



## Recommended Format for Quality Assurance/Quality Control Plans

### Applicable Rules

MSW:	OAC 3745-27-06(C)(9)(c) OAC 3745-27-08
ISW:	OAC 3745-29-06(C)(8)(c) OAC 3745-29-08
RSW:	OAC 3745-30-05(C)(9)(c) OAC 3745-30-07
Tires:	OAC 3745-27-70(C)(8)(a) OAC 3745-27-72

### Purpose

This document contains the recommended narrative outline and a list of recommended specification tables with an example table for the site specific quality assurance/quality control (QA/QC) plans required by the permit-to-install application rules.

### Applicability

This document applies to permit applicants and permit holders of municipal, industrial, and residual solid waste disposal facilities, and scrap tire monocells and monofill disposal facilities.

DSIWM recommends using this narrative outline and these specification tables when submitting landfill permit applications or alteration requests.

### Background

During meetings to discuss proposed changes to Ohio solid waste regulations, Ohio solid waste industry representatives requested that Ohio EPA publish a standardized recommended format for QA/QC plans.

The rules require that the QA/QC plan address the following:

- i. Surveying.
- ii. Calibration of testing equipment.
- iii. Sampling and testing procedures to be used in the field and in the laboratory, including but not limited to the following:
  - a. Testing required by the design and construction rules.
  - b. Testing required due to design requirements that must be met.
  - c. Voluntary testing.

Procedures shall establish testing frequency, parameters, and sample locations.

- iv. Procedures to be followed if a test fails.

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<sup>1</sup> Note: This document was originally published on the date noted above. DMWM re-issued the document to make it consistent with current formatting and publication standards after evaluating the content and determining it is still relevant and appropriate. No substantive changes were made to the document.

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The purpose of a QA/QC plan is to identify the testing methods that will be used to document that acceptable materials and construction procedures are used during the construction of engineered components of a landfill facility. The rules provide many material specifications, performance standards and testing requirements (including methods, frequency and parameters). Also, during the design process, site specific material and construction specifications and additional testing requirements may be detailed in the permit application.

### Procedure

DSIWM recommends using the following table of contents, list of ASTM test methods, and example table when developing a permit application or when altering existing permits. The following table of contents for the chapters and tables of the QA/QC plan generally follows the organizational format of the rules addressing landfill facility permit applications and facility construction. This document also includes two appendices. Appendix I is a list of ASTM tests required by the landfill facility construction rules. Appendix II is an example table that can aid applicants in table formatting. The use of the same chapter and table numbers, titles and formatting is strongly encouraged, since it will enable a more efficient and consistent review.

The italicized chapters in the table of contents are items not required by the permit application rules. Although there is no regulatory requirement to include this information in the QA/QC plan, including the information will aid the owner or operator in complying with construction certification requirements and will aid DSIWM reviewers in understanding what is proposed by the applicant. Examples of approved plans that have included the aforementioned information are available for review at any Ohio EPA district office upon request.

Please be aware that paragraph (B)(2) of the operational criteria rules requires the owner or operator to conduct all construction and operation at a sanitary landfill facility in strict compliance with the applicable authorizing document(s). The inclusion of exacting details in the QA/QC plan that are subject to frequent change will result in the QA/QC plan needing frequent alterations. Therefore, inclusion of such exacting details is not recommended.

If an engineered component is not included in a facility's design, that table or portion of the QA/QC plan should be marked "not applicable."

### Contact

If you have questions regarding this document or would like additional information, please contact:

Central District Office DMWM Supervisor (614) 728-3778

Northeast District Office DMWM Supervisor (330) 963-1200

Northwest District Office DMWM Supervisor (419) 352-8461

Southeast District Office DMWM Supervisor (740) 385-8501

Southwest District Office DMWM Supervisor (937) 285-6357

Central Office Authorizing Actions and Engineering Unit (614) 644-2621

### Disclaimer

This document is intended for guidance purposes only. Completion of the activities and procedures outlined in this document shall not release an owner or operator from any requirement or obligation for complying with Ohio Revised Code (ORC) Chapter 3734 (or 3714 if appropriate), the OAC rules adopted thereunder, or any authorizing documents or orders issued thereunder, nor shall it prevent Ohio EPA from pursuing enforcement actions to require compliance with ORC Chapter 3734 (or 3714), the OAC rules, or any authorizing documents or orders issued thereunder.

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<b>Quality Assurance/Quality Control Plan</b>	
<b>Example Table of Contents</b>	
Section	Description of Contents
1.0 <i>Personnel and Qualifications</i>	Description of the experience, training, responsibilities in decision making, and other qualifications of the personnel that provide construction oversight and conduct testing (e.g. designer, manufacturer, earthwork contractor, geosynthetic installer, and soil quality assurance consultant).
2.0 <i>Record Retention Procedures</i>	Description of the minimum types of records that will be kept and maintained, including location and retention time. Some examples of types of records that should be kept are calibration records, laboratory testing records, daily construction logs, and geosynthetic installer logs.
3.0 <i>Sample Archiving</i>	Description of the minimum types of samples (e.g. soil, geosynthetic, GCL) that will be kept and maintained, including location and retention time.
4.0 <i>Construction Procedures</i>	Description of any site specific construction techniques.
5.0 Table (Component numbering comes directly from OAC 3745-27-08(D). A facility may not use all the components listed below. If a component is not used, please state or indicate (NA) in the table of contents.)	
5.01	Survey Marks.
5.02	Surface Water Control Structures.
5.03	Sedimentation Ponds.
5.04	Permanent Ground Water Control Structures.
5.05	In-situ Foundation.
5.06	Structural Fill.
5.07	Added Geologic Material.
5.08	Recompacted Soil Liners.
5.09	Geosynthetic Clay Liners.
5.10	Flexible Membrane Liners.
5.11	Liner Cushion Layer.
5.12	Leachate Collection Layer.
5.13	Leachate Collection Pipes.
5.14	Filter Layers.
5.15	Sumps.
5.16	Leachate Conveyance Apparatus.
5.17	Leachate Storage Tanks.
5.18	Access Roads.
5.19	Transitional Covers.
5.20	Explosive Gas Collection System.
5.21	Cap Soil Barrier Layers.
5.22	Engineered Subbases.
5.23	Cap Geosynthetic Clay Liners.
5.24	Cap Flexible Membrane Liners.

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5.25	Cap Drainage Layers.
5.26	Cap Protection Layers.
5.27	Explosive Gas Control Systems.
5.28	Other Optional Engineering Components

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## Appendix I

### ASTM tests required in OAC 3745 Construction Rules

#### 1. PARAGRAPH (D)(5) "IN-SITU FOUNDATIONS"

ASTM D3080-98	Direct Shear Test
ASTM D4767-95	Consolidated Undrained Triaxial Compression Test
ASTM D6467-99	Torsional Ring Shear Test
ASTM D2850-95	Unconsolidated Undrained Triaxial Compression Test

#### 2. PARAGRAPH (D)(6) "STRUCTURAL FILL"

ASTM D698-00a	Standard Proctor Test
ASTM D1557-00	Modified Proctor Test
ASTM D2922-01	Nuclear Density Test
ASTM D3017-01	Nuclear Moisture Test
ASTM D1556-00	Sand Cone Density Test
ASTM D2167-94	Rubber Balloon Density Test

#### 3. PARAGRAPH (D)(7) "ADDED GEOLOGIC MATERIAL"

ASTM D698-00a	Standard Proctor Test
ASTM D1557-00	Modified Proctor Test
ASTM D5084-00e1	Falling Head Permeameter Test
ASTM D422-63	Sieve and Hydrometer Test
ASTM D2922-01	Nuclear Density Test
ASTM D3017-01	Nuclear Moisture Test
ASTM D1556-00	Sand Cone Density Test
ASTM D2167-94	Rubber Balloon Density Test

#### 4. PARAGRAPH (D)(8) "RECOMPACTED SOIL LINERS"

ASTM D698-00a	Standard Proctor Test
ASTM D1557-00	Modified Proctor Test
ASTM D422-63	Sieve and Hydrometer Test
ASTM D4318-00	Atterburg Limits
ASTM D5084-00e1	Falling Head Permeameter Test
ASTM D2922-01	Nuclear Density Test
ASTM D3017-01	Nuclear Moisture Test
ASTM D1556-00	Sand Cone Density Test
ASTM D2167-94	Rubber Balloon Density Test

#### 5. PARAGRAPH (D)(9) "GEOSYNTHETIC CLAY LINERS"

ASTM D6243-98	Direct Shear Test
ASTM D5993-99	Dry Bentonite Mass Test

#### 6. PARAGRAPH (D)(12) "LEACHATE COLLECTION LAYER"

ASTM D2434-68	Constant Head Permeameter
ASTM D422-63	Sieve and Hydrometer Test
ASTM D3042-97	Carbonate Content Test
ASTM D4716-01	Transmissivity of Geosynthetic Drainage Net Test

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## **7. PARAGRAPH (D)(21) "CAP SOIL BARRIER LAYERS"**

ASTM D698-00a	Standard Proctor Test
ASTM D1557-00	Modified Proctor Test
ASTM D422-63	Sieve and Hydrometer Test
ASTM D5084-00e1	Falling Head Permeameter Test
ASTM D2922-01	Nuclear Density Test
ASTM D3017-01	Nuclear Moisture Test
ASTM D1556-00	Sand Cone Density Test
ASTM D2167-94	Rubber Balloon Density Test

## **8. PARAGRAPH (D)(22) "ENGINEERED SUBBASES IN CAP IF A GCL IS USED"**

ASTM D698-00a	Standard Proctor Test
ASTM D1557-00	Modified Proctor Test
ASTM D2922-01	Nuclear Density Test
ASTM D3017-01	Nuclear Moisture Test
ASTM D1556-00	Sand Cone Density Test
ASTM D2167-94	Rubber Balloon Density Test

## **9. PARAGRAPH (D)(25) "CAP DRAINAGE LAYERS"**

ASTM D2434-68	Constant Head Permeameter
ASTM D422-63	Sieve and Hydrometer Test
ASTM D3042-97	Carbonate Content Test
ASTM D4716-01	Transmissivity of Geosynthetic Drainage Net Test

## **10. PARAGRAPH (E) "TEST PAD CONSTRUCTION AND CERTIFICATION"**

ASTM D698-00a	Standard Proctor Test
ASTM D1557-00	Modified Proctor Test
ASTM D422-63	Sieve and Hydrometer Test
ASTM D4318-00	Atterburg Limits
ASTM D2922-01	Nuclear Density Test
ASTM D3017-01	Nuclear Moisture Test
ASTM D1556-00	Sand Cone Density Test
ASTM D2167-94	Rubber Balloon Density Test
ASTM D6391-99	Two Stage Borehole Test
ASTM D3385-94	Double Ring Infiltrometer Test
ASTM D5093-90	Sealed Double Ring Infiltrometer

## **11. PARAGRAPH (G) "PRE-CONSTRUCTION INTERFACE TESTING AND REPORTING"**

ASTM D5321-92	Direct Shear Test
ASTM D6243-98	GCL Direct Shear Test

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**Appendix II**

**Example Table\***

\* This example table includes tests and specifications not established in rule. These are italicized.

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5.08 Composite Liner System Recompacted Soil Liner (RSL)				
Test <sup>i</sup>	Frequency & Timing	Acceptance Parameters	Sample Location	Procedures to Follow if Failed Test
Sieve and Hydrometer Analysis (ASTM D422)	Every 1,500 cu. yd. of borrow material. Submit 7 days prior to use	Correlation with test pad results plus 100% <2-inch and 90% < 3/4-inch.	1,500 cu. yd. borrow source subset	Reject inappropriate material.
Unified Soil Classification (ASTM D2487)	Every 1,500 cu. yd. of borrow material. Submit 7 days prior to use	Correlation with test pad results.	1,500 cu. yd. borrow source subset	Reject inappropriate material.
Atterberg Limits (ASTM D4318)	Every 1,500 cu. yd. of borrow material. Submit 7 days prior to use	Correlation with test pad results.	1,500 cu. yd. borrow source subset	Reject inappropriate material.
Density/Moisture Relationship (ASTM D698 or D1557)	Every 1,500 cu. yd. of borrow material. Submit 7 days prior to use	Correlation with test pad results.	1,500 cu. yd. borrow source subset	Reject inappropriate material.
Permeability: Flexible Wall Permeameter (ASTM 5084)	Every 10,000 cu. yd. of borrow material. Submit 7 days prior to use	Permeability < $1 \times 10^{-7}$ cm/sec.	1,500 cu. yd. borrow source subset	Reject inappropriate material.
Consolidated-Undrained Triaxial Compression test with pore water pressure measurements (ASTM D4767) <sup>ii</sup>	Twice per soil type. Submit 14 days prior to use (with test pad certification)	Correlation with Permit <sup>iii</sup>	Shelby tube samples from test pad	Reject borrow source.
Survey to confirm bottom of RSL	100 ft grid plus grade breaks and other critical locations such as bottom of sump and along leachate lines	> elevation in the approved permit and appropriate grade is maintained	Bottom of RSL	Fill with appropriate fill material and resurvey.
Clod size	General construction observation	<3 inch or half lift thickness, whichever is less	Placed material	Process to eliminate clods, add water if necessary.
<i>Borrow soil tracking</i>	<i>Continuous</i>	<i>Correlation with qualified borrow source subset (QA/QC personnel shall know the source of borrow material at all times)</i>	<i>Placed material</i>	<i>Confirm borrow source and remove placed material if necessary.</i>



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<i>Visual Classification</i>	<i>Continuous</i>	<i>Correlation (color, texture, compactibility) with qualified soil</i>	<i>Placed material</i>	<i>Confirm borrow source and or perform one point compaction test to confirm correlation with known non-crossing family of proctor curves. If unable to pass, reject material.</i>
Free of unacceptable material	General construction observation	No stone > 2 inch per acre, no solid waste, debris, foreign material or deleterious material	Placed material	Reject stockpile and remove unacceptable material or implement unacceptable material picking for the rest of phase or subphase construction.
Counting number of passes per lift	General construction observation	Correlation with test pad construction details	Placed material	Compact area with additional passes until the appropriate number of passes is made.
Density (ASTM D2922)	5 tests per acre/lift	Be compacted to at least 95% of the maximum dry density as determined by ASTM D698-00a (Standard proctor) or at least 90% of the maximum dry density as determined by ASTM D1557-00 (Modified proctor) or as modified by test pad results.	Placed material	Disc if material is too wet, (re)compact and retest. If unable to pass, remove material.
Moisture Content (ASTM D3017)	5 tests per acre/lift	Minimum soil Moisture content that shall not be less than the optimum moisture and not more than +4% of optimum moisture content or as modified by test pad results.	Placed material	Process and add water or dry out as necessary, recompact and retest.

<sup>i</sup> Calibration of testing equipment is required. The owner or operator should confirm equipment is calibrated per ASTM method procedures and retain the information in accordance with any stated record retention procedures.

<sup>ii</sup> Test specimens shall be prepared at minimum density and maximum moisture content allowed during construction. The test shall be run after approximately 100% saturation is reached. The samples shall be sheared until 20% axial strain is achieved. Failure shall be considered the maximum principal stress difference  $\Delta\sigma_f = (\sigma_1 - \sigma_3)_f$  if a

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peak maximum principal stress difference occurs. If a peak maximum principal stress difference does not occur, the maximum effective principal stress ratio ( $\sigma'_1 / \sigma'_3$ ) shall be used to determine the point of failure.

With the limited number of tests performed, the use of a statistical method or an unconservative approximation to determine the typical shear strength of the recompacted soil liner will not be used. The lowest representative shear strength for the recompacted soil liner will be considered the shear strength of the soil.

<sup>iii</sup> All Consolidated-Undrained Triaxial compression tests (ASTM D4767-95) shall plot on or above the line established by the shear strengths in the following table.

Effective normal stress (psi) <small>Listed for example purposes only</small>	Minimum Shear strength (psi)
5	Correlation with permit*
10	Correlation with permit*
20	Correlation with permit*
90	Correlation with permit*

\*These values should be included in the QA/QC tables but were left out of the guidance in order to avoid designers putting in non-site specific specifications.