SOAH DOCKET NO. 582-08-2186
TCEQ DOCKET NO. 2006-0612-MSW

IN THE MATTER OF THE APPLICATION OF WASTE MANAGEMENT OF TEXAS, INC., FOR A MUNICIPAL SOLID WASTE PERMIT AMENDMENT PERMIT NO. MSW-249D	§ § § § § § §	**BEFORE THE STATE OFFICE OF ADMINISTRATIVE HEARINGS**

PREFILED DIRECT TESTIMONY

OF

REX H. HUNT, P.E.

ON BEHALF OF TJFA, L.P.

FEBRUARY 13, 2009

EXHIBIT TJFA 100

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I. INTRODUCTION AND QUALIFICATIONS

Q. WHAT IS YOUR NAME?

A. My name is Rex H. Hunt.

Q. WHAT IS YOUR BUSINESS ADDRESS AND TELEPHONE NUMBER?

A. My business address is Alan Plummer Associates, Inc. ("APAI"), 6300 La Calma, Suite 400, Austin, Texas, 78752. My business telephone number is (512) 452-5905.

Q. WHAT IS YOUR EDUCATIONAL BACKGROUND?

A. I obtained a Bachelor of Science in Civil Engineering from the University of Texas at Austin in 1975 and a Master of Science in Civil Engineering from the University of Texas at Arlington in 1984.

Q. ARE YOU A LICENSED PROFESSIONAL ENGINEER?

A. Yes. I am a licensed professional engineer in the State of Texas.

Q. WHEN DID YOU BECOME A LICENSED PROFESSIONAL ENGINEER?

A. I have been licensed in the State of Texas since November 1980. My professional engineering license number is 48237.

Q. WHAT IS YOUR OCCUPATION?

A. I am a civil engineer.

Q. HOW ARE YOU CURRENTLY EMPLOYED?

A. I am a Principal with APAI.

Q. WHAT TYPES OF WORK DOES APAI PERFORM?

A. APAI provides civil/environmental engineering services to municipalities, water authorities, private clients, and regulatory agencies. Our work primarily involves planning, permitting, design, and construction management for water, wastewater, and solid waste infrastructure projects. APAI also provides water resource planning services, water quality studies, and other environmental assessment and permitting support for public and private clients.

Q. HOW LONG HAVE YOU BEEN WITH APAI?

A. Ten years.

Q. WHAT IS YOUR PREVIOUS EMPLOYMENT HISTORY?

A. After receiving my Bachelor of Science in Civil Engineering in December 1975, I worked as a field engineer for the Texas Department of Health ("TDH") in the north central Texas region. At that time, TDH was the agency with responsibility for municipal

solid waste ("MSW") regulation in Texas. TDH was also named the Texas Department of Health Resources for a period of time between 1976 and 1977. For purposes of my testimony, references to TDH will refer to either agency, as appropriate. My primary duties at TDH were the following: compliance evaluations of MSW management facilities (*i.e.*, landfills and transfer stations); regulatory review of solid waste permit applications and designs; and inspections of public water systems.

In 1984, I joined a consulting engineering firm in north Texas, Baker-Shiflett, Inc. My primary duties included: preparation of solid waste permit applications and landfill designs; coordination with TDH, and later with the Texas Natural Resource Conservation Commission ("TNRCC"), a predecessor agency of the Texas Commission on Environmental Quality ("TCEQ"); coordination with clients to develop solid waste permits and permit amendments; and the development of new solid waste business. Baker-Shiflett merged with EMCON in approximately 1993. I continued with EMCON, with similar duties. In 1994, I opened the EMCON office in Austin, Texas, and was in charge of the Austin office until leaving to join APAI in October 1998.

Q. HOW LONG HAVE YOU BEEN INVOLVED WITH MSW DISPOSAL IN TEXAS?

A. I have been involved professionally with MSW disposal in Texas for over thirty (30) years.

Q. HOW MANY MSW PROJECTS HAVE YOU BEEN INVOLVED WITH?

A. As a regulator with TDH, I personally inspected over fifty (50) MSW facilities (many on a regular basis over several years with the agency) and worked with facility operators, permittees, and protestants, primarily in a nineteen (19) county region of north central

Texas that included Dallas and Fort Worth. As a consultant with Baker-Shiflett, EMCON, and APAI, I have been involved with approximately thirty (30) MSW facilities throughout Texas and elsewhere. Most of my solid waste consulting projects have involved some aspect of permitting with TCEQ or its predecessor agencies.

Q. HAS YOUR WORK ON MSW LANDFILL PROJECTS BEEN ON BEHALF OF APPLICANTS OR PROTESTANTS?

A. With one exception, all of my solid waste consulting projects have been performed as an engineer for the owner of the solid waste facility (*i.e.*, the applicant in permitting projects). I have provided engineering support services to an attorney representing a protestant on one MSW facility project.

Q. WHAT SORT OF WORK DO YOU DO ON BEHALF OF APPLICANTS?

A. My work has included preparation of permit applications for MSW facilities, permit-level design for MSW facilities, and regulatory coordination for permitting projects. In recent years, my work has shifted to include what could be termed peer review or quality assurance/quality control ("QA/QC"). Usually this involves review of the application, comparison to regulatory requirements, examination for potentially fatal flaws, and suggestions for improvements, both technical and editorial. I have also recently worked with municipal clients on the design and permitting for water treatment plant sludge and wastewater treatment plant sludge disposal facilities and biosolids composting facilities.

Q. IS YOUR RÉSUMÉ ATTACHED TO THIS PREFILED TESTIMONY?

A. Yes. It is attached as Exhibit TJFA 101.

Q. IS EXHIBIT TFJA 101 A TRUE AND ACCURATE COPY OF YOUR RÉSUMÉ?

A. Yes.

Q. IS EXHIBIT TJFA 101 AN ACCURATE REFLECTION OF YOUR EDUCATION, PROFESSIONAL HISTORY, AND QUALIFICATIONS?

A. Yes.

[MOVE TO ADMIT EXHIBIT TJFA 101]

II. PURPOSE OF TESTIMONY

Q. WHAT IS THE PURPOSE OF YOUR TESTIMONY TODAY?

A. My testimony will address the regulatory and technical requirements for permitting a MSW landfill. I will explain MSW landfill design requirements, discuss certain environmental regulatory requirements based on those design requirements, and define key regulatory terms related to MSW landfills. I will also describe various types of wastes that may be accepted by MSW landfills and briefly distinguish the technical requirements for accepting MSW in a MSW landfill from the technical requirements for accepting industrial wastes in a MSW landfill. The overall purpose of my testimony is to provide a foundation for the testimony of other TJFA witnesses, so certain background and regulatory information is not needlessly duplicated.

Q. ARE YOU FAMILIAR WITH TCEQ'S MSW RULES THAT BECAME EFFECTIVE IN MARCH 2006—30 TEX. ADMIN. CODE CHAPTER 330—CONCERNING THE PERMITTING AND OPERATION OF MSW LANDFILL FACILITIES, i.e., THE MSW RULES?

A. Yes, I am familiar with TCEQ's new MSW rules.

Q. ARE YOU FAMILIAR WITH THE FEDERAL SUBTITLE D REGULATIONS CONCERNING PERMITTING OF MSW LANDFILL FACILITIES?

A. Yes, I am familiar with the federal Subtitle D regulations.

III. INTRODUCTION OF IMPORTANT TERMS AND BRIEF SUMMARY OF REGULATORY HISTORY

A. Introduction of Important Terms

Q. BEFORE WE BEGIN, PERHAPS WE SHOULD CLARIFY SEVERAL TERMS. FIRST, COULD YOU PLEASE DEFINE THE TERM "MUNICIPAL SOLID WASTE"?

A. The term "municipal solid waste" is a subset of the term "solid waste," and so I need to first define this broader term.

Q. OKAY. PLEASE DEFINE THE TERM "SOLID WASTE."

A. TCEQ defines the term "solid waste," at 30 TEX. ADMIN. CODE § 330.3(145), as follows:

> Garbage, rubbish, refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility, and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, municipal, commercial, mining, and agricultural operations and from community and institutional activities. The term does not include:
>
> > (A) solid or dissolved material in domestic sewage, or solid or dissolved material in irrigation return flows, or industrial discharges subject to regulation by permit issued under Texas Water Code, Chapter 26;
> >
> > (B) soil, dirt, rock, sand, and other natural or man-made inert solid materials used to fill land if the object of the fill is to make the land suitable for the construction of surface improvements; or
> >
> > (C) waste materials that result from activities associated with the exploration, development, or production of oil or gas or geothermal resources and other substance or material regulated by

> the Railroad Commission of Texas under Natural Resources Code, § 91.101, unless the waste, substance, or material results from activities associated with gasoline plants, natural gas liquids processing plants, pressure maintenance plants, or repressurizing plants and is hazardous waste as defined by the administrator of the United States Environmental Protection Agency under the federal Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act, as amended (42 United States Code, §§6901 *et seq.*).

Thus, broadly speaking, solid waste may be defined as material that: (1) has been produced and used by humans for human benefit and is discarded because it is no longer used; or (2) is a by-product of a process, such as manufacturing, water or wastewater treatment, or air treatment. Solid waste may be municipal, commercial, institutional, agricultural, or industrial in nature. Despite the word "solid" in the term, "solid waste" may be a solid, semi-solid, liquid, or contained gas. Solid waste does not include domestic sewage, industrial point-source discharges, irrigation return flows, natural or manmade inert materials, or oil or gas exploration wastes.

Q. SO NOW THAT WE UNDERSTAND THE BROAD TERM "SOLID WASTE," WHAT IS "MUNICIPAL SOLID WASTE"?

A. Again, TCEQ defines the term "municipal solid waste," at 30 TEX. ADMIN. CODE § 330.3(88), as:

> Solid waste resulting from or incidental to municipal, community, commercial, institutional, and recreational activities, including garbage, rubbish, ashes, street cleanings, dead animals, abandoned automobiles, and all other solid waste other than industrial solid waste.

Thus, municipal solid waste, or MSW, includes wastes generated by individuals, commercial operations, institutions (*e.g.*, hospitals), community or municipal operations, and recreational activities. It generally includes household garbage, rubbish, ashes, dead animals, street sweeping wastes, brush and yard wastes, abandoned automobiles, and

construction and demolition wastes. MSW does not include industrial or hazardous wastes.

Q. WHAT IS THE PROPER WAY TO DISPOSE OF MSW?

A. The traditional method of managing MSW in the United States has been by land disposal, meaning disposal of MSW in a landfill, which has evolved substantially over the past forty (40) years or so. During this period, other methods of managing MSW have become more common including recycling, composting, and incineration for energy recovery. However, land disposal is still the primary method of disposal in the United States today.

Q. WHAT IS A "LANDFILL"?

A. TCEQ's MSW rules define the term "landfill," at 30 TEX. ADMIN. CODE § 330.3(75), as:

> A solid waste management unit where solid waste is placed in or on land and which is not a pile, a land treatment unit, a surface impoundment, an injection well, a salt dome formation, a salt bed formation, an underground mine, a cave, or a corrective action management unit.

The TCEQ definition refers to a modern, engineered facility that has been designed for the disposal of MSW.

Q. DOES TCEQ DEFINE THE TERM "MUNICIPAL SOLID WASTE LANDFILL"?

A. No, TCEQ's MSW rules do not define the term "municipal solid waste landfill." Instead, the MSW rules define the terms "municipal solid waste facility" and "municipal solid waste landfill unit."

Q. WHAT IS A "MUNICIPAL SOLID WASTE FACILITY"?

A. TCEQ's MSW rules define the term "municipal solid waste facility," at 30 TEX. ADMIN. CODE § 330.3(89), as:

> All contiguous land, structures, other appurtenances, and improvements on the land used for processing, storing, or disposing of solid waste A facility may be publicly or privately owned and may consist of several processing, storage, or disposal operational units, e.g., one or more landfills, surface impoundments, or combinations of them.

Under this definition, a MSW facility includes the disposal unit and all associated drainage features, internal access roads, fences, berms, buildings, monitoring devices, and other features necessary to the MSW disposal operation.

Q. WHAT IS A "MUNICIPAL SOLID WASTE LANDFILL UNIT"?

A. TCEQ's MSW rules define the term "municipal solid waste landfill unit," at 30 TEX. ADMIN. CODE § 330.3(90), as:

> A discrete area of land or an excavation that receives household waste and that is not a land application unit, surface impoundment, injection well, or waste pile, as those terms are defined under 40 Code of Federal Regulations §257.2. A municipal solid waste (MSW) landfill unit also may receive other types of Resource Conservation and Recovery Act Subtitle D waste, such as commercial solid waste, nonhazardous sludge, conditionally exempt small-quantity generator waste, and industrial solid waste. Such a landfill may be publicly or privately owned. An MSW landfill unit may be a new MSW landfill unit, an existing MSW landfill unit, a vertical expansion, or a lateral expansion.

This definition is more limited than the definition of the term "municipal solid waste facility." A "municipal solid waste facility" is made up of one or more "municipal solid waste landfill units." The term "municipal solid waste landfill unit" refers to the actual disposal operation, or the "hole-in-the-ground," if you will, that receives the MSW for final disposal. Simply put, a "landfill unit" is part of a "landfill facility." A landfill unit is the part of a landfill facility where the waste is placed.

Q. THE TCEQ DEFINITION OF THE TERM "MUNICIPAL SOLID WASTE LANDFILL UNIT" INDICATES THAT INDUSTRIAL SOLID WASTE MAY BE DISPOSED OF IN THESE UNITS. SO CAN ANY INDUSTRIAL SOLID WASTE BE DISPOSED AT ANY MSW LANDFILL?

A. No, there are limitations on the types of industrial waste that may be authorized for disposal in a MSW landfill. To understand the requirements, it is necessary to understand what is meant by "industrial solid waste."

Q. OKAY. HOW IS THE TERM "INDUSTRIAL SOLID WASTE" DEFINED?

A. TCEQ's MSW rules define the term "industrial solid waste," at 30 TEX. ADMIN. CODE § 330.3(66), as: "Solid waste resulting from or incidental to any process of industry or manufacturing, or mining, or agricultural operations." The MSW rules also divide industrial solid wastes into three classes of wastes.

Q. CAN YOU PLEASE DEFINE THOSE THREE CLASSES OF INDUSTRIAL SOLID WASTE?

A. Yes. The three classes of industrial solid waste are defined at 30 TEX. ADMIN. CODE § 330.3(21), (22), and (23), respectively, as:

- Class 1 wastes – Any industrial solid waste or mixture of industrial solid wastes that because of its concentration, or physical or chemical characteristics is toxic, corrosive, flammable, a strong sensitizer or irritant, a generator of sudden pressure by decomposition, heat, or other means, or may pose a substantial present or potential danger to human health or the environment when improperly processed, stored, transported, or disposed of or otherwise manage, as further defined in §335.505 of this title (relating to Class 1 Waste Determination).

- Class 2 wastes – Any individual solid waste or combination of industrial solid waste that are not described as Hazardous, Class 1, or Class 3 as defined in §335.506 of this title (relating to Class 2 Waste Determination).

- Class 3 wastes – Inert and essentially insoluble industrial solid waste, usually including, but not limited to, materials such as rock, brick, glass, dirt, and certain plastics and rubber, etc., that are not readily decomposable, as further defined in §335.507 of this title (relating to Class 3 Waste Determination).

Q. NOW THAT WE HAVE AN UNDERSTANDING OF THE TERM "INDUSTRIAL SOLID WASTE," PLEASE EXPLAIN WHAT TYPES OF INDUSTRIAL SOLID WASTES CAN BE DISPOSED AT A MSW LANDFILL.

The acceptance of industrial solid wastes at a MSW landfill is addressed primarily at 30 TEX. ADMIN. CODE § 330.173 (part of 30 TEX. ADMIN. CODE Chapter 330, Subchapter D, Operational Standards for Municipal Solid Waste Landfill Facilities). Under the MSW rules, the disposal of Class 1 wastes is of the greatest concern due to its potentially dangerous nature. Class 1 wastes are prohibited in a MSW landfill unless the owner/operator of the MSW landfill has obtained prior written approval from the Executive Director of TCEQ and there is specific authorization in the landfill permit. Requests to receive Class 1 waste must be submitted to TCEQ with a description of the chemical and physical characteristics of the waste, a statement as to whether the waste is a hazardous waste, and the quantity and rate at which the waste will be disposed in the MSW landfill.

Q. ARE THERE OTHER RESTRICTIONS ON THE ACCEPTANCE OF CLASS 1 WASTES?

A. Yes. There are several other restrictions on the acceptance and disposal of Class 1 wastes at a MSW landfill. First, the MSW landfill Site Operating Plan must contain proposed procedures for handling the Class 1 waste, including specifications for required protective

equipment and on-site emergency equipment. In addition, the Site Operating Plan must include contingency plans for handling emergency situations related to the Class 1 waste.

Second, all shipments of Class 1 waste must be accompanied by a waste shipping control document, *i.e.*, a manifest, that identifies the origin of the waste and other tracking information. In addition, the MSW landfill permittee must provide monthly reports of Class 1 waste shipments to TCEQ.

Third, it is also important to note that in accordance with 30 TEX. ADMIN. CODE § 330.331(e), MSW landfills that accept Class 1 wastes (other than asbestos wastes) must have dedicated cells for disposal of the Class 1 waste. The dedicated cells must meet specific design requirements that are more stringent than those design requirements for a MSW landfill. The more stringent design requirements are intended to further limit the potential for Class 1 wastes to "escape" the cell, and, therefore, provide additional protection to human health and the environment. The more stringent design requirements for Class I waste are in the MSW rules in recognition of the significant adverse impacts that some Class 1 wastes could have on a liner system as well as on the environment beyond, should the Class 1 wastes escape the liner system.

Q. YOU HAVE MAINLY FOCUSED ON CLASS 1 WASTES. ARE THERE ALSO LIMITATIONS ON THE ACCEPTANCE AND DISPOSAL OF THE OTHER CLASSES OF INDUSTRIAL SOLID WASTES AT A MSW LANDFILL?

A. Yes, but to a lesser degree. Unless defined as a special waste, Class 2 wastes may be accepted at a MSW landfill, provided that the disposal of the Class 2 wastes does not interfere with the operation of the facility. Likewise, Class 3 wastes may be accepted at a MSW landfill provided their disposal does not interfere with the operation of the facility.

Q. YOU JUST USED THE TERM "SPECIAL WASTE." IS THAT ALSO A TYPE OF WASTE SPECIFICALLY DEFINED IN THE MSW RULES?

A. Yes, the term "special waste" is also defined in the MSW rules. Generally, the term is defined, at 30 TEX. ADMIN. CODE § 330.3(148), as:

> Any solid waste or combination of solid wastes that because of its quantity, concentration, physical or chemical characteristics, or biological properties requires special handling and disposal to protect the human health or the environment. If improperly handled, transported, stored, processed, or disposed of or otherwise managed, it may pose a present or potential danger to human health or the environment. . . .

TCEQ then defines a number of examples of special wastes, including, for example, pesticides, hazardous waste from conditionally exempt small-quantity generators, untreated medical waste, incinerator ash, and used oil.

Q. YOU HAVE ALSO USED THE TERM "HAZARDOUS WASTE." HOW IS THAT TERM DEFINED IN THE MSW RULES?

A. The term "hazardous waste" is defined in the MSW rules, at 30 TEX. ADMIN. CODE § 330.3(62), as:

> Any solid waste identified or listed as a hazardous waste by the administrator of the United States Environmental Protection Agency under the federal Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, 42 United States Code, §§6901 *et seq.*, as amended.

Q. HAS THE DISPOSAL OF CLASS 1 WASTE ALWAYS BEEN SO TIGHTLY CONTROLLED?

A. No. The current MSW rules relating to the disposal of Class 1 wastes in a MSW landfill have only been around since the federal Subtitle D regulations became effective in Texas. Before that regulation was more lax. In Texas, the MSW rules began to address the disposal of Class 1 wastes in 1977. The MSW rules, then known as the "Municipal Solid

Waste Management Regulations" ("MSW Mgmt. Regulations"), dated January 1976, do not even mention the disposal of industrial solid waste in a MSW landfill. *See* Texas Dep't of Health Resources, *Municipal Solid Waste Management Regulations* (Jan. 1976) ("1976 MSW Mgmt. Regulations"). However, the next evolution of the MSW Mgmt. Regulations, dated April 1977, states that significant quantities of Class 1 industrial solid wastes received at a MSW landfill must receive authorization before it may be received. *See* Texas Dep't of Health, *Municipal Solid Waste Management Regulations* § F-2.5.d. at 44 (Apr. 1977) ("1977 MSW Mgmt. Regulations"). The 1977 MSW Mgmt. Regulations define "significant," for purposes of Class 1 industrial solid waste, as an amount "in excess of an estimated 5% by weight or volume of the total combined waste during any phase of collection, handling, storage, transportation, or disposal." *See id.* Even at that time, authorization required a complete description of the chemical and physical characteristics of the Class 1 waste, along with handling safeguards, protective equipment, and contingency plans for emergency procedures. It should also be noted that requirements for documenting the movement of industrial wastes from their place of origin to their place of disposal were not well developed at the time, so it is difficult to say how well the "5% rule," or any other requirements relating to the disposal of Class 1 waste in a MSW landfill, could have been enforced.

Q. IS IT PROPER TO REFER TO A LANDFILL FACILITY AS A "DUMP"?

A. Historically, landfills were referred to as "dumps" because disposal essentially consisted of waste being "dumped" in a hole; however, today the federal regulations have actually defined the term "open dump" as "a facility for the disposal of solid waste which does not comply with [40 C.F.R. Part 257]." *See* 40 C.F.R. § 257.2. In essence, the U.S. Environmental Protection Agency ("EPA") has defined the term "open dump" to include

any facility that fails to comply with the federal Subtitle D regulations and thus fails to protect the environment. By contrast, a modern MSW landfill is an engineered facility that has been designed for the disposal of MSW in accordance with regulations for protection of the environment.

Q. WHAT DO YOU MEAN WHEN YOU REFER TO AN "ENGINEERED FACILITY"?

A. By "engineered facility," I mean a facility, or in this case a MSW landfill, for which: (1) an environmental investigation of the site has been conducted to establish certain surface and subsurface characteristics of the site and the surrounding area; (2) an engineering design, which complies with applicable regulations and good engineering practices and which is based on the results of the environmental investigation, has been prepared; (3) an appropriate site operating plan ("SOP") has been prepared; and (4) appropriate plans for monitoring of the site and the facility, *i.e.*, the MSW landfill, have been prepared.

In addition to the above, an engineered facility will have appropriate environmental permits authorizing the development and operation of the facility. An engineered MSW landfill is designed, constructed, and operated to be protective of human health and the environment. This is accomplished by the installation and maintenance of liners, leachate collection systems, landfill caps, and environmental monitoring systems that have been incorporated into the design of the facility; and by the operation of the facility in accordance with the SOP and relevant regulations.

Q. PLEASE EXPLAIN THE TERMS "LINER," "CAP," AND "LEACHATE COLLECTION SYSTEM."

A. When I use the term "liner," I am referring to a barrier constructed between solid waste that is disposed in the landfill and natural soils and ground water located outside of the disposal area. The liner, therefore, defines the bottom and sides of the disposal cell.

By "cap," I mean the covering that is constructed over the top of the waste that provides the barrier between the waste within the landfill and the air above. The cap, therefore, defines the top of the disposal cell. The cap is sometimes referred to as the final cover system.

"Leachate" is the liquid that has come into contact with solid waste disposed in the landfill. In an engineered landfill facility, leachate is collected by means of the leachate collection system ("LCS") and managed through treatment or disposal by other means. These terms will be described in more detail later in my testimony.

B. <u>Brief Summary of Regulatory History</u>

Q. HAS THE REGULATION OF THE DISPOSAL OF MSW CHANGED OVER THE PAST HALF CENTURY?

A Yes, the regulation of the disposal of MSW has changed substantially over the past half-century.

Q. CAN YOU PLEASE BRIEFLY DESCRIBE THE HISTORY OF THE REGULATION OF THE DISPOSAL OF MSW?

A. Prior to the 1960s, environmental laws and regulations were generally few in number and unfocused in scope. Responsibility for protection of human health and the environment

fell to numerous federal agencies, such as the U.S. Public Health Service ("USPHS") or the U.S. Department of Interior ("DOI"). There was often little cooperation between federal agencies or between federal and state agencies. The 1960s, however, brought an increasing awareness of the need for improved protection of the environment. New legislation, including solid waste legislation, began to address environmental protection in a fundamental way. With the new legislation came new agency focus and the promulgation of new environmental regulations to carry out the legislative initiatives. With each decade since the 1960s, the breadth of environmental regulation has expanded substantially, and the focus has sharpened dramatically. The history of the regulation of the disposal of MSW mirrors the history of all environmental regulatory programs, in that the regulations have gotten more strenuous with time as necessary to address environmental concerns.

Q. PLEASE IDENTIFY WHAT HAS BEEN MARKED AS EXHIBIT TJFA 102?

A. Exhibit TJFA 102 shows the growth of federal environmental legislation in the twentieth century. As discussed above, since beginning in the 1960s, there has been a sharp acceleration in the rate of new federal environmental legislation.

Q. DID YOU CREATE EXHIBIT TJFA 102?

A. No, I did not.

Q. WHAT IS THE SOURCE OF EXHIBIT TJFA 102?

A. This graph was prepared by Dr. Davis Ford, Ph.D., P.E., an environmental engineering consultant and professor of civil engineering at the University of Texas.

Q. WHAT DOES EXHIBIT TJFA 102 DEPICT?

A. Exhibit TJFA 102 is a graph demonstrating how environmental legislation produced by the federal government amounted to just a handful of bills for the first sixty (60) years of the twentieth century. Then, beginning in the 1960s, the number of bills began to rapidly increase. Since 1960, the rate of passage of environmental legislation has expanded at a rapid pace.

Q. IS EXHIBIT TJFA 102 USEFUL IN YOUR TESTIMONY TODAY AND/OR IN ASSISTING THE ADMINISTRATIVE LAW JUDGE TO UNDERSTAND YOUR TESTIMONY TODAY, SPECIFICALLY REGARDING THE HISTORY OF ENVIRONMENTAL REGULATION?

A. Yes, it is.

[MOVE TO ADMIT EXHIBIT TJFA 102]

Q. PLEASE IDENTIFY WHAT HAS BEEN MARKED AS EXHIBIT TJFA 103?

A. Exhibit TJFA 103 is a timeline illustrating how various federal and state environmental legislative initiatives and regulations, which have affected MSW disposal practices, have come into play from the 1960s through today.

Q. WHAT DOES EXHIBIT TJFA 103 DEPICT?

A. Exhibit TJFA 103 depicts a timeline extending from about 1960 to the present. Federal and state legislation and regulations that are relevant to MSW management are shown in blue and red boxes, respectively. MSW milestones and events in Texas that are a result of the legacy of legislation and regulations relevant to MSW management are shown in green boxes.

Q. DID YOU CREATE EXHIBIT TJFA 103?

A. Yes, I did.

Q. WHAT IS THE SOURCE OF THE INFORMATION DEPICTED ON EXHIBIT TJFA 103?

A. Personal knowledge of solid waste management regulations at both the federal and state level.

Q. IS EXHIBIT TJFA 103 USEFUL IN YOUR TESTIMONY TODAY AND/OR IN ASSISTING THE ADMINISTRATIVE LAW JUDGE TO UNDERSTAND YOUR TESTIMONY TODAY, SPECIFICALLY REGARDING THE HISTORY OF ENVIRONMENTAL REGULATION?

A. Yes, it is.

[MOVE TO ADMIT EXHIBIT TJFA 103]

Q. COULD YOU PLEASE BRIEFLY SUMMARIZE THE MAJOR MILESTONES IN THE REGULATION OF MSW?

A. Yes. The first significant attempt to regulate MSW occurred in 1965 when Congress passed the Solid Waste Disposal Act ("SWDA"). The SWDA laid the groundwork for states to begin tackling solid waste issues by providing funding, technical support, and legislative mandates for improved solid waste management. In 1976, the Resource Conservation and Recovery Act ("RCRA") was passed by Congress as a sweeping amendment of the SWDA, overhauling the way we managed both MSW and hazardous waste in the United States and adding enforcement authority. Then in 1991, EPA

implemented regulations overhauling the design, construction, operation, and closure of MSW landfills. These regulations are still in effect today, and are commonly referred to as the federal "Subtitle D" regulations, since this is the designation of the subtitle where the regulations are codified in 40 C.F.R. Parts 257 and 258.

Q. PLEASE EXPLAIN THE SIGNIFICANCE OF THE FEDERAL SUBTITLE D REGULATIONS.

A. The federal Subtitle D regulations brought landfill design and operation to a new, much more engineered, level. The federal Subtitle D regulations amended 40 C.F.R. Part 257, Criteria for Classification of Solid Waste Disposal Facilities and Practices, and added a new 40 C.F.R. Part 258, Criteria for Municipal Solid Waste Landfills. The federal Subtitle D regulations represented a significant departure from previous landfill requirements, in that they focused on waste "entombment" within very low permeability liners and landfill caps. The liner and cap systems would minimize the movement of water into the MSW landfill and the seepage of leachate from the MSW landfill. The federal Subtitle D regulations also provided for the removal and management of leachate that is generated within the landfill, a concept not previously used in MSW landfills in Texas.

Q. PLEASE IDENTIFY WHAT HAS BEEN MARKED AS EXHIBIT TJFA 104?

A. Exhibit TJFA 104 is a copy of the Federal Register notice for the final promulgation of the federal Subtitle D regulations, 56 Fed. Reg. 50,978, adopting amendments to 40 C.F.R. Part 257 and adopting new 40 C.F.R. Part 258, dated October 9, 1991.

Q. IS EXHIBIT TJFA 104 A TRUE AND CORRECT COPY OF THE FEDERAL REGISTER NOTICE OF THE FINAL PROMULGATION OF THE FEDERAL SUBTITLE D REGULATIONS?

A. Yes, it is.

Q. IS EXHIBIT TJFA 104 USEFUL TO YOUR TESTIMONY TODAY?

A. Yes. The regulatory requirements established by the federal Subtitle D regulations are really the backbone of all regulations of MSW landfill facilities today. An understanding of the federal Subtitle D regulations and the background of those regulations, as discussed in the preamble set out in the Federal Register notice, is necessary to understand sound MSW landfill design and permitting.

[MOVE TO ADMIT EXHIBIT TJFA 104]

Q. HOW WERE THE FEDERAL SUBTITLE D REGULATIONS IMPLEMENTED IN TEXAS?

A. In response to EPA's promulgation of the federal Subtitle D regulations, Texas, through the TNRCC, went through a comprehensive rulemaking, which resulted in TNRCC's adoption of revised MSW rules in 1993.

Q. WHAT WAS THE RESULT OF THE PROMULGATION OF THE FEDERAL SUBTITLE D REGULATIONS AND THE REVISED 1993 MSW RULES?

A. Since the adoption of the federal Subtitle D regulations and the 1993 MSW rules, MSW landfills have become much more secure in that solid wastes are essentially entombed within the landfill, leachate (as explained above, the free liquid that accumulates within the landfill) is removed and managed, landfill gas is collected and removed or managed,

and the system (*i.e.*, the entirety of the MSW landfill itself) is monitored and maintained for an extended period of time. Through these efforts, potential environmental impacts are significantly reduced as compared to prior practices.

Q. ARE YOU FAMILIAR WITH MSW DISPOSAL PRACTICES IN TEXAS PRIOR TO THE ADOPTION OF RCRA IN 1976?

A. Yes, I began working for TDH in 1976 as a field engineer, where, as identified above, my primary duties included compliance evaluations of MSW landfills and transfer stations and the regulatory review of solid waste permit applications and designs. When I began work in 1976, the improvements adopted through RCRA and its implementing regulations were not yet common practice in the MSW management and disposal industry.

Q. WERE LANDFILLS REGULATED IN TEXAS PRIOR TO RCRA?

A. Landfill regulation in Texas was very limited prior to RCRA, but TDH had begun publishing specific rules for solid waste disposal at least a couple of years prior to the adoption of RCRA.

Q. PLEASE DESCRIBE A TYPICAL MSW LANDFILL IN TEXAS PRIOR TO RCRA.

A. In Texas, the disposal of MSW prior to RCRA can be characterized as uncontrolled dumping in most rural areas and (at best) semi-controlled dumping in urban areas. The use of sound engineering practices, as required today to ensure environmental protection at MSW landfills—notably composite liners and landfill caps—were unheard of in Texas prior to 1976, even in urban landfills.

Q. YOU SEEM TO HAVE DRAWN A DISTINCTION BETWEEN URBAN LANDFILLS AND RURAL LANDFILLS. HOW WERE RURAL LANDFILLS REGULATED PRIOR TO RCRA?

A. Rural landfills were characterized by a lack of access control, a lack of engineering design, and no operational consistency. Often, these sites had no operators on the site at all. This meant that individual citizens, businesses, and industries could potentially dispose of any solid waste at the site at more-or-less any time. Rural landfills were not "designed," meaning there was no sequence of development or control over how the waste brought to the site should be disposed. A rural landfill might consist of a pit excavated by the "operator" (*e.g.*, a City or a County) into which users could deposit waste. In some cases, the site consisted of a flat area adjacent to a steep drop in topography. Users would deposit their waste on the ground surface and the "operator" would occasionally push the accumulated wastes over the cliff with a bulldozer.

Q. WERE LANDFILLS IN URBAN AREAS MORE REGULATED THAN LANDFILLS IN RURAL AREAS?

A. Urban landfills prior to RCRA were a little better, in some cases, with minimal design standards or controls on access or disposal operations. Beginning in the late 1960s, many cities began to exercise some control over landfill operations. For example, open burning of solid waste in urban landfills was eliminated, for the most part, prior to 1970. Still, design criteria for landfills were minimal prior to RCRA, requiring only the most basic of considerations for health, safety, and the environment.

Q. ABOVE YOU IDENTIFIED THAT COMPOSITE LINERS AND LANDFILL CAPS WERE UNHEARD OF IN TEXAS PRIOR TO RCRA. WHAT TYPE OF CONTROLS WERE THERE TO LIMIT POSSIBLE LEAKS OR SEEPS FROM A MSW LANDFILL?

A Controls prior to RCRA focused mainly on the use of low hydraulic conductivity soils. For example, in the 1976 MSW Mgmt. Regulations, control of the seepage of leachate out of, and ground water into, a landfill was addressed, to some extent, by the use of soils with low hydraulic conductivity. The 1976 MSW Mgmt. Regulations called for a minimum thickness of three feet of "relatively impermeable soil," and indicated that "relatively impermeable soil" should have a permeability of not more than 1.0×10^{-7} centimeters per sec (cm/sec). Notably, the 1976 MSW Mgmt. Regulations said either "natural" soils or compacted liners of clay or other suitable material could be used as the required barrier.

Q. YOU USED THE TERM "HYDRAULIC CONDUCTIVITY" IN YOUR DISCUSSION. CAN YOU PLEASE EXPLAIN WHAT IT MEANS?

A. "Hydraulic conductivity" is defined in the *Glossary of Geology*, 2005 Edition, as:

> The volume of water at the existing kinematic viscosity that will move in a porous medium in unit time under a unit hydraulic gradient through a unit area measured at right angles to the direction of flow. In contrast to permeability, it is a function of the properties of the liquid as well as the porous medium. (*See* Neuendorf, Klaus K.E., James P. Mehl, Jr., & Julia A. Jackson eds., *Glossary of Geology*, 5th Edition, at 310 (2005).)

In laymen's terms, the hydraulic conductivity is the rate at which a fluid moves through a porous medium. It is usually described in terms of centimeters per second, which is a velocity.

Q. WHAT IS THE DIFFERENCE BETWEEN AN "IN-SITU" SOIL LINER AND A COMPACTED CLAY LINER?

A. An "in-situ" soil liner depends on the naturally low permeability of the existing on-site soil or formation underlying the landfill cell to impede the subsurface movement of water or leachate. For a compacted clay liner, existing natural clays or imported clays are used in the construction of the clay liner beneath the site for the purpose of impeding the movement of leachate out of the landfill or ground water into the landfill. The compacted clay liner depends on the availability and use of clay soils that can be compacted in such a way as to have a low hydraulic conductivity, as well as good construction techniques to manipulate the clay soils to meet the hydraulic conductivity requirements. The compacted clay liner is, by nature, a relatively thin barrier. In order to use natural soils to justify an in-situ soil liner, a substantial investigation of the subsurface soils must demonstrate that the soils underlying the landfill are naturally low in hydraulic conductivity and are relatively monolithic (*i.e.*, not subject to fissures and cracks that could allow the rapid movement of seepage). The in-situ soil liner is generally much thicker than the standard constructed clay liner.

Q. HOW DID THE DESIGN AND OPERATION OF MSW LANDFILLS CHANGE IN TEXAS AS A RESULT OF THE ADOPTION OF RCRA IN 1976?

A. The requirements set out in RCRA provided impetus for the strengthening of the MSW program in the State. RCRA enabled the expansion of the State's MSW management program and led to the promulgation of more stringent rules pertaining to MSW management and disposal. Between 1976 and the adoption of the federal Subtitle D regulations in 1993, the State's regulations pertaining to MSW management went through numerous changes, each time increasing the technical requirements applicable for

development of a MSW landfill. Likewise, requirements for the operation of a MSW landfill became much more stringent throughout the 1980s. The State's rules for MSW management and disposal became even more stringent after adoption of the federal Subtitle D regulations by the State. The many changes to the regulations came largely as a result of RCRA and its subsequent amendments.

Q. HOW IS MSW MANAGED IN TEXAS TODAY?

A. As generally seen on the national level, MSW in Texas is managed primarily by landfilling, recycling, composting, and incineration. The predominant method of disposal in Texas is landfilling, *i.e.*, disposal in an MSW landfill. Based on information provided in *Municipal Solid Waste in Texas: A Year in Review – FY 2007 Data Summary and Analysis* (TCEQ AS-187-07, Sept. 2008), approximately seventy-five percent (75%) of the MSW generated in Texas is currently disposed in a MSW landfill.

III. KEY ELEMENTS OF A MODERN MUNICIPAL SOLID WASTE LANDFILL

A. Siting Considerations

Q. WHAT ARE THE PRIMARY CONSIDERATIONS IN SELECTING A SITE FOR A MSW LANDFILL?

A. The most important considerations in siting a MSW landfill are as follows:

(1) Area geology and hydrogeology (*i.e.*, soils, ground water, fault areas, seismic impact zones, and unstable areas).

(2) Surface water (*i.e.*, surface water runoff and floodplain impacts).

(3) Site environmental and cultural/historical characterization (*i.e.*, wetlands, endangered/threatened species, and site archeology).

(4) Area characterization (*i.e.*, surrounding land uses, adequacy of access roads, and airport safety).

TCEQ's requirements governing the siting of a MSW landfill are found primarily in 30 TEX. ADMIN. CODE Chapter 330, Subchapters B and M. Subchapter B describes the contents of an application for a permit to operate a new MSW landfill or to amend a permit for an existing MSW landfill. The requirements for the general characterization of soil, ground water, and surface water are found in Subchapter B. Information requirements for the characterization of the area around the site are also found in this subchapter. Location restrictions for airport safety, floodplains, ground water, endangered/threatened species, fault areas, seismic impact zones, and unstable areas are addressed in Subchapter M of the MSW rules. In general, the above-listed issues must be addressed whether the MSW landfill is a new site or an expansion of an existing one, although some specific requirements vary between the two.

Q. WHY IS IT IMPORTANT TO UNDERSTAND THE GEOLOGY AND HYDROGEOLOGY ASSOCIATED WITH A MSW LANDFILL SITE?

A. An understanding of the geology and hydrogeology of a MSW landfill site is needed in order to:

- Determine whether the site is subject to faulting, seismic activity, or unstable foundation characteristics, which could jeopardize the functionality of the site or the expansion area.
- Determine the soil characteristics and hydrostatic head levels beneath the site, in order to promote the proper design of an appropriate liner and leachate collection system.

- Determine the ground water characteristics (*i.e.*, gradient, quality, *et cetera*) beneath and adjacent to the site in order to identify an appropriate point of compliance for a ground water monitoring system and enable the design of the ground water monitoring system.

Q. ARE THESE FACTORS ASSOCIATED WITH GEOLOGY AND HYDROGEOLOGY IMPORTANT TO BOTH THE DESIGN OF THE MSW LANDFILL AS WELL AS THE ABILITY TO MONITOR THE LANDFILL?

A. Yes. It is crucial to the design of an engineered MSW landfill to understand (ideally, before disposal operations commence) the subsurface characteristics of the site and the vicinity around the site. Such knowledge can help determine whether the site is suitable for use as a MSW landfill. Assuming the site is determined to be suitable, an understanding of the subsurface can also affect specific design parameters for the disposal area, including its lateral extent, its depth, the type of ground water protection needed, and other design parameters.

Geologic and hydrogeologic factors also affect the ground water monitoring program for a MSW landfill site. Understanding subsurface characteristics enables the design engineer or hydrogeologist to determine the point of compliance for the site, the appropriate well spacing, and monitor well locations, depths, and screened intervals. Regulations typically determine the parameters to be tested and frequency of testing. However, the quality of the ground water, as determined in a subsurface investigation, can also affect testing requirements.

Q. WHAT DID YOU MEAN BY THE TERM "POINT OF COMPLIANCE"?

A. The MSW rules at 30 TEX. ADMIN. CODE § 330.3(106) provide the following definition of the term "point of compliance":

> A vertical surface located no more than 500 feet from the hydraulically downgradient limit of the waste management unit boundary, extending down through the uppermost aquifer underlying the regulated units, and located on land owned by the owner of the facility.

Thus, the bases for determining the point of compliance are (1) the investigation of the hydrogeological characteristics of the site required to determine ground water flow direction (*i.e.*, to determine "downgradient") and (2) limitations imposed by regulations (*e.g.*, horizontal distance of 500 feet from the landfill unit boundary, and extending vertically to the uppermost aquifer). Because of the complexities inherent in ground water conditions, determining an appropriate point of compliance for a MSW landfill can be a very difficult task.

Q. WHAT IS MEANT BY THE TERM "DOWNGRADIENT"?

A. Ground water moves through a geologic formation in response to a gradient. In the case of an unconfined aquifer (which is the type of aquifer most often encountered in MSW landfill design), the gradient is essentially created by gravity, and the ground water moves through the formation from high elevation to low elevation. The ground water surface for the unconfined aquifer defines the direction of flow. In landfill terms, downgradient means the direction from the landfill that ground water in the aquifer below the landfill is moving. Therefore, the point of compliance is a location to where ground water that has been contaminated by the landfill would move. Likewise, the term "upgradient" means locations in the aquifer where ground water has not reached the landfill and, presumably, could not have been contaminated by leakage from the MSW landfill.

Q. WHY IS AN UNDERSTANDING OF SURFACE WATER ISSUES IMPORTANT?

A. There are two primary concerns about surface water that need to be considered: (1) surface water drainage on a site and (2) floodplains.

Q. FIRST, PLEASE DISCUSS THE ISSUE OF SURFACE WATER DRAINAGE ON A SITE.

A. Surface water entering a landfill site (sometimes called run-on) must be analyzed in order to adequately control it. Without proper controls, run-on can cause localized flooding on a landfill site and damage to access roads, monitoring facilities, and other landfill features. Inadequate control of run-on can also result in excessive water in the landfill area. For pre-Subtitle D landfills that do not have leachate collection systems, excessive run-on can accumulate in the disposal area, with no effective way to remove it. Inadequate control of run-on can also adversely affect areas with leachate collection systems by overwhelming the collection system and creating large quantities of contaminated water that must then be properly managed.

Likewise, quantity and patterns of surface water that exits the site (that is, run-off) must be analyzed in order to design for proper control of berms, dikes, *et cetera*, to control run-off. Proper controls are needed for the containment of run-off that has come into contact with solid waste, to prevent flooding of neighboring property, and to minimize erosion of soil from the site that could cause excessive sedimentation in drainage conveyances, storm water detention facilities, or streams. Together, surface water run-on and run-off must be properly characterized in order to demonstrate that the landfill design does not adversely alter drainage patterns, as the MSW rules stipulate at 30 TEX. ADMIN. CODE § 330.305(a).

Q. PLEASE DISCUSS THE ISSUE OF FLOODPLAINS.

A. Floodplains are important because solid waste disposal cannot be permitted within an area subject to inundation by the 100-year frequency flood, unless it can be demonstrated that the landfill is designed to prevent restrictions in flow of the 100-year flood, reduce temporary storage capacity of the floodplain, and prevent the washout of waste during a 100-year storm event. Therefore, it is necessary that an investigation of flood elevations be conducted in order to know the extent of the floodplain and how to mitigate potential impacts. As provided for at 30 TEX. ADMIN. CODE § 330.547, MSW landfill units (new, existing, or lateral expansions) cannot be located within a 100-year floodplain if the flow of the 100-year flood is restricted. Further, 30 TEX. ADMIN. CODE § 330.307 stipulates that MSW landfills be protected from flooding by levees to prevent the washout of solid waste from the landfill facility. Existing landfills that are found to be located within the 100-year floodplain but that do not have adequate protection levees must then provide mitigation. This might include construction of levees, if possible, or the removal of solid waste from flood-prone areas.

Q. PLEASE EXPLAIN THE IMPORTANCE OF THE ENVIRONMENTAL AND CULTURAL/HISTORICAL CHARACTERIZATIONS OF A SITE.

A. The environmental characterization of a site focuses on wetlands areas and endangered/threatened species that may be located on a site and that could be impacted by the location of a new MSW landfill or expansion of an existing MSW landfill. With regard to wetlands, an inventory of existing wetlands on the site is needed in order to assess potential impacts. Using this information, the design of the MSW landfill can often avoid wetland areas altogether. The wetlands location demonstration requirements

at 30 TEX. ADMIN. CODE § 330.553 must be met as part of the permitting process. These requirements include a demonstration that the landfill does not cause a violation of water quality standards, will not violate applicable toxic effluent standards, and will not result in the destruction or adverse modification of critical habitat protected under the federal Endangered Species Act of 1973 ("ESA"). In addition, the MSW landfill cannot contribute to the significant degradation of existing wetlands. There must be a demonstration that steps have been taken to prevent the net loss of wetlands.

Likewise, a demonstration must be made that endangered/threatened species (*i.e.*, plants or animals that have been federally listed as endangered or threatened under the ESA or the State's own version, the Texas Endangered Species Act, will not be harmed. In accordance with 30 TEX. ADMIN. CODE § 330.551, this demonstration must show that the destruction of or adverse modification of critical habitat will not occur. In addition, the landfill cannot cause the "taking" of any endangered or threatened species. In this case, the term "taking" includes harassing, harming, pursuing, hunting, wounding, trapping, capturing, or collecting, or attempting to engage in such conduct.

The cultural/historical characterization of the site refers to cultural or historical resources that may be affected by the development of a new MSW landfill or lateral expansion of an existing one. A cultural resources investigation is performed, which includes a review of documentation on cultural resources of the area, a site visit by a qualified expert in cultural resources, and identification/documentation of any such resources that are found. Consultation with the Texas Historical Commission may be necessary if potential cultural resources are found to be in an area subject to disturbance as a result of the MSW landfill.

Q. EXPLAIN THE IMPORTANCE OF WHAT YOU IDENTIFIED AS THE AREA CHARACTERIZATION.

A. A properly designed, constructed, and operated MSW landfill will minimize adverse impacts on the surrounding community. However, impacts from landfill operations are possible, and characterization of the surrounding area is a necessary part of the evaluation of potential impacts and mitigation factors. A careful examination of the character of surrounding land use (including residential, commercial, institutional, industrial, and agricultural), growth trends, zoning, availability and adequacy of public roads near the site, airports, area drainage, wind direction, water supply, water wells, and other relevant information is a necessary part of a MSW landfill application. Another related component of the characterization of the area is coordination with local governments that may have jurisdiction over zoning in the area, or other requirements for siting that go beyond State requirements. For this reason, the MSW rules require documentation of coordination with applicable councils of government and other local government agencies, as may be required.

Q. PLEASE DESCRIBE THE TYPES OF POTENTIAL IMPACTS YOU MIGHT SEE FROM A MSW LANDFILL.

A. Examples of potential major impacts to the community from a MSW landfill could include the following:

- Increased traffic on nearby public roads resulting from vehicles transporting waste to the site.
- Windblown waste generated by disposal operations, if not controlled properly.
- Odors generated by the landfill operation, if not controlled properly.

- Bird-nuisance problems for aircraft, if the site is located too near an airport.
- Vector (*e.g.*, rats) attraction caused by improper or inadequate cover of MSW disposed at the site.
- Adverse impacts to offsite drainage, if on-site drainage controls are improperly designed, installed, or maintained.
- Pollutant discharges or seepage, if environmental safeguards (*e.g.*, liner, landfill cap, *et cetera*) are not installed or maintained properly.
- Noise or visual impacts if site screening is not appropriate.

B. <u>Design Considerations</u>

Q. WHAT ARE THE MAJOR ENGINEERING ISSUES ASSOCIATED WITH MSW LANDFILL DESIGN?

A. The design of a modern MSW landfill involves the preparation of a Site Development Plan. A Site Development Plan includes, at a minimum, the following elements:

(1) Fill sequence plan.

(2) Ground water protection (*i.e.*, liner and leachate collection system) design.

(3) Surface water run-on/run-off controls.

(4) Final cover system design.

(5) Landfill gas management.

(6) Environmental monitoring.

Q. WHEN YOU USE THE TERM "SITE DEVELOPMENT PLAN," TO WHAT ARE YOU REFERRING?

A. A Site Development Plan ("SDP") is an engineering document that provides design plans and supporting engineering calculations to address all phases of the development of a MSW landfill and to ensure developmental safeguards to protect human health and the environment. The SDP will include site layouts, cross-sections, drainage calculations, ground water modeling, liner and leachate collection system design, landfill cap design, landfill gas management design, design details for environmental monitoring systems, and other related supporting documentation and calculations necessary to develop the MSW landfill in accordance with the MSW rules and the federal Subtitle D regulations.

1. Fill Sequence Plan

Q. AS REFERENCED IN YOUR LISTING OF DESIGN ELEMENTS ABOVE, WHAT IS A "FILL SEQUENCE PLAN"?

A. A fill sequence plan includes a flow diagram and a sequential site fill plan. The flow diagram depicts schematically the movement of solid waste from its entry through the landfill gate to its final destination within the MSW landfill; or if the waste is to be recycled, to its subsequent removal from the MSW landfill to its next destination as a recyclable material. The fill sequence plan shows how the filling of the MSW landfill site will take place over time. This may be a series of site plans showing how the MSW landfill site appears at various stages of development. The sequential fill sequence depicts a logical order in which landfill areas are to be excavated, liner and leachate collection system constructed, and otherwise prepared for filling. It will also show when environmental monitoring systems, landfill gas control systems, and other critical landfill environmental control and monitoring functions are to be installed or expanded.

Q. WHY IS THE FILL SEQUENCE PLAN IMPORTANT?

A. The fill sequence plan guides the operator of the MSW landfill site. It also helps the regulatory authority establish whether the site is in compliance with good environmental practices and applicable MSW rules and federal Subtitle D regulations. Without a fill sequence plan, it may be difficult or impossible to determine how the development and operation of the MSW landfill is protective of human health and the environment.

2. Ground Water Protection

Q. AS REFERENCED IN YOUR LISTING OF DESIGN ELEMENTS ABOVE, WHY IS IT NECESSARY TO ADDRESS GROUND WATER PROTECTION IN A MODERN MSW LANDFILL.

A. The need to fully understand subsurface conditions at a MSW landfill in order to design an appropriate ground water protection system was discussed above. The basis for ground water protection in a modern MSW landfill is the liner system and the leachate collection system. A properly designed and constructed liner system and leachate collection system protect ground water by effectively preventing the seepage of leachate from the MSW landfill.

Q. PLEASE IDENTIFY WHAT HAS BEEN MARKED AS EXHIBIT TJFA 105?

A. Exhibit TJFA 105 is an illustration of one typical liner and leachate collection system design, as might be used in a modern MSW landfill.

Q. WHAT DOES EXHIBIT TJFA 105 DEPICT?

A. Exhibit TJFA 105 depicts the clay and synthetic components of a standard Subtitle D composite liner and the drainage, piping, and protective cover components of a standard leachate collection system for a MSW landfill.

Q. DID YOU CREATE EXHIBIT TJFA 105?

A. Yes, someone under my supervision and control created Exhibit TJFA 105.

Q. WHAT IS THE SOURCE OF THE INFORMATION DEPICTED ON EXHIBIT TJFA 105?

A. Personal knowledge of and experience with solid waste management design requirements in Texas. In addition, various textbooks, guidance documents, and technical papers relating to liner or leachate collection system design were consulted in development of the attachment.

Q. IS EXHIBIT TJFA 105 USEFUL IN YOUR TESTIMONY TODAY AND/OR IN ASSISTING THE ADMINISTRATIVE LAW JUDGE TO UNDERSTAND YOUR TESTIMONY TODAY, SPECIFICALLY REGARDING LINERS AND LEACHATE COLLECTION SYSTEMS?

A. Yes, it is.

[MOVE TO ADMIT EXHIBIT TJFA 105]

Q. EARLIER YOU DEFINED THE TERM "LINER." COULD YOU PLEASE DISCUSS THE PURPOSE OF THE LINER SYSTEM?

The liner system provides an effective barrier between naturally occurring ground water outside of the MSW landfill and the solid waste contained within the MSW landfill. The liner system must conform to existing MSW rules regarding liner design, currently found in 30 TEX. ADMIN. CODE Chapter 330, Subchapter H, and any applicable federal Subtitle D regulations. The rules for liner design provide for two alternative approaches, as follows:

(1) A composite liner system; or,

(2) A liner system that ensures the concentrations of twenty-four (24) pollutants, which are listed in Table 1 in 30 TEX. ADMIN. CODE Chapter 330, Subchapter H of the MSW rules, will not be exceeded in the uppermost aquifer at the point of compliance for the MSW landfill.

The composite liner system is depicted in Exhibit TJFA 105, described above.

Q. ARE THERE OTHER OPTIONS FOR A LINER DESIGN?

A. Subchapter H of 30 TEX. ADMIN. CODE Chapter 330 also states that an alternative liner design may be approved. The requirements for the alternative liner design, however, are identical to the requirements stated for the liner system described in item (2), above. That is, with the alternate liner, it must be demonstrated that the pollutant concentrations for the parameters listed in Table 1 will not be exceeded in the uppermost aquifer at the point of compliance. Therefore, once the operator of the landfill demonstrates the performance of the alternate liner in accordance with the regulations, then the alternate liner design and the liner system described in item (2) will provide the same level of protection.

Q. EARLIER YOU DEFINED THE TERM "LEACHATE COLLECTION SYSTEM." COULD YOU PLEASE DISCUSS THE PURPOSE OF THE LEACHATE COLLECTION SYSTEM?

A. The leachate collection system ("LCS") generally consists of a layer of permeable material and piping installed overlying the liner system. The LCS is designed to allow the rapid transmission of liquids that are contained within the deposited waste into the LCS and then to a leachate collection sump (transmission is usually by gravity). At the sump, the leachate may be withdrawn (usually by pumping) and removed from the landfill for disposal elsewhere. The regulations stipulate that the LCS must be designed to maintain less than a 30-cm (about 1-foot) depth of leachate over the liner system. The LCS is also depicted in Exhibit TJFA 105, described above.

Q. HOW DO THE COMPOSITE LINER SYSTEM AND LCS LIMIT SEEPAGE?

A. Seepage from within the MSW landfill and through the liner is a function of the hydraulic conductivity of the liner, the area over which the seepage may occur, and the driving head of the seeping liquid (that is, leachate) on top of the liner. Design engineers can calculate the seepage rate using Darcy's equation, which uses these parameters to calculate the volume of seepage that might occur in a given period of time.

The liner system and LCS control the volume of seepage by controlling the hydraulic conductivity of the medium, the allowable area of seepage, and the driving head. By minimizing all of these parameters, the volume of seepage that is available to contribute to contamination in the subsurface outside the landfill can be effectively minimized or eliminated.

Q. PLEASE EXPLAIN.

A. As provided in the MSW rules, a composite liner is comprised of two components. The lower component is a compacted clay liner that is a minimum of two (2) feet in thickness, with a hydraulic conductivity of no more than 1.0×10^{-7} cm/sec. The upper component of the composite liner is a synthetic, or geomembrane, layer. The contact between the clay layer and geomembrane layer must be direct and uniform.

Q. PLEASE DESCRIBE THE SYNTHETIC COMPONENT OF THE LINER SYSTEM.

A. The synthetic component of the liner system is a manufactured layer of synthetic material. The synthetic component provides two forms of protection. First, the synthetic liner is essentially impermeable, to the extent that it contains no holes, tears, broken seams, or other discontinuities. By this, I mean that fluid movement through the synthetic layer is essentially nil. Second, the synthetic component limits the accessibility of leachate within the site to the clay component of the liner. Essentially, this is a limitation on the area of seepage. Thus, the synthetic component significantly limits the hydraulic conductivity of the system.

Q. HOW DO THE SYNTHETIC LAYER AND CLAY LAYER WORK TOGETHER?

A. Because discontinuities are possible, the clay component of the liner system provides a low hydraulic conductivity medium through which escaping liquids could move. Therefore, the synthetic and clay components of the liner system work together to maintain a very low hydraulic conductivity and a limitation to the area over which liquids may move.

Q. WHAT ARE THE DESIGN REQUIREMENTS FOR THE LCS?

A. The MSW rules at 30 TEX. ADMIN. CODE Chapter 330, Subchapter H stipulate that the LCS be constructed of materials that are chemically resistant to the leachate and that are of sufficient strength to prevent collapse under the pressure exerted by waste fill over the LCS. There is significant flexibility in how the LCS is designed, subject to demonstrations that the design can achieve the performance standard and strength requirements. The LCS consists, generally, of the following components:

- A drainage layer with a relatively high hydraulic conductivity that promotes the rapid movement of accumulating landfill leachate through it.
- A system of perforated lateral pipes embedded in or otherwise connected to the drainage layer that can receive the leachate that is moving through the drainage layer.
- A central collection pipe to which the lateral pipes are connected to receive the leachate from the laterals.
- A sump (or sumps) to which the central collection pipe is connected to receive the leachate from the collection pipe.
- A means of removing the leachate collecting within the sump. This is typically done with an extraction pipe and pumping system. It is necessary that the leachate levels within the sump be maintained at or below the 30-cm height, in accordance with regulations.

The leachate collection system depicted in Exhibit TJFA 105 is just one of a number of designs that could be used.

Q. DESCRIBE WHAT THE LCS DOES?

A. The LCS controls the height of liquid that can be stored on top of the liner to less than one foot. At this level, the driving head on the liner is almost nil. Without the driving head, the movement of leachate through the composite liner could be described as extremely low.

Q. WHAT HAPPENS IF THE LEACHATE LEVEL GETS TOO HIGH?

A. The LCS is designed to prevent an excessive accumulation of leachate. However, if the LCS malfunctioned, and higher levels of liquid were to build up in the MSW landfill, then the driving head increases proportionately. Fortunately, the very low hydraulic conductivity and available area for seepage afforded by the composite liner provides a level of back-up protection in the unlikely event that a malfunction of the LCS allowed the build-up of leachate.

Q. HOW IS THE CONSTRUCTION OF A LINER SYSTEM AND LCS ACCOMPLISHED?

A. The liner and LCS are usually constructed by private construction companies under contract to the MSW landfill owner. The area to be lined must be prepared to appropriate elevation and slope, in accordance with the approved landfill cell design. Then, the compacted clay liner component is constructed using heavy equipment to move the soil into place on the prepared area and compact the clay as required by specifications. Care must be taken to ensure that the new clay liner is properly tied into any previous clay liner. A liner quality control team tests the compacted clay liner to ensure it meets specifications.

The synthetic component of the liner system is then installed by the contractor. Care must be taken to ensure the synthetic component is in continuous contact with the clay component below (*i.e.*, no air pockets or ripples in the synthetic liner, *et cetera.*). Seams between sections of synthetic liner must be heat-welded or otherwise glued in accordance with specifications in order to eliminate gaps between liner sections. The quality control team must also ensure the integrity of the synthetic layer. This is done by inspecting the liner before it is installed for signs of holes, tears, *et cetera*, and testing seams and observing the contact between the clay component and synthetic component in the field.

After the synthetic component is in place, the contractor will begin construction of the LCS, installing drainage material, piping, protective cover, and any other components of the LCS in accordance with the design. The contractor will also construct the leachate sump and leachate extraction piping. The quality control team will generally inspect the installation of the LCS, ensuring that the drainage layer material is within specifications, piping is of the correct size and type, and protective cover is in place, *et cetera*. Finally, if the liner is being installed in an area that is subject to high ground water levels that could cause unmanageable upward pressure on the liner, the contractor may be required to place ballast material (*i.e.*, additional soil material) on top of the LCS to provide weight against the uplift force.

Q. IT WOULD SEEM THAT THE CONSTRUCTION OF THE LINER AND LCS IS VERY TECHNICAL AND POTENTIALLY DIFFICULT. WHAT SAFEGUARDS ARE THERE TO ENSURE THAT THESE ENVIRONMENTAL PROTECTIONS ARE APPROPRIATELY DEVELOPED?

A. The installation of a liner and LCS in an engineered MSW landfill is a very involved and highly technical operation. What is more, proper installation techniques and quality control of construction are critical to the ability of the MSW landfill owner to ensure that the landfill performs as designed—to permanently contain the MSW that is disposed in the site. Therefore, TCEQ requires extensive documentation of the installation operation and of quality control efforts on the installation. Documentation requirements are outlined in the Soil and Liner Quality Control Plan ("SLQCP"), which is a requirement of the application for the landfill permit. The SLQCP specifies construction methods, liner details, and quality control testing requirements for the installation of the liner system, including test types, frequencies, and criteria. The SLQCP also describes documentation requirements for constructed liner systems.

Q. WHAT DOCUMENTATION IS REQUIRED FOR A CONSTRUCTED LINER SYSTEM?

A. When a liner and LCS are installed, the quality control engineer for the installation must prepare a Soil and Liner Evaluation Report ("SLER") for the compacted clay component, and a Geomembrane Liner Evaluation Report ("GMLER") for the synthetic liner component. If ballast is needed to prevent uplift from ground water, then a Ballast Evaluation Report ("BER") is also required. The appropriate documentation must be submitted to TCEQ for review prior to beginning waste disposal operations in the new landfill cell.

Q. HAVE THE SLQCP, SLER, GMLER, AND BER ALWAYS BEEN REQUIRED?

A. No. Prior to about 1980, very little documentation of liner construction was required. Of course, at that time, liner systems were much less sophisticated and leachate collection was not required at all. During the 1980s, requirements for documentation of clay liner construction became increasingly more stringent and formalized. When the federal Subtitle D requirements became effective in Texas in 1993, documentation requirements began to address the synthetic component of the liner system. Also at that time, issues associated with uplift from ground water became more acute. Ballasting of liner systems and LCS became common where ground water levels were high enough to be of concern. Documentation of the ballast placement through the BER became a requirement during the 1990s.

3. Surface Water Run-on/Run-off Controls

Q. LET'S TURN OUR ATTENTION TO LANDFILL DRAINAGE ISSUES. WHAT IS NECESSARY FOR SURFACE WATER RUN-ON AND RUN-OFF CONTROLS IN A MSW LANDFILL?

A. Subchapter G of 30 TEX. ADMIN. CODE Chapter 330 requires that a MSW landfill not adversely alter existing drainage patterns for surface water run-off. Specifically, the MSW landfill must be constructed and operated to manage run-on and run-off during the peak discharge for a 25-year rainfall event. Landfill covers (interim or final) and other external surfaces for the MSW landfill must be designed to provide erosional stability during all phases of the landfill. In other words, the MSW landfill must be designed with appropriately sized drainage conveyances, berms, detention ponds, and any other

drainage feature necessary to ensure that existing drainage patterns off the site are not adversely altered and that erosion from the landfill to offsite areas is minimized.

Q. ARE THERE STANDARD FORMULAS OR PROCEDURES THAT ENGINEERS USE WHEN EVALUATING DRAINAGE FROM A LANDFILL?

A. Yes. For drainage areas of less than 200 acres, the MSW rules at 30 TEX. ADMIN. CODE § 330.305(f) call for the use of the "Rational Method," as specified by the Hydraulic Design Manual of the Texas Department of Transportation ("TxDOT"). For drainage areas in excess of 200 acres, the MSW rules stipulate that one of the following methods must be used:

- Hydraulic equations compiled by the United States Geological Survey ("USGS") and TxDOT (TxDOT Administrative Circular 36-86)
- Hydrologic Engineering Center ("HEC") – Hydrologic Modeling System
- HEC – River Modeling System
- Other appropriate HEC legacy computer programs.

The MSW rules also state that other methods approved by TCEQ may be used as well.

Q. WHY IS IT IMPORTANT THAT A MSW LANDFILL NOT ALTER EXISTING DRAINAGE PATTERNS?

A. The MSW rules specifically prohibit the adverse alteration of drainage patterns off the site of the MSW landfill (*i.e.*, drainage on property owned by others). In other words you cannot modify a drainage pattern such that it causes flooding, erosion, or other surface runoff problems on others' property.

Q. HOW DOES ONE DETERMINE WHAT THE EXISTING DRAINAGE PATTERNS ARE?

A. Generally, it is a matter of having a contour map of the existing drainage area and using an accepted drainage run-off model to determine existing run-off volumes and patterns.

Q. FOR A LANDFILL THAT IS ALREADY IN EXISTENCE AND IS SUBMITTING AN APPLICATION TO EXPAND THE LANDFILL, WHEN THE RULES REFER TO "EXISTING" DRAINAGE PATTERNS, DOES THIS MEAN EXISTING PRIOR TO THE TIME THAT ANY DEVELOPMENT OCCURRED AT THE SITE, IN OTHER WORDS, PRIOR TO THE TIME OF THE EXISTING LANDFILL, OR ONLY PRIOR TO THE CHANGES PROPOSED IN THE AMENDMENT APPLICATION?

A. The MSW rules do not explicitly state the meaning of the term "existing." I would generally interpret the rule to mean that drainage conditions prior to the existence of the landfill must not be adversely altered. If the permittee is pursuing an amendment of an existing permit, then, presumably, an analysis of the impact of the existing landfill permit on prior drainage patterns exists. If so, then there is a presumption that the previous analysis adequately demonstrated that the landfill was not adversely altering prior drainage patterns, and the permittee may only need to show that the proposed amendment would not adversely alter drainage patterns from existing permitted conditions. However, the accuracy of the drainage calculations that are used to design the new surface water drainage controls is dependent on the previous work. It is incumbent on the drainage design engineer to at least review prior drainage calculations to ensure that they were properly prepared. These are good engineering practices.

Q. ARE THERE ANY CONCERNS WITH THE APPROACH OF SIMPLY MAKING SURE THAT EXISTING (*i.e.*, PREVIOUSLY PERMITTED) DRAINAGE PATTERNS ARE NOT ADVERSELY ALTERED?

A. Maybe. If each prior evaluation was done correctly, then there should be no problem with this approach. However, the concern arises if a prior drainage analysis was not done correctly or if a prior drainage analysis made assumptions that were not correct at the time or are no longer correct. Another concern is that the engineers from one evaluation to the next may have used different formulas in their evaluation.

Q. MUST A LANDFILL NOT ALTER EXISTING DRAINAGE PATTERNS AT EACH STAGE OF DEVELOPMENT THROUGHOUT THE ENTIRE LIFE OF THE LANDFILL?

A. The MSW rules state that existing drainage patterns may not be adversely altered by the landfill. My interpretation of that rule is that existing drainage patterns may not be adversely altered at any time during the landfill development or afterward.

Q. WHAT ARE THE CONSEQUENCES OF IMPROPER CONTROL OF SURFACE DRAINAGE AND CAN THE CONSEQUENCES BE SIGNIFICANT?

A. The consequences can be very significant. Some specific problems include the following:

- Erosion of soil from completed or inactive portions of a MSW landfill caused by excessive run-off velocities over poorly vegetated areas of the MSW facility. Such run-off can carry a significant load of suspended solids that can be deposited in drainage ditches, storm water detention ponds, or other drainage control features. If allowed to exit the MSW

landfill site, sediment-laden surface run-off can affect offsite drainage features, including streams and ponds by facilitating the deposition of suspended solids in these water bodies.

- Flooding of property downstream of the MSW landfill site, caused by increased storm water volumes and decreased time of concentration of flow. Flooding can cause property damage and soil erosion downstream.

*4. **Final Cover System Design***

Q. PLEASE IDENTIFY WHAT HAS BEEN MARKED AS EXHIBIT TJFA 106?

A. Exhibit TJFA 106 is an illustration of a typical landfill cap that would be used in a modern MSW landfill.

Q. WHAT DOES EXHIBIT TJFA 106 DEPICT?

A. Exhibit TJFA 106 depicts the clay, synthetic, drainage, and erosion control components of a standard landfill cap for a MSW landfill.

Q. DID YOU CREATE EXHIBIT TJFA 106?

A. Yes, someone under my supervision and control created Exhibit TJFA 106.

Q. WHAT IS THE SOURCE OF THE INFORMATION DEPICTED ON EXHIBIT TJFA 106?

A. Personal knowledge of and experience with solid waste management design requirements in Texas. In addition, various textbooks, guidance documents, and technical papers relating to landfill cap design were consulted in development of the attachment.

Q. IS EXHIBIT TJFA 106 USEFUL IN YOUR TESTIMONY TODAY AND/OR IN ASSISTING THE ADMINISTRATIVE LAW JUDGE TO UNDERSTAND YOUR TESTIMONY TODAY, SPECIFICALLY REGARDING LANDFILL CAPS?

A. Yes, it is.

[MOVE TO ADMIT EXHIBIT TJFA 106]

Q. WHAT IS NECESSARY FOR THE FINAL COVER SYSTEM FOR A MSW LANDFILL?

A. The minimum requirements for a final cover system are found in 30 TEX. ADMIN. CODE Chapter 330, Subchapter K. The basic thrust of these requirements is to ensure that the final cover system over a modern MSW landfill minimizes infiltration of water into the landfill and minimizes erosion of soil from off of the landfill cap. The regulations describe standard methods of restricting infiltration and erosion, but also allow for alternative designs that provide for equivalent performance.

Q. WHY IS AN EFFECTIVE FINAL COVER AN IMPORTANT COMPONENT OF THE SITE DEVELOPMENT PLAN?

A. The final cover performs at least two critical functions on a MSW landfill. When coupled with the liner system, the cover serves as an effective barrier to the movement of liquid between the MSW within and the environment without. The liner and cover work together to minimize the risk of the release of contaminants, such as leachate, contained within the site to the environment; and, likewise, the risk of intrusion of ground water and surface water into the waste.

The second function of the MSW landfill cover system is to provide a barrier to the release to the atmosphere of landfill gas generated by the decomposition of MSW.

However, because the permeability of the landfill cover is so low, landfill gas must be managed by collection and removal to prevent dangerous build-up under the cover.

Q. WHAT ARE THE STANDARD FINAL COVER SYSTEM REQUIREMENTS?

A. The regulations address two types of MSW landfills in operation after the federal Subtitle D regulations became effective in Texas. They are (1) landfills with a synthetic component in the liner system and (2) landfills without a synthetic component in the liner system. For a MSW landfill with a synthetic component in the liner system, the final cover system must consist of a synthetic membrane in the landfill cover overlain by a clay-rich soil layer of eighteen (18) inches and a hydraulic conductivity of no more than 1.0×10^{-5} cm/sec. For MSW landfill units without a synthetic component in the bottom liner, the final cover system must consist of a clay cap with a hydraulic conductivity no greater than that of the bottom liner. In both cases, the requirements call for a layer of soil at the top of the cover system that is capable of sustaining a vegetative cover.

Q. DO THE REGULATIONS DESCRIBE ALL THAT IS NEEDED FOR A FINAL COVER SYSTEM?

A. No. The final cover system requirements for the first case (the one with the synthetic component) are not sufficient to provide for a good engineering design of a final cover system in most situations for a MSW landfill. Exhibit TJFA 106 depicts additional components in the final cover system, including a landfill gas collection layer below the synthetic component of the final cover system and a drainage layer above the synthetic component. The landfill gas collection layer is part of the landfill gas collection system, which will be discussed in more detail below, that prevents the buildup of landfill gases

beneath the cap system. The drainage layer is essential for minimizing the risk of failure of the landfill cap.

Q. WHY IS IT IMPORTANT TO PREVENT THE BUILD UP OF LANDFILL GAS BENEATH THE FINAL COVER SYSTEM?

A. A MSW landfill produces a substantial volume of gas over a long period of time. The volume can be enough to accumulate beneath a final cover system and cause the failure of the system by bulging or rupture of the synthetic component. It can also cause weakening of the final cover system on the side slope of the landfill, resulting in its failure by sliding. This would necessitate a costly reconstruction of the final cover system to restore the integrity of the cover.

Q. HOW DOES THE DRAINAGE LAYER MINIMIZE THE RISK THAT THE LANDFILL CAP WILL FAIL?

A. The drainage layer carries off water that seeps through the infiltration layer, accumulates on top of the synthetic component, and creates a low-friction surface between the synthetic component and the infiltration layer. On a flat top slope of a MSW landfill, this might not be much of an issue, but on a steeper side slope of the landfill, the reduced friction caused by allowing water to build up between the infiltration layer and the synthetic component can allow soil above the synthetic component to slide off of the side. Again, this would necessitate reconstruction of the failed portion of the final cover to restore its integrity as a final cover system.

Q. WHAT DO THE ALTERNATE FINAL COVER REQUIREMENTS ENTAIL?

A. An alternate final cover design must achieve an equivalent reduction in infiltration as the clay component of the standard final cover. It must also provide an equivalent protection from wind and water erosion as specified for the erosion layer in the standard final cover.

Q. WHY WOULD ONE WANT TO HAVE AN ALTERNATE FINAL COVER AT A MSW LANDFILL?

A. Essentially, the alternate final cover requirements allow for other innovations in final cover design that might be more appropriate under some circumstances. For example, in a landfill with ample cover material at the end of the life of the site, an alternate final cover system might consist of infiltration and erosion layers of combined thickness of several feet. If the alternate design can be shown to be sufficiently impermeable, then the synthetic layer would not be needed. This can represent both a cost savings to the landfill operation and quite possibly an improvement in the stability of the final cover system.

5. Landfill Gas Management

Q. SO LET'S DISCUSS LANDFILL GAS. WHAT IS LANDFILL GAS?

A. Landfill gas is a by-product of the decomposition of MSW contained within the MSW landfill. The exact composition will vary from one landfill to another, just as the exact composition of the waste contained in one landfill is slightly different than the waste contained in another landfill. However, regardless of the MSW landfill, landfill gas is primarily made up of carbon dioxide and methane in about equal proportions. Other components vary, but are generally trace levels of volatile organics contained within the waste materials.

Q. WHY IS LANDFILL GAS MANAGEMENT IMPORTANT FOR A MSW LANDFILL?

A. Landfill gas, if not managed properly, presents a risk to the safety of site personnel and the general public in the vicinity of the landfill. The primary safety hazard is the fire hazard associated with methane generation. In addition, as discussed above, improperly managed landfill gas can contribute to the failure of a final cover system by creating upward pressure on the final cover system and reducing its stability on side slopes.

Q. I UNDERSTAND THE POTENTIAL RISK TO LANDFILL PERSONNEL, BUT HOW CAN LANDFILL GAS BE A PROBLEM FOR THE GENERAL PUBLIC AROUND THE LANDFILL?

A. Landfill gas will tend to move in the direction that presents the least resistance to its movement. Improperly managed, landfill gas can move laterally from a MSW landfill through shallow permeable soil layers, through utility trenches where there is generally a highly permeable bedding material, or into utility conduits if they are not sufficiently tight to prevent gas intrusion. Landfill gas can potentially move through such avenues for significant distances and collect in confined spaces off the landfill site, such as manholes, lift stations, or structures. Methane, if allowed to build up to a certain range of concentrations, is a fire or explosion hazard. The movement of landfill gas off of a site is much less of a problem in most modern, engineered landfills—due, in part, to improved liner and final cover systems and gas collection systems—but it has historically been a significant problem with some older landfills.

Q. CAN YOU PROVIDE AN EXAMPLE OF A PROBLEM WITH LANDFILL GAS PROBLEMS AND THE PUBLIC?

A. One of the best local examples is that of the Watersbend Apartments in Austin. The apartments were constructed in 1984 on the site of an old closed MSW landfill. The landfill had closed in the 1960s. However, the development of enclosed structures over the landfill enabled the collection and concentration of landfill gas, including methane, in the apartment units. In 1992, residents of the apartments were ordered to evacuate. In a matter of a couple of days, approximately a thousand residents were forced to relocate as Austin, Travis County, and the State reacted to the potential hazard to public health by closing the apartment complex and beginning a lengthy investigation. The problem was the inadequate management of the landfill gas still being generated within the old landfill twenty-five (25) years after the last waste was disposed in the site. Eventually, the apartment complex was retrofitted with a sophisticated landfill gas collection system and gas detection system at a cost of over a million dollars. After significant redevelopment, the apartment complex reopened for occupancy.

Q. PLEASE DESCRIBE WHAT HAS BEEN IDENTIFIED AS EXHIBIT TJFA 107.

A. Exhibit TJFA 107 is a copy of an article entitled "Watersbend: Appraising a Brownfield Redevelopment Project," by Rudy R. Robinson, III, MAI, Scott R. Lucas, and Garland G. Rasberry, which appeared in the July 2002 edition of *The Appraisal Journal.*

Q. IS EXHIBIT TJFA 107 A TRUE AND CORRECT COPY OF THE WATERSBEND ARTICLE THAT YOU DESCRIBED?

A. Yes. Exhibit TJFA 107 is a true and correct copy of the Watersbend article.

Q. IS EXHIBIT TJFA 107 USEFUL IN YOUR TESTIMONY TODAY AND/OR IN ASSISTING THE ADMINISTRATIVE LAW JUDGE TO UNDERSTAND YOUR TESTIMONY TODAY, SPECIFICALLY REGARDING LANDFILL GAS HAZARDS?

A. Yes, it is.

[MOVE TO ADMIT EXHIBIT TJFA 107]

Q. COULD YOU BRIEFLY DESCRIBE A TYPICAL LANDFILL GAS CONTROL SYSTEM?

A. As previously indicated, one of the primary functions of a landfill gas control system is to prevent the build up of gases beneath the final cover system. The landfill gas collection layer component of the final cover system (as shown on Exhibit TJFA 106), is essentially the foundation of the collection system. This is a highly permeable layer of soil or a synthetic material capable of transmitting gas. To remove the gas that collects in the landfill gas collection layer, a grid of pipes are placed extending through the landfill cap to allow the gas to pass at controlled locations through the cap. The landfill gas that is transmitted through the cap via these pipes is then gathered by manifolding the pipes together and pulling the gas to a central collection point. The gathering of the landfill gas is generally facilitated by placing a vacuum on the pipe collection system. The spacing of the pipes extending through the landfill cap, the design of the manifold system for collection, and the design of the vacuum system is a function of the size of the landfill and projections of the amount of landfill gas expected to be generated.

Q. WHAT CAN BE DONE WITH THE LANDFILL GAS THAT IS COLLECTED FROM THE MSW LANDFILL?

A. Early landfill gas management systems usually included a flaring device that would ensure that the flammable component of the landfill gas was ignited and burned in a controlled manner. However, landfill gas has increasingly been seen as an alternate source of energy. Many landfill gas collection systems today use the collected gas to power generators that produce electricity for use either at the landfill site or to power other facilities.

6. Environmental Monitoring

Q. WHAT MONITORING IS REQUIRED AT A MSW LANDFILL?

A. Monitoring requirements at MSW landfills will vary depending on the specific environmental issues at a site, but generally include ground water monitoring, surface water monitoring, and landfill gas monitoring.

Q. WHY IS MONITORING IMPORTANT AT A MSW LANDFILL?

A. An engineered MSW landfill incorporates many environmental safeguards (liner system, LCS, final cover system, landfill gas management system, surface water run-off controls, *et cetera*). In addition, the MSW landfill Site Operating Plan, to be discussed below, contains procedures aimed at strict safeguards to the environment and human health. Nevertheless, the MSW landfill is a significant structure intended to permanently contain discarded wastes within the envelope of the liner and final cover system. The impact on the surrounding community of the failure of the liner system, final cover system, or other safeguard would, therefore, be very costly to mitigate and potentially a danger to the environment and human health. The environmental monitoring described above is

essential to ensuring that the integrity of the safeguards developed at the landfill remains intact.

Q. PLEASE EXPLAIN THE GROUND WATER MONITORING REQUIREMENTS.

A. Ground water monitoring requirements for MSW landfills are found primarily in 30 TEX. ADMIN. CODE Chapter 330, Subchapter J. In general, the requirements state that the ground water monitoring system must consist of monitoring wells in appropriate locations and at appropriate depths to yield representative samples of ground water from the uppermost aquifer underlying the site. The monitoring well system consists of background monitoring wells and point-of-compliance monitoring wells.

Q. WHAT DO YOU MEAN BY THE "UPPERMOST AQUIFER"?

A. As defined by the MSW rules, the uppermost aquifer is the geologic formation located nearest the ground surface that is capable of yielding significant quantities of water to wells or springs.

Q. WHAT ARE BACKGROUND MONITORING WELLS?

A. Background monitoring wells are designed to establish ground water quality in the aquifer in an area that has not been contaminated by leakage from the MSW landfill unit. This typically means monitoring wells that are located hydraulically upgradient of the landfill unit, although it may be possible to demonstrate that a well that is not strictly upgradient of the landfill can still adequately define background water quality.

Q. WHAT ARE POINT OF COMPLIANCE MONITORING WELLS?

A. The term "point of compliance" was previously defined as a vertical surface located no more than 500 feet from the hydraulically downgradient limit of the waste management unit boundary, extending down through the uppermost aquifer underlying the regulated units, and located on land owned by the owner of the facility. Point of compliance monitoring wells are located on the defined point of compliance. According to the MSW rules, the maximum horizontal well spacing for point of compliance monitoring wells is 600 feet, unless a wider spacing can be justified through sophisticated ground water modeling.

Q. ARE THERE ANY EXCEPTIONS TO THE REQUIREMENT TO LOCATE MONITORING WELLS AT THE POINT OF COMPLIANCE?

A. Yes. The MSW rules, at 30 TEX. ADMIN. CODE § 330.403(a)(2), state that if there are physical obstacles that preclude the location of point of compliance monitoring wells at an existing landfill unit, then the wells may be placed at the closest practicable distance that will still ensure the detection of contamination of the aquifer.

Q. CAN YOU PROVIDE AN EXAMPLE OF AN EXCEPTION PROVIDED FOR IN THE REGULATIONS?

A. Only a hypothetical one. It might be necessary to locate a point of compliance monitoring well further than the prescribed 500 feet from the landfill unit if there were a structure located at 500 feet from the landfill unit. The monitoring well could be placed beyond the structure as long as it was still downgradient of the landfill unit. The regulations do not state whether this exception would allow a downgradient monitoring well to be placed on property not owned by the owner of the landfill.

Q. ONCE A GROUND WATER MONITORING SYSTEM IS IN PLACE, HOW IS MONITORING ACCOMPLISHED?

A. The regulations at 30 TEX. ADMIN. CODE §§ 330.405 through 330.409 describe procedures for sampling and analysis of ground water. Procedures are included for background sampling, detection monitoring, and assessment monitoring. Specific procedures to be used at the MSW landfill are to be incorporated in a Ground Water Sampling and Analysis Plan ("GWSAP"), which defines sampling frequencies, sample preservation, analytical methods, constituents to be tested, and statistical modeling techniques that will be used to determine whether contamination appears to be showing up in a monitoring well. The purpose of the GWSAP is to ensure that consistent sampling and analysis procedures are used throughout the monitoring period (that is, throughout the life of the MSW landfill and post-closure care period).

Q. WHAT SURFACE WATER MONITORING IS REQUIRED?

A. The MSW rules do not address surface water quality monitoring at a MSW landfill. Instead, MSW landfill operations are required to obtain coverage for storm water discharges from the site under TCEQ's Texas Pollutant Discharge Elimination System ("TPDES") General Permit No. TXR050000, relating to storm water discharges associated with industrial activity. This permit is sometimes referred to as the "Multisector General Permit" ("MSGP"), so named because it is divided into various industrial sectors with specific storm water management and monitoring requirements for each industrial sector. MSW landfill activities are covered under Sector L of the MSGP. Basically, the MSGP calls for semi-annual sampling of storm water discharges from the MSW landfill site. Storm water must be analyzed for total iron and total suspended

solids. In addition, annual sampling of storm water discharges must be analyzed for twelve (12) metals.

Q. WHAT IS REQUIRED FOR LANDFILL GAS MONITORING?

A. The requirements for landfill gas management are found in Subchapter I of 30 TEX. ADMIN. CODE Chapter 330. To summarize these requirements, landfill gas management generally includes monitoring systems for the MSW landfill units. In order to prevent potential damage to the final cover system or the accumulation of landfill gas in facility structures, a landfill gas collection system is generally necessary as well. Gas monitoring and control are addressed in the Landfill Gas Management Plan ("LGMP"), a requirement of the MSW rules. The LGMP must provide a description of the monitoring system, including locations of monitoring devices, monitoring frequency, and maintenance of the monitoring system, *et cetera*; and provisions for back up monitoring if the primary monitoring system should fail. Although the MSW rules state that gases must be controlled, specific requirements for how to control gases are not addressed.

Q. WHAT OTHER ENVIRONMENTAL MONITORING MIGHT BE REQUIRED AT A MSW LANDFILL?

A. Other monitoring might be required for unique situations associated with a MSW landfill. For example, air monitoring could be required by TCEQ to address specific concerns about dust emissions or other air emissions from the landfill site. In some situations, noise monitoring might also be required to address concerns about noise from heavy equipment or vehicles on the site. TCEQ could also require traffic monitoring at the landfill entrance or nearby to address concerns about increases in traffic. However, none of these types of environmental monitoring are typically required by the MSW rules.

C. MSW Landfill Operations

Q. WHAT ISSUES SHOULD BE ADDRESSED IN A SITE OPERATING PLAN ("SOP") FOR A MSW LANDFILL?

A. Every solid waste disposal site, and thus every MSW landfill, is unique and, therefore, requires a Site Operating Plan ("SOP") that is uniquely developed for conditions associated with the MSW landfill and its operation. At a minimum, the SOP must meet the requirements of 30 TEX. ADMIN. CODE Chapter 330, Subchapter D. Beyond the regulatory requirements, it is necessary for the landfill operator to determine what additional requirements are needed to properly maintain the MSW landfill and to protect human health and the environment.

Q. WOULD THE SOP TYPICALLY ADDRESS CONTROLS ON INCOMING WASTES?

A. Yes. Access control is a critical feature of the SOP. It is addressed in the SOP with procedures for inspection of waste transport vehicles at the site entrance and ongoing observation of waste disposal operations at the working face. In addition, the SOP addresses fencing requirements intended to prevent access to the site by unauthorized personnel.

Q. TO WHAT DOES THE TERM "WORKING FACE" REFER?

A. The "working face" is the location on the MSW landfill where solid waste is unloaded from waste transport vehicles onto the surface of the landfill. It is here that the day-to-day landfill disposal activities for incoming waste occur. The working face is not a static

location on the site, but moves each day in an orderly fashion (following, generally, the fill sequence plan for the site).

Q. IT WOULD SEEM THAT THE WORKING FACE IS A CRITICAL OPERATING FEATURE OF THE LANDFILL. HOW SHOULD OPERATION AT THE WORKING FACE BE ADDRESSED GENERALLY IN THE SOP?

A. Proper operations at the working face are addressed in the SOP through procedures for proper spreading, compaction, and daily cover of the waste. In addition, surface water run-on and run-off controls at the working face should be addressed in the SOP. Control of operations at the working face promotes efficient use of the landfill by minimizing the space taken up by waste and cover. It also reduces problems with windblown waste (*i.e.*, litter), animal and bird attraction to wastes, and odors from the waste. Proper controls at the working face will also reduce the introduction of surface water run-on into the waste and the escape of contaminated surface water from the working face.

Q. WHAT ARE SOME OF THE OTHER IMPORTANT FEATURES OF THE SOP?

A. As stated above, every SOP is unique to some degree. However, some of the other general features of the SOP might include the following:

(1) Intermediate and final cover – to ensure that areas that are temporarily closed or have been filled to capacity do not attract vectors or birds or produce odors and to minimize the infiltration of surface water run-off into these areas of the MSW landfill.

(2) Environmental monitoring – to address requirements for ground water monitoring, surface water monitoring, landfill gas monitoring, or other

site-specific environmental monitoring requirements included as part of the permit, as discussed above.

(3) Landfill gas management – to address the control of dangerous gases on the site and in facility structures, as discussed above.

(4) Emergency response procedures – to address potential fire emergencies, environmental releases, or other emergencies that could occur on the MSW landfill site; and procedures for maintaining the safety of personnel and the public in the event of an emergency.

(5) Landfill unit closure – to address the procedures necessary for the permanent closure of landfill units or the entire landfill facility.

(6) Post-closure maintenance – to address procedures for the long-term maintenance and ongoing monitoring of the closed landfill.

V. REGULATORY REQUIREMENTS

Q. DOES THE TCEQ REQUIRE THE APPLICANT TO PROVIDE ALL OF THE INFORMATION AND ANALYSES YOU HAVE DESCRIBED IN A PERMIT APPLICATION?

A. Yes. TCEQ has prescribed very specific regulations, *i.e.*, the MSW rules, identifying the information requirements and the format in which the information must be provided.

Q. IS THE FORMAT OF A PERMIT APPLICATION IMPORTANT?

A. Yes, for at least two reasons. First the information requirements are detailed and voluminous. Different parts of the application are reviewed by different permit technicians at TCEQ, and the information must be provided in the TCEQ designated

format in order to ensure that the various parts of the application are complete and are reviewed and evaluated by the correct person.

Second, the application is used by TCEQ regional inspection staff to determine compliance throughout the life of the MSW landfill, and the proper organization better allows TCEQ inspectors to fully evaluate the landfill during inspections. For example, there are certain requirements for the GWSAP. For an operational landfill, the TCEQ inspector will pull this part of the permit application and review it prior to determining the facility's compliance with the sampling and analysis requirements. However, if the applicant fails to include all of the information in the QWSAP portion of the application, then, even though the original permit writer may find all of the GWSAP requirements in various parts of the application, perhaps years later a TCEQ inspector may not conduct a full or accurate inspection simply because the GWSAP itself may not have included all of the required sampling and analysis requirements.

Q. WHAT INFORMATION IS REQUIRED FOR PART I OF THE APPLICATION?

A. Part I of the application contains information required in 30 TEX. ADMIN. CODE §§ 330.59, 281.5, and 305.45. The information in this part is general, relating primarily to facility location, property owner information, and evidence of competency to operate a MSW landfill.

Q. WHAT INFORMATION IS REQUIRED FOR PART II OF THE APPLICATION?

A. The information in Part II is intended to describe existing conditions at the site and in the vicinity around the site. Required information includes the following:

- The character of the waste to be received, including projected volumes.
- Potential impacts to the surrounding area

- Transportation impacts
- Geology, ground water, and surface water characteristics
- Floodplain issues
- Endangered and threatened species impacts
- Archeological and historical impacts
- Evidence that the permit or permit amendment is consistent with the regional solid waste plan.

Part II also requires that a number of maps and plans be submitted, providing additional detail related to the above issues.

Q. WHAT INFORMATION IS CONTAINED IN PART III OF A PERMIT APPLICATION?

A. Part III is the Site Development Plan ("SDP"). It contains the details of and the basis for the design of the MSW landfill. The requirements for Part III are laid out in 30 TEX. ADMIN. CODE §§ 330.57(c)(3) and 330.63, with references to other subchapters of Chapter 330 of Title 30 of the Texas Administrative Code.

Q. PLEASE EXPLAIN WHAT THE NEW MSW RULES REQUIRE WITH REGARD TO PART III OF AN APPLICATION?

A. As stated in 30 TEX. ADMIN. CODE § 330.63(a), the SDP is to address landfill design criteria to "provide for safeguarding of the health, welfare, and physical property of the people and the environment through consideration of geology, soil conditions, drainage, land use, zoning, adequacy of access roads and highways, and other considerations as the specific facility dictates." Part III requires the following sections:

- General Facility Design

- Facility Surface Water Drainage Report
- Waste Management Unit Design
- Geology Report
- Groundwater Sampling and Analysis Plan ("GWSAP")
- Landfill Gas Management Plan
- Closure Plan
- Post-Closure Plan
- Cost Estimate for Closure and Post-Closure Care

Part III of the application contains the technical detail related to the investigation of the site that is required for design. This part of the application is the longest section; sometimes longer than the other three parts of the application combined. It is, therefore, a very detailed technical document.

Q. WHAT IS PART IV OF THE APPLICATION?

A. Part IV of the application is the Site Operating Plan ("SOP"). The SOP was previously described in my testimony. It is the design engineer's direction on how the landfill is to be operated considering the applicable rules and the design advanced in the permit application. The specific requirements are laid out in 30 TEX. ADMIN. CODE §§ 330.57(c)(4) and 330.65 and Subchapter D.

VI. SUMMARY AND CONCLUSIONS

Q. IS IT POSSIBLE FOR YOU TO SUMMARIZE YOUR TESTIMONY TODAY?

A. The best way to summarize my testimony would be that an MSW landfill is a highly engineered system designed to contain MSW on a permanent basis. As such, the design of the landfill, the design of the environmental monitoring systems, the development of

the Site Operating Plan, the construction of the MSW landfill, and its operation are all critical to the need for the facility to be secure.

Q. DOES THIS CONCLUDE YOUR DIRECT TESTIMONY?

A. Yes. However, I would like to reserve my rights to supplement or amend my testimony as appropriate and as permitted by the Administrative Law Judge.