University Transportation Research Center - Region 2

The Region 2 University Transportation Research Center (UTRC) is one of ten original University Transportation Centers established in 1987 by the U.S. Congress. These Centers were established with the recognition that transportation plays a key role in the nation’s economy and the quality of life of its citizens. University faculty members provide a critical link in resolving our national and regional transportation problems while training the professionals who address our transportation systems and their customers on a daily basis.

The UTRC was established in order to support research, education and the transfer of technology in the field of transportation. The theme of the Center is “Planning and Managing Regional Transportation Systems in a Changing World.” Presently, under the direction of Dr. Camille Kamga, the UTRC represents USDOT Region II, including New York, New Jersey, Puerto Rico and the U.S. Virgin Islands. Functioning as a consortium of twelve major Universities throughout the region, UTRC is located at the CUNY Institute for Transportation Systems at The City College of New York, the lead institution of the consortium. The Center, through its consortium, an Agency-Industry Council and its Director and Staff, supports research, education, and technology transfer under its theme. UTRC’s three main goals are:

Research

The research program objectives are (1) to develop a theme based transportation research program that is responsive to the needs of regional transportation organizations and stakeholders; and (2) to conduct that program in cooperation with the partners. The program includes both studies that are identified with research partners of projects targeted to the theme, and targeted, short-term projects. The program develops competitive proposals, which are evaluated to insure the most responsive UTRC team conducts the work. The research program is responsive to the UTRC theme: “Planning and Managing Regional Transportation Systems in a Changing World.” The complex transportation system of transit and infrastructure, and the rapidly changing environment impacts the nation’s largest city and metropolitan area. The New York/New Jersey Metropolitan has over 19 million people, 600,000 businesses and 9 million workers. The Region’s intermodal and multimodal systems must serve all customers and stakeholders within the region and globally. Under the current grant, the new research projects and the ongoing research projects concentrate the program efforts on the categories of Transportation Systems Performance and Information Infrastructure to provide needed services to the New Jersey Department of Transportation, New York City Department of Transportation, New York Metropolitan Transportation Council, New York State Department of Transportation, and the New York State Energy and Research Development Authority and others, all while enhancing the center’s theme.

Education and Workforce Development

The modern professional must combine the technical skills of engineering and planning with knowledge of economics, environmental science, management, finance, and law as well as negotiation skills, psychology and sociology. And she/he must be computer literate, wired to the web, and knowledgeable about advances in information technology. UTRC’s education and training efforts provide a multidisciplinary program of course work and experiential learning to train students and provide advanced training or retraining of practitioners to plan and manage regional transportation systems. UTRC must meet the need to educate the undergraduate and graduate student with a foundation of transportation fundamentals that allows for solving complex problems in a world much more dynamic than even a decade ago. Simultaneously, the demand for continuing education is growing – either because of professional license requirements or because the workplace demands it – and provides the opportunity to combine State of Practice education with tailored ways of delivering content.

Technology Transfer

UTRC’s Technology Transfer Program goes beyond what might be considered “traditional” technology transfer activities. Its main objectives are (1) to increase the awareness and level of information concerning transportation issues facing Region 2; (2) to improve the knowledge base and approach to problem solving of the region’s transportation workforce, from those operating the systems to those at the most senior level of managing the system; and by doing so, to improve the overall professional capability of the transportation workforce; (3) to stimulate discussion and debate concerning the integration of new technologies into our culture, our work and our transportation systems; (4) to provide the more traditional but extremely important job of disseminating research and project reports, studies, analysis and use of tools to the education, research and practicing community both nationally and internationally; and (5) to provide unbiased information and testimony to decision-makers concerning regional transportation issues consistent with the UTRC theme.

Project No(s): 49997-18-24 & 75144-03-24

Project Date: August 2014

Project Title: Landfill Closure with Dredged Materials - Desktop Analysis

Project’s Website: http://utrc2.org/research/projects/landfill-closure-dredged-materials

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Membership as of January 2014
Landfill Closure with Dredged Materials - Desktop Analysis

FINAL REPORT
September 2014

Submitted by:

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In cooperation with

New Jersey
Department of Transportation
Bureau of Research
And
U.S. Department of Transportation
Federal Highway Administration
DISCLAIMER STATEMENT

The contents of this report reflect the views of the authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the New Jersey Department of Transportation or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.
This report describes a Rutgers University project for the New Jersey Department of Transportation (NJDOT) designed to analyze the potential for closure of New Jersey landfills using dredge material from existing Confined Disposal Facilities (CDF). The project included an update of the existing New Jersey Department of Environmental Protection (NJDEP) landfill database, the development of a rating system to identify sites with the highest potential to utilize dredged material for their closure, and the identification and preliminary investigation of the top five candidate landfills based on this rating system. Due to information developed during the project it was determined that all but four of the landfills assessed for closure were considered unsuitable for closure as a result only four landfills were selected and investigated further. The results of this project can be used by the NJDOT to facilitate the efficient closure of selected landfills, the beneficial reuse of the materials in CDFs, and the continued use of the state's CDFs and dredging activities.

**Key Words**

Confined Dredge Facilities, Landfill Closure, Dredged Sediment
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EXECUTIVE SUMMARY

The New Jersey Department of Transportation (NJDOT) has identified many confined disposal facilities (CDFs) as at or near capacity with dredged materials. Periodic dredging of channels and marinas is of significant importance to New Jersey’s recreational and commercial marine transportation. Establishment of new CDFs has been deemed improbable, thus the most efficient solution to this problem is reuse of dredged materials to increase the longevity of existing CDFs. Rutgers University was contracted to investigate the potential for utilizing dredged material from these CDFs in the closure of New Jersey’s uncapped landfills.

The investigation involved the update of the New Jersey Department of Environmental Protection’s (NJDEP) existing landfill database to fill existing data gaps. Next, a numerical rating system was established to evaluate landfill/CDF pairs for potential closure of the landfill with dredged materials. The pairs with the greatest potential for closure were identified in collaboration with personnel from the NJDOT Office of Maritime Resources and the NJDEP Solid and Hazardous Waste Management Program. Phase I Environmental Site Assessments were then conducted for the selected landfills to determine their suitability for closure.

The project yielded several results, including the following:
- The NJDEP landfill database was updated and converted to GIS form.
- A ranking system was developed to identify landfill/CDF pairs with the greatest potential for closure.
- The ranking system was applied to the database and the top landfill/CDF pairs were identified.
- Phase I Environmental Assessments were completed for the selected landfills.

Due to the post-ranking identification of several of the highly ranked landfills as previously closed, redeveloped, or undergoing an active site remediation, as well as a shift in the NJDOT Office of Maritime Resources’ CDF priorities following Hurricane Sandy, the four landfills ultimately selected for Phase I Assessment were not among the most highly ranked pairs. These landfills were the Tinton Falls Municipal Sanitary Landfall in Tinton Falls, Monmouth County; Winzinger Landfill in Hainesport, Burlington County; Elsinboro Township Sanitary Landfill in Elsinboro, Salem County; and Filmore Sanitary Landfill in Middle Township, Cape May County. Personnel from T&M Associates and a team of undergraduate Rutgers University BioEnvironmental Engineering students conducted the Phase I Environmental Site Assessments for these four landfills.
BACKGROUND

Confined disposal facilities (CDFs) are facilities that accept and store dredged materials. CDFs are located throughout the coastal areas of New Jersey and are traditionally within a relatively short distance of the channels and marinas that require periodic dredging. The New Jersey Department of Transportation (NJDOT) has recently inventoried and sampled the existing CDFs and has determined that many are at or near capacity. The creation of new CDFs is unlikely due to high land prices in coastal regions of New Jersey and the environmental issues inherent with dredged material. A potential solution to this lack of storage space is to remove and reuse the dredged material for some beneficial use. Without reuse of at least portion of the dredged material, there is a potential for the reduction of dredging activities, which would negatively affect New Jersey's marine transportation of both recreational and commercial vessels.

The NJDOT has identified landfill closure with dredged material as a beneficial use option for the material stored in CDFs. Prior to this effort, the New Jersey Department of Environmental Protection (NJDEP) landfill database identified over 90% of the landfills in New Jersey's Cape May, Atlantic, Burlington, Ocean, and Monmouth Counties that stopped operating prior to 1982 as having not been officially closed. There is a potential to utilize significant amounts of dredged material in the capping of these landfills to aid in the viability of the CDFs.

OBJECTIVES

This project was completed to identify the best candidate pre-1982 landfills for closure with dredged material stored in CDFs. The project’s objectives were defined as:

- Identification of existing pre-1982 landfills requiring closure in the southern half of the state that are potential candidates for closure with dredged material.

- Development of a rating system of potential landfill sites with the assistance and guidance of the NJDOT and NJDEP.

- Identification of landfills with the highest potential for closure with dredged materials via rating system.

- Investigation of the suitability for closure of identified landfills via Phase I Environmental Site Assessments.
INTRODUCTION

The project team utilized the existing NJDEP Bureau of Solid & Hazardous Waste and Permitting database to identify pre-1982 landfills that required closure in Cape May, Atlantic, Burlington, Ocean, and Monmouth Counties. This database contained several data gaps at the beginning of the project. In cooperation with the NJDEP and local government officials, the database has been updated to close data gaps. In addition, a landfill database shape file was developed in ArcGIS to geo-locate each of the landfills. The attribute table from the database containing all of the pertinent data for each landfill is tied to the locations.

Using the updated landfill database, the guidance of the NJDOT and NJDEP, and the analysis of material transport parameters, a rating system was created to analyze the characteristics of landfills and nearby CDFs. This rating system was used to prioritize landfills with the highest potential for closure with dredged materials. Parameters were identified that impacted closure activities. Each parameter in this rating system was appropriately weighted in order to reach the desired goals of the department. Once the rating system was developed and accepted by the NJDEP and NJDOT personnel, it was applied to the landfill database. The rating system identified landfill/CDF pairs that represented the highest potential for closure. However, further investigation of the identified landfill sites indicated that several of them were either redeveloped, undergoing site remediation, or otherwise not available for closure. As a result, the project team selected the four highest rated landfill/CDF pairs for further investigation via Phase I Environmental Site Investigations.

The four selected landfills were the Tinton Falls Municipal Sanitary Landfall in Tinton Falls, Monmouth County; Winzinger Landfill in Hainesport, Burlington County; Elsinboro Township Sanitary Landfill in Elsinboro, Salem County; and Filmore Sanitary Landfill in Middle Township, Cape May County. Each of these landfills was investigated by personnel from T&M Associates and a team of undergraduate Bio-Environmental Engineering students from Rutgers University. These Phase I Investigations have been conducted in accordance with the New Jersey Department of Environmental Protection (NJDEP) Preliminary Assessment procedure specified at NJAC 7:26E, 3.1, and 3.2.

SUMMARY OF LITERATURE REVIEW

Review/Update of Existing NJDEP Landfill Database

The project team used the existing NJDEP Landfill Database from August 2011 to identify candidate landfills for potential closure with CDF material. Only those landfills that ceased operation prior to 1982 were included in the analysis as directed by NJDOT guidance. The database contains several fields with pertinent information about the landfill. In several cases much of this data was incomplete or completely missing,
especially details regarding location. The project team then conducted a records search to obtain the missing data and to spatially delineate the landfills. The records search included review of the following sources:

- Public tax records subdivision maps.
- Exhaustive internet searches for government site reports, municipal meeting minutes, news articles, etc.
- Visits to county environmental health offices to speak with local solid waste experts and environmental health officers, including:
  - Atlantic County Division of Public Health.
  - Cape May County Municipal Utilities Authority.
  - Gloucester County Division of Environmental Services.
- Landfill history expertise provided by Mr. Bashar Assadi.
- Aerial photography.

At the onset of this project, 387 landfills were identified in the focus area (Monmouth County and areas south). Prior to our records search only 142 of these had Block/Lot information. After the records search this number increased to 279 landfills. In addition, four new fields were added to those in the existing landfill database through the records search. These include:

- Year operation ceased
- Acreage
- Waste type
- Ownership

Once the spatial extent of each landfill was determined, a shapefile was developed in ArcGIS of each delineated landfill. Each parameter included in the database was included in the attributes for each delineated landfill. A digital version of the database is included on a CD-ROM as appendix A.

![Figure 1. Landfill delineation shapefile polygons (a) Delilah Road Landfill, Atlantic County, (b) Waste Disposal Inc./Aero Marine Landfill, Monmouth County](image)
A total of 243 landfill polygons were developed during the project. (See figure 2.) Each polygon has corresponding data in its attribute table corresponding to the fields in the appended landfill database. These fields are:

- Estimated quantity of material needed for closure.
- Proximity to CDFs appropriate for providing material for closure.
- Landfill size.
- Demand for fill in addition to cover.
- Degree of contamination per NJDEP data base.
- Proximity to major highways, ports and waterways.
- Proximity to power facility or electric grid.
- Owner(s) willingness to close landfill.
- Costs.
- Site conditions.
- Potential site redevelopment.
- Environmental habitat concerns using LANDSCAPE.
- Possible remediation action required.
SUMMARY OF WORK PERFORMED

In order to assess the potential success of closure of a landfill with material from a CDF, the characteristics of material transport between the landfills and CDFs are required in addition to the characteristics of the landfills and CDFs. Thus landfill/CDF pairs were identified. This was completed by analyzing the surrounding road network and determining the three closest CDFs to each landfill. This analysis was completed using the existing CDF database developed by the Richard Stockton College, Coastal Research Center for the NJDOT (Farrell et al., 2009), the existing New Jersey GIS road...
The characteristics of three landfill/CDF pairs for each pre-1982 landfill were then compiled for the ranking system. The ranking system that was developed for this project required a numerical score for each assessed parameter. These scores were normalized and weighted according to the relative importance of the parameter. An aggregate score was then compiled to determine the landfill/CDF pair that represented the highest potential for successful closure with dredged material. The weighting factors for each parameter were determined in cooperation with the NJDOT Office of Maritime Resources, the NJDEP Solid and Hazardous Waste Management Program and NJDEP Site Remediation Program, and the project team. The parameters that were decided upon for the final ranking system were:

- CDF Ownership (Public or Private)
- Landfill Ownership (Public or Private)
- Volume of CDF greater than required to cover landfill (Y/N)
- Aggregate Distance Score
- Average Landfill Slope Score
- Distance to Residential Development
- Clearing Type (Trees, Brush, None)
- CDF Area in acres (<5 = 0.1, 5 < n < 22 = 0.5, >22 = 1)
- Landfill Area in acres (Normalized to second largest to avoid skewing by outlier)
- Landfill Topography Standard Deviation
- At Capacity (Yes=1, No=0.1, Could be with work = 0.5)
- CDF within 3 miles of channel

The first two parameters involved ownership of the CDFs and landfills. It was decided that publicly owned facilities were far superior to privately owned facilities with respect to accessibility and funding methods. As a result, publicly owned facilities were given a score of 1 and privately owned facilities were given a score of 0.1. The third parameter involved the ability of a CDF to provide enough material to close the landfill. The use of a single CDF of higher capacity would be advantageous due to the avoided added costs associated with establishing more than one transfer operation for a single landfill. This benefit was viewed as limited, however, thus the score of 1 was given to a CDF that contained sufficient material to cover a target landfill and 0.8 to one that was not. These first three scores were used to create an operational multiplier, M. All landfill/CDF pairs were analyzed with and without the multiplier in order to determine rank based solely on the physical properties, and with the anticipated operational limitations imposed via these parameters.

The remaining parameters were obtained via overlays created from the identified attributes in GIS. The values determined for each parameter were then normalized to a
score from 1 to 0 with the most favorable score being 1 and the least favorable being 0. For example the landfill/CDF pair that had the least distance between them scored a one and the greatest scored a zero. Certain parameters were identified that skewed the data towards certain CDFs. It was determined that categorical scores would be more appropriate so CDF Area was scored using three categories (<5 = 0.1, 5 < n < 22 = 0.5, >22 = 1) and the percent-filled capacity of the CDF was also scored using three categories (Yes = 0.1, N = 1, Could be with work = 0.5). The weights determined for these parameters were:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Weight</th>
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<tr>
<td>Aggregate Distance Score</td>
<td>8</td>
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<tr>
<td>Average Landfill Slope Score</td>
<td>2</td>
</tr>
<tr>
<td>Distance to Residential Development</td>
<td>4</td>
</tr>
<tr>
<td>Clearing Type</td>
<td>6</td>
</tr>
<tr>
<td>CDF Area</td>
<td>7</td>
</tr>
<tr>
<td>Landfill Area (Normalized to second largest to avoid skewing by outlier)</td>
<td>7</td>
</tr>
<tr>
<td>Landfill Topography Standard Deviation</td>
<td>4</td>
</tr>
<tr>
<td>At Capacity</td>
<td>7</td>
</tr>
<tr>
<td>Within 3 miles of channel</td>
<td>7</td>
</tr>
</tbody>
</table>

The aggregate distance score was determined using a weighting procedure that favored major roads (State or interstate roads, identified as Road I) over local roads (identified as Road II). This was quantified using a weight for Road II that was twice that of Road I, thus one mile on a local road was the equivalent of two on a major road.

\[
\text{Distance Score} = (1.0)\text{Dist}_{\text{Road I}} + (2.0)\text{Dist}_{\text{Road II}}
\]  

(1)

Once all of the parameters were normalized and the weighting factors determined, a total score of a landfill/CDF pair was determined as the aggregate of all parameters adjusted by their weights.

\[
\text{Total Score}_i = M_i \cdot \sum_{all\ j} W_j \cdot P_{ij}
\]  

(2)

Where \( M_i \) is the landfill/CDF pair specific operational multiplier, \( W_j \) is the parameter specific weighting factor, and \( P_{ij} \) is the normalized value of each parameter, \( j \), for each
landfill/CDF pair, i. Of the 172 landfill/CDF pairs analyzed the highest score was a 36.44 and lowest was < 1. The landfill/CDF pairs identified in table 2 are the highest 20 scores identified by this analysis.

<table>
<thead>
<tr>
<th>Landfill</th>
<th>CDF</th>
<th>Operational Multiplier</th>
<th>Raw Score</th>
<th>Total Score</th>
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<tbody>
<tr>
<td>'CAP_020'</td>
<td>Devil's Island'</td>
<td>1</td>
<td>34.66</td>
<td>34.66</td>
</tr>
<tr>
<td>'CAM_023'</td>
<td>Cinnaminson CDF'</td>
<td>1</td>
<td>33.66</td>
<td>33.66</td>
</tr>
<tr>
<td>'MON_027'</td>
<td>Lightning Jacks Marina'</td>
<td>1</td>
<td>28.58</td>
<td>28.58</td>
</tr>
<tr>
<td>'OCE_016'</td>
<td>High Bar Harbor'</td>
<td>1</td>
<td>28.27</td>
<td>28.27</td>
</tr>
<tr>
<td>'BUR_011'</td>
<td>Enterprise Range'</td>
<td>1</td>
<td>25.46</td>
<td>25.46</td>
</tr>
<tr>
<td>'OCE_024'</td>
<td>Long Point Thorofare'</td>
<td>0.8</td>
<td>31.51</td>
<td>25.21</td>
</tr>
<tr>
<td>'BUR_011'</td>
<td>Devlin Channel'</td>
<td>1</td>
<td>24.91</td>
<td>24.91</td>
</tr>
<tr>
<td>'CUM_023'</td>
<td>Clubhouse Lagoon #1'</td>
<td>1</td>
<td>24.77</td>
<td>24.77</td>
</tr>
<tr>
<td>'OCE_024'</td>
<td>Tuckerton Creek #1'</td>
<td>0.8</td>
<td>30.88</td>
<td>24.71</td>
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<tr>
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<td>0.8</td>
<td>29.22</td>
<td>23.38</td>
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<tr>
<td>'CAP_020'</td>
<td>Ludlam Thorofare #1'</td>
<td>0.8</td>
<td>29.15</td>
<td>23.32</td>
</tr>
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<td>0.8</td>
<td>29.00</td>
<td>23.20</td>
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<tr>
<td>'CAM_022'</td>
<td>Fisher Point'</td>
<td>0.8</td>
<td>28.55</td>
<td>22.84</td>
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<tr>
<td>'CAM_041'</td>
<td>Fisher Point'</td>
<td>0.8</td>
<td>28.52</td>
<td>22.82</td>
</tr>
<tr>
<td>'CUM_023'</td>
<td>All Seasons Marina'</td>
<td>0.8</td>
<td>28.09</td>
<td>22.47</td>
</tr>
<tr>
<td>'OCE_024'</td>
<td>Story Island'</td>
<td>0.8</td>
<td>28.04</td>
<td>22.43</td>
</tr>
<tr>
<td>'MON_005'</td>
<td>Leonardo Harbor'</td>
<td>0.8</td>
<td>28.02</td>
<td>22.42</td>
</tr>
<tr>
<td>'MON_021'</td>
<td>Atlantic Highlands Harbor'</td>
<td>1</td>
<td>22.27</td>
<td>22.27</td>
</tr>
<tr>
<td>'MON_059'</td>
<td>Atlantic Highlands Harbor'</td>
<td>1</td>
<td>22.21</td>
<td>22.21</td>
</tr>
<tr>
<td>'BUR_040'</td>
<td>Newbold Island'</td>
<td>1</td>
<td>22.08</td>
<td>22.08</td>
</tr>
</tbody>
</table>

A second analysis was completed that was independent of the operational multiplier; this was done to identify landfill/CDF pairs that represented the greatest potential for closure based solely on the physical parameters of the pair. This was identified as the raw score. Table 3 presents the twenty highest landfill/CDF pairs identified by the raw score.
Table 3 - Landfill/CDF Scores (Twenty Highest Raw Scores)

<table>
<thead>
<tr>
<th>Landfill</th>
<th>CDF</th>
<th>Operational Multiplier</th>
<th>Raw Score</th>
<th>Multiplier Adjusted Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>'BUR_049'</td>
<td>Cinnaminson CDF'</td>
<td>0.1</td>
<td>41.47</td>
<td>4.15</td>
</tr>
<tr>
<td>GLO_033*</td>
<td>Logan Plant'</td>
<td>0.4</td>
<td>36.35</td>
<td>14.54</td>
</tr>
<tr>
<td>'MON_054'</td>
<td>Keansburg CDF'</td>
<td>0.08</td>
<td>36.29</td>
<td>2.90</td>
</tr>
<tr>
<td>'CAP_020'</td>
<td>Devil’s Island'</td>
<td>1</td>
<td>34.66</td>
<td>34.66</td>
</tr>
<tr>
<td>'CAM_046'</td>
<td>Cinnaminson CDF'</td>
<td>0.1</td>
<td>34.58</td>
<td>3.46</td>
</tr>
<tr>
<td>'BUR_049'</td>
<td>Dredge Harbor'</td>
<td>0.08</td>
<td>33.67</td>
<td>2.69</td>
</tr>
<tr>
<td>'CAM_023'</td>
<td>Cinnaminson CDF'</td>
<td>1</td>
<td>33.66</td>
<td>33.66</td>
</tr>
<tr>
<td>'GLO_026'</td>
<td>Logan Plant'</td>
<td>0.04</td>
<td>33.48</td>
<td>1.34</td>
</tr>
<tr>
<td>'CAM_020'</td>
<td>Fisher Point'</td>
<td>0.08</td>
<td>33.45</td>
<td>2.68</td>
</tr>
<tr>
<td>'GLO_039'</td>
<td>Fisher Point'</td>
<td>0.4</td>
<td>33.40</td>
<td>13.36</td>
</tr>
<tr>
<td>'ATL_037'</td>
<td>Broad Thorofare #2'</td>
<td>0.008</td>
<td>31.54</td>
<td>0.25</td>
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<tr>
<td>'OCE_024'</td>
<td>Long Point Thorofare'</td>
<td>0.8</td>
<td>31.51</td>
<td>25.21</td>
</tr>
<tr>
<td>'BUR_017'</td>
<td>Burlington Island Cell B'</td>
<td>0.01</td>
<td>31.42</td>
<td>0.31</td>
</tr>
<tr>
<td>'BUR_017'</td>
<td>Newbold Island'</td>
<td>0.01</td>
<td>31.34</td>
<td>0.31</td>
</tr>
<tr>
<td>'CAM_018'</td>
<td>Fisher Point'</td>
<td>0.08</td>
<td>31.03</td>
<td>2.48</td>
</tr>
<tr>
<td>'OCE_024'</td>
<td>Tuckerton Creek #1'</td>
<td>0.8</td>
<td>30.88</td>
<td>24.71</td>
</tr>
<tr>
<td>'CAM_006'</td>
<td>Fisher Point'</td>
<td>0.08</td>
<td>30.52</td>
<td>2.44</td>
</tr>
<tr>
<td>'BUR_011'</td>
<td>Burlington Island Cell B'</td>
<td>0.1</td>
<td>30.45</td>
<td>3.05</td>
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<tr>
<td>'ATL_009'</td>
<td>Broad Thorofare #2'</td>
<td>0.01</td>
<td>30.27</td>
<td>0.30</td>
</tr>
<tr>
<td>'GLO_023'</td>
<td>Logan Plant'</td>
<td>0.4</td>
<td>29.98</td>
<td>11.99</td>
</tr>
</tbody>
</table>

The entire ranked dataset, including parameter specific scores, is included as appendix B.

Subsequent to the ranking analysis, findings were shared with the personnel from the NJDOT Office of Maritime Resources and the NJDEP Solid and Hazardous Waste Management Program to determine their priorities for CDF excavation and landfill closure. Upon further investigation, several of the highly ranked landfills in the pairs were identified as previously closed, redeveloped, or undergoing and active site remediation. In addition, the occurrence of Hurricane Sandy in October 2012 changed the CDF priorities of the NJDOT Office of Maritime Resources. As a result, the landfills selected for Phase I Environmental Site Investigation are not from the landfill/CDF pairs identified as those with the highest potential for closure with dredged material.

The four selected landfills were the Tinton Falls Municipal Sanitary Landfall in Tinton Falls, Monmouth County; Winzinger Landfill in Hainesport, Burlington County; Elsinboro...
Township Sanitary Landfill, Elsinboro, Salem County; and Filmore Sanitary Landfill, Middle Township, Cape May County. Each of these were identified as part of a landfill/CDF pair with a relatively high total score determined by the ranking system developed for this project. The landfill/CDF pairs were:

<table>
<thead>
<tr>
<th>Landfill</th>
<th>CDF</th>
<th>Raw Score</th>
<th>Multiplier Adjusted Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winzinger</td>
<td>Burlington Island Cell B'</td>
<td>25.42</td>
<td>2.54</td>
</tr>
<tr>
<td>Winzinger</td>
<td>Hawk Island'</td>
<td>23.03</td>
<td>2.30</td>
</tr>
<tr>
<td>Winzinger</td>
<td>Castle Harbor'</td>
<td>16.92</td>
<td>0.17</td>
</tr>
<tr>
<td>Filmore</td>
<td>Richardson Channel #5'</td>
<td>28.63</td>
<td>0.23</td>
</tr>
<tr>
<td>Filmore</td>
<td>Linger Pt #1'</td>
<td>22.67</td>
<td>0.23</td>
</tr>
<tr>
<td>Filmore</td>
<td>Dickenson Creek'</td>
<td>26.96</td>
<td>0.22</td>
</tr>
<tr>
<td>Tinton Falls</td>
<td>Belmar Marina'</td>
<td>26.52</td>
<td>21.22</td>
</tr>
<tr>
<td>Tinton Falls</td>
<td>Leonardo Harbor'</td>
<td>24.43</td>
<td>19.55</td>
</tr>
<tr>
<td>Tinton Falls</td>
<td>Atlantic Highlands Harbor'</td>
<td>22.39</td>
<td>1.79</td>
</tr>
<tr>
<td>Elsinboro</td>
<td>Penns Neck'</td>
<td>19.77</td>
<td>9.89</td>
</tr>
<tr>
<td>Elsinboro</td>
<td>Killcohook #1'</td>
<td>18.73</td>
<td>9.36</td>
</tr>
<tr>
<td>Elsinboro</td>
<td>Artificial Island'</td>
<td>17.86</td>
<td>8.93</td>
</tr>
</tbody>
</table>

The landfills that were investigated were parts of landfill/CDF pairs that scored relatively high in raw score, but lower when adjusted for the operational multiplier. The reasons for these low scores are: Winzinger is a privately owned landfill, Filmore is a privately owned landfill and the three associated CDFs are also private, the CDFs that are paired with Tinton Falls are small and have insufficient volume to close the landfill alone, and the CDFs paired with Elsinboro are all federal facilities.

Each of these landfills was investigated by personnel from T&M Associates and a team of undergraduate Bio-Environmental Engineering students from Rutgers University. These Phase I Investigations have been conducted in accordance with the New Jersey Department of Environmental Protection (NJDEP) Preliminary Assessment procedure specified at NJAC 7:26E, 3.1, and 3.2. The Phase I Reports for each of the sites are contained in appendices C, D, E, and F.
SITE ASSESSMENTS RESULTS

Each of the four selected landfills was investigated to determine the presence of potential issues associated with closure of the landfills. The following potential issues materials were identified by T&M Associates:

**Tinton Falls Municipal Sanitary Landfill**

“The file reviews conducted for the PA have not identified any formal NJDEP Solid Waste Program closure approval for the greater TFLS landfill including the Route 18 Portion which encompasses the majority of the greater, historic area of landfilling. However, the Route 18 Portion is currently capped and encumbered by the NJDOT Route 18 freeway lanes and exit ramps which presumably would not be available for capping with dredge materials due to completed engineering profiles achieved for the roadway project. The balance of the historic landfill area referred to here as the TFLS Site is approximately 2.50 acres in area with 2 foot thick cap of clean material placed in 1982. The TFLS Site receives stormwater sheet flow from the developed lands to the south as well as point-discharge flow from the GSP and Route 18 stormwater drainage systems. During the Site visit conducted for this PA, T&M identified area of ponding with phragmites growth indicating the potential presence of wetland areas at the TFSL Site. The NJDEP GeoWeb program mapping depicts “Managed Wetlands” area intersecting the south edge of the TFSL Site.

The NJDOT installed and sampled five (5) groundwater monitoring wells at the greater landfill area as part of the NJPDES Permit required for the development of the Route 18 Freeway in 1984. Monitoring well “MW-1” is situated at the TFSL Site and was located by T&M. The remainder of the monitoring wells installed and sampled by the NJDOT are/were located to the north, south and east of the TFSL Site. The groundwater analysis reporting reviewed for this PA has not identified any groundwater exceedances or contaminants in the groundwater at the TFSL Site MW-1with the exception of dissolved iron. No NJDEP Spill Case Numbers indicating the reporting of or documentation of soil and/or groundwater contamination at the TFSL Site were identified for this PA.”

**Winzinger Landfill**

“The Baseline Ecological Evaluation dated February 2012 (the 2012 BEE) indicates that groundwater sampling conducted in April 2008 has indicated exceedances of the NJDEP Groundwater Quality Standards (GWQS) for Arsenic; sediment sampling data shows one sediment sample location with a concentration of arsenic above the residential direct contact soil remediation standard (RDCRS) and polycyclic aromatic hydrocarbons (PAHs) below the RDCRS; and PAHs were detected above the RDCRS at the base of the fill material during sampling at test pits.”
**Elsinboro Township Sanitary Landfill**

“The July 20, 1989 NJDEP Discharge Surveillance Report for the Discharge To Groundwater NJPDES Permit for the ETSL Site indicates that there is one (1) permitted discharge to groundwater at the Site. The DSR Comments and attached Discharge Data table state that the following analytes exceeded the discharge limits during the 3rd and 4th quarters of 1988 and the 1st and 2nd quarters of 1989 at “some of the wells”: Cadmium, chlorides, coliform, Iron, Manganese, Selenium, Total Dissolved Solids, Ammonia, Nitrogen, Color, Sodium and Arsenic.

T&M’s comparison of the 1988 and 1989 discharge sampling event results with the current NJDEP Groundwater Quality Standards (GWQS) indicates that several of the listed parameters exceeded the current GWQS. The Discharge Report includes a sketch of the ETSL with locations of the four (4) on-Site monitoring wells. The correspondence provided by the Township indicates that groundwater monitoring at the ETSL was discontinued in 1990.

According to the NJDEP Case Transfer Report, the contamination case for the ETSL was transferred from the Bureau of Aquifer Restoration to the Bureau of Site Case Management for the “uncontrolled source” of groundwater contamination. The “Media Affected” is Groundwater which was sampled in 1987, 1988, 1989 and 1990. The Pollutants listed are Arsenic, Lead and Ammonia which were reported above the current NJDEP GWQS.”

**Filmore Sanitary Landfill**

“Based on the presence of permanent groundwater monitoring wells and temporary well sampling points throughout the FSL Site, T&M presumes that contaminated groundwater is being monitored and remediated at the Site. In addition, an approximately 11.6 acre portion of the original landfill area is developed with gasoline filling station/auto repair facility and family fun park. The developed areas may not be available for capping with dredge materials under the current conditions.”

More information regarding the potential issues and areas of concern for the four landfills can be found in T&M Associates’ Phase I Reports, included in appendices C, D, E, and F. Based on these results, it is recommended that prior to initiation of any closure activities, additional investigation of the identified potential issues be conducted at these sites.

The topography of the four landfill sites are either flat or sloping in one direction. As a result there are no apparent depressions that require filling which would expand the capacity of the landfills need to be filled up. This means you could use dredge mainly for the capping. It would be safe to assume 3,200 CY per acre. The site in Tinton Falls might be extended beyond where the contours are. I think the clover leaf and other
surrounding areas are in what used to be the landfill. Please refer to the historical aerial photographs included in the PA for Tinton Falls. So the area is bigger and would require more material.”

Initial calculations to determine the volume of dredged materials necessary to cap each of the four landfills produced the following results:

Table 5 - Volume of Dredged Materials Required for the Selected Landfills

<table>
<thead>
<tr>
<th>Landfill</th>
<th>Volume required for a 2-foot cover (yd³)</th>
<th>Volume required for a 4-foot cover (yd³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tinton Falls Municipal Sanitary Landfill</td>
<td>8,067</td>
<td>16,134</td>
</tr>
<tr>
<td>Winzinger Landfill</td>
<td>70,987</td>
<td>141,974</td>
</tr>
<tr>
<td>Elsinboro Township Sanitary Landfill</td>
<td>38,720</td>
<td>77,440</td>
</tr>
<tr>
<td>Filmore Sanitary Landfill</td>
<td>51,627</td>
<td>103,254</td>
</tr>
</tbody>
</table>
REFERENCES

