Benefits of Early Landfill Survey Control

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Landfill Survey Control Measures/Practices

• Permanent on-site benchmarks
• As-built surveys of constructed landfill components
• Periodic surveys of landfill development
Permanent On-site Benchmarks

• There must be installed on-site a permanent benchmark (e.g., a concrete marker) of known elevation (0400-11-01-04(2))

• Engineering Plans must show the location(s) of the permanent on-site benchmark(s), with reference to Tennessee datum (0400-11-01.04(9))

• A common, consistent network of physical monuments that are the basis for the horizontal and vertical location measurements at the facility.
As-Built Surveys

• Required prior to TDEC authorization of waste placement in newly constructed landfill cell

• Conducted during landfill construction quality assurance (CQA) monitoring

• As-built surveys should include:
  • Elevations of landfill liner system components (e.g., geologic buffer, clay liner, geomembrane liner, etc.)
  • Edge of lined/waste disposal areas
  • Liner anchors
  • Landfill sump/manhole locations
  • Leachate collection system pipes
Periodic Surveys

Rule 0400-11-01-.02:

11. Periodic Survey of Disposal Facility

(i) Within 60 days of his receipt of the written request of the Commissioner to do so, the permittee shall cause to be conducted a survey of active and/or closed portions of his facility in order to determine if operations (e.g., cut and fill boundaries, grades) are being conducted in accordance with the approved design and operational plans. The permittee must report the results of such survey to the Commissioner within 90 days of his receipt of the Commissioner’s request.

(ii) The Commissioner may request such a survey:

(I) If he has reason to believe that operations are being conducted in a manner that significantly deviates from the approved plans; and/or

(II) As a periodic verification (but no more than annually) that operations are being conducted in accordance with the approved plans.

(iii) Any survey performed pursuant to this part must be performed by a qualified land surveyor duly authorized under Tennessee law to conduct such activities.
Example

- Landfill cell in operation since 2006
- 2017 DSWM inspection – landfill slopes exceeding the permitted slope and elevations provided in the landfill permit documents.
- V2 violation issued (Operation does not correspond to Engineering Plans), topographic survey requested.
- Corrective Action Plan prepared and submitted to DSWM to address the over built slopes.
- Approximately 25,000 cubic yards (cy) of cover soil and landfilled waste were excavated and relocated during corrective action construction.
Example Landfill Cross-Section

- Constructed Landfill Slope
- Permitted Landfill Cover Slope
Completed Construction

Inside Edge of Berm Marker
Project Cost Summary

<table>
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<tr>
<th>Item</th>
<th>Total Cost</th>
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<tbody>
<tr>
<td>Topographic Landfill Survey</td>
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<td>Waste Excavation &amp; Relocation</td>
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<td>As-Built Survey</td>
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<td>Total Project Cost</td>
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2006 to 2017 – 9 years of operation

Assume annual period survey cost of $5,000
(9 years)($5,000/year) = $45,000

Cost Savings = $121,500 - $45,000 = $76,500
Conclusions

• Greater upfront operating costs associated with periodic surveys when compared to the alternative (no surveying).

• Periodic surveys help avoid overbuilt landfill areas.

• Reduce the need to relocate landfilled waste and the potential for eroding/unstable landfill slopes.

• Lower construction costs at closure by reducing amount of grading during final cover construction.

• Excellent tool for tracking airspace and cover soil consumption.

• Accurate vertical and horizontal information of key landfill components can be vital when dealing with landfill management issues.
Survey Early & Survey Often
Stages of Control

• Establish Control
  • Waste-in... Waste-out...

• Protect Control
  • Types of monuments used, while important, is not as critical as steps taken to protect them.
  • When GPS is primary tool, off-site is better.

• Utilize Control
  • Measure twice. Cut once!
Establish & Protect Control
On-Site Control Datum

• Local Datum (Assumed – Not based on accepted standard)
  • If all monuments are damaged or destroyed, reliance on previous as-built data on improvements must be used.

• Tennessee State Plane Coordinate System of 1983 (Horizontal) & North American Vertical Datum of 1988 (Vertical)
  • If all monuments are damaged or destroyed, may be reestablished by independent GPS survey.

• If on Local Datum, consider updated survey on SPCS with datum shift noted
Permanent Monuments
## U.S. SURVEY FEET

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Utilize Control
On-Site Control Datum

• Conduct Periodic Surveys to verify elevations of waste
  • Avoids costly mistakes such as overfilling cell.
  • sUAS (drone) surveys are efficient, safe and accurate options

• Request staking of Top of Waste with cut/fill to assess remaining airspace
  • Provides clear, on-the-ground, information to operators

• Consider it regular maintenance similar to servicing your heavy equipment.
Questions?