 Sample Collection:
Improper sample collection is the most common source of contamination and data error. Proper collection procedures must include:

1. Use of approved collection bottles;
2. Sufficient volume for lab analysis (the laboratory will state the volume required);
3. Ensuring proper bottle decontamination;
4. Use of adequate water and sediment collection devices;
5. Ensuring proper decontamination of collection devices;
6. Uncontaminated transport of bottles and sampling devices to the site; and
7. Decontaminating sampling devices in the field between sites.

Sampling Devices
Sampling devices are specialized gear to collect water samples from which the water is poured into sample bottles for preservation and transport to a lab for analysis or for supplying water for field measurements. Simple plastic buckets with attached ropes can be lowered into a stream from a bridge to collect water for field measurements as



well as filling sample collection bottles for the lab. Dippers and other types of water samplers on long poles can also be used to collect samples.

There are other, more sophisticated sampling devices and methods, but these will not be necessary for a routine Phase II stormwater inspection program. Numerous internet resources can provide additional sampling information on sample splitters, depth integrated sampling, automatic samplers and other methods for specialized requirements.

Decontamination

Care must be taken to decontaminate the collection devices prior to sampling and between each site so that cross-contamination between sites is avoided. Sampling devices must also be transported into the field, and between sites, in a manner that will not cause contamination. Most commonly this will involve field cleaning and wrapping the sampling device in large polyethylene plastic bags to prevent dust, dirt, water or other materials from touching the device.

Field decontamination can be as simple as rinsing a bucket three times with the water to be sampled prior to collecting the sample, or as difficult as acid-rinsing in the field with 50% nitric acid followed by three to five rinsings with deionized water. Acids and other waste water containing chemicals (acids, reagents, etc.) should not be thrown on the ground. Rather, a waste container should be taken to the field. Also, bucket rinsings should not be placed into the water to be sampled.

Having formal written procedures for protecting and using sampling devices adds to data integrity. These methods are also required to be specified in a formal QAPP. There are numerous internet and EPA document resources on proper field sampling methods.

IX.3 Sample Preservation and Holding Times:

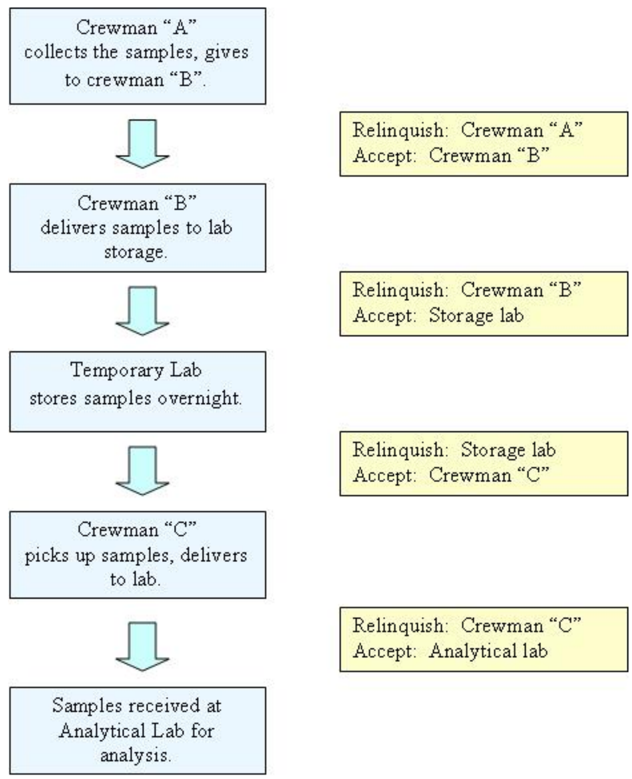
Samples that are collected in the field and transported to a laboratory for analysis must be preserved in very specific ways. All analytical methods listed in 40 CFR Part 136 have specific preservation requirements as well as how long a preserved sample can be stored prior to analysis. Most laboratories now provide properly cleaned collection bottles, either containing the correct amount of preservative, or with a small bottle of preservative which must be added via eyedropper in the field to each sample bottle by the field crew.

Preservation of samples involves use of appropriate bottle material (e.g., glass, plastic, Teflon, etc.), that has been properly cleaned (i.e., decontaminated) to EPA standards, and to which small amounts of preservative have been added (e.g., sulfuric acid, nitric acid, sodium hydroxide, etc.). Holding times range anywhere from 6 – 24 hours for bacteria samples to 6 months for metals samples. In addition, many samples from the field must be iced to <4 ^{o}C while in the field and kept in cold storage at the lab.

Failure to meet preservation and holding time requirements will be cause to reject all analytical data. The laboratory may also reject the samples at time of delivery, or at least submit written caveats with the data indicating that the samples were not adequately preserved at time of delivery or that the holding times were exceeded. Data under these conditions have little value.

IX.4 Chain of Custody and Sample Transport:

All samples collected in the field for transport to a laboratory directly, or to a temporary storage for later lab transport, must be accompanied by a formal Chain of Custody (COC). Appendix C has an example of such a form, and there are numerous examples found in guidance from EPA and other environmental agencies. The purpose of the COC is to document "ownership" of the sample(s) from time of initial collection to final delivery to the laboratory. If "ownership" is transferred along the way then each "owner" must sign for acceptance and relinquishing.



For example, city crewman "A" collects three sample bottles in the field, preserves them, and delivers them to city crewman "B" who takes the samples to another city's laboratory for temporary storage. The next day, city crewman "C" picks up the samples and delivers them to the laboratory. There were a total of five "owners" of the three samples (crewman "A", crewman "B", the intermediate lab, crewman "C" and the final analytical lab. Each owner must sign the Chain of Custody form.

All samples must be labeled properly to indicate the date and time of collection, site identification, and ownership. The following items are typically placed on a separate label on each sample bottle:

- City name
- Sample date and time
- Site name and code number
- Preservative
- Names of field crew members
- Parameter(s)

City of Sand Springs
November 11, 2006
Polecat Creek PC-3
HNO_3 at 4 ^oC
Joe Smith / Bob Jones
Metals (lead, copper, zinc, cadmium)

EXAMPLE

IX.5 QA/QC Samples for Field and Lab:

In addition to the samples to be collected and the field measurements to be made, it is recommended that additional types of samples be collected that will increase the value and defensibility of the data. These special types of samples and measurements are called Quality Control (QC) samples. The analytical laboratory that performs sample analysis will employ QC analysis as required for continued lab certification from ODEQ. Field sampling and measurements have similar QC requirements. There are many types of QC samples that can be performed, but the most common are: duplicates, blanks, spikes, splits and performance (check) samples.

The lab's analytical report may include QC sample results of these. Therefore, it is important to know what they mean and how to interpret the QC results. A formal QAPP will set quantitative requirements, such as 90% to 110% range for analyte (parameter being tested) spike recovery, or results within 80% on inter-laboratory split sampling. Limits such as these define the level of data integrity set by the city and as needed for the local stormwater program.

Obviously, having to analyze additional samples and making extra measurements in the field adds to the time and cost of a monitoring program. A thorough QA/QC program will typically add 20% to the costs of data generation, not only for added time and lab costs of QC data generation, but staff time to interpret and track QC results, and resolve problems made aware by QC tests. The benefit is that the data that survives QA/QC scrutiny is very defensible.

For large batch runs at a lab with dozens of samples, QC samples are typically run with every 10 or 20 samples (analytical frequency of 10% or 5%, respectively). For field QC there are many variations on definitions and terminology, so the terms used herein are the most basic and common. Consult QA guidance from EPA and other environmental agencies for a more thorough descriptions of QA/QC.

It is important to decide up front, through the Data Quality Objectives (DQO) process, what level of data quality will be required for various aspects of the stormwater program. Certainly not all field efforts will require the same level of QA/QC, but some monitoring and inspection results may need full QA/QC application. The DQO process helps to sort out what will be needed. The following table summarizes each of the QC types.

QC SAMPLE	DESCRIPTION	PURPOSE	COMMENTS
Field Blank	Lab-pure "DI" water [3] placed in sample collection bottle and transported to the lab.	Positive result indicates contamination from either field handling or lab analytical process.	Bottle can be either filled before the sampling event and carried into the field unopened ("trip blank") or the DI water taken to the field in a separate container and poured into the collection bottle in the field.
Field Dupe	A second sample (duplicate) is collected in the field from the same location, in the same manner, at the same time as the regular sample. Also applies to a duplicate reading of a field instrument.	Results indicate precision – how close replicate sampling results are to each other.	Dupes can be from the same water in the sample collection device, or separate samples are collected from the stream.
Field Split	Replicate samples collected in the field are sent to different labs.	To be able to compare analytical results between 2 or more labs.	Not frequently done, and usually only when laboratory methods or problems need investigating.

[3] *Laboratory pure water is deionized (DI) and/or distilled and frequently filtered water that is made and supplied by a laboratory to be free of contamination of the parameter(s) being analyzed.*

QC SAMPLE	DESCRIPTION	PURPOSE	COMMENTS
Field Spike	Either a blank or an environmental sample has a small but known amount of analyte added.	Percent recovery of the spike analyte(s) indicates a lab's accuracy, with matrix spikes also indicating the ability to overcome analytical interference.	Not normally done due to difficulty of performing the "spiking" procedures in the field. Can spike a "blank" sample or an environmental sample ("matrix spike").
Field Check	Sample of known concentra-tion, transported to the field in a separate container, is either measured in the field or placed in a sample bottle for lab analysis.	Results indicate accuracy of field measurements or accuracy of lab analysis, and it also can indicate potential contamination of the sampling or measurement process.	Not normally done as accuracy is addressed in other QC tests.
Lab Blank	Lab pure water sample processed by the lab along with all other samples.	Positive result indicates contamination from lab analytical process.	Essential lab test of contamination of glassware, sample processing and analytical methods.
Lab Dupe	A separate sample is processed from the same sample bottle.	Results indicate precision – how close replicate analytical results are to each other.	Essential lab test of precision; how multiple tests of the same sample compare to each other.
Lab Split	The lab sends a separate sub-sample to a different lab.	To be able to compare analytical results between 2 or more labs.	Not frequently done, and usually only when laboratory methods or problems need investigating.
Lab Spike	The lab mixes into a regular sample or a blank a known concentration of one or more analytes to determine recovery effectiveness.	Percent recovery of the spike analyte(s) indicates a lab's accuracy, with matrix spikes also indicating the ability to overcome analytical interference.	Essential lab test of accuracy; both blank spikes and matrix spikes are normally run by the lab as part of their internal QA/QC.
Lab Check	The lab processes a sample containing one or more analytes of known concentration.	Results indicate degree of accuracy of analytical methods through the entire sample processing sequence.	Essential lab test of accuracy; there are various names for this test, and the sample can be known to the analyst or unknown (blind).

X. QA GUIDANCE AND REFERENCES

ANSI/ASQC E4-1994, *Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs*. 1994. American Society for Quality. Milwaukee, Wisconsin.

ASTM D 5172-91 (1999), *Standard Guide for Documenting the Standard Operating Procedures*

Used for the Analysis of Water. 2000. American Society for Testing and Materials. West Conshohocken, Pennsylvania.

Center for Watershed Protection, 2004. *Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments.* Center for Watershed Protection, Ellicott City, MD.

Pitt R., D. Barbe, D. Adrian, and R. Field, 1992. *Investigation of Inappropriate Pollutant Entries into Storm Drainage Systems-A Users Guide*. U.S. EPA, Edison, NJ.

U.S. Environmental Protection Agency, 2001a. *EPA Requirements for Quality Assurance Project Plans (QA/R-5),* EPA/240/B-01/003, Office of Environmental Information.

U.S. Environmental Protection Agency, 2001b. *EPA Requirements for Quality Management Plans (QA/R-2),* EPA/240/B-01/002, Office of Environmental Information.

U.S. Environmental Protection Agency, 2000. *EPA Quality Manual for Environmental Programs (EPA Manual 5360 A1).*

U.S. Environmental Protection Agency, 2000a. *Guidance for Data Quality Assessment: Practical Methods for Data Analysis (QA/G-9)*, EPA/600/R-96/084, Office of Environmental Information.

U.S. Environmental Protection Agency, 2000b. *Guidance for the Data Quality Objectives Process (QA/G-4)*, EPA/600/R-96/055, Office of Environmental Information.

EPA Test Methods Website: http://www.epa.gov/epahome/index/nameindx.htm

EPA BMP Database Website: http://www.bmpdatabase.org/

EPA Region VI Stormwater Website: http://www.epa.gov/earth1r6/6wq/npdes/sw/index.htm

ODEQ Stormwater Website: http://www.deq.state.ok.us/WQDnew/stormwater/index.html

XI. DEFINITIONS AND TERMS

Units

mg/L milligrams per liter, approximately parts per million.

ug/L micrograms per liter, approximately parts per billion.

lbs/d pounds per day (a measure of pollutant loadings).

cfs cubic feet per second (a measure of “discharge”)

fps feet per second (a measure of velocity of flowing water)

Definitions

The following definitions (except analyte) are taken verbatim from either ODEQ's OKR04 stormwater general permit for small MS4s or from EPA regulations for NPDES (40 CFR Part 122.2) or from the Oklahoma Water Quality Standards (OS Title 785:45).

Analyte, a parameter being measured in an analytical test, such as copper or ammonia.

Best Management Practices ("BMPs") means schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of "waters of the United States." BMPs also include treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

Clean Water Act ("CWA" formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972) Public Law 92-500, as amended by Public Law 95-217, Public Law 95-576, Public Law 96-483 and Public Law 97-117, 33 U.S.C. 1251 *et seq*

Construction Site Operator means the party or parties that meet one or more of the following descriptions:

(1) Has operational control over construction plans and specifications, including the ability to make modifications to those plans and specifications or;

(2) Has day-to-day operational control of those activities at a project that are necessary to ensure compliance with a Storm Water Pollution Prevention Plan for the site or other permit conditions (e.g., they are authorized to direct workers at a site to carry out activities required by the SWP3 or comply with other permit conditions).

Discharge, when used without a qualifier, refers to "discharge of a pollutant" as defined at 40 CFR §122.2. Also, with respect to flow as cubic feet per second, used to calculate discharge loadings in pounds per day using: conc. (mg/L) x 8.34 x discharge (cfs)

Hazardous Substance means any substance designated under 40 CFR part 116 pursuant to section 311 of CWA.

Illicit Connection means any man-made conveyance connecting an illicit discharge directly to a municipal separate storm sewer.

Illicit Discharge is defined at 40 CFR §122.26(b)(2) and refers to any discharge to a municipal separate storm sewer that is not entirely composed of storm water, except discharges authorized under an OPDES or NPDES permit (other than the OPDES permit for discharges from the MS4) and discharges resulting from fire fighting activities.

Load is a term for amount of a substance introduced into the environment in lbs/d, calculated using discharge and substance concentration: conc. (mg/L) x 8.34 x discharge (cfs).

MEP is an acronym for "Maximum Extent Practicable," the technology-based discharge standard for Municipal Separate Storm Sewer Systems to reduce pollutants in storm water discharges that was established by CWA §402(p). A discussion of MEP as it applies to MS4s is found at 40 CFR § 122.34.

MS4 is an acronym for "Municipal Separate Storm Sewer System" and is used to refer to either a Large, Medium, or Small Municipal Separate Storm Sewer System. The term is used to refer to either the system operated by a single entity or a group of systems within an area that are operated by multiple entities (e.g., the Oklahoma City MS4 includes MS4s operated by Oklahoma City, the Oklahoma Department of Transportation, and others).

Municipal Separate Storm Sewer System is defined at 40 CFR § 122.26(b)(8) and means a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains): (i) Owned or operated by a state, city, town, borough, county, parish, district, association, or other public body (created by or pursuant to State law) having jurisdiction over disposal of sewage, industrial wastes, storm water, or other wastes, including special districts under State law such as a sewer district, flood control district or drainage district, or similar entity, or an Indian tribe or an authorized Indian tribal organization, or a designated and approved management agency under section 208 of the CWA that discharges to waters of the United States; (ii) Designed or used for collecting or conveying storm water; (iii) Which is not a combined sewer; and (iv) Which is not part of a Publicly Owned Treatment Works (POTW) as defined at 40 CFR §122.2.

National Pollutant Discharge Elimination System (NPDES) means the national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of CWA. The term includes an "approved program."

Storm Water is defined at 40 CFR §122.26(b)(13) and means storm water runoff, snow melt runoff, and surface runoff and drainage.

Storm Water Management Program (SWMP) refers to a comprehensive program to manage the quality of storm water discharged from the municipal separate storm sewer system.

Waters of the state means all streams, lakes, ponds, marshes, watercourses, waterways, wells, springs, irrigation systems, drainage systems, and all other bodies or accumulations of water, surface and underground, natural or artificial, public or private, which are contained within, flow through, or border upon this State or any portion thereof.

Waters of the United States or waters of the U.S. means:

(a) All waters which are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;

(b) All interstate waters, including interstate "wetlands;"

(c) All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, "wetlands," sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds the use, degradation, or destruction of which would affect or could affect interstate or foreign commerce including any such waters:

(1) Which are or could be used by interstate or foreign travelers for recreational or other purposes;

(2) From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or

(3) Which are used or could be used for industrial purposes by industries in interstate commerce;

(d) All impoundments of waters otherwise defined as waters of the United States under this definition;

(e) Tributaries of waters identified in paragraphs (a) through (d) of this definition;

(f) The territorial sea; and

Terms

BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
COC	Chain of Custody form
CWA	Clean Water Act (Federal Water Pollution Control Act)
DEQ	Department of Environmental Quality, also ODEQ
DI	Deionized water, considered analyte free
DMR	Discharge Monitoring Report
DO	Dissolved Oxygen
DQO	Data Quality Objectives
DWFS	Dry Weather Field Screening
GIS	Geographic Information System
MBAS	Methylene Blue-Activated Substances (detergent test)
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
ODEQ	Oklahoma Department of Environmental Quality
OPDES	Oklahoma Pollutant Discharge Elimination System
pH	Negative log of the hydrogen ion concentration
QA	Quality Assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
QMP	Quality Management Plan
SOP	Standard Operating Procedure
STI	Source Tracking Inspection
SWMP	Storm Water Management Program
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
TPH	Total Petroleum Hydrocarbons
TSS	Total Suspended Solids

APPENDIX A

EPA QA/G-6 EXAMPLE OF SOP FOR COLLECTING WATER SAMPLES

STANDARD OPERATING PROCEDURE
FOR SURFACE WATER SAMPLING
DRAFT EXAMPLE - DO NOT QUOTE OR CITE

Prepared by: ____ Date:_____________
Environmental Engineer

Reviewed by: ____ Date:_____________
Monitoring Section Chief

Approved by: ____ Date: _____________
Quality Assurance Officer

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION XI

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PROCEDURES

1.0 Scope & Application

1.1 This Standard Operating Procedure is applicable to the collection of representative aqueous samples from streams, rivers, lakes, ponds, lagoons, and surface impoundments. It includes samples collected from depth, as well as samples collected from the surface.

2.0 Summary of Method

2.1 Sampling situations vary widely and therefore no universal sampling procedure can be recommended. However, sampling of liquids from the above mentioned sources is generally accomplished through the use of one of the following samplers or techniques:

- Kemmerer bottle
- bacon bomb sampler
- dip sampler
- direct method

2.2 These sampling techniques will allow for the collection of representative samples from the majority of surface waters and impoundments encountered.

3.0 Health and Safety Warnings

3.1 When working with potentially hazardous materials, follow EPA, OSHA, and specific health and safety procedures.

3.2 When sampling lagoons or surface impoundments containing known or suspected hazardous substances, take adequate precautions. The sampling team member collecting the sample should not get too close to the edge of the impoundment, where bank failure may cause them to lose their balance. The person performing the sampling should be on a lifeline and be wearing adequate protective equipment.

3.3 When conducting sampling from a boat in an impoundment or flowing waters, follow appropriate boating safety procedures.

4.0 Interferences

4.1 There are two primary interferences or potential problems with surface water sampling. These include cross-contamination of samples and improper sample collection.

- Cross-contamination problems can be eliminated or minimized through the use of dedicated sampling equipment. If this is not possible or practical, then decontamination of sampling equipment is necessary. Refer to SOP R11-200, Sampling Equipment Decontamination.
- Improper sample collection can involve using contaminated equipment, disturbance of the stream or impoundment substrate, and sampling in an obviously disturbed area.

4.2 Following proper decontamination procedures and minimizing disturbance of the sample site will eliminate these problems.

5.0 Personnel Qualifications

5.1 All field samplers are required to take the 40-hour health and safety training course and regular refresher courses prior to engaging in any field collection activities.

6.0 Equipment and Supplies

6.1 Equipment needed for collection of surface water samples includes:

- Kemmerer bottles*
- bacon bomb sampler*
- line and messengers
- sample bottle preservatives as specified by the analysis to be performed
- plastic zip-sealed bags
- ice
- cooler(s)
- chain of custody forms, field data sheets
- decontamination equipment and reagents (decontamination solutions are specified in SOP R11 #200, Sampling Equipment Decontamination)
- maps/plot plan
- safety equipment
- compass
- tape measure
- Global Positioning System (GPS)
- survey stakes, flags, or buoys and anchors
- camera and film
- logbook and waterproof pen
- sample bottle labels
- approved QA project plan
- approved field health and safety plan

* The appropriate sampling device must be of proper composition. Samplers constructed of glass, stainless steel, PVC or PFTE (Teflon) should be used based upon the analyses to be performed.

7.0 Sample Collection - Preparation

1. Determine the extent of the sampling effort, the sampling methods to be employed, and which equipment and supplies are needed.
2. Obtain necessary sampling and monitoring equipment.
3. Decontaminate or pre-clean equipment, and ensure that it is in working order.
4. Prepare scheduling and coordinate with staff, clients, and regulatory agency, if appropriate.
5. Perform a general site survey prior to site entry in accordance with the site-specific health and safety plan and QA Project Plan.
6. Use stakes, flags, or buoys to identify and mark all sampling locations. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions.

8.0 Sample Collection - Secondary Parameters

1. Water quality data should be collected in impoundments to determine if stratification is present. Measurements of dissolved oxygen, pH, and temperature can indicate if strata exist which would effect analytical results. Measurements should be collected at 1-meter intervals from the substrate to the surface using an appropriate instrument, such as a Hydrolab (or equivalent).
2. Water quality measurements such as dissolved oxygen, pH, temperature, conductivity, and oxidation-reduction potential can assist in the interpretation of analytical data and the selection of sampling sites, and depths anytime surface water samples are collected.
3. Generally, the deciding factors in the selection of a sampling device for sampling liquids in streams, rivers, lakes, ponds, lagoons, and surface impoundments are:
    a. Will the sample be collected from the shore or from a boat on the impoundment?
    b. What is the desired depth at which the sample is to be collected?
    c. What is the overall depth and flow direction of the river or stream?

9.0 Sample Collection - Method Options

9.1 Kemmerer Bottle

A Kemmerer bottle may be used in most situations where site access is from a boat or structure such as a bridge or pier, and where samples at depth are required. Sampling procedures are as follows:

1. Using a properly decontaminated Kemmerer bottle, set the sampling device so that the sampling end pieces are pulled away from the sampling tube, allowing the substance to be sampled to pass through this tube.
2. Lower the pre-set sampling device to the pre-determined depth. Avoid bottom disturbance.
3. When the Kemmerer bottle is at the required depth, send down the messenger, closing the sampling device.
4. Retrieve the sampler and discharge the first 10 to 20 ml to clear any potential contamination on the valve. Transfer the sample to the appropriate sample container.

9.2 Bacon Bomb Sampler

A bacon bomb sampler may be used in similar situations to those outlined for the Kemmerer bottle. Sampling procedures are as follows:

1. Lower the bacon bomb sampler carefully to the desired depth, allowing the line for the trigger to remain slack at all times. When the desired depth is reached, pull the trigger line until taut.
2. Release the trigger line and retrieve the sampler.
3. Transfer the sample to the appropriate sample container by pulling the trigger.

9.3. Dip Sampler

A dip sampler is useful for situations where a sample is to be recovered from an outfall pipe or along a lagoon bank where direct access is limited. The long handle on such a device allows access from a discrete location. Sampling procedures are as follows:

1. Assemble the device in accordance with the manufacturer's instructions.
2. Extend the device to the sample location and collect the sample.
3. Retrieve the sampler and transfer the sample to the appropriate sample container.

9.4 Direct Method

For streams, rivers, lakes, and other surface waters, the direct method may be utilized to collect water samples from the surface. This method is not to be used for sampling lagoons or other impoundments where contact with contaminants is a concern. Using adequate protective clothing, access the sampling station by appropriate means. For shallow stream stations, collect the sample under the water surface pointing the sample container upstream. The container must be upstream of the collector. Avoid disturbing the substrate. For lakes and other impoundments, collect the sample under the water surface avoiding surface debris and the boat wake.

When using the direct method, do not use pre-preserved sample bottles as the collection method may dilute the concentration of preservative necessary for proper sample preservation.

10.0 Sample Handling and Preservation

10.1 Once samples have been collected:

1. Transfer the sample(s) into suitable labeled sample containers.
2. Preserve the sample or use pre-preserved sample bottles, when appropriate.
3. Cap container, tape the cap securely to the container and then place container into plastic zip-locked plastic bag. If the latter is unavailable, use plastic bags and secure closure with tape.
4. Load all sample containers into cooler(s) ensuring that bottles are not totally immersed in ice.
5. Record all pertinent data in the site logbook and on a field data sheet.
6. Complete the chain-of-custody form.
7. Attach custody seals to the cooler prior to shipment.
8. Decontaminate all sampling equipment prior to the collection of additional samples.

11.0 Data and Records Management

All data and information (e.g., sample collection method used) must be documented on field data sheets or within site logbooks with permanent ink.

12.0 Quality Control And Quality Assurance

12.1 Representative samples are required. In order to collect a representative sample, the hydrology and morphometrics, (e.g., measurements of volume, depth, etc.) of a stream or impoundment should be determined prior to sampling. This will aid in determining the presence of phases or layers in lagoons or impoundments, flow patterns in streams, and appropriate sample locations and depths.

12.2 All field QC samples required in the QA Project Plan must be followed; these may involve field blanks, trip blanks, and collection of replicate samples.

13.0 References

SOP R11 #200 Sampling Equipment Decontamination, Version 1.1.

APPENDIX B

List of Laboratories Certified by ODEQ

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY
LABORATORY ACCREDITATION PROGRAM
707 N ROBINSON, OKLAHOMA CITY OK 73102
PO BOX 1677, OKLAHOMA CITY OK 73101-1677

LIST OF ACCREDITED
GENERAL WATER QUALITY/ SLUDGE
LABORATORIES AND ANALYTES

09-01-05 TO 08-31-06

http://www.deq.state.ok.us
Customer Services Division

This document lists every certified lab and all parameters that the lab is certified to perform for OPDES compliance monitoring. The list can be found on the internet at: http://www.deq.state.ok.us/CSDnew/labcert.htm

The following is a geographical list of the commerical laboratories currently in the ODEQ Laboratory Accreditation Program. To verify that a laboratory is currently certified for a parameter, refer to its list of certified parameters.

Oklahoma Commercial Laboratories

Ada	Environ. Resources Technologies
Broken Arrow	Outreach Laboratory
Claremore	Donnelly Consulting LLC
Heavener	Ecology Management, Inc.
Miami	EP Scientific Products, LLC
Norman	Surbec-ART Environmental
Oklahoma City	Accurate Labs - OKC Red River Environmental Lab & Con. Okla. City-County Health Department OK Dept. of Agriculture Lab. Sv Isotek, L.L.C. Alpha Analytical Laboratories Oilab, Inc. Environmental Testing Inc.
Pryor	Mid America Industrial Testing Inc.
Stillwater	Wilkins Environmental Laboratory OSU Water Quality Research Lab Accurate Labs, Inc.
Tulsa	Tulsa City-County Health Department Accurate Labs Environmental Support Services Green Country Testing, Inc. CRC & Associates, Inc. Laboratory 2

Out-of-State Commercial Laboratories

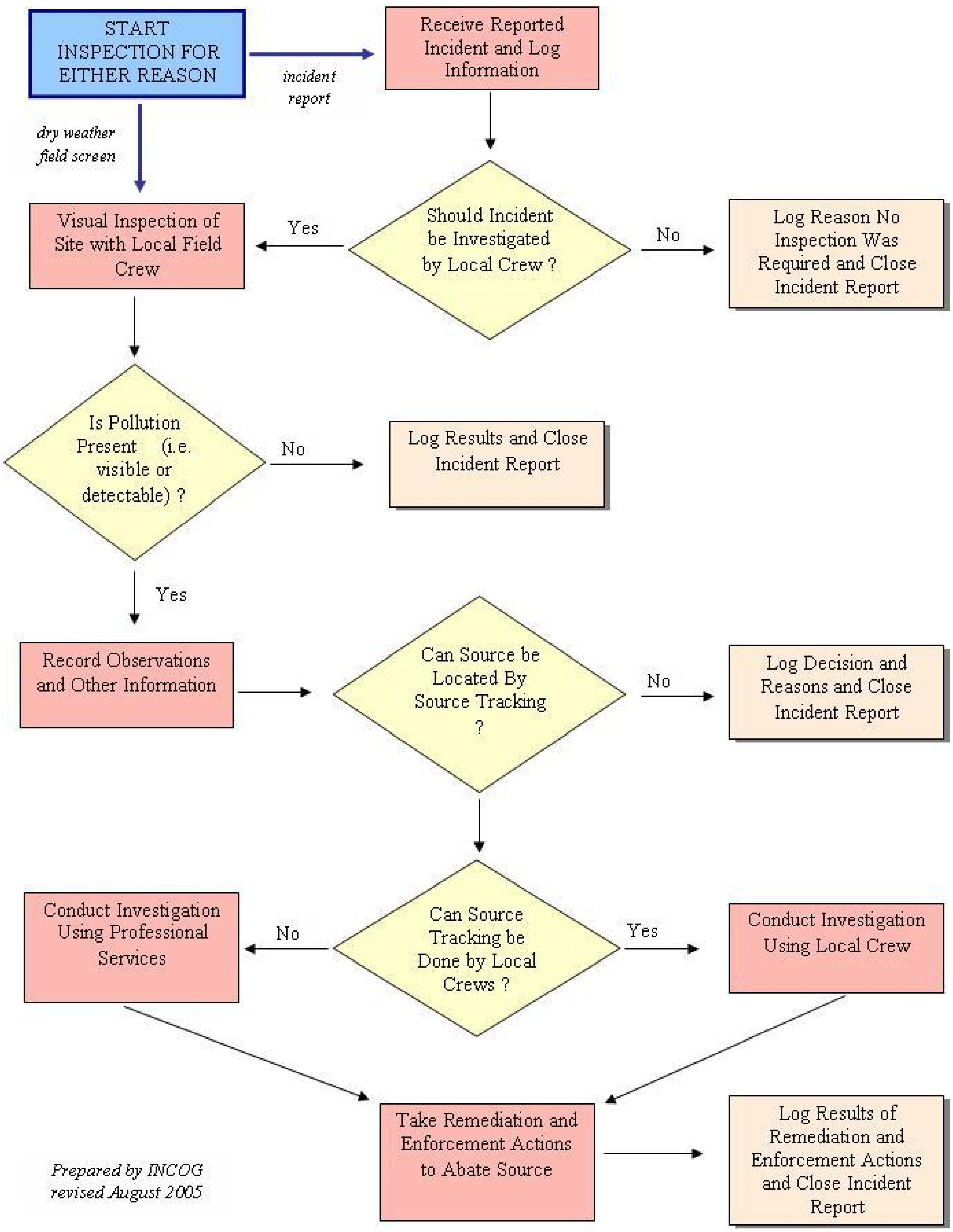
Arkansas		
	Fort Smith	Data Testing, Inc.
	Ft. Smith	Chem Lab Analytical Services
	Little Rock	Arkansas Analytical, Inc.
	Little Rock	American Interplex Corporation
California		
	Fresnso	APPL, Inc.
	Redding	Columbia Analytical Services-RDD
	Torrance	EMAX Laboratories, Inc.
Colorado		
	Arvada	STL Denver
	Ft. Collins	ENSR Toxicology Laboratory
	Ft. Collins	Paragon Analytics, Div of Datachem
	Golden	ESN: Rockymountain
	Steamboat Springs	ACZ Laboratories, Inc.
Connecticut		
	Plainville	Averill Environmental Laboratory In
Florida		
	Orlando	Accutest Laboratories Southeast Inc
	Pensacola	STL Pensacola
Georgia		
	Savannah	STL Savannah
Illinois		
	University Park	STL Chicago
Indiana		
	Indianapolis	Heritage Environmental Services,LLC
	Valaraiao	STL Valaraiao
Kansas		
	Dodge City	Servi-Tech Laboratories
	Frontenac	Pace Analytical Service, Inc. SE
	Lenexa	PACE Analytical Services-Lenexa
	Mound Valley	Trinity Analytical Laboratories
	Olathe	Analytical Management Laboratories,
	Salina	Continental Analytical Services Inc
Louisiana		
	Baton Rouge	Gulf Coast Analytical Lab, Inc.
	Lafayette	Sherry Laboratories-LA
	Shreveport	American Electric Power
Maryland		
	Frederick	GPL Laboratories, LLLP
Michigan		
	Grand Rapids	TriMatrix Laboratories, Inc.
Minnesota		
	Minneapolis	PACE Analytical Services Inc. - Mn
Mississippi		
	Ocean Springs	Micro-Methods, Inc.
New Jersey		
	Mountainside	Chemtech
New York		

	Amherst	STL Buffalo
North Carolina		
	Cary	CompuChem
	Durham	Eno River Labs, Inc.
Ohio		
	Akron	Summit Environmental Technologies,
	Dayton	TestAmerica Anal. Test Corp Dayton
	Marietta	KEMRON Environmental Services
Pennsylvania		
	Lancaster	Lancaster Laboratories
South Carolina		
	Charleston	General Engineering Labs L.L.C.
Tennessee		
	Knoxville	STL Knoxville
	Memphis	Environmental Testing & Con
	Mt. Juliet	Environmental Science Corporation
	Nashville	TestAmerica Analytical Testing Corp
Texas		
	Allen	Anachem, Inc.
	Allen	ERMI Environmental Laboratories
	Amarillo	ASK Laboratories, Inc.
	Austin	AnalySys, Inc.
	Austin	STL Austin
	Carrollton	Certes Environmental laboratory, LC
	Carrollton	Bio-Aquatic Testing, Inc.
	Corpus Christi	STL Corpus Christi
	Denton	Huther & Associates, Inc.
	Denton	TRAC Laboratories, Inc.
	Fort Worth	Star Analytical
	Houston	Columbia Analytical Services
	Houston	STL Houston
	Houston	e-Lab Analyrical Inc.
	Houston	Accutest Laboratories Gulf Coast
	Houston	Southern Petroleum Laboratories,Inc
	Houston	XENCO Laboratories
	Kilgore	Ana-Lab Corporation
	Lubbock	Traceanalysis
	Plano	Oxidor Corporation
	Richardson	LNS Environmental Services, Inc.
	Round Rock	DHL Analytical
	The Woodlands	A4 Scientific, Inc.
Washington		
	Kelso	Columbia Analytical Services
Wyoming		
	Sheridan	Inter-Mountain Laboratories, Inc.

70 Out-of-State Commercial Laboratories

APPENDIX C
Sample Forms for Inspections

Inspection Flow Chart:



Chain of Custody Form:

<table>
<tr><td colspan="4">Collector:</td><td>Date Sampled:</td></tr>
<tr><td colspan="4">Address:</td><td>FAX:</td></tr>
<tr><td colspan="4">Project:</td><td>Project #:</td></tr>
<tr><td colspan="5">Analyses Requested: (Arranged by present contract).</td></tr>
<tr><td>LAB SAMPLE NUMBER</td><td>CITY SAMPLE NUMBER</td><td>CONTAINER
P / G</td><td>PRESERVATIVE</td><td>FIELD INFORMATION</td></tr>
<tr><td>1</td><td></td><td></td><td></td><td></td></tr>
<tr><td>2</td><td></td><td></td><td></td><td></td></tr>
<tr><td>3</td><td></td><td></td><td></td><td></td></tr>
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<tr><td>17</td><td></td><td></td><td></td><td></td></tr>
<tr><td>18</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Relinquished By:</td><td>Date / Time:</td><td colspan="2">Accepted By: Date / Time:</td></tr>
<tr><td colspan="2">Relinquished By:</td><td>Date / Time:</td><td colspan="2">Accepted By: Date / Time:</td></tr>
<tr><td colspan="2">Relinquished By:</td><td>Date / Time:</td><td colspan="2">Accepted By: Date / Time:</td></tr>
<tr><td colspan="2">Relinquished By:</td><td>Date / Time:</td><td colspan="2">Accepted By: Date / Time:</td></tr>
</table>

EPA Dry Weather Field Screen Field Form:

Outfall # ______________ Photograph # ______________ Date: ______________

Location: ____

Weather: air temp.: ________ ^{0}C rain: Y N sunny cloudy

Outfall flow rate estimate:______L/sec

Known industrial or commercial uses in drainage area? Y N

Describe: ____

PHYSICAL OBSERVATIONS

Odor: none sewage sulfide oil gas rancid-sour other: __________

Color: none yellow brown green gray other: __________

Turbidity: none cloudy opaque

Floatables: none petroleum sheen sewage other: ____________ (collect sample)

Deposits/stains: none sediment oily describe: ___________ (collect sample)

Vegetation conditions: normal excessive growth inhibited growth

extent: ____

Damage to outfall structures:

identify structure: _________________________________

damage: none / concrete cracking / concrete spalling / peeling paint / corrosion

other damage: ___________________________________

extent: ____