Appendix C

Construction Quality Assurance Plan

ARCADIS

Appendix C
Construction Quality Assurance Plan

Mayflower Pipeline Incident Response
Mayflower, Arkansas

Table of Contents

Attachment

Acronyms and Abbreviations

ADEQ	Arkansas Department of Environmental Quality
ARCADIS	ARCADIS U.S., Inc.
CQA	construction quality assurance
CQAP	Construction Quality Assurance Plan
EMES	ExxonMobil Environmental Services Company
HASP	Health and Safety Plan
$\mu g/m^3$	micrograms per cubic meter
NTU	nephelometric turbidity units
PCB	polychlorinated biphenyl
SVOC	semivolatile organic compounds
site	Mayflower Pipeline Incident Response located in Mayflower, Arkansas
VOC	volatile organic compound

1. Introduction

ARCADIS U.S., Inc. (ARCADIS) prepared this Construction Quality Assurance Plan (CQAP) for ExxonMobil Environmental Services Company (EMES) on behalf of ExxonMobil Pipeline Company for the Mayflower Pipeline Incident Response located in Mayflower, Arkansas (the site). The purpose of this document is to provide quality assurance and quality control related to the construction and installation of the mitigation action selected for the cove in the designated areas, which consist of the Inlet Channel, Open Water Area, and Heavily Vegetated Area. Procedures are identified and described for monitoring and documenting the quality of materials and the condition and manner of their construction, installation, and removal.

Post-construction monitoring activities are not included in the scope of this CQAP, but will be proposed in the Mitigation Action Completion Report.

1.1 CQAP Content and Organization

This remainder of this CQAP is organized as follows:

- *Section 2 – General Construction Quality Assurance (CQA) Requirements*. This section provides an overview of general CQA requirements, including the roles and responsibilities of key personnel, project meetings, and documentation.

- *Section 3 – Site Preparation Activities.* This section describes the site preparation activities that will be performed prior to construction and installation of the mitigation action.

- *Sections 4 and 5* – These sections describe verification, inspection, transport, and disposal activities specific to the construction phases of targeted removal in the Inlet Channel (*Section 4*), sediment capping in the Open Water Area, and in-situ amendment placement in the Heavily Vegetated Area (*Section 5*).

- *Section 6 – Monitoring Activities.* This section describes the air and surface water monitoring activities that will be performed during the construction and installation of the mitigation action.

- *Section 7 – Demobilization.* This section provides an overview of demobilization activities that will be performed after construction of the mitigation action.

2. General Construction Quality Assurance Requirements

2.1 Construction Quality Assurance

CQA will be provided under the oversight of the CQA Manager throughout the construction process. Final Construction Drawings and Specifications (referred to herein as "Drawings and Specifications") will be developed prior to mobilization and stamped by an Arkansas-licensed Professional Engineer. CQA refers to the means and actions used to ensure that work is performed in accordance with this CQAP and the Final Construction Drawings and Specifications. Sections 3 through 6 of this CQAP list the requirements for providing CQA, including monitoring, sampling, inspections, observations, tests, and criteria.

2.2 Roles and Responsibilities

Specific roles and responsibilities associated with the project are described below.

- *Owner*. EMES is responsible for coordinating and performing the mitigation action at the site, as well as providing oversight and direction during construction activities.

- *Contractor*. The firm(s), including subcontractors, are responsible for performing construction activities at the site in accordance with the CQAP, Drawings, Specifications, and Health and Safety Plan (HASP). Specific responsibilities include facilitating the completion of CQA activities and participating in project meetings and planning. EMES has retained Conestoga-Rovers & Associates to implement the mitigation action, including health and safety oversight.

- *CQA Manager.* The CQA Manager is a licensed Professional Engineer of the State of Arkansas (or working under a licensed Arkansas Professional Engineer) and is responsible for overseeing the implementation of this CQAP. The individual does not need to be on site full-time during construction and will rely on the field staff to perform CQA field tasks such as sample collection, construction observation and documentation, and material acceptance. Specific responsibilities include:

  - Review all CQA data related to the project and work with the CQA Monitor to interpret CQA field and laboratory testing results.
  - Coordinate routinely and provide necessary guidance to the CQA Monitor on the proper completion of CQA activities at the site.
  - Resolve CQA issues with the CQA Monitor and Site Field Manager.

- *CQA Monitor.* The CQA Monitor(s) performs CQA field tasks at the direction of CQA Manager. The CQA Monitor will be on site throughout the duration of the project. Specific responsibilities include:

- Complete a Daily Project Report for each day of construction.
- Attend daily work meetings and weekly progress meetings.
- Coordinate/perform sample collection and observation, inspection, and documentation of the construction activities including preparing any forms, checklists, and/or data sheets that will facilitate data handling, communications, and routine observations.
- Stop work if needed due to noncompliance issues.

- *Site Field Manager.* The individual is an employee of the Contractor and has the overall responsibility for all construction aspects of the project. The Site Field Manager will be on site throughout the duration of the project. Specific responsibilities include:
  - Manage daily construction activities and provide construction information to the CQA Monitor for the Daily Project Report.
  - Coordinate and attend daily work meetings and weekly progress meetings.
  - Maintain daily contact with the Site Health and Safety Officer.
  - Communicate with the CQA Manager and/or Monitor for items that require CQA Manager direction or approval.
  - Coordinate all Contractor activities and verify all Contractor qualifications.
- *Site Health and Safety Officer.* The individual is an employee of the Contractor and has the overall responsibility for the technical health and safety aspects of the project, including review and approval of the HASP. The Site Health and Safety Officer will be on site throughout the duration of the project and this role may be combined with other tasks, as practical.

2.3 Project Meetings

To attain a high degree of quality during construction, clear and open channels of communication are essential. To maintain communications throughout construction, specific project meetings will be held, as described below.

- *Pre-Construction Meeting.* A Pre-Construction Meeting will be held prior to commencing construction activities. This meeting will include the CQA Manager, CQA Monitor, Engineer, Site Field Manager, and Site Health and Safety Officer. The purpose of the Pre-Construction Meeting is to coordinate the completion of CQA tasks, discuss any potential problems that might cause quality issues and delays in construction, and discuss the roles and responsibilities of CQA personnel. Specific topics considered for this meeting may include review of critical design details, lines of authority and communication, required

documentation, and the schedule for all construction operations. Minutes of the meeting will be recorded by the Site Field Manager and transmitted in a timely manner to all parties.

- *Daily Work Meeting.* Daily Work Meetings will be held at the beginning of each work day at the work area. At a minimum, the Daily Work Meetings will be attended by the Site Field Manager, Site Health and Safety Officer, and appropriate subcontractors. The purpose of this meeting is to briefly discuss the previous day's work activities and any problems encountered, review the work activities for the current day, and review health and safety-related requirements. The Site Field Manager will coordinate the Daily Work Meetings.

- *Weekly Progress Meeting.* A Weekly Progress Meeting will be held at the work area and, at a minimum, will be attended by the CQA Manager, CQA Monitor, Site Field Manager and appropriate subcontractors. The purpose of this meeting is to review the previous week's activity and accomplishments, review the work schedule, work activities, and location for the week, discuss weekly assignments for the construction personnel and equipment, discuss possible problems, and review construction documentation requirements. The Site Field Manager will coordinate the Weekly Progress Meeting, develop and circulate a weekly meeting agenda, and develop and circulate weekly meeting minutes.

2.4 Documentation

The documentation of CQA activities is the most effective method of confirming that the CQA requirements have been addressed and satisfied. The documentation process includes:

- Recognition of construction tasks that should be observed and documented.

- Assignment of responsibilities for the observation, testing, and documentation of these tasks.

- Completion of the required forms, data sheets, notes, and reports to provide an accurate record of the work performed during construction.

The CQA Monitor will provide the CQA Manager with fully completed and signed reports, forms, data sheets, and checklists to document that CQAP requirements have been carried out. All documents will be stored in a project folder on site throughout the duration of construction activities.

The following reports and documentation activities will be completed through the duration of construction activities:

- *Daily Project Report*. A Daily Project Report will be completed by the CQA Monitor and will consist of field notes, descriptions of work in progress, monitoring and testing data sheets, summaries of meetings with the Contractor, reports of construction problems, resolutions, and other requirements discussed in this CQAP. A template of the Daily Project Report is included in Attachment A. The report will be submitted to the CQA Manager the following morning and filed on site.

- *Photo Documentation*. Phases of construction, including observations, problems, deficiencies, and work in progress, will be photographically documented and logged. Photographs will be presented in print or electronic format and will be filed in chronological order in a permanent file by the CQA Manager and/or the CQA Monitor.

- *Design Modifications, Clarifications, and Changes*. During construction, the need to document design and/or specification clarifications, modifications, and/or changes may arise. In such cases, the CQA Manager will notify the Site Field Manager, Site Health and Safety Officer, and Contractor of the need for any clarifications, modifications, or changes, which will only be made with written agreement from the Owner. The Design Modifications, Clarifications, and Changes Form (Attachment A) will be used for this purpose.

- *Field Equipment Calibration Log*: Instruments and equipment used to gather, generate, or measure field data will be calibrated at the intervals specified by the manufacturer or more frequently, and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. Equipment found to be out of tolerance during the period of use will be removed from the field. The Field Equipment Calibration and Maintenance Log (Attachment A) will be used for this purpose.

- *Pre-Final Inspection Documentation*: After conducting a pre-final inspection (see Section 7.2), the Contractor will prepare Pre-final Inspection documentation that identifies the deficiencies, proposed completion dates for the outstanding items, and proposed date for a final inspection.

- *Final Inspection Documentation*. Based on the final inspection (see Section 7.2), the CQA Manager, with assistance from the CQA Monitor, will provide written notification that field activities have been completed and the date the work was completed in accordance with the Arkansas Department of Environmental Quality- (ADEQ)-approved Mitigation Action Plan.

- *Mitigation Action Completion Report*. A Mitigation Action Completion Report will be prepared by the CQA Manager and submitted to the regulatory agencies to provide notice of completion of construction. The report will contain data and reports generated throughout the duration of construction activities.

3. Site Preparation Activities

This section describes the activities that will be performed prior to the start of the construction activities.

3.1 Mobilization and Site Preparation

Prior to mobilizing to the site, the Site Field Manager will coordinate with the CQA Monitor to confirm equipment staging areas, access routes, and stockpile locations. All materials and equipment will be available for inspection by the CQA Manager prior to initiating field activities.

The Contractor will locate all utilities within the limits of work prior to any site work. If necessary, utilities will be disconnected per the approved Construction Work Plan (to be prepared by the Contractor prior to mobilization).

Site clearing will include debris and vegetation removal in accordance with the approved Construction Work Plan. Protection around mature vegetation will be constructed prior to clearing activities or mobilization of heavy equipment.

The CQA Monitor will make daily visual observations of the material and equipment staging areas, access roads, and stabilized construction surfaces and will document observations in the Daily Project Reports. Any instances of non-conformance will promptly be reported to the CQA Manager and corrected.

3.2 Environmental Protection and Monitoring

Erosion and sedimentation controls will be implemented in accordance with the approved Stormwater Pollution Prevention Plan, which will be provided in the Construction Work Plan. The CQA Monitor will visually inspect the erosion and sedimentation controls daily and once after a storm event, and document observations in the Daily Project Report. Instances of non-conformance will be documented by the CQA Monitor, promptly reported to the Site Field Manager, and corrected accordingly.

At a minimum, the following water quality controls will be installed:

- Turbidity curtains will be maintained and/or installed downstream of the work area.
- Containment booms.
- Absorbent booms.

The CQA Monitor will visually inspect the water quality controls daily during the work, and will document observations in the Daily Project Report. Instances of non-conformance will be documented by the CQA Manager, promptly reported to the Field Site Manager, and corrected accordingly. Sheen monitoring requirements are discussed in Section 6.

3.3 Cleaning Area

Personnel and equipment that have come into contact with oily materials on site will require cleaning prior to leaving the work area or handling potentially non-impacted materials. Equipment will be cleaned within designated area(s).

The Site Field Manager will observe cleaning activities to document in the Daily Project Report that the following activities are completed:

- Project equipment (e.g., trucks, hand tools) that comes in contact with oil materials is cleaned prior to demobilization from the work area and prior to handling non-impacted or clean material.

- No visible soil, debris, or stains are present on the equipment surfaces upon arrival at the site or prior to leaving the site.

- Solids and other materials generated during equipment cleaning that require off-site treatment/disposal are collected and placed into appropriate containers for characterization and off-site disposal.

The Site Field Manager will request additional cleaning, if necessary.

4. Sediment Removal and Handling Activities

This section describes the CQA activities to be conducted during removal activities. The purpose of these removal activities is to excavate the sheen-bearing sediment and bank soils from the Inlet Channel, which includes approximately 1,300 feet of main channel between Interstate 40 and the Open Water Area. After completion of removal activities, the Contractor will backfill the removal areas using clean borrow materials.

The CQA Manager will notify the Contractor to proceed with the removal activities after reviewing the completion of site preparation activities (e.g., utilities mark-out, vegetation removal, demarcated removal areas, installation of erosion and sedimentation controls, installation of water management controls, and construction of sediment handling areas).

4.1 Removal Verification and Inspection Activities

The removal areas (e.g., areas with 6-inch target removal depths, areas with 12-inch target removal depths, and areas with 18-inch target removal depths) will be marked in the field by the Contractor prior to the start of removal activities. Removal dates, locations, times, and any problems or deviations from the Mitigation Action Plan will be recorded in the Daily Project Report by the CQA Monitor.

During the removal activities, visual inspections, interim topographic surveys, and elevation measurements will be performed, as needed, to evaluate the progress of removal activities. After completion of removal activities within a section of the Inlet Channel, the removal extent and effectiveness will be verified by confirmation sampling as described below.

4.1.1 Confirmation Sampling

Confirmation sampling will be performed to confirm that the removal goal (i.e., sheen-bearing material) has been achieved. Confirmation sampling will be performed at least every 20 feet along the centerline of the Inlet Channel. After confirming that the removal depth has been met within the removal area, the CQA Monitor will conduct the sheen stir test as described below:

- Collect a sediment sample up to 6 inches below the sediment surface using push cores (Zipliner soil sampling sleeves or equivalent) or hand auger. Decant the overlaying water after the sediment core is collected. Record the coordinates of the sampling location using a handheld global positioning system unit.

- Section the sample and take a photograph of the sample.

- Place the sample from 0 to 3 inches into a clean aluminum pan or a steel pan for homogenization. After homogenization, place the sample into a clean jar and add clean water to observe immediate sheen generation, if any. If sheen does not generate immediately, gently stir the water and sediment mix using a clean stick, and allow sheen to release from the sediment, if present. Document sheen characteristics in the Confirmation Sampling Form (Attachment A) and photograph the sheen development for each sample, in accordance with the Sheen Field Description and Characterization Standard Operating Procedure (Attachment B). Dispose of the sample using appropriate procedures.

If sheen is observed in the confirmation sample, then the sample from 3 to 6 inches will be tested using the same procedure. The CQA Manager will review the confirmation sampling results. If sheen is observed in the confirmation sample, then the CQA Manager will direct the Contractor to remove additional material, depending on the sample results. Additional samples may be collected at 5-foot or 10-foot stepouts from the confirmation sample to delineate the area for additional removal. After additional removal, sheen stir test will be conducted by collecting a second confirmation sample, as described above. The CQA Manager will review the results and direct additional excavation, if necessary. The removal activities will take place until the underlying clean sediment layer has been encountered, or the results have been discussed with the ADEQ.

4.1.2 Targeted Backfill

The Contractor will be responsible for providing certifications that the borrow materials are clean earthen fill. The Contractor will also send fill material samples to Lancaster Laboratories in Lancaster, Pennsylvania to be analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), inorganic constituents (including cyanide), pesticides, herbicides, and polychlorinated biphenyls (PCBs) at a frequency of one sample per 1,000 cubic yards. The CQA Manager will confirm suitability prior to delivery to the site

The CQA Monitor will record the amount of material delivered to each area where the removal depth was greater than 6 inches. The CQA Manager will confirm that all requirements of the backfill have been met prior to re-inundating any dewatered areas.

4.1.3 Post-Backfill Survey

Following completion of removal and backfill activities, a licensed surveyor (hired by the Contractor) will perform post-backfill topographic surveys to document the post-removal conditions of the Inlet Channel. Survey equipment will be maintained and calibrated prior to the survey activities each day. This post-backfill survey will meet the following minimum requirements:

- 20-foot transect spacing in the limits of excavation

- Measurements will be made to nearest 0.1 foot in horizontal and vertical
- +/- 0.1-foot accuracy vertical
- +/- 0.1-foot accuracy horizontal
- Horizontal Datum – North American Datum of 1983, Arkansas State Plane
- Vertical Datum – National American Vertical Datum of 1988

The CQA Manager will use the survey to complete the final Mitigation Action Completion Report.

4.2 Sediment Handling Inspection Activities

Removed sediment will be transferred to the upland staging area for solidification. Solidified sediment will meet the requirements of the Paint Filter Test by Method 9095B (United States Environmental Protection Agency 2004) and contain no free liquid prior to being transport to an off-site disposal facility. The Contractor will be responsible for conducting a field-based Paint Filter Test at a frequency of one test per 100 cubic yards. The CQA Monitor will oversee these tests and will record the results (pass or fail) in the Daily Project Report.

4.3 Sediment Transport and Disposal

Dewatered sediment will be loaded into roll-off boxes (or similar) at the site and transported to the approved off-site disposal facility. The trucks will contain a tarp to cover material while transporting, and onboard scales (or equivalent) to measure the weight of material loaded onto the trucks. The CQA Monitor will be responsible for:

- Observing the trucks to ensure they have been properly cleaned, as described in Section 3.3.
- Observing the secure placement of the tarp on the trucks prior to leaving the site.
- Obtaining waste manifests and bills of lading for each truck load leaving the site.

The transported materials will be disposed at an approved off-site disposal facility.

5. Sediment Capping and Amendment

This section describes the CQA activities during the placement of a reactive cap over sediment in the Open Water Area and the placement of amendment material over the Heavily Vegetated Area. Sediment capping activities include placement of a mixture of sand and organoclay over sheen-bearing sediments within the Open Water Area and will cover approximately 4.5 acres. In-situ amendment placement will include the placement of organoclay in the Heavily Vegetated Area within an area of approximately 2.0 acres.

5.1 Reactive Cap Material and Placement Verification in Open Water Area

The reactive cap materials for the Open Water Area include clean sand and organoclay. The Contractor will provide certifications or documentation that the sand is clean earthen fill and meets the required grain size criteria. The Contractor will also send sand material samples to Lancaster Laboratories in Lancaster, Pennsylvania to be analyzed for VOCs, SVOCs, inorganic constituents (including cyanide), pesticides, herbicides, and PCBs at a frequency of one sample per 1,000 cubic yards. The Contractor will provide a material certification from the vendor providing the results of the organoclay testing. The CQA Manager will confirm that organoclay testing results provided on the certification are in accordance with the manufacturer's accepted values.

The Contractor will be responsible for staking the boundaries of the capping area prior to the start of capping activities. In addition, the CQA Monitor will place three to five sediment collection pans at random locations in the first 100 foot by 100 foot grid (or approximately 10,000 square feet area) to be capped. Following placement of the cap material in the target grid, the CQA Monitor will pull up the trays and record the thickness of material placed to ensure the target thickness is met. If the cap thickness is not within the target range at specific collection plan locations, then push cores may be collected on a step out pattern around those locations to evaluate the area requiring placement of additional cap materials. The CQA Monitor will observe and document the settlement collection pan and any related push core observations in the Daily Project Report, and, with confirmation from the CQA Manager, will direct the Contractor for additional material placement, if required.

In addition, the Contractor will document the sand and organoclay amounts for each batch of material that is mixed. The CQA Monitor will record the amount (weight and volume) of sand and organoclay mixed and placed each day in the Daily Project Report.

5.2 Amendment Material and Placement Verification in Heavily Vegetated Area

The amendment materials for the Heavily Vegetated Area include pure organoclay. The Contractor will provide a material certification from the vendor providing the results of the organoclay testing. The CQA

Manager will confirm that organoclay testing results provided on the certification are in accordance with the manufacturer's accepted values.

The CQA procedures associated amendment placement will include verification of amendment/sand mixing ratios, application rates, precise tracking and documentation of the amendment supply rates, as well as weight of amendment delivered to the site and placed in the Heavily Vegetated Area.

The Contractor will be responsible for maintaining the required application rate of 1 pound per square foot. Only areas that can be accessed safely will be treated. If an area cannot be accessed safely, then the CQA Manager will approve deviation from the target area. The CQA Monitor will record the volume and weight of amendment material placed in the Heavily Vegetated Area in the Daily Project Report.

6. Environmental Monitoring Activities

6.1 Air Monitoring

For the purpose of construction worker safety, air will be monitored in accordance with the HASP. Continuous real-time monitoring for particulates (dust) will be performed during construction activities which entail ground intrusive operations. Ground-intrusive operations include, but are not limited to, site grading, soil excavation, material transfers, and stockpiling. Monitoring will be performed using portable tripod- or pole-mounted stations equipped with particulate monitoring equipment. A minimum of two stations will be used to represent the background or upwind conditions and the maximum disturbance or downwind conditions. Monitoring stations may be relocated to accommodate the concerns associated with the current phase of work, prevailing wind direction, local wide channels, or other site considerations.

Action levels will be based on the National Ambient Air Quality Standard for direct impact on human health. These standards are established based on the presence of particulate matter less than 10 microns in diameter (PM_{10}). Based on an examination of air quality composition, respiratory tract deposition, and health effects, PM_{10} is considered conservative for the primary air quality standard requisite to protect public health with an adequate margin of safety. Observations of PM_{10} particulate concentrations above 100 micrograms per cubic meter ($\mu g/m^3$) and visual observations of dust plumes will be recorded on the Dust Monitoring Form (Attachment A). Corrective actions will be taken to address particulate concentrations according to the table below.

Observation	Corrective Action
Visible dust	Notify contractor of conditions and request for contractor to apply control measures as necessary to mitigate visible dust.
PM_{10} <100 $\mu g/m^3$ downwind of work area	Continue monitoring and implement control measures necessary to prevent visible dust.
PM_{10} >100 $\mu g/m^3$ over a 5-minute period	Notify contractor of elevated particulate levels and continue monitoring.
PM_{10} >125 $\mu g/m^3$ above background (upwind of work area) over a 5-minute period	Notify contractor of elevated particulate levels and that continuation of current conditions could result in exceedances. Recommend appropriate control measures (e.g., use of water spray or dust suppressant foam) and continue monitoring.
PM_{10} >150 $\mu g/m^3$ above background (upwind of work area) over a 15-minute period	Cease work activity that is creating fugitive emissions if PM_{10} concentration cannot otherwise be lowered. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM_{10} particulate concentration to within 150 $\mu g/m^3$ of the upwind level and in preventing visible dust migration.

Combined with an adequate dust suppression program, air monitoring will protect both onsite personnel from exposure to high levels of dust and the public around the site from any exposure to dust.

6.2 Sheen Monitoring

Ongoing weekly sheen monitoring and maintenance will continue per the approved Sheen Monitoring and Maintenance Plan (Revision 2; EMES 2014) until after mobilization is complete and prior to the start of site construction activities. At the start of site construction activities, the sheen monitoring activities described below will supersede the weekly program.

6.2.1 Sheen Monitoring in the Active Work Area

During construction activities, surface water in the active work area will be monitored for the presence of sheens. If sheens are observed during construction in the work area, the sheens will be removed.

6.2.2 Sheen Monitoring Downstream of the Heavily Vegetated Area

Daily surface water sheen monitoring and removal will be performed in the cove downstream of the Heavily Vegetated Area in accordance with the procedures outlined in Sheen Field Description and Characterization Standard Operating Procedure (Attachment B). The results of the daily sheen monitoring will be recorded on the Sheen Monitoring Form for the B-On Water (Attachment A). The sheen monitoring results will be summarized in the Mitigation Action Completion Report.

6.2.3 Sheen Monitoring within the Heavily Vegetated Area

Following the application of in-situ amendment in the Heavily Vegetated Area, sheen monitoring and removal will be performed within the Heavily Vegetated Area three times per week. The monitoring will be performed in accordance with the procedures outlined in Sheen Field Description and Characterization Standard Operating Procedure (Attachment B). The results of the sheen monitoring will be recorded on the Sheen Monitoring Form (Attachment A) and will be used to evaluate whether additional application of in-situ amendment is warranted.

6.3 Surface Water Monitoring

6.3.1 Turbidity Monitoring

Prior to construction activities, turbidity readings will be recorded during normal flow conditions at the Inlet Channel culvert under I-40 and at the cove outlet to establish background data[1]. Pre-construction turbidity data will be collected at both locations twice daily over a monitoring period of 7 days.

During active construction and normal flow conditions (i.e., not during or 24-hours following rainfall events), turbidity readings from the cove outlet will be recorded at approximately two times per day. These data will be compared to pre-construction data to identify variations in turbidity from background levels. The turbidity trigger level of 100 nephelometric turbidity units (NTU) above background during normal flow conditions is selected to identify if modification of turbidity control measures or construction operations is needed. If the turbidity readings are above the trigger level for three successive readings, then engineering controls and construction activities will be adjusted as necessary to decrease turbidity. If the turbidity readings do not return to below trigger level values within a period of three additional measurements following corrective measures, then work will be temporarily stopped and/or additional controls will be implemented to allow turbidity levels to decline. The monitoring results will be included in the Mitigation Action Completion Report.

Additional turbidity readings may be collected based on field conditions, such as storm event and visible runoff in the vicinity of a work area. Turbidity readings will be recorded on a Water Quality Monitoring Log included in Attachment A.

6.3.2 Surface Water Sampling

Ongoing weekly surface water sampling at the five locations near the cove outlet will continue through construction, per the ADEQ-approved Surface Water Sampling and Analysis Plan (ARCADIS 2014).

[1] Based on turbidity readings from the cove outlet since January 2014, turbidity is generally between 25 NTU and 100 NTU, except during rainfall events when the turbidity can be much higher (approximately 500 NTU).

7. Site Demobilization

This section describes the CQA procedures associated with the removal of construction-related access roads and staging areas and final inspections upon completion of construction activities.

7.1 Demobilization

Upon completion of construction activities at the site, a site walk through with the Owner will be conducted to verify which equipment, temporary facilities, and personnel will be systematically demobilized and removed from the site. Construction-related debris and/or other remaining materials will be removed or disposed of in accordance with applicable rules and regulations, and equipment or material cleaning will be performed, as required, prior to removal from the site. The Site Field Manager will document demobilization activities to confirm completeness and document any access road materials left in place. This information will be included in the Daily Project Report.

7.2 Final Inspection

The following inspections will be conducted when construction activities are complete:

- *Pre-Final Inspection.* After the construction activities have been completed, the Site Field Manager, the CQA Manager, and the Contractor will perform a pre-final inspection of the work areas. During the walkthrough, a list of deficiencies will be developed and documented as part of the pre-final inspection documentation. Corrective measures will be implemented to address identified deficiencies.

- *Final Inspection.* The Final Inspection will be scheduled after the completion of the corrective measures identified during the pre-final inspection. The final inspection will be attended by the Site Field Manager, the CQA Manager, and the Contractor. After the final inspection, the CQA Manager will provide written notification to ADEQ that all construction activities have been properly completed and the date activities were completed.

8. References

ARCADIS. 2014. Surface Water Sampling and Analysis Plan, Revision 10. Mayflower Pipeline Incident Response, Mayflower, Arkansas. March 21.

EMES. 2014. Sheen Monitoring and Maintenance Plan, Revision 2. Mayflower Pipeline Incident Response, Mayflower, Arkansas. March 11.

United States Environmental Protection Agency. 2004. Method 9095B Paint Filter Liquids Test. Revision 2, November.

ARCADIS

Attachments

Attachment A

Reporting and Inspection Forms

DAILY PROJECT REPORT

PROJECT NAME	XOM-Mayflower
REPORT PREPARED BY	
CQA MONITOR	
SITE FIELD MANAGER	
WORK DAY START TIME	
WORK DAY STOP TIME	
VISITORS	
COVE WATER LEVEL	

DATE / /

DAY
- ☐ Sunday
- ☐ Monday
- ☐ Tuesday
- ☐ Wednesday
- ☐ Thursday
- ☐ Friday
- ☐ Saturday

WEATHER
- ☐ Bright Sun
- ☐ Clear
- ☐ Overcast
- ☐ Rain
- ☐ Snow

WIND
- ☐ Calm
- ☐ Moderate
- ☐ Strong

TEMPERATURE
- ☐ < 32
- ☐ 32 to 50
- ☐ 50 to 70
- ☐ 70 to 85
- ☐ > 85

HUMIDITY
- ☐ Dry
- ☐ Moderate
- ☐ Humid

HEALTH AND SAFETY

DAILY SAFETY TOPIC:

HAZARDS IDENTIFIED / MITIGATION TAKEN:

FIELD WORK

CONTRACTORS ON SITE (INCLUDE NUMBER OF PERSONNEL):

EQUIPMENT ON SITE:

CONSTRUCTION ACTIVITIES:

REMOVAL:		**CY**		**BACKFILL CY**
REACTIVE CAP PLACEMENT:		**TONS**		**SF**
REACTIVE CAP MATERIALS:	**SAND**	**TONS**	**ORGANOCLAY**	**TONS**
AMENDMENT PLACEMENT:		**TONS**		**SF**
OFFSITE TRANSPORT/DISPOSAL:		**TONS**		**TRUCKS**

QUALITY CONTROL ACTIVITIES (INCLUDING TEST OR RETEST RESULTS, LOCATIONS, AND CORRECTIVE ACTIONS):

PROBLEMS ENCOUNTERED / CORRECTIVE ACTION TAKEN:

OFF-SITE MATERIALS RECEIVED / COMPLIANCE WITH PROJECT SPECIFICATIONS:

TEST EQUIPMENT CALIBRATIONS:

SUMMARY OF CONTRACTOR MEETINGS:

CQA MONITOR _____ TITLE _____

SIGNATURE _____ PAGE _____ OF _____

Design Modification, Clarification, or Change Form

PROJECT:_____ DATE:_____

PROJECT NUMBER:_____ LOCATION:_____

TASK:_____ CQA MONITOR:_____

ATTENDEES:_____

_____

_____

QUESTION/PROBLEM (location, cause, how and when the deficiency was identified, if applicable):_____

_____

_____

_____

_____

ANSWER/DIRECTION:_____

_____

_____

_____

_____

_____

_____

_____

_____

MEASURES TAKEN TO PREVENT SIMILAR PROBLEMS IN THE FUTURE:_____

_____

_____

_____

_____

ACTION BY CONSTRUCTION CONTRACTOR:

_____Provide a cost proposal **BEFORE** proceeding with work.

_____Proceed with work at a cost not to exceed $_____, and _____ days' time extension.

_____Information only, no change in cost or time.

SIGNED:_____, Site Field Manager, CRA

SIGNED:_____, CQA Monitor, ARCADIS

SIGNED:_____, CQA Manager/Engineer, ARCADIS

SIGNED:_____, Owner, ExxonMobil Environmental Services Company

FIELD EQUIPMENT CALIBRATION AND MAINTENANCE LOG

Project Name : XOM – Mayflower **Project Location: Mayflower, AR**

Project Number: B0086022 **Instrument Model: _____**

Instrument Manufacturer: _____ **Identification Number: _____**

Date / Time	Person Performing Calibration	Battery Check	Calibration Standard			Calibration Method	Calibration Frequency	Comments
			Source	Type	Concentration			

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CONFIRMATION SAMPLING FORM

Site Location: Mayflower, AR **Project No:** B0086022 **Project Name:** XOM-Mayflower **Removal Area:** Cove Inlet Channel

CQA Monitor: ______________________________

Removal Segment	Sample ID	Date & Time	Coordinates	Target Removal Depth (inches)	Penetration Depth (inches)	Recovery (inches)	Sample Interval (inches)	Sheen after Water Addition (circle one)	Sheen Characterization (circle applicable)	Oil Spots (if any)	Photos	Qualitative Sheening Amount (circle one)	Sediment Description (include presence of sheen on sediment before adding water, if any)
								Yes / No	Dark / Metallic / Rainbow / Silver gray No Structure / Patches / Streamers			Lighter / Medium / Heavier	
								Yes / No	Dark / Metallic / Rainbow / Silver gray No Structure / Patches / Streamers			Lighter / Medium / Heavier	
								Yes / No	Dark / Metallic / Rainbow / Silver gray No Structure / Patches / Streamers			Lighter / Medium / Heavier	
								Yes / No	Dark / Metallic / Rainbow / Silver gray No Structure / Patches / Streamers			Lighter / Medium / Heavier	
								Yes / No	Dark / Metallic / Rainbow / Silver gray No Structure / Patches / Streamers			Lighter / Medium / Heavier	
								Yes / No	Dark / Metallic / Rainbow / Silver gray No Structure / Patches / Streamers			Lighter / Medium / Heavier	
								Yes / No	Dark / Metallic / Rainbow / Silver gray No Structure / Patches / Streamers			Lighter / Medium / Heavier	
								Yes / No	Dark / Metallic / Rainbow / Silver gray No Structure / Patches / Streamers			Lighter / Medium / Heavier	
								Yes / No	Dark / Metallic / Rainbow / Silver gray No Structure / Patches / Streamers			Lighter / Medium / Heavier	
								Yes / No	Dark / Metallic / Rainbow / Silver gray No Structure / Patches / Streamers			Lighter / Medium / Heavier	
								Yes / No	Dark / Metallic / Rainbow / Silver gray No Structure / Patches / Streamers			Lighter / Medium / Heavier	
								Yes / No	Dark / Metallic / Rainbow / Silver gray No Structure / Patches / Streamers			Lighter / Medium / Heavier	

DUST MONITORING FORM

Project Name: XOM-Mayflower **Project Location:** Mayflower, AR

Project Number: B0086022 **Sampler(s):** _____

Date	Starting Time	Location	Dust Reading	Wind Location (up, down, cross)	Visual Observations (Dust Observed?)	Remarks (Include information regarding construction activities, potential off-site sources of dust, and abatement actions as applicable)

Note: When dust observations occur, report the results to Site Field Manager.

WATER QUALITY MONITORING LOG

Project Name: XOM – Mayflower **Date: _____**

Project Number: B0086022 **Sampler(s): _____**

Location	Date (MM/DD/YY)	Time (hr:min)	Turbidity (NTU) Make: _____ Model: _____ I.D.: _____	Remarks (Include information regarding construction activities, storm events or runoff, and abatement actions as applicable)

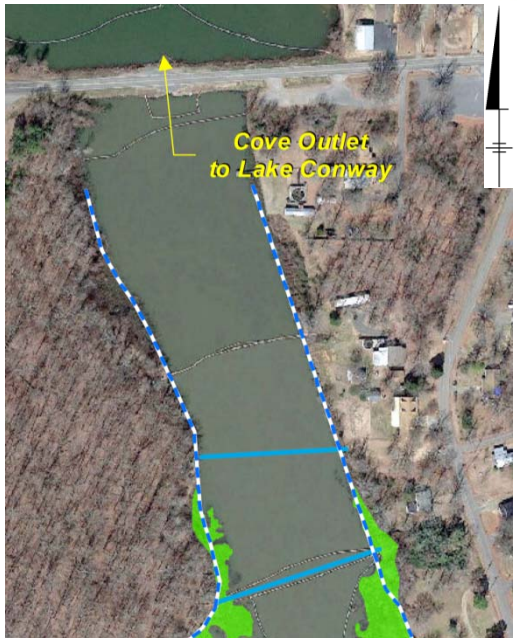
Note: When result is above trigger level, report the results to Site Field Manager.

B-On Water Area

Sheen Observation Form

Personnel: **Date:**

Wind Conditions: Windy/Light Breeze/Calm **Temperature:** **Sky Conditions: Sun/Clouds/Part Sun/Part Clouds**



LOCATION:	**TIME:**
If yes, sketch on Figure 1 to show approximate location	
Approximate size (dimensions)	
Over what percentage of surface?	Trace <1% ☐ 1-10% ☐ 11-30% ☐ 31-50% ☐ 50-70% ☐ >70% ☐
Color of sheen: Dark / Metallic / Rainbow / Silver Gray	
Sheen structure: No structure / Patches / Streamers / Tar Balls / Windrows	
Observations when sheen is disturbed: Breaks Apart/Brittle ☐	Does not Break/Non-Brittle ☐
If streamers are present, what is their orientation?	
Is sheen blossoming?	Yes ☐ No ☐
If yes, what is the frequency (per 15 minutes)?	
Sheen origination (if noticable)?	
Flow Condition:	
Picture taken	Yes ☐ No ☐
Action taken:	
Notes	

LOCATION:	**TIME:**
Sketch on Figure 1 to show approximate location	
Approximate size (dimensions)	
Over what percentage of surface?	Trace <1% ☐ 1-10% ☐ 11-30% ☐ 31-50% ☐ 50-70% ☐ >70% ☐
Color of sheen: Dark / Metallic / Rainbow / Silver Gray	
Sheen structure: No structure / Patches / Streamers / Tar Balls / Windrows	
Observations when sheen is disturbed: Breaks Apart/Brittle ☐	Does not Break/Non-Brittle ☐
If streamers are present, what is their orientation?	
Is sheen blossoming?	Yes ☐ No ☐
If yes, what is the frequency (per 15 minutes)?	
Sheen origination (if noticable)?	
Picture taken	Yes ☐ No ☐
Flow Condition:	
Action taken:	
Notes	

LOCATION:	**TIME:**
If yes, sketch on Figure 1 to show approximate location	
Approximate size (dimensions)	
Over what percentage of surface?	Trace <1% ☐ 1-10% ☐ 11-30% ☐ 31-50% ☐ 50-70% ☐ >70% ☐
Color of sheen: Dark / Metallic / Rainbow / Silver Gray	
Sheen structure: No structure / Patches / Streamers / Tar Balls / Windrows	
Observations when sheen is disturbed: Breaks Apart/Brittle ☐	Does not Break/Non-Brittle ☐
If streamers are present, what is their orientation?	
Is sheen blossoming?	Yes ☐ No ☐
If yes, what is the frequency (per 15 minutes)?	
Sheen origination (if noticable)?	
Picture taken	Yes ☐ No ☐
Flow Condition:	
Action taken:	
Notes	

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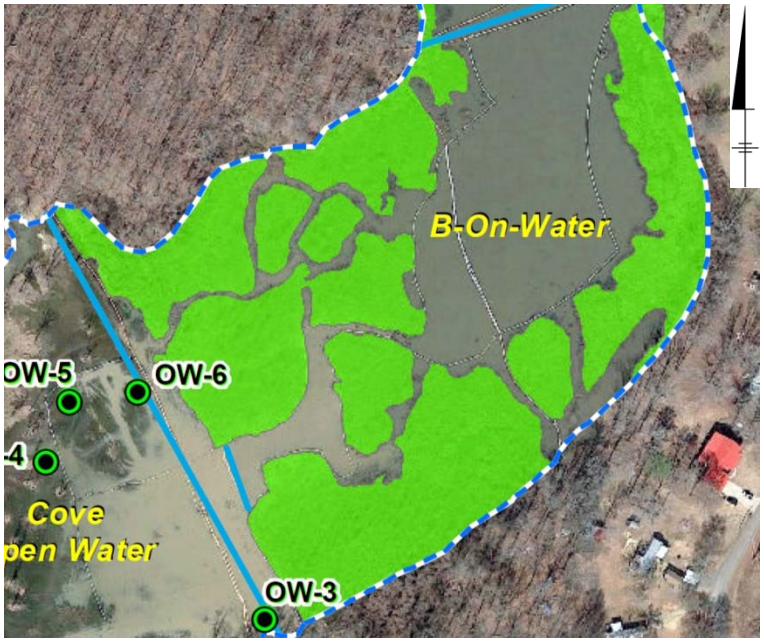
Heavily Vegetated Area

Sheen Observation Form

Personnel: **Date:**

Wind Conditions: Windy/Light Breeze/Calm **Temperature:** **Sky Conditions: Sun/Clouds/Part Sun/Part Clouds**



LOCATION:	**TIME:**
If yes, sketch on Figure 1 to show approximate location	
Approximate size (dimensions)	
Over what percentage of surface? Trace <1% ☐ 1-10% ☐ 11-30% ☐ 31-50% ☐ 50-70% ☐ >70% ☐	
Color of sheen: Dark / Metallic / Rainbow / Silver Gray	
Sheen structure: No structure / Patches / Streamers / Tar Balls / Windrows	
Observations when sheen is disturbed: Breaks Apart/Brittle ☐ Does not Break/Non-Brittle ☐	
If streamers are present, what is their orientation?	
Is sheen blossoming? Yes ☐ No ☐	
If yes, what is the frequency (per 15 minutes)?	
Sheen origination (if noticable)?	
Flow Condition:	
Picture taken Yes ☐ No ☐	
Action taken:	
Notes	

LOCATION:	**TIME:**
Sketch on Figure 1 to show approximate location	
Approximate size (dimensions)	
Over what percentage of surface? Trace <1% ☐ 1-10% ☐ 11-30% ☐ 31-50% ☐ 50-70% ☐ >70% ☐	
Color of sheen: Dark / Metallic / Rainbow / Silver Gray	
Sheen structure: No structure / Patches / Streamers / Tar Balls / Windrows	
Observations when sheen is disturbed: Breaks Apart/Brittle ☐ Does not Break/Non-Brittle ☐	
If streamers are present, what is their orientation?	
Is sheen blossoming? Yes ☐ No ☐	
If yes, what is the frequency (per 15 minutes)?	
Sheen origination (if noticable)?	
Picture taken Yes ☐ No ☐	
Flow Condition:	
Action taken:	
Notes	

LOCATION:	**TIME:**
If yes, sketch on Figure 1 to show approximate location	
Approximate size (dimensions)	
Over what percentage of surface? Trace <1% ☐ 1-10% ☐ 11-30% ☐ 31-50% ☐ 50-70% ☐ >70% ☐	
Color of sheen: Dark / Metallic / Rainbow / Silver Gray	
Sheen structure: No structure / Patches / Streamers / Tar Balls / Windrows	
Observations when sheen is disturbed: Breaks Apart/Brittle ☐ Does not Break/Non-Brittle ☐	
If streamers are present, what is their orientation?	
Is sheen blossoming? Yes ☐ No ☐	
If yes, what is the frequency (per 15 minutes)?	
Sheen origination (if noticable)?	
Picture taken Yes ☐ No ☐	
Flow Condition:	
Action taken:	
Notes	

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Attachment B

Standard Operating Procedures

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Sheen Field Description and Characterization

Rev. #: 2

Rev Date: January 12, 2014

I. Scope and Application

This ARCADIS standard operating procedure (SOP) describes proper procedures to describe and characterize in-situ sheens on surface water and saturated surface soils in the field.

Field personnel will record the location of the sheen with reference to the site and site structures or features, and coordinates, if possible. Field personnel will use standardized terms conveyed within this SOP to characterize and describe the following attributes of sheen on surface water or saturated surface soil:

- Location of sheen with respect to monitoring area
- Estimated orientation and dimensions of sheen area
- Color and appearance
- Sheen structure and distribution
- Potential sheen sources, if readily apparent
- Frequency of sheen “blossoms”, if present
- Environmental conditions such as temperature, cloud cover, wind, and wind direction and other relevant information

This SOP is applicable to sheens on surface water and saturated surface soil, and should be followed for sheens regardless of their origin, unless there is a regulatory-required, alternative SOP.

II. Terminology and Definitions

According to the United States Environmental Protection Agency (USEPA), “Sheen means an iridescent appearance on the surface of water” (USEPA 2013). Iridescent objects appear to change color depending on the angle of view. Although anthropogenic materials like oil and tar can produce sheens, natural microbial processes and metals in clean water bodies can also produce sheens (Minnesota Pollution Control Agency [MPCA] 2008)

Terminology from NOAA (2007)

The National Oceanographic and Atmospheric Administration (NOAA) published a document to assist responders in describing and characterizing oil spills on open water (NOAA 2007). Therefore, NOAA’s definitions - presented below - focus predominantly on sheens caused by oil. As noted above, not all sheens are caused by oil.

Sheen: A very thin layer of oil floating on the water surface and is the most common form of oil seen in the later stages of a spill or release.

Streamers: Narrow bands or lines of oil (sheens, dark or emulsified) with relatively clean water on each side. Streamers may be caused by wind and/or currents, but should not be confused with multiple parallel bands of oil associated with “windrows,” or with “convergence zones or lines” commonly associated with temperature and/or salinity discontinuities.

Convergence Zone: A long narrow band of oil (and possibly other materials) often caused by the convergence of two masses of water with different temperatures and/or salinities. Unlike “windrows” and “streamers,” commonly associated with wind, convergence zones are normally associated with the interface between differing water masses, or with the effects of tidal and depth changes that cause currents to converge due to density differences or due to large bathymetric changes. Such zones may be several kilometers in length, and consist of dark or emulsified oil and heavy debris surrounded by sheens.

Windrows: Multiple bands or streaks of oil (sheens, dark, or mousse) that line up nearly parallel with the wind. Such streaks (typically including seaweed, foam, and other organic material) are caused by a series of counter rotating vortices in the surface layers that produce alternating convergent and divergent zones. “Windrows” begin to form with wind speeds of approximately six knots or more.

Patches: Oil configurations or “structures” that reflect a broad range of shapes and dimensions. Numerous “tarballs” could combine to form a “patch”; oil of various colors and consistency could form a patch or single layer 10s of cm to 10s (or even 100s) of meters in diameter; and a large patch of dark or rainbow oil could have patches of emulsion within it. Patches of oily debris, barely able to float with sediment/plants in them, might be called “tarmats,” circular patches at sea might be called “pancakes”; really big patches might simply be called “continuous” slicks. But, they are all “patches.”

Tarballs: Discrete, and usually pliable, globules of weathered oil, ranging from mostly oil to highly emulsified with varying amount of debris and/or sediment. Tarballs may vary in size from millimeters to 20- 30 centimeters across. Depending on exactly how “weathered,” or hardened, the outer layer of the tarballs is, sheen may or may not be present.

No Structure: Random eddies or swirls of oil of any thickness. This distribution of oil is normally the result of little to no wind and/or current.

Black oil: A black or very dark brown-colored layer of oil.

Dispersion: The breaking up of an oil slick into small droplets that are mixed into the water column as a result of sea surface turbulence. For response purposes, dispersed oil is defined as oil droplets that are too small to refloat back to the surface. The physical properties of the oil and the sea state are the main factors that determine how much oil is dispersed.

Emulsification: The formation of a water-in-oil mixture. The tendency for emulsification to occur varies with different oils and is much more likely to occur under high energy conditions (winds and waves). This mixture is frequently referred to as “mousse”.

Recoverable Oil: Oil that is in a thick enough layer on the water to be recovered by conventional techniques and equipment.

Slick: Oil spilled on the water that absorbs energy and dampens out the surface waves making the oil appear smoother or “slicker” than the surrounding water. “Slicks” refer to oil layers that are thicker than Rainbow and Silver “sheens”. Natural slicks, from plants or animals, also may occur on the water surface and may be mistaken for oil slicks.

Weathering: A combination of physical and environmental processes such as evaporation, dissolution, dispersion, photo-oxidation, and emulsification that act on oil and change its physical properties and composition.

Additional Terminology

Brittle: Sheen that cracks, breaks apart, or disaggregates upon disturbance. Brittle sheens are often of natural biogenic origin (MPCA 2008).

Non-brittle: Sheen that rapidly coalesces upon disturbance. Non-brittle sheens are often related to anthropogenic sources, including petrogenic sources (e.g., petroleum hydrocarbons).

III. Personnel Qualifications

Sheen characterization will be completed only by persons who have been trained in ARCADIS sheen characterization procedures. Field personnel will complete training on the ARCADIS sheen characterization SOP in the office and/or in the field under the guidance of a person experienced in sheen characterization.

IV. Equipment List

The following equipment should be taken to the field to facilitate sheen characterization:

- Field book, field form, or electronic data collection device to record observations
- Digital camera with polarizing filters
- Site map including sheen monitoring areas and IDs
- Field book to take supplemental notes
- Stop watch or watch
- Floating scale for use when photographing sheens
- Wooden or steel rod
- Absorbent booms or pads
- Global positioning system device – optional, but recommended
- This SOP for sheen characterization
- NOAA's *Open Water Oil Identification Job Aid for aerial observation* (NOAA 2007)
- Personal protective equipment as required by the HASP

V. Health and Safety Considerations

Personnel performing sheen characterization may be required to work near rivers, lakes, or other surface water features. Personnel may also be required to operate small watercraft or to observe sheens from bridges or roads. Water, watercraft, and traffic related hazards are discussed in the site-specific HASPs and are not discussed in this SOP.

Generally, personnel performing sheen characterization will not be in contact with impacted surface water or soils. However, secondary tasks such as sheen sampling may be required. Surface water and saturated surface soil may contain hazardous substances. Routes for exposure may contain dermal contact, inhalation, and ingestion. Avoid contact with bare hands due to possibility of contacting face, ears, or other body parts with hands. Wear appropriate personal protections equipment during sheen monitoring and sheen sampling activities.

Surface water sheen sampling procedures and hazards are not discussed in this SOP. Please refer to the ARCADIS Surface Water Sheen Sampling SOP and the project specific HASP for guidance if sheen sampling will take place during sheen characterization activities.

VI. Procedure

The procedure for sheen characterization is divided into the following tasks.

In this section the tasks are first outlined, and then each one is explained in detail.

1. Identify the **location, orientation, and dimensions** of the sheen.
2. Observe and record sheen **color and appearance** using standard terminology and codes.
3. Observe and record **sheen structure and distribution** using standard codes.
4. Record **sheen "blossom" frequency**, if applicable over a 5-minute period.
5. Identify potential **sheen source(s)** if apparent.
6. Record **environmental conditions** and other observations.
7. Record the **action taken**.

Each task is important for sheen characterization and should be completed when possible. However, field personnel should use their stop work authority if they feel that any task cannot be completed safely given the current site conditions. The correct order to perform the tasks will vary for each situation. Refer to the ARCADIS Surface Water Sheen Sampling SOP and the project specific HASP for guidance if sheen sampling will take place during sheen characterization activities.

1. Identify the location, orientation, and dimensions of the sheen

Identify the location of sheen and sketch it on a map relative to key site features, and/or compass directions. Record the location of the sheen relative to the site by using permanent, easily identifiable structures or site features as reference. Record the areal dimensions of the sheen onto the map and in field notes. If not already done, divide the site into distinct sheen monitoring areas with site references as station boundaries. Record and sketch the sheen position with respect to the site, shoreline, and the sheen monitoring areas.

Photograph the sheen using a digital camera with standard photographic polarizing filters. Take photographs by holding the filter between your eye and the sheen, and rotating through 90 degrees to optimize the polarization by maximizing or minimizing admission of polarized light. The rotation of polarizing filter will screen out glare from reflective water surface in order to allow the true colors of sheen to pass through the camera sensor. Take 1 or 2 photos when the polarization is parallel to the fluid surface and take 1 or 2 photos when the polarization is perpendicular to the fluid surface. Record the rotation, approximate photo direction (north, east, northeast, etc.), and photo number for each photo in the field book. Place a floating scale (floating object of known and documented size) near the sheen in photos for scaling purposes.

In presence of tar balls/oil spots, take a zoomed-in photo with a floating scale placed near tar ball/oil spot to record the approximate size. If tar balls/oil spots vary in size, take additional photos to document the size ranges of tar balls/oil spots. Additionally, take a photograph of the overall area of the sheen. Polarization effects on sheen appearance are included below:

- Biogenic sheens generally appear to be more blue or bluish purple.
- Petrogenic sheen (petroleum hydrocarbon-related) colors will intensify, deepen in hue or become brighter. For very thin sheens, polarization will brighten the sheen color and make the sheen more visible (see example below).
- Pyrogenic sheen (combustion-related) colors will appear to be slightly metallic under some circumstances such as low sun angles typical of late fall, winter, and early spring.

Non-Brittle Sheen Picture – Without a Polarizing Filter

Non-Brittle Sheen Picture – With a Polarizing Filter

2. Observe and record the sheen color and appearance.

Observe the sheen's color and record in the field form or field book. The following terminology will be used when describing sheen color. Note that these terms are listing in general order of increasing sheen thickness.

Color	Code	Description
Sheen (Silver/Gray)	**S**	Near **transparent** for thinnest layers to **silver/gray** for slightly thicker.
Rainbow	**R**	Rainbow colors are visible.
Metallic	**M**	The sheen reflects/mirrors the color of the sky with some element of oil color, often between light gray and dull brown.
Dark (or True) Color	**D**	The sheen is a continuous true oil color.

3. Structure and Distribution

Using standard terms, describe the structure and distribution of the sheen. Depending on the nature of the sheen, structures may include Streamers, Convergence Zones, Windrows, Patches, Tarballs/Oil Spots, or No Structure. See Section II for term definitions.

Gently agitate the sheen by moving a device (e.g., stick, steel/wooden rod, absorbent boom /pad or other object) horizontally through the sheen. While doing so, and after removing the object, observe if the sheen rapidly coalesces as a liquid (“non-brittle sheen”) or if the sheen cracks, breaks, and disaggregates (“brittle sheen”). Record the observation for brittle or non-brittle sheen in the field form or field book. See Section II for term definitions.

4. Sheen Blossom Frequency

A sheen “blossom” is the occurrence of a new sheen due to the migration of a droplet of a non-aqueous liquid to the water surface, often (but not always) due to gas bubbling (ebullition) from sediments.

If sheen “blossoms” are observed, count and record the number of “blossoms” that appear during a 5 minutes. The presence of gas bubbles that rise to the surface of the water (with or without causing sheen blossoms) and the rate of bubbles will be recorded (i.e., number per 60 seconds). Record the frequency observed.

5. Identify potential sheen sources, if readily apparent

Determine whether the sheen source is obvious and, if so, draw it on a map.

6. Record environmental conditions and other observations

Record the date, time, weather, water current, and wind conditions.

7. Record the action taken

After recording the sheen observations in the field form or field book, remove the sheen using absorbent booms or pads, to the extent practical if it is a petrogenic sheen. Record the removal action taken in the field form or field book.

VII. Data Recording and Management

Sheen observations will be maintained in a field notebook, log, or electronic data collection device. Sheen location sketches should be made on a location map. Sheen observations, locations, and associated photographs will be entered into the site database and electronic files for inclusion in summary reports. Upon project completion, field notebooks will be forwarded to the Project Manager for storage in the project files. Field personnel should keep copies for their files. Field personnel will forward copies to the Project Manager for quality assurance checks during project implementation at a frequency determined by the Project Manager.

VIII. Quality Assurance

Sheen characterization should be completed only by appropriately trained personnel. Field personnel will forward copies of any field notes, field logs, and maps to the Project Manager for quality assurance checks during project implementation at a frequency determined by the Project Manager.

IX. References

USEPA. 2013. Web site - http://www.epa.gov/oem/content/lawsregs/sheenovr.htm

Minnesota Pollution Control Agency (MPCA). 2008. Nonpetroleum Sheens on Water. Cleanup/Emergency Response, vol. 4, no. 07, April 2008. http://www.pca.state.mn.us/index.php/view-document.html?gid=2958

NOAA. 2007. NOAA Open Water Oil Identification Job Aid, updated 2007, http://response.restoration.noaa.gov/sites/default/files/OWJA_2012.pdf