209.1 GENERAL

Embankments over swamps and compressible soils/soft ground can be designed with one or a combination of the following alternatives:

1. Excavation Method

2. Floatation Method

3. Displacement Method

Trucking of excavated swamp material is not included in work for the Rental of Swamp Excavation Equipment items. The trucking cost is paid with equipment rental items on an hourly basis under CDED B299-1, Rental of Equipment.

209.1.1 Excavation Method

Excavation method means to remove the swamp material mechanically.

The excavation method is the most commonly used because it minimizes the risk of post construction embankment settlement. Excavation is most often used for shallower depths of swamp; however it is also used for deep swamps when appropriate. Backfill to the excavated swamp is usually by the items Rock Embankment, Select Subgrade Material or Granular B.

209.1.2 Floatation Method

Floatation method means to build the embankment directly on the swamp minimizing the displacement of the swamp material.

Floatation methods include use of wick drains, lightweight fill materials such as expanded polystyrene, slag and lightweight cementitious materials, geotextiles, other materials to aid in floatation and/or preloading or surcharging to promote consolidation of soils.

Floatation methods are most commonly used where swamp depths exceed 6 metres and suitable soil conditions exist. The application of wick drains with preloading or surcharging may offer environmental, cost and embankment performance advantages.

209.1.3 Displacement Method

Displacement method means to build the embankment directly on the swamp such that the underlying swamp material is displaced away from the embankment fill.
The displacement method is a higher risk option because some of the compressible material may not be displaced and hence becomes “trapped” beneath the embankment. This may cause post construction settlement. The decision to use this method must consider the effects of post construction settlements and the impacts to highway surface due to settlements. In cost estimates, the cost to repair settled areas in the years after initial construction needs to be considered.

A variation of the displacement method involves partial excavation and then displacement of remaining material. This combination method is sometimes used in deeper swamps.

The displacement method is rarely used in modern highway construction.

209.1.4 Use of Surcharges

Surcharges may be used to help minimize post construction settlements. A decision to use surcharges is made on a site specific basis.

A surcharge may be required by the foundation design.

A surcharge may be used when the swamp excavation depth exceeds 6 metres as it is difficult to ensure all soft material has been removed and a surcharge helps reduce or eliminate most post construction settlements that may occur due to soft material that has been left, despite all efforts to remove it. In this case, the foundation design may not theoretically require a surcharge but it is done to enhance the long term performance of the roadway and can be achieved at minimal cost.

209.2 REFERENCES

OPSS 201
OPSS 206
OPSS 1010
Foundation Investigation and Design Report – project specific.
Pavement Design Report – project specific.

The above reports typically include a description of the behaviour and properties of the soil in the swamp, provides recommendations for the method of construction, units of measurement for payment, borehole locations and soil strata drawings.

The determination of which report is appropriate for a specific site is determined collectively by the Pavements and Foundation Section, Materials Engineering and Research Office (MERO) and the Geotechnical Section in the region.

These reports are referred to as “Design Reports” hereafter in this document.
209.3 **TENDER ITEMS**

- Rental of Swamp Excavation Equipment, Dragline (variation item)
- Rental of Swamp Excavation Equipment, Hydraulic Backhoe (variation item)
- Geotextile for Swamp Treatment
- Select Subgrade Material
- Select Subgrade Material (End Area Method)
- Select Subgrade Material (Truck Box Method)

209.4 **SPECIFICATIONS**

OPSS 209 (April 2009); Construction Specification for Embankments Over Swamps and Compressible Soils

209.5 **SPECIAL PROVISIONS**

Refer to Chapter "E" of this Manual to review the applicable standard special provisions.

209.6 **STANDARD DRAWINGS**

Applicable standard drawings are contained in the OPSD 200 series.

Notes:

1. OPSDs are only valid for where the depth of the swamp, \( d \leq 6 \) metres.

2. For any swamp excavation exceeding 6 metres in depth, project specific recommendations and applicable drawings are required. Refer to the Foundation Investigation and Design Report.

209.7 **DESIGN**

Recommendations for the design and construction of embankments over swamps and compressible soils/soft ground are contained in the Design Reports. The Design Reports typically contain site-specific investigations and recommendations.

The project schedule may allow for a delay in the completion of the full pavement structure over embankments for a defined period of time (i.e. 2 to 6 months or longer)
capturing primary consolidation and limiting settlements once the remainder of pavement structure is placed.

When surcharges are used, the Contract Documents are to specify how the payment for the placement, removal and use of the surcharge material is to be paid. Surcharges are usually subsequently used on the project, however staging may preclude this.

The placement of a granular surcharge is done under the granular item(s) and a NSSP is needed to state this and that no compaction of the granular is required in the surcharge location. When the surcharge is granular, the subsequent surcharge removal and use of the granular elsewhere in the work must be described in a NSSP and is paid under the appropriate tender item, Granular from Stockpile (see OPSS 314).

209.7.1 Management of Excavated Swamp Material

The management of excavated swamp material must be determined and specified in the Contract Documents.

The Design Reports should address how the excavated swamp material may be used within the work, depending upon its physical characteristics. How the material will function over the long term should be considered before the material is determined to be used within the work.

Excavated swamp material that is excess may be disposed of at locations specified in the contract or the contractor may be required to arrange for the disposal locations.

Disposal of excess excavated swamp material within the Contract Limits can be the most cost effective option and should be investigated and considered.

Trucking of excavated swamp material is required when it cannot be placed adjacent to the excavation via side casting. Trucking of excavated swamp material is not part of the work done under OPSS 209.

The sequence of overall construction operations, including the swamp excavation and embankment construction, must be such that disposal areas that are specified will be available and accessible when the associated swamp is excavated.

Where excavated swamp material is suitable, it should be used as much as possible within the right-of-way, when property is available and when drainage is not impacted. This can be done by:
- widening embankments,
- flattening side slopes, including elimination of need for guide rail, however consideration of stability for an errant vehicle must be made,
- placing beside the highway embankment,
• constructing modified cross-sections, and
• used for berms and at other locations.

Future settlement or sloughing of excavated swamp material is a key consideration when flattening slopes and only suitable material is to be used. Settlement or sloughing is to be avoided in providing a traversable roadside for errant vehicles.

Considerations for use and disposal locations for excavated swamp material:

1. The quantity of material that can be placed at a location needs to be determined. Factors to consider include material characteristic (maximum stable slope of excavated material, will the material flow) and area.

2. Disposal sites must be able to accept 110% of the quantity of material that is stated to go to the site. The extra 10% is not to be shown in the contract documents.

3. Property designated as a disposal location must be owned by MTO, or MTO must have a legal agreement in place. MTO ownership is preferred.

4. Where excavated material will be placed beside the excavation or beside the highway embankment, it is a requirement to have ownership of the land as highway right-of-way. With the disposal locations made part of the highway right-of-way and having the disposal part of the required work, the protocols for management of excess material should apply. In many instances, it will be necessary to acquire a wider right-of-way as part of the property needs for the project. This may involve purchasing from a private owner or acquiring crown land. It is recommended for MTO to own the adjacent crown lands as highway right-of-way, instead of obtaining permission to place the material on crown lands adjacent to the right-of-way, as this resolves any uncertainty about who controls the land.

5. The capability of underlying soils to support a new load and not fail to support the load.

6. Where any excavated material from any source is being considered for placement near any swamp or compressible soil areas, the Pavements and Foundations Section/Geotechnical Section must agree to the location, as the material weight could cause embankment instability.

7. Access to the disposal locations.

8. Any required haul and temporary roads for access to disposal locations and construction operation sequencing.

9. Double handling of material.
10. Dewatering and draining of disposal locations required before they can be used.

11. Retaining embankments needed to contain the material.

12. Impacts on drainage during and post construction.

13. Environmental considerations (i.e. excess material protocols, species at risk, etc.).

When disposal locations require retaining embankments and/or haul and temporary roads to be built, these are to be designed and quantities paid for under the appropriate items. They are not to be included in the swamp excavation items.

209.7.2 Backfill and Embankment Material

Backfill and embankment material is to be specified in the Contract Documents.

The Design Reports identify the backfill and embankment material to be used for each swamp.

Backfilling and embankment construction is in accordance with OPSS 206. References: CDED B206-1, CDED B206-2.

When Select Subgrade Material is used in backfilling swamp excavation it shall be according to OPSS 1010 and shall be placed according to OPSS 206.

209.7.3 Settlement and Embedment in the Embankment Underlying Founding Stratum

Settlement and embedment prediction is not an exact science. In general, if the founding soils are relatively competent, over-consolidated and unyielding, only negligible settlements or elastic recompression of the native soils will occur during construction. These cases form the vast majority of the embankments constructed, and do not require any further estimation for settlement or embedment. However, where the founding soils are weak or unconsolidated, there will be a need to estimate settlement and embedment in the founding material.

In cases of weak or unconsolidated founding material, a settlement and embedment quantity estimate for the founding material must be determined during detail design. The settlement estimate will reflect the project specific founding material, thickness and compressibility characteristics.

209.7.4 Excavation Method

Excavation can be administered as either an earth excavation (grading) tender item or as an hourly rental tender item.
In wetter deposits, where measurement by volume would be impractical, the swamp excavation is accomplished using hourly rental dragline or hydraulic backhoe equipment.

The Design Reports will recommend how the excavation is to be completed. It will identify swamps for excavation using an Earth Excavation tender item with a volume (m³) unit-of-measure, and excavation using Rental of Swamp Excavation Equipment item(s) with a time (hour) unit-of-measure.

Different swamps can vary widely in depth, consistency, and groundwater conditions. However, the following general guidelines can be provided:

1. Where depth is less than or equal to 2m, swamps are usually administered by the Earth Excavation item, regardless of material consistency, however Design Reports should confirm.

2. Where depth is greater than 2m, a recommendation on the excavation method and item(s) to be used will be provided in the Design Reports.

Subsurface investigations conducted in accordance with the ministry engineering requirements provide a very comprehensive and accurate determination of the subsurface conditions. The investigation enables a specific expected depth of excavation to be determined and this gives accurate information for design purposes. Excavation depth may vary across a swamp.

A founding elevation for the embankment backfill and a practical excavation cut geometry is normally part of the Design Report. The Design Report will also address the stability and settlement characteristics of excavated material and its suitability for subsequent use.

Geotechnical/Foundation specialists are to ensure when specifying firm bottom that information supports the depths to firm bottom. Typically, firm bottom is the stratum for which the resistance measured by the Standard Penetration Test exceeds 100 blows per 0.3 m of penetration or the material that will provide resistance to settlement or instability for the proposed embankment.

209.7.4.1 Swamp Excavation by Equipment Rental

The work performed under the “Rental of Swamp Excavation Equipment” tender items, includes the excavation of swamp material to the limits specified and its disposal as specified in the Contract Documents.

When excavated material cannot be side casted, the excavated material must be trucked to a disposal or re-use location and this must be specified in the Contract Documents. Payment for trucking of excavated swamp material is not included in work for the Rental of Swamp Excavation Equipment tender items. The trucking cost
is paid with equipment rental tender items on an hourly basis. Reference: CDED B299-1 Rental of Equipment. The size and type of trucks to be used is dependant on the distance to distance to disposal locations. Typical trucks are tandem 18,000 kg and triaxle 32,000 kg. For longer hauls triaxle trucks are more efficient.

The equipment, including type and size, used to excavate the swamp is to be determined by the designer. The Estimating Section, Contract Management Office and Regional Operations Office should be contacted to assist in determining the type of equipment and rates of excavation. The Regional Geotechnical Section and Pavements and Foundations Section, MERO, can also provide information and advice.

For each excavation area, the selection of the appropriate excavation equipment and size is critical to ensuring the construction operation is efficient and cost effective.

The selection of equipment should also consider equipment availability and the amount of material to be excavated (i.e. duration of the operation).

As a guideline it has been found that:
- For wet/soft material, a dragline with side casting is the most economical option.
- When trucks are used to haul excavated material, a hydraulic backhoe is the most cost effective and easiest to use.

Some swamps could require more than one type of equipment to have an efficient operation.
- For example, a swamp could have depths that vary from a few metres to over 10 m. A backhoe would be used for the shallow depths and a dragline for the deeper areas.
- For example, a swamp could have ‘stiffer’ material near the edges and ‘softer’ material farther away from the edges. A backhoe would be used for the stiffer material and a dragline for the softer material.

Table 1 - Backhoe versus Dragline, compares some of the common equipment characteristics as they relate to the use of a hydraulic backhoe and the dragline in regards to swamp excavation. These characteristics are to be considered in the selection process for deciding on the type of equipment and size to be used to excavate the swamp material.
### Table 1 – Backhoe versus Dragline

<table>
<thead>
<tr>
<th>Features</th>
<th>Hydraulic Backhoe</th>
<th>Dragline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ownership</td>
<td>Commonly owned</td>
<td>Few contractors own</td>
</tr>
<tr>
<td>Removal of Amorphous, Liquid Deposits</td>
<td>Not conducive to backhoe use</td>
<td>Ideal for removal</td>
</tr>
<tr>
<td>Removal of stiff deposits</td>
<td>Ideal, Low cycle times **</td>
<td>High cycle times</td>
</tr>
<tr>
<td>Side casting ability</td>
<td>Limited Reach **</td>
<td>Long Reach</td>
</tr>
<tr>
<td>Excavation Depth</td>
<td>Limited Depth **</td>
<td>Depth is of no concern</td>
</tr>
<tr>
<td>Production</td>
<td>Low cycle times *</td>
<td>High cycle times</td>
</tr>
<tr>
<td>Truck Loading Ability</td>
<td>Low cycle times but limited to height **</td>
<td>High cycle times</td>
</tr>
<tr>
<td>Restricted work environment</td>
<td>Conducive to this type of equipment</td>
<td>Less efficient in restricted areas</td>
</tr>
<tr>
<td>(i.e.) Narrow Widening</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Winter Operations</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

* Cycle time is the time for a complete excavation cycle, as determined by measuring the time from a bucket being empty to the time the next bucket of excavated material is emptied either by side casting or into a truck. Cycle time includes the time for trucks to manoeuvre into position for loading.

** Estimating Office should be consulted to determine achievable excavation depths, casting distances and loading heights for hydraulic backhoes.

The equipment must be capable of reaching the required depth of excavation (achievable excavation depth) when the slope of fill material and bucket rotation is taken into account.

The reach on a “long reach hydraulic backhoe” is the distance from the bottom of the tracks to the tip of the bucket teeth when measured vertically with the bucket at the lowest point of the bucket swing path. Note that this “reach” measurement is not the depth that can be excavated due to the slope of the fill material and the bucket rotation that causes the achievable excavation depth to be reduced. For example, a sample Long Reach Hydraulic Backhoe with a 14 m reach can only excavate to approximately 10.5 metres effectively when taking into account the 1.25H:1V slope of rock fill and the bucket rotation. The achievable excavation depth would be less for select subgrade material or earth that has a 2H:1V slope according to OPSDs.

Typical equipment configurations for excavating swamps are:
Typical Crawler Mounted Equipment Configurations for Excavating Swamps

<table>
<thead>
<tr>
<th>Swamp Depth m</th>
<th>Equipment Minimum Operating Weight</th>
<th>Minimum Bucket Size m³</th>
<th>Side Casting</th>
<th>Truck Loading</th>
</tr>
</thead>
<tbody>
<tr>
<td>less than 2 m</td>
<td>26,500 kg hydraulic backhoe</td>
<td>1.5</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>2 m to less than 8 m</td>
<td>26,500 kg hydraulic backhoe, 12 m reach</td>
<td>1.5</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>8 m to less than 10 m</td>
<td>32,000 kg hydraulic backhoe, 14 m reach</td>
<td>1.0</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>less than 6 m</td>
<td>40,000 kg dragline</td>
<td>1.15</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>any depth</td>
<td>75,000 kg dragline</td>
<td>2.3</td>
<td>yes</td>
<td>not used for truck loading</td>
</tr>
<tr>
<td>any depth</td>
<td>75,000 kg dragline</td>
<td>1.5</td>
<td>not used for side casting</td>
<td>yes</td>
</tr>
</tbody>
</table>

Notes:
1. Hydraulic Backhoe Reach means the distance from the bottom of the tracks to the tip of the bucket teeth when measured vertically with the bucket at the lowest point of the bucket swing path.
2. Reach measurement is not the depth that can be excavated due to the slope of the fill material and the bucket rotation that causes the achievable excavation depth to be reduced.

Rates of excavation are influenced by the properties, behaviour and depth of the swamp material, the type and size of equipment, and whether the excavated material is trucked or managed beside the excavation (side-casted). Typical rates of excavation for the following types of equipment are:
- 40,000 kg crawler mounted dragline with 1.15 m bucket – 40-55 cubic metres / hour
- 26,500 kg crawler mounted hydraulic backhoe with 1.5 m bucket – 85-100 cubic metres / hour

Contact the Estimating Section, Contract Management Office, to discuss equipment configurations and excavation rates for the site specific conditions.

The contractor may propose to use larger equipment than that specified and if approved, during construction, the appropriate price adjustments are completed in accordance with the Contract Documents. Details of how this is done are in OPSS 209 and associated special provision.
209.7.4.2 Swamp Excavation by Earth Excavation (Grading)

The earth excavation method shall be carried out in accordance with OPSS 206 and the appropriate tender items. Refer to CDED Section B206-1 and the OPSD 200 series drawings for design information.

209.7.5 Floatation Method

Any surcharges that are used with the floatation method are removed as specified in the Contract Documents from above the subgrade.

With the floatation method any swamp waves are not to be excavated or otherwise disturbed.

209.7.5.1 Prefabricated Vertical Drains or Wick Drains

Prefabricated vertical drains or “wick drains” are commonly used in conjunction with preloading and surcharging to accelerate time rate consolidation settlements. The concept of floatation using wick drains is often very cost effective because it eliminates the requirement for excavation and backfilling of compressible soils. Peats and organics are routinely sub-excavated but the clayey silts, silty clays and clays are often left in place providing environmental advantages in addition to the cost effectiveness. Information on wick drains is available from Pavements and Foundations Section, MERO.

209.7.5.2 Geotextile for Swamp Treatment

Installation of geotextiles below embankments and over swamp materials separates fill materials or granulars from the underlying material. This will help to prevent cross-migration of soil particles and provide a stable road base and reduce differential settlement.

Geotextile recommendations are in the Design Reports and will include the following:

1. The strength of the fabric;
   - Woven or non-woven;
   - Class of fabric;
   - Thickness of material.

2. The Filtration Opening Size (FOS);

3. Type of soil to be protected; and

4. Depth and characteristics of underlying soil.
When geotextile is to be placed, the area where this is to be done is to be close cut cleared and cleared of objects that may damage the geotextile. The root mat is not to be damaged.

209.7.6 Displacement Method

With the displacement method there is usually excavation of swamp waves and displaced material, removal of surcharges and hauling and incorporating of this material into the work.

The Design Reports will recommend where and how the displacement method is to be completed. The report will include details of any surcharge requirements.

209.7.7 Other Related Work

Clearing and close cut clearing, where required, is to be completed in accordance with OPSS 201 and the associated tender items. Reference: CDED B201-1, B201-2.

209.8 COMPUTATION

209.8.1 Rental of Swamp Excavation Equipment, Dragline
Rental of Swamp Excavation Equipment, Hydraulic Backhoe

These items are not Plan Quantity Payment items.

These items are paid by the hour.

To compute the hours (h) of rental excavation equipment time for each excavation location and type of equipment:

\[
\text{hours} = \frac{\text{estimated volume of swamp excavation (m}^3\text{)}}{\text{rate of excavation (m}^3/\text{h}) \text{ of the dragline or the hydraulic backhoe}}
\]

The rate of excavation (m³/h) for each swamp is very important to estimating accurate quantities and hence an accurate cost estimate. Refer to Section 209.7.4.1.

To estimate volume of swamp excavation (m³), the volume of swamp excavation in cubic metres is computed as outlined in CDED Section B206-1-Earth Excavation (Grading) and also include any excavation of swamp material to ensure stable slopes, as in many swamps material will slide into the excavation and this must be accounted for in the volume of material to be removed, in order to have accurate time estimates for equipment rental.

The volume of swamp to be excavated by rental equipment is not included in the tender item “Earth Excavation (Grading)”.

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209.8.1.2 **Trucking Excavated Swamp Material**

When trucking of excavated swamp material is required for the material excavated by Rental of Swamp Excavation Equipment items, the trucking hours are required to be determined for the items under CDED B299-1 Rental of Equipment.

The number of trucks required must be sufficient so that there is always a truck available to be loaded. Factors to consider in determining the number of truck required are loading times, and round trip times from the excavation location to the dumping locations.

To compute the hours (h) for rental of truck for each excavation location and type of equipment:

\[
hours (h) = \text{number of hours for Rental of Swamp Equipment} \times \text{number of trucks.}
\]

209.8.2 **Earth Excavation (Grading)**

Earth excavation is in cubic metres and is described in the CDED Section B206-1-Earth Excavation (Grading).

The volume of excavation in cubic metres is computed as outlined in Section B206-1.

209.8.3 **Geotextile for Swamp Treatment**

This item is a Plan Quantity Payment item.

The unit of measure is by area, in place, in square metre, with no allowance for overlaps.

209.8.4 **Select Subgrade Material**

These items are not Plan Quantity Payment items.

The items and unit of measurement are:
- Select Subgrade Material, t
- Select Subgrade Material (End Area Method), m³
- Select Subgrade Material (Truck Box Method), m³

The preferred method of measurement is by the tonne. The m³ method may be used when the quantity is small and there is not a weigh scale on the project.

The volume of material is determined by considering the swamp excavation volume to be completed and the embankment design.
209.8.5 Embankment Quantities for Fill

Each fill material has its own unique quantity requirements that are dependent upon the material used.

For the each embankment fill item quantity, determine the quantity of material for backfill and embankment material by considering the following:

1. Neat lines of the embankment;
2. Embedment of fill material into the foundation material;
3. Settlement during construction in the underlying founding stratum;
4. Settlement during construction of fill material that is not compacted; and
5. Construction loss for material below the water line.

The Design Reports should have information about embedment and settlement during construction in the underlying founding stratum.

For each swamp, the total quantity for embedment, settlement and construction loss for material below the water line quantities is to be included in the contract documents in a special provision or the contract drawings. The table below provides a guideline for how to display the information.

<table>
<thead>
<tr>
<th>Item: Fill Material:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embankment Fill Quantities for Embedment, Settlement, and Construction Loss for Material Below the Water Line</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Station to Station</th>
<th>Embedment of fill material into the foundation material, m$^3$</th>
<th>Settlement during construction in the underlying founding stratum, m$^3$</th>
<th>Settlement during construction of fill material that is not compacted, m$^3$</th>
<th>Construction loss for material below the water line, m$^3$</th>
<th>Total Quantity, m$^3$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

When completing the table:

1. Construction loss for material below the water line does not apply to all materials. Refer to the construction specification for the material.
2. Total quantities are to be included in the appropriate fill material item.
209.9  **DOCUMENTATION**

209.9.1  **Contract Drawings**

Drawings are to show for each swamp the construction information for location, depth, cross-section and embankment material.

Modifications to standard drawings and project typical sections are required for the locations where material excavated from swamps is to be disposed of or used within the right-of-way.

When surcharges are used the drawings are to indicate:
- surcharge material;
- surcharge location;
- surcharge thickness; and
- cross-section including slopes.

Where excavated materials have disposal sites, the drawings are to show the disposal site design and generally are to indicate:
- the area boundaries;
- maximum height;
- side slope angles;
- setbacks from sensitive areas;
- estimated capacity should be indicated on the contract drawings for each disposal site (do not include the 10% extra allowance);
- specify/label the sites for swamp material disposal closest to swamp excavations, especially for hourly swamp excavation sites;
- retaining embankment requirements;
- drainage and dewatering requirements;
- environmental protection; and
- other information as required.

Drawings may be required for temporary haul roads, berms and other works required so that the disposal sites may be used.

209.9.1.1  **Rental of Swamp Excavation Equipment, Dragline**

**Rental of Swamp Excavation Equipment, Hydraulic Backhoe**

Each area of swamp excavation is shown on the plan. Start and end chainage, maximum offset left and right and any other dimensions outlining the horizontal limits of the boundary are noted. This is labelled with the tender item name, and the OPSD number (if applicable).

When the depth of excavation exceeds 6 metres, a drawing showing the embankment construction requirement details is needed as OPSDs do not apply in this situation.
The limits of excavation must be clearly documented to avoid confusion with adjacent areas that may be excavated under other tender items. This is important to avoid double payment for the same work.

In most cases, the elevation of unyielding competent soil (firm bottom) can be predicted. This elevation should be determined during detail design and given on the drawings and on the highway design cross-sections.

Each area of swamp excavation is shown on the profile. Start and end chainage are noted. The profile shows the profile of the swamp excavation, including depth or bottom elevation, along the centerline. Where the elevations for the left and/or right limits of the excavation are different from the centreline elevation these should also be indicated. The locations of any preloading or surcharges are shown.

The profile drawings must indicate if the swamp is to be excavated to a firm bottom or a specific elevation. Include one of the following notes for each swamp;
- “Excavate to Firm Bottom”
- “Excavate to an Elevation of _______m”.

A note is to be added to the profile drawings for each location where a dragline or hydraulic backhoe operation is to be used, indicating that the swamp material is to be excavated with equipment rental and the type of backfill required. Include the following note for each swamp;
- “Excavate Swamp by Rented Equipment and Backfill with __ (state the fill material) __”.

209.9.1.2 Geotextile for Swamp Treatment

Each area of geotextile is shown on the plan. Start and end chainage, maximum offset left and right and any other dimensions outlining the horizontal limits are noted. This is labelled with the tender item name.

209.9.1.3 Select Subgrade Material

Each area of embankment construction using select subgrade material is shown on the plan. Start and end chainage, toe-of-slope left and right are noted. This is labelled with the tender item name and the applicable OPSD number.

Each area of embankment construction using select subgrade material is shown on the profile. Start and end chainage are noted. The profile shows the embankment, including bottom and top elevations, along the centerline.
209.9.2 Quantity Sheets (Q-sheets)

209.9.2.1 Rental of Swamp Excavation Equipment, Dragline
Rental of Swamp Excavation Equipment, Hydraulic Backhoe

For each area of swamp excavation show the following information on the Quantities-Miscellaneous Sheet:
- type of equipment to be used, by selecting the appropriate tender item(s)
- minimum operating weight of equipment and bucket size
- tender quantity (hours) based on use of the specified equipment
- start and end station limits of each area of swamp excavation
- locations for the placement/disposal of swamp material and the quantity, m$^3$, of material to be placed at the location
- when the contractor is required to truck the excavated material to a location found by the contractor off the contract, enter the following: “Contractor to remove and manage excavated material off the right-of-way” and the quantity, m$^3$, of material is also to be shown.

Where all of the above information cannot be accommodated on the quantity sheet some may be put in a NSSP or in a table in the Contract Drawings.

209.9.2.2 Geotextile for Swamp Treatment

Each area of Geotextile for Swamp Treatment installation is documented in one line of the Miscellaneous Quantities sheet. One column heading is the tender item. The start and end chainage are provided. The quantity in square metres is provided in the column.

Where multiple types of geotextile are required on one contract, this should be documented in the Quantities - Miscellaneous sheet for each area of installation.

Specific requirements for geotextile should be documented for each different type of geotextile specified on the Quantity sheets.
Requirements include:
- Woven or non-woven;
- Class of fabric;
- Filtration opening size (FOS); and
- Thickness of material.

209.9.2.3 Select Subgrade Material

The unit of measure (tonne, m$^3$ (end area method) or m$^3$ (truck box method)) for select subgrade material is documented by selecting the appropriate tender item name.

When computed in m$^3$, the quantity of Select Subgrade Material is entered on the Quantities - Grading sheet in a separate column.
When computed in tonnes, SSM is entered on the Quantities – Hot Mix and Granular sheet.

209.9.3 Non-Standard Special Provisions (NSSPs)

Write any required project specific requirements in a NSSP. For example;
- embankment construction requirements that influence disposal areas,
- excavation restrictions,
- backfilling requirements,
- surcharge areas and surcharge requirements,
- settlement monitoring,
- time constraints before pavement is placed,
- disposal site requirements,
- restrictions on use of excavated swamp material, and
- environmental considerations.

Where alternative materials are required or allowed in embankment construction (e.g. expanded polystyrene, wood chips, bark or granular blast furnace slag) this is documented in an NSSP.

209.9.3.1 Operational Constraint for Construction Sequence

The sequence of excavation and embankment construction must be such that disposal areas that are specified will be available when the associated swamp is excavated.

A NSSP may be required to establish a mandatory construction sequence to ensure the specified disposal areas are available when the associated swamp is excavated.

209.9.3.2 Surcharges

The removal of surcharges from above the subgrade or grade, depending upon the surcharge material, and hauling and incorporating of the surcharge material into the work is have the details specified in the Contract Documents.

When surcharges are used specify:
- surcharge material;
- surcharge thickness;
- length of time and/or the condition to be met for surcharge removal;
- if surcharge is to remain in place at end of the construction contract;
- how removed surcharge materials are to be used;
- how payment for surcharge material removal and reuse will be handled; and
- any unique requirements related to the surcharge
209.9.4 **Documentation Accuracy**

All quantities are rounded to whole numbers.

209.9.5 **Information to be Provided to Bidders**

The following information is to be provided to Bidders:

- Foundation Investigation Report (Note this is not the Foundation Investigation and Design Report.).
- Soils Data sheets as part of the Contract Drawings.

Soils Data sheets will contain, when applicable:

- title block (date(s) of investigation, name of firm, type of equipment used, and disclaimers),
- soils borehole logs,
- soils and aggregates laboratory testing data, and
- other information as required for other work.