

## REDEVELOPING LANDFILLS INTO GOLF COURSES

An article in the *Wall Street Journal* reported on plans for the redevelopment of a Superfund site a short boat ride from Manhattan, New York, into a world-class golf club. In Newport Beach, California, plans are under way to redevelop the Coyote Canyon landfill into an upscale golf course.

Coyote Canyon, a Class III solid waste sanitary landfill, was used for the disposal of roughly 60 million cubic yards of nonhazardous and inert refuse from 1963 until it was closed for general use on March 3, 1990. Small amounts of trash, some 750 to 1,000 tons per day, were then accepted for slope trimming at the roughly 300-acre landfill until the site was permanently closed on March 20, 1990.

These projects demonstrate the growing interest in reclaiming real estate formerly occupied by municipal and other types of landfills. Regulatory programs are changing to offer both opportunities and new challenges for converting old landfills into productive real estate developments. One trend that continues to be popular is the redevelopment of landfills into golf courses.

### LEGAL ISSUES

Redeveloping landfills into golf courses or other productive uses can provide excellent potential commercial and/or community benefits. Redeveloping old landfill sites, however, poses various challenges. From the legal perspective, several issues must be addressed. In particular, liability concerns regarding potential environmental claims under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or Superfund) can dissuade private developers and their lenders.

Changes to CERCLA in 2002 offer some liability protection for those who qualify as bona fide prospective purchasers of property where historical releases of hazardous substances may have occurred. Under Section 222 of the Small Business Liability Relief and

Brownfields Revitalization Act, a prospective purchaser can receive liability protections if specific conditions are met:

- Purchaser makes "all appropriate inquiry" into past uses of the site.
- Purchaser complies with any duties to report what is discovered and cooperates with the authorities.
- Purchaser complies with deed restrictions and controls, such as maintaining or improving landfill cap.
- Purchaser exercises appropriate care regarding the site, including taking reasonable steps to limit threats to human health and the environment.

Prospective purchasers of a closed landfill site probably can meet these conditions if they are prepared to meet the technical challenges of landfill redevelopment, including providing for mitigating methane gas hazards and providing for proper foundations.

### TECHNICAL ISSUES

As it ages, solid waste in a landfill decomposes and consolidates. Active settlement can take place for many years, depending on the depth of the trash fill, the types of waste present (construction and demolition waste versus municipal solid waste), and the method of placement (trench versus area fill). Before buildings or other improvements can be constructed on a site, estimates of expected settlement must be made based on experience, empirical settlement observations, and numerical models.

Heavy loads will surcharge the waste mass and accelerate consolidation and settlement. Many site operators stockpile cover soils or excess waste on portions of the landfill before final closure; such operating practices should be identified and considered when estimating settlement and differential settlement rates.

Although some buildings have been constructed using floating foundations (normally after replacing a few feet of the underlying trash with structural fill), most larger buildings and sensitive structures constructed on landfills use deep foundations (piles or caissons). A combination of the two approaches has

been used over old shallow landfills, in which building walls are constructed on piles or caissons and a floating slab is used for the building floor.

The result often is a stable building, surrounded by a settling ground surface as the underlying landfill consolidates. At one California landfill, a hinged slab was connected to a retail building on one side, and allowed to "float" with the land surface on the other side. If settlement causes the slab to sink too far on the floating side, it can be jacked up and the land surface regraded to create a proper entranceway to the building.

Where utilities enter natural ground or fixed structures supported on deep foundations, allowance must be made for differential settlement. Flexible utility connections have been developed for such applications. Pipe runs beneath buildings constructed on deep foundations should be hung from the overlying structural concrete slabs with noncorrosive hangers and surrounded by noncohesive backfill material. Otherwise, settlement of the underlying fill could pull the pipe away from the building.

### INCORPORATING PROTECTIVE MEASURES

As solid waste decomposes, landfill gas (LFG), consisting primarily of methane and carbon dioxide, is produced. If allowed to accumulate within a confined area in the presence of an ignition source, methane, which can explode, presents a fire hazard. Any improvements constructed on or near a landfill should incorporate appropriate LFG protection measures.

Several approaches are available to protect structures from LFG. Active control technologies include LFG extraction (normally followed by flaring, if gas production rates warrant treatment) to remove LFG before it reaches structures, and air injection or air curtain systems to create positive pressures, driving LFG away from structures.

Passive control technologies include use of membrane barriers and vents to prevent LFG from entering structures, and monitoring and alarm systems to warn of accumulating LFG. Passive

systems are commonly used where the landfill is old, and most of the decomposition has occurred (LFG production rates are low). Passive systems also may be appropriate where the building will have limited usage or is of open construction (open parking structures having six or more air changes per hour).

LFG control systems protecting higher occupancy buildings often have redundant systems (barriers, active extraction, and monitoring alarms), especially when the landfill is not old. Special care must be taken where utilities or other site features penetrate barrier systems; LFG will follow preferential flow paths along utility trenches and enter buildings at points of penetration unless properly sealed.

LFG protection systems require proper operation, monitoring, and maintenance. Monitoring alarm sensors can become "poisoned" by LFG constituents and rendered useless. LFG condensate and corrosive gas constituents can affect mechanical systems. As the closed landfill ages, LFG production patterns change, requiring adjustments in extraction system operation.

### CASE STUDY: INDUSTRY HILLS

The Industry Hills Recreation and Conference Center is located on the same development as two of southern California's prestigious golf courses. The development, some 10 miles east of downtown Los Angeles, also contains a conference center, Olympic-sized swimming pool, tennis complex, equestrian center, laundry facility, and 11-story hotel.

The 617-acre site includes 155 acres formerly used for sanitary land filling purposes between 1951 and 1969. About 3.6 million tons of municipal waste was deposited into the landfill, which has an average refuse fill depth of approximately 35 feet.

The LFG management facilities at the project consist of two main systems, with the initial installation in February 1974. The first system prevents methane gas from accumulating beneath on-site structures and migrating beyond property lines. Migrating LFG is collected and then destroyed at a blower/

flare station capable of burning 500 cfm of LFG.

The second gas control system was designed for LFG energy recovery. While this system aids in LFG migration and surface emission control, it also supplies medium Btu fuel for convention center boilers and water heaters for the pool and laundry complex. The LFG process facility compresses and cools the gas to remove free liquids and is capable of supplying approximately 2,100 MM Btu fuel each month. This saves the city of Industry roughly \$10,000 to \$15,000 each month in displacing natural gas demands.

Operation and maintenance of the gas system are regulated by strict guidelines from a number of state and local enforcement agencies. In addition to these guidelines, the design engineers have developed operating criteria that present unique challenges to the facility's operators. Some of the major challenges are health and safety; coordination with numerous on-site personnel, such as security guards and ground maintenance crews; odor control; and maintenance repair and access.

### THE FUTURE OF "GREENS" REDEVELOPMENT

The challenges inherent in redeveloping a closed landfill are substantial. Experience has shown, however, that the health and safety issues and technical challenges of long-term and differential settlement, unstable foundation conditions, and LFG control and protection are solvable in most cases. On the other hand, legal liability challenges continue to present impediments to landfill redevelopment.

Recent brownfields policy initiatives at the federal and state levels, coupled with increasing experience on the part of national lending institutions, suggest that such impediments also can be overcome. With the proper planning mechanisms and resources in place, the redevelopment of brownfields into "greens" can continue to be successful.

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## BROWARD COUNTY ENCOURAGES ENVIRONMENTAL STEWARDSHIP WITH MAKEOVER CONTEST

Rather than enacting new restrictions or facilitating public debate, Broward County, Florida, took a unique approach to protecting the environment. The county sponsored a contest called the NatureScape Makeover to educate residents on water conservation, pollution, and wildlife habitat preservation.

The contest was similar to popular TV makeover shows. Using NatureScape Broward landscaping principles, a team of landscape experts will design the grand prize winner's yard. The design is likely to showcase such ideas as mulched beds of native plants that require little to no water or fertilizer, native shade trees placed to reduce air-conditioning costs, a wildlife habitat—including a water feature for butterflies and birds—and an ultra-efficient irrigation system that waters in zones according to plant needs.

NatureScape Broward is an outreach program that helps residents create and maintain environmentally friendly, water-wise yards. There are more than 1,100 certified NatureScape yards, school, and businesses in Broward County. The program is run by the county commission's water resources division.

The contest ran September 1–30, 2005. The winner was announced in November, and the yard transformation—worth up to \$50,000—was scheduled to take place in February 2006. For more information, call NatureScape Broward at 954/519-0317 or visit the Web site at [www.broward.org/naturescape](http://www.broward.org/naturescape).

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