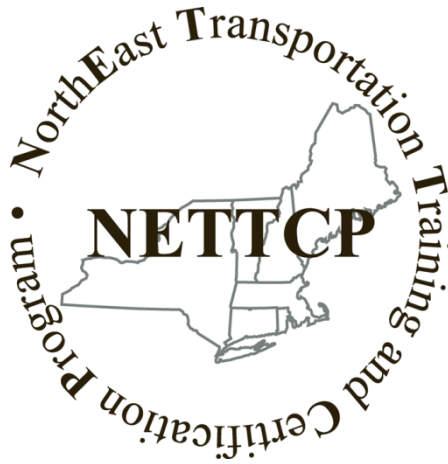




# APPENDIX F

## Typical "Model Quality Control Plan"



## ***Appendix F***

### ***Typical "Model Quality Control Plan"***

#### **Appendix Overview**

The **NETTCP "Model Quality Control Plan"** provided in this Appendix is intended to serve as a generic tool to assist Contractors in preparing complete and useful QC Plans. The Model QC Plan follows a recommended standard format that includes ten separate Sections plus Appendices. Each Section addresses one of the major QC Plan items presented in Chapter 5 (Section 5.4). These Sections are:

- ❑ **Terms and Definitions (optional)**
- ❑ **1.0 Scope and Applicable Specifications**
- ❑ **2.0 Quality Control Organization**
- ❑ **3.0 Quality Control Laboratories**
- ❑ **4.0 Materials Control**
- ❑ **5.0 Quality Control Sampling and Testing**
- ❑ **6.0 Production Facilities**
- ❑ **7.0 Field Operations**
- ❑ **Appendices**

It is recommended that Transportation Agencies adopt the format (Section and Subsection headings) provided in the NETTCP Model QC Plan as a standard for Contractors to follow.



The Model QC Plan presented in Appendix F is an example of a completed Earthwork QC Plan for a fictitious major transportation construction project. QC Plans for other materials (e.g. HMA, PCC, etc.) can be developed following the same standard format (Section and Subsection headings) provided in the Model QC Plan.

The level of detailed information in any QC Plan will obviously change depending upon the size and complexity of the individual construction project. As a minimum, all text highlighted in yellow (shaded grey) throughout the Model QC Plan will require replacement or deletion to address the specific Quality Control information related to a given project.





State Route 99 Construction Project  
Anytown, USA  
Transportation Agency Contract #54321

ABC Contractors, Inc.

***NETTCP***  
***MODEL QC PLAN***

Construction Quality Control Plan

Section 1 - Earthwork

December 2, 2003

Submitted By:

\_\_\_\_\_  
ABC Contractors, Inc.

\_\_\_\_\_  
Date

Approved By:

\_\_\_\_\_  
Transportation Agency

\_\_\_\_\_  
Date

## Section 1 - Earthwork

This Quality Control Plan (QC Plan) identifies the specific resources and procedures which will be utilized by ABC Contractors to control the quality of all Earthwork materials and ensure that all associated Work is completed in accordance with Project Specifications.

### TERMS & DEFINITIONS

The following terms and definitions are applicable to this QC Plan:

- **Contractor Information Testing (CIT)** – Testing that is performed at the discretion of the QC Inspector (non-random) for information to guide Production or Field Placement of material.
- **Control Strip** – An area of Earthwork placed at the beginning of each new Earthwork operation which is used to establish the rolling pattern and compactive effort required to achieve the in-place Target Density at Optimum Moisture Content.
- **Control Strip Section** – One of 3 approximately equal parts of a Control Strip which are sequentially placed and tested for In-Place Density and Moisture Content.
- **Crushed Stone** – Processed Earthwork material used for “Embankment Under Bridge Foundations” which meets the materials specification requirements contained in Subsection M2.01.0.
- **Earth Excavate** – Earthwork material, obtained from On-Site excavation (cut) activity, which is used for “Roadway Embankment Material”, and which meets the materials specification requirements contained in Section M1.01.0 (Ordinary Borrow) and contains up to 50% boulders or rock fragments with a maximum size of 600 millimeters largest dimension.
- **Field Quality Control (FQC)** – All sampling, testing, and inspection activity performed to control the quality of Field Placement operations.



- **Gravel Borrow** – Earthwork material, obtained either from On-Site excavation (cut) activity or from Off-Site Borrow Producers, which is used for “Roadway Embankment Material”, “Embankment Under Bridge Foundations”, or “Backfill Material for Structures and Pipes”, and which meets the materials specification requirements contained in Subsection M1.03.0.
- **Ordinary Borrow** – Earthwork material, obtained either from On-Site excavation (cut) activity or from Off-Site Borrow Producers, which is used for “Roadway Embankment Material”, and which meets the materials specification requirements contained in Subsection M1.01.0.
- **Producer** – A Subcontractor who supplies either “project produced” materials or “commercially manufactured” materials for incorporation into the Work.
- **Production Quality Control (PQC)** – All sampling, testing, and inspection activity performed by ABC Contractors or their Producers to control the quality of material produced at the Production facility.
- **Rock Excavate** – Earthwork material, obtained from On-Site excavation (cut) activity, which is used for “Backfill Material for Muck Excavation” or “Roadway Embankment Material”, and which is comprised of boulders or rock fragments with a maximum size of 1 meter largest dimension.
- **Source Characterization (SC)** – Sampling and testing performed to determine the specific “Earthwork Material Type” which an individual material source location (On-Site or Off-Site) contains.
- **Source Quadrant** – An area of defined boundaries at an individual Earthwork material source location (On-Site or Off-Site) which has been evaluated by Source Characterization sampling and testing.
- **Special Borrow** – Earthwork material, obtained either from On-Site excavation (cut) activity or from Off-Site Borrow Producers, which is used for “Backfill Material for Muck Excavation” or “Roadway Embankment Material”, and which meets the materials specification requirements contained in Subsection M1.02.0.

## **1.0 SCOPE AND APPLICABLE SPECIFICATIONS**

The relevant specifications for all Earthwork activities are as indicated below.

### **1.1 – Standard Specifications**

This QC Plan applies to all Work covered by the following sections of Transportation Agency Standard Specifications for Highways and Bridges, 1995 Metric Edition:

- ❖ Division II - Section 150: Embankment
- ❖ Division II - Section 170: Grading
- ❖ Division III - Section M1: Soils and Borrow Materials, limited to:
  - Subsection M1.01.0 Ordinary Borrow
  - Subsection M1.02.0 Special Borrow
  - Subsection M1.03.0 Gravel Borrow (Type a)
  - Subsection M1.04.0 Sand Borrow (Type b)
  - Subsection M1.08.0 Impervious Soil Borrow
- ❖ Division III - Section M2: Aggregates and Related Materials, limited to:
  - Subsection M2.01.0 Crushed Stone
  - Subsection M2.01.1 Grading Requirements (37.5 mm)



## 1.2 – Supplemental Specifications

Transportation Agency Supplemental Specifications, December 23, 1998 Metric Edition, applicable to Work addressed by this QC Plan include:

- ❖ Division II - Section 150: Embankment
- ❖ Division II - Section 170: Grading

## 1.3 – Project Special Provisions

Special Provisions applicable to Work addressed by this QC Plan include:

- ❖ Division II - Section 150: Embankment (June 26, 2001)
  - Subsection 150.20 General
  - Subsection 150.66 Gravel Borrow for Bridge Foundations
  - Subsection 150.69 Crushed Stone for Stabilized Construction Entrances
  - Subsection 150.70 Gravel Borrow for Sidewalk
  - Subsection 150.72 Sedimentation Control

## 1.4 – Project Drawings

A current listing of drawings applicable to all Work addressed by this QC Plan will be maintained by ABC Contractors. The "Project Drawings List" will be updated and submitted monthly to Transportation Agency in electronic format. An example copy of the "Project Drawings List: Section 1 – Earthwork" is contained in **Appendix A**.

## 1.5 – Standard Drawings

All Standard Drawings related to Earthwork contained in the Transportation Agency Construction and Traffic Standard Details (1996) are applicable to Work addressed by this QC Plan.

## **2.0 QUALITY CONTROL ORGANIZATION**

The personnel and their corresponding responsibilities for all Earthwork Quality Control activities are as indicated below.

### **2.1 – QC Plan Manager**

The QC Plan Manager is Mr. "Plan Manager", P.E. He is employed by ABC Contractors, Inc. (ABC Contractors). Mr. "Plan Manager" is located at the ABC Contractors State Route 99 Project Office in Anytown, USA and can be contacted as follows:

Office Phone: (508) 123-4567  
Cell Phone: (508) 123-4568  
Pager: (508) 123-4500

The QC Plan Manager has responsibility and authority for the following items:

- ❖ Development and submission of this QC Plan for Transportation Agency approval
- ❖ Overall coordination of personnel performing QC inspection, sampling, and testing at all Off-Site Production facilities, QC Laboratories, and On-Site Field operations
- ❖ Approval of Material Sources prior to the start of any related work addressed by this QC Plan
- ❖ Ensure that Producers have required certifications and qualified personnel and laboratories
- ❖ Complete adherence to all QC requirements and activities contained in this QC Plan
- ❖ Initiating Work suspension and determining appropriate corrective action when testing or inspection identifies nonconforming materials or construction as outlined under Section 6.5 and Section 7.6 below
- ❖ Review and evaluation of all QC documentation for content and completeness
- ❖ Maintaining the "QC Record System – Earthwork" in accordance with Section 5.5 below
- ❖ Preparing and submitting a "Weekly QC Summary Report" to Transportation Agency within 7 Calendar Days following the end of the reporting period.



**2.2 – Qualified Off-Site Production Facility QC Personnel**

Personnel assigned to perform Off-Site Production Facility QC sampling, testing, and inspection of Earthwork materials will be as indicated in the table below. A current listing of qualified Off-Site Production Facility QC personnel will be included in the "Weekly QC Summary Report".

Project Segment	QC Position	Personnel - Company	Qualifications
1, 2, 3	Soils Inspector	Various – Producers (See Weekly QC Summary Report)	NETTCP Soils & Agg. Inspector (See Weekly Report)

Off-Site Production QC activities by ABC Contractors will be scheduled as necessary and will generally involve the collection of samples for Source Characterization testing from potential Earthwork material Producers.

Where Earthwork materials Producers possess their own qualified QC personnel and laboratories, the results of the Producer’s QC inspection and testing may be used by ABC Contractors. In such instances, the Producer will perform Source Characterization sampling and testing in accordance with the required test methods and frequencies outlined in Section 4.0 below.

Off-Site Production Facility QC personnel have responsibility and authority for the following items:

- ❖ Obtaining random Source Characterization samples of Earthwork materials at each Production Facility
- ❖ Inspecting Earthwork Production operations at each Production Facility
- ❖ Preparing and signing standard QC Inspection report forms for each Production location
- ❖ Identifying Production Facility practices or materials which do not conform with the requirements of the relevant specifications and this QC Plan, and discussing appropriate corrective action with the Production Facility Superintendent and the QC Manager
- ❖ Suspending the transport of Earthwork materials to On-Site placement locations when materials are not in conformance with the relevant specification requirements or when corrective actions have been determined necessary and are not implemented

### 2.3 – Qualified QC Laboratory Personnel

Personnel assigned to perform QC Laboratory sampling and testing of Earthwork materials are identified in the table below. A current listing of qualified QC Laboratory personnel will be included in the "Weekly QC Summary Report".

Project Segment	QC Position	Personnel – Company	Qualifications
1, 2, 3	Laboratory Supervisor (ABC Contractors Anytown, USA)	Bob Supervisor – XYZ	NETTCP Soils & Agg. Technician # SAT 100
1, 2, 3	Laboratory Technician	Cathy Technician – XYZ	NETTCP Soils & Agg. Technician # SAT 190
1, 2, 3	Laboratory Technician	Mike Technician – XYZ	NETTCP Soils & Agg. Inspector # SAI 450

QC Laboratory personnel have responsibility and authority for the following items:

- ❖ Sampling of Earthwork materials
- ❖ Laboratory testing of Earthwork materials
- ❖ Preparing and signing standard Test Report Forms (TRFs) for each test completed
- ❖ Properly storing all Earthwork material samples
- ❖ Identifying Earthwork materials test results which do not conform with the requirements of the relevant specifications and this QC Plan, and discussing with the QC Manager



## 2.4 – Qualified On-Site Field QC Personnel

Personnel assigned to perform On-Site Field QC sampling, testing, and inspection of Earthwork materials are identified in the table below. A current listing of qualified On-Site Field QC personnel will be included in the "Weekly QC Summary Report".

Project Segment	QC Position	Personnel - Company	Qualifications
1	Lead QC Inspector	Kevin Boulder – XYZ	NETTCP Soils & Agg. Inspector # SAI 491
2	Lead QC Inspector	George Troxler – XYZ	<b>Not Currently NETTCP Certified</b>
3	Lead QC Inspector	Mike Gravel – XYZ	<b>Not Currently NETTCP Certified</b>
1, 2, 3	Soils Inspector	Various – XYZ (See Weekly QC Summary Report)	NETTCP Soils & Agg. Inspector (See Weekly QC Summary Report)

On-Site Field QC personnel have responsibility and authority for the following items:

- ❖ Obtaining random Field samples of Earthwork materials for laboratory testing
- ❖ Performing In-Place sampling and testing of Earthwork
- ❖ Preparing and signing standard Test Report Forms (TRFs) for each test completed
- ❖ Inspecting On-Site Earthwork production and placement operations
- ❖ Preparing and signing standard QC Inspection report forms for each placement location
- ❖ Identifying On-Site Field placement practices or materials which do not conform with the requirements of the relevant specifications and this QC Plan, and discussing appropriate corrective action with the Segment Field Superintendent and the QC Manager
- ❖ Suspending the placement of Earthwork materials when materials are not in conformance with the relevant specification requirements or when corrective actions have been determined necessary and are not implemented

### **3.0 QUALITY CONTROL LABORATORIES**

The Quality Control Laboratories to be used for all Earthwork materials and their corresponding testing responsibilities are as indicated below.

#### **3.1 – Qualified Primary QC Laboratory**

The primary QC Laboratory responsible for performing sampling and testing of Earthwork materials is identified in the table below.

<b>Project Segment</b>	<b>Laboratory</b>	<b>Location</b>	<b>Qualifications</b>
1, 2, 3	ABC Contractors State Route 99 Project Laboratory	Anytown, USA	NETTCP Laboratory Qualification Program – Category 2-T: Soils, Aggregates ( <b>MM/DD/YY</b> )

The ABC Contractors State Route 99 Project Laboratory is responsible for performing testing of all On-Site Earthwork materials as well as testing of any Off-Site Borrow material. The following tests will be performed on Earthwork materials by this laboratory:

- |                                  |                            |
|----------------------------------|----------------------------|
| ❖ Soil Classification            | AASHTO M145                |
| ❖ Gradation                      | AASHTO T11 and T27         |
| ❖ Liquid Limit                   | AASHTO T89                 |
| ❖ Plastic Limit/Plasticity Index | AASHTO T90                 |
| ❖ Optimum Moisture Content       | AASHTO T99 and AASHTO T180 |
| ❖ Maximum Dry Density            | AASHTO T99 and AASHTO T180 |
| ❖ Coarse Particles Correction    | AASHTO T224                |
| ❖ Grain-Size Analysis            | AASHTO T311                |



## **4.0 MATERIALS CONTROL**

The types, sources, properties, and procedures for storing of materials to be used for each Earthwork category are as indicated below.

### **4.1 – Material Types and Source(s) of Supply**

Earthwork material will be classified according to the following Earthwork Item categories:

- ❖ Backfill Material for Muck Excavation
- ❖ Roadway Embankment Material
- ❖ Embankment Material under Bridge Foundations
- ❖ Backfill Material for Structures
- ❖ Backfill Material for Pipes

#### **4.1.1 – Backfill Material for Muck Excavation**

The types and potential sources of material currently identified for use as Backfill Material for Muck Excavation are listed in the table below.

<b>Backfill Material for Muck Excavation</b>	
<b>Material Type</b>	<b>Material Source</b>
Rock Excavate	<ul style="list-style-type: none"> <li>• On-Site, Segment 1, Rte 99 Median</li> <li>• On-Site, Segment 3, Rte 99 Median</li> </ul>
Special Borrow	<ul style="list-style-type: none"> <li>• On-Site, Segment 1</li> <li>• On-Site, Segment 2</li> <li>• Borrow Producer (<b>TBD</b>)</li> </ul>

ABC Contractors will submit updated information on the types and sources of Backfill Material for Muck Excavation as part of the "Weekly Schedule of Earthwork Materials Production Operations" as outlined under Section 6.1 below.



#### 4.1.2 – Roadway Embankment Material

The types and sources of material currently identified for use as Roadway Embankment are listed in the table below. At this time, sufficient quantities of Earth Excavate, Rock Excavate, Ordinary Borrow, and Gravel Borrow appear to be available On-Site for Roadway Embankment construction. If Off-Site sources of these materials are determined necessary by ABC Contractors, the table will be updated to reflect these sources.

Roadway Embankment Material	
Material Type	Material Source
Rock Excavate	<ul style="list-style-type: none"> <li>• On-Site, Segment 1, Rte 99 Median</li> <li>• On-Site, Segment 3, Rte 99 Median</li> </ul>
Earth Excavate	<ul style="list-style-type: none"> <li>• On-Site, Segment 1, Rte 99 Median</li> <li>• On-Site, Segment 3, Rte 99 Median</li> </ul>
Ordinary Borrow	<ul style="list-style-type: none"> <li>• On-Site, Segment 1</li> <li>• On-Site, Segment 2</li> <li>• On-Site, Segment 3</li> <li>• Borrow Producer <b>(TBD)</b></li> </ul>
Gravel Borrow	<ul style="list-style-type: none"> <li>• On-Site, Segment 1</li> <li>• On-Site, Segment 3</li> <li>• Borrow Producer <b>(TBD)</b></li> </ul>
Special Borrow	<ul style="list-style-type: none"> <li>• On-Site, Segment 1</li> <li>• On-Site, Segment 2</li> <li>• Borrow Producer <b>(TBD)</b></li> </ul>

ABC Contractors will submit updated information on the types and sources of Roadway Embankment Material as part of the "Weekly Schedule of Earthwork Materials Production Operations" as outlined under Section 6.1 below.

#### 4.1.3 – Embankment Material Under Bridge Foundations

The types and potential sources of material currently identified for use as Embankment Material under Bridge Foundations are listed in the table below.

Embankment Material Under Bridge Foundations	
Material Type	Material Source
Gravel Borrow	<ul style="list-style-type: none"> <li>• <i>Borrow Producer (TBD)</i></li> </ul>
Crushed Stone	<ul style="list-style-type: none"> <li>• <i>Borrow Producer (TBD)</i></li> </ul>

ABC Contractors will submit updated information on the types and sources of Embankment Material under Bridge Foundations as part of the "Weekly Schedule of Earthwork Materials Production Operations" as outlined under Section 6.1 below.

#### 4.1.4 – Backfill Material for Structures

The types and potential sources of material currently identified for use as Backfill Material for Structures are listed in the table below.

Backfill Material for Structures	
Material Type	Material Source
Gravel Borrow	<ul style="list-style-type: none"> <li>• <i>Borrow Producer (TBD)</i></li> </ul>

ABC Contractors will submit updated information on the types and sources of Backfill Material for Structures as part of the "Weekly Schedule of Earthwork Materials Production Operations" as outlined under Section 6.1 below.



**4.1.5 – Backfill Material for Pipes**

The types and potential sources of material currently identified for use as Backfill Material for Pipes are listed in the table below.

<b>Backfill Material for Pipes</b>	
<b>Material Type</b>	<b>Material Source</b>
Ordinary Borrow	<ul style="list-style-type: none"> <li>• On-Site, Segment 1</li> <li>• On-Site, Segment 2</li> <li>• On-Site, Segment 3</li> <li>• Borrow Producer (<b>TBD</b>)</li> </ul>
Gravel Borrow	<ul style="list-style-type: none"> <li>• <b>Borrow Producer (TBD)</b></li> </ul>

ABC Contractors will submit updated information on the types and sources of Backfill Material for Pipes as part of the "Weekly Schedule of Earthwork Materials Production Operations" as outlined under Section 6.1 below.

## 4.2 – Material Properties

Earthwork material Source Characterization and Mix Designs will be performed as described below.

### 4.2.1 – Material Source Characterization Sampling & Testing

Earthwork materials will be fully characterized by ABC Contractors prior to their use in the intended location. Grids will be established and maintained at each Earthwork source location identifying "Quadrants". Each Quadrant will be numbered for Source Characterization identification (e.g. SC-1, SC-2, SC-99, etc.) ABC Contractors will submit the results of Source Characterization testing for each Source Quadrant of Earthwork material to Transportation Agency a minimum of two (2) calendar days prior to placement of any material from the Source Quadrant. The following table identifies the specific Source Characterization testing that will be performed on all Earthwork materials.



<b>Material Source Characterization Sampling &amp; Testing</b>			
<b>Material Type</b>	<b>Characteristic tested</b>	<b>Test Method</b>	<b>Test Frequency</b>
Rock Excavate	Maximum Size (< 1m)	Visual/Tape	Minimum 4/Day/Quadrant
Earth Excavate (M1.01.0 Modified) (Contains Boulders < 600mm)	Soil Classification	AASHTO M 145	Minimum 4/Quadrant
	Liquid Limit	AASHTO T89	Minimum 4/Quadrant
	Plastic Limit/ PI	AASHTO T90	Minimum 4/Quadrant
	Maximum Dry Density	AASHTO T 180 (Method D)	Minimum 4/Quadrant
	Optimum Moisture Content	AASHTO T 180 (Method D)	Minimum 4/Quadrant
	Coarse Particles Correction	AASHTO T 224	Minimum 4/Quadrant
	Grain-Size Analysis	AASHTO T 311	Minimum 4/Quadrant
Ordinary Borrow (M1.01.0)	Soil Classification	AASHTO M 145	Minimum 4/Quadrant
	Liquid Limit	AASHTO T89	Minimum 4/Quadrant
	Plastic Limit/ PI	AASHTO T90	Minimum 4/Quadrant
	Maximum Dry Density	AASHTO T 99 (Method C)	Minimum 4/Quadrant
	Optimum Moisture Content	AASHTO T 99 (Method C)	Minimum 4/Quadrant
	Coarse Particles Correction	AASHTO T 224	Minimum 4/Quadrant
	Grain-Size Analysis	AASHTO T 311	Minimum 4/Quadrant
Gravel Borrow (M1.03.0)	Soil Classification	AASHTO M 145	Minimum 4/Quadrant
	Gradation	AASHTO T 11, T27	Minimum 4/Quadrant
	Maximum Dry Density	AASHTO T 180 (Method D)	Minimum 4/Quadrant
	Optimum Moisture Content	AASHTO T 180 (Method D)	Minimum 4/Quadrant

Material Source Characterization Sampling & Testing (-Continued-)			
Material Type	Characteristic tested	Test Method	Test Frequency
Special Borrow (M1.02.0)	Soil Classification	AASHTO M 145	Minimum 4/Quadrant
	Gradation	AASHTO T 11, T27	Minimum 4/Quadrant
	Plastic Limit/ PI	AASHTO T90	Minimum 4/Quadrant
	Maximum Dry Density	AASHTO T 180 (Method D)	Minimum 4/Quadrant
	Optimum Moisture Content	AASHTO T 180 (Method D)	Minimum 4/Quadrant
	Maximum Percentage of Wear (LA Abrasion)	AASHTO T 96	Minimum 4/Quadrant
Crushed Stone (M2.01.0)	Soil Classification	AASHTO M 145	Minimum 1/10,000 m <sup>3</sup>
	Gradation	AASHTO T 11, T27	Minimum 1/10,000 m <sup>3</sup>
	Maximum Percentage of Wear (LA Abrasion)	AASHTO T 96	Minimum 1/10,000 m <sup>3</sup>
	Flat & Elongated Particles	ASTM D 4791	Minimum 1/10,000 m <sup>3</sup>

All Earthwork Source Characterization samples will be obtained randomly in accordance with ASTM D3665. The random sample locations within each Source Quadrant will be determined by Station, Offset, and elevation within the Quadrant. All random sample locations will be documented on NETTCP Standard Test Report Form D3665 or D3665RNG. A copy of these Random Sampling Forms is located in **Appendix B**.

All Earthwork Source samples will be obtained following AASHTO T2 and split in accordance with AASHTO T248.



All Source Characterization sampling and testing results will be documented on the following standard Test Report Forms (TRFs):

Source Characterization Standard Test Report Forms	
Form No.	Form Title
M145-T89-T90	Classification of Soils (Includes Liquid Limit & Plastic Limit)
NETTCP T27	Sieve Analysis Test Report
NETTCP T96	Resistance to Degradation of Aggregate by Abrasion Test Report
T99	Moisture-Density Relations of Soils (Standard)
T180	Moisture Density Relations of Soils (Modified)
T311	Grain-Size Analysis of Granular Soil Materials
Rock Size	Evaluation of Maximum Rock Size in Earthwork Materials

A copy of the standard TRFs used for Source characterization sampling and testing is located in **Appendix C**.

#### 4.2.2 – Mix Designs

Earthwork Materials "Mix Designs" are generally not required. Source Characterization testing will determine whether specific Earthwork Materials sources meet the specification requirements for a particular material type required (i.e. Ordinary Borrow, Gravel Borrow, Special Borrow, etc.).

#### 4.3 – Processing of Existing Materials

Where On-Site excavate proposed to be used for Earthwork is found to not meet specification requirements, the following procedures will be used to process or blend the material to meet the requirements of a specific Earthwork Material Type:

- ❖ A blended material "Mix Design" will be developed by the Project Laboratory.
- ❖ A stockpile of the excavate, not to exceed one day's production, will be blended with other material per the "Mix Design".
- ❖ At the completion of blending of the stockpile, samples will be obtained and Source Characterization testing will be performed to confirm that the blended material meets the specification requirements.

#### **4.4 – Material Storage & Stockpiling**

All Earthwork materials will be properly stored and maintained to prevent contamination or commingling of different materials. Storage and stockpiling procedures will be as follows:

- ❖ The limits of each storage or stockpile location will be clearly marked by grade stakes legibly marked indicating the corresponding Source Characterization sample number (i.e. SC-1, SC-2, etc.) contained in the Project "Soils Source Characterization Log".
- ❖ All active/working stockpiles of Earthwork materials will be characterized in accordance with Section 4.2.1 above a minimum of once per week.



## **5.0 QUALITY CONTROL SAMPLING AND TESTING**

The requirements and procedures to be used for QC sampling and testing of Earthwork are as indicated below.

### **5.1 – Lot and Sublot Sizes**

Each Lot of Earthwork material will represent material from the same source, be produced or obtained under the same controlled process, and will possess normally distributed specification properties. Each Lot will be divided into Sublots of equal size in order to assess the Quality Characteristics of the Lot. The Lot size and corresponding Sublot size for each Earthwork Item is identified in the following table.

<b>Earthwork Lot and Sublot Sizes</b>			
<b>Earthwork Item</b>	<b>Material Type(s)</b>	<b>Lot Size</b>	<b>Sublot Size</b>
Backfill Material for Muck Excavation (Section 150.65)	<ul style="list-style-type: none"> <li>• Rock Excavate</li> <li>• Special Borrow</li> </ul>	Total Quantity (m <sup>3</sup> ) of Backfill material type, per material Source, per Project Segment	(See Table 5.4.1)
Roadway Embankment Material (Section 150.62 & Section 150.63)	<ul style="list-style-type: none"> <li>• Rock Excavate</li> <li>• Earth Excavate</li> <li>• Ordinary Borrow</li> <li>• Gravel Borrow</li> <li>• Special Borrow</li> </ul>	Total Quantity (m <sup>3</sup> ) of Embankment Material Type, per Material Source, per Project Segment	(See Table 5.4.2)
Embankment Material Under Bridge Foundations (Section 150.66 & Section 150.67)	<ul style="list-style-type: none"> <li>• Gravel Borrow</li> <li>• Crushed Stone</li> </ul>	Total Quantity (m <sup>3</sup> ) of Embankment material type, per material Source, per Project Segment	(See Table 5.4.3)
Backfill Material for Structures (Section 150.64)	<ul style="list-style-type: none"> <li>• Gravel Borrow</li> </ul>	Total Quantity (m <sup>3</sup> ) of Backfill material type, per material Source, per Project Segment	(See Table 5.4.4)
Backfill Material for Pipes (Section 150.64)	<ul style="list-style-type: none"> <li>• Gravel Borrow</li> <li>• Ordinary Borrow</li> </ul>	Total Quantity (m <sup>3</sup> ) of Backfill material type, per material Source, per Project Segment	(See Table 5.4.5)

## 5.2 – Random Sampling Plan

ABC Contractors will establish a Random Sampling Plan for QC sampling and testing for each Lot of Earthwork material prior to placement of the Lot. All Earthwork samples will be obtained randomly in accordance with ASTM D3665. The random sample location for each Sublot will be determined by Station, Offset, and depth within the Sublot.

All random sample locations will be documented on NETTCP Standard Test Report Form D3665 or D3665RNG. A copy of the Random Sampling Forms is located in **Appendix B**. ABC Contractors will provide Transportation Agency a copy of the Random Sampling locations (i.e. completed NETTCP Form D3665) for each Earthwork placement operation, during the start of the placement operation each day.

## 5.3 – Sample Identification System

All Earthwork material samples will be clearly identified as follows:

- Project Segment (i.e. 1, 2, 3)
- Material Type (i.e. Rock Excavate, Earth Excavate, Ordinary Borrow, etc.)
- Sample Type (QC, CIT) and Random/Non-Random
- Lot Number and Sublot Number
- Sample Location (i.e. Rte 99 Median, Borrow Subcontractor, etc.)
- Station, Offset, and Depth
- Sample Date
- Technician or Inspector

## 5.4 – QC Sampling & Testing Requirements

The specific requirements (Quality Characteristics, frequency, location, methods) for QC sampling and testing of each Earthwork item are outlined in the tables below.



### 5.4.1 – Backfill Material for Muck Excavation

QC Sampling & Testing Requirements					
Quality Characteristic	Test Method(s)	Lot Size	Sublot Size/ Test Frequency	Point of Sampling	Sampling Method
Gradation	AASHTO T11 AASHTO T27	Total Quantity of Backfill Material Type / Source / Project Segment	1 Sample/ 5,000 m <sup>3</sup> for 1 <sup>st</sup> 50,000 m <sup>3</sup> and 1 Sample/ 10,000 m <sup>3</sup> thereafter	From In-Place Lift of Backfill	Random T2, T248
Maximum Dry Density & Optimum Moisture Content	AASHTO T99 (Method C) AASHTO T180 (Method D)	Total Quantity of Backfill Material Type / Source / Project Segment	1 Sample/ 5,000 m <sup>3</sup> for 1 <sup>st</sup> 50,000 m <sup>3</sup> and 1 Sample/ 10,000 m <sup>3</sup> thereafter	From In-Place Lift of Backfill	Random T2, T248
Maximum Rock Size (< 1 m)	Visual/Tape	Total Quantity of Backfill Material Type / Source / Project Segment	Minimum 4/Lift/Day	From In-Place Lift of Backfill	Random Visual
Maximum Lift Thickness (< 300 mm)	Rod/Grade Stake	Total Quantity of Backfill Material Type / Source / Project Segment	Minimum 4/Lift/Day	From In-Place Lift of Backfill	Random Visual
In-Place Density & Moisture Content (Per Targets)	AASHTO T310 (Method B)	Total Quantity of Backfill Material Type / Source / Project Segment	1 Sample/1,000 m <sup>3</sup> , but not less than 1/Placement Location/Day	From Compacted Backfill	Random T310

### 5.4.2 – Roadway Embankment Material

QC Sampling & Testing Requirements					
Quality Characteristic	Test Method(s)	Lot Size	Sublot Size/ Test Frequency	Point of Sampling	Sampling Method
Gradation	AASHTO T11 AASHTO T27	Total Quantity of Embankment Material Type / Source / Project Segment	1 Sample/ 5,000 m <sup>3</sup> for 1 <sup>st</sup> 50,000 m <sup>3</sup> and 1 Sample/ 10,000 m <sup>3</sup> thereafter	From In-Place Lift of Embankment	Random T2, T248
Maximum Dry Density & Optimum Moisture Content	AASHTO T99 (Method C) AASHTO T180 (Method D)	Total Quantity of Embankment Material Type / Source / Project Segment	1 Sample/ 5,000 m <sup>3</sup> for 1 <sup>st</sup> 50,000 m <sup>3</sup> and 1 Sample/ 10,000 m <sup>3</sup> thereafter	From In-Place Lift of Embankment	Random T2, T248
Maximum Rock Size (< 1 m)	Visual/Tape	Total Quantity of Embankment Material Type / Source / Project Segment	Minimum 4/Lift/Day	From In-Place Lift of Backfill	Random Visual
Maximum Lift Thickness (< 600 mm for Earth Excavate)	Rod/Grade Stake	Total Quantity of Embankment Material Type / Source / Project Segment	Minimum 4/Lift/Day	From In-Place Lift of Embankment	Random Visual
Maximum Lift Thickness (< 300 mm for Ordinary Borrow & Gravel Borrow)	Rod/Grade Stake	Total Quantity of Embankment Material Type / Source / Project Segment	Minimum 4/Lift/Day	From In-Place Lift of Embankment	Random Visual
Maximum Lift Thickness (< 200 mm for Special Borrow)	Rod/Grade Stake	Total Quantity of Embankment Material Type / Source / Project Segment	Minimum 4/Lift/Day	From In-Place Lift of Embankment	Random Visual
In-Place Density & Moisture Content (Per Targets)	AASHTO T310 (Method B)	Total Quantity of Embankment Material Type / Source / Project Segment	1 Sample/1,000 m <sup>3</sup> , but not less than 1/Placement Location/Day	From Compacted Embankment	Random T310



### 5.4.3 – Embankment Material Under Bridge Foundations

QC Sampling & Testing Requirements					
Quality Characteristic	Test Method(s)	Lot Size	Sublot Size/ Test Frequency	Point of Sampling	Sampling Method
Gradation	AASHTO T11 AASHTO T27	Total Quantity of Embankment Material Type / Source / Project Segment	1 Sample/ Placement Location	From In-Place Lift of Embankment	Random T2, T248
Maximum Dry Density & Optimum Moisture Content	AASHTO T99 (Method C) AASHTO T180 (Method D)	Total Quantity of Embankment Material Type / Source / Project Segment	1 Sample/ Placement Location	From In-Place Lift of Embankment	Random T2, T248
Maximum Stone Size (< 75 mm)	Visual/Tape	Total Quantity of Backfill Material Type / Source / Project Segment	Minimum 4/Lift/Day	From In-Place Lift of Backfill	Random Visual
Maximum Lift Thickness (< 300 mm)	Rod/Grade Stake	Total Quantity of Embankment Material Type / Source / Project Segment	Minimum 4/Lift/Day	From In-Place Lift of Embankment	Random Visual
In-Place Density & Moisture Content (Per Targets)	AASHTO T310 (Method B)	Total Quantity of Embankment Material Type / Source / Project Segment	Gravel Borrow: 1 Sample/ Each Lift/ Placement Location/Day	From Compacted Embankment	Random T310
			Crushed Stone: N/A		

### 5.4.4 – Backfill Material for Structures

QC Sampling & Testing Requirements					
Quality Characteristic	Test Method(s)	Lot Size	Sublot Size/ Test Frequency	Point of Sampling	Sampling Method
Gradation	AASHTO T11 AASHTO T27	Total Quantity of Backfill Material Type / Source / Project Segment	1 Sample/1,000 m <sup>3</sup>	From In-Place Lift of Backfill	Random T2, T248
Maximum Dry Density & Optimum Moisture Content	AASHTO T99 (Method C) AASHTO T180 (Method D)	Total Quantity of Backfill Material Type / Source / Project Segment	1 Sample/1,000 m <sup>3</sup>	From In-Place Lift of Backfill	Random T2, T248
Maximum Stone Size (< 75 mm)	Visual/Tape	Total Quantity of Backfill Material Type / Source / Project Segment	Minimum 4/Lift/Day	From In-Place Lift of Backfill	Random Visual
Maximum Lift Thickness (< 150 mm)	Rod/Grade Stake	Total Quantity of Backfill Material Type / Source / Project Segment	Minimum 4/Lift/Day	From In-Place Lift of Backfill	Random Visual
In-Place Density & Moisture Content (Per Targets)	AASHTO T310 (Method B)	Total Quantity of Backfill Material Type / Source / Project Segment	1 Sample/100 m <sup>3</sup> , but not less than 1/Lift/Day	From Compacted Backfill	Random T310



### 5.4.5 – Backfill Material for Pipes\*

QC Sampling & Testing Requirements					
Quality Characteristic	Test Method(s)	Lot Size	Sublot Size/ Test Frequency	Point of Sampling	Sampling Method
Gradation	AASHTO T11 AASHTO T27	Total Quantity of Backfill Material Type / Source / Project Segment	1 Sample/1,000 m <sup>3</sup>	From In-Place Lift of Backfill	Random T2, T248
Maximum Dry Density & Optimum Moisture Content	AASHTO T99 (Method C) AASHTO T180 (Method D)	Total Quantity of Backfill Material Type / Source / Project Segment	1 Sample/1,000 m <sup>3</sup>	From In-Place Lift of Backfill	Random T2, T248
Maximum Stone Size (< 75 mm)	Visual/Tape	Total Quantity of Backfill Material Type / Source / Project Segment	Minimum 4/Lift/Day	From In-Place Lift of Backfill	Random Visual
Maximum Lift Thickness (< 150 mm)	Rod/Grade Stake	Total Quantity of Backfill Material Type / Source / Project Segment	Minimum 4/Lift/Day	From In-Place Lift of Backfill	Random Visual
In-Place Density & Moisture Content (Per Targets)	AASHTO T310 (Method B)	Total Quantity of Backfill Material Type / Source / Project Segment	Gravel Borrow: 1 Sample/100 m of Trench, but not less than 1/Lift/Day	From Compacted Backfill	Random T310
			Ordinary Borrow: 1 Sample/100m of trench, but not less than 1/Placement Location/Day		

(\*)**Backfill Material for Pipes** will include Gravel Borrow and Ordinary Borrow to be placed as follows:

Gravel Borrow – Gravel Borrow shall be used for bedding and backfilling of pipe to a point 600mm above the top of pipe.

Ordinary Borrow – Ordinary Borrow shall be used to backfill the remaining depth of trench from the top of the Gravel Borrow to the top of the finished subgrade.

### 5.5 – QC Test Result Reporting

All QC sampling and testing of In-Place Earthwork materials will be documented on the following Standard Test Report Forms (TRFs):

Form No.	Form Title
NETTCP T27	Sieve Analysis Test Report
T99	Moisture-Density Relations of Soils (Standard)
T180	Moisture Density Relations of Soils (Modified)
T310	Soils In-Place Density & Moisture Content Test Report
Rock Size & Lift	Maximum Rock Size and Lift Thickness Test Report

A copy of the Standard TRFs used for QC sampling and testing of Earthwork materials is located in **Appendix C**.

ABC Contractors will retain a complete record of all completed Earthwork testing and inspection in accessible files which will be labeled as the "QC Record System – Earthwork". The QC Record System will contain the following QC documents:

- ❖ The approved Earthwork QC Plan
- ❖ Original copies of all completed Earthwork QC Standard Test Report Forms (including Random Sampling Forms)
- ❖ Earthwork Control Charts
- ❖ Summaries of all Earthwork test results
- ❖ Records of Earthwork Daily Production quantity information

ABC Contractors will also submit copies of all completed QC sampling and testing Report Forms to Transportation Agency with each "Weekly QC Summary Report".

### 5.6 – QC Sample Storage and Retention Procedures

All physical QC samples of Earthwork material will be split prior to testing in accordance with relevant AASHTO and NETTCP procedures.

The split sample portion of Earthwork material not used for testing will be retained in the original sample bag with proper identification. The split sample will be stored in the Sample Storage Room at the Laboratory which performed the test for a minimum of 60 Days following testing.



## **6.0 PRODUCTION FACILITIES**

The activities and procedures to be followed for QC during production of Earthwork materials are as indicated below.

### **6.1 – Schedule of Production Operations**

ABC Contractors will provide Transportation Agency with a "Weekly Schedule of Earthwork Materials Production Operations" on each Friday prior to the week of production. A copy of the "Weekly Schedule of Earthwork Materials Production Operations" is located in **Appendix D**. The weekly schedule of Production Operations will identify the following:

- Material Type
- Material Source
- Production Location
- Estimated Production Quantity

ABC Contractors will track the actual production quantities on a daily basis and maintain a "Record of Earthwork Production" for each week. Copies of the "Record of Earthwork Production" will be made available to Transportation Agency in the "Weekly QC Summary Report".

### 6.2 – Production Facilities & Equipment

ABC Contractors and their Subcontractors and Suppliers will utilize conventional facilities and equipment for the production of all Earthwork materials. The major types of facilities and equipment to be utilized for On-Site and Off-Site production are summarized below.

Material Source Production Facility	Production Equipment
On-Site, Segment 1, 2, & 3	• Crawler Drills (Multiple, Various Make)
	• Explosives & Blasting Mats
	• Backhoes (Multiple, Various Make)
	• Tractor/Dozers (Multiple, Various Make)
	• Front End Loaders (Multiple, Various Make)
	• End Dump Trucks (Multiple, Various Make)
Bedrock Industries, Bedrock, MA	
	• Tractor/Dozers (Multiple, Various Make)
	• Rock Crusher
	• Conveyor Belt
	• Front End Loaders (Multiple, Various Make)
Borrow Producer(s) (TBD)	
	• Tractor/Dozers (Multiple, Various Make)
	• Front End Loaders (Multiple, Various Make)
	• End Dump Trucks (Multiple, Various Make)



### 6.3 – Production Quality Control Activities

Production Quality Control (PQC) personnel will perform the following inspection, sampling, and testing activities at the frequencies indicated:

#### 6.3.1 – Pre-Production QC Activities

- ❖ Conduct a Pre-Production Quality Control Audit at each Earthwork Source facility or location in accordance with CQMP Part XIII prior to the start of Earthwork production
- ❖ Maintain a reference grid system (Stations, Offsets) and boundaries for each Earthwork Source facility or location
- ❖ Determine and document random sampling locations of Earthwork materials at Production Facility in accordance with Section 4.2.1 above
- ❖ Obtain and properly label all Source Characterization (SC) samples of Earthwork materials at the frequencies indicated in Section 4.2.1 above
- ❖ Transport Earthwork Source Characterization samples to the appropriate laboratory for testing
- ❖ Ensure that Source Characterization sampling and testing is completed for each Source Quadrant prior to production/removal of material from the Source Quadrant
- ❖ Inspect stockpiles to ensure that different Earthwork material types are not commingled or contaminated

#### 6.3.2 – Production QC Activities

- ❖ Visually monitor Earthwork materials production to ensure no change in material type within the Source Quadrant
- ❖ Determine and document random sampling locations for each Sublot of Earthwork material produced.
- ❖ Obtain and properly label all PQC Field samples of Earthwork materials.
- ❖ Transport Earthwork PQC Field samples to the appropriate laboratory for testing.
- ❖ Perform PQC sampling and testing of Earthwork in accordance with the required test methods and frequencies outlined in Section 5.0 above.
- ❖ Prepare and sign standard Test Report Forms (TRFs) for each test completed.
- ❖ Maintain Production Facility Control Charts per Section 6.4 below.
- ❖ Monitor loading and transportation of Earthwork materials to ensure that the correct materials are being transported to the correct Project location
- ❖ Ensure that all Borrow Pits are neatly trimmed and finished to the minimum grades and dimensions required under Section 150.21 of the Standard Specifications
- ❖ Document Off-Site and On-Site Earthwork Production QC inspection activities and findings on standard QC Inspection Report Forms (IRFs) for each production location in accordance with Section 6.6 below

- ❖ Identify Production Facility practices or materials which do not conform with the requirements of the relevant specifications and this QC Plan, and discuss appropriate corrective action with the Production Facility Superintendent and the QC Manager

#### **6.4 – Production Facility Control Charts**

Control Charts may be used by ABC Contractors and their Earthwork material Producers to control production operations as described below.

##### **6.4.1 – Off-Site Production Control Charts**

Off-Site Earthwork material Producers will use Control Charts as needed to provide adequate control of their production operations. Prior to production, ABC Contractors will request each Earthwork material Producer to identify and submit examples of any Control Charts to be used. ABC Contractors will monitor and discuss the Control Charts with the Producer during Earthwork production.

##### **6.4.2 – On-Site Production Control Charts**

At this time, the application of Control Charts does not appear necessary for the production of On-Site Earthwork materials (i.e. Earth Excavate). However, in the event that Rock Crushing operations are established to produce Earthwork materials from On-Site Rock Excavate, Control Charts will be maintained to monitor control of the operation.



## 6.5 – Procedures for Corrective Action of Non-Conforming Materials

The following procedures will be followed for corrective action of non-specification materials encountered at the Source/Production facility:

- ❖ If contaminated materials are encountered, the limit of contaminated material will be identified. The contaminated material will be clearly marked off by signs labeled **"No Use On Rte 99"**.
- ❖ If a change in material type is encountered within a Source Lot, additional sampling and testing will be performed to characterize the material. The disposition of such material will be as follows:
  - If the material meets specification requirements for another Project Material Type, then the material will be approved for use at an appropriate location for that Material Type.
  - If the material can be blended with other material and subsequently meet specification requirements for a Project Material Type, then the material will be approved for use at an appropriate location for that Material Type.
  - If the material does not meet specification requirements for a Project Material Type, the material will not be permitted for use on the Project. ABC Contractors will prepare a Non-Conformance Report (NCR) for such material in accordance with Part X of the CQMP. If the source of such material is On-Site (e.g. Rte 99 Median), ABC Contractors will dispose of the material Off-Site at an approved disposal site. If the source of such material is Off-Site (e.g. Borrow), the material will be clearly marked off by signs labeled **"No Use On Rte 99"**.

### 6.6 – Production QC Inspection Reporting

All PQC inspection activities will be documented on the following standard QC Inspection Report Forms (IRFs):

Form No.	Form Title
PQC-PPA	Production QC - Pre-Production Audit Report
PQC-IDR	Production QC – Inspectors Daily Report

A copy of the Standard IRFs used for Production QC inspection of Earthwork materials is located in **Appendix E**.



## **7.0 FIELD OPERATIONS**

The activities and procedures to be followed for QC during placement of Earthwork materials are as indicated below.

### **7.1 – Schedule of Field Placement Operations**

ABC Contractors will provide Transportation Agency with a "Weekly Schedule of Earthwork Materials Placement Operations" on each Friday prior to the week of placement. A copy of the "Weekly Schedule of Earthwork Materials Placement Operations" is located in **Appendix F**. The weekly schedule of Placement Operations will identify the following:

- Project Segment
- Placement Location
- Maximum Placement Depth
- Intended Placement Locations (Roadway, Station Limits)
- Material Type(s)
- Estimated Placement Quantities
- Material Source(s)

ABC Contractors will track the actual placement quantities on a daily basis and maintain a "Record of Earthwork Placement" for each week. Copies of the "Record of Earthwork Placement" will be made available to Transportation Agency.

### 7.2 – Field Placement Facilities & Equipment

ABC Contractors will utilize conventional facilities and equipment for the placement of all Earthwork materials. The major types of facilities and equipment to be utilized for Earthwork placement are summarized below for each type of Earthwork Item.

Earthwork Item	Placement Equipment
Backfill Material for Muck Excavation & Roadway Embankment Material	• End Dump Trucks (Multiple, Various Make)
	• Tractor/Dozers (Multiple, Various Make)
	• Vibratory Rollers - 50 Ton (Multiple, Various Make)
	• Sheepsfoot Rollers (Multiple, Various Make)
	• Water Trucks (Multiple, Various Make)
Embankment Material Under Bridge Foundations	• End Dump Trucks (Multiple, Various Make)
	• Tractor/Dozers (Multiple, Various Make)
	• Vibratory Rollers - 50 Ton (Multiple, Various Make)
Backfill Material for Structures and Pipes	• End Dump Trucks (Multiple, Various Make)
	• Backhoes (Multiple, Various Make)
	• Front End Loaders (Multiple, Various Make)
	• Vibratory Sled Compactors (Various Make)

### 7.3 – Establishment of Compaction Rolling Pattern (Control Strips)

Control Strips will be constructed at the start of each Earthwork placement operation. A new Control Strip will be constructed whenever one of the following occurs:

- A new Earthwork Lot
- A change in weather
- A change in environment
- A PWL < 85% for 3 or more consecutive QC Test Results

The Control Strips will be used to establish an effective rolling pattern and the corresponding compactive effort required to achieve the in-place Target Density (Maximum Dry Density) at Optimum Moisture Content. The procedure to be followed for developing a Control Strip is outlined as follows:



### 7.3.1 - Earthwork Compacted by Rollers

**Step A.** – The Control Strip will be established on the first lift to be constructed within an area not to exceed 30m long by 15m wide. The Strip will be divided longitudinally into 3 approximately equal Control Strip Sections.

**Step B.** – Material will be loose placed in the first Control Strip Section. The Field Superintendent, Roller Operator(s) and QC Field Inspector will visually assess the moisture content of Earthwork placed and determine whether additional moisture is needed to achieve Optimum Moisture Content.

**Step C.** – The Field Superintendent, Roller Operator(s) and QC Field Inspector will discuss and agree upon the proposed number and sequence of passes and compactive mode(s) (static, vibratory) to be used for the particular Earthwork being placed.

**Step D.** – The Roller Operator(s) will compact Control Strip Section #1 following the agreed upon number and sequence of passes and compactive mode(s).

**Step E.** – After compacting Control Strip Section #1, the Roller Operator will suspend operation. The QC Inspector will perform Contractor Information Testing (CIT) within Control Strip Section #1 and obtain a minimum of three separate (Random or Non-Random) In-Place Density and Moisture Content readings.

**Step F.** – The Field Superintendent, Roller Operator(s) and QC Field Inspector will review the In-Place Density and Moisture Content readings for Control Strip Section #1 and determine any necessary adjustment to the number and sequence of passes and compactive mode(s).

**Step G.** - The Roller Operator will move on to Control Strip Section #2 and compact the material following the agreed upon number and sequence of passes and compactive mode(s).

**Step H.** – After compacting Control Strip Section #2, the Roller Operator will suspend operation and permit the QC Inspector to obtain a minimum of three separate random In-Place Density and Moisture Content readings in Control Strip Section #2.

**Step I.** – The CIT results for Control Strip Section #2 will be evaluated by the QC Inspector using Quality Level Analysis (QLA). The QLA must indicate a Percent Within Limits (PWL) of 85% or more for the In-Place Density and Moisture Content as indicated in Section 8.1 below.

**Step J.** – If the PWL for Control Strip Section #2 is 85% or greater, then the number and sequence of passes and compactive mode(s) used in Control Strip Section #2 will be established as the approved "Compaction Pattern" for the remainder of the placement operation on that day.

**Step K.** – If the PWL for Control Strip Section #2 is less than 85%, then Steps F through I above will be repeated on segment #3.

### 7.3.2 - Earthwork Compacted by Hand Operated Compactors

**Step A.** – The Control Strip will be established on the first lift to be constructed within an area not to exceed 24m long by 1m wide. The Strip will be divided longitudinally into 3 approximately equal Control Strip Sections.

**Step B.** – Material will be loose placed in the first Control Strip Section. The Field Superintendent, Compactor Operator and QC Field Inspector will visually assess the moisture content of Earthwork placed and determine whether additional moisture is needed to achieve Optimum Moisture Content.

**Step C.** – The Field Superintendent, Compactor Operator(s) and QC Field Inspector will discuss and agree upon the proposed number and sequence of passes and compactive mode to be used for the particular Earthwork being placed.

**Step D.** – The Compactor Operator will compact Control Strip Section #1 following the agreed upon number and sequence of passes and compactive mode.

**Step E.** – After compacting Control Strip Section #1, the Compactor Operator will suspend operation. The QC Inspector will perform Contractor Information Testing (CIT) within Control Strip Section #1 and obtain a minimum of three separate (Random or Non-Random) In-Place Density and Moisture Content readings.

**Step F.** – The Field Superintendent, Compactor Operator and QC Field Inspector will review the In-Place Density and Moisture Content readings for Control Strip Section #1 and determine any necessary adjustment to the number and sequence of passes and compactive mode.

**Step G.** - The Compactor Operator will move on to Control Strip Section #2 and compact the material following the agreed upon number and sequence of passes and compactive mode(s).

**Step H.** – After compacting Control Strip Section #2, the Compactor Operator will suspend operation and permit the QC Inspector to obtain a minimum of three separate random In-Place Density and Moisture Content readings in Control Strip Section #2.



**Step I.** – The CIT results for Control Strip Section #2 will be evaluated by the QC Inspector using Quality Level Analysis (QLA). The QLA must indicate a Percent Within Limits (PWL) of 85% or more for the In-Place Density and Moisture Content as indicated in Section 8.1 below.

**Step J.** – If the PWL for Control Strip Section #2 is 85% or greater, then the number and sequence of passes and compactive mode(s) used in Control Strip Section #2 will be established as the approved "Compaction Pattern" for the remainder of the placement operation on that day.

**Step K.** – If the PWL for Control Strip Section #2 is less than 85%, then Steps F through I above will be repeated on segment #3.

#### 7.4 – Field Quality Control Activities

Field Quality Control (FQC) personnel will perform inspection, sampling, and testing of Earthwork as described below.

##### 7.4.1 – Pre-Placement QC Activities

- ❖ Check Earthwork line and grade for conformance to the design documents.
- ❖ Ensure that all erosion control measures are in place per approved plans and specifications.
- ❖ Ensure that the existing ground has been cleared, grubbed and stripped as specified in Section 101 and 120 of the Standard Specifications, prior to the placing of any Earthwork materials.
- ❖ Verify that all vegetation and other organic material is removed within and immediately adjacent to Earthwork placement location.
- ❖ Determine that excavations have been conducted to suitable founding material and grade.
- ❖ Where Earthwork material is to be placed against existing earth slopes steeper than 1 Vertical:3 Horizontal, ensure that the slope is broken up into steps of random width in order to provide a suitable bond between the existing ground and the new material.

##### 7.4.2 – Placement QC Activities

- ❖ Ensure that Control Strips are constructed at the start of each Earthwork placement operation and as required thereafter per Section 7.3 above.
- ❖ Ensure that stumps, rubbish, sod, or other unsuitable materials are not incorporated in the Earthwork.
- ❖ Ensure that frozen Earthwork materials are not placed and that Earthwork is not placed on material frozen to a depth of over 75 millimeters.
- ❖ Ensure that correct Earthwork material type, per Section 4.1 above, is being delivered/received at the intended placement location.

- ❖ Ensure that Earthwork is placed in successive layers of uniformly distributed material and compacted over the full width of the cross section.
- ❖ Monitor lift placement to ensure that maximum lift thicknesses specified in Section 5.4 above are not exceeded.
- ❖ Ensure that each lift of compacted Earthwork materials is visibly crowned to allow drainage of surface water and rainwater off the surface.
- ❖ Monitor maximum Rock Size and maximum Stone Size in Earthwork materials for conformance with the requirements of Section 5.4 above.
- ❖ Ensure that where Rock Excavate is placed, all voids and interstices are filled with an appropriate clean, granular Earthwork material type identified in Section 4.1 above.
- ❖ Ensure that the placed Earthwork moisture content is near the optimum moisture content established through Source Characterization testing (Section 4.2 above) and through the Control Strip (Section 7.3 above).
- ❖ Ensure that moisture is added when Earthwork material is too dry and that Earthwork which is too wet is dried by disking, harrowing, blading, rotary mixing, or other approved means so that proper compaction can be achieved.
- ❖ Monitor compaction patterns against the approved Control Strip "Compaction Pattern" and perform Contractor Information Testing (CIT) to ensure that the in-place density is near the target (100%) in-place density.
- ❖ Ensure that no rock in excess of 150 millimeters in its largest dimension is incorporated in the top 600-millimeter layer of Earthwork immediately below the finished Subgrade elevation.
- ❖ Perform check measurements during placement of Roadway Embankment Material final Subgrade Course (Special Borrow) in accordance with Section 170.61 of the Standard Specifications to ensure proper depth and elevations of finished Subgrade within +/-15 millimeters.
- ❖ Ensure that Roadway Embankment Material 3 meters or more in height from the elevation of the Subgrade to the original ground elevation is constructed to the elevation of the proposed Subgrade and then allowed to settle for 60 days (or other period as specified by the Design Engineer) before the pavement structure is constructed thereon.
- ❖ Ensure that Embankment Material under Bridge Foundations is placed in embankment prior to driving piles.
- ❖ Determine and document random sampling locations for each Sublot of Earthwork material placed.
- ❖ Obtain and properly label all Field samples of Earthwork materials.
- ❖ Transport Earthwork Field samples to the appropriate laboratory for testing.
- ❖ Perform In-Place QC sampling and testing of Earthwork in accordance with the required test methods and frequencies outlined in Section 5.0 above.
- ❖ Prepare and sign standard Test Report Forms (TRFs) for each test completed.
- ❖ Maintain Control Charts per Section 7.5 below.



- ❖ Document On-Site Earthwork QC inspection activities and findings on standard QC Inspection Report Forms (IRFs) for each On-Site placement location per Section 7.7 below.
- ❖ Identify On-Site Field placement practices or materials which do not conform with the requirements of the relevant specifications and this QC Plan, and discuss appropriate corrective action with the Segment Field Superintendent and the QC Manager.

## 7.5 – Placement Control Charts

Control Charts may be used by ABC Contractors to control placement operations for each of the five Earthwork Item categories as described below.

### 7.5.1 – Control Charts for Backfill Material for Muck Excavation

Since the placement of Backfill Material for Muck Excavation will generally involve smaller Earthwork quantities at sporadic locations, the application of Control Charts as a tool to provide field control for this Earthwork Item will yield limited QC information. Accordingly, Control Charts will not be used for placement of Backfill Material for Muck Excavation.

### 7.5.2 – Control Charts for Roadway Embankment Material

The placement of Roadway Embankment Material will involve large quantities of Earthwork within each Project Segment. Accordingly, Control Charts will be used as a tool to assist in the field control for placement of this Earthwork Item. Control Charts will be maintained for each Lot of Roadway Embankment Material by the QC Field Inspection staff. Control Charts will monitor the In-Place Density and Moisture Content of each Lot. The Mean QC Test results will be plotted according to daily subgrouping.

### 7.5.3 – Control Charts for Embankment Material under Bridge Foundations

The placement of Embankment Material under Bridge Foundations will involve large quantities of Earthwork within each Project Segment. Accordingly, Control Charts will be used as a tool to assist in the field control for placement of this Earthwork Item. Control Charts will be maintained for each Lot of Embankment Material under Bridge Foundations by the QC Field Inspection staff. Control Charts will monitor the In-Place Density and Moisture Content of each Lot. The Mean QC Test results will be plotted according to daily subgrouping.

### 7.5.4 – Control Charts for Backfill Material for Structures

Since the placement of Backfill Material for Structures will generally involve smaller Earthwork quantities at various locations, the application of Control Charts as a tool to provide field control for this Earthwork Item will yield limited QC information. Accordingly, Control Charts will not be used for placement of Backfill Material for Structures.

### 7.5.5 – Control Charts for Backfill Material for Pipes

Since the placement of Backfill Material for and Pipes will generally involve smaller Earthwork quantities at various locations, the application of Control Charts as a tool to provide field control for this Earthwork Item will yield limited QC information. Accordingly, Control Charts will not be used for placement of Backfill Material for Pipes.



An example of the types of Control Charts which will be used for Earthwork placement is contained in **Appendix G**.

### **7.6 – Procedures for Corrective Action of Non-Conforming Materials**

The following procedures will be followed for corrective action of non-specification materials encountered during placement of Earthwork Items:

- ❖ If the Earthwork material delivered/received at the placement location is not the correct Material Type (i.e. Earth Excavate, Ordinary Borrow, Special Borrow, etc.), it will be removed (if placed) and returned to the material source.
- ❖ If the Earthwork material delivered/received at the placement location is determined to be the correct Material Type, but does not meet specification requirements (e.g. gradation), the limits of such material will be determined and it will be removed from the Project. Further receipt and placement of Earthwork material from the source will be suspended until Quality Control personnel have determined and corrected the cause of non-specification material.
- ❖ If new Earthwork material delivered/received at the placement location is commingled with existing On-Site non-specification material (e.g. Organic material, Other), the limits of the commingled area will be determined and the commingled material will be removed and disposed of at an approved Off-Site location.
- ❖ If rock contained in Earthwork material is determined to exceed the specified size limits (e.g. Earth Excavate: <600mm), appropriate equipment will be used to break the rock to conform to the maximum size requirements, or the rock will be removed and disposed of at an approved Off-Site location.
- ❖ If the percentage of rock contained in Earthwork material is determined to exceed the specified limit (e.g. Earth Excavate: <50%), the material will either be spread and blended with other material to conform with requirements or it will be removed.
- ❖ If the lift thickness of Earthwork material is determined to exceed the specified limits, the lift will be cut using appropriate equipment and regraded to conform to the maximum lift thickness requirements.
- ❖ If an individual QC test result for in-place density or in-place moisture content is outside the Engineering Limits contained in Section 8.6 below, placement of Earthwork material in the corresponding Sublot will be stopped. The following steps will be taken:

- A Re-Test within 300mm of the original random test location may be performed only if the cause of the results is believed to be due to sampling/testing error.
- If a Re-Test is not warranted, or if a Re-Test is performed and the test results of the Re-Test are also outside the Engineering Limits, then three (3) additional random QC tests may be performed within the Sublot. The results of the 3 additional random QC tests will be evaluated as follows:
  - ❖ If all three tests are above the Lower Engineering Limit (95%), then the Sublot will be accepted and all of the test results (The original failing result + the 3 passing results) will be included for Quality Level Analysis.
  - ❖ If any one of the 3 additional random QC tests is below the Lower Engineering Limit (95%), then the Sublot will not be accepted. Field QC personnel will troubleshoot to determine if the failing results are due to:
    - Improper compaction procedure
    - Inadequate moisture content
    - Other
  - ❖ Once the cause of the failing test results is determined, appropriate corrective action will be taken (e.g. Add moisture, Regrade and compact. The failing Earthwork material will be reworked and three additional random QC tests will be performed for the Sublot. The results of the 3 additional random QC tests will be evaluated in accordance with the steps above until all 3 additional test results are within the Engineering Limits and the overall Percent Within Limits (PWL) for the Sublot equals or exceeds 85%.
- Earthwork material that cannot be reworked to achieve the specified in-place density and in-place moisture content will be disposed of Off-Site.



### 7.7 – Field QC Inspection Reporting

All FQC inspection activities will be documented on the following standard QC Inspection Report Forms (IRFs):

Form No.	Form Title
FQC-MRIR	Field QC – Material Receiving Inspection Report
FQC-IDR	Field QC – Inspectors Daily Quality Surveillance Report
FQC-EBIR	Field QC – Embankment & Backfill Inspection Report

(\* For Off-Site Earthwork Producer material only)

A copy of the Standard IRFs used for Field QC inspection of Earthwork materials is located in **Appendix H**.



## **APPENDIX A**

### **Example of Project Drawings List: Section 1 - Earthwork**



## **APPENDIX B**

### **Random Sampling Report Forms**



## **APPENDIX C**

### **Standard Test Report Forms for Source Characterization and QC Sampling and Testing of Earthwork Materials**



## **APPENDIX D**

### **Weekly Schedule of Earthwork Materials Production Operations**

## Weekly Schedule of Earthwork Materials Production Operations

Week Beginning: \_\_\_\_\_

Material Type	Material Source	Production Location (STA to STA, Stockpile, Pit, etc.)	Estimated Production Quantity
Ordinary Borrow	<b>Rte 99 On-Site Borrow Pit</b>	Quadrant SC-234	5,000 m <sup>3</sup>
Ordinary Borrow	Rte 99 On-Site Borrow Pit	Quadrant SC-240	<b>4,000 m<sup>3</sup></b>
Ordinary Borrow	Rte 99 On-Site, Segment 1	Rte 99 Median, STA 114+10 to STA 116+50	4,000 m <sup>3</sup>
Ordinary Borrow	Rte 99 On-Site, Segment 1	Rte 99 Median	4,000 m <sup>3</sup>
Ordinary Borrow	Rte 99 On-Site, Segment 1	Rte 99 Median	4,000 m <sup>3</sup>
Ordinary Borrow	Rte 99 On-Site, Segment 1	Rte 99 Median	4,000 m <sup>3</sup>
Ordinary Borrow	Rte 99 On-Site, Segment 1	Rte 99 Median	4,000 m <sup>3</sup>
Rock Excavate	Rte 99 Segment 1, 2, 3	Rte 99 Median, Outboard	2,200 m <sup>3</sup>
Earth Excavate	Rte 99 Segment 1, 2, 3	Rte 99 Median, Outboard	4,000 m <sup>3</sup>
Ordinary Borrow	Borrow Producer (TBD)	Stockpile	6,000 m <sup>3</sup>
Gravel Borrow	Borrow Producer (TBD)	Stockpile	3,000 m <sup>3</sup>



## **APPENDIX E**

### **Standard Inspection Report Forms for Production Quality Control**



## **APPENDIX F**

### **Weekly Schedule of Earthwork Materials Placement Operations**



The weekly schedule of Placement Operations (Appendix F) will identify the following:

- **Project Segment**
- **Placement Location**
- **Maximum Placement Depth**
- **Intended Placement Locations (Roadway, Station Limits)**
- **Material Type(s)**
- **Estimated Placement Quantities**
- **Material Source(s)**



## **APPENDIX G**

### **Control Charts Used for Earthwork Materials Placement**



## **APPENDIX H**

### **Standard Inspection Report Forms for Field Quality Control**

**- END OF APPENDIX F -**

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