APPENDIX F

DREDGE AND CAP DESIGN PLANS
When preparing an engineering design for removing sediment, a major component of the design is to define the dredge prism (horizontal and vertical extents of required dredging). This memorandum describes the procedures used to define the dredge prism (see draft Dredging Plan drawings) for the Onondaga Lake (Lake) remediation project. The draft Dredging Plan drawings herein consist of the dredge prism for Remediation Areas A, B, C, D, and E. A summary description of these remediation areas is provided below (see Drawing D-1 for remediation area locations):

- Remediation Area A – Mouth of Ninemile Creek (Sediment Management Unit [SMU] 4 and adjacent impacted areas in SMU 3 and SMU 5)
- Remediation Area B – Offshore of Wastebeds 1 through 8 (SMU 3)
- Remediation Area C – Offshore of the New York State Department of Transportation (NYSDOT) Turnaround Area and the Willis/Semet Interim Remedial Measure (IRM) barrier wall exclusive of in-lake waste deposit (ILWD) (SMU 2 exclusive of the ILWD)
- Remediation Area D – ILWD (SMU 1 and adjacent portions of SMU 2 and SMU 7 where ILWD is present)
- Remediation Area E – Southwestern end of the Lake (SMU 6 and SMU 7 exclusive of the ILWD)
The remainder of this memorandum discusses how the dredge prisms were developed assuming mean cap placement tolerances; assumptions and procedures used to develop the dredge prisms; and concludes with a specific discussion on each of the five remediation areas.

This lake design submittal includes portions of the designs for three areas along the shoreline that are being remediated in addition to the lake: the spits at the mouth of Ninemile Creek, the connected wetlands and shoreline stabilization at Wastebeds 1 through 8, and the Wastebed B/Harbor Brook (WBB/HB) Outboard Area. Due to similarities in remedial approaches and the connectivity with the adjacent lake dredging, capping and habitat designs, remediation of these areas will occur at about the same time as the remediation of the adjacent lake area, as detailed in Section 3.4 of this design report. Remediation in these areas will include removal of material above and below the water table, construction of an isolation cap, and habitat restoration. The removal area and depth and cap construction details for these areas are being developed as part of this design due to the similarities in design and the connectivity between the lake remediation and these areas. The material removal approach and associated material management strategy associated with these areas is being advanced as part of documentation associated with those sites.

**DEVELOPMENT OF ELEVATION-BASED DREDGE PRISM BOUNDARIES**

The lateral extents of the remediation areas (including both dredging and capping remedial action) were established using data obtained from individual cores (Parsons 2007; Parsons 2008; Parsons 2009a; Parsons 2009b; Parsons 2010). Specifically, the remediation area boundaries were drawn from core to core based on the analytical results from pre-design investigation (PDI) sampling locations (Phases I through VI) where the sediment cleanup criteria (i.e., mean probable effects concentration quotient [PECQ] of less than 1 and a mercury concentration of less than 2.2 milligrams per kilogram [mg/kg]) were not exceeded at any depth. Section 3 and Appendix A of the Onondaga Lake Capping, Dredging and Habitat Intermediate Design Report provide additional details pertaining to development of the remediation area boundaries.

Within the remediation areas, the remedy was subdivided into two categories, only one of which includes dredging:

1. Elevation-based dredging, which will be followed by capping
2. Capping without prior dredging to isolate impacted sediments (i.e., “capping only”)

Elevation-based dredging will be performed in select areas to prevent loss of lake surface area after the cap is placed and/or to meet a specific post-capping elevation based on habitat considerations. Elevation-based dredging will be performed in Remediation Area D to achieve the 2-meter average removal and 1-meter hotspot removal.

The lateral and vertical extents of elevation-based dredging areas in Remediation Areas A, B, C, and E are largely driven by habitat considerations. The Remedial Design Elements for Habitat Restoration (Parsons 2009d; Habitat Plan) identifies 11 habitat modules targeted for inclusion in the restoration of Onondaga Lake. Habitat modules are areas with specific physical characteristics suitable for various representative species, and are defined by three basic habitat parameters: water depth, substrate type, and water energy as described in the Habitat Plan. Habitat modules presented in the Habitat Plan (including module name, target water depth, and substrate type) within the Lake are summarized below (Parsons 2009d).

- Module 2A – Mid-water depth (7 – 20 feet). Sand/fine gravel substrate. Low to medium energy.
- Module 2B - Mid-water depth (7 – 20 feet). Coarse gravel/cobble substrate. High energy
- Module 5B - Shoreline shallows/limited emergent wetland (½ – 2 feet). Gravel substrate. High energy.
- Module 6A - Persistent emergent wetland (1 foot above water to 1-foot deep). Organics/fines/sand substrate. Low energy.
- **Module 6B** - On shore to shallows/limited emergent wetland (1 foot above water to 1-foot deep). Coarse gravel/sand substrate. High energy.

- **Module 7A** - Mudflats/unvegetated shoreline (0.7 feet above water to 0.7-feet deep). Fines/sand/gravel substrate. High energy or fluctuating water levels.

The vertical extent of dredging (e.g., dredging elevation \([E]\)) was computed for the elevation-based dredging areas using the equation below.

\[ E = WL - T_c - WD + \Delta H \]

Each of the equation parameters is described below.

- **Project water level \((WL)\)** – The project water level was set at 362.5 feet North American Vertical Datum of 1988 (NAVD 88) to meet habitat objectives focused on the sensitivity of plant communities in the nearshore areas of the Lake. This elevation of 362.5 feet NAVD 88 was selected for the design, as it represents the average lake level during the aquatic plant growing season (see Section 3.3 of the Onondaga Lake Capping, Dredging and Habitat Intermediate Design Report).

- **Estimated mean cap thickness \((T_c)\)** – The estimated mean cap thickness consists of the sum of the minimum thicknesses for up to four layers of the cap (mixing layer, chemical isolation layer, erosion protection layer, and habitat layer), plus a mean over-placement for each layer (Tables 1 through 5). The mean capping over-placement was utilized to account for the remedial contractor’s demonstrated cap placement experience (see Section 4.3.4). The capping over-placement will be further evaluated as part of the constructability and value engineering reviews in the Final Design.
  
  - Mixing layer thickness is conservatively 0.25 feet.
  
  - Chemical isolation layer thickness is a minimum of 1 foot (in accordance with the ROD). In some portions of the Lake, cap amendments including pH amendment (e.g., siderite) and/or activated carbon will be integrated into the caps to meet ROD objectives, as detailed in Appendix B and Section 4.1.4 of the Onondaga Lake Capping, Dredging and Habitat Intermediate Design Report.
- Erosion protection layer thickness is sized according to the results of Appendix D of the Onondaga Lake Capping, Dredging and Habitat Intermediate Design Report. The minimum stable particle size and thickness are typically based on the wind-induced waves during a 100-year event.

- Habitat layer thickness is based on a minimum habitat layer for a specific water depth, as defined in the Habitat Plan and Section 4.3 of this design report.

- **Target water depth (WD)** – In general, the target water depth was set at the shallowest water depth within a habitat module (excluding habitat module 6 where the water depth was set to zero), as defined in the Habitat Plan, and summarized in Tables 1 through 5. For example, Module 5A has a target water depth ranging from 0.5 to 2 feet (Tables 1 through 5). The dredging elevation was developed based on the shallowest water depth in this habitat module (0.5 feet).

- **Settlement (ΔH)** – Settlement refers to the compressing of sediments due to an increase in the stress (i.e., the added weight of a cap) on those sediments. The change in stress is a function of the thickness/load removed by initial dredging (if any) and the thickness/load of the applied cap. If the sediment is subjected to a net increase in stress/load (e.g., the increase in load resulting from the placement of the cap more than offsets the reduction in load from the removal of dredge material), some settlement could occur. The amount and rate of settlement are dependent on the compressibility and permeability of the sediments. For fine-grained sediments like those in Onondaga Lake, this settlement typically occurs over a period of several too many years and will gradually slow over time. Appendix E of the Onondaga Lake Capping, Dredging and Habitat Intermediate Design provides additional details of long-term settlement predictions. Although settlement was accounted for in estimating long-term, post-construction surface elevations for habitat planning, it was conservatively assumed to be zero (ΔH = 0) when determining dredging elevations; this way, dredge depths could be planned deep enough to meet habitat elevation goals, without relying on predicted settlements.

Cross-sections in Remediation Areas A, B, C, D, and E, illustrate the development of the dredging elevation by including the existing ground surface, removal limit, and proposed cap elevations at construction (see Dredging Plan). The proposed cap surface illustrates
placement of the mean cap thickness without settlement. In general, the elevation at construction for all modules deeper than 3 feet will be between the minimum and mean cap surface at construction, prior to the effects of settlement.

**GENERAL DREDGE PRISM DEVELOPMENT ASSUMPTIONS AND PROCEDURES**

In addition to defining the lateral and vertical extents of the dredge prism, general assumptions or procedures that were globally applied during dredge prism development include:

- **Project datums** – Horizontal survey information is referenced to the New York State Plane Feet North American Datum of 1983 (NAD 83), Central Zone. All elevations are referenced to the NAVD 88 vertical datum.

- **Shoreline** – The project boundary along the shoreline was defined by the project water level of 362.5 feet NAVD 88.

- **Bathymetry (e.g., existing ground)** – A bathymetric survey was conducted by CR Environmental, Inc. in 2005 and is documented in *Lake Phase I Pre-design Investigation Geophysical Survey Report* (CR Environmental, Inc. 2007). This bathymetric survey formed the basis of the existing bathymetry presented in the dredge plans. The existing bathymetry will be adjusted in future designs based on pre-dredge surveys.

- **Transition between shoreline and dredging** – Sufficient dredging will be completed up to the shoreline to allow placement of the mean cap thickness without losing lake surface area (see Figure 1). In areas not contiguous with adjacent wetland remediation the dredge prism was designed with a 5 horizontal to 1 vertical (5H:1V) slope from the bottom of the dredge cut (e.g., toe of slope) to the daylight line along the upland of the shoreline. Minor exceptions to this approach are identified under the discussion pertaining to individual remediation areas. A slope of 5H:1V was conservatively chosen based on available offshore vane shear test data, professional experience, and judgment in the absence of nearshore geotechnical data. Nearshore geotechnical data, including in situ vane shear testing and laboratory strength testing, was collected as part of the Phase V PDI. This Phase V data indicates that steeper slopes (steeper than 5H:1V) may be stable in some shoreline areas. Therefore, additional evaluations and/or adaptive
management may be used during construction to refine shoreline dredge slopes such that they are stable, yet minimize upland disturbance.

- **Transition between dredging elevations/cuts** – A slope of 5H:1V was designed to transition between two different target dredging elevations/cuts (see Figure 1).

- **Transition between elevation-based dredging areas and sediments outside remediation area boundary** – In areas where elevation-based dredging occurs away from the shoreline, the bottom of the dredging prism was set at the required elevation along the remediation area boundary (see Figure 1). The slope of the dredge cut was extended into the sediment outside of the remediation area boundary, thus addressing the contaminated sediment through removal and/or with a cap.

- **Transition between elevation-based dredging and cap-only areas** – In areas where the elevation-based dredging boundary is planned to abut the cap-only boundary, the dredge prism was set at the required elevation within the elevation-based dredging area, and the slope of the dredge cut was extended into the cap-only area, thus addressing the contaminated sediment through removal and/or with a cap (see Figure 1).

- **Minimum dredge cut** – A minimum dredge cut of 0.5 feet was used within the dredge prism to maintain efficient production rates and minimize low solids contents in the dredge slurry.

Volumes associated with the design of the dredges prism were calculated using Auto Desk’s Land Development Desktop (LDD) software. A three-dimensional surface was created in AutoCAD v. 2008 for both the existing bathymetry and the required dredge prism, accounting for design side slopes. These surfaces each consisted of a set of contiguous, non-overlapping triangles known as a triangulated irregular network (TIN). Using LDD, the volume between these two TINs was calculated to represent the required dredge volume. An allowable over-dredge surface was developed by lowering the required dredge prism by 0.5 feet in elevation, and over-dredge allowance volume was computed using this surface.

**REMEDIATION AREA-SPECIFIC DREDGE PRISM DEVELOPMENT**

In addition to the general assumptions and procedures outlined above, each remediation area contained dredge prism development nuances (e.g., dredge cut thickness, habitat
considerations) that are specific to that remediation area. In light of the complex design, Tables 1 through 5 were developed in conjunction with the habitat work group as a tool to guide the dredging and capping design for each remediation area. Each remediation area-specific table includes:

- Targeted habitat modules
- Location inside or outside of the surf zone (as defined as the approximate depth of the breaking wave during a 100-year event [see Appendix D of the Onondaga Lake Capping, Dredging and Habitat Intermediate Design Report])
- Proposed remediation (elevation-based dredging, or capping only)
- Chemical isolation components, including a mixing layer, chemical isolation layer including pH and/or activated carbon amendments where indicated, an assumed mean over-placement allowance, and the mean total layer thickness
- Erosion protection/habitat layer components, including a minimum erosion protection/habitat layer based on the results of Appendix D of the Onondaga Lake Capping, Dredging and Habitat Intermediate Design Report, an assumed mean over-placement allowance, and the mean total layer thickness. For constructability concerns, the minimum erosion protection/habitat layer depth was set at 0.5 feet
- Additional habitat layer components, including a dedicated minimum habitat layer (in addition to the erosion protection layer), an assumed mean over-placement allowance, and the mean total layer thickness
- Total minimum cap thickness
- Assumed total mean over-placement allowance for all layers
- Total mean cap thickness
- Assumed total maximum over-placement allowance for all layers
- Total maximum cap thickness
- Top of cap elevation
- Water depth from cap surface
- Dredging volume computations including total area, dredge volume based on the dredge prism, over-dredge volume estimate (assuming 6 inches across the total dredge area), and total dredge volume
The dredge depths and volumes were largely developed to achieve the desired post-construction habitat objectives and elevations. It is Honeywell's objective to conduct comprehensive constructability and value engineering reviews during the Final Design stage. These reviews will allow the cap and dredge tolerances to be reviewed further with Sevenson Environmental and the Honeywell team resulting in an optimized dredge and cap plan that incorporates reasonably efficient construction tolerances. In addition to the constructability reviews, Honeywell will continually monitor the progress of the construction, allowing continued project implementation enhancement. This continuous monitoring can lead to design assumption revisions, allowing the project construction schedule and final effectiveness to be optimized. As such, adaptive management will be used during the remedial construction to refine components of the dredge prism design with an overall objective of continuous optimization of the project.

An area-by-area summary of unique dredge prism components is provided below.

**Remediation Area A**

Remediation Area A is approximately 86 acres and is located off the mouth of Ninemile Creek (Drawings D-2 to D-3 and D-11 to D-13 show plan views and cross-sections of Remediation Area A). Remediation Area A contains both elevation-based dredging and capping only remedies. Additionally, the conceptual removal prism for the adjacent spits along the mouth of Ninemile Creek and the removal of the connected emergent wetlands have been integrated into the Remediation Area A dredge prism.

The shoreline area just east of the mouth of Ninemile Creek will be updated as part of the draft Final Design, based on slope stability analyses near the Wastebeds 1 through 8 and the removal of the spits.

Remediation Area A contains five habitat modules where elevation-based dredging will occur (Module 6A, 5A, 4A, 3A, and 2A). Target dredge elevations were assigned based on target water depths, presence of amended cap material, and mean cap thickness, as shown in Table 1.
A vertical dredge cut is shown along the shoreline west of Ninemile Creek. The sediment removal at this location will be integrated with the SW-10 as part of the draft Final Design.

**Remediation Area B**

Remediation Area B is approximately 17 acres and is located offshore of Wastebeds 1 through 8 (Drawings D-4 and D-14 show plan views and cross-sections of Remediation Area B). Within Remediation Area B, there are two elevation-based dredging areas (Module 5A & 3A). The target dredge elevations are shown in Table 2.

Nearshore sediment dredging in this area is relatively shallow, and no sensitive structures are located along the shoreline. However, as discussed in Section 3.4, a groundwater collection trench will be installed along the shoreline as part of the Wastebeds 1 through 8 IRM. The groundwater collection trench will be located outside of the Remediation Area B dredge boundary.

The conceptual removal prism for the Wastebeds 1 through 8 connected wetland area was developed adjacent to the Remediation Area B dredge prism. The integration between the Remediation Area B dredge prism and the Wastebeds 1 through 8 removal prism will be incorporated in the draft Final Design. A vertical line represents the demarcation between the two prisms.

**Remediation Area C**

Remediation Area C is approximately 24 acres and is located offshore of the NYSDOT Turnaround area and the Willis/Semet IRM barrier wall exclusive of ILWD (Drawings D-5 and D-15 to D-16 show plan views and cross-sections of Remediation Area C). Remediation Area C contains three habitat modules (Module 6B, 5B, and 3B) where elevation-based dredging will occur near the shoreline. Target dredge elevations were assigned based on target water depths and mean cap thickness as shown in Table 3.

Shoreline stability in this area is of particular concern due to the proximity of shoreline utilities and existing steep slopes. The dredge prism along the shoreline east of the NYSDOT turnaround was modified to prevent dredging into the existing utilities along the shoreline. The NYSDOT turnaround area is located on top of hard slag waste material, which was
deposited in the lake by industrial processes not associated with Honeywell or its predecessors. Removal of shoreline material is not included due to the extremely hard nature of this material and to facilitate future development of this area as a boat launch. The remainder of the shoreline in this area consists of rip-rap leading up to a gravel access road leading to Wastebed B that is located between the lake and the highway.

**Remediation Area D**

Remediation Area D is approximately 99 acres and is comprised of SMU 1 and the ILWD portions of SMUs 2 and 7 (see Drawings D-6 to D-8, and D-17 to D-20). The dredging requirements in Remediation Area D are based on the ROD-required, 2-meter-average dredge cut per former SMUs 1, 2, and 7. Additional dredging (beyond the 2-meter average dredge cut) of 3.3 feet (1 meter) is proposed at 7 hot spot locations (A through G) where remaining sediment concentrations exceeded the hot spot criteria. The details pertaining to the development of the general dredge depths in each SMU and hot spot areas is presented in Appendix G of the Onondaga Lake Capping, Dredging and Habitat Intermediate Design Report. Remediation Area D contains three habitat modules (Module 6B, 5B, and 3B). Table 4 presents the targeted habitat modules that will be incorporated into the dredge prism.

A vertical dredge cut is shown along the shoreline in SMU 1/Wastebed B where the remedy abuts the Outboard Area remediation. The shoreline of the western third of Remediation Area D consists of the exposed sheet pile barrier wall installed in 2008 as part of the Willis/Semet IRM. Dredging design and implementation in this area will consider potential stability issues associated with the wall, as well as ensuring dredging operations and shoreline support activities do not subject the sheet pile wall to excessive stress and compromise structural integrity that could lead to potential damage and safety risks. The dredge prism for Remediation Area D will include a 10-feet offset along the barrier wall, with a 5:1 slope extending from the toe of the dredge prism up to the barrier wall.

**Remediation Area E**

Remediation Area E is approximately 181 acres and is located at the southwestern end of the lake (Drawings D-7 to D-10 and D-21 to D-27 show plan views and cross-sections of Remediation Area E). Remediation Area E contains three habitat modules (Module 6B, 5B, and 3B) where elevation-based dredging will occur near the shoreline. Target dredge
elevations were assigned based on target water depths and mean cap thickness, as shown in Table 5.

A fourth elevation-based dredging area has been designed for the navigation channel that extends from Onondaga Creek into Onondaga Lake (see Drawing D-8). The navigation channel is authorized by the State of New York. Based on information from the New York State Canal Corporation (NYSCC), the dredge prism was developed with a water depth of 16 feet (an authorized depth of 14 feet plus 2 feet below authorized dredge depth to prevent dredge-induced damage to the cap associated with future navigational dredging), a channel width of 100 feet, and a 5H:1V side slope. An erosion protection layer consisting of 3-inch stone with a minimum erosion layer thickness of 6 inches was assumed for two purposes: 1) the larger stone would serve as an indicator layer for future navigational dredging; and 2) to protect the side slopes inside the surf zone (e.g., approximately 7 feet). Although the bottom of the channel is outside of the surf zone, a portion of the side slopes are subjected to erosive wind-wave forces within the surf zone. Therefore, the larger stone size to resist wind-waves was applied to the entire channel.

The shoreline adjacent to the southern portion of Remediation Area E is dominated by an active rail line which is directly adjacent to the shoreline. Design and implementation of dredging and capping in this area will consider potential stability limitations associated with the presence of the rail line. A 150-feet offset from the shoreline was incorporated into the dredge prism design to indicate the area that is being evaluated due to the potential stability concerns in this area during dredging. Capping and dredging plans will be developed for this area as part of the draft Final Design.

REFERENCES


Summary of Cap Thicknesses and Dredge Volume

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Notes and Assumptions:

**MINIMAL**

- SGC: granular activated carbon
- CI: chemical isolation
- GAC: granular activated carbon
- OD: overdredge

**EXTENDING**

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**HABITAT LAYER**

- Assumed chemical isolation and habitat layer on the same material in Modules 1 and 2 (without amendment), which results in only one layer of over placement.
- Assumed water depths 10 to 15 ft in a 50 ft by 50 ft grid for the habitat layer calculation.

**OVER PLACEMENT**

- Assumed 0.25 ft mean over placement for the habitat layer. SGC, chemical isolation, habitat/erosion protection outside the surf zone, and additional habitat material.
- Assumed 0.25 ft mean over placement for the habitat erosion protection outside the surf zone due to constructability issues with coarse grain material.
- Assumed 0.25 ft mean over placement for Modules 1 and 2 with amendments.

**MINIMUM**

- Assumed mean over placement was used for dredged material volume calculation.
- Minimum cap thicknesses assumed no over placement.

**SURFZONE**

- No confinement was normally assumed for determining dredging elevations.

**MINERAL**

- No confinement was normally assumed for determining dredging elevations.

<table>
<thead>
<tr>
<th>Location of Benthic Zone</th>
<th>Remediation Area</th>
<th>Drilling Elevation (ft)</th>
<th>Top Cap Elevation (ft)</th>
<th>Water Depth From Cap Surface (ft)</th>
<th>Mean Cap Thickness (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (-20 to -30 ft) CI</td>
<td>Outside</td>
<td>2.00</td>
<td>360.50</td>
<td>1.00</td>
<td>3.75</td>
</tr>
<tr>
<td>2 (-10 to -20 ft) CI</td>
<td>Outside</td>
<td>2.00</td>
<td>359.50</td>
<td>1.00</td>
<td>3.50</td>
</tr>
<tr>
<td>3 (-2 to -3 ft) CI</td>
<td>Outside</td>
<td>2.00</td>
<td>359.00</td>
<td>1.00</td>
<td>4.00</td>
</tr>
<tr>
<td>4 (-1 to -3 ft) CI</td>
<td>Outside</td>
<td>2.00</td>
<td>359.00</td>
<td>1.00</td>
<td>4.00</td>
</tr>
<tr>
<td>5 (-0.5 to -2 ft) CI</td>
<td>Outside</td>
<td>2.00</td>
<td>359.00</td>
<td>1.00</td>
<td>4.00</td>
</tr>
<tr>
<td>6 (+1 to -1 ft) CI</td>
<td>Outside</td>
<td>2.00</td>
<td>358.50</td>
<td>1.00</td>
<td>4.50</td>
</tr>
</tbody>
</table>

**ECOSYSTEM PROTECTION**

- Surf zone is at 3.4 feet based on wind/wave analysis by Anchor QEA.
- Chemical isolation requirements are as follows (based on 103 layer):
  - 0.6 ft = coarse grain (≤0.35 ft mean grain size)
  - 0.3 ft = fine grain (0.35 to 0.075 ft)
  - 0.1 ft = very fine grain (≤0.075 ft)
- Assumed potential for substrate issue to 0.3 feet of water depth. Habitat layer will be a minimum of 0.5 feet in 0 to 1.5 water depth habitat modules that have an isolation cap.

**TOTAL**

<table>
<thead>
<tr>
<th>Total</th>
<th>Total Dredge Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.125</td>
<td>8,198,487</td>
</tr>
<tr>
<td>4.875</td>
<td>13,752,133</td>
</tr>
<tr>
<td>5.500</td>
<td>18,802,666</td>
</tr>
<tr>
<td>Habitat Module</td>
<td>Location of Surf Zone (3.6 ft)</td>
</tr>
<tr>
<td>----------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>1 (-20 to -30 ft) AC</td>
<td>Outside amended cap only</td>
</tr>
<tr>
<td>3A (-4 to -7 ft) AC</td>
<td>Inside elevation-based dredging &amp; AC</td>
</tr>
<tr>
<td>3A (-2 to -3 ft) AC</td>
<td>Inside elevation-based dredging &amp; AC</td>
</tr>
<tr>
<td>3A (-3 to -4 ft) AC</td>
<td>Inside elevation-based dredging &amp; AC</td>
</tr>
<tr>
<td>3A (-4 to -7 ft) AC</td>
<td>Outside elevation-based dredging &amp; AC</td>
</tr>
<tr>
<td>5A (-0.5 to -2 ft) AC</td>
<td>Inside elevation-based dredging &amp; AC</td>
</tr>
<tr>
<td>5A (-0.5 to -2 ft) AC</td>
<td>Inside elevation-based dredging &amp; AC</td>
</tr>
</tbody>
</table>

**Notes and Assumptions:**

**GENERAL**
- GAC = granular activated carbon
- CI = chemical isolation
- GAC = granular activated carbon

**DRAINAGE**
- Mean drainage layer thickness is 0.25 ft to be conservative
- CI = amended cap

**EROSION PROTECTION**
- Surf zone is at 3.6 feet based on wind/wave analysis by Anchor QEA.
- Coarser grained material is used for erosion protection in the surf zone due to constructability issues with coarser grained material.

**OVER PLACEMENT**
- No settlement was conservatively assumed for determining dredging elevations.

**REMEDIATION AREA B DREDGE VOLUME ESTIMATE**

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Total Mean Cap Thickness (ft)</th>
<th>Assumed Total Mean Over Placement (ft)</th>
<th>Total Mean Cap Thickness (ft)</th>
<th>Total Mean Over Placement (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>103.245</td>
<td>3.0</td>
<td>17,685</td>
<td>1,631,413</td>
</tr>
<tr>
<td>Total</td>
<td>188.2</td>
<td>1.125</td>
<td>2.25</td>
<td>17,685</td>
</tr>
<tr>
<td>Total</td>
<td>1,753,679</td>
<td>1.125</td>
<td>2.25</td>
<td>17,685</td>
</tr>
</tbody>
</table>

Assumed mean over placement of 3.75 ft is used to address embayment issues with coarse grained material.

**Notes:**
- Assumed total dredge volume includes a 0.25-ft drainage offset.
Grainsize for water depths 4 to 30 ft are based on a 100 yr wind/wave analysis by Anchor QEA.

Grainsize for water depths less than 4 ft are based on habitat modules and include erosion protection/habitat material based on a 100 yr wind/wave analysis by Anchor QEA.

No settlement was conservatively assumed for determining dredging elevations.

<table>
<thead>
<tr>
<th>Habitual Module</th>
<th>Location of Surf Zone (ft)</th>
<th>Remediation Area</th>
<th>Dredging Elevation (ft)</th>
<th>Water Depth from Surface (ft)</th>
<th>Mean Cap Thickness (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2A (-10 to -20 ft) AC</td>
<td>Outside Amended Cap Only</td>
<td>358.125</td>
<td>362.50</td>
<td>0.0</td>
<td>4.375</td>
</tr>
<tr>
<td>2A (-10 to -20 ft) AC</td>
<td>Inside Elevation-Based Dredging &amp; AC</td>
<td>356.125</td>
<td>360.50</td>
<td>2.0</td>
<td>4.375</td>
</tr>
<tr>
<td>2A (-7 to -10 ft) AC</td>
<td>Inside Elevation-Based Dredging &amp; AC</td>
<td>355.625</td>
<td>359.50</td>
<td>3.0</td>
<td>3.875</td>
</tr>
<tr>
<td>2A (-4 to -7 ft) AC Outside Amended Cap Only</td>
<td>Inside Elevation-Based Dredging &amp; AC</td>
<td>355.00</td>
<td>358.50</td>
<td>4.0</td>
<td>3.50</td>
</tr>
<tr>
<td>6B (+1 to -1 ft) AC</td>
<td>Inside Elevation-Based Dredging &amp; AC</td>
<td>357.625</td>
<td>362.00</td>
<td>0.5</td>
<td>4.375</td>
</tr>
<tr>
<td>5B (-0.5-2 ft) AC</td>
<td>Inside Elevation-Based Dredging &amp; AC</td>
<td>358.125</td>
<td>362.00</td>
<td>0.5</td>
<td>4.375</td>
</tr>
<tr>
<td>4B (-2 to -3 ft) AC</td>
<td>Inside Elevation-Based Dredging &amp; AC</td>
<td>358.125</td>
<td>362.00</td>
<td>0.5</td>
<td>4.375</td>
</tr>
<tr>
<td>3B (-3 to -4 ft) AC</td>
<td>Inside Elevation-Based Dredging &amp; AC</td>
<td>355.625</td>
<td>359.50</td>
<td>3.0</td>
<td>3.875</td>
</tr>
<tr>
<td>3B (-4 to -7 ft) AC Outside Elevation-Based Dredging &amp; AC</td>
<td>Inside Elevation-Based Dredging &amp; AC</td>
<td>355.00</td>
<td>358.50</td>
<td>4.0</td>
<td>3.50</td>
</tr>
<tr>
<td>3B (-2 to -3 ft) AC</td>
<td>Inside Elevation-Based Dredging &amp; AC</td>
<td>355.00</td>
<td>358.50</td>
<td>4.0</td>
<td>3.50</td>
</tr>
<tr>
<td>3B (-4 to -7 ft) AC Outside Elevation-Based Dredging &amp; AC</td>
<td>Inside Elevation-Based Dredging &amp; AC</td>
<td>355.00</td>
<td>358.50</td>
<td>4.0</td>
<td>3.50</td>
</tr>
<tr>
<td>1 (-20 to -30 ft) AC Outside Amended Cap Only</td>
<td>Inside Elevation-Based Dredging &amp; AC</td>
<td>342.50</td>
<td>352.50</td>
<td>7.0</td>
<td>3.00</td>
</tr>
<tr>
<td>2A (-7 to -10 ft) AC Outside Amended Cap Only</td>
<td>Inside Elevation-Based Dredging &amp; AC</td>
<td>355.50</td>
<td>355.50</td>
<td>7.0</td>
<td>3.00</td>
</tr>
</tbody>
</table>

Notes and Assumptions:

CAPPING
Mixing layer is 0.25 feet to be conservative. Minimum cap thickness assumes no over placement.

Sediment Protection
This area was assumed to be medium energy based on the results of the wind/wave analysis from Anchor QEA. Remediation Area Dredging Volume Estimate

<table>
<thead>
<tr>
<th>Remediation Area</th>
<th>Dredging Volume Estimate (cy)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remediation Area C</td>
<td>Total Volume (cy)</td>
</tr>
<tr>
<td>Total Overdredge</td>
<td>8,198,487</td>
</tr>
<tr>
<td>146.2</td>
<td>362.5</td>
</tr>
<tr>
<td>1,673,413</td>
<td>80,266</td>
</tr>
</tbody>
</table>

Shoreline elevation: Assumed a 0.375 ft mean over placement for habitat/erosion protection material in water depths shallower than 7 ft due to constructability issues with coarse grained material.

Habitat Module Locations:
- Surf Zone (4-2 feet)
- Remediation Area
- Dredging Elevation (ft)
- Water Depth from Surface (ft)
- Mean Cap Thickness (ft)

Assumed potential for ice scour to 1.5 feet of water depth. Habitat layer will be a minimum of 24 inches in 0 to 2 ft water depth habitat modules that have an isolation cap.

Assumed potential for ice scour to 1.5 feet of water depth. Habitat layer will be a minimum of 24 inches in 0 to 2 ft water depth habitat modules that have an isolation cap.

Notes and Assumptions:

DREDGING
Dredging in shallower water areas off borrow well to provide adequate water depth for placement of an isolation cap.

Erosion Protection requirements are as follows (based on 50:1 slope):

EROSION PROTECTION
Assumed for water depths less than 7 ft are based on habitat modules and include erosion protection/habitat material based on a 100 yr wind/wave analysis by Anchor QEA.

OVER PLACEMENT
Assumed over placement for pH amendment, GAC amendment, and habitat/erosion protection in water depths greater than 4 ft and additional habitat material.

Remediation Area C (SMU 2)

Grainsize for water depths 6 to 30 ft are based on a 100 yr wind/wave analysis by Anchor QEA.

Grainsize for water depths less than 6 ft are based on habitat modules and include erosion protection/habitat material based on a 100 yr wind/wave analysis by Anchor QEA.

Notes and Assumptions:

Overdredge (OD) volume includes 6 inches of dredged material

Table 3
Summary of Cap Thicknesses and Dredge Volume
Remediation Area C (SMU 2)
### Table 4: Summary of Cap Thicknesses and Dredge Volume

**Remediation Area D (SMU 7, 1, 2 [ILWD])**

<table>
<thead>
<tr>
<th>Habitat Module</th>
<th>Location of Surf Zone (4.2 ft)</th>
<th>Remediation Area</th>
<th>Dredging Elevation (ft)</th>
<th>Top Cap Elevation (ft)</th>
<th>Water Depth from Cap Surface (ft)</th>
<th>Mean Cap Thickness (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (-20 to -30 ft) AC</td>
<td>Outside</td>
<td>Amended Cap Only</td>
<td>0.50</td>
<td>0.25</td>
<td>0.25</td>
<td>0.75</td>
</tr>
<tr>
<td>2A (-7 to -10 ft) AC</td>
<td>Outside</td>
<td>Amended Cap Only</td>
<td>0.375</td>
<td>0.875</td>
<td>Coarse Gravel</td>
<td>1.00</td>
</tr>
<tr>
<td>3B (-4 to -7 ft) AC</td>
<td>Inside</td>
<td>Elevation-Based Dredging &amp; AC</td>
<td>Varies</td>
<td>358.50</td>
<td>4.0</td>
<td>3.75</td>
</tr>
<tr>
<td>3B (-2 to -3 ft) AC</td>
<td>Inside</td>
<td>Elevation-Based Dredging &amp; AC</td>
<td>Varies</td>
<td>360.50</td>
<td>2.0</td>
<td>4.375</td>
</tr>
<tr>
<td>5B (-0.5 to -2 ft) AC</td>
<td>Inside</td>
<td>Elevation-Based Dredging &amp; AC</td>
<td>Varies</td>
<td>362.50</td>
<td>0.5</td>
<td>4.375</td>
</tr>
<tr>
<td>6B (+1 to -1 ft) AC</td>
<td>Inside</td>
<td>Elevation-Based Dredging &amp; AC</td>
<td>Varies</td>
<td>362.50</td>
<td>0.0</td>
<td>4.375</td>
</tr>
<tr>
<td>5B (-0.5 to -2 ft) AC</td>
<td>Outside</td>
<td>Elevation-Based Dredging &amp; AC</td>
<td>Varies</td>
<td>355.50</td>
<td>7.0</td>
<td>3.25</td>
</tr>
<tr>
<td>3B (-3 to -4 ft) AC</td>
<td>Inside</td>
<td>Elevation-Based Dredging &amp; AC</td>
<td>Varies</td>
<td>360.50</td>
<td>0.0</td>
<td>4.375</td>
</tr>
<tr>
<td>3B (-2 to -3 ft) AC</td>
<td>Inside</td>
<td>Elevation-Based Dredging &amp; AC</td>
<td>Varies</td>
<td>360.50</td>
<td>2.0</td>
<td>4.375</td>
</tr>
<tr>
<td>2A (-10 to -20 ft) AC</td>
<td>Outside</td>
<td>Amended Cap Only</td>
<td>NA</td>
<td>352.50</td>
<td>10.0</td>
<td>3.00</td>
</tr>
<tr>
<td>2A (-7 to -10 ft) AC</td>
<td>Outside</td>
<td>Amended Cap Only</td>
<td>NA</td>
<td>355.50</td>
<td>7.0</td>
<td>3.25</td>
</tr>
<tr>
<td>1 (-20 to -30 ft) AC</td>
<td>Outside</td>
<td>Amended Cap Only</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.75</td>
</tr>
<tr>
<td>3B (-2 to -3 ft) AC</td>
<td>Inside</td>
<td>Elevation-Based Dredging &amp; AC</td>
<td>Varies</td>
<td>358.50</td>
<td>4.0</td>
<td>3.75</td>
</tr>
<tr>
<td>3B (-4 to -7 ft) AC</td>
<td>Inside</td>
<td>Elevation-Based Dredging &amp; AC</td>
<td>Varies</td>
<td>360.50</td>
<td>2.0</td>
<td>4.375</td>
</tr>
<tr>
<td>2A (-7 to -10 ft) AC</td>
<td>Outside</td>
<td>Amended Cap Only</td>
<td>NA</td>
<td>355.50</td>
<td>7.0</td>
<td>3.25</td>
</tr>
<tr>
<td>1 (-20 to -30 ft) AC</td>
<td>Outside</td>
<td>Amended Cap Only</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.75</td>
</tr>
</tbody>
</table>

### Notes and Assumptions:

**GENERAL**
- GAC = granular activated carbon
- CI = chemical isolation
- Ac = amended cap
- pH = chemical isolation

**DREDGING**
- Surf zone elevation: 362.5 ft
- ILWD removal approach to address average 2-meters plus turbidity.
- Capping:
  - Mining layer is 2.25 feet to be conservative.
  - AC is amended cap area

**MINING PROTECTION**
- Surf zones at 4.2 feet based on wave/wave analysis conducted by Anchor QEA.
- Erosion protection requirements are as follows based on CI layer (assembly):
  - 4.2 feet = coarse gravel (0.17 ft stone 0.3 ft thick)
  - 2.25 feet = medium sand (1.0 ft stone 2.0 ft thick)
  - 1.0 feet = coarse gravel (2.0 ft stone 4.0 ft thick)
- Assumed potential for ice scour to 1.5 feet of water depth.
- Habitat layer will be a minimum of 24 inches in 0 to 2 ft water depth habitat modules that have assumed potential for ice scour to 1.5 feet of water depth.
- Assumed 1.5 feet for backfill off western portion of the ILWD/109 barrier wall.

**HABITAT LAYER**
- Estimates for water depths 4 to 10 ft are based on a 100 year wind/wave analysis by Anchor QEA.
- Estimates for water depths less than 4 ft are based on habitat modules and include habitat/erosion protection material based on a 100 year wind/wave analysis by Anchor QEA.

**OVERPLACEMENT**
- Assumed a 0.375 ft mean over placement for habitat/erosion protection material inside the surf zone due to constructability issues with coarse grained material.
- Assumed three layers of over placement for Modules 6B, 5B, 3B (-2 to -4 ft) and 2A (-7 to -10 ft).
- Assumed two layers of over placement for Modules 1 and 2A (-10 to -20 ft).

**SITETECH**
- No confinement wall was conservatively assumed for determining dredging elevations.

**OVERDREDGE VOLUME**
- Overdredge volume is for module 1 & 6, which is approximately 2.7 acres.
### Table 5

#### Summary of Cap Thicknesses and Dredge Volume Remediation Area E (SMU 6/7)

<table>
<thead>
<tr>
<th>Habitat Module</th>
<th>Location of Surf Zone (ft)</th>
<th>Remediation Area</th>
<th>Dredging Elevation (ft)</th>
<th>Mean Cap Thickness (ft)</th>
<th>Minimum Mean Over-Placement (ft)</th>
<th>Assumed Mean Over-Placement (ft)</th>
<th>Mean Total Layer Thickness (ft)</th>
<th>Material Type</th>
<th>Minimum Additional Material (ft)</th>
<th>Assumed Mean Over-Placement (ft)</th>
<th>Mean Total Layer Thickness (ft)</th>
<th>Material Type</th>
<th>Total Mean Over-Placement (ft)</th>
<th>Total Maximum Over-Placement (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (-20 to -30 ft)</td>
<td>Inside Elevation-Based Dredging &amp; Cap Only</td>
<td>358.125 359.00 0.15 3.50</td>
<td>358.00 359.50 0.00 3.875</td>
<td>3.00</td>
<td>3.875</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>2 B (-7 to -10 ft)</td>
<td>Outside Cap Only</td>
<td>358.125 359.00 0.15 3.50</td>
<td>358.00 359.50 0.00 3.875</td>
<td>3.00</td>
<td>3.875</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>3 B (-2 to -3 ft)</td>
<td>Inside Elevation-Based Dredging &amp; Cap Only</td>
<td>358.125 359.00 0.15 3.50</td>
<td>358.00 359.50 0.00 3.875</td>
<td>3.00</td>
<td>3.875</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>4 B (-2 to -3 ft)</td>
<td>Inside Elevation-Based Dredging &amp; Cap Only</td>
<td>358.125 359.00 0.15 3.50</td>
<td>358.00 359.50 0.00 3.875</td>
<td>3.00</td>
<td>3.875</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>5 B (-2 to -3 ft)</td>
<td>Inside Elevation-Based Dredging &amp; Cap Only</td>
<td>358.125 359.00 0.15 3.50</td>
<td>358.00 359.50 0.00 3.875</td>
<td>3.00</td>
<td>3.875</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
</tbody>
</table>

#### Notes and Assumptions:

**GENERAL**
- GAC = granular activated carbon
- For chemical isolation scenarios, assumed the surf zone occurs for a 100-meter wide area where stability due to the presence of the railroad tracks is being evaluated.

**DRAWING**
- Water depth:
  - 3.75 ft for dredging or 3.25 ft for cap to accommodate 1 ft of crown above the cap surface.
- Water depth:
  - 3.75 ft for dredging or 3.25 ft for cap to accommodate 1 ft of crown above the cap surface.
- Water depth:
  - 3.75 ft for dredging or 3.25 ft for cap to accommodate 1 ft of crown above the cap surface.
- Water depth:
  - 3.75 ft for dredging or 3.25 ft for cap to accommodate 1 ft of crown above the cap surface.
- Water depth:
  - 3.75 ft for dredging or 3.25 ft for cap to accommodate 1 ft of crown above the cap surface.

**EROSION PROTECTION**
- Surf Zone:
  - 1 ft for granular activated carbon (GAC) cap.
  - 3.25 ft for cap placement.

**SETTLEMENT**
- Dredging in shallow water depths to meet objectives for habitat and navigation.
- Assumed a 0.375 ft mean over placement for erosion protection/habitat material in waters shallower than 7 ft due to constructability issues with coarse grained material.

**MATERIALS**
- Only granular material was considered for determining dredging situations.
- Notes and Assumptions:
  - 0.15 ft mean over placement was used for dredged material volume calculation.
FIGURES
DRAWINGS
ONONDAGA LAKE DRAFT CAPPING, DREDGING AND HABITAT INTERMEDIATE DESIGN
DREDGING PLAN

STATE MAP

VICINITY MAP

0 4000 8000

SCALE IN FEET

NOT TO SCALE

NEW YORK

ROCHESTER

BUFFALO

SYRACUSE

ONONDAGA LAKE

PROJECT LIMITS

PROJECT LIMITS

PROJECT LIMITS

PROJECT SITE

290 Elwood Davis Road, Suite 230 | Liverpool, NY 13088 | (315) 453-9009

DRAFT DOCUMENT
SUBJECT TO CHANGE IN WHOLE OR IN PART.
PRELIMINARY DRAFT - NOT FOR CONSTRUCTION

ONONDAGA LAKE DRAFT CAPPING,
DREDGING AND HABITAT
INTERMEDIATE DESIGN

Honeywell

ANCHOR QEA

ONONDAGA LAKE DRAFT CAPPING,
DREDGING AND HABITAT
INTERMEDIATE DESIGN

COVER SHEET

DESIGNED BY:
GRANTED BY:
CHECKED BY:
APPROVED BY:
SCALE:
DATE:

DRAFT NO. 1 OF 20