CHAPTER VI

FACILITIES SITING AND HEALTH & ENVIRONMENTAL ISSUES

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Environmental Toxicology International, Inc. (ETI) was asked by the Delaware Solid Waste Authority (DSWA) to prepare a detailed report that evaluates siting, health, and environmental issues associated with solid waste management facilities. Release of the DSWA Draft Final Solid Waste Management Plan in December 1992 generated public concerns and criticism that these issues were not properly addressed by the Authority. The following is an Executive Summary that reviews available siting criteria for waste management facilities, and summarizes the environmental and public health impacts associated with both municipal solid waste (MSW) landfill and energy recovery facilities. Accompanying this summary is a technical report (Appendix H) that expands on these issues and provides specific references for information sources.

A. FACILITY SITING

One of the most controversial and complex steps in devising a MSW management plan is the facility site selection process. Site selection is a step-by-step process, in which environmental, engineering, and socioeconomic criteria are assessed. Development of a standardized site selection process by enlisting the support and knowledge of public, regulatory, and private industry representatives can greatly expedite the siting of a new facility.

The purpose of the site selection process is to examine data regarding a predetermined set of selection criteria in order to locate sites where conditions are suitable for the development of a new facility.

Site Selection Criteria

The impacts of a facility are highly variable, both on a site-specific basis and within the political and economic framework in which it occurs. There are many possible site selection criteria, yet some states have no siting criteria, while others may use only one or two of these criteria. Site selection criteria may be categorized into five types. The following are examples within each category:

1. Environmental and resource parameters: Wetlands, endangered and threatened species habitat

2. Public health parameters: Odor, noise

3. Facility siting parameters: Access to highways, land acquisition factors

4. Socioeconomic parameters: Proximity to residences, schools, agricultural areas, historical and cultural areas

5. Technical siting parameters: Depth to aquifer, flow direction and speed of groundwater.

Public Involvement

Influence of public participation on siting success may be less dependent on the number of different opportunities for participation offered, than on the actual manner in which participation is incorporated into the process. A single, effective opportunity for public participation may be the key element. The more the public is involved through representation, education, and consensus, the more trust is developed in the legitimacy of the process. Some examples of public involvement are:

1. Use of a siting board with local representatives for siting application review

2. Technical assistance for host community, i.e., providing access to scientific and engineering information

3. Economic incentives for host community

4. Use of negotiation or mediation with the host community

5. Local decision-making or monitoring authority.

6. There are examples of states that have followed some aspects of public involvement that have not been successful.

7. The community can hire an independent representative, or set up a citizen's monitoring committee. Community representation could be ensured by including a locally-appointed participant on a management team or oversight committee.

Some states and local governments also include the following areas as an opportunity for community involvement:

1. A review of the facility owner's past and prospective performance, including oversight by regulatory officials.

2. Development of provisions concerning what type of waste is accepted: the composition, quantity (which can indirectly put a ceiling on facility size), and origin.

3. Determination of the facility's impact on the community. This includes definition of a "buffer zone" or "setback zone" for hydrogeological, aesthetic, or any of the other criteria. Also included is a community representative for creation of a community "benefits package", discussing the issue of property values, and mitigating nuisance complaints.

4. Long-term planning to include environmental protection, environmental equity, a post-closure environmental trust fund, post-closure use of the site that is acceptable to the community, and long-term land use planning so the community does not become a Locally Undesirable Land Use (LULU) area.

The DSWA Board of Directors is the voluntary citizens board for siting facilities in the State of Delaware. The Board has been successful at siting three facilities through a series of steps that include development of criteria for a site, ranking procedures, and participation at public hearings and meetings.

Selection Methodology

A typical first step in site selection is to define the study area. This study area, or "host community," may cross voting jurisdictions, and political, municipal, and economic boundaries. The study area can be a local municipality, county, or the entire state, which would be served by the facility. Definition of the study area is followed by setting the data within the study area. In this step, sources, quantity, and composition of the waste stream are defined.

The next step is regional screening, a procedure used in the State of Delaware. Regional screening results in identification of a few areas for potential sites. This restricts the more detailed and costly evaluation which follows to relatively few sites. The two major ways the site selection criteria are applied to the region are 1) suitability mapping, and 2) numerical ranking (e.g. a weighting procedure). Sometimes these applications are combined using a matrix of site criteria.

Once the regional screening has produced a group of final sites to consider, detailed environmental assessments of the sites are performed. Some states require a formal Environmental Impact Assessment, or Environmental Impact Report.

Historically, the site selection process has tended to stimulate community discord. Whether this is characterized by communication problems or debate over other issues concerning the host community, it is a response to the legitimacy of the siting itself. Environmental equity, or "geographical fairness", is another aspect of siting that is widely endorsed by the public and addressed by some states, but with the specifics still under debate. To address this issue specifically, as well as the site selection process in general, experts agree that more is needed than public relations, education, and increased economic incentives. The process needs to be consensual to be perceived as legitimate by the public.

Measurement of Environmental and Public Health Impacts

Current federal and state requirements for measurements of environmental and health impacts for MSW facilities are primarily based on location, ambient air, and emission standards. Environmental impact assessments or risk assessments for landfills and MSW combustors are sometimes completed for federally funded facilities under the National Environmental Policy Act (NEPA) or are required by individual states. In general, federal siting and permitting procedures associated with environmental and public health impacts of MSW landfills fall under the Resource Conservation and Recovery Act (RCRA), whereas procedures for permitting MSW combustors fall primarily under the Clean Air Act (CAA). Specifically, 40 CFR Part 258 (i.e., Section 40 of the Code of Federal Regulations) provides restrictions on the location of landfill facilities relative to airports, floodplains, wetlands, fault areas, seismic impacts zones, and structurally unstable areas.

Federal procedures for siting MSW combustors focus primarily on impacts associated with stack emissions in the form of ambient air and emission standards. All major stationary sources must comply with pre-construction permitting requirements under the CAA. National Ambient Air Quality Standards (NAAQS) are the basis for controlling pollutants within a particular location area. In addition, 40 CFR Part 60, Subpart Ea applies specifically to MSW combustors and provides emission standards for metal particulates, dioxins and furans, sulfur dioxide, hydrogen chloride, nitrogen oxides, and carbon monoxide.

The Delaware Department of Natural Resources and Environmental Control (DNREC) permitting requirements for landfills and MSW combustors include a variety of prohibitions as part of their current siting criteria. For both facility types, applicants must provide an environmental assessment that demonstrates the proposed facility will not impact the environmental quality (i.e., air, water, and public health and safety) in the vicinity. In addition, DNREC policy for permitting of any facility with air emissions considers maximum off-site air impacts with respect to human health.

B. IMPACTS OF MSW LANDFILLS

Landfilling is still the dominant method of MSW disposal in the U.S., although many regions are running out of sites as older facilities are being closed for environmental reasons and sitings of new facilities are often met with public resistance. The more severe environmental and health impacts discussed herein are associated with MSW landfill leachate and gas emissions from older, poorly operated facilities. Historically, landfills were open, often burning, city dumps and very few remain in operation. Open dumps were traditionally associated with vermin, odors, windblown trash, and other nuisance impacts. Current regulatory requirements for modern sanitary landfills are designed to minimize these impacts and contain MSW in a safe and healthy manner. Liners, leachate collection, and recirculation systems are used to prevent leachate contamination of groundwater and enhance its biodegradation, and gas collection mechanisms serve to reduce air impacts and sometimes to generate energy. Nevertheless, the potential long-term impacts of sanitary landfills on the environment and public health are important to consider when comparing with other waste management alternatives.

Environmental Impacts

The primary environmental impacts associated with older MSW landfills include leaching of contaminants into ground and surface waters, and gaseous emissions to air. Other environmental concerns include potential adverse effects on fish and wildlife, and nuisance aspects such as odor, windblown litter and dust, noise, truck traffic, unsightly views, and birds, vermin, and insects attracted to the waste. The following discusses these potential environmental impacts.

Leaching is the mobilization of contaminants that occurs due to rainfall or snowmelt infiltration through landfilled MSW. If leachate is not collected, subsequent groundwater pollution can impact the quality of surface water and water wells, which can in turn affect fish and wildlife and eventually human health. Subsurface migration of leachate through soil can be slow, thus the consequences of inadequate leachate controls usually become evident several decades later. Rainwater run-off from a MSW landfill can also be an environmental concern at locations with heavy rainfall or flooding conditions if not controlled. In these locations, polluted run-off can deposit directly into surface water-bodies, such as rivers, creeks, and wetlands, causing oxygen depletion and the killing of fish and other freshwater organisms.

Landfill gas impacts the environment in several ways if not collected. The generation of gases at MSW landfills results primarily from biological processes, although gas can also be generated as waste items volatilize and chemical reactions occur. Gases released will migrate through the waste vertically or laterally into the soils of adjacent areas. The primary gas associated with decomposition of MSW in landfills is methane. Besides its contribution to greenhouse gases, the most common environmental effect of methane gas generation is damage to surrounding vegetation. Fires and explosions within confined spaces have also been reported in sewers and basements where methane has migrated from a nearby landfill.

Vertical and lateral expansion of sanitary landfills may have impacts on the balance of local ecosystems through loss of habitat for wildlife and vegetation. The presence of a landfill can also enhance the populations of select wildlife species. Undisturbed buffer zones surrounding a landfill facility can act as a protected habitat for deer. In Alaska, the scavenging behavior of bald eagles has led to population enhancement in the vicinity of a community garbage dump. The attraction of vermin and insects to MSW landfills for feeding and breeding can sometimes act as disease vectors posing a potential threat to human health. It has also been reported that scavenging birds such as seagulls constitute a problem during take-off and landings at adjacent airports, making siting near an airport undesirable.

Landfill facilities are often considered a source of noise due to increases truck traffic. Noise largely stems from emptying of collection trucks and the use of compactors and heavy earthmoving equipment on site. Quantities of birds attracted to waste may also produce a significant noise nuisance. The quality of residential and/or recreational areas may be impacted by unsightly views associated with the existence of exposed waste piles, waste trucks, and compactors. Windblown litter and dust can also be considered a nuisance. The former history of a site including past site-use will tend to play a role in the acceptability of views for a particular area. In addition, daily cover and tidy operation and maintenance schemes may effectively reduce these impacts.

Natural disasters, such as floods, may cause indirect environmental effects by increasing the potential spread beyond landfill boundaries of pathogens that exist in garbage. When siting landfill facilities, flooding potential of an area as well as seismic assessments and fault locations are usually considered so as to prevent such impacts.

Public Health Impacts

Potential public health impacts associated with older MSW landfills are traditionally linked with leachate contaminated groundwater; however, if requirements under RCRA Subtitle D are met, public health impacts are expected to be minimized. Given somewhat less attention are the potential health effects associated with gaseous emissions, disease vectors, and fires. With the exception of human exposure to contaminated drinking water, occupational exposures to landfill workers are expected to be greater than to off-site residents.

Modern MSW landfill facilities are designed with liners equipped to collect landfill leachate, preventing contamination of ground and surface waters. Recirculation of collected leachate has been shown to enhance biodegradation processes, hence modern operations typically collect and recirculate leachate prior to treatment. Recent research also indicates that landfills operated with leachate recycle can decrease the mobility of many toxic metal species and reduce the leachate concentrations of several chlorinated species.

Exposures to landfill leachate can be of potential human health impact if released to groundwater, both chemically as well as microbiologically. Some organic compounds can occur naturally, but many are associated with the increase in chemical manufacturing that has occurred in the last 50 years. Many man-made organics found in MSW leachate in trace concentrations are of potential concern due to their toxic, carcinogenic, or mutagenic properties, and their potential persistence in the environment. The presence of heavy metal contamination is largely a function of leachate characteristics such as pH, flow rate, and the presence of other compounds. Heavy metals frequently found in leachate include zinc, copper, cadmium, lead, nickel, chromium, and mercury. A potential for human health impacts associated with pathogens present in leachate is also of concern, although several studies indicate that the likelihood of significant numbers of microbes being transported in landfill leachates upon release is remote.

Another potential source of health risk at sanitary landfills is due to the emission of air pollutants. Of primary concern is the explosive nature of methane in confined spaces. Other important landfill gas compounds are volatile organic compounds (VOC) and potentially toxic organic compounds such as vinyl chloride. Health impacts associated with odorous sulfur compounds are expected to be minimal at normal dilution rates. Research has indicated that vinyl chloride can be formed in landfills during decomposition of MSW containing small quantities of chlorine, typically found in common cleaning solvents. Other compounds such as benzene, carbon tetrachloride, dichloromethane, and toluene have also been detected in landfill gas samples. Research has shown that high concentrations of organic chemicals in landfill gas typically decrease rapidly in the surrounding areas. Thus, when gas emissions are collected and treated at modern facilities, health risks fall within an acceptable range.

Rodents, birds, and insects attracted to decomposing MSW can act at disease transmitters, resulting in a significant impact to public health if not adequately controlled. Seagulls feeding on landfills have been known to carry salmonella, and rat reduction efforts and daily covering of waste is frequently required at landfill locations.

Several types of fires can occur at MSW landfills, posing a potential health concern to workers in particular. Oxidation of refuse can generate heat to the point of combustion if a continuous source of oxygen is available. Surface fires can also occur at the tipping area when burning refuse is dumped from a vehicle. However, well operated landfills that provide daily cover have virtually no fires, as demonstrated in the State of Delaware where there have been no fires in twelve years of modern landfill operations.

C. IMPACTS OF MSW ENERGY RECOVERY FACILITIES

Although landfills have been the solid waste management option of choice historically, energy recovery has increasingly been explored as an alternative waste management option. Public concerns over the environmental impacts of landfills and the availability of better pollution control devices for incinerators have also supported energy recovery as a solid waste management option. Newer facilities with modern pollution control devices (e.g., fabric filters, scrubbers) typically achieve state-of-the-art rates of particulate and gaseous emissions. Older facilities with less emissions controls, or no controls, frequently fail to achieve such low emission rates. Concerns over environmental and health impacts generally have arisen over emissions from these older facilities.

Environmental Impacts

In general, plants and animals in terrestrial habitats can be exposed directly to the same concentrations of chemical contaminants present in air or deposited on the ground as humans at the same location. Exposure of aquatic organisms occurs primarily through deposition of emitted particulates to surface waters.

Many of the chemicals known to be present in MSW combustor emissions can be toxic to aquatic and terrestrial organisms in sufficient concentrations. In particular, the metals arsenic, cadmium, mercury, and zinc can pose a threat to aquatic organisms, while emissions of organic compounds may be the greater concern to terrestrial organisms, primarily because of their potential to bioaccumulate in the food chain. Biomonitoring studies have not shown elevated concentrations of chemicals in soils or plants in areas around MSW combustors. In general, the contribution of emissions from MSW combustors to the environment is low enough to be indistinguishable from normal background concentrations.

Organic compounds in fly ash tend to be of concern more for aquatic exposures because of their potential to bioaccumulate in fish, where they could exert toxic effects or be passed up the food chain to consumers of the fish. Metals content of fly ash has been studied because of concern over uptake by terrestrial plants and animals following its disposal.

Although dioxin (specifically 2,3,7,8-TCDD) has been shown to be present in fly ash in small amounts, studies of fish exposures to actual fly ash from MSW incinerators have failed to show adverse effects to their health. Studies have also not observed bioaccumulation of dioxins in fish from exposure to fly ash.

Metals present in fly ash can be bioavailable to plants if the ash is added to soils. Contaminated vegetation could be consumed by herbivorous mammals and other animals at such sites. However, whether such consumption might adversely affect wildlife depends on the amount of metals concentrating in vegetation.

Public Health Impacts

The primary concern over public health impacts from energy recovery facilities has arisen from the potential for exposures to air emissions from combustor stacks. A number of chemicals present in typical stack emissions from MSW combustors are considered potentially toxic to human health if present in sufficient quantities. These include polycyclic aromatic hydrocarbons (PAHs), polychlorinated dibenzo-dioxins (PCDDs, dioxins), polychlorinated dibenzofurans (PCDFs, furans), polychlorinated biphenyls (PCBs), arsenic (frequently referred to as a metal), and the metals cadmium, chromium, lead, and mercury.