

Puget Sound Nearshore Ecosystem Restoration Project

Strategic Restoration Conceptual Engineering – Design Report

Appendix B: Guidelines for Estimating Quantities

March 2011

Quantity Estimate Memorandum
PSNERP Strategic Restoration Site Conceptual Engineering
Contract No. 100-000204
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Scope Exhibit 2

A key component of the 10% designs is the estimate of construction quantities. The USACE will rely on the quantity estimates as a basis for estimating likely construction costs. This memorandum describes our proposed approach, and the Quantity Estimate Template.

Approach

The overall approach is to use items and unit quantities, with quantities measured in “rolled up” units (e.g., linear foot, square foot, cubic yard). Each line item will have a description that provides additional information to the audience, which is assumed to be either the cost estimator or a reviewer. Lump sums or units of “each” can be used, but require more detailed descriptions.

Accuracy, precision and record keeping are required. Accuracy should be consistent with a 10%-level-of-completion. We anticipate a level of accuracy that requires a contingency of about +50% as follows.

Design Contingency – 30% to be added to the pre-tax subtotal. Taxes will be applied to this number

Construction Contingency – 20%. This is applied to the total construction costs (below the tax line). But since the tax is in that subtotal, it would be built-in and accounted for.

Precision will be achieved by standardization of the quantity estimate format: A Quantity Estimate Template is provided for review and refinement. The template includes items that are categorized and described in general. The estimator will use those items that best apply to the action, insert the estimated quantity, and populate the other columns with descriptive information. For example, 1,200 LF of New Water Line would be under Utilities, and the description would clarify it is a 6-inch transmission line with no distribution lines and typical burial depth.

Record Keeping will consist of backup for each item. The backup can be a drawing with the basic dimensions (e.g., length and location of new water line). Backup will also include digital files used to create the plan and cross-section drawings. The quantity estimates can be derived from the plan and section figures to be included in the 10% description of each action. Ideally, hard copy backup will be on a sheet size that will facilitate scanning and digital records (i.e. 11”x17” or 8-1/2” x 11”).

Other – Units: Ideally, the quantity estimate will be in units that are compliant with cost-benefit analysis. For example, linear feet of bulkhead removal with a description of bulkhead height and material may be preferred over quantities in square feet. Use of linear feet would allow a more direct adjustment of action effort to change cost-benefit (e.g., adjust to 500 lf of bulkhead removal instead of 800 lf). Similarly with bridges and roadways..

Other – Earthwork: There are multiple earthwork items. This is because many restoration projects are mostly earthwork, and therefore the unit costs estimated greatly affect the total estimate. Also, a range of earthwork types may be needed, with different equipment and unit costs. For example, roadway

earthwork is very different from excavation of marsh channels: Roadway earthwork could use scrapers where as marsh channel excavation might require low-ground-pressure equipment on timber mats. Line items for bucket and hydraulic suction / cutter dredging are provided. Only a couple of these will be needed for any particular action.

Other – Descriptions: We have drafted descriptions for each item in the Quantity Template. Some of these can probably be used ‘as is’. This helps standardize the estimates, but also is intended to save time for those estimating quantities and costs. Therefore, we request that a review of the descriptions (see template column “Explanation...”). For example, we propose that every action have a *Mobilization* item as described, which might typically amount to 8% or 10% of the total construction estimate, unless the site is remote, in which case the percentage would be greater. Special items such as building a road to access the site would be additional to typical *Mobilization* and included in *Site Access*.

Other – Materials: Material testing is built in to unit costs for the estimates we develop. Suppliers provide the material and testing requirements in the specifications.

Descriptions of Estimate Items

Descriptions for each item are provided in the Template. Additional explanation is provided here.

Acquisition and Conservation: Estimated total Required Project Lands will be the sum of Partner / Proponent Owned Lands (i.e., those that do not require purchasing) and Lands to be Acquired (i.e., those lands that may need to be purchased, easements acquired or other costs). We expect these quantities to be approximate based on existing, publically available parcel and landownership information

Mobilization and Access: Mobilization and Access includes those items of work that are preparatory to major improvements, and are required prior to and or during of construction, but may not be permanent of physical elements.

Mobilization for each action area would include the movement of equipment and materials to the action location and construction site, demobilization and site cleanup. Additional activities included under this heading include development of the staging area, general site access, project office setup and erection of any fencing required at the site and staging areas. Mobilization also includes any up-front costs such as bonding, financing, planning, and other staff time not specifically associated with physical construction site preparation.

Site Access entails construction of new site access (e.g. roadways, bridges) rather than typical minor actions associated with existing access. A description of the work required to develop and maintain construction access to the site should be included.

Barger Access would account for sites that require use of a barge for construction or demolition.

Temporary Traffic Control is temporary traffic control measures that will need to be in-place during construction at the Action site. A range of intensity of traffic control is provided:

- None: none required

- Signs: passive control.
- Flags / Spotters: active control; requires estimate of duration due to manpower.
- Unique: Define as needed.

Temporary Roadway may be required at sites that will otherwise fully disrupt the current vehicular traffic through or adjacent to the action area. This line item should be used to estimate the work required to construct any roadways, shoe-flys (railway shoe-flys are under Roadway/Railway), bypasses, or similar that will be used only during construction. Units would be lump sum. A description will be provided.

Control of Water: The proximity of the sites to both fluvial and tidal water systems will require control of water during construction. This line item should include any temporary placement of coffer dams, bypass channels, pumping, water control structures, or other that would be necessary to allow construction to proceed at the site without interference from surface or groundwater. A complete description of the planned approach for control of water should be provided, including the level of protection (i.e. storm event capacity if known or estimated dimensions of conveyance feature).

Site Demolition Activities: Many of the actions will require the demolition and removal of existing structures, roadways, buildings, utilities, revetments, bridges, and other material from both land and marine settings. Clearing and grubbing items are also included, and typically include minor demolition and debris removal. The quantities will include the demolition of the element and in most cases removal of the waste material from the action area. It may be advantageous to dispose of some vegetation, topsoil and large wood within the action area for permanent disposal or reuse. In these cases, the quantities should be separated to reflect onsite or local disposal. Also, invasive non-native plants may exist and require off haul. The haul distance is assumed to be 20miles.

Hazardous / Contaminated Waste Removal: Earth and other materials that are not compatible with exposure to water and habitat areas shall be considered contaminated and removed and disposed offsite. Given the conceptual nature of the project, we have greatly simplified the possibilities to either (a) *contaminated* (not compatible with wetlands but ok for upland or standard landfills) or (b) *hazardous* (requires special excavation, handling, testing and disposal). The estimator can provide more specific information in the description, especially if there are specifics about the contamination and prior remediation efforts.

Earthwork – Excavation & Grading: This category includes activities associated with the removal, transport, and placement of earth and rock material. The action areas will require excavation of earth and removal of rock from both land and marine environments. We have defined a range of earthwork categories that require different equipment and access. These construction line items will be based on volumetric or areal measurements.

Excavation – Upland involves traditional earthwork equipment and would likely include scrapers that provide high production rates at a low cost. This type of excavation is appropriate for higher ground locations that are dry and do not pose much potential for equipment to become stuck or have areas with limited access.

Excavation – Lowland is appropriate for locations that require low ground pressure equipment due to softened soil conditions and higher water levels. Typical methods would include low production

bucket excavation methods with equipment such as hydraulic excavators and front end loaders with material being hauled from the site in trucks.

Dredging – Bucket – Land is appropriate for land based equipment but beneath the groundwater table or underwater. This work is typically associated with equipment that has limited reach and a low production (i.e. bucket methods). Low ground pressure equipment with mats (for bearing) are typically used.

Dredging – Bucket – Marine is appropriate for any excavation to be completed using floating or amphibious equipment with an excavator, clamshell, or drag-line bucket. This equipment is more suited for excavation in below the water line and will typically have a higher production rate than land-based dredging, but not as high as a hydraulic dredge operation.

Dredging – Hydraulic is appropriate for any excavation to be using a hydraulic cutter and suction dredge to slurry and pump marine sediments. This method allows for higher production rates but also requires some method for removing water (decanting) from the slurried sediment and requires special mobilization. A description of the method and location for decanting the slurry should be included, and confirmation that the cost of mobilization is spread or is a separate item.

Fine Grading is small tolerance grading to be completed following rough grading. This work would typically be required for embankments, levees, and grading prior to placement of any vegetation. This does not include any fine grading associated for vehicular roadways, which will be included in the roadway line item estimates. This is typically an area based estimate.

Earthwork Fill Placement: Placement of fill at the Action sites should be presented as an additive item to excavation. Three basic methods for fill placement are anticipated for the Actions. Excavated material may be side-cast, hauled and placed, or stockpiled and placed. Material to be placed will either be uncontrolled or controlled (requirements for placement and grades).

Fill Placement – Side Cast material will be placed within reach of the excavator or dredge without intermediate handling. It should be assumed that any some shaping and minor compaction would be conducted with the excavator bucket.

Haul – Uncontrolled Placement material would be loaded into trucks and hauled to another location within the Action area to be placed. The estimate should include the haul distance required between the excavation and placement locations.

Haul – Controlled Placement material would be loaded into trucks and hauled to another location within the Action area to be placed. The estimate should include the haul distance required between the excavation and placement locations. Additional handling is required to place soil in lifts, compact or track walk, moisture condition, and compaction testing.

Stockpile – Uncontrolled Placement material would be loaded into trucks and hauled to another location within the Action area to be temporarily stockpiled. This is an intermediate step required for drying of material, or storage prior to placement elsewhere at the Action site. The estimate should include the haul distance required between the excavation and stockpile locations.

Stockpile – Controlled Placement material would be loaded into trucks and hauled to another location within the Action area to be temporarily stockpiled. This is an intermediate step required for drying of material, or long-term storage prior to another phase or later off-haul. The estimate should include the haul distance required between the excavation and stockpile. Additional handling that is required for placement at the stockpile site is included in this line item: Additional handling may require site prep, grading, erosion control and drainage control activities.

Earthwork - Imported Fill: The use of imported fill may be required for the construction of specific design elements such as levees, planting base, and soil blending for structural enhancement. Additionally, special materials are required to restore beach morphology. Each type of material to be imported to the Action area should be specified based on its intended purpose. The imported material for shore nourishment should be separated by material type, (sand, gravel, cobble). Includes all costs complete and in place (purchase, transport, placement).

Restoration Features: Restoration Features are specialty items such as stream channels, biotechnical structures, large wood debris / log complexes, animal fences, etc. Descriptions are key for these items.

Structures: The actions will require a variety of structures to control and direct water, provide vehicular and pedestrian access, and realign or relocated utilities. It is anticipated that the structures will be presented based on the number of a similar type. Additional descriptions of the structures (dimensions, material types, other) will be provided

Water Control Structures – Culverts with Gates: A description of each culvert requiring control gates should be provided. Information should include the number of openings, culvert material and dimensions, type of gate. If an Action requires multiple configurations, a separate line item for each unique configuration should be provided.

Water Control Structures – Weirs: A description of each weir structure water control should be provided. Information should include the number of weir dimensions, type, construction material, as well as the purpose of the weir (i.e., diversion, emergency overflow, etc). If an action requires multiple configurations, a separate line item for each unique configuration should be provided.

Rock Slope Protection: A description of the extent of rock slope protection should be provided that clearly describes the slope, rock size, layering, and use of underlying fabric. It is desirable to convert this line item into a linear estimate and provide backup of the quantities estimate used to determine the linear quantity.

Other structures will be required as a part of one or two actions. One example is a boat launch ramp. A description will be provided.

Utilities: It is anticipated that some existing utilities will require replacement or relocation as a result of construction activities. Each impacted utility should be included in the estimate as a separate line item. Note that there is a separate line item for demolition. A detailed description of the utility should be provided including type, size, length, and owner. Utility estimates should be provided as a linear foot estimates including incidentals such as earthwork, excavation control, materials, testing, service switching.

Roadway / Railway: Multiple actions include modification to major road and rail crossings to allow restoration of processes. Roadways consisting of earth embankments and short bridges will be removed and replaced with longer bridges. New routes may be used. Railways will be converted from embankments to trestles (like bridges but with multiple pipes and framing to support train loads) or have culverts inserted using trenchless technology.

Roadway refers to new surface street roadway of a standardized pavement section, with appurtenant drainage. A unit of Square Feet is proposed. *Roadway – Traffic Signal* is an add-on for powered intersection traffic control.

Culverts come in multiple types. The type will be specified (e.g., *Arch culvert*, pre-cast concrete arch, large, bottomless span); *Culvert-jacking* (steel pipe is pushed through embankment) and *Culvert – Horizontal Pile Driving* (steel pipe is hammered through embankment). Descriptions of appurtenances, materials, dimensions and numbers are required.

Bridges will each be comprised of *Bridge – Superstructure, Foundation and Appurtenances*. This item will include elements such as approach slab, abutment, barriers, railings, etc. to conform to one of three or four types to be developed. Unit of measurement will be Square Feet:

Railway Trestles will be treated as comprised of the Superstructure and Foundation, with shoefly. The Superstructure will consist of Precast concrete box girders. The Foundations will consist of steel piles with precast concrete caps. We will provide an assumed depth for the piles and would measure per linear foot as described for the roadway pile foundations above. The only variance might be with a higher structure such as the case at Sequalitchew Creek, longer spans may be used than the standard 26-foot. A shoefly, if needed could be of the same construction if it was to remain as permanent. If temporary there is some flexibility with the materials that can be used.

Permanent Access Features: We anticipate the need for access to and within some sites for the public and utilities.

Public Access and Recreation Features: Many actions will include local requirements for public access. A range of items are listed, but additional items may be required for one or more action. Since each may be somewhat unique, a description is important. Some examples:

Bridge - Pedestrian Traffic: A description of the pedestrian bridge should be provided with information including owner, material, length, span, width and level of use.

Boardwalk: A description of the boardwalk pedestrian bridge should be provided with information including owner, material, length, span, width and level of use.

Interpretive signage: An estimate of the number of signs based on the number of primary public access locations within the Action site will be provided.

Vegetation and Erosion Control: Each Action will require some level of erosion control during and following construction. Some Actions may also require vegetation following construction activities.

Hydroseeding may be required for temporary or permanent site stabilization. Include a description of the purpose of the hydroseeding application as well as a description of the desired seed mix,

noting that native mixes may have a higher cost. The quantity estimate should be based on the area to receive hydroseeding. If multiple applications are planned, this should be noted and accounted for as necessary.

Planting will be required at several sites to restore plants disturbed or removed during construction, or enhance the reestablishment of new vegetation, or provide new vegetation to the site. A general description of the proposed planting palette (riparian, intertidal, upland, etc) should be provided and quantities estimated by unit area of each unique planting regime.

Vegetation Maintenance is necessary to ensure that young plants are able to establish as planned and repair any areas damaged due to flooding or dry periods. Maintenance would also include periodic watering, weeding, thinning, and plant replacement for the course of a year. The estimate for vegetation maintenance should be provided on a acre-year basis.

Erosion & Sediment Control BMPs are required to protect the sites from erosion during and following construction activities. These measures protect work that has been completed and prevent off-site migration of air and water borne sediments. A general description of BMPs likely to be used at the site should be included. This line item estimate should be presented as area based on the total area of the site to be protected by the BMPs. Waterside Controls are a special case, typically consisting of a floating silt curtain with anchors and cabling to the banks.

Construction Management: Each Action will require construction management during implementation. The level of effort will be based on the expected duration of construction in terms of weeks or construction seasons.

Design and Detailed Site Investigations: Each Action will require additional study and assessment as part of the subsequent design phases. Estimates of cost for 35%, 60%, 90% and 100% design are typical reported as a percentage of construction costs:

- 35% PS&E = 35% x 25% x Engineer's Estimate
- 65% PS&E = 65% x 25% x Engineer's Estimate less the cost for 35% PS&E
- 90% PS&E = 35% x 25% x Engineer's Estimate less the cost for 35% + 65%PS&E
- 100% PS&E = 25% x Engineer's Estimate less previous costs

Typical studies required during the design process include property research and surveys, geotechnical investigation, hazardous materials investigations, and cultural resources surveys. The need for these studies will be described in the design report but it is not possible to provide a credible quantity estimate at 10 percent design.

Project Agreement Activities includes activities such as scoping and administering design agreements and certifying lands available for construction. It is not possible to provide a credible quantity estimate at 10 percent design.

Site-Specific Adaptive Management Features & Activities may be required at one or more action sites in order to ensure that the restoration benefits accrue over time. Adaptive management involving the re-application of a management measure or re-construction of a design features that can be reasonably foreseen will be described and the quantity estimated based on the units appropriate for that item.

Monitoring Activities will be performed at each Action site to assess site performance compliance with design parameters and for regulatory compliance purposes. Specific monitoring needs will be identified in the design report and an estimate will be provided based on the number of parameters to be monitored.

Operations & Maintenance (O & M) includes activities such as maintaining bridges, levees and other infrastructure. Most sites have infrastructure that needs ongoing maintenance. Future O&M quantities are difficult to credibly estimate at 10 percent design.

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