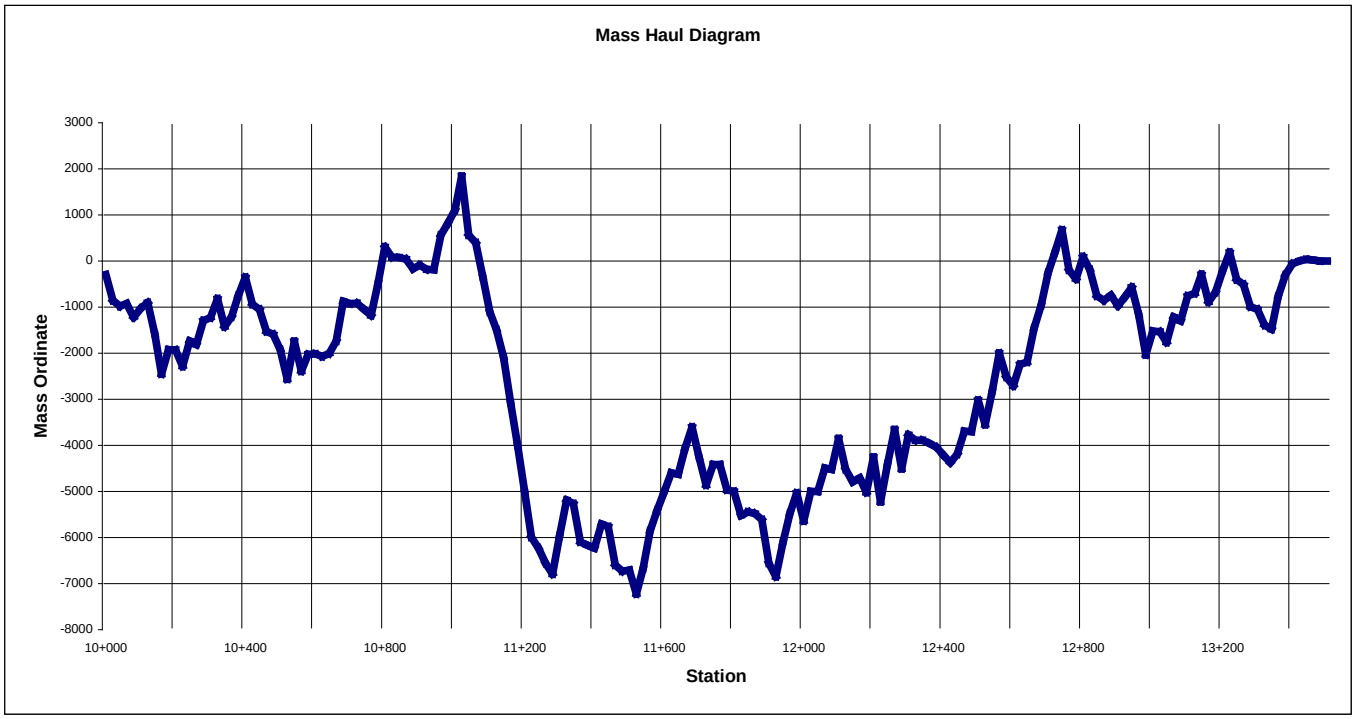
EARTHWORK REPRESENTATION:

GRADING SUMMARIES

&

MASS HAUL DIAGRAMS



CFLHD Guidelines
November 2011

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Introduction

This document provides a guide to the Central Federal Lands standard procedure for calculating and representing earthwork volumes in the plans. Typically, earthwork representation in the plans includes the Grading Summary, Mass Haul Diagram, and cross sections. This guide applies to both internal designers and A/E consultants. The companion to this guide is Chapter 23 of the CFLHD CADD Standards Manual.

Earthwork operations represent an area of substantial risk to contractors. In CFLHD contracts, the risk is typically associated with one to four pay items, with Pay Item 20401-0000, Roadway excavation, generally being the primary payment item. Under this pay item, the contractor must anticipate and price the work associated with excavation, haul, embankment, benching, adding or subtracting moisture from soils, finishing, and other associated operations. Estimating costs is further complicated by:

- The type and variation in the materials to be excavated (rock, clay, soil);
- If blasting is required and how much;
- The type of equipment to be used in excavating and hauling material;
- If the haul is primarily uphill or downhill;
- Coordination of earthwork operations with other installations (walls, culverts, underdrains, etc.);
- Weather considerations; and
- Impacts of materials testing.

When representing earthwork, the focus is on prism excavation and embankment, added excavation and embankment quantities, quantities unavailable for embankment, and other details related to the construction of a project to design subgrade elevation.

Refer to the CFLHD Earthwork Representation Template Drawings for a visual representation of the earthwork quantities.

Earthwork Considerations

The earthwork representation of the work can only be as good as the information upon which the design assumptions are based. Before performing detailed earthwork calculations, consider the following items:

- Coordinate with the Geotechnical Engineer while developing the Grading Summary. There are inherent difficulties in earthwork estimation, and the Geotechnical Engineer can provide valuable insight into difficult terrain issues, engineering properties of different geologic units and soil types, and the impact that small or large fills can have on shrink/swell. Incorporate recommendations from the Geotechnical Report, including shrink/swell, topsoil stripping depth, and backfill material anticipated to be available from on-site excavation.
- Coordinate with the Pavements Engineer to determine locations and depths of subexcavation.
- Coordinate with Surveys to obtain the appropriate level of accuracy in topographic surveys.
- Coordinate with Construction to better understand constructability issues related to earthwork.
- Ensure curve correction is used in the GEOPAK earthwork input file. Curve correction adjusts earthwork volumes to account for end area discrepancies at horizontal curves. This shown as ‘Centroid Adjustment’ near the bottom of the input file. The default for CFLHD is to include the centroid adjustment on every project.
- Avoid sliver cuts and fills.

Cross Section Data (XS Data)

XS Data is a worksheet in the Grading Summary spreadsheet currently in use at CFLHD. The XS Data worksheet includes each cross section station and the corresponding earthwork quantities. The XS Data worksheet includes quantities taken directly from GEOPAK output and quantities hand-calculated by the user.

Excavation Volumes

See Table 1 for a summary of excavation volumes.

Embankment Volumes

See Table 2 for a summary of embankment volumes.

The only wall backfill quantities shown in the XS Data sheet are anticipated to be generated from on-site excavation. By including quantities in the Grading Summary, the designer is representing that material excavated or found on-site WILL meet the gradations and material quality requirements according to the FP-03 and SCRs. Coordinate with the Cross Functional Team (CFT); make sure that materials tests are performed to verify this requirement. Do not assume the material will meet the specifications.

If wall backfill material will be imported from off-site, do not show the quantities in the XS Data worksheet.

Earthwork Calculations

Calculations for added and subtracted earthwork quantities occur on this worksheet. In addition, calculations for pay item quantities occur on this worksheet.

See Table 3 for a summary of earthwork calculations that occur on this worksheet.

Table 1: Summary of Excavation Volumes

Column in XS Data	Description	How is Quantity Calculated?	Remarks
B	Roadway Prism Excavation	GEOPAK	▪ *Unadjusted* volumes (the numbers do not account for shrink or swell)
C	Approach Road Excavation	GEOPAK or User Calculated (Input by User)	▪ Input excavation volumes under the mainline stationing that best represents the approach road location. By doing so, the Mass Haul Diagram will better reflect the anticipated haul of material. ▪ If the approach road length is excessive, the volumes can be tabulated in a separate Grading Summary or at the bottom of the mainline summary. If values are tabulated at the bottom of the mainline summary, be sure NOT to include the quantities in the Mass Haul Diagram.
D	Roadway Excavation	Calculated on spreadsheet	▪ Total unadjusted excavation for the specified station. ▪ If roadway excavation is used as a pay item, the quantity in this column is the plan quantity.

E	(+) Structure Excavation (Walls)	GEOPAK	▪ Volume of material displaced by retaining walls and associated backfill below original ground of the existing roadway.
			▪ Walls that typically have this earthwork quantity include:
			  ▪ Mechanically-stabilized earth (MSE) wall
			  ▪ Concrete cut and fill walls
			  ▪ Soil nail wall
			  ▪ Rockery
			  ▪ Guardwall
			  ▪ Shored mechanically-stabilized earth (SMSE) wall
			  ▪ Gabion faced mechanically-stabilized earth (GFMSE) wall

F	(+) Excavation from Roadway Obliteration	User Calculated	▪ Volume of excavation from an obliterated area located outside the project slope stake limits. ▪ Input excavation volumes under the mainline stationing that best represents the obliteration location. ▪ If the roadway obliteration is a significant distance from mainline (e.g. 1000’ or more), add these volumes on a separate row at the bottom of the Grading Summary. Do NOT include in the Mass Haul Diagram. ▪ Typically, excavation for roadway obliteration is not paid for under Section 204. Roadway obliteration is paid under Section 211 and is measured as an area. The obliteration area should be calculated separately and shown in the Miscellaneous Summaries. [The exception is when excavation material from one obliteration area is moved to another obliteration area. When material is moved between obliteration areas, the excavation material would need to be paid for under Section 204.]

Column in XS Data	Description	How is Quantity Calculated?	Remarks
G	(+) Subexcavation	User Calculated	▪ Volume of subexcavated material ▪ Use Column J also if this material is unsuitable for fill
H	(-) Pavement Removal in Cuts	GEOPAK	▪ Volume of pavement removed in cuts ▪ Quantity included only if existing pavement will not be used in fills (e.g., existing pavement recycled for base course or hauled off project). ▪ If the project will incorporate the existing pavement as fill material, do not use this column.
I	(-) Topsoil Stripping in Cuts	GEOPAK	▪ Volume of topsoil conserved from cuts ▪ Use the depth of topsoil stripping recommended in Geotechnical Report
J	(-) Disposal of Subex	User Calculated	▪ Volume of subexcavation wasted offsite ▪ If subexcavated material can be used for embankment, do not use this column.
K	Shrink/Swell	Input by User	▪ Shrink/swell factors are used to adjust quantities from the bank (BCY (BCM)) state to the compacted (CCY (CCM)) state. ▪ Use the shrink/swell recommended in the Geotechnical Report. ▪ Swell factors (values greater than one) are typically associated with rocky materials and mean that the compacted volume will be greater than the bank volume. ▪ Shrink factors (values less than one) are typically associated with clayey or granular materials and mean that the compacted volume will be less than the bank volume.
L	Total Excavation Available for Fills	Calculated on spreadsheet	▪ Total *adjusted* excavation for the specified station (quantities have been adjusted by estimated shrink/swell factors)

Table 2: Summary of Embankment Volumes

Column in XS Data	Description	How is Quantity Calculated?	Remarks
M	Roadway Prism Embankment	GEOPAK	▪ Unadjusted volumes calculated directly by GEOPAK.
N	Approach Road Embankment	GEOPAK or User Calculated (Input by User)	▪ Input the approach road embankment volumes under the mainline stationing that best represents the approach road location. ▪ If the approach road length is excessive, the volumes can be tabulated in a separate Grading Summary or at the bottom of the mainline summary. If they are tabulated at the bottom of the mainline summary, be sure NOT to include the tabulations in the Mass Haul Diagram

O	(+) Wall Backfill	GEOPAK	▪ Assumes on-site material can meet requirements of SCRs Subsection 704.13(b).
			▪ Walls that typically have this earthwork quantity include:
			  ▪ MSE wall
			  ▪ SMSE wall
			  ▪ Rockery
			  ▪ Concrete retaining wall with parapet

P	(+) Foundation Fill	GEOPAK	▪ Assumes on-site material can meet requirements of the FP-03 Subsection 704.01.
			▪ If foundation fill will be imported from off-site, do not use this column to show the quantities.
			▪ Walls that typically have this earthwork quantity include:
			  ▪ MSE wall
			  ▪ SMSE wall
			  ▪ Rockery
			  ▪ Guardwall
			  ▪ Concrete cut wall
			  ▪ Concrete retaining wall with parapet
			  ▪ Concrete fill wall

Q	(+) Select Wall Backfill	GEOPAK	▪ Assumes on-site material can meet requirements of SCRs Subsection 704.13(a).
			▪ If select wall backfill will be imported from off-site, do not use this column to show the quantities.
			▪ Walls that typically have this earthwork quantity include:
			  ▪ MSE wall
			  ▪ SMSE wall
			  ▪ GFMSE wall

Column in XS Data	Description	How is Quantity Calculated?	Remarks
R	(+) Rock	GEOPAK	▪ Assumes on-site material can meet requirements of SCRs Subsection 705.07. ▪ If rockery rocks will be imported from off-site, do not use this column to show the quantities. ▪ Walls that typically have this earthwork quantity include: ▪ Rockery
S	(+) Granular Rock Backdrain	GEOPAK	▪ Assumes on-site material can meet requirements of SCRs Subsection 703.03(c). ▪ If granular rock backdrain will be imported from off-site, do not use this column to show the quantities ▪ Walls that typically have this earthwork quantity include: ▪ Rockery

T	(+) Structural Backfill	GEOPAK	▪ Assumes on-site material can meet requirements of the FP-03 Subsection 704.04.
			▪ If structural backfill material is imported from off-site, do not show any quantities in this column.
			▪ Walls that typically have this earthwork quantity include:
			  ▪ Concrete cut wall
			  ▪ Concrete retaining wall with parapet
			  ▪ Concrete fill wall

U	(+) Backfill Material	GEOPAK	▪ Assumes on-site material can meet requirements of the FP-03 Subsection 704.03.
			▪ If backfill material will be imported from off-site, do not use this column to show the quantities
			▪ Walls that typically have this earthwork quantity include:
			  ▪ Guardwall
			  ▪ Concrete retaining wall with parapet
			  ▪ Soil nail wall

V	(+) Granular Backfill	GEOPAK	▪ Assumes on-site material can meet requirements of the FP-03 Subsection 703.03. ▪ If granular backfill will be imported from off-site, do not use this column to show the quantities. ▪ Walls that typically have this earthwork quantity include: ▪ GFMSE wall
W	(+) Backfill for pavement removal under fill	GEOPAK	▪ Quantity included only if existing pavement will not be used in fills (e.g., existing pavement recycled for base course or hauled off project) ▪ Volume of material needed to backfill the existing pavement area. ▪ If the project will incorporate the existing pavement as fill material, do not use this column.
X	(+) Topsoil replacement under fill	GEOPAK	▪ Volume of fill material needed to replace topsoil conserved under new fills of the roadway.

Column in XS Data	Description	How is Quantity Calculated?	Remarks
Y	(+) Subexcavation	GEOPAK or User Calculated	▪ Typically, this column should have the same quantities identified in Column G (Subexcavation). If the subexcavation quantities are calculated by GEOPAK, the quantity in this column will be larger than the quantity in Column G in embankment sections because GEOPAK assumes all the material from the bottom of subex to the top of subgrade will be subex backfill. ▪ In cases where material will be subexcavated and recompacted in place, Columns G and Y still need to have the same value because subexcavated material will typically experience volume changes once it is excavated and recompacted (note the difference in the definition of material, Column G is bank (BCY (BCM)), while Column AC is compacted (CCY (CCM)).
Z	(+) Aggregate Base	User Calculated	▪ Volume of material conserved from roadway excavation and processed for use as aggregate base. ▪ Assumes on-site material can meet requirements of the FP-03 Subsection 703.05 or 703.06. ▪ If aggregate base will be imported from off-site, do not use this column to show the quantities.
AA	(+) Riprap	User Calculated	▪ Volume of material conserved from roadway excavation and processed for use as riprap ▪ Assumes on-site material can meet requirements of the FP-03 Subsection 705.02. ▪ Quantity included only if onsite material will be conserved for riprap. ▪ If riprap will be imported from off-site, do not use this column to show the quantities.
AB	(+) Special Rock Embankment	User Calculated	▪ Volume of material conserved from roadway excavation and processed for use as special rock embankment ▪ Assumes on-site material can meet requirements of the FP-03 Subsection 705.04. ▪ If material for special rock embankment will be imported from off-site, do not use this column to show the quantities.
AC	(+) Embankment for Roadway Obliteration	User Calculated	▪ Show quantities in this column for obliteration areas where additional embankment will be needed. If the sections of obliterated roadway are adjacent to the proposed construction, input the embankment quantities in the row with the appropriate station. ▪ If the obliterated areas are not nearby the proposed construction, add the quantities in a separate row at the bottom of the Grading Summary. Do not use quantities shown at the bottom of the Grading Summary when making the Mass Haul Diagram, as they will not accurately portray the hauling needs of the project.
AD	(+) Topping or Select Topping	User Calculated	▪ This column represents material conserved from roadway excavation to be used as topping or select topping. ▪ Subsection 704.05 (topping) or Subsection 704.08 (select topping) of the FP-03. ▪ If material for topping or select topping will be imported from off-site, do not use this column to show the quantities.
AE	Total Embankment	Calculated on spreadsheet	▪ Total volume of material required to construct the embankments in the identified station range.

Table 3: Earthwork Calculations

Column in XS Data	Description	How is Quantity Calculated?	Remarks
AF	Excavation - Embankment	Calculated on spreadsheet	▪ Volume of the surplus or shortage of material at each station. ▪ Total Excavation Available for Fills (Column L) minus Total Embankment (Column AE).
AG	Waste	Calculated on spreadsheet	▪ The value in this column is the same as the value in Column AF (Excavation – Embankment) ▪ When all the values in this column are added together, this value represents the volume of waste, or excess material, for the entire project.
AH	Embankment Construction	Calculated on spreadsheet	▪ The values in the column are the same as the values in Column M (Roadway Prism Embankment) + Column N (Approach Road Embankment) for each row. ▪ When all the values in this column are added together, it represents the total prism volume of embankment needed to construct the project.
AI	Unclassified Borrow Required	Calculated on spreadsheet	▪ The value in this column is the same as those in Column AF (Excavation – Embankment).
AJ	Unclassified Borrow Shrink/Swell	User Input	▪ Unclassified borrow is measured in the field in its original position, so the material needs to be in bank state. (See Subsection 204.16(e) of FP-03.) An estimated shrink/swell of the borrow material must be applied to the compacted volumes to get from compacted state to bank state. ▪ A common estimated shrink/swell for unclassified borrow is 0.9.
AK	Unclassified Borrow	Calculated on spreadsheet	▪ This column is associated with Pay Item 20403-0000, Unclassified borrow. ▪ Divide Column AI (Unclassified Borrow Required) by Column AJ (Unclassified Borrow Shrink/Swell). ▪ When the values in this column are totaled at the bottom of the summary, the resulting value is the total volume of unclassified borrow needed to build the embankments for the entire project.

<table>
<tr><th>Column in XS Data</th><th>Description</th><th>How is Quantity Calculated?</th><th>Remarks</th></tr>
<tr><td>AL</td><td>Mass Ordinate</td><td>Calculated on spreadsheet</td><td>

This column represents the cumulative mass differential as the project moves from the start through the end. The values in this column are best shown through the use of an example table:
<table>
<tr><th>Excavation – Embankment</th><th>Mass Ordinate</th></tr>
<tr><td>-518</td><td>-518</td></tr>
<tr><td>1169</td><td>(-518 + 1169) = 651</td></tr>
<tr><td>2451</td><td>(651 + 2451) = 3102</td></tr>
<tr><td>-1822</td><td>(3102 + -1822) = 1280</td></tr>
</table>

The mass ordinate for the first row of the Grading Summary is always identical to the Excavation – Embankment value. To obtain subsequent mass ordinate values, add the mass ordinate in the row above to the Excavation – Embankment value in the row you are working in.

</td></tr>
</table>

Grading Summary

Grading Summaries are structured to be read in a logical left to right format. Nearly all projects will contain some unique features and must be dealt with on a case-by-case basis. However, the general format (headings, column titles, and layout of the columns) should remain the same. If a specific column does not apply to a specific project, hide the column within the Excel spreadsheet to avoid confusion. Uniformity of the general format will aid in comprehension.

The Grading Summary shows the earthwork volumes in the plans: prism excavation and embankment volumes, added excavation and embankment volumes, and volume of material unavailable for fill. Shown below is a typical layout for the Grading Summary (example shown is for a balanced project)

GRADING SUMMARY									
	Roadway Excavation		Pay Item 20401-0000	Additional Excavation For info only		Embankment For info only		For info only	Pay Item 20403-0000
(a) Station to Station	(b) Roadway Prism	(b) Approach Roads	(b) Roadway Excavation	(c) (+) Available Material (see note 1)	(d) (-) Unavailable Material (see note 2)	(b) Roadway Prism	(b) Approach Roads	(e) (+) Various Backfill Material Generated Onsite (see note 3)	(f) Unclassified Borrow (see note 4)
	(m3)	(m3)	(m3)	(m3)	(m3)	(m3)	(m3)	(m3)	(m3)

(a) *Station Ranges*

The number of station breaks shown within the Grading Summary will vary with the project. On large projects, a good rule of thumb is to show each Plan and Profile Sheet on a separate row. On simple projects, the station ranges can be broken out for each cross section, or every 150 to 300 feet (50 to 100 meters).

(b) *Prism Excavation and Embankment*

These columns represent the roadway prism excavation and embankment volumes calculated by GEOPAK.

(c) *Available Material*

This column represents all the additional excavation material that is available for embankment. This may include:

- Structure excavation (walls)
- Excavation from roadway obliteration
- Subexcavation

(d) *Unavailable Material*

This column represents all the additional excavation material that is unavailable for embankment. This may include:

- Pavement removal in cuts
- Topsoil stripping in cuts
- Disposal of subexcavation material

(e) *Various Backfill Material Generated Onsite*

This column represents all the embankment material that is anticipated to be generated form onsite material. This may include:

- Wall Backfill

- Foundation Fill
- Select Wall Backfill
- Rock
- Granular Rock Backdrain
- Structural Backfill
- Backfill Material
- Granular Backfill
- Backfill for Pavement Removal under Fills
- Topsoil Replacement under Fills
- Aggregate Base
- Riprap
- Special Rock Embankment
- Embankment for Roadway Obliteration
- Subexcavation
- Topping or Select Topping

(f) ***Additional Pay Item***

This column varies depending on the project type. See Table 4 for information on selecting appropriate pay items.

Notes

To facilitate communication regarding Grading Summaries, the following notes should typically be used at the bottom of the table:

1. Available material includes (*fill in project specific information*). See Miscellaneous Summaries.
2. Unavailable material includes (*fill in project specific information*). See Miscellaneous Summaries.
3. Various backfill material generated on site includes (*fill in project specific information*).
4. (*Waste or unclassified borrow*) quantity calculated using volumes adjusted for shrink/swell. Refer to the Geotech Report for estimated shrink/swell factors.
5. The quantities shown herein are approximations. Payment will be made for the actual quantities of work performed and accepted.
6. BCY = Bank cubic yard - one cubic yard of material as it lies in the natural state.
7. CCY = Compacted cubic yard - one cubic yard of material after it has been compacted to specification density.

The addition of other notes that reference geotechnical and pavement investigations, materials studies or assumptions made, should also be used as appropriate.

Table 4: Selection of Earthwork Pay Items

Type of Project	Pay Items	Remarks
Balanced Project	▪ 20401-0000 Roadway Excavation ▪ Either 20441-0000 Waste or 20403-0000 Unclassified Borrow	▪ Do not include a pay item for construction of embankments ▪ Typically include a pay item for either waste (Pay Item 20441-0000) or unclassified borrow (Pay Item 20441-0000) to allow flexibility during construction to handle field changes in earthwork.
Waste Project	▪ 20401-0000 Roadway Excavation ▪ 20441-0000 Waste	
Borrow Project	Two options: ▪ 20420-0000 Embankment Construction Or ▪ 20401-0000 Roadway Excavation ▪ 20441-0000 Unclassified Borrow	▪ Borrow projects have several inherent drawbacks, including: 1. During the design phase, roadway excavation and borrow pit shrink/swell factors are sometimes estimated without the benefit of a materials investigation. This leads to uncertainty in the final amount of borrow (based on pit measurements) that will be needed to complete the project. 2. When a borrow pay item is used, borrow is generally measured by determining the volume of material removed from the borrow source (this would be a bank cubic meter measurement, not a compacted cubic meter measurement). Payment of the borrow based on pit cross sections places the risk of shrink/swell changes from those estimated above on the Government. This is true whether the source is a Government-designated source or a contractor-selected source. ▪ By using Pay Item 20420-0000, Embankment construction, (instead of a combination of Pay Item 20401-0000, Roadway excavation, and Pay Item 20441-0000, Unclassified borrow) the contractor is paid on a slope stake basis (embankment in its final position). This places the risk of shrink/swell factor changes at the chosen borrow source on the contractor. When borrow constitutes a significant amount of the earthwork to be performed, and particularly when the selection of the borrow source is up to the contractor, it is recommended that an embankment construction pay item be used. Coordinate with the CFT during the selection of pay items for borrow projects. ▪ Generally, Pay Item 20401-0000, Roadway excavation and Pay Item 20420-0000, Embankment construction, should not be used together in the same contract.

Mass Haul Diagram

Note: Not all projects with earthwork require a mass haul diagram. Please consult with the Project Manager and Highway Design Manager before including a Mass Haul Diagram in the plans.

Haul can significantly influence the cost of performing contract-related earthwork. Contractors must estimate the total amount of haul to be performed, the equipment to perform the haul and the estimated rate of haul (productivity) as part of the bid price. In the event the work changes as a result of Government error or a differing site condition, equitable adjustments in the price are determined (in part) by comparing the total haul anticipated from the design earthwork with the total haul required as a result of the change.

Productivity (rate of haul) is of critical importance in estimating haul costs. In order to estimate the required haul, the contractor must know where the gross material movements occur. A relatively well-detailed Mass Haul Diagram will provide sufficient information for the contractor to estimate total haul. The Mass Haul Diagram should depict a visual representation of the cut and fill material on the project, as well as indicate the cumulative balance (excess or deficit) of material available to construct the project to subgrade at given locations on the project. The diagram should be detailed enough to show all the peaks and valleys associated with the movement of the material; a simple line diagram showing only a few points along the project is not acceptable.

Much like quantities shown for roadway obliteration in realigned sections of roadway, quantities of material obtained from borrow sources should not be included in the Mass Haul Diagram. By not showing borrow, the contractor can evaluate the on-site material and consider the most cost effective manner of constructing the project by considering existing material placement, haul, scheduling concerns, grading limitations, borrow source location, etc. The contractor may, for example, choose to move the existing material in a manner inconsistent with normal movements so as to reduce borrow haul, provide for culvert pipe or wall placement, to work wet materials in the order and at the time most conducive to deal with them, or for other reasons. If borrow materials or roadway obliteration quantities associated with realignments are shown in the Mass Haul Diagram, the shape of the diagram is altered, thus obscuring the evaluation of what the on-site project dirt can do.

Final Thoughts

There are a multitude of situations that can occur when trying to accurately represent project-specific earthwork. Care must be taken to ensure that earthwork is estimated correctly.

The general layout of the Grading Summary (major headings, pay item row, column location within the summary and column headings) and notes are important. When specific conditions result in deviations from the general format, an attempt should be made to preserve as much of the standard template as possible.

Including volumes in the Mass Haul Diagram that do not accurately reflect the true project haul conditions can lead to a misrepresentation of earthwork and claims during construction.

There are several questions designers must consider each time to prepare a Grading Summary and Mass Haul Diagram in order to make sure all items of earthwork are accounted for:

1. Does the Grading Summary approximate, as closely as possible, the generic Grading Summary format?
2. Do the Grading Summary and Mass Haul Diagram accurately identify the factors that are important to successfully bid the earthwork? For example:

- Are materials that will not be available for embankment operations appropriately subtracted?
- Would the project be best served by including appropriate pay items for waste, embankment, borrow, etc?
- Are the Grading Summary and Mass Haul Diagram accurately derived from the earthwork run and hand calculations necessary for retaining walls?
- Do the shrink/swell factors match those presented in the Geotech report? Was sufficient investigation performed to estimate the shrink/swell factors, especially in borrow sites if they are Government-identified?
- Are design assumptions identified and the proper notes used at the bottom of the Grading Summary?

3. Are the Grading Summary and Mass Haul Diagram complete and easily understood?
    - Are column headings clear and labeled correctly?
    - Are all pay items and pay units clearly identified?
4. Are representative cross sections included in the plans?
5. Do the SCRs adequately describe expectations that are not clear in the Grading Summary and Mass Haul Diagram (such as disposal of unsuitable material, potential waste sites, etc)?