AECOM

Prepared for:
BASF Corporation
Florham Park, NJ

Prepared by:
AECOM
Chelmsford, MA
Project No.60323713
July 2019

Hudson River Operable Unit 2
Sediment Remediation

Surface Water Remedial Action Monitoring Plan

BASF Rensselaer
Rensselaer, New York

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List of Acronyms

µg/L	micrograms per liter
AECOM	AECOM Technical Services
BASF	BASF Corporation
BMP	Best Management Practice
COC	contaminant of concern
CY	Cubic yard
DER-10	DER-10 Technical Guidance for Site Investigation and Remediation
ELAP	Environmental Laboratory Accreditation Program
Ft	Foot
MDL	method detection limit
mg/L	milligram per liter
NOAA	National Oceanographic and Atmospheric Administration
NTU	nephelometric turbidity unit
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OU-2	Operable Unit 2
PCB	polychlorinated biphenyl
ppm	parts per million
QAPP	Quality Assurance Project Plan
QC	quality control
RA	Remedial Action
RAMP	Remediation Action Monitoring Plan
RD	Remedial Design
RM	river miles
TAT	turn-around time
TBD	to be determined
TOGS	Technical and Operational Guidance Series
TSCA	Toxic Substances Control Act
TSS	total suspended solids
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

1.0 Introduction and Purpose

This Surface Water Remedial Action Monitoring Plan (RAMP) has been prepared by AECOM Technical Services (AECOM) on behalf of BASF Corporation (BASF) in support of remedial actions for Hudson River Operable Unit 2 (OU-2) at the Former BASF Facility (the "Site") located in Rensselaer, New York. The Site is located approximately 148 river miles (RM) north of New York Harbor, and 10 RM below the Federal Dam in Troy. The Hudson River OU-2 is designated as Class C water (NYSDEC, 2013). The Hudson River is tidal below the Federal Dam. In Albany, across the river from and to the west of Rensselaer, the mean tidal range is 4.6 feet and the spring range is 5.0 feet (National Oceanographic and Atmospheric Administration [NOAA], 2011). Figure 1-1 depicts the Site location.

Remedial actions for OU-2 include bulkhead replacement, debris removal, dredging of approximately 38,400 cubic yards of sediments impacted with volatile organic compounds (VOCs), metals, and non-Site-related Toxic Substance Control Act (TSCA) and Non-TSCA polychlorinated biphenyls (PCBs), on-site handling/treatment of impacted sediments, off-site disposal of impacted sediments, placement of clean cover materials, and habitat restoration in the river. A conceptual depiction of the OU-2 remedial action plan is provided as Figure 1-2. This RAMP presents the scope of work for in-water monitoring/sampling activities, action levels, and corrective measures that will be implemented to minimize potential impacts to the river during bulkhead replacement, debris removal[1], dredging, and cover system placement.

During bulkhead replacement activities, there may be potential for a short term increase in suspended sediments in the water column, however these actions are less invasive than the proposed dredging operations. During mechanical dredging operations, there is potential for the resuspension (fluidization and dispersion) of contaminated sediments within the water column. During backfilling and habitat restoration activities, there is not anticipated to resuspension of contaminated sediments in the water column, as the dredging will have removed the contaminated material from the cover placement area. For all activities, site controls and best management practices (BMPs) will be put in place to minimize impacts to the water column.

There are two primary objectives for this plan:

1. Establish a criterion that can be readily measured in real-time by which decisions regarding the efficacy of BMPs, or the need to implement additional BMPs, can be made. Turbidity is the only parameter that can be measured in real-time, so it has been chosen as this criterion. An initial turbidity value of 100 nephelometric turbidity units (NTU) over background will be the exceedance criteria, until a calibrated control limit for turbidity can be established.

[1] Debris removal will occur concurrently with dredging operations. As such, in the remainder of the document, the term "dredging operations" will be inclusive of debris removal.

Additionally, 1 NTU turbidity to 1 mg/L total suspended solids (TSS) will be used as a correlation between turbidity and TSS until a field relationship is established. If a viable turbidity/ TSS relationship cannot be established, TSS will be used to monitor the dredging. As discussed in Section 2.2, an exceedance of the turbidity criterion will also trigger collection of samples for chemistry. A 48-hour rapid turnaround time for samples will be adopted to aid in implementing a "rapid" response.

2. Collect routine data to document that there is no transport of constituents at concentrations greater than NYSDEC guidance values (see Table 3-1). As discussed further in this RAMP, daily samples will be collected during the bulkhead installation, TSCA PCB dredging, and VOC/non-TSCA PCB dredging. These are the activities that could result in the resuspension of sediment containing VOCs, metals, and/or PCBs. If the results of this initial sampling effort document no exceedances of NYSDEC guidance values, a proposal for a reduced sampling frequency will be prepared and submitted to NYSDEC.

This RAMP has been prepared in accordance with New York State Department of Environmental Conservation (NYSDEC) and New York State Department of Health (NYSDOH) requirements as outlined in DER-10 Technical Guidance for Site Investigation and Remediation (referred to herein as DER-10) (NYSDEC, 2010) and NYSDEC Technical and Operational Guidance Series [TOGS] 5.1.9 "In-Water and Riparian Management of Sediment and Dredge Material" [November 2004]).

In developing this RAMP, BASF reviewed water column monitoring plans prepared for the following 3 sites: (1) General Electric Hudson River PCB Superfund Site (Anchor QEA, 2009); (2) Central Hudson Gas & Electric Kingston MGP dredging project (Arcadis, 2015); and (3) Buffalo River Great Lakes National Program Office sediment remediation project (CH2M Hill, 2013). Technical approaches from each of these plans have been adapted in consideration of the site-specific conditions at the BASF Rensselaer Site.

BASF submitted this RAMP in draft form to the NYSDEC on February 22, 2018. On March 23, 2018 the NYSDEC provided comments on this draft document. BASF submitted a revised version of the RAMP as part of the 90% Design Package on April 19, 2018. On July 10, 2018, NYSDEC provided additional comments. On July 28, 2018, BASF submitted a revised version of the RAMP as part of the 100% Design Package, which included responses to NYSDEC comments in Attachment A. On August 31, 2018, NYSDEC provided their final comments on the water column sampling plan. On September 5, 2018, AECOM, on behalf of BASF, issued a letter concurring with NYSDEC's comments.

Based on their review of Season 1 water column monitoring program results, on June 28, 2019 the NYSDEC provided BASF with comments and recommended changes to the BASF Water Column Monitoring Plan. This RAMP has been updated to incorporate all of the recommended changes (see Section 2.3).

2.0 Water Quality Monitoring

The remedial response actions at OU-2 that require in-water monitoring are included in Table 2-1, which also provides an overview of the use of turbidity controls and monitoring requirements. Figures 2-1 through 2-3 display a typical monitoring layout and associated sampling protocols.

Table 2-1 Water Quality Monitoring During Work Activities

Activity	Use of Turbidity Curtains?	Turbidity Monitoring? [a]	Total Suspended Solids (TSS) and Chemical Analysis of Water? [b]
Bulkhead Replacement	Yes – Single curtain	Yes	Yes
Dredging Operations	Yes – Double curtains	Yes	Yes
Backfill (Cover Placement)	Yes – Single curtain	Yes	Yes – TSS only

a - TSS/Turbidity relationship will be developed (Section 2.2.1) upon commencement of in-water work.

b - Details for sampling for chemistry/TSS are presented in Section 3.

2.1 Best Management Practices (BMPs) to Minimize Turbidity

The potential to create turbidity and impacted water column quality will be minimized by adherence to the following mechanical dredging BMPs, several of which were originally generated to support an upper Hudson River dredging project and were incorporated into this BASF Rensselaer plan per the request of NYSDEC:

- Turbidity curtains will be in place during any activities that may disturb the sediment surface.
- Barges will be watertight and regularly inspected to confirm water-tightness during dredging operations and dredged material transport.
- Mechanical dredging operations will utilize an environmental bucket (or equivalent) during dredging operations.
- During pre-dredge debris removal, the number of attempts to remove an object will be minimized. Raking for debris removal will not be permitted.
- Efforts will be made to avoid grounding of barges, and water levels will be allowed to rise before attempting to free grounded vessels.
- Use of equipment appropriate for the water depth of the work area.
- Minimizing bucket bites.
- Maintaining bucket closure unless prohibited by debris.
- Maintaining expeditious movement of the closed bucket to the receiving barge after completing a cut to reduce water leakage from the bucket into the river, to the extent practicable. The dredge operator shall not intentionally drain the dredge bucket over the water column.

- Smoothing with the dredging bucket to contour the dredge cut will not be permitted during dredging impacted sediments. Smoothing during cover placement is allowed.
- Re-handling or stockpiling material on the river bottom will not be permitted.
- Limiting tug propeller revolutions per minute.
- Work on slopes will proceed from top of slope to toe of slope, where practical.
- Utilization of precision dredge and bucket guidance systems (e.g., integrated with real-time kinematic differential global positioning systems [RTK – DGPS]), will allow the operator to deploy/retrieve the dredge bucket with a high level of operational accuracy.
- Use of an experienced environmental dredging operator capable of implementing appropriate BMPs to limit re-suspension will be required.
- The operator will not fill the dredge bucket beyond its stated capacity.
- The operator will optimize the rate of bucket descent and retrieval during operations in order to reduce sediment re-suspension.
- The operator will perform single “bites” with the bucket, and each bucket will be brought to the surface and emptied into the watertight barge between “bites”.
- The operator will not overfill barges with the dredged sediments and oil absorbent booms will be available for deployment in an emergency situation. Additionally, oil absorbent booms will be available for deployment should sheens be observed, particularly in the areas where TSCA level PCBs are being dredged.
- The method and rate of backfill and cover material placement will be designed to minimize suspension of solids and downstream transport.

In the event that exceedances of NYSDEC guidance values (Table 3-1) occur, the following contingency BMPs may be implemented:

- Adjusting the sequence of dredging to include areas with a low potential for suspending Chemicals of Concern (COCs) (i.e., areas with lower concentrations and velocities) at the same time as high potential areas.
- Use of smaller equipment (e.g., shallower draft or less powerful engines).
- Reducing the removal rate or temporarily suspending dredging if necessary.

Dredging specification 02 27 00 (Dredging and Marine Work) has been updated in the 100% Design to include these BMPs, and they have been discussed with the remediation contractor.

This project will involve two seasons of mechanical dredging, with an estimated average production rate of between 400 and 600 cubic yards (CY) per day. The dredge will operate 10 hours per day and five days per week. Placement of the habitat cover materials will follow a similar schedule and will be conducted as dredging sections are completed.

The BMPs, coupled with the proposed production rates, are expected to minimize potential sediment re-suspension issues. Dredging activities will be conducted within a combination of fixed and modular containment systems (i.e., moon pool) comprised of sectional barges. However, additional measures (e.g., dual containment silt curtains) will also be put in place along the nearshore dredge area to

ensure that any downstream transport of potentially impacted sediment is prevented to the extent practicable. Turbidity curtains (NYSDOT Type III) will be deployed during dredging operations and sequentially re-positioned as the dredging operations progress from north to south. A dual turbidity curtain system will be maintained around the moon pool during dredging operations. The inner curtain will be affixed to telescoping spuds that will be spaced around the interior of the moon pool. The outer curtain will be affixed to the exterior of the moon pool and will be ballasted on the bottom and mid-curtain. Silt curtain usage will comply with the following:

- Silt curtains will be long enough to cover the full length of the water column, with an allowance for tidal flux (approximately 2-4 feet [ft] off of the bottom). The curtains will be adjusted such that they are in not contact with the sediment surface in an effort to minimize the resuspension of Site sediments.
- Near-shore silt curtains will be anchored using a multi-point anchoring system and affixed to a mechanical winch system to ensure that they are not moved out of position by tidal action, vessel wakes, etc.
- Moon pool inner curtain will be fixed by a weighted frame and spud poles (not anchors). The outer curtain will be fixed with ballast chains.

Near shore fixed turbidity curtains will be affixed to soldier piles using a tide-adjusting cable ring system to cover up to 1 ft from the bottom sediment surface during mean tide condition.

2.2 Monitoring Approach

The monitoring approach, as summarized in Table 2-2, incorporates use of three fixed buoy-monitoring stations[2] located 300 ft upstream, 300 ft downstream, and adjacent to marine construction operations, as well as boat-based mobile monitoring units.

Table 2-2 Water Quality Monitoring Approach

Work Stage	Visual Inspections	Real-time and Laboratory Turbidity Measurements	Total Suspended Solids by Laboratory Method	VOCs, metals, hardness, and PCB Analysis by Laboratory Method
Bulkhead Replacement	Yes	Continuous (once every 30 minutes) from three fixed buoy stations (300 ft stations), plus mobile monitoring outside silt curtain Samples will be collected from three stations at three	First Two Weeks: Samples from three stations at three depths in the water column. Remainder of Bulkhead Installation: Upon NYSDEC approval, when turbidity criterion is exceeded	First Two Weeks: Samples from three stations from near-bottom in the water column (or from depth where highest turbidity observed). VOCs, hardness, total and dissolved samples for metals and PCBs. The potential for PCBs to be re-suspended into the water column will be assessed to

[2] A fully equipped backup buoy system will be on Site in the event one of the deployed systems gets damaged or displaced.

Work Stage	Visual Inspections	Real-time and Laboratory Turbidity Measurements	Total Suspended Solids by Laboratory Method	VOCs, metals, hardness, and PCB Analysis by Laboratory Method
		depths in the water column for laboratory turbidity (at the same locations and times as the TSS samples) and compared to the real-time turbidity meter results.		determine whether they are in the dissolved or particulate form. If PCBs are in the dissolved form, direct water column monitoring of PCBs will be required, and turbidity/TSS will not be used as a surrogate for predicating PCB contamination. Remainder of Bulkhead Installation: Upon NYSDEC approval, based on results of the first two weeks of monitoring, two samples per week (VOCs, hardness, total and dissolved metals and PCBs). When the turbidity criterion is exceeded.
Debris Removal/ Dredging in Areas where TSCA PCBs are present	Yes	Continuous (once every 30 minutes) from four fixed buoy stations (300 ft stations), plus mobile monitoring outside silt curtain	First Two Weeks: Daily samples to confirm turbidity/TSS relationship developed during bulkhead installation (at single depth where highest turbidity was observed during baseline sampling)	First Month: One sample per day (VOCs, hardness, total and dissolved metals and PCBs) from three stations from near bottom or at depth where highest turbidity was observed during baseline sampling. Remainder of Schedule for Dredging in Areas where TSCA PCBs are present: Upon approval by NYSDEC based on the results of the first month of monitoring, two samples per week (VOCs, hardness, total and dissolved metals and PCBs) from four stations. When the turbidity criterion is exceeded
Debris Removal/ Dredging in Areas Where TSCA PCBs are not present	Yes	Continuous (once every 30 minutes) from four fixed buoy stations (300 ft stations), plus mobile monitoring outside silt curtain	First Month: Daily samples to confirm turbidity/TSS relationship developed during bulkhead replacement and prior dredging activities (at single depth where highest turbidity was observed during baseline sampling).	First Month: One sample per day: (VOCs, hardness, total PCBs, and total/ dissolved metals) from four stations. Remainder of Dredging Program: Upon approval by NYSDEC based on the results of monitoring during the dredging of the areas where TSCA PCBs are present and the

Work Stage	Visual Inspections	Real-time and Laboratory Turbidity Measurements	Total Suspended Solids by Laboratory Method	VOCs, metals, hardness, and PCB Analysis by Laboratory Method
			When the turbidity criterion is exceeded	first two weeks of monitoring results, two samples per week (VOCs, hardness, total PCBs, and total/ dissolved metals). When turbidity criterion is exceeded.
Backfill/Cover Placement	Yes	Continuous (once every 30 minutes) from three fixed buoy stations (300 ft stations), plus mobile monitoring outside silt curtain	Yes, if there is a visible plume emanating from the containment system.	No – river sediments not expected to be re-suspended.

Using the 1 mg/L TSS to 1 NTU correlation, a turbidity control limit of 100 NTUs above ambient background (determined by the up-current monitoring station) will be used during dredging operations (until a calibrated control limit for turbidity can be established). An up-current, off-Site fixed buoy monitoring station will also be established to track ambient conditions (outside the potential influence of the Site). This value will be used to trigger mitigation/response actions as described in Section 4. This plan was written using turbidity (NTUs) as a proxy for TSS until the TSS/turbidity relationship can be defined in the field. In the event that a viable TSS/ turbidity relationship cannot be established, additional TSS sampling may be warranted to further define the relationship.

2.2.1 Bulkhead Replacement Monitoring

The first two weeks of the bulkhead replacement program will be used to: 1) collect data upon which to affirm or revise the initial turbidity criterion of 100 NTU; and 2) collect adequate data to evaluate the potential for down-current transport of VOCs, metals and/or PCBs at concentrations greater than NYSDEC guidance values.

During the first two weeks of bulkhead replacement, monitoring will be conducted as per the following schedule:

- Turbidity measurements will be collected continuously at 30-minute intervals from the three monitoring buoys at three depths in the water column;
- Three TSS samples will be collected each day from each monitoring buoy at approximately shallow, mid-depth, and near bottom in the water column. The samples will be collected once per day across various tidal stages to provide an understanding of the TSS concentrations and associated turbidity during each tide. These samples will also be evaluated in the laboratory for turbidity to allow comparison with the real-time measurements and TSS data. ;
- Three samples will be collected each day (one from each monitoring station from near bottom in the water column, unless the worst case turbidity is observed at another depth in which case that depth will be sampled) for laboratory analysis for VOCs, hardness and dissolved and total metals and PCBs. This will provide an understanding of potential background

contributions from upstream (during ebb tide), and downstream (during flood tide), as well as the concentrations of COCs that may result from resuspension during the bulkhead replacement activities.

- The potential for PCBs to be re-suspended into the water column will be assessed to determine whether they are in the dissolved or particulate form. If PCBs are in the dissolved form, direct water column monitoring of PCBs will be required, and turbidity/TSS will not be used as a surrogate for predicating PDB contamination.

- Samples will be collected for chemistry and TSS when the turbidity criterion (either the 100 NTU or a value based on the site-specific turbidity/TSS relationship) is exceeded (Figure 2-2).

Once sufficient data are available from the first two weeks of the bulkhead monitoring program, a memorandum describing the Site specific TSS/turbidity relationship will be sent to NYSDEC for concurrence. Until this relationship is established, a correlation of one milligram per liter (mg/L) TSS to 1 NTU will be used as a "trigger" for evaluation for the need to implement mitigation/response actions (see Section 4) and conduct additional sampling for chemistry. The memorandum to NYSDEC will affirm or refine the initial assumption and propose a turbidity value to be used for the remainder of the bulkhead installation program.

Additionally, if the first two weeks of chemistry data document that COCs are not being transported down-current at concentrations greater than NYSDEC guidance values, a memorandum summarizing these data will be prepared and presented to NYSDEC with a request to reduce the sampling frequency to twice per week. Continuous turbidity monitoring will continue, with the following actions triggered by an exceedance of the turbidity criterion (Figure 2-3):

- On a real-time basis, an initial turbidity measurement will be taken within the curtain to establish a baseline "active operation" level. If during operations, the turbidity levels inside the turbidity curtain are less than the control limits (100 NTU above background assumed until until a calibrated control limit for turbidity can be established), then the operations will continue as planned and the buoys will perform the monitoring. If the turbidity levels inside the turbidity curtain are greater than the control limits, the operations can be continued, but the BMPs need to be inspected/upgraded as applicable and monitoring will be triggered outside the turbidity curtain. If these exceedances are sustained for a period of 30 minutes or more, the next level of monitoring will be triggered. Figure 2-3 outlines the single-curtain monitoring program in the form of a decision tree.
- If the turbidity levels outside the turbidity curtain are less than the calibrated control limit for turbidity, then the operations will continue as planned. All BMPs in place will continue to be monitored. If the turbidity levels outside the turbidity curtain is greater than the calibrated control limit for turbidity and a visible plume is observed, in-water activities will be paused in order to adjust the operations. Additionally, monitoring will be shifted approximately 300 feet down current. If the measured turbidity at the limit of the 300-foot down current station exceeds the calibrated control limit, then additional monitoring would be triggered 600-feet down current to define the limit of the plume. Monitoring will continue (30 minute intervals) to see if the plume dissipates or persists.
- Exceeding the specified control limit at the 600-foot boundary (with or without a visible plume) will trigger COC monitoring and a temporary cessation of activities until corrective actions are implemented.

2.2.2 Dredging Operations

Dredging will be conducted over two seasons. During the first season, sediment will be dredged from those areas where PCBs have been found at concentrations greater than or equal to 50 mg/kg (TSCA PCBs), and during the second season, the remainder of the sediment will be dredged. During both seasons, real-time measurements of turbidity will be used to trigger mitigation/response actions, and routine sampling will be conducted to verify that COCs are not being transported at concentrations greater than NYSDEC guidance values. The water quality monitoring program will also include ongoing visual inspections for evidence of solids transport that may not be monitored by the turbidity measurements.

The initial phase of the monitoring program during both seasons will consist of an intensive data collection effort to: a) verify the turbidity/TSS relationship developed during the bulkhead replacement; and b) collect adequate data to document that COCs are not being transported at concentrations greater than NYSDEC guidance values. This initial phase of monitoring will, at a minimum, extend through dredging of the “higher concentration” TSCA PCBs, even if it takes more than one month to reach the sediment with the higher concentrations. Once the highest source strength TSCA PCBs are removed, and the turbidity/TSS relationship is verified, and if it is determined that COCs are not being transported down-current at concentrations greater than NYSDEC guidance values, memoranda detailing these conclusions will be submitted to NYSDEC. The turbidity criterion will be used to trigger mitigation/response actions, and a reduced sampling frequency may be proposed. In the event that a viable TSS/ turbidity relationship cannot be established, daily TSS sampling will be conducted until such time when a relationship can be established and agreed to by NYSDEC.

The initial monitoring frequency and the anticipated reduction in monitoring during each phase are shown in Table 2-2. Since sediment containing the highest concentrations of PCBs will be dredged during the first season, a longer period of initial monitoring is proposed. During both seasons, the response to the monitoring results will be the same:

- A double turbidity curtain system will be employed during dredging. Site environmental staff will take daily measurements around the dredge barge (immediately outside of the double turbidity curtain) to measure turbidity levels and gauge the effectiveness of the double curtain system. Ambient (background) turbidity levels will be determined from the 300 ft up-current continuously logging buoy platform, and down current point of compliance data will be collected from the fixed 300-ft down current buoy. An up-current, off-Site fixed buoy monitoring station will also be established to track ambient conditions (outside the potential influence of the Site). An example monitoring layout is included as Figure 2-1.
- A water column monitoring decision tree has been developed to help inform the monitoring effort and ensure environmental compliance (Figure 2-2). An initial turbidity measurement will be taken at several points immediately adjacent to the dredge barge outside of the double curtain to establish a baseline “active dredging operation” level. If during dredge operations, the turbidity levels adjacent to the dredge barge (outside of the curtains) are less than the control limits (100 NTU above background or calibrated control limit) and there is no visible plume present, then the operations can continue as planned and the buoys will perform the monitoring.
- If the turbidity levels adjacent to the dredge barge (outside the curtains) are greater than the control limits and a visible plume is observed, the dredging can be continued, but the BMPs need to be inspected/upgraded as applicable. Additionally the extent of the plume will be

identified, and a surface water sample for VOCs, metals (total and dissolved), hardness, PCBs (total), and TSS will be collected from a single depth in the water column (within the horizon of highest turbidity, assumed to be near bottom) within the plume. The sample will be collected at the extent of the plume, or at 300 ft, whichever is closer to the dredging operations. Section 4.2 details how these data will inform decision-making.

- Monitoring will continue and focus on the data collected from the fixed buoy 300 feet down current of the dredge barge. If these exceedances are sustained for a period of 30 minutes or more, the next level of monitoring will be triggered. If the turbidity levels at the 300-foot monitoring location are less than the calibrated control limit, then the operations will continue, and the buoys will perform the monitoring. All BMPs in place will continue to be monitored. If the turbidity levels at the 300-foot monitoring location are greater than the calibrated control limit, and a visible plume is observed, dredging will be paused in order to adjust the operations and potentially modify BMPs.
- Additionally, monitoring will be shifted approximately 600 feet down current. If the measured turbidity at the limit of the 600-meter down current sampling station exceeds the calibrated control limit and a visible plume is observed, then monitoring will continue (30 minute intervals) to see if the plume dissipates or persists. TSS and COCs will also be sampled within this plume. In the event sustained turbidity measurements indicate that the 100 NTU criterion has been exceeded at the limit of the 600-foot down current station, project operations will cease until the causes for the plume are evaluated and corrective actions are implemented. COCs shall not exceed the concentration in Table 3-1 Guidance Values for Evaluating Surface Water Monitoring, or 30% over ambient concentrations if ambient concentration exceed the limits in Table 3-1.

- A TSS sample will be collected daily at the 600 foot down-current monitoring station from a single depth (based on observed turbidity, assumed to be the bottom horizon). Additionally, TSS monitoring will occur at the 600 foot down-current monitoring location, using a YSI EXO probe (or equivalent). If TSS at this monitoring location exceeds the TSS at the fixed upstream ambient monitoring location by more than 100 mg/l over ambient, then COCs shall be analyzed at the 600 foot down-current monitoring location and as per Figure 2-3 temporarily cease operations. COC concentrations shall be compared with the water quality standards. If the COC concentrations exceed the water quality standards, then operational changes must be made to the dredging practices as per procedures outlined in Section 4-1.

2.2.3 Cover System Placement

During cover system placement, the water quality monitoring program will include visual inspections, real-time turbidity measurements, and sampling for TSS (if triggered). A single turbidity curtain will be employed during these in-water activities.

An initial turbidity measurement will be taken within the curtain to establish a baseline “active operation” level. If during operations, the turbidity levels inside the turbidity curtain are less than the calibrated control limit, then the operations will continue as planned and the buoys will perform the monitoring. If the turbidity levels inside the turbidity curtain are greater than the control limits, the operations can be continued, but the BMPs need to be inspected/upgraded as applicable and monitoring will be triggered outside the turbidity curtain. If these exceedances are sustained for a period of 30 minutes or more, the next level of monitoring will be triggered. Figure 2-3 outlines the single-curtain monitoring program in the form of a decision tree.

If the turbidity levels outside the turbidity curtain are less than the calibrated control limit, then the operations will continue as planned. All BMPs in place will continue to be monitored. If the turbidity levels outside the turbidity curtain is greater than the calibrated control limit, and a visible plume is observed, in-water activities will be paused in order to adjust the operations. Additionally, monitoring will be shifted approximately 300 feet down current. If the measured turbidity at the limit of the 300-foot down current station exceeds the calibrated control limit, then additional monitoring would be triggered 600-feet down current to define the limit of the plume. Monitoring will continue (15 minute intervals) to see if the plume dissipates or persists.

Exceeding the specified control limit at the 600-foot boundary will trigger the collection of a TSS sample and operations will be ceased until corrective actions are implemented.

Prior to commencement of backfill operations, a technical memorandum evaluating the potential for use of a tremie system will be prepared for NYSDEC review. This memorandum will focus on use of a tremie system placement method for backfill in areas where high concentrations of COCs will remain to be sequestered/capped by the backfill. The field crew will pay extreme attention to backfilling operations. Resuspension will not be allowed.

2.3 Updates to Season 2 Monitoring Program

Based on the June 25, 2019 memorandum from NYSDEC, a series of modifications to the water column monitoring program will be instituted during the 2019 remedial dredging program. These include the following actions:

1. A fourth fixed buoy-monitoring station will be deployed in the river at an up-current location to provide data on ambient background conditions. Samples for chemical analyses will be collected from this additional location, as well as the upstream, adjacent, and downstream stations (See Figure 2-1).

2. The chemical parameters to be analyzed will include TSS, PCB Aroclors, VOCs, hardness, and metals (whole water and filtered). Filtered PCB samples will no longer be collected.

3. All samples will be analyzed with an expedited turnaround time (48 hours) in order to facilitate potential field program and dredging operational changes and changes to best management practices, should they be deemed necessary.

4. The tables supporting the reporting memoranda will be modified to include the following information, in addition to the existing format: buoy location based on tide (U/D/A), water depth, field turbidity, tidal elevation, tidal stage, lab measured turbidity (if analyzed), TSS (if analyzed), containment in place, and the time dredging commenced.

5. Compliance checks of TSS and turbidity will be conducted at the 600 ft downstream location on a daily basis during sampling activities.

6. A refined TSS/turbidity calibration curve will be prepared using data from Season 1 (September and October 2018 data) as well as data from the first 2 weeks of the Season 2 (2019) field program. This revised curve will be provided to NYSDEC under separate cover from this Work Plan, and BASF will continue to collect both turbidity and TSS data until the state has reviewed and confirmed the revised curve.

7. Daily water column samples will be collected during the 2019 dredge season. Based on the results of this program, a request to reduce sampling can be presented to the NYSDEC for approval after the first month of dredging.

3.0 Sampling Methods

3.1 Sampling Layout

It is anticipated that bulkhead replacement, debris removal, dredging, and backfill/habitat placement, activities will be conducted in one general area at a time. Therefore, where required, a single upstream and downstream monitoring location will be used to assess potential water quality impacts attributable to the operations. However, as the in-water operations move around the Site, monitoring activities will be re-positioned accordingly. In order to simplify implementation of the monitoring program and due to fluctuation in the flow regime within the Hudson River, the up-current and down current monitoring stations will each be located approximately 300 feet from the active work areas. An additional fourth buoy will be established as ambient/ background monitoring station approximately 1500 ft upriver (Figure 2-1).

The remedial contractor(s) will monitor flow conditions while in-water activities are being performed. Up-current and down current directions from the in-water work activities will be based upon the flow direction determined during the tides. The upriver, background fixed buoy monitoring station will be established for monitoring and sampling activities (Figure 2-1) and considered the background location.

3.2 Real-Time Turbidity Measurements

Turbidity sensors will be deployed at each location towards the bottom water column (approximately three feet from the sediment surface) based on low tide conditions. The tidal range at the Site is approximately 4.5 feet, so depending on the current phase of the tide, the height of the instrumentation would need to be adjusted appropriately in order to avoid contact with the river bottom. Site environmental staff will monitor the predicted tides for the day and plan the monitoring approach accordingly.

The instrumentation will either be operated by dedicated on-water staff or be installed on floating buoy platforms. Both approaches will facilitate rapid relocation, as necessary. Turbidity readings will be recorded, compiled, and made available virtually real-time to the Site environmental staff. Data from the turbidity sensors also will be downloaded and placed in redundant storage in a field laptop computer. Readings will be recorded once every 30 minutes at the each turbidity monitoring stations.

Since no off-site laboratory analyses are required, the turbidity monitoring approach has the benefit of alerting the Site environmental staff on a real time basis when exceedance criteria are met or exceeded. The turbidity control limits will be set using a rolling average and a trigger value based initially on 100 NTU above background. The value was determined based on an anticipated correlation between the TSS and turbidity of 1 mg/L to 1 NTU (as detailed in Section 2.2.1). TSS samples will be collected shortly after the commencement of dredging by Site environmental staff in accordance with NYSDEC TOGS 5.1.9 to establish the project-specific correlation between turbidity and TSS.

Note that the rolling average for turbidity will not be implemented at the 600-foot down current location. At this location, TSS shall not exceed 100 ppm over ambient, per NYSEC TOGS 5.1.9

Section V.C. TSS will be directly measured, especially if the turbidity exceeds 100 NTU/turbidity corresponding with 100 ppm TSS.

3.3 Sampling and Analysis of Constituents of Concern

Samples for VOCs, metals, hardness, PCBs, and TSS will be collected as a grab sample (with a pump/ tubing system). Initially, the PCBs will be sampled as both a whole water sample and a filtered sample. If triggered during dredge operations, samples from the water column will be collected at one depth near the bottom of the water column, or where highest turbidity was observed during baseline sampling. The sampling inlet will be paired with a water quality sonde. The Site environmental staff will have a sampling crew whose primary responsibility will be to collect the water quality samples and reposition the sampling locations, when necessary. Samples will be labeled, preserved and shipped as described in the Quality Assurance Project Plan (QAPP).

PCB and other COC samples will be collected on a daily basis during the first two weeks of the bulkhead replacement and dredging in areas where PCBs are found at concentrations less than 50 mg/kg, and during the first month of dredging in those areas with TSCA-regulated PCBs are present. For the second dredge season, sampling will occur daily for the first month of operation before being re-evaluated to determine if lower frequency sampling is acceptable. In the event that the highest concentrations of TSCA PCBs and chlorinated benzenes are not addressed during these initial sampling periods, COC sampling will extend beyond these time frames, as needed, until the areas with the highest concentrations of COCs have been dredged.

Samples will be collected from three stations at one depth (assumed to be near the bottom of the water column, or where highest turbidity was observed during baseline sampling). These water samples will be collected just outside the confines of the double silt curtain. The chemistry data will be evaluated against the water quality standard (Table 3-1). If COC concentrations are found to be consistently below the screening value, sampling will be reduced to twice per week upon concurrence with the NYSDEC.

Proposed analytical methods are summarized on Table 3-2. Sample analysis will be undertaken at an environmental analytical laboratory certified by the New York State Department of Health (ELAP). Additional details on sample handling, analysis, and data validation are provided in the QAPP.

Table 3-1 Guidance Values for Evaluating Surface Water Monitoring

Contaminant	NYSDEC Guidance Values for Acute Aquatic Toxicity and Protection, µg/L[1]	Note
Inorganics		
Dissolved Arsenic	150	2
Dissolved Cadmium	3.2	2, 3
Dissolved Chromium	498.8	2, 3
Dissolved Copper	11.5	2, 3
Dissolved Lead	81.3	2, 3
Dissolved Zinc	102.1	2, 3
Total Mercury	0.05	2, 4

Contaminant	NYSDEC Guidance Values for Acute Aquatic Toxicity and Protection, µg/L[1]	Note
VOC		
Benzene	10	2
Chlorobenzene	5	2
Dichlorobenzene Sum	5	2
PCBs		
PCB per Aroclor	0.2	2, 5
Turbidity		
TSS	100 ppm over ambient (to be measured and complied with at 600-ft downstream location)	2

Notes:

1 - Values from Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations (NY TOGS 1.1.1, June 1998), as amended by NYSDEC comments on the draft Water Column Monitoring Plan.

2 - Use EPA analytical method with the lowest possible Method Detection Limit as promulgated under 40 CFR Par 136.

3 - Criterion adjusted to mean hardness concentration of 85 mg/L using equations presented in NYSDEC TOGS 1.1.1. Actual values will be updated/recalculated based on the hardness measured during the baseline monitoring.

4 - When a Method Detection Limit listed below is greater than the listed Water Quality Standard, the Water Quality Standard will be presumed to be met when analytical results demonstrate compliance with the Method Detection Limit. For example, for mercury, the water quality standard is 0.0007 ppb (as per 6 NYCRR 703.5b and H(FC) standard) but the standard based on detectability is 0.05 ppb total mercury.

5 - On a per Aroclor basis. Limit for PCB concentration is total although the portion of PCB in the dissolved form must be determined.

Table 3-2 Analysis Requirements for River Water Monitoring, Hudson River

Analysis	Matrix	Method	Lab	Notes
TSS	Water	EPA 160.1	TBD	48 hour TAT
Hardness	Water	EPA 130.1/ Standard Methods (Ca/Mg)	TBD	
VOCs	Water	EPA 8260C	TBD	48 hour TAT. Report to MDLs to meet Table 3-1 guidance values for aquatic toxicity and protection
Metals	Water	EPA 200.7/200.8	TBD	
Total PCB Aroclors	Water	EPA 608	TBD	

Analytical laboratory must be accredited for the method and matrix under the New York State Environmental Laboratory Accreditation Program.

Water samples will be filtered to measure dissolved parameters, with the exception of the whole water PCBs.

TAT - Turnaround time from the time of sample collection

TBD - To be determined

EPA - 40 CFR 136 Clean Water Methods

MDL - method detection limit

4.0 Mitigation and Response Actions

Monitoring will be performed by Site environmental staff to verify that BMPs are in use at all times and no visual deficiencies are observed during the dredging operations. The areas near the barges will be monitored for oil sheens and other visual plumes. In the event that sheens are observed, the contractor will install oil booms to control the spread of such sheens. In the event of any other visual plumes, the BMPs in place will be evaluated.

4.1 Mitigation Based on Real-Time Turbidity Monitoring

Turbidity/TSS monitoring will be performed via a water quality sonde operated by Site staff or mounted to an automated sampling buoy. The average value of the up-current (background) location will be compared to the rolling average value of the down current location for the same period. The monitoring limit will be based on 100 NTUs above the upstream (background) level, assuming a 1 mg/L to 1 NTU correlation between TSS and turbidity. Sampling activities are initially triggered when turbidity outside the second turbidity curtain is >100 NTUs above background (or the calibrated control limit).

Typically during monitoring activities, it is not uncommon to get occasional one-time spikes that cannot be tied to activities in the water (e.g., the sensor makes contact with the bottom, biofouling). If this happens regularly (that is, more frequently than twice per day), the sensor will be inspected and cleaned, repaired, or replaced.

Turbidity readings will be reported in the daily reports by the Site environmental staff. If there is an exceedance as described above, the dredge contractor and the Site environmental staff will conference immediately. After review and verification, the NYSDEC will be notified immediately and provided additional documentation of corrective action or employment of BMPs listed in Section 2.1 as the information becomes available.

If after employing BMPs, an exceedance of the turbidity criteria of 100 NTUs above ambient conditions (assuming a 1 mg/L to 1 NTU correlation between TSS and turbidity) is reported and if it is determined that the cause for the exceedance is related to the remedial action. If the source of the turbidity or visible plume can be traced back to the marine construction (bulkhead improvement, cover system installation, or dredging action), as determined by mapping of the plume through navigating in a zig-zag pattern and/or longitudinally through the plume, additional response actions may be employed. Actions will be coordinated with NYSDEC. Potential mitigation measures are outlined below:

- Reducing the dredging operations removal rate or otherwise adjusting the specific dredging operations.
- Temporarily suspending dredging operations until the source of the exceedance can be determined and remedied.

- If turbidity curtains have already been established around the dredging operation(s) where the confirmed exceedance was obtained, an additional turbidity curtain layer could be established around the dredging operation in question.
- Suspend operations until site conditions (tide, wind, or other factors), improve.

Action will be taken when turbidity measurements indicate that the 100 ppm TSS over ambient condition is being exceeded outside the second turbidity curtain and if exceeded at the down-current compliance point located at the 600-foot down-current location. These actions should include sampling for laboratory TSS concentration.

Depending upon the situation in which the exceedance is identified and investigated by the environmental monitor, a single mitigation measure may be used to correct the issue or a combination of measures may be implemented. Mitigation measures will be coordinated with the Site environmental staff. As more data are obtained as part of the real-time turbidity monitoring, additional mitigation measures may be developed and implemented, or the additional measures suspended if values are significantly lower.

In addition to inclusion on daily reports, turbidity readings will be summarized and provided weekly to the NYSDEC. Mitigation measures that were implemented based on turbidity readings will also be included in these reports. Raw turbidity reading data will be provided monthly to NYSDEC.

4.2 Mitigation Based on Laboratory Results

The up-current monitoring data will be used to evaluate whether an exceedance of the surface water criteria at the down current monitoring location is related to dredging operations. The general approach to mitigation will be based on the following:

- **COC levels below guidance values**: No mitigation measures
- **COC levels exceed guidance values:** Implement corrective measures and continue monitoring until three consecutive results below guidance values.

Results will be reported in the daily reports by the Site environmental staff. If there is an exceedance as described above, Site environmental staff will get notified immediately by the laboratory. After review and verification, NYSDEC will be notified within 24 normal business hours with additional documentation of corrective action or reanalysis.

If sampling continues to demonstrate that dredging operations do not result in significant increases in surface water concentrations above ambient conditions, then sampling frequency may be reduced if approved by NYSDEC. If results indicate significant increases in surface water concentrations above ambient conditions, then sampling frequency may be increased. Additional BMPs may be put in place if analytical results indicate significant increases in surface water concentrations above ambient.

If after a single mitigation measure or combination of measures has been implemented and monitoring data indicate the surface water criteria are no longer being exceeded, the necessity of continuing the implementation of the mitigation measure(s) will be evaluated with NYSDEC. Following this evaluation, some or all of the measures implemented may be used at reduced levels or eliminated entirely.

5.0 References

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Figures

N
W
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S

NORTHERN SEDIMENT MANAGEMENT AREA

BASF FACILITY SITE

Legend

Study Area

Site

Distance From Site

1500 River Feet

Site Locus

Surface Water Remedial Action Monitoring Plan
BASF Corporation
Rensselaer, New York

SCALE	DATE	PROJECT NO.
1:6,000	2/18	60323713

AECOM

Figure Number

1-1

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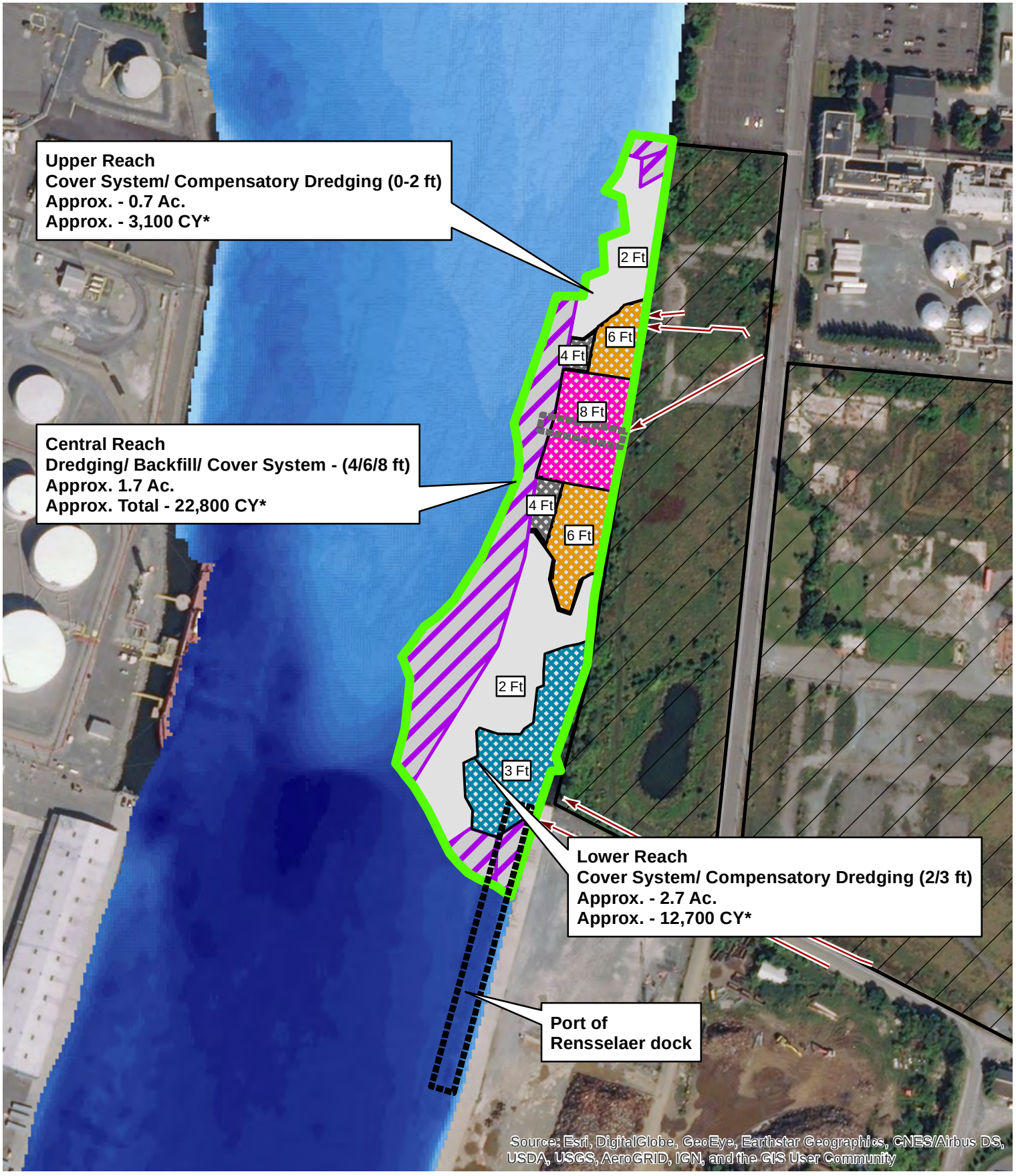

Depth (Feet)

-45 - -40 | -39 - -35 | -34 - -30 | -29 - -25 | -24 - -20 | -19 - -15 | -14 - -10 | -9 - -5 | -4 - 0

0 50 100 200 300 400 500 Feet

Study Area
2 ft Removal Area
3 Ft Removal Area
4 Ft Removal Area
6 Ft Removal Area
8 Ft Removal Area
Area of Upstream Deposition
Approximate Locations of Outfall Pipes
Approximate Property Boundaries
Approx Location of Diffuser Pipe
Approx Location of New Dock

*Note: Dredge volumes include 0.5 foot overdredge and 15% side wall slough factor

Conceptual Depiction of OU-2 Remedial Action Plan

Surface Water Remedial Action Monitoring Plan
BASF Corporation
Rensselaer, New York

SCALE	DATE	PROJECT NO.
1:3000	2/18	60323713

AECOM

Figure Number

1-2

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Fenceline
Study Area
Approximate Property Boundaries

0 50 100 200 300 Feet

Note: Mobile turbidity monitoring will be conducted in a research vessel.

Conceptual Water Quality Monitoring Layout

Surface Water Remedial Action Monitoring Plan
BASF Corporation
Rensselaer, New York

SCALE	DATE	PROJECT NO.
See Insets	01/18	60323713

AECOM

Figure Number

2-1

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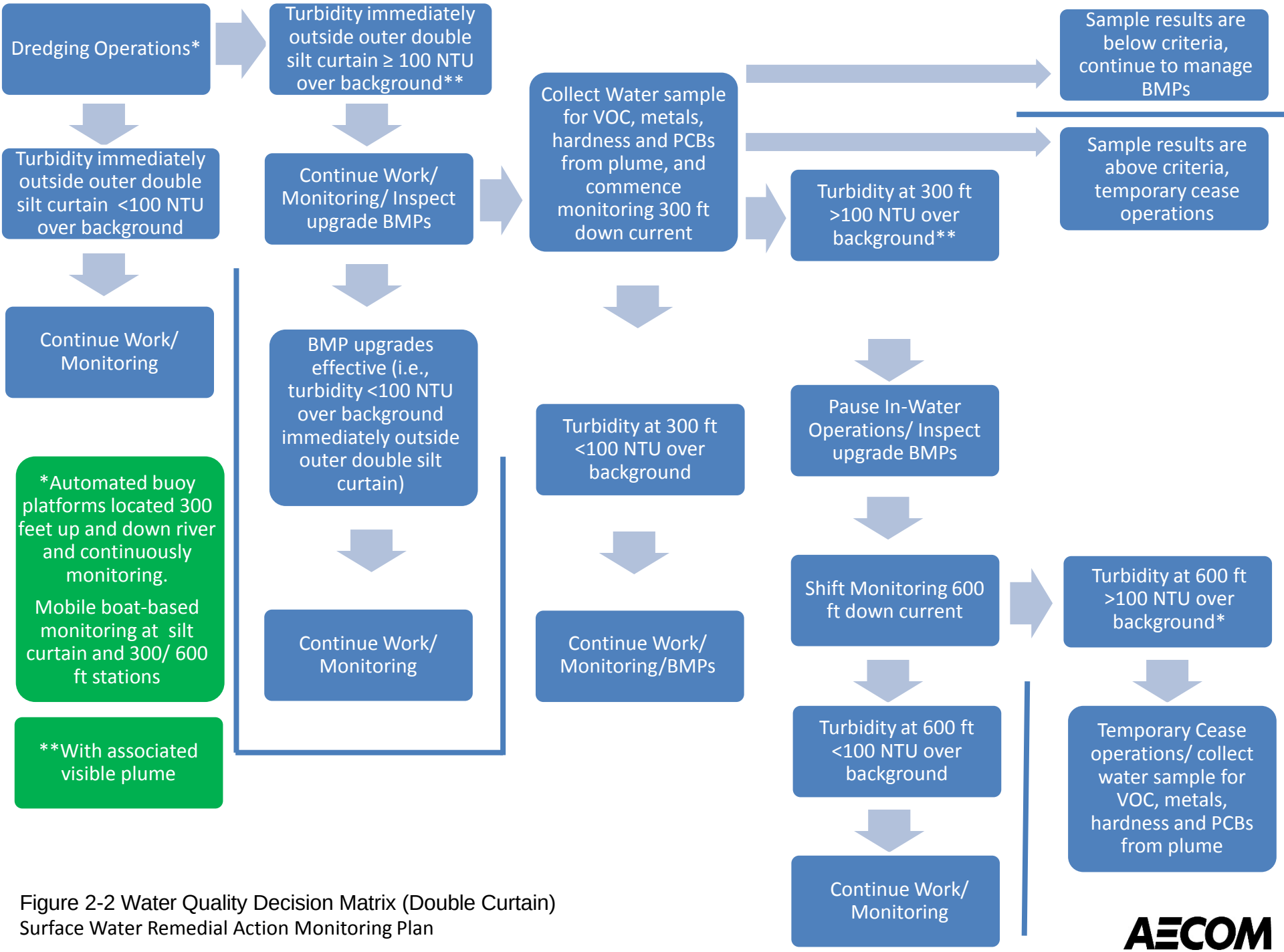

Figure 2-2 Water Quality Decision Matrix (Double Curtain)
Surface Water Remedial Action Monitoring Plan

AECOM

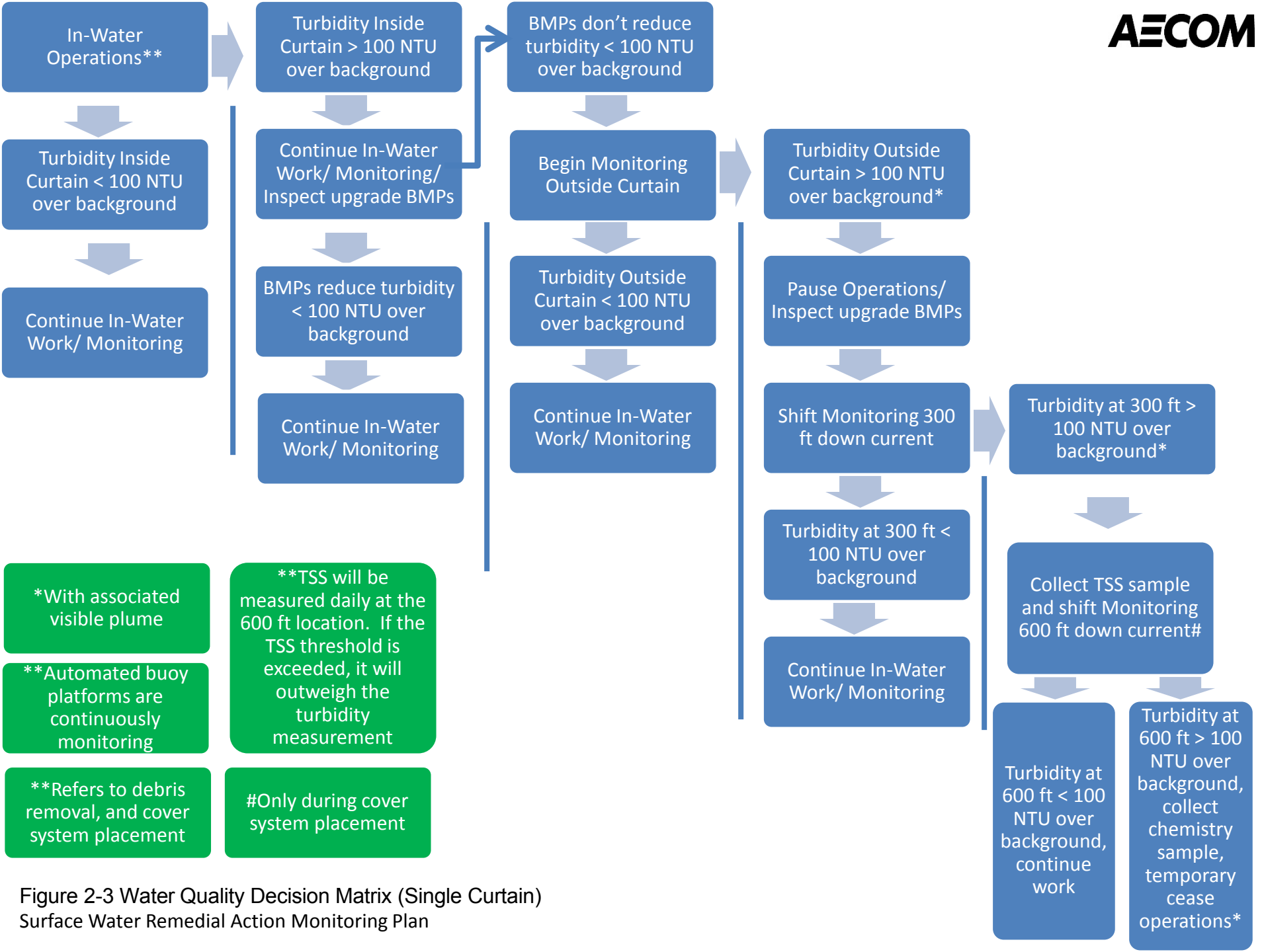

Figure 2-3 Water Quality Decision Matrix (Single Curtain)
Surface Water Remedial Action Monitoring Plan