RAIL SHIPMENT AND LANDFILL DISPOSAL OF DREDGED SEDIMENTS FOR THE HEAD OF THE HYLEBOS PROJECT IN COMMENCEMENT BAY

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ABSTRACT

Upland disposal of contaminated sediments provides unique challenges and opportunities for the remediation of contaminated sediment sites. There are limited alternatives for the disposal or reuse of contaminated sediments. The transport of sediments by rail makes it physically and economically feasible to dispose of sediments at landfills hundreds of miles away from the point of dredging.

One typical constraint on upland landfill disposal has been related to free liquids and need to pass the paint filter test. The standard method for passing the paint filter test has been the addition of stabilizing material or to dry the material prior to disposal by use of filter presses, geotubes or other mechanical methods.

This paper will discuss the successful application of upland disposal and transport by rail at the Head of Hylebos Project in Commencement Bay. The development of the transportation and disposal methods, as well as issues related to the disposal of wet material will be discussed. Methods developed during the course of the project for handling sediments containing asbestos will also be presented.

Keywords: Moisture enhancement, upland disposal, rail transport, Intermodal, contaminated sediments

INTRODUCTION

The proper disposal of contaminated dredged sediments has been a major concern to the environmental community for the past 15+ years. Determining where these contaminated sediments would be placed in order to confine them; eliminating future harm the sediments may have to the environment has been a difficult task. It has been the trend in the industry to place contaminated dredged material in a near-shore/upland confined disposal facility (CDF) or in a constructed confined aquatic disposal (CAD) location constructed on or near the site being remediated with the belief that placement of these particular sediments in one of these disposal location options was both environmentally positive and economically less expensive than placement in an existing landfill that may not be near the remediation site.

Contrary to the industry trend, the most environmentally sound choice for disposal of contaminated sediments may be the placement of these sediments in existing, permitted, properly constructed landfills. Economically, landfill placement of these sediments can be less expensive than the CAD/CDF alternatives, eliminating the design, construction, and long-term monitoring of these facilities. The use of an existing landfill may also reduce future liability to the site owner or party performing the remediation. RCRA Subtitle D Landfills are permitted to receive non-hazardous dredge material resulting in no Section 404 Clean Water Act issues, Endangered Species Act (ESA) issues and no regulatory opposition to disposal. Environmental risks such as ground water exposure, surface water exposure, or marine environment exposures are removed by placing dredge material into the lined containment cells at permitted landfills. Placing material in landfills also protects against possible unknown environmental releases that could occur in the less controlled and less monitored in-water disposal options.

Transportation of contaminated dredge sediments is also a concern when evaluating the environmental and economic impacts of the disposal location. Rail transportation of dredge material is effective both environmentally and economically and creates a disposal option that has been proven effective in the Puget Sound Region of the

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United States by the Head of the Hylebos Cleanup Group (HHCG) on the disposal of over 550,000 tons of contaminated sediments during the successful remediation of the Head of the Hylebos Waterway in Commencement Bay, Washington. Rail transportation is a proven system and typically transports a variety of materials which are more hazardous than the sediments generated by many sediment remediation projects.

Roosevelt Regional Landfill

The Head of the Hylebos Cleanup Group (HHCG) chose upland disposal at Roosevelt Regional Landfill in the arid hills of Klickitat County, Washington, as the preferred location for disposal of over 498,951.6 metric tons (550,000.0 tons) of contaminated sediments during the successful remediation of the Head of the Hylebos Waterway in Commencement Bay, Washington.

The Roosevelt Regional Landfill, Figure 1, is a technically and environmentally sound disposal facility, operated by Regional Disposal Company (RDC), a wholly owned subsidiary of Allied Waste Industries. The Roosevelt Regional Landfill meets or exceeds all Environmental Protection Agency (USEPA) Resource Conservation and Recovery Act (RCRA) Subtitle D standards and the State of Washington WAC 173-351 Criteria for Municipal Solid Waste Landfills. Over 2.4 km (1.5 miles) in diameter and comprising more than 809 ha (2,000 acres) in an area that receives only 15.2 to 22.9 cm (6.0 to 9.0 inches) of precipitation per year, the property is ideal for a disposal facility. The actual footprint of the Landfill will be over 370 ha (915 acres) and provides capacity for over 109 million metric tons (120 million tons) of waste, beyond public view, with the nearest neighbor two miles away, in a sparsely populated setting. The landfill combines the natural advantages with quality engineered solutions to provide the best disposal option available. The site has superior geological and hydrogeological characteristics that significantly minimize the risk of groundwater contamination.

Figure 1. Roosevelt regional landfill.

The landfill is designed with a state-of-the-art composite bottom liner and leachate collection system to ensure that the regional aquifer is protected. Landfill methane gas emissions are also monitored and controlled through an active collection system built into the landfill. This methane gas is collected at the landfill and used as fuel in an onsite electrical generation facility.

The geology of the site, from the surface down, consists of a roughly 18.3 m (60.0 ft.) thick series of deposits (some clay) known as the Rattlesnake Ridge formation, a 36.6 m (120.0 ft.) thick fractured basalt layer called the Pomona

Basalt and a 103.6 m (340.0 ft.) thick, very low permeability silt/clay formation known as the Selah clays. Beneath the Selah are several basalt flows which eventually intersect the regional groundwater table more than 304.8 m (1,000.0 ft.) below the surface. The Rattlesnake Ridge formation is not present at the center of the site and its absence helps create the bowl shape. Rainwater which infiltrates at the surface runs through the fractured Pomona Basalt and ponds on top of the Selah clays, forming a low yield local aquifer ideal for monitoring purposes. The recharge area for this monitoring aquifer is entirely within the site property boundaries and the aquifer itself is not used as a potable water supply by anyone. The travel time for water passing through the Selah member has been estimated at 15,000 years. The Rattlesnake Ridge formation, in addition to providing some of the site relief, is also the source of high quality clays used for the liner and other construction materials.

Benefits of Landfill Disposal

The benefits of landfill disposal result from a combination of engineering and operational characteristics which provide an environmental safe-zone, well beyond the minimum regulatory requirements resulting in a disposal location that eliminates future impacts on water quality, fish habitat, and endangered species, without causing additional harm to surrounding neighbors and businesses. By using an existing facility, the permitting requirements and public opposition typically associated with onsite CAD/CDF options are eliminated, potentially shortening the time required for completion of remediation projects.

RDC also takes title and ownership of the dredge material upon placement into the transportation containers for shipment. RDC defends, indemnifies, and holds the customer harmless from and against all claims, costs, losses, penalties, fines, liabilities and expenses once ownership has been established by RDC, protecting customers, in this case the HHCG, against future unknowns and unforeseen effects. This can be an important consideration for responsible parties concerned about future liability from past cleanups.

Moisture Enhancement Program

RCRA Subtitle D standard requires that all non-hazardous material approved for disposal in a Subtitle D landfill must contain no free liquids, which is typically determined by the paint filter test. For large dredging projects looking at landfill disposal as an option, this paint filter test requirement adds additional economic and environmental risks related to dewatering or stabilizing the material. Methods such as mixing the sediment with an admixture to stabilize, processing through filter presses, geotubes or other mechanical dewatering methods have been used to achieve a passing paint filter test. However, each of these methods adds costs and uncertainties. Stabilization materials must be purchased and mixed with the sediment which increases costs and increases the volume of material to be disposed of. Stabilization can be difficult, sometimes requiring more stabilization material than originally planned. Additionally, precipitation can interfere with stabilization.

Historically, moisture is a problem at landfills for a number of reasons, particularly requirements for management of the resulting leachate. Roosevelt Regional Landfill, because of its arid climate which averages 17.8 cm (7.0 in.) of annual rainfall, operates at a moisture deficit,. This moisture deficit can hinder waste compaction and degradation within the landfill and subsequent methane production and power generation. The leachate generated and collected is reinjected as part of a permitted moisture enhancement program that improves the moisture conditions in the landfill, providing greater compaction ratios, and increasing both methane gas generation and power production. Roosevelt Regional Landfill is operated to capture the methane that is generated from the solid waste decomposition for use by the Klickitat County PUD to generate electricity. The landfill is currently generating more than 10 megawatts of power.

Roosevelt Regional Landfill's current Plan of Operation contemplates moisture enhancement, specifically discussing the volume of leachate and/or water that could be introduced to the landfill to reach "field capacity" or, optimum conditions for decomposition and methane generation. That volume is estimated to be between 132,489.4 and 189,270.6 liters (35,000.0 and 50,000.0 gallons) per 907.2 metric tons (1,000.0 tons) of solid waste. Since Roosevelt received an average of approximately 7,257.5 metric tons (8,000.0 tons) of solid waste per day, field capacity is on the order of 1,135,623.5 liters (300,000.0 gallons) per day. Each gallon of moisture added up to the optimum capacity, actually improves the function of the landfill by increasing the total net capacity through greater compaction, and by increasing the power production through increased methane generation.

Figure 3. Barge offloading and direct rail loading (Photo Courtesy of DOF, Inc.).

Rail Container Lining

A large fabric tent approximately 43.9 m (144.0 ft.) long was constructed to provide a Lining Operations Area where HDPE liners could be installed in the containers prior to loading wet material. The HDPE liners are very similar to extremely large, heavyweight "Hefty" trash bags. This lining operations area is shown on Figures 4 and 5. This enclosed area provided protection for the lining crew against wind and other weather elements to safely and efficiently install the HDPE liners into the containers prior to loading with dredge material. The railcars and containers were pushed through the lining facility and lined and then moved forward to the loading area.

Figure 4. Lining operations area tent (Photo Courtesy of DOF, Inc.).

Figure 5. Scaffolding to allow access to containers within the lining operations area (Photo Courtesy of DOF, Inc.).

Rail Transportation – Equipment and Procedures

RDC and the BNSF RR have in place a long-term contract to ensure predictable costs and reliable service for the transport of dredged material from various Ports and Intermodal sites within the Puget Sound Region to Roosevelt Regional Landfill. The BNSF provides daily transport of municipal solid waste from various locations to the landfill. For the Head of the Hylebos Project, the Rail Loading Facility could not be directly served by the BNSF as the local tracks are owned by the TMBL. The TMBL in partnership with BNSF worked together to exchange empty and loaded railcars for shipment to and from the project site and the Roosevelt Regional Landfill.

RDC provided twenty-foot open top shipping containers for the transport of excavated or dredged material. The number of containers necessary varied during the course of the project depending on project production. These shipping containers have approximate dimensions of 6.1 m long by 2.4 m wide by 2.6 m high (20.0 ft. long by 8.0 ft. wide by 8.5 ft high). Containers generally have the capacity to handle up to 33.1 metric tons (36.5 tons) of material. The containers are typically carried by either single well or triple well railcars. There are two containers per standard (single well) rail car, each rail car is approximately 21.9 m (72.0 ft.) in length. A triple well car is basically three single well cars that are permanently connected and share a common set of wheels. Triple well cars carry 6 containers, are approximately 61.0 m (200.0 f.t.) in length and are articulated between each well.

For work completed prior to the 2004 in-water work window, productions were estimated at approximately 199.6 metric tons (220.0 tons) of asbestos contaminated material per day and 471.7 metric tons (520.0 tons) of contaminated soil per day for a total daily quantity of approximately 798.3 metric tons (880.0 tons). RDC planned on providing 36 containers each day to facilitate HHCG and Envirocon, the HHCG material loading contractor, during this phase. An additional 108 containers were available in the transportation system either at the landfill, in transit, or staged in Tacoma.

During the in-water work window the estimated daily production was 3,175.1 metric tons (3,500.0 tons) of dredge material. RDC made available four (4) sets of containers (120 containers each set) to facilitate daily production by the project. RDC was even able to provide additional equipment when the demand necessitated on several occasions.

Once the TMBL delivered empty rail containers to the Rail Loading Facility, RDC placed a 0.15 mm (6-mil) HDPE liner into each 6.1 m (20.0 ft.) open-top container that would be used for wet dredged material. A liner was not installed in containers loaded with upland excavated material. For containers loaded with asbestos contaminated material (ACM) two (2) 0.15 mm (6-mil) HDPE liners were installed to ensure proper handling at the landfill. ACM requires special handling both onsite and at the landfill. ACM must be double bagged and properly placarded to ensure proper disposal.

For the work during the upland excavation and asbestos contaminated material removal, material was loaded at the ramp located at the northeast portion of the track on the project site. The first set of rail cars were delivered to the loading area during the early morning hours ready for the lining crews start This start time gave the lining crew a jump in front of the loading crew. The asbestos contaminated material (ACM) was loaded into the first set of rail cars each day. The lining crew manually placed two (2) 0.15 mm (6-mil) HDPE liners into the asbestos containers, secured the liners to the containers and placed a sandbag in each of the four (4) corners of the container. The sandbag ensured the liners remained in the container while waiting to be loaded with material. After each container was loaded, an Envirocon employee closed the liner over the top of the material and secured the load for transport.

RDC provided an on-site representative that worked with the Envirocon staff to determine the volume of material that made up an average 31.3 to 32.7 metric tons (34.5 to 36 tons) of material in each container. Evaluating the material density, overall volumes within each container and actual weights generated at the landfill upon disposal assisted in making this determination. RDC worked with Envirocon in the handling of the ACM to ensure proper loading requirements were met. The ACM was loaded in such a way that when disposed at the landfill, the bags were not ripped or torn and the shipping containers were properly placarded.

Once the loading of the first set of rail cars was completed, RDC arranged for the second set of rail cars to be delivered and the first set taken away. This process is called a switch, the movement of rail cars from the BNSF yard to the Hylebos site and back to the BNSF yard. RDC and TMBL worked together to make the switch as smooth as possible. Although, there were times the TMBL was not able to make the switches happen at the designated time, the communication between RDC, Envirocon and the HHCG was crucial to ensure minimal delays onsite.

Figure 6. Tacoma municipal beltline railroad (Photo Courtesy of DOF, Inc.).

During the high production, in-water work window phase, the TMBL provided a dedicated engine, shown in Figure 6, to service the loading and rail car movement process. This allowed for a more consistent and reliable method of moving cars through the system as a TMBL engine is permitted to place cars on the mainline not otherwise accessed by the on-site car puller. The TMBL delivered a maneuverable amount of rail cars and containers to the Rail Loading Facility at one time and staged the first two-wells in the lining area. RDC's lining crew lined the four containers within the liner area and secured the liners to the containers and, as necessary, placed one (1) sand bag in each of the four (4) corners to ensure the liner remained within the container until loaded. The duration for the lining of four containers was on average 20 minutes. Once the liners were installed, RDC coordinated, via handheld radio, with the TMBL and the container loading operator, the movement of the rail cars forward for placement of the lined containers within the loading area, shown in Figure 7. This movement placed two more rail cars of unlined containers within the lining area. Once loaded, an Envirocon employee will secure the liner over the material in each container. These processes continued as shipping containers were filled, shown in Figure 8 and 9, and empty containers were available for loading. The TMBL was responsible for the staging of the loaded rail cars back to the Tacoma Yard where they were transferred back to the BNSF.

Figure 7. Lined railcars staged for loading from the sediment stockpile area (Photo Courtesy of DOF, Inc.).

Figure 8. 6.1 m (20.0 ft.) shipping container being loaded (Photo Courtesy of DOF, Inc.).

Figure 9. Containers loaded with dredge material (Photo Courtesy of DOF, Inc.).

Transportation to Roosevelt Regional Landfill

RDC created a new train, known as a unit train, originating from the project site, when daily quantities permitted. A unit train generally consists of 83 rail cars or 1,828.8 m (6,000.0 ft.) of train. The dedicated unit train from the Hylebos left Tacoma daily. If quantities were not sufficient to support a dedicated train, RDC transported the Hylebos material on one of RDC's existing daily trains bound for Roosevelt. This generally occurred during the upland excavation and ACM removal stages.

Disposal Operations

Once trains arrived at RDC's Roosevelt Intermodal, shown in Figure 10, the containers loaded with upland excavation (dry) material were moved by top-pick, shown in Figure 11, from the rail cars to truck chassis and then truck transported approximately 4.8 km (3.0 miles) to the landfill scales where they were weighed in. The containers were tipped at locations near the landfill working face, typically incorporating the material into the daily waste arriving at the landfill from other sources. Empty containers were returned to the scales to be weighed out then returned to the Roosevelt Intermodal for placement on the return train to Seattle/Tacoma.

Figure 10. RDC's Roosevelt Intermodal, Roosevelt, Washington.

Figure 11. Top-pick lifting 6.1 m (20.0 ft.) shipping container from a rail car.

A swing shift was added to the operating schedule at the landfill to facilitate the disposal of material from the added train the Hylebos project generated during the high production, in-water work window phase. Once the Hylebos train arrived at RDC's Roosevelt Intermodal, the containers loaded with wet dredge material were moved by top-pick and truck transported approximately 4.8 km (3.0 miles) to the landfill scales where they were weighed in as they were with upland excavated material. The containers were tipped at a dedicated dredge containment area, Figure 12, constructed over approximately 36.6 m (120.0 ft.) of previously tipped municipal solid waste. A shipping container on the self-tipper at the face of the dredge containment area is shown in Figures 13 and 14. Placing the wet dredge material over tipped waste adds moisture to the area and aids in the compaction of the material, speeding up the methane gas production. Empty containers were weighed out and returned to the Roosevelt Intermodal for placement on the return train to the Rail Loading Facility.

Figure 12. Dredge material containment area within Roosevelt Regional Landfill.

Figure 13. Dredge material being tipped.

Figure 14. Self-tipper tipping a container of dredge material.

Project Challenges

Railroad coordination was challenge throughout the course of the project. While RDC partners with BNSF and agreements were in place for the increase service requirements, the acquisition of railcars presented challenges at various times. Railcars are owned and managed by a third-party holding company separate from the railroad companies. When rail service requires additional railcars, requests are made to the holding company and railcars filter into RDC's pool of cars as they become available. As production demands grow and the request is made, it may take two to three weeks to "ramp-up" or transfer empty railcars into the RDC pool of available cars. Three-well articulating railcars are a unique specification of railcars and as an example, in a batch of six railcars the holding company has available at a given time, only one match the specifications required for dredge material.

Production schedules varied and the BNSF can only justify the need for additional railcars when productions actually exceed current productions. In order to make this justification and to facilitate rail scheduling challenges, onsite stockpile storage areas were constructed to maintain dredging and barge offloading schedules. RDC's ability to move railcars within the existing RDC railcar pool allowed rail productions to maintain efficient flow both when project production levels were slow and when production levels exceeded the maximum daily estimate.

The biggest railcar shortage challenge occurred during the 2005 season, just after the Hurricane Katrina disaster. Rail transportation equipment and services were focusing efforts on the effected regions of the gulf coast which resulted in poor service in the Pacific Northwest. It was necessary to increase the existing onsite storage and surge capacities to maintain dredging and barge offloading productions.

SUMMARY

In summary, RDC has title and ownership of just over 557,011.4 metric tons (614,000.0 tons) of contaminated dredge material and 13,154.2 metric tons (14,500.0 tons) of asbestos contaminated material removed from the Head of the Hylebos Project during the construction seasons spanning from 2004 to 2006. Figure 15 shows the containment area at Roosevelt Regional Landfill with dredge material from multiple project sources, as RDC received over 907,184.7 metric tons (1,000,000.0 tons) of dredge material over the course of two years on various projects within the region. Table 1 (Dalton, Olmsted & Fuglevand, Inc. 2006) shows actual summary quantities for all materials removed and disposed on the Head of the Hylebos Project.

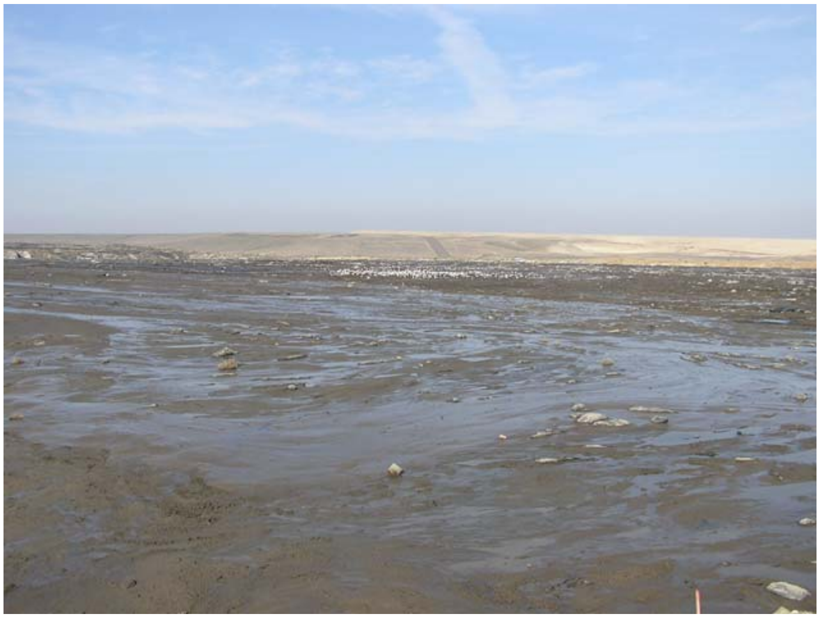

Figure 15. Sea of dredge material at Roosevelt Regional Landfill.

Table 1. Head of Hylebos rail transportation and landfill disposal quantities (Dalton, Olmsted & Fuglevand 2006).

TRANSPORTATION AND LANDFILL DISPOSAL PARAMETER	QUANTITY
Volume (in-situ) of material to Subtitle D landfill	
Marine-based dredged volume, m^3 (cy)	309,000 (404,000)
Upland-based removed volume, m^3 (cy)	11,000 (15,000)
Total in-situ volume of material to Subtitle D landfill, m^3 (cy)	320,000 (419,000)
Asbestos containing material (ACM) to Subtitle D landfill	
Marine-based ACM dredged material to Subtitle D landfill, metric tons (short tons)	5,200 (5,700)
Upland based ACM removed material to Subtitle D landfill, metric tons (short tons)	8,100 (8,900)
Total ACM removed material to Subtitle D landfill, metric tons (short tons)	13,200 (14,600)
Non-ACM material to Subtitle D landfill	
Marine-based non-ACM dredged material to Subtitle D landfill, metric tons (short tons)	534,000 (588,100)
Upland based non-ACM removed material to Subtitle D landfill, metric tons (short tons)	24,000 (26,300)
Total non-ACM removed material to Subtitle D landfill, metric tons (short tons)	557,000 (614,400)
Volume (in railcar) to Subtitle D landfill	
Marine-based dredged material railcar volume to Subtitle D landfill, m^3 (cy)	369,000 (483,000)
Containers of remediation material sent to Subtitle D landfill, by source area	
Marine-based dredged material containers	18,821
Upland-based removed material containers	1,017
Total containers to Subtitle D landfill	19,838
Containers of remediation material sent to Subtitle D landfill, ACM & Non ACM	
Non-ACM material containers	19,277
ACM material containers	561
Total containers to Subtitle D landfill	19,838

CONCLUSION

The transportation and disposal methods RDC developed for the work on the Head of the Hylebos Project was a success. The movement of wet dredge material proved to be a feasible process and the HHCG benefited from the systems established for the upland disposal of the contaminated dredge material, ACM and upland excavated material. RDC is monitoring the effects the wet dredge material has on Roosevelt Regional Landfill in relation to compaction rates and methane gas collection.

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