MUNICIPAL LANDFILL REDEVELOPMENT

FROM LEGACY LANDFILL TO WATERSHED-PROTECTIVE SPORTS STADIUM IN ASTORIA OREGON

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Landfill ReUse

INTRODUCTION

Astoria is a historic coastal town in Oregon. In 1811, just five years after Lewis and Clark wintered at nearby Fort Clatsop, it became the first permanent US settlement on the Pacific Coast. Astoria was also the home of the first US Post Office — established in 1847 — west of the Rockies. The City of Astoria (the City) began operating a municipal solid waste landfill in 1965. By 1978, uncontrolled leachate discharge to a nearby creek and wetland led the Oregon Department of Environmental Quality (ODEQ) to require closure of the landfill. Closing and capping the landfill was a long, complicated, and costly process for the City, and the closure permit from ODEQ expired in 1995 with only a small portion of the work completed.

Leachate Discharge

Astoria's location at the mouth of the Columbia River and abutting the Northern Oregon Coast Range has resulted in development constraints. When Columbia Memorial Hospital, one of the largest institutions in Astoria, needed to expand, they had very limited options. The existing hospital campus was landlocked on all sides but one. To the west of the hospital stood the local high school's outdated football facility, Warren Field.

Land Swap

A strategic plan was formulated between Columbia Memorial Hospital, the City, and Astoria School District to do a land swap with the school district for the old football field in order to expand the hospital campus. In return, Columbia Memorial Hospital would provide the bulk of the $7.5 million required not only to officially close the landfill for the City, but also to redevelop the old municipal landfill as a new, 17-acre athletic field complex to serve the school district and the entire community.

BACKGROUND

Landfill History

The City began operating the landfill as a municipal solid waste disposal and open waste burning facility. The facility accepted general household waste and certain commercial industrial waste. The primary sources of the site's industrial waste were fish and seafood processing plants and the Crown-Zellerbach paper pulp mill located in nearby Wauna. As with many mid-century landfills, the Astoria landfill was unlined. It was also located in a natural ravine at the confluence of two creeks, West Craig Creek and East Craig Creek, which capture runoff from a nearly 200 acre watershed. Flows from these two creeks, along with surface runoff and groundwater, fed the 6+ acre Craig Creek Wetland (*see* Figure 1). The water flows through the Craig Creek Wetland and outfalls to Youngs Bay, which then flows to the Columbia River.

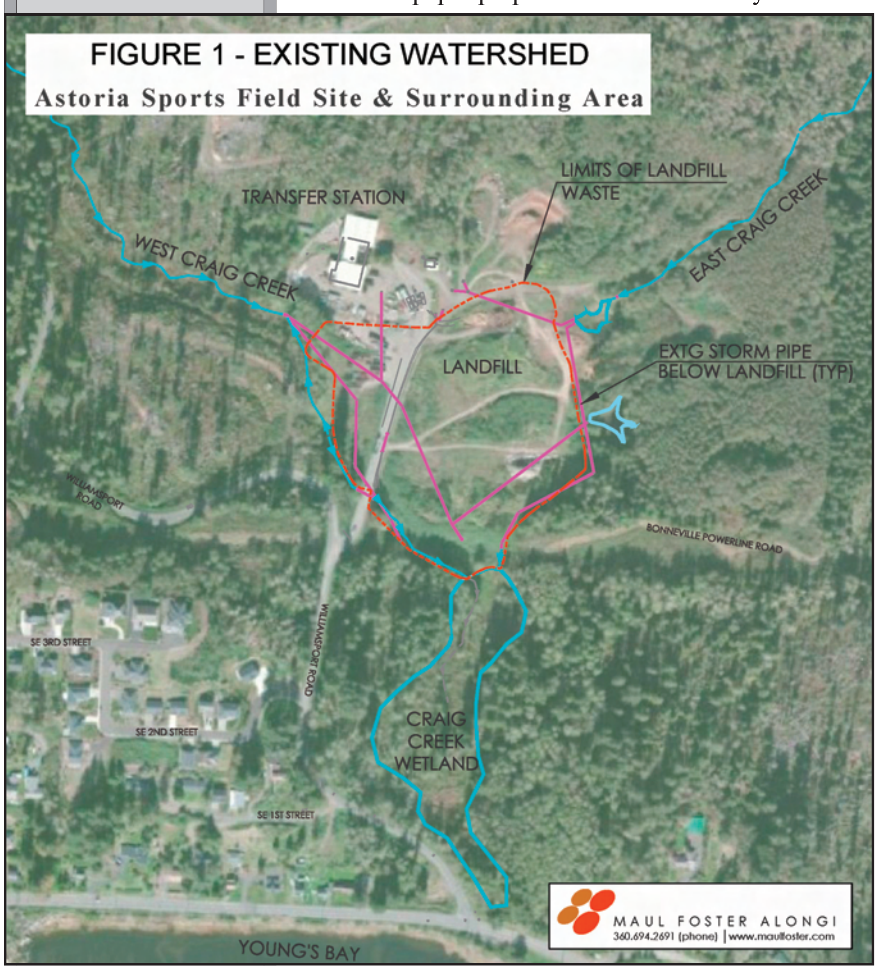

FIGURE 1 - EXISTING WATERSHED
Astoria Sports Field Site & Surrounding Area

When the landfill was originally constructed, drainage pipes were installed in the bottom to convey the flows from West Craig Creek and East Craig Creek through the landfill and then discharge to the wetland. Over the years of operation, the depth of waste reached 60 feet in some areas of the landfill. This weight can compress the drainage pipes beyond their design strength and lead to separation at the pipe joints. The condition of the drainage pipes was unknown, but there was a high probability that contaminated leachate was leaking into the pipes and reaching the wetland downstream.

The location of the landfill in a ravine and the condition of the aging drainage pipes led to problems with control of landfill-created leachate, which derives from surface water or groundwater that has come into contact with the landfill waste and leached out some of the constituents. Because of this issue, ODEQ (the regulatory agency with jurisdiction over the landfill) required the City to close the landfill. However, because there were

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limited alternative solid waste disposal options, the landfill was allowed to operate on an interim basis. A solid waste transfer station, now operated by Recology Western Oregon, was finally constructed in 1985, immediately northwest of the landfill. ODEQ issued a closure permit in 1986 and the landfill stopped accepting waste. As with many small communities, the City was financially unable to proceed with ODEQ's requirements for the official landfill closure. For more than 30 years the landfill was a cost and liability posing substantial watershed risk.

Integrated Design

PROJECT APPROACH AND DESIGN STRATEGY

The project approach and strategy were to integrate landfill closure design elements with the proposed development of the athletic field complex. Not only would the final closure elements and athletic field complex improvements be constructed concurrently, but both projects could undergo a single agency review.

Redevelopment Interests

Maul Foster & Alongi, Inc. (MFA) was retained to design the closure and redevelopment of the landfill because the firm offered a diverse array of solid-waste experience and brownfield redevelopment design, as well as an integrated approach that combines engineering and environmental science. MFA worked with the City, the school district, Recology Western Oregon, and Columbia Memorial Hospital to meet ODEQ requirements for official closure, minimize the future creation of leachate and associated potential contamination, and provide the community of Astoria with a long-lasting and safe sports facility.

The new athletic field complex was programmed to include a 1,200-seat grandstand building with restrooms and concessions; surface parking for over 400 vehicles; an auxiliary locker room building with equipment storage, home and visitor locker rooms, and coaches' offices; and synthetic turfed football field, baseball field, softball field, and soccer field (*see* Figure 2).

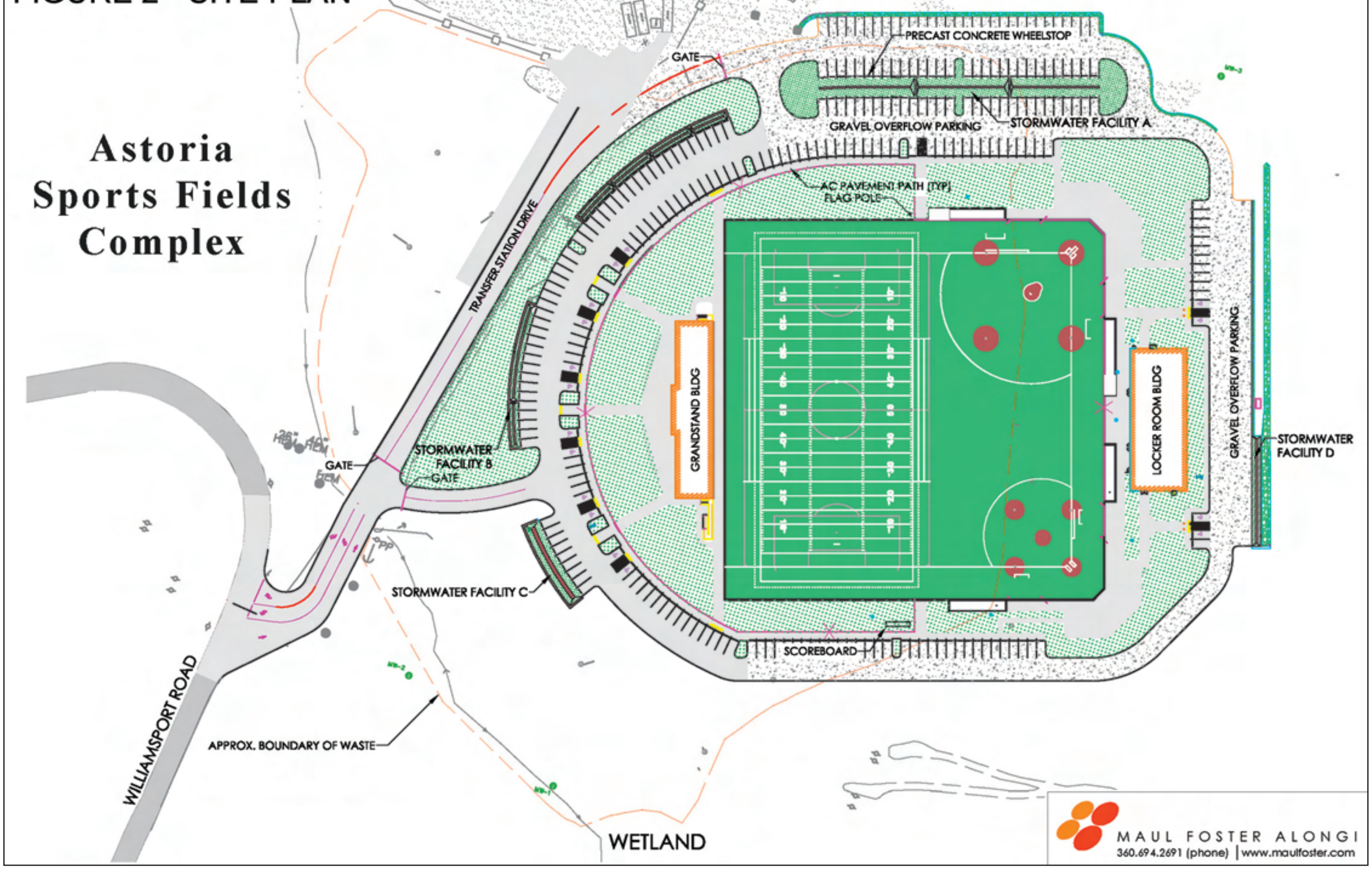
The facility design was also required to include:

- An off-site, gravity sanitary sewer main
- Potable water and sanitary sewer services
- On-site stormwater collection, conveyance, and treatment systems

Contamination Analysis

Field testing indicated that the site's groundwater and surface water had been contaminated with elevated concentrations of toxic metals, ammonia, and other contaminants. Methane had also been detected in soil gas at potentially explosive concentrations. The facility design was also required to include measures to prohibit leachate creation and to protect against exposure to methane gas.

FIGURE 2 - SITE PLAN



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Leachate Control

Differential Settlement

To minimize the creation of leachate, the design included multiple measures: rock preloading; a grading scheme to promote positive drainage; impervious cap material and liners; impervious surface covering in high-traffic areas; and a sealed stormwater collection, conveyance, and treatment system. Since the development was to take place on top of a landfill, one major influence on the design of the facility was the consolidation of the landfill waste in the future and the potential of differential settlement (unequal settlement of the material in the subgrade). This fact had to be considered in the design of all proposed improvements above the 12.5-acre footprint of the delineated landfill. Settlement of landfill waste is inevitable, even after 30 years. If this settlement is not considered when leachate control measures are selected, then those measures may fail after settlement occurs. To minimize future settlement, 35,000 tons of rock was placed on the landfill as a preload to compact the waste. The preload was placed in three phases, each for a minimum of three months. Pre- and post-load surveys of the settlement plates found settling amounts ranging from nearly zero up to one foot.

Preload Placement

Drainage Design

The first round of defense against leachate creation was a grading design that promoted positive drainage. The grading design utilized a minimum slope of one percent for paved surfaces and two percent for landscaped surfaces. The exception to this scheme was the slope of the synthetic turf field. The field is 400 feet long, and a two percent slope from one end to the other would yield an unacceptable elevation difference of eight feet. For an athletic field, the grade must be nearly unnoticeable to players, yet steep enough to allow for proper surface water drainage. The design team worked with ODEQ to obtain approval of a 0.5 percent design slope, but with some additional measures of protection.

Soil Cap & Liner

Several low-permeability layers were used to both combat leachate creation and control the landfill-created methane gas. The entire area of the delineated 12.5-acre landfill was capped with a minimum 30 inches of low-permeability clay soil, required by ODEQ to have a hydraulic conductivity of less than 1 x 10^{-6} cm/sec. This soil cap acts as an impervious layer to stop surface runoff from reaching the waste and creating leachate. It also acts to inhibit methane gas from migrating to the open air and to minimize human exposure. There was some public concern regarding health issues related to locating a youth sports facility on a former landfill site. So in addition to the clay soil cap, the client chose to install a linear low-density polyethylene liner under the synthetic turf field to provide an extra layer of protection against both leachate creation and methane gas migration. Asphalt was used as an impervious surface cover on the access road, drive isles, main parking area, and walkways around the complex. Asphalt, instead of traditional cement concrete, was selected for the walkways because it is much easier to repair if any future settlement occurs.


Pre-Development


Opening Day

Stormwater Design

The design of the stormwater collection, conveyance, and treatment systems was a major undertaking, and several factors led to the final system layout. The first factor was the site location. Astoria, being a Pacific Northwest coastal community, is subject to large rain events. So the collection and conveyance system had to be sized to convey the stormwater runoff from the ten-year storm event (five inches in 24 hours) without surcharging (stormwater overfilling the pipes and backing up) in the system. Consideration was also given to the 100-year storm event (6.60 inches in 24 hours) runoff. Since the site is located at the bottom of a ravine, the design of the collection and conveyance system had to consider not only runoff from the new facility but also run-on from the entire watershed above the site. The collection and conveyance system was broken into two systems, each flowing on either side of the site, emulating West and East Craig creeks. The collection system for the athletic field complex includes area drains and catch basins, while the collection system for run-on from the upstream watershed includes rock-lined v-ditches.

In addition to surface run-on, groundwater flow was a concern. A large groundwater interceptor trench (4-foot-

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Stormwater Design

wide by 12-foot-deep trench with perforated pipe and rock backfill) was installed on the uphill side of the athletic fields. Stormwater runoff from the impervious portions of the site that are subject to vehicular traffic is conveyed to one of four stormwater quality treatment biofiltration facilities (Stormwater Treatment Facilities A-D) around the perimeter of the parking area. All of the biofiltration facilities are lined with 20 millimeter-thick polyvinyl chloride and have perforated pipe underdrains to prevent infiltration of the stormwater. Stormwater runoff from the pervious synthetic turf field percolates through a sand layer under the turf. The water moves through gravel under the sand, into low-profile drain piping, and is conveyed to the on-site storm system via a 12 inch-diameter header pipe. All stormwater runoff is conveyed in watertight, high-density polyethylene pipes and, after treatment, discharged to the Craig Creek Wetland maintaining the historical flow path of the watershed.

Wetland Impacts

Leachate Creation

Since the landfill had been sited in a ravine with a confluence of two creeks, the fill created two ponds immediately adjacent to the east of the landfill. Over time, these ponds developed some wetland characteristics. In addition to the ponds, there was a 360 linear-foot, open channel section of West Craig Creek that flowed through the delineated landfill limits of waste. To officially close the landfill and prevent the future creation of leachate, it would be necessary to fill in the ponds and install piping in the open-channel section of West Craig Creek. These impacts were mitigated by daylighting an approximately 1,000-foot section of East Craig Creek currently piped under the landfill. These areas provide limited wetland functions and values. The lost wetland functions and values were replaced through the Oregon Department of State Lands In-Lieu Fee (ILF) Program. The ILF program involves mitigation banks where large wetlands have been restored or created to generate wetland credits for sale to developers who need to offset unavoidable impacts to waters of the state. A total of 0.29 acre of credits was purchased, at an approximate cost of $21,750, to mitigate the 0.29 acre of impact. More information on the ILF program can be found at www.oregon.gov/dsl/PERMITS/Pages/mitbank_intro.aspx or www.aswm.org/pdf_lib/final_fil_instrument_dec_2008.pdf.

Mitigation Banks

Other Design Features

Unique Design Features

The project had many unique features that were incorporated into the design.

- The grandstand building was built on grade beams and steel piles through the landfill waste and into bedrock 100 feet below the surface to minimize the effects of settlement.
- Multiple membrane liners were used (liner low-density polyethylene, high-density polyethylene, and polyvinyl chloride).
- Where possible, native clay was used for a landfill cap.
- Native clay dams were used in the utility trenches to prevent landfill gas migration off site.
- Gravel surfacing was used for the overflow parking area to allow for easy repair of any areas of future differential settlement.
- The off-site sanitary sewer main was installed using micro-tunneling (remote controlled pipe jacking method without open trenching) to minimize impacts to the adjacent wetland and to reduce construction costs.
- Precast concrete wheel stops were installed instead of solid concrete curb to decrease the likelihood of vehicle damage due to differential settlement.
- A passive gas system (system without blowers or fans to extract the gas) was utilized at the building structures and piped to the rooftops to vent landfill gas to the atmosphere far above the public's breathing zone.

OUTCOMES

Public-Private Partnership

This project is a great example of an innovative private-public partnership and how a brownfield can successfully be redeveloped into a functional piece of property for the community. All parties involved in the project benefited from the redevelopment.

The City was able to close the municipal landfill and meet the requirements of official closure ordered by ODEQ. They were able to terminate the industrial stormwater discharge permit and ongoing monitoring that was required with the open landfill. They decreased the risk of hazardous landfill leachate creation polluting downstream waters.

The Astoria School District now has a new athletic field to replace the outdated football field. They now have a facility capable of hosting regional and state athletic events, as well as the potential to generate revenue for the district with the ability to rent out the facility for events.

The relocation of the sports field will allow Columbia Memorial Hospital to move forward on a much-needed expansion in the future. This expansion will allow the hospital to provide new services such as cancer diagnosis and treatment, eliminating the need for patients to travel 90 miles to Portland or 45 miles to Longview for treatments. Construction of a new cancer center would increase employment in the community and provide year-round jobs.

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Sanitary Sewer Main

The 1,400-linear-foot sanitary sewer main that was installed to serve the athletic field complex also now serves Recology Western Oregon. Before the installation of the sanitary sewer main, water used to clean the garbage collector tipping floor was directed to a holding tank, then transported to a wastewater treatment center. This process was both costly and a major inconvenience for the facility. The transfer station also now has a safer intersection at Williamsport Road (which had been a high-risk blind corner), as well as a paved access drive for the transfer station clients and service truck drivers.

Environmental Benefits

The Community of Astoria is the real winner in this story. It now has a public accessible event space and a place of pride where they can watch their "Fighting Fishermen" high school teams. Closure of the landfill will minimize the possibility of contaminants from the former landfill leaching into the downstream wetland that leads to Youngs Bay and the Columbia River. Protection of these resources is important not only to the environment, but also to the continued success of Astoria's fishing-based economy.

CONCLUSION

Social Benefits

The Fighting Fishermen's new home stadium, CMH Field, exemplifies the many benefits of multiple public and private parties coming together in the redevelopment of a brownfield to better their community. In addition to capping and closing an inactive municipal landfill, the new athletic field complex has created a potential source of revenue for the Astoria School District, while freeing developable land for a much-needed expansion of the community hospital.

For Additional Information:

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As this issue goes to press, we have received word that the redevelopment project described in this article has received the Phoenix Award for US EPA Region 10. This annual award by the Phoenix Award Institute is given in recognition of "exemplary brownfield redevelopment and revitalization. Winning projects offer a fresh take on significant environmental issues, show innovation, and demonstrate masterful community impact."

Congratulations to All Involved!

Stacy Frost has over 14 years of experience in civil engineering and has been heavily involved in brownfield redevelopment. He has led project teams in the design of park, commercial, residential, education facility, light industrial, heavy industrial, waterfront, and port developments. His experience includes site development master planning, utility system master planning, transportation system master planning, street design, water system design, sanitary sewer system design, storm drainage system design, grading design, earthwork analysis, erosion control design, stormwater analysis, and permitting. Throughout his career, Mr. Frost has had the opportunity to design and manage a wide variety of projects ranging from small commercial developments to large industrial subdivisions. He has worked closely with both large and small project teams to develop design concepts, meet the needs of the clients, and help create developments that benefit the community.

Neil Alongi's expertise includes industrial facility siting and expansion, solid- and hazardous-waste facilities, and industrial wastewater and stormwater management. He has been the project manager and lead engineer for multimillion-dollar industrial siting projects involving master planning, permitting, civil design, and construction management. He produces high-quality designs that can be permitted and constructed within a project's time and budget constraints. He has served as an expert witness for a variety of legal proceedings, and has testified at and conducted numerous public hearings for various types of projects.

