Example QAPP

General Instructions

PLEASE READ BEFORE USING THE EXAMPLE QAPP!!

1. Consult EPA QA/R-5, "EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations" and EPA QA/G-5 "EPA Guidance for Quality Assurance Project Plans" before preparing a QAPP. On-line versions of these documents can be found at http://www.epa.gov/r10earth/offices/oea/qaindex.htm#National QA Guidances and Requirements Documents. The R-5 document identifies the information that must be addressed in QAPPs. The G-5 document is a user-friendly companion to R-5 and provides suggestions and guidance for complying with the R-5.

2. This example QAPP is intended to provide an example QAPP format and to demonstrate the link between the systematic planning process (the DQO process) and a QAPP. A systematic planning process worksheet is provided to help demonstrate the outputs from the DQO process and how they are incorporated into the QAPP. The inclusion of the worksheet is not intended to imply a requirement for a DQO worksheet.

3. The site, EPA personnel and contractors used in this example are ***fictitious*** and the QAPP does not include "boilerplate" language that can be used in QAPPs prepared for Region 7.

QUALITY ASSURANCE PROJECT PLAN

FOR THE SITE INSPECTION AT

COLDWATER MARSH

CRANKY CREEK, WANNABEASTATE

CERCLIS NO.: IAZ7458963216
TDD: J51-54799-128 PAN: 4533CBMLKR

Prepared for:

United States Environmental Protection Agency Region 7
Superfund Division

Prepared by:

Wee R. Contractors, Inc.
Special Services Team
January 23, 1998

This is an example Quality Assurance Project Plan. The site, EPA personnel, and contractors are fictitious.

QUALITY ASSURANCE PROJECT PLAN
for the
SITE INSPECTION AT COLDWATER MARSH
CRANKY CREEK, WANNABEASTATE

SIGNATURE/APPROVAL PAGE*

Approved by:

Rose Petal   2/1/98

Rose Petal, Project Leader; Wee R. Contractors, Inc.   Date

2/13/98

Hugo Mercury, QA Officer; Wee R. Contractors, Inc.   Date

Rusty Anchor   2/15/98

Rusty Anchor, EPA Project Manager; Superfund Division   Date

2/30/98

Jay Bird, EPA Regional Quality Assurance Manager   Date

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List of Attachments:

<u>A3. Distribution List</u> *(Systematic Planning Process Step 1)*

The following individuals will receive copies of the approved Quality Assurance Project Plan (QAPP) and subsequent revisions:

Rusty Anchor, EPA Project Manager
Jay Bird, EPA Regional Quality Assurance Manager (RQAM)
Rose Petal, Project Leader; Wee R. Contractors, Inc.
Hugo Mercury, Quality Assurance Officer; Wee R. Contractors, Inc.
Chuck Wagon, Field Team Leader; Wee R. Contractors, Inc.
Bobbie Socks, Analytical Services Director; A. Laboratory Co.
Johnny Cakes, Wannabeastate/EPA Liaison; Wannabeastate Environmental Task Force*
Penny Loafer, Administrator; Camel County Human Health and Environment Services*
May Pole, Director; Camel County Department of Wildlife and Parks*
Harry Nuckles, President, Camel County Environmental Coalition*

*These individuals are receiving copies of the QAPP and subsequent revisions at their request. The Environmental Task Force and Camel County Human Health and Environment Services may use the resulting data to determine future needs for regulating the use of lead shot at outdoor shooting ranges and by hunters. These individuals do not have any project responsibilities or duties.

<u>A4. Project/Task Organization</u> *(Systematic Planning Process Step 1)*

A project organization chart is provided as Attachment E. The individuals participating in the project and their specific roles and responsibilities are discussed below:

Rusty Anchor, EPA Project Manager - the primary decision maker for the project and the primary user of the data to determine whether or not further action is required at the site. Mr. Anchor's duties are:

4. Overall responsibility for the investigation
5. Reviewing and approving the QAPP and subsequent revisions in terms of program-specific requirements
6. Reviewing reports and ensuring plans are implemented according to schedule
7. Making final project decisions with the authority to commit the necessary resources to conduct the project

Jay Bird, EPA RQAM - The RQAM will be responsible for final review and approval of the QAPP and subsequent revisions for compliance with the current version of R-5, "EPA

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Requirements for Quality Assurance Project Plans for Environmental Data Operations." The RQAM will provide QA technical assistance to the EPA Project Manager and will conduct QA audits of the project. At this time, no RQAM audits are planned; however, the EPA Project Manager can request an audit by the RQAM at anytime during the project. If an audit is conducted, the RQAM will report audit results to the EPA Project Manager.

Rose Petal, Project Leader; Wee R. Contractors, Inc. - The Project Leader will coordinate the project activities and her specific responsibilities will include:

1. Developing the QAPP.
2. Coordinating field and laboratory activities.
3. Conducting the project activities in accordance with the QAPP and work order.
4. Validating the field data.
5. Reporting to the EPA Project Manager regarding the project status per the work order and preparing interim and final reports to EPA.

Hugo Mercury, QA Officer; Wee R. Contractors, Inc. - The QA officer will remain independent of the groups responsible for data generation and will provide QA technical assistance to the Project Leader. The QA officer will also be responsible for final internal review and approval of the QAPP and for internal QA audits of the project per the Wee R. Contractors, Inc. Quality Management Plan (approved by EPA on January 25, 1998). The QA officer will report audit results to the Project Leader.

Chuck Wagon, Field Team Leader; Wee R. Contractors, Inc. - The field team leader will perform the following duties:

1. Select the field sampling team.
2. Conduct the field activities per the approved QAPP and supervise the field sampling team.
3. Distribute the approved QAPP and subsequent revisions to the members of the field sampling team.
4. Report problems in the field to the Project Leader.

Field Team Technicians; Wee R. Contractors, Inc. - These individuals will perform the actual field work per the QAPP and at the direction of the field team leader. The field team typically consists of 4-5 people and will be named at a later date by the field team leader.

Bobbie Socks, Analytical Services Director; A. Laboratory Co. - This individual will be responsible for coordinating the analysis of the samples and laboratory validation of the data. She will coordinate the receipt of the samples at the laboratory, select the analytical

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team, ensure internal laboratory audits are conducted per the A. Laboratory, Co. QA Manual, and distribute the applicable sections of the QAPP and subsequent revisions to members of the analytical team. The complete A. Laboratory, Co. QA Manual was approved by Wee R. Contractors on March 3, 1997. Mrs. Socks will also report laboratory problems affecting the project data to the Wee R. Contractors, Inc. Project Leader and QA officer.

A5. Problem Definition/Background *(Systematic Planning Process Steps 1 & 2)*

Coldwater Marsh is a semi-permanent wetland located in Camel County, Wannabeastate near the city of Cranky Creek. Coldwater Marsh was identified as a semi-permanent wetland per the 1987 *Corps of Engineers Wetlands Delineation Manual* during the 1994 “Let’s Save Our Wetlands” campaign sponsored by the Camel County Department of Wildlife and Parks (CCDWP). Coldwater Marsh supports an abundance of obligate wetland plants as well as a large population of waterbirds during the spring season. Coldwater Marsh is located along Coldwater Creek, and during the spring season surface water overflow from the marsh enters the creek. The depth of the marsh ranges between one to two feet. See Attachment A for a site map.

The Shiny Gun Shooting Range (SGSR) operated between 1982-1995 on 100 acres of land located two miles outside the city limits of Cranky Creek and includes the 45 acres of open water making up Coldwater Marsh.

The SGSR was a private shooting range open only to members. In 1985, in order to meet the demands of its current membership and to attract new members, the SGSR built three shooting platforms for the purpose of offering skeet shooting. The shooting platforms overlook and extend into Coldwater Marsh. At the time the platforms were built, shotgun shells filled with lead shot were readily available and widely used in the sport of skeet shooting. Past members of the SGSR reported that many members purchased these types of shells from the clubhouse for use during skeet shooting events held at the SGSR.

Between 1990-1993, the CCDWP received anonymous complaints about the shooting range including a number of deceased ducks found in and around Coldwater Marsh. The CCDWP made several attempts to investigate the complaints but was repeatedly denied access to the property by the owner of the SGSR. In 1994, the CCDWP declared Coldwater Marsh to be a recognized state wetland subject to the newly passed state wetland protection act during its “Let’s Save Our Wetlands” campaign. Under the provisions of this act, access to state recognized wetlands for study or investigation could no longer be denied. During the spring and summer of 1995, the CCDWP conducted an investigation into the increased occurrence of duck deaths in Coldwater Marsh based on previous and continued complaints.

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The CCDWP found the SGSR to be closed and abandoned at the time of their investigation; the owner could not be located. Several moribund ducks were collected from Coldwater Marsh. Subsequent examinations by veterinary pathologists determined the ducks to be suffering from acute lead poisoning as indicated by high concentrations of lead in the liver, lead shot recovered from the gizzard, and lesions characteristic of lead poisoning. In 1997, the Camel County Environmental Coalition initiated a volunteer water quality monitoring project funded in part with EPA grant funds. Coldwater Creek was one of the surface water bodies targeted by this project. Elevated levels of lead (10 μg/L) were discovered in Coldwater Creek at a permanent sampling station established on the creek downstream of the SGSR site. This elevated lead level was reported to the CCDWP, as required, due to the use of Coldwater Creek for sport fishing by local citizens. The CCDWP forwarded the information to the Wannabeastate Environmental Task Force who then turned the site over to EPA for further investigation.

To determine whether or not lead shot used at the SGSR is contributing to the death of ducks in Coldwater Marsh and elevated lead levels in Coldwater Creek, lead shot densities in the sediment will be determined and water samples will be analyzed for total lead. This information will then be used to decide if the marsh sediment needs remediation or if no further action is required. Non-critical determination will also be made but will not be used in the decision making process.

A6. Project/Task Description and Schedule *(Systematic Planning Process Steps 1-3, & 5)*

The objective for this site investigation is to determine if lead shot in Coldwater Marsh is contributing to acute lead poisoning of ducks and to elevated lead levels in Coldwater Creek and needs remediation or if no further action is required. To make this decision, the following measurements will be made and the resulting data compared to the applicable action level:

1. A count of the lead shot currently in the sediment of Coldwater Marsh impacted by skeet shooting activities; the sediment will be collected using an Ekman dredge.

2. The concentration of total lead in the water of Coldwater Marsh; water samples will be collected at mid-depth with a bomb sampler.

3. The concentration of total lead in the surface water of Coldwater Creek downstream of the site at the permanent sampling station established for the volunteer water quality monitoring project; surface water samples will be collected by dipping the sample containers directly into the water.

4. A surface water sample upstream of the site will be collected from Coldwater Creek to determine background concentrations; surface water samples will be collected by dipping the sample containers directly into the water.

5. Non-critical determinations for water sample collection will include temperature, conductivity, pH, wetland biological characteristics, and total lead in sediment at the creek sampling locations; non-critical determinations for sediment sample collection will include sediment volume; this information will be used only to supplement the critical data and not in decision making

Ecological assessments (Reference 1) conducted at other marsh/shooting range sites determined direct ingestion of lead shot by waterbirds to be the pathway of most ecological significance. These studies determined that lead shot densities of 19.5 shot/ft^2 presents a high risk to waterbirds. For water, the EPA freshwater (chronic) Ambient Water Quality Criteria (AWQC) is 6.1 μg/L for lead. These values will be the action limits for this site. Water samples will be analyzed for lead using atomic absorption (AA).

If the mean lead shot density for any decision unit (see §B1) is $\geq$19.5 shot and/or the total lead concentration in water exceeds 6.1 μg/L, then remediation of the lead shot is needed. If the mean lead shot density in a given decision unit is <19.5 shot and the total lead concentration in water is <6.1 μg/L, then no further action is required. If the decision to remediate is made, a separate QAPP will be prepared to cover the remediation and its associated sampling activities.

A complete equipment list is provided in §B1. Standard 1L Cubitainers will be used for the water samples. See section A8 of this QAPP for personnel requirements.

The assessment tools needed for this project will include one audit of the field activities, and data verification and validation of all data submitted to the EPA Project Manager. The sample collection activity will begin early in spring before the heavy, seasonal flooding period; the anticipated start of field activities is March 15. This will allow the water level to be high enough for overflow into Coldwater creek, but low enough not to endanger the safety of the sampling team. The project, including laboratory analysis, should be completed within 60 days of the conclusion of the field activities.

Required QA records are described in section A9 of this QAPP. Due to the short duration of this project, only a final report will be prepared and submitted to the EPA Project Manager. The final report will summarize project results and QC data, and will include the data validation report and raw data package. Section C2 of the QAPP provides additional details regarding the final report.

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A complete list of all standard operating procedures identified in the QAPP can be found in Attachment B.

A7. Data Quality Objectives for Measurement Data *(Systematic Planning Process Steps 1-2 & 4-6)*

Valid data of known and documented quality is needed for the decision units sampled to determine the mean lead shot density in sediment and total lead in water. The data will be compared to the decision limits to determine if remediation is needed or if no further action is required. Step 6 of the systematic planning process (Attachment D) provides the details for specifying the limits on decision errors. The results are summarized here.

The null hypothesis is that the site is dirty and will require remediation. For the water matrix, the lower bound of the gray region is 5.4 μg/L and the upper bound is 6.1 μg/L. The false positive error rate is 5% and the false negative error rate is 15%. The water matrix is considered to be one homogeneous decision unit.

For the sediment matrix, the lower bound of the gray region is 15.5 lead shot density and the upper bound is 19.5 lead shot density. The false positive error rate is 10% and the false negative error rate is 15%. The sediment is divided into 25 separate homogeneous decision units.

The computer program DEFT (Decision Error Feasibility Trials) was used to develop a sampling design that meets the established acceptable error rates. As a result, seven random mid-depth water samples will be collected from the impacted marsh area (with additional samples, one each, taken from the surface of Coldwater Creek upstream and downstream of the site) and 10 random sediment samples will be collected from each of the 25 sediment decision units. If the mean lead shot density is $\geq$19.5 and/or the total lead concentration in water exceeds 6.1 μg/L, then remediation of the lead shot is needed. Otherwise, no further action is required.

Data Quality Indicators:

If the collected data meet the design criteria described above, the following data quality indicators will be applicable and the above listed remediation decisions can be made with this data. All sampling points will be randomly selected within pre-defined decision units. For the water matrix, only one decision unit will be defined. For the sediment samples, 25 decision units (DU) will be defined of approximate size of 50 ft x 50 ft. The mean result within each decision unit will be calculated and used for the decision at the site. Data quality indicators include precision, accuracy, representativeness, comparability, and completeness. Definitions for each of these data quality indications can be found in Attachment D.

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Precision. The precision at this site will be calculated as the relative percent difference (RPD) for laboratory duplicates (matrix spike/matrix spike duplicates) for the water samples. The frequency for laboratory duplicates is discussed in section B5 and their acceptance criteria are defined in Table 3. For the lead shot counts, one determination per decision unit will be confirmed by a second field team member and should be within 10%. Co-located field duplicates for the water matrix will not be collected at this site because the seven marsh samples are considered to be replicates and will provide an indication regarding the precision associated with sample collection procedures for the water matrix. The EPA Project Manager will evaluate the replicates during the review and verification process.

Accuracy. Accuracy will be determined for lead in water with a performance evaluation (PE) sample, analyzed to determine any possible bias. The laboratory will also analyze a matrix spike and a matrix spike duplicate to verify the effect of the matrix on analytical bias. The percent recovery for the PE sample and the matrix spike will be calculated and the acceptance criteria are defined in Table 3. For the lead shot in sediment, no known method for determining accuracy is available.

Representativeness. Representativeness will be assured by using a statistically significant number of samples (as determined using the DEFT program) and by collecting randomly selected samples. Selection of random samples will provide representativeness over the decision unit. For the water sample, the area will be divided into 25 units (matching the 25 decision units for sediment) and seven (7) samples will be randomly collected. For the sediment samples within each decision unit, the area will be divided into 25 more units and ten (10) samples will be randomly collected. This type of random sampling within decision units will assure that a representative collection of samples occurred.

Completeness. To generate data with the final test design criteria, 100% of the samples must be collected and analyzed. If all the critical samples are not collected and analyzed, re-sampling will occur because each sample is needed in order to meet the final test design criteria.

Comparability. For this project, comparability will be addressed through the use of common and accepted sampling and analytical techniques and by reporting data in standard units.

A8. Special Training Requirements/Certification

Specialized training for field sampling and analyses and off-site analyses and validation have not been identified as necessary during the planning of this project. The Wee R. Contractors field team lead will be responsible for ensuring that all members of the field team have valid and current specialized training required by the OSHA regulations. The EPA Project Manager will be responsible for ensuring that all EPA personnel have valid and current specialized training required

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by the OSHA regulations as a pre-requisite for site visit(s). Specific certifications have not been identified as necessary during the planning of this project.

Chemical preservatives and samples will be transported to the site and shipped to the lab as directed by the site health and safety plan (HSP) prepared by the contractor and approved by the EPA Project Manager. These transporting and shipping procedures will be written in compliance with the Department of Transportation regulations.

A9. Documents and Records

The records for this project will include miscellaneous correspondence, field logs and field data worksheets, laboratory analytical reports, a field activity report, and a final report. All reports will be submitted to the EPA Project Manager. Field logs will be recorded with no more than one entry per page, in bound notebooks with pre-numbered pages. Field logs will include observations about weather conditions at the site when samples are collected and field analyses are conducted. Any other pertinent observations or deviations from the procedures in this QAPP, deemed noteworthy by any member of the field team will also be recorded in the field log book. Field data worksheets (Attachment C) will be used to record all field measurements. Each page of the field logs and field data worksheets will be dated and signed by the person making the entries.

One laboratory analytical report will be generated for all the samples received by the laboratory and signed by the A. Laboratory, Co. Analytical Services Director. The analytical data report will include an original signed report of the analytical results, a narrative report about the analysis, original complete chain of custody forms, and any other documentation received with the samples. A summary of the calibration data, and laboratory quality control data will also be included in the analytical report. The raw analytical data (e.g., instrument printouts and manual records) will be available upon request. Laboratory analytical report will be submitted to the Wee R. Contractors, Inc. Project Leader within 30 calendar days after receipt of samples who will then forward the analytical report EPA Project Manager upon verification of its completeness. The narrative report will describe at least:

1. the dates of sample receipt, preparation, and analysis,
2. the condition of the samples upon receipt,
3. sample preparation and analytical procedures,
4. any problems encountered during sample handling, storage, preparation, or analysis, and their solutions,
5. any deviations from standard operating procedures,
6. and a discussion of the quality of the reported analytical.

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A field activity report will be generated by the Wee R. Contractors, Inc., Project Leader, and submitted to the EPA Project Manager within 60 days of completion of the field activities described in this QAPP. This report will include the analytical data report, a signed narrative about field activities, a summary of all field data collected, a written report of the audit of field activities (see section C1), and all the original field log books and field data worksheets for this project. The narrative report will include at least discussions of all field activities, any problems encountered and their solutions, any deviations from procedures described in this QAPP, and a discussion of the quality of all field data.

The EPA Project Manager will disseminate copies of the QAPP to the people listed in the distribution list (see section A3) once it is approved. Any revisions to the QAPP will be numbered sequentially. It will be the responsibility of the EPA Project Manager to see to it that each person on the distribution list receives copies of any revisions.

All EPA records and documents from this project will be handled according to EPA SOP #EPA-90251.3b "Handling and Disposition of Project Records and Documents." A. Laboratory Co. will manage the original raw data from this project (both hard copy and electronic) in accordance with A. Laboratory Co. SOP #LAB-505-3a "Records Management," except that they will maintain records from this project at least six years and the EPA Project Manager will be consulted before they are disposed. These SOPs include information about where records will be stored, who will be responsible for records management, and how long specific types of records and documents will be retained. The Wee R. Contractors, Inc. Project Leader, will submit all original records to the EPA Project Manager with the field activity report, so they will have no long term records' management for this project. Any deviations from these procedures will be approved by the EPA Project Manager before implementation.

B1. Sampling Process Design *(Systematic Planning Process Steps 5 & 7)*

This is a site investigation to determine whether the lead shot used at SGSR is contributing to the deaths of the ducks and high lead levels in Coldwater Creek. The sample collection design is such that homogeneous areas (decision units) will be tested and evaluated, and that the areas for remediation may be minimized. Random samples will be collected from each decision unit, and a mean will be determined from the individual results. Collection of random samples will assure that the results are representative within each decision unit. Use of standard methods and technically accepted methods will assure that data may be comparable to other sources of data. See Attachment A for a site map. The rationale for the chosen sampling design is detailed in Attachment D, the Systematic Planning Process worksheet.

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Schedule

Sample collection will begin in the spring prior to the spring floods anticipated in April. The anticipated start date is March 15. The wetlands area will have 1-2 feet of water coverage, and will be representative of the typical concentrations of lead throughout most of the year. Sample collection should take approximately one week with a team of four to five members. The water samples will be collected first in order to obtain undisturbed lead concentrations in the water. The samples will be shipped overnight to the analytical laboratory for analysis (following SOP No. WRC-FLD-500-D). Sediment samples will be collected using the procedure described below. No laboratory analyses will be performed on the marsh sediment samples; creek sediment samples will be analyzed for total lead (a non-critical determination). Laboratory results should be sent to the Wee R. Contractors, Inc. Project Leader within 30 days of sample receipt. Results and decisions for the Coldwater Creek Wetlands should be complete within 60 days of initial sample collection. The EPA Project Manager will receive the final report from the Wee R. Contractors, Inc. Project Leader within 60 days of the completion of field activities.

Equipment

3	Ekman Dredges
10	1L cubitainers with nitric acid
1	Nitric acid preservative bottle
2	8oz. Glass Jars
3	5L graduated cylinders
3	No. 10 Mesh
3	Short stem, square, large funnels
3	Steel bowls
1	Cooler for shipment of water samples
2	Bomb samplers
1	Combination water quality meter

Field sheets (see Attachment C)
Hip waders

Procedure

Based on the results from DEFT program, samples will be randomly collected from each decision unit and a mean value will be calculated from the results. Table 1 summarizes the number of samples to be collected, and the following subsections will discuss the details for each of the two matrices.

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B1.1 Lead in Water Samples (Critical)

The wetlands area where the shot are expected will be considered to be one decision unit, 250ft by 250ft. This decision unit will be divided into 25 equal units of approximately 50ft by 50ft. These units will be numbered sequentially from 1-25. A random number generator will be used to identify the locations for the seven random samples to be collected within the wetland area. Because lead tends to sink and there is little flow and mixing of the water within the marsh, the highest concentration of lead is expected to be below the surface; therefore, water samples within the marsh will be collected at mid-depth in the center of the randomly selected grid.

One sample will be collected upstream of the wetland area to determine background levels of lead in Coldwater Creek. One sample will be collected downstream at the permanent sampling station. The lead concentration is expected to be homogenous within the water column of the creek due to the continuous flow and mixing of the water within the creek; therefore, the upstream and downstream creek samples will be collected at the surface. The field team will begin the water sampling in Coldwater Creek at the downstream location and will work their way upstream in order to obtain undisturbed lead concentrations in water from the creek.

B1.2. Lead Shot in Sediment Samples (Critical)

The wetlands area where the shot are expected will be divided into 25 equal decision units of approximate size 50ft by 50ft. See Attachment A for the planned design. Each decision unit will be further divided into 25 units, and numbered sequentially. A random number generator will be used to identify the locations of the ten samples to be collected within each decision unit. The sample will be collected from the center of the specified random unit. One determination per decision unit will be confirmed by a second person.

B1.3 Non-critical Determinations

Several non-critical determinations will be made in the field for both the water and the sediment samples. Non-critical determination for water samples will include water quality characteristics (pH, temperature, conductivity), biological characteristics (plant, animal, and insect life), and total lead in sediment at the upstream and downstream sampling locations. Non-critical determinations for the marsh sediment samples will include the measure of volume of the sediment from each sample. This information will simply be used to supplement the critical data; it is not needed to make the decision of whether or not remediation is needed.

Table 1. Summary of the Number of Critical Field Samples

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Location	Matrix	Analyte	No. of DU[1]	No. of Samples/DU	No. of PE Samples	No. of Verified Samples
Wetland	Water	Lead	1	7	1	NA[2]
Up-stream	Water	Lead	1	1	0	NA
Down-stream	Water	Lead	1	1	0	NA
Wetland	Sediment	Lead shot	25	10	NA	1/DU[3]

(1) DU = Decision Unit

(2) NA = Not Applicable

(3) 1/DU means that one sample will have the number of shots verified by a second person while in the field. The verification will be noted on the field sheet by the initials of the second person.

B2. Sampling Methods Requirements

Water samples will be collected to confirm the concentration of lead in water within the marsh. Water samples upstream and downstream will also be collected. Water quality characteristics and biological characteristics will be collected to support the critical measurements of lead in water. Sediment samples will be collected in order to determine the number of lead shots present. The sediment volume will be measured to support the critical measurement of lead shot count. Sample collection locations will be selected using a random number generator, and identified using GPS technology (SOP No. WRC-FLD-1001-A).

Lead in Water

Three SOPs will be followed for the sample collection of water samples for lead. SOP No. WRC-FLD-1453-C describes the aqueous, sample collection of grab samples for inorganic analyses. The depth of the marsh ranges between 1-2 feet and the depth of the creek ranges between 3-4 feet. Samples will be collected by carefully wading into the marsh or the creek to reach the sampling point. SOP No. WRC-FLD-1414-C describes the container types and the number of containers for each analysis type in water. SOP No. WRC-FLD-1421-C describes the sample preservation for various aqueous samples. Specifically, the procedure for lead in water will be followed using 1L cubitainers for sample storage; nitric acid will be added to the sample for a final sample pH less than 2. Pre-cleaned, single use sample containers will be used for sample collection. The bomb sampler will be rinsed with the wetland water at the site in between sampling locations. In general, precautions will be taken to prevent contamination. If the field team encounters any problems or unexpected situations while in the field (e.g., access problems, safety

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issues, inadequate supplies), the field team leader will be contacted and will be responsible for corrective actions.

For non-critical determinations for water sample collection, the following SOPs will be followed:

1. SOP No. WRC-FLD-905, "Determination of Field Characteristics of Water," describing field measurements including temperature, conductivity, and pH.
2. SOP No. WRC-FLD-906, "Determination of Biologic Characteristics of a Wetlands," describing the field observations of plant, animal, and insect populations in a permanent wetlands area.
3. WRC-FLD-2304-B, "Operation of Ekman Dredge for Sediment Sample Collection SOP" for collecting the sediment samples at the upstream and downstream locations (an aliquot from the Ekman dredge will be collected to fill up the sample containers).

Samples have an analysis holding time of six months. However, the laboratory has agreed to perform the analysis within 30 days to expedite the possible remediation of the site.

Lead Shot in Sediment

Two SOPs will be followed for the sample collection and determination of lead shot in sediment. SOP No. WRC-FLD-2304-B describes the use of the Ekman Dredge for the sample collection of sediment samples in wetlands. It is anticipated that the dredge may not function properly when a large number of shot are encountered. For these situations, the dredge will be forced into the sediment no deeper than 12 inches and the dredge's jaws manually closed.
SOP No. WRC-FLD-2305-B describes the use of a screen to separate shots from sediment using a No. 10 mesh screen, and transfer to a steel bowl for counting the shot. Lead shot will then be counted and recorded on the field sheet (Attachment C). One sample per decision unit will be verified by a second person. The verified number will be recorded along with the initials of the reviewer. If the verified number of shots does not match within 10%, the sample will be recounted, and another sample within the decision will be verified. The field team leader will report the problem and possible solution to the Wee R. Contractors, Inc. Project Leader.

A non-critical determination of the volume of the sediment will be made for each sediment sample. SOP No. WRC-FLD-2305-B describes the collection of sediment from the No. 10 mesh screen and measured in a 5-L graduated cylinder.

SOP No. WRC-FLD-2304-B and WRC-FLD-2406-B describe decontamination procedures for the Ekman Dredge and the screen respectively. Generally, both will be rinsed with the wetland or stream water at the site followed by a rinse with clean water.

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B3. Sample Handling and Custody Requirements

This is a site investigation and will determine the need for remediation. Therefore, the following sample custody procedures will be followed.

Lead in Water

SOPs by both contractors will be followed which describe the sample handling and custody requirements for this activity. SOP No. WRC-1401-A describes the sample logging, collection, and tracking for non-litigation samples. Examples of sample log sheets, sample labels, and tracking form are available in the SOP. SOP No. LAB-100-4c describes the sample receipt and tracking system at the laboratory.

Lead Shot in Sediment

Because samples will be collected and evaluated in the field, sample tracking will be not be required except as recorded on the field sheets. Data will be recorded at the site and verified at the site, and the sample returned to the sediment.

B4. Analytical Methods Requirements

The measurement of lead shot will be performed in the field, and is described in Section B2. The measurement of lead in water will be performed by A. Laboratory Co. Table 2 summarizes the field and analytical methods to be used.

Once the samples are received and logged in at the laboratory, the samples will be digested and analyzed using EPA Method 239.2. Laboratory SOP No. LAB-141-2b describes the sample preparation of water samples for acid digestion for lead analysis. SOP No. LAB-142-2b describes the sample analysis for lead analysis using atomic absorption (AA), analytical method performance criteria, and corrective actions for analytical failures. If any data are lost or do not meet the method performance criteria, the A. Laboratory, Co. Analytical Services Director will contact the Wee R. Contractors, Inc. Project Leader prior to submission of the data. The creek sediment samples will be analyzed according to SOP No. LAB-141-2c, “Digestion of Solid Samples for Lead” and SOP No. LAB-142-1c, “Analysis of Lead Using ICAP” (the lower detection limits achieved by AA are not required for these non-critical samples and ICAP will be acceptable).

Table 2. Summary of Methods

Analyte	**Total Lead**	**Lead Shots**	**Total Lead**
Matrix	Water	Marsh Sediment	River Sediment

Project Action Limit	6.1 μg/L	19.5 mean shots/ft^2	NA [3] Non Critical
Project Quantitation Limit	0.6 μg/L	1 mean shots/ft^2	0.6 mg/Kg
Field SOP **Field Method**	WRC-FLD-1210 [1]	WRC-FLD-1330 Reference 1	WRC-FLD-1330 [1]
Analytical SOP **Analytical Method**	LAB-141-2b, LAB-142-2b [2] EPA Method 239.2	NA [3]	LAB-142-2b, LAB-141-3c [2]

(1) SOP located at Wee R. Contractors, Inc.
(2) SOP located at A. Laboratory Co.
(3) NA=Not Applicable

B5. Quality Control Requirements

The laboratory quality control (QC) procedures and associated criteria are contained in SOP No. Lab-142-2b. The laboratory QC samples and control limits identified in the SOP were reviewed by the project personnel. The quality of the data generated using this SOP will provide analytical data of a sufficient quality for this project. The field QC samples will be a field blank and a PE sample obtained from Iamgreat, Inc. The concentration of the PE sample will be 6 μg/L. The field blank will be collected and preserved with the same bottle of acid preservative used to adjust the pH of the water samples.

Laboratory Quality Control

The lab will be required to analyze a method blank, a matrix spike/martix spike duplicate set, and a calibration curve verification (CCV) sample for each matrix. The method blank must be below the reporting limit; the CCV and the PE sample must be within 10% of the expected value.

Field Quality Control for Water Samples

A water field blank will be collected and preserved with the same bottle of acid preservative used to adjust the pH of the water samples. DI water collected with the bomb sampler will be used as the field blank. A water PE sample (at 6 μg/L) purchased from Iamgreat, Inc. will be submitted with the samples. Because the river sediment samples are not critical, no field quality control samples will be collected relating to river sediment.

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Field Quality Control for Sediment Samples

One lead shot count per decision unit will be confirmed by a second field team member and should be within 10%. If the count of the lead shot does not match, the sample will be recounted, and another sample within the decision will be verified.

Table 3. Summary of Quality Controls for the Methods

Method	Lead in River Sediment	Lead in Water	Lead Shots in Marsh Sediment
SOP No.	LAB-142-2b	LAB-142-2b (1)	WRC-FLD-1330 (2)
Calibration Criteria	10%	10%	NA (3)
Blank Concentration	< 0.6mg.Kg	< 0.6μg/L	NA (3)
Matrix Spike Samples (Recovery)	90-110%	90-110%	NA (3)
Matrix Spike Duplicate (%RPD)	≤ 10%	≤ 10%	NA (3)
Count Verification	NA (3)	NA (3)	10%
PE Criteria	NA (3)	± 10%	NA (3)

(1) SOP located at A. Laboratory Co. (2) SOP located at Wee R. Contractors, Inc. (3) NA=Not Applicable

B6. Instrument/Equipment Testing, Inspection, & Maintenance Requirements

The only field equipment requiring testing, inspection, and maintenance is the model 2000 Do-It-All Water Quality meter. This meter will be used to measure pH, temperature, and conductivity for water samples while in the field. SOP No. WRC-FLD-905 describes the procedures for testing and inspecting the meter. These procedures include a battery check, verification that the meter was successfully calibrated during its previous use, and ensuring preventative maintenance has been completed per the manufacturer's recommendations (Reference 2).

An inspection checklist and initial calibration check will be completed by a field team member upon checkout of the meter per SOP No. WRC-FLD-402-D, "Field Equipment Checkout Procedures." A maintenance kit which includes extra batteries, calibration standards, and commonly needed spare parts will also be obtained upon checkout. Any preventive or corrective maintenance done will be documented in the equipment log per SOP No. WRC-FLD-905. If the model 2000 meter fails the initial testing and inspection, a model 1500 meter is available as a backup instrument.

SOP No. LAB-142-2b addresses the testing, inspection, and maintenance for the AA instrument. These procedures include reviewing the instrument log for any notations regarding

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problems experienced during the previous use and verifying the preventative maintenance has been completed per the manufacturer's recommendations (Reference 4). Any preventive or corrective maintenance done will be documented in the maintenance log per SOP No. LAB-142-2b. Spare parts are kept in the laboratory's supply room and are available when needed.

B7. Instrument Calibration & Frequency

The model 2000 Do-It-All Water Quality meter will be calibrated at the beginning of each sampling day and after every 10 measurements per SOP No. WRC-FLD-905. The meter will be calibrated using NIST standards. The lot number of the standards used will be documented in the equipment log per SOP No. WRC-FLD-905. The calibration for the pH function will be at least a two point calibration and will occur in the field (with the exception of the initial calibration check which will be done at the time of checkout). Calibration for the conductivity function will be performed with a potassium chloride (KCl) solution in the field. The meter does have temperature compensation; therefore, temperature differences between the sample and the calibration standards will not be an issue.

The AA instrument will be calibrated using NIST standards at a frequency per SOP No. LAB-142-2b. The lot number of the standards used will be documented in the instrument log.

B8. Inspection/Acceptance Requirements for Supplies and Consumables

The field team leader will be responsible for inspecting sample containers before leaving for the field. Only new sample containers accompanied by the manufacturer's certification of pre-cleaning will be used. The sample containers will also be inspected for cracks, ill-fitting lids, and other obvious defects before use and will be discarded if defects are found to be present.

The A. Laboratory Co. analyst assigned to conduct the analysis will be responsible for inspecting equipment and supplies upon receipt. The manufacturer's specifications for product performance and purity will be used as the acceptance criteria.

B9. Data Acquisition Requirements for Non-direct Measurements

The data obtained during the 1997 volunteer water quality monitoring project sponsored by the Camel County Environmental Coalition was used to determine the need for upstream and downstream sampling in Coldwater Creek. The permanent sampling station established during the volunteer monitoring will also be used as the downstream sampling location for this project. The data obtained during the volunteer monitoring project were generated under an EPA-approved QAPP (EPA QA Document No. 97149). The resulting data were validated and met the objectives for that project (per the final report issued September 12, 1997). Because the data were originally

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collected as an educational tool for the public, the data were used only as a preliminary indicator of potential Coldwater Creek contamination. The data from this project will be used to make the decision regarding the need for remediation of Coldwater Marsh.

B10. Data Management

Data for this project will be produced in two locations: onsite and at A. Laboratory Co. Data collected onsite will be recorded on field data worksheets (copy attached) and into field logbooks. These field data worksheets and logbooks will be submitted by the Wee R. Contractors, Inc., Project Leader to the EPA Project Manager with the field activity report when field activities are complete, and will become a part of the project file. Laboratory data will be submitted by the A. Laboratory Co. Analytical Services Director to the Wee R. Contractors, Inc. Project Leader within 30 calendar days of the laboratory's receipt of the samples. The Wee R. Contractors, Inc. Project Leader will be responsible for ensuring the analytical report meets the requirements in section A9 and for forwarding it to the EPA Project Manager. A computer compatible with Lotus 1-2-3 spreadsheet software will be used by the EPA Project Manager for calculating means and standard deviations. No other special data handling equipment or software will be needed for data management. As discussed previously in this document, project records will be managed according to EPA SOP #EPA-90251.3b "Handling and Disposition of Project Records and Documents," and laboratory records will be managed according to A. Laboratory Co. SOP #LAB-505-3a "Records Management." All field records and the analytical report will be submitted to the EPA Project Manager, so there will be no long-term management of project records by the field contractor. Adherence to these SOPs will assure that applicable information resource management requirements are satisfied.

C1. Assessment and Response Actions

Due to the limited duration of this project, the only assessments that are planned include one audit of field activities and the verification and validation of all reported data (conducted in accordance with sections D1 and D2). The audit of field activities will be conducted by the Wee R. Contractors, Inc. QA Officer, on-site, at the time(s) when samples are being collected for both field and laboratory analysis and when field analyses are conducted. This audit will be conducted in accordance with Wee R. Contractor Inc. SOP WRC-FLD-3306-D "On-site Assessment of Field Activities." This SOP covers how on-site assessments for field activities will be planned, conducted, and reported. The purpose of this audit will be to verify conformance with the procedures discussed and referenced in this QAPP. A written report of the findings from this audit will be prepared by the Wee R. Contractors, Inc., QA Officer to be included in the field activity report submitted to the EPA Project Manager. The Wee R. Contractors QA Officer will have the authority to stop work on-site if he deems the findings from the audit to justify such actions. The Wee R. Contractors, Inc. Field Team Leader, in consultation with the Wee R. Contractors, Inc.

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Project Leader, will be responsible for corrective actions relating to field activities. A water PE sample (at 6 μg/L) purchased from Iamgreat, Inc. will be provided to the laboratory.

The narrative report included with each laboratory data report will include a discussion of the quality of the reported laboratory data, which will result from the A. Laboratory Co. Analytical Services Director's audit of data quality according to SOP #LAB-504-2a "Data Package Generation, Review, and Validation." The A. Laboratory Co. Analytical Services Director will be responsible for corrective actions at the laboratory. The narrative report included with the field activity report will include a discussion of the quality of the reported field data, which will result from the Wee R. Contractors, Inc. QA Officer's audit of the field data quality according to Wee R. Contractors, Inc. SOP # WRC-FLD-3326-B "Validating Field Data." These SOPs both address the process and criteria for evaluating data, and processes for addressing the requirements of specific projects. The EPA Project Manager will review the results from the PE sample and all reported data to verify that it is useable for the purposes of this project, and that it is reasonable when taken with other facts known about the site. Sections D1 and D2 of this QAPP discuss the verification and validation process in detail.

C2. Reports to Management

Due to the short duration of this project, the only reports to management will be a final project report, a field activities report and an analytical data report for all the samples. The final project report will be generated by the EPA Project Manager for inclusion in the project file at the completion of the project. This report will include a summary description of all project activities, a summary of all data, a discussion of any problems encountered and associated corrective actions, a discussion of the conclusions drawn from the results of this project and the rationale for those conclusions, and the results of the data quality assessment. The field activity report will be generated by the Wee R. Contractors, Inc. Project Leader and submitted to the EPA Project Manager at the completion of field activities. Laboratory analytical reports will be generated by the A. Laboratory Co. Analytical Services Director and submitted to the Wee R. Contractors, Inc. Project Leader 30 calendar days after receipt of the samples who will then forward the analytical information to the EPA Project Manager in conjunction with the field information. Any significant QA problems encountered in the laboratory or in the field, as deemed by the A. Laboratory Co. Analytical Services Director or the Wee R. Contractors, Inc. QA Officer (respectively), will be reported immediately to the Wee R. Contractors, Inc. Project Leader via telephone.

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D1. Data Validation and Usability

Data will be accepted if they meet the following criteria:

1. Field data sheets are complete.
2. Field data and laboratory data were validated
3. Actual sample locations and collection procedures match the proposed sample locations and collection procedures identified in sections B1 and B2, respectively.
4. Sample handling procedures documented on chain-of-custody forms, the field activity report, and case narrative match the proposed sample handling procedures identified in sections B2 and B3 (e.g., water samples were acid preserved, holding time of six months not exceeded).
5. Field QC was conducted as planned and meets the acceptance criteria in section B5 (e.g., field blank is < the reporting limit, PE sample recovery is 90-110%, one lead shot count per decision unit verified to be within 10%).

Any deviations from the QAPP are to be reported in the field activity report or analytical data report and the analytical data report will the information described in section A9. The EPA Project Manager will verify the content of these reports.

If the data fails to meet the criteria, they will be flagged by the EPA Project Manager as estimated. Any flagged data will be discussed with the project team and regional Superfund management to determine if the data point will be rejected and re-sampling done.

D2. Data Validation and Verification

The Wee R. Contractors, Inc. Project Leader will validate the field data according to SOP No. WRC-FLD-3326-B, “Validating Field Data.” Any problems identified during this process will be reported to the EPA Project Manager in the field activity report.

The A. Laboratory Co. Analytical Services Director will validate the laboratory data according to SOP No. LAB-504-2a, “Data Package Generation, Review, and Validation.” Any problems identified during this process will be reported to the Wee R. Contractors, Inc. Project Leader in the analytical data report.

The EPA Project Manager will review and verify the field sheets, the field activity report, and the analytical data report. Any problems or deviations identified will be discussed with the project team. The EPA Project Manager will calculate the field sheet statistics (mean, standard deviation) and the mean for the water samples collected in the marsh using a Lotus 1-2-3 worksheet.

D3. Reconciliation with Data Quality Objectives

The EPA PM will prepare a ranked data plot for the 7 water samples collected in the marsh and the 10 lead shot counts in each of the 25 decision units. The EPA PM will use the Dixon's test to identify extreme values. The EPA PM will calculate the studentized range test for each decision unit. The EPA PM will test the sample mean of each decision unit to the respective action limit using the hypothesis testing described in Section 3.2 of EPA QA/G-9, *Guidance for Data Quality Assessment* (Reference 5). A separate decision will be made for each decision unit.

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REFERENCES

1. Road, Dusty. 1992. *Lead Shot in Sediment and its Detrimental Affects on Ducks-A Comprehensive Study at the Hundred Acres Swamp.* Center City, Wannabeastate: Any Publishers, Inc.

2. Meters, Inc. Model 2000 Do-It-All Water Quality Meter Instruction Manual. 1997. *Calibration and Preventative Maintenance*, pp. 25-79.

3. Meters, Inc. Model 1500 Do-It-All Water Quality Meter Instruction Manual. 1992. *Calibration and Preventative Maintenance*, pp.17-48.

4. The You-Need-It & We-Have-It Instrument Co. Series 210B Atomic Absorption Equipment Manual. 1995. *Preventative Maintenance and Troubleshooting*, pp. 49-124.

5. U.S. Environmental Protection Agency. 1998. *Guidance for Data Quality Assessment.* pp. 3.2-1-3.2-10. EPA QA/G-9. EPA/600/R-96/084. January.

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Attachment A: Coldwater Marsh Site Map

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Attachment B: List of SOPs

EPA :

EPA-90251.3b	Handling and Disposition of Project Records and Documents

Wee R. Contractors

WRC-FLD-402-D	Field Equipment Checkout Procedures
WRC-FLD-500-D	Shipment of Field Samples to the Laboratory
WRC-FLD-905	Determination of Field Characteristics of Water
WRC-FLD-906	Determination of Biologic Field Characteristics of a Wetlands
WRC-FLD-1001-A	Use of GPS to Determine Sampling Locations
WRC-FLD-1201	Water Sample Collection–Overall Summary
WRC-FLD-1330	Sediment Sample Collection–Overall Summary
WRC-FLD-1401-A	Sample Tracking for Non-litigation Samples
WRC-FLD-1414-C	Containers Needed for Inorganic Analytes
WRC-FLD-1421-C	Sample Preservation for Water Samples
WRC-FLD-1453-C	Water Sample Collection for Inorganic Analytes
WRC-FLD-1454-A	Use of a Bomb Sampler
WRC-FLD-2304-B	Operation of Ekman Dredge for Sediment Sample Collection
WRC-FLD-2305-B	Separation Techniques for Sediment and Lead Shot
WRC-FLD-2406-B	Decontamination of Field Equipment Used for Water Samples
WRC-FLD-3306-D	On-site Assessment of Field Activities
WRC-FLD-3326-B	Validating Field Data

A. Laboratory Co.

LAB-142-1c	Analysis of Lead Using ICAP
LAB-142-2b	Analysis of Lead Using Atomic Absorption
LAB-141-2b	Digestion of Water Samples for Lead
LAB-141-3c	Digestion of Solid Sample for Lead
LAB-100-4c	Sample Receipt and Tracking
LAB-504-2a	Data Package Generation, Review, and Validation
LAB-505-3a	Records Management

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Attachment C: Field Sheet

Lead Shot Determination

Site:____

Samplers:____Date:_________________

Reviewer:____Date:_________________

Decision Unit: _____________ Location (GPS Coordinates):________________________

Gridded area for sampling: Record results in randomly selected samples (10).
Record verified results and initials of analyst.
Results recorded as number of shots.

North

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

South

Average of ten samples: _________________

Average = (sum of results)/10

Standard Deviation: _________________

Standard Deviation(raw scores) = $\left\{\left\{\sum X^2 - (\sum X)^2/n\right\}/ (n-1)\right\}^{1/2}$

Comments

- ☐ No difficulties were observed.
- ☐ Difficulties and observations are recorded on the reverse side. (Initials:____)

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Attachment D: Systematic Planning Process

Note: this systematic planning process is based on the Data Quality Objectives (DQO) process. This worksheet covers the highlights of the process for developing project-specific DQOs. For more details, please refer to EPA/G-4, "Guidance for the Data Quality Objectives Process."

SYSTEMATIC PLANNING PROCESS WORKSHEET

SITE NAME: Coldwater Marsh; Cranky Creek, Wannabeastate

1. STATE THE PROBLEM

a. *Planning Team Members*

Rusty Anchor - EPA Project Manager (primary decision maker)
Jay Bird - EPA Regional Quality Assurance Manager
Rose Petal - Project Leader, Wee R. Contractors, Inc.
Hugo Mercury - QA Manager, Wee R. Contractors, Inc.
Chuck Wagon - Field Team Leader, Wee R. Contractors, Inc.
Bobbie Socks - Analytical Services Director, A. Laboratory Co.

b. *Concise Description of Problem*

Dying ducks have been found by and reported to the Cranky Creek Department of Wildlife and Parks. All of the ducks have been found in or near Coldwater Marsh. Subsequent analysis by veterinary pathologists determined the ducks to be suffering from acute lead poisoning as indicated by high concentrations of lead in the liver, lesions characteristic of lead poisoning, and lead shot recovered from the gizzard. A shooting range with an outdoor skeet shooting area is located near Coldwater Marsh. The shooting platforms overlook and extend into the marsh. The shooting range reportedly sells shotgun shells filled with lead shot to its members at the shooting range clubhouse. A volunteer water quality monitoring project sponsored by the county has discovered elevated levels of lead in Coldwater Creek downstream from the shooting range and Coldwater Marsh. The problem is to determine whether the shooting range is contributing to the death of ducks in Coldwater Marsh and the elevated levels of lead in Coldwater Creek.

c. *Available Resources and Deadlines*

Funds for the site inspection have been provided through Superfund in the amount of $75,000. A final report including recommendations regarding further action at the site has been requested by the EPA Regional Administrator in six months.

2. IDENTIFY THE DECISION

This is an example Quality Assurance Project Plan. The site, EPA personnel, and contractors are fictitious.

a. *Primary Study Question*
Is the lead shot used by the members of the shooting range contributing to the death of ducks in Coldwater Marsh and the downstream elevated lead levels in Coldwater Creek?

b. *Alternate Actions from the Resolution of the Primary Study Question*
(1) Remediate the lead shot in Coldwater Marsh and regulate the type of shot used
(2) Take no action

c. *Decision Statement*
Determine whether or not the lead shot used by members of the shooting range is contributing to the death of ducks in Coldwater Marsh and the elevated lead levels in Coldwater Creek and needs to be remediated.

3. IDENTIFY THE INPUTS TO THE DECISION

a. *Identify Information Needed to Resolve Decision Statement*
Measurements of lead shot in the sediment and the concentration of lead in the surface water of Coldwater Marsh are needed. A background sample upstream of the site will also be needed.

b. *Determine Sources for Needed Information*
The lead shot in the sediment must be counted and compared to ecological-based criteria for lead shot densities. The concentration of lead in the surface water must be determined and compared to health-based water quality criteria for lead.

c. *Identify Information Needed to Establish Action Levels*
EPA freshwater (chronic) Ambient Water Quality Criteria (AWQC) for lead and ecological-based criteria for lead shot densities.

d. *Confirm Appropriate Measurement Techniques Exist to Provide the Data*
Ecological assessments have been conducted at other marsh/shooting range sites to determine the effects of lead shot on waterfowl. Ecological-based criteria and risks associated with lead shot densities in sediment have been determined. An effective approach for counting lead shot in sediment has been developed and used at similar sites. Lead in surface water can be measured by inductively coupled argon plasma (ICAP) or atomic absorption (AA).

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4. DEFINE THE BOUNDARIES OF THE STUDY

a. *Specify Characteristics that Define the Population of Interest*

Lead shot in the marsh sediment will be counted and the total lead concentration in the surface water of the marsh and the creek will be measured.

b. *Define Spatial Boundary of the Decision Statement*

Decisions will apply to the sediment and surface water in Coldwater Marsh.

c. *Define Temporal Boundary of the Decision Statement*

It will be assumed that the sampling data will represent the current concentrations of lead shot and lead in Coldwater Marsh. The data will be collected in early spring to avoid the heaviest flooding period of the marsh and to ensure adequate overflow into Coldwater Creek.

d. *Define Scale of Decision Making*

The scale of decision making will be the area of the marsh impacted by the shooting range activities.

e. *Identify Practical Constraints on Data Collection*

The most important practical consideration that could interfere with the study is the inundation of the marsh. The area must be flooded enough to allow for surface water sample collection and for overflow into Coldwater Creek but not flooded to the extent of restricting access to sampling points or risking the safety of samplers. Based on historic records, the heaviest flooding occurs in mid-to-late April. By conducting field activities in late March, there should be adequate inundation of the marsh to allow for sampling while avoiding the heaviest flooding period.

5. DEVELOP A DECISION RULE

a. *Specify Statistical Parameter Characterizing the Population of Interest*

The planning team is interested in the average number of lead shot per square foot of sediment and the total lead concentration in surface water (including the background sample).

b. *Specify the Action Level for the Study*

(1) $\geq$19.5 shot/ft^2 (shot densities presenting a high risk to waterfowl)
(2) 6.1 μg/L (AWQC for lead); the routine detection limit for analysis of lead in water by ICAP is 25 μg/L and the routine detection limit for analysis of lead in water by AA is 1.5 μg/L

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c. *Develop a Decision Rule*

If the lead shot densities are $\geq$19.5 shot/ft^2 and/or the surface water total lead concentration exceeds 6.1 μg/L, then remediation of the lead shot is needed. If the lead shot densities are <19.5 shot/ft^2 and the surface water total lead concentration is <6.1 μg/L, then no further action is required.

6. SPECIFY LIMITS ON DECISION ERRORS

It is important now to look at the risks or possibilities of errors with the environmental data results. Environmental data results are not right 100% of the time. There are errors associated with each method. In general, the allowed errors with the methods are for a 95% confidence level. In other words, the determined value would be as stated with the error range for 19 out of 20 attempts for the same sample. (E.g. 100 μg/L +/- 20μg/L) Let's look at the two types of methods and errors relative to each of the risks associated with the errors.

a. *ICAP/AA methods for lead*

In reviewing the possible methods, the detection limits as well as the method errors were reviewed. The detection limit for lead in the ICAP method was above the action limit. Therefore, the AA method was selected. The method detection limits of the AA method were acceptable and well below the action limit (5 times or greater). Looking at the method, there is a 10% error allowed on the standards for the method, as well as 10% difference allowed for duplicate analyses. What that means is the determined value for one sample may be 6.0μg/L, while the true value of the sample may be anywhere from 5.4 to 6.6 μg/L. In general, the method indicates that 95% of the determined data would be within this given range. These are the allowed and routine errors with the method when meeting method criteria.

If the action limit is 6.1 μg/L, what are the chances that the next determination would be above the action limit? Under normal circumstances, this would be 50% of the time or the equivalent of flipping a coin and getting heads. Not many people are willing to risk having to come back a year later, retesting, and cleaning up a site they thought was clean. How can these risks be lowered to something more reasonable? If the decision level was changed to 5.4 μg/L for the determined value, then the possible range of true values would be 4.9 to 6.0 for 95% of the time. Or any repeat analyses would be less than the action limit of 6.1 μg/L for 19 out of 20 tries, based on the method allowed errors.

The new decision rule for lead could be

"If the total lead concentrations exceed 5.4 μg/L, then reanalysis and possibly remediation is needed. Otherwise, no further action is required."

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OR

"If the total lead concentrations exceed 5.4 μg/L but less than 6.6 μg/L, then reanalysis and possibly remediation is needed. If the total lead concentration is greater than 6.6 μg/L, then remediation is needed. Otherwise, no further action is required."

b. *Lead Shot Densities*

Let's look at the way the wetland area will be tested for the method. Obviously, every square foot of the entire marsh cannot be tested when one is looking at an estimated 62,500 square feet or a 250 foot by 250 foot area. One approach would be to divide the area into grids and collect one sample from each of the grid areas.

At this point, you may want to ask a statistician for some advice or consultation. Essentially, the areas should be sufficiently large to minimize the cost and number of collected samples, but sufficiently small to provide a representative sample. The collection technique should be representative enough to provide accurate data within an error measure. If the sampling device collected sample from a square foot area, then simply counting shots would be sufficient because 19 shots is a small number. Depending on the quality of data needed, the samples could be collected from the center of each area or from a random location within the area.

Let's discuss some possible examples for this site before refining our decision rule. When shooting over the water, lead shots will travel a short or a long distance from the deck, because each participant has different reflexes and skills. In general, most of the shot will land in a concentrated area near the middle of the range. The table below shows what we anticipate the profile of the area should look. No values are provided, because they are unknown.

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Shooting Range–estimated concentrations

x	xx	xxx	xx	x
x	xx	xxxx	xxx	x
xx	xxx	xxxxx	xxx	xx
x	xxx	xxxx	xx	x
x	xx	xxx	xx	x

If we were the shooting range company, we would want only a handful of samples to minimize our cost, so we might only collect four samples. If we divide the area of concern into four grid areas (grid test 1), and collect from the center of the areas, we may miss the highest concentration of shot in the center. If the centers were just below the action limit at 19.5 shots per square foot or 304,000 shots per grid area, then the average may well be above the action limit average. Also the potential for errors would be very large.

Shooting Range–grid test 1

If the environmental group selected the grid area, they may select a 1 x1 or a 3 x 3 grids because they know the center area would require remediation.

Either case, the interested parties would bias the data in their favor. Additionally, neither of these plans accurately describe the area. Perhaps the situation would be to set the area into a 25 section grid as shown below. Depending on the money available, anywhere from 1-9 samples could be collected from each of the grid areas.

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Shooting Range-Grid Selection

A1	B1	C1	D1	E1
A2	B2	C2	D2	E2
A3	B3	C3	D3	E3
A4	B4	C4	D4	E4
A5	B5	C5	D5	E5

Now let's look at the potential errors with this sampling plan. There are two errors that could occur with this method. First, the person counting the shots from the sample could make a mistake. A second person verifying the results would be able to confirm any mistakes. Therefore, the largest error likely is the count +/- 1. Second, a single sample may not be completely representative for the area. One way to check the variability or the error of the determined value would be to further subdivide one grid area into 9 or 25 smaller areas, pulling samples from each of these areas, and averaging the results to determine the error. After accounting for these two errors, then we could proceed as with the lead method.

For arguments sake, let's say that nine samples were collected from each grid area and averaged. It was found that the largest error of the average results was 20%. Using the process from the lead method, then we could refine our decision rule as such:

"If the average lead shot for any area exceeds 15.5 shots, then reanalysis and possibly remediation is needed. Otherwise, no further action is required."

OR

"If the average lead shot for any area exceeds 15.5 shots but less than 23.4 shots, then reanalysis and possibly remediation is needed. If the average lead shot is greater than 23.4 shots, then remediation is needed. Otherwise, no further action is required."

c. *Refine the Decision Rule:*

The decision rule will remain the same: If the lead shot densities are $\geq$19.5 shot/ft^2 and/or the surface water total lead concentration exceeds 6.1 μg/L, then remediation of the lead shot is needed. If the lead shot densities are <19.5 shot/ft^2 and the surface water total lead concentration is <6.1 μg/L, then no further action is required. However, the modified limits (15.5 shots and 5.4 μg/L) will be used to set the gray region later in the process.

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d. *Specify Tolerable Limits on Decision Errors:*

i. Possible range of the parameter of interest:

For the lead shot, previous studies at a similar site have shown lead shot counts as few as 1 lead shot/ft^2 and as high as 283 lead shot /ft^2. Therefore, the minimum-maximum values for the lead shot are set as 1-283 lead shot/ft^2. For the water matrix, we would not expect the marsh or the creek to contain environmentally significant concentrations of lead because no naturally occurring sources of lead are known to exist in the area. The volunteer monitoring project sponsored by the Camel County Environmental Coalition reported a lead concentration of 10 μg/L. Therefore, the minimum-maximum values for total lead in water are set as 0-10 μg/L.

ii. Define the null hypothesis and assign terms false positive and false negative to the appropriate decision

Because this project concerns human health and ecological risk, the decision error that has the most adverse potential consequences will be defined as the null hypothesis.

Null Hypothesis: The site is dirty and will require further action. (Baseline condition)
Alternate Hypothesis: The site is clean and no action is needed.

False Positive, F(+): Reject the null hypothesis when it is really true (decide site is clean when it is really dirty). The consequences of a F(+) error are the most severe because not cleaning up the site when it should be remediated could cause harmful human health and ecological effects at a later date. The acceptable F(+) error rates were initially set as 10% for the lead in water (based on the error associated with the method) and 20% for the lead shot in sediment (selected by the planning team as an estimate based on previous studies at a similar site).

False Negative, F(-): Accept the null hypothesis when it is not true (decide site is dirty when it is really clean.) The consequences of a F(-) error are less severe because, although time and resources may be wasted on unnecessarily remediating an already clean site, human health and ecological interests will still be protected. The acceptable F(-) rates were initially set as 20% for the lead in water (based on the error associated with the method) and 30% for the lead shot in sediment (selected by the planning team as an estimate based on previous studies at a similar site).

iii. Define the Gray Region

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As described previously in step 6, decision limits were established based on the action limits and the error associated with the methods. The decision limits and the action limits were used to establish the gray regions. For water, the gray region will be defined as 5.4 μg/L - 6.1 μg/L. For sediment, the gray region will be defined as 15.5 lead shot/ft^2 - 19.5 lead shot/ft^2.

7. OPTIMIZE THE DESIGN

a. *Considerations for optimizing the design:*

- Develop a statistical base for sample results using a mean (average) value
- Develop a sample collection design within budget (<$75,000)
- Develop a sampling design sufficient to reduce errors in the decision
- Optimize the design for future remediation (require remediation where needed)

Generally, two approaches can be used to optimize the sampling design for the above listed considerations. One way would be to hire a statistician and to manually calculate the statistics, budget, and design. A second way would be to input the information from steps 1-6 into EPA's computer program called Decision Error Feasibility Trials (DEFT). DEFT is a software program that will provide the cost of the sampling and analysis for a project, as well as the minimum number of random samples needed to satisfy the hypothesis and the acceptable error limits using a mean value. Input values include the action level, the standard deviation, the false positive error, the false negative error, estimated field costs per sample, and estimated analytical costs per sample. DEFT assumes that each decision unit is a homogeneous matrix and the Coldwater Marsh site has been divided into decision units considered to be homogenous by the planning team members based on the size of the impacted area and the matrices.

Let's review the planning decisions so far:

Null Hypothesis: The site is dirty and will require further action.
Alternate Hypothesis: The site is clean, and no action is needed.

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b. *Develop the Sample Collection Design-Use of DEFT*

Using the limits on decision errors established in step 6 above, the following information was entered into DEFT for the water matrix:

parameter of interest:	arithmetic mean (also the default for DEFT)
minimum:	0
maximum:	10
standard deviation:	0.6
action limit:	6.1
gray limit:	5.4
Null hypothesis:	arithmetic mean > 6.1
F(-) error rate:	0.20
F(+) error rate:	0.10
field cost/sample:	$50
lab cost/sample:	$50

This information yielded a sampling design using five samples. Based on further discussion among the planning team members, it was decided to tighten the acceptable errors because of the greater risk presented by lead contaminated surface water to waterfowl in the marsh and fishermen downstream of the site. The F(-) error rate was changed to 15% and the F(+) error rate was changed to 5%. The information was entered into DEFT again which resulted in a sampling design calling for seven random samples to satisfy the hypothesis and the acceptable error limits using a mean value. Therefore, seven surface water samples will be collected from Coldwater Marsh, one sample will be collected upstream as the background, and one sample will be collected downstream at the permanent sampling station established for the volunteer water quality monitoring project with a total cost of $900 (at $100/sample).

Using the limits on decision errors established in step 6 above, the following information was entered into DEFT for the sediment matrix:

parameter of interest:	arithmetic mean (also the default for DEFT)
minimum:	1
maximum:	283
standard deviation:	5
action limit:	19.5
gray limit:	15.5
Null hypothesis:	arithmetic mean > 19.5
F(-) error rate:	0.30
F(+) error rate:	0.20

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field cost/sample: $100
lab cost/sample: $0

This information yielded a sampling design using four samples. Because the decision for each decision unit will be based on the mean and at least seven samples are needed to calculate a statistically significant mean, the error rates were also tightened for the sediment. The F(-) error rate was changed to 15% and the F(+) error rate was changed to 10%. The information was entered into DEFT again which resulted in a sampling design calling for ten samples per decision unit to satisfy the hypothesis and the acceptable error limits using a mean value with a total cost of $25,000 (at $1000/decision unit for 25 decision units).

Assumptions: For this study, the following assumptions were made:

i. Each decision unit is homogeneous within the selected errors.
ii. Wetland water travels downstream in the watershed and would have a larger impact as far as risk.
iii. All shots are lead, none are steel based at this time.
iv. All decision units on the edge would be clean based on expected shooting patterns and the range of the shotguns used; therefore, implying that lead shot contamination is limited to the design area.

c. *Data Quality Indicators- PARCC*

All data will be evaluated using random sampling within pre-defined decision units. For the water matrix, only one decision unit will be defined. For the sediment samples, 25 decision units (DU) will be defined of approximate size of 50 ft x 50 ft. The mean result within each decision unit will be calculated and used for the decision at the site. Data quality indicators include precision, accuracy, representativeness, comparability, and completeness.

Precision: the measure of agreement among replicate measurements of the same property. The precision at this site will be calculated as a standard deviation within each decision unit. For lead in the water samples, a standard deviation equal to or less than 0.6 ug/L (based on previous studies at a similar site) for the seven samples would be acceptable. For lead shot in the sediment samples, a standard deviation equal to or less than five shots (based on previous studies at a similar site) for the ten samples within each decision unit would be acceptable. Standard deviations greater than those listed above would indicate that the matrices were not as homogenous as anticipated, and may have a larger error associated with the results.

Accuracy: the measure of the closeness of an individual measurement of the average of a number of the measurements to the true value. Accuracy includes the combination of random

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error (precision) and systematic error (bias) components that may result from the sampling and analytical operations. For the lead in water, a blind spiked sample will be analyzed to determine any possible bias. As long as the recovery of lead is within the limits defined in the method, then there will be no significant bias in the analytical data. Therefore, as long as the bias and precision are acceptable, then the accuracy of the lead results would be acceptable. If the accuracy for lead in water is not acceptable, then the data may not be very precise or may be biased. For the lead shot in sediment, no known method for determining accuracy is available. However, one out of every ten determinations will be confirmed by a second field team member. As long as the count is within +/- 1 shot, then the determination will be considered to be accurate for the decision unit. If the count of the lead shot does not match, the sample will be recounted, and another sample within the decision will be verified.

Representativeness: the degree to which data accurately and precisely represent a characteristic of a population parameter at a sampling point. By using the DEFT program and a random number generator, individual samples will be collected for each decision unit. Selection of random samples will provide representativeness over the decision unit. For the water sample, the area will be divided into 25 units (matching the 25 decision units for sediment) and seven (7) samples will be randomly collected. For the sediment samples within each decision unit, the area will be divided into 25 more units and ten (10) samples will be randomly collected. This type of random sampling within decision units will assure that a representative collection of samples occurred.

Completeness: the measure of the amount of valid data obtained from a measurement system, expressed as a percentage of the number of valid measurements that should have been collected. To generate data with the final test design criteria, 100% of the samples must be collected and analyzed.

Comparability: a measure of the confidence with which one data set or method can be compared to another. For this project, comparability will be addressed through the use of common and accepted practices and by reporting data in standard units.

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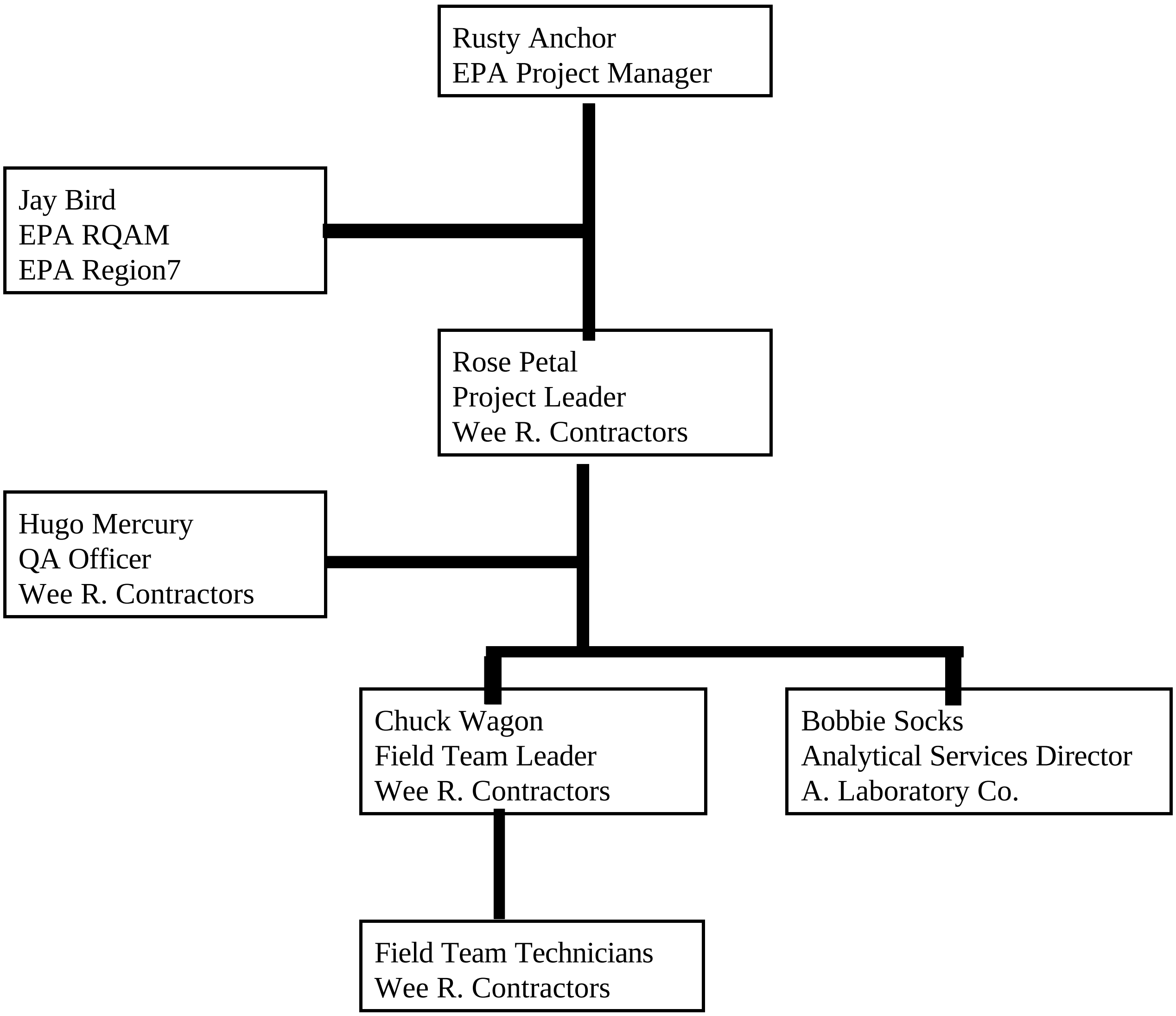
Attachment E: Project Organization Chart

Site Inspection at Coldwater Marsh
Organizational Chart



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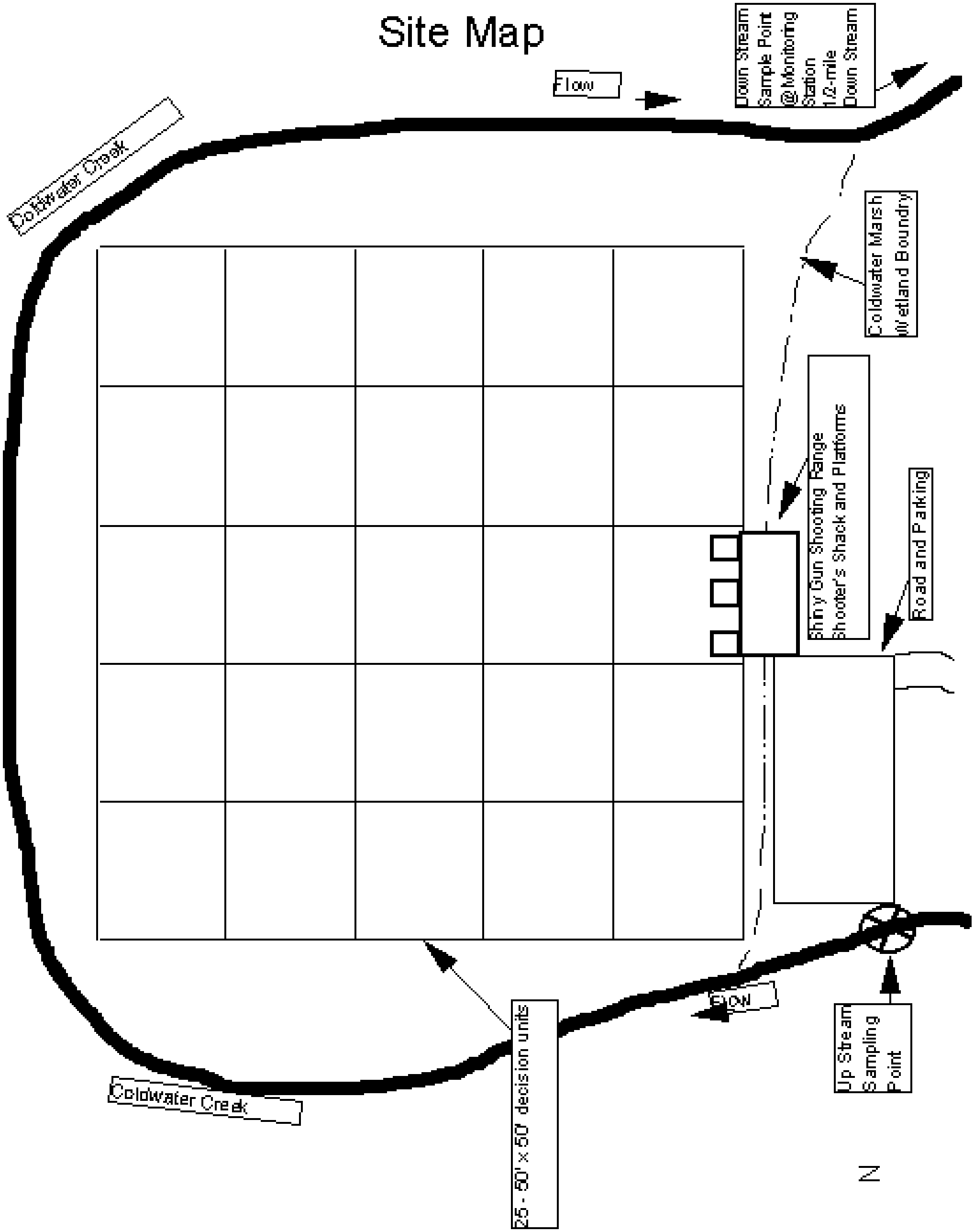
Attachment A
Coldwater Marsh
Site Map



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