SWANA LANDFILL RE-USE EXCELLENCE AWARD APPLICATION 2011

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CROSS STATE LANDFILL REDEVELOPMENT

SOLID WASTE AUTHORITY OF PALM BEACH COUNTY

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Executive Summary

The Solid Waste Authority of Palm Beach County (SWA) balanced benefits and challenges in redevelopment of a 74 acre former landfill site that included a 10 acre adjacent junk yard, and a former 12 acre adjacent asphalt batching operation in Palm Beach County Florida.

The Cross State Site is a closed landfill with a waste footprint of 54 acres within a larger 74 acre site. The landfill was initially developed on the site of an abandoned shell pit, and was first used for solid waste disposal in 1938. Palm Beach County acquired the landfill in 1954 and began utilizing the site for waste disposal until 1976. The landfill reportedly accepted household garbage, wood, and construction and demolition debris. Approximately 2.5 million cubic yards of trash and garbage was disposed of at this site between 1938 and 1976. The Cross State Landfill site ceased operations prior to introduction of the current State landfill design and closure regulations. The landfill site does not have a liner system, and was not required to go through the current landfill closure permitting process. On this basis regulatory agencies had significant flexibility in managing redevelopment of the site while protecting human health and the environment. Long term site monitoring had demonstrated that the landfill impacts were limited and stable.

The adjacent junk yard and asphalt batch plant parcels were decommissioned in the 1990’s and buried debris at the junkyard site was removed. This was followed by remediation of residual petroleum impacts in accordance with State clean-up requirements.

The challenge to overcome during redevelopment of the former landfill, junkyard, and batch plant sites required innovative engineering and multi stakeholder cooperation. Knowledgeable management of redevelopment to accommodate the former site land use and history was a key factor in project success. Obtaining cooperation from multiple regulatory agencies, and stakeholders was critical to achieving landfill re-use success, maintaining landfill closure criteria, and minimizing impacts related to past land use. The permitting, engineering and construction challenges were managed through innovative and cost effective approaches.

The benefits of the redevelopment include land purchase savings to Palm Beach County for a major capital project, convenience of a central location for operations and training and reduced costs in landfill long term maintenance. The availability of a construction material recycling facility central to the County promotes construction material recycling, while reducing transportation costs and related greenhouse gas production. Better management of stormwater for the site and adjacent areas reduces environmental impacts related to the former site use, and improves drainage for neighboring properties.
1) SITE PLANNING

There were many challenges to overcome during redevelopment of the former landfill and adjacent junkyard and asphalt plant sites. Project success was achieved through multi-stakeholder cooperation and knowledgeable management of the former site land use and history. Landfill closure, permitting, engineering and construction challenges had to be managed, along with obtaining the cooperation of multiple regulatory agencies, and stakeholders.

The overall redevelopment area included:

- Former Cross State Landfill-owned by SWA
- Former Junk Yard-Owned by SWA
- Lake parcel-Owned by the County
- Former Dixie Asphalt –Owned by the County

The Cross State Site is a closed landfill with a waste footprint of 54 acres located on a 74 acre site. The landfill was initially developed on the site of an abandoned shell pit, and was first used for solid waste disposal in 1938. Shell rock accumulated in the early history of Florida when sea levels were higher from the remains of marine life and was used as a source of high quality fill. Palm Beach County acquired the landfill in 1954 and utilized the site for waste disposal until 1976. The landfill reportedly accepted household garbage, wood, construction and demolition debris. Approximately 2.5 million cubic yards of trash and garbage was disposed of at this site between 1938 and 1976. The Cross State Landfill site ceased operations prior to introduction of the current Federal & State landfill design and closure regulations. The landfill predates requirements for a top or bottom liner system, and was closed prior to enactment of the current landfill closure permitting process.

A 10 acre junk yard parcel adjacent to the southeast corner of the former landfill was decommissioned in the 1990’s and buried debris at the site had been removed. This was followed by remediation of residual petroleum impacts in accordance with State clean-up requirements.

The former Dixie Asphalt site was located adjacent to the southwest corner of the former landfill, and the lake parcel was located west of the junk yard and southeast of Dixie Asphalt.
Site development was planned mindful of the fact that stormwater and any surface water management be designed in such a way that the historic groundwater flow patterns at the site not be affected. This required that a perimeter drainage system be maintained, and that stormwater management systems be designed to maintain the current groundwater flow status quo. In addition, water levels in the onsite lake were managed to avoid creating a gradient from the landfill toward the lake.

Two tenants were identified that were compatible with the former land use that could operate with the need for minimal site improvements or adverse impact on the site. Initial leases were granted to a concrete and asphalt recycling operation, as well as a wood waste recycling operation. As the tenants planned their use of the site, it became clear that stormwater improvements to the site would be necessary to properly manage stormwater flows. This need triggered the development of an integrated stormwater planning approach for all parcels, and studies began on a stormwater master plan that could support the initial and future possible tenants.

At about the same time, the County was looking for a convenient location to build a training facility for their Fire Rescue Department. This potential major additional tenant was the driver to seriously consider what was needed to accomplish a well managed site redevelopment. Based on preliminary multi-agency meetings that were held between the tenants, landowner and the regulatory agencies, no fatal flaw to the redevelopment concept was found. The following plan shows the overall development after completion. Four development parcels emerged at the site: a concrete and asphalt recycling facility, a vegetative waste recycling facility, a fire rescue training and administration complex, and the Sheriff’s driver training pad.
In order for the project to move forward, the two landowners had to agree to a parcel land swap so the county could own the lake parcel and the adjacent junkyard for the proposed Fire Rescue facility south of the eastern part of the former landfill to be leased from the Solid Waste Authority for a training area. This was accomplished by executing an inter-local agreement which documented the required land swap as well as ongoing responsibilities for the management of the combined site development.

The following sections of this paper describe how various issues were managed to allow successful redevelopment of the site.

2) DESIGN AND CONSTRUCTION

Foundation and Paving Systems
Designing, installing and maintaining foundation and pavement systems on unconsolidated and potentially unstable landfill conditions was a critical component of the facility design, development and use. Additionally, areas of the junk yard, where the administrative complex was to be located, had been excavated and refilled in the past as a result of shell rock mining and site remediation. Therefore, there was a potential for added development costs for foundations and pavement/drainage systems, as well as higher pavement maintenance costs than normal sites constructed structural free. These additional costs were accepted by the County Fire Rescue and Sherriff Departments as acceptable in view of the excellent location and favorable land costs as a result of the former landfill site reuse.

Development of the site from a geotechnical perspective included two (2) distinct subgrade support areas. The lower southern area of the site, where the administration and maintenance facilities were constructed, was reported to be generally free from debris and waste from the former junk yard operations as a result of the decommissioning activities. While some localized consolidation may be required, facilities would be constructed on natural soils. A geotechnical investigation was completed for this area to establish foundation design criteria.

In the area of the former landfill, subsurface conditions were more complex and problematic. Training Prop pads, roadways and drive training pavement courses were to be installed in this area, in addition to minor support structures. Field observations and historical information indicated the landfill consisted of the following layers:

**Layer 1**: Surface layer of recycled organics (mulch) 6 to 12 inches deep
**Layer 2**: Recent cover layer of Brazilian Pepper and Australian pine trees covered with between one to two feet of recycled screening material (RSM).
**Layer 3**: Initial thin 6-12 inch landfill cover layer
**Layer 4**: Landfill debris
**Layer 5**: Underlying natural sand deposits
Completed Development of Landfill Area

The general approach to managing development on top of the former landfill was to minimize disturbance of the cover by adding fill to accommodate redevelopment. This provided an effective consolidated fill sub base for all roads, prop pads, and the driving courses. For minor structures, mat foundations would 1) distribute the light structural loads over a large area (thus bridging over weaker compressible zones), and 2) provide an impervious surface for the collection of fire water to avoid point infiltration issues. A mat system will float and move with the consolidation of the landfill material beneath the mat area. For the 4 story burn building located on the former landfill, a decision was made to remove waste and backfill with suitable material in the localized area as the lowest cost approach to avoid settlement of this substantial structure. Waste removed was disposed of at the operating Solid Waste Authority Class I landfill.

**Pavement System Design**

Pavement system design on the former landfill was one of the most problematic components of the facility design, whereas, pavement designs in the former junk yard area, on natural soils, could be designed as traditional asphalt pavement areas for heavy vehicle loading.

In the junk yard area designated parking areas for the fire trucks and other heavy emergency vehicles, a reinforced concrete pad would be provided to handle static long-term wheel loads from the heavy firefighting equipment. This approach was proposed for areas such as the apron area for the Apparatus building.
In spite of proper sub base fill, pavement designs, performance and maintenance will be more problematic on the landfill area. Due to the nature of the landfill and cover material, the pavements will likely continue to settle over the long-term in spite of attempts to consolidate the areas and placing good sub base material. In pavement areas underlain by construction type landfill debris, settlement of the pavements may be minimal. In areas of the landfill underlain by garbage and organic debris, settlements will be greater and more compressible (i.e. spongy) under pavement loadings. Additionally, the presence of tires, old refrigerators and tanks, etc. pose a small potential for localized pavement subsidence/collapse particularly as metal containers rust out over the years.

From a pavement maintenance perspective, differential landfill settlements will cause asphalt concrete, pavement surfaces to crack, allowing infiltration of, or ponding of, water in the pavement base and accelerated degradation and failure of the pavement. In roadway alignments, localized pavement settlement may be less of a problem than in the proposed broader road course and skid pad areas. In broad road course and skid pad areas, undulations and depressions would likely result in standing water and eventually accelerated pavement degradation.

Due to the site conditions, it was recommended that a more economical, easily maintained pavement system be provided in landfill areas. The following pavement section was recommended:

1. Surface course of sprayed emulsion asphalt covered by rock chips.
2. 15 inches of compacted FDOT approved lime rock base course
3. Layer of Tensar BX 4100 geogrid or engineer approved equal.
4. 12 inches of compacted RMS subgrade compacted to at least 95% of modified Proctor density per ASTM D1557.

The benefit of this type of pavement system is that depressed areas in the pavement wearing surface can simply be scarified to a depth of a few inches, lime rock base material added, the area recompacted and a fresh wearing course reapplied. An alternative to this approach was actually installed. It consisted of a minimum of 12 inches of recycled asphalt material which was available from the adjacent materials recycling operation and used in conjunction with the stabilized sub-base fill. This material sets-up almost like asphalt due to the Florida heat and truck traffic. No sealer is required and the repair of depressions is readily accomplished by filling depressions with reclaimed asphalt material.

In isolated landfill pavement areas where asphaltic pavements was desired (such as the skid pad area), it was accepted that a higher maintenance budget would be required.

**Airport Proximity and Safety Issues**
The former landfill site is on a runway approach path for the Palm Beach County Airport. As a part of the preliminary feasibility evaluation for the project, a Notice of Proposed Construction that may affect Navigable Airspace was submitted to the U.S. Department of Transportation Federal Aviation Administration Southern Regional Office. This was the initial step in making sure that the project would not receive objections from the FAA or the local airport authority.

The notice described the proposed a new fire training facility to be located approximately 4 miles west of the Palm Beach County, Florida, International Airport (PBIA) just west and north of the Florida Turnpike and Southern Boulevard (in close alignment with the glide path to the main E-W PBIA’s runway). The notice included that the fire training facility would utilize propane gas for their fires, but noted, the various training props and structures will generate periodic smoke and steam clouds which will rise vertically. While significant impact was not anticipated it was important to advise that plumes/clouds may be visible to pilots and air traffic controllers.

**3) ENVIRONMENTAL CONTROLS AND LANDFILL CLOSURE**

**Landfill Closure**
The Cross State Landfill ceased operations in 1976 prior to introduction of the current Florida Department of Environmental Protection (FDEP) landfill design and closure regulations. The landfill site does not have a bottom or top liner system, and was not required to go through the current landfill closure permitting process. The site closure included clean fill cover graded to manage stormwater.

In 2002, several years prior to formal redevelopment, the site was cleared and re-graded to resolve settlement issues. Combined chipped vegetation, recovered screened material (RSM) and lime sludge was used to create the grading material. The RSM material is screening from the processing of construction and demolition debris in accordance with Florida Administrative Code (FAC) 62-701. The larger sections of the trees unsuitable for chipping were buried under the new cap material placed at the site. The FDEP had
significant flexibility in managing the former site and the planned redevelopment without requiring formal submissions that might be required under current landfill closure regulations. Work was completed in accordance with a guidance document which was available from the Florida Department of Environmental Protection (FDEP) “Guidance For Disturbance and Use of Old Closed Landfills or Waste Disposal Areas in Florida” dated May 3, 2001 which provided the framework for proceeding with redevelopment.

The former landfill site has been subject groundwater monitoring requirements under the rules in force at the time of closure. A groundwater monitoring permit from FDEP required SWA to provide groundwater quality data to FDEP quarterly for many years. The permit has expired, and SWA does not expect that FDEP will require further monitoring. There is no currently identified groundwater quality concern related to the site that would require ongoing groundwater monitoring.

**Junkyard Remediation**

A 10 acre portion of the site adjacent to the south east corner of the former landfill was used until 1995 as an automotive junk yard and recycling center. In an effort to be proactive with respect to environmental issues at the former Recycling Center of Palm Beach County site, the Solid Waste Authority initiated an environmental assessment and remediation program. While it was assumed that the site had areas of contamination, the extent and magnitude of buried materials and contaminated soil was not known. To delineate the scrap metal and buried debris at the site, a geophysical survey was conducted which included an electromagnetic terrain conductivity (EM) survey and a magnetic survey. The EM survey identified areas of buried metal and debris and the magnetic survey was used to confirm the results of the EM survey and to evaluate the depth to which the material is buried. A trenching program was conducted at the site to obtain information regarding subsurface conditions. Based on the results of the trenching activities, areas were identified to have extensive amounts of buried material—both scrap metal and construction and demolition (C&D) debris, as well as areas of petroleum contaminated soil.

A program was initiated to recover and recycle the buried metals at the site using the recycling facilities at the Solid Waste Authority’s main facilities that processed recycle metals from the Renewable Energy facility. C&D debris was recycled using private sector resources. Approximately 35,000 cubic yards of metallic mass was recovered from the site and recycled along with over 100,000 waste tires.
The tires were shredded and used as drainage medium at the currently operating Solid Waste Authority Class I landfill site. Based on the trenching and soil excavation completed at the site, it was estimated that approximately 2,400 cubic yards of petroleum contaminated soil was removed from the site. In 1999, the Solid Waste Authority initiated a remedial evaluation of petroleum contaminated soil and groundwater from a former leaking underground storage tank at the Recycling Center. The evaluation concluded that based on the nature and extent of contaminants, a passive venting system would be sufficient to remediate the soil and groundwater.

The passive venting system proved to be simple, economical and effective. The system utilized off the shelf attic wind driven ventilator turbines in the source area for exhaust, and inlet vent stacks installed on perimeter wells to provide constant low flow air circulation through the formation. The turbine installation is shown above and the well head and manifold are shown below.

Air Extraction Turbine Installation
The SWA submitted a Site Rehabilitation Completion Report to Palm Beach County and the Florida Department of Environmental Protection (FDEP) in October 2004. A No Further Action status was granted on February 23, 2005.

**Former Dixie Asphalt Site Remediation**

An asphalt plant operated on a 9.7 acre parcel at the southwest corner of the site for many years. After Palm Beach County purchased the property in 1987, the County registered the UST’s and applied for the FDEP’s Early Detection Incentive (EDI) program in September 1988. The ASTs, USTs and related piping were removed in February 1989. Following acceptance into the EDI program, assessment activities identified several areas of concern, including an area immediately surrounding the former tank fields south of the drainage canal. Approximately 300 to 500 cubic yards of hydrocarbon-impacted soil was removed during the tank removal activities in 1989. In addition, hydrocarbon impacted soil was removed from the drainage canal easement in 1998, during the installation of a 54 inch drainage pipe. The installation of the pipe became an effective part of the remedy to limit off site impacts from low level petroleum residuals. A Limited Scope Remedial Action Plan (LSRAP) was submitted to PBERM in July 2004, and approved in August 2004. The LSRAP proposed the removal of approximately 4,000 tons of soil, followed by temporary air sparging in the open excavation. A work order to execute the LSRAP was received on January 7, 2005. The area is currently part of the operating asphalt and concrete recycling operation parcel of the site.
Site Hydrogeology
Normal groundwater gradients in Palm Beach County dip in a gentle east-southeasterly direction; however, local site gradients may be impacted by lakes and drainage canals adjacent to the parcels. Historic groundwater monitoring at the site confirmed that the site groundwater gradients were typical of the overall area. At the Cross State Landfill site, groundwater gradients are to the east and southeast direction and a series of monitoring compliance wells are located primarily at the southeast corner of the site.

Discussion with County Fire Rescue indicated a desire to utilize the onsite lake as a water supply source for training activities. It was determined that periodic filling of pumper trucks for training purposes would not be a problem; however, extensive pumping from the lake to meet overall training needs could be a concern. Extensive pumping from the lake which causes longer term drawdown had the potential to temporarily alter groundwater gradients across the landfill which could affect groundwater flow. Consequently was decided that general training water flow would have to be obtained from the County Water Utility Department, which would have the benefit of training with the municipal utility system.
Environmental Resource Permits (ERP) for stormwater management were required from the FDEP not the South Florida Water Management District (SFWMD) due to the past site use as a landfill. The key to stormwater planning success was the early inclusion of all agencies and stakeholders early in the site planning process. This allowed the design team to identify and start addressing agency and stakeholder concerns early in the process.

Site drainage system design was impacted by the nature of the underlying subsurface conditions in different areas of the site. Stormwater management related to rainfall at the site required special management of drainage from roadway and impervious areas at the site to minimize changes to the site conditions which could aggravate environmental issues. The design allowed stormwater generated on top of the former landfill to continue to percolate into the site using a distributed approach avoiding point infiltration loading on top of the landfill that could result in significant localized concentration of stormwater infiltration. An analysis of the proposed quantity of fire training water demonstrated that training water infiltration would be a small percentage of annual rainfall percolation. Similarly, the training water quality issued would need to be addressed to avoid impact to the stormwater system. Therefore a large detention area was created on top of the landfill area to limit discharges to the on site lake system for normal rainfall events up to a 25 year storm.
The drainage canal and right of way between the landfill and the junkyard parcels created an impediment to combined parcel development. An agreement with the drainage district was negotiated to purchase the canal and easement between the sites so that the two parcels would not be separated by the canal. The co-operation of multiple agencies was required to approve this agreement which was a key element to combined parcel site development. Once the agreement was in place, the master drainage plan was finalized for all land parcels, and to accommodate drainage from the adjacent industrial area to the south of the site. The incorporation of this area in the planning process by the landowners and the agencies corrected flooding problems and improved stormwater discharge quality.

**Methane Management**

The landfill is sufficiently old that methane production was not expected to be an impediment to the proposed redevelopment. While the methane production potential of the site was expected to be limited, a monitoring program was completed, and appropriate design accommodations were made to accommodate residual methane at the site.

The potential for methane gas generation at the site was evaluated in accordance with the FDEP “Guidance for Disturbance and Use of Old Closed Landfills or Waste Disposal Areas in Florida” dated May 3, 2001. URS conducted a methane gas screening survey to measure the potential combustible gases to affect the proposed structures at the former landfill. The FDEP Guidance recommends that combustible gases not exceed 25% of the lower explosive limit (LEL) in proposed structures and/or ambient air.

Combustible gas screening probes were installed to measure the percentage of the LEL of methane gas just below the surface of the former landfill area in locations of proposed structures and proposed training areas. The methane gas screening points consisted of a 1½-inch diameter Schedule 40 PVC casing that was inserted into a 4-inch diameter boring. The PVC casings within the landfill footprint extended approximately 5 feet below ground surface (ft bgs) with a slotted screen interval from 1 to 5 ft bgs. The PVC casings advanced along the edge of the former landfill were set at 3 ft bgs, approximately one foot above the water table, and screened from 1 to 3 ft bgs. The annulus around the 1½-inch diameter PVC casing and screen was backfilled with fine quartz sand to within six-inches of the ground surface and then plugged to the ground surface with bentonite clay. The PVC casings were capped and left to allow gas concentrations below the surface to stabilize for screening.

The methane gas screening points remained capped for approximately 24 hours before the first reading was collected using a QRAE Plus Multi-Gas Monitor using a small tube inserted through a small hole in the screening point cap. A second reading was recorded approximately 48 hours following the first reading. Follow up readings were taken after a week.
All of these screening points located on the former landfill site showed detectable levels of methane gas with some levels exceeding the 25% LEL for methane, but screening points on the adjacent junk yard where the administration building was to be located parcel were all below the detection limit.

While the detection of methane on the site above the screening criteria was somewhat surprising, settling of areas on top of the landfill after trees were removed and regrading was completed in 2002 indicated potential degradation of recently buried vegetation a potential source of methane.

Follow up methane screening results were comparable to the levels measured by URS confirming the screening results were valid. Discussion of the results concluded that the low concentrations detected below grade should not affect use of the site for open air training exercises which are planned for the Fire Training Facility to be located on top of
the landfill. However utilities and any enclosed structures would need to be designed mindful of the potential for methane production.

The design of buildings on top of the former landfill included methane gas exclusion methods as a precaution consisting of under drain piping type systems in a gravel bed to intercept released residual gas. Care was taken with underground electric utilities to ensure sealing of all conduits as they entered buildings or exterior transformers and panels. Finally all fire training props were placed on concrete pads to minimize the potential related to the low levels of methane detected.

5) PUBLIC ACCEPTANCE/APPEARANCE

Enhanced Flood Protection and Stormwater Quality
A key element for successful redevelopment was the expansion of the onsite lake to accommodate flood plain losses from raising grade for redevelopment of the administration facilities for County Fire Rescue, and to manage stormwater from the site for planed and future development. However it was found that expansion of the lake would require mining and recycling of tons of concrete debris. While this might have been an unpleasant surprise during construction, advance knowledge allowed the lake expansion to proceed with a plan to recycle all materials excavated.

A preliminary study of the site found that the adjacent 30 acre industrial area to the south was granted permission to use the one site lake as part of their stormwater management system. Flooding problems had been reported in the industrial area, and so it was agreed that stormwater planning for site redevelopment needed to accommodate historic stormwater flows from the adjacent land and correct flooding problems. The end result of the project was a significant benefit in flood protection and stormwater quality.

Site Appearance
The before and after photographs included in this submission clearly demonstrate that redevelopment has created a showpiece for Palm Beach County combining public use for Fire rescue and the Sherriff as well as leases for privately operated materials recycling. The overall site appearance is much improved over the barren former landfill site.

Public Relations and Education
The SWA, along with the County Facilities, Fire Rescue and Sherriff’s Departments cooperated to provide benefits to adjacent property owners including improvements to roadways, flood protection, and increased property values. The ongoing voluntary monitoring of the site by SWA provides the community with a comfort level that the former landfill redevelopment has not resulted in adverse impacts. Fire Rescue holds regular tours of the facility for school children and other groups.

Land Value Enhancement
In addition to saving the County millions of dollars in site acquisition costs for their new Fire Rescue facility, the property surrounding the site benefits from the site appearance and improved infrastructure including roadways and flood protection.
7) INNOVATION & CREATIVITY

Site development required a creative effort led by Fire Rescue, County Facilities Development and SWA to gain cooperation from diverse stakeholders including two County landowners, and mixed private and public sector uses. The stakeholders worked cooperatively to agree on basic site redevelopment criteria and worked tirelessly on cost sharing agreements and obtaining the required regulatory approvals for the mixed use re-development.

Innovative design features included:
- Flexible paving systems for the landfill area that are inexpensive and easy to maintain using recycled materials,
- Open storm water conveyance avoiding buried pipes that could settle,
- HDPE designed sanitary force mains servicing the landfill structures to provide maximum piping flexibility,
- Low energy use bioventing remediation approaches to manage petroleum impacts,
- Passive methane barrier systems for structures and careful treatment of buried electrical utilities entering all panels,
- Distributed rainfall and training water infiltration on the former landfill area to maintain historic infiltration patterns, and
- Resolving drainage and flooding problems in an adjacent neighborhood.