U.S. Department of Energy
Office of River Protection
P.O. Box 450, MSIN H6-60
Richland, Washington 99352

0064151

05-ED-024

MAR 23 2005

Mr. Michael A. Wilson, Program Manager
Nuclear Waste Program
State of Washington
Department of Ecology
3100 Port of Benton Blvd.
Richland, Washington 99352

RECEIVED
MAR 24 2005
EDMC

Dear Mr. Wilson:

APPROVAL OF NONRADIOACTIVE AIR EMISSIONS NOTICE OF CONSTRUCTION (NOC) FOR OPERATION OF THE INTEGRATED DISPOSAL FACILITY (IDF)

Attached for your review and approval is the NOC application for operation of the IDF. Estimated emissions of toxic air pollutants, regulated under Washington Administrative Code (WAC) 173-460, from the operation of the IDF are below emission thresholds. Estimated emissions of criteria pollutants, regulated under WAC 173-400, from the operation of the IDF are above emission thresholds; therefore, the U.S. Department of Energy, Office of River Protection is required to submit an NOC for the subject activity.

If you have any questions, please contact me, or your staff may contact Dennis W. Bowser, Environmental Division, (509) 373-2566.

Sincerely,

Roy J. Schepens
Manager

ED:DWB

Attachment

cc: See page 2

cc w/attach:
C. J. Kemp, CH2M HILL
D. W. Hendrickson, Ecology
J. L. Hensley, Ecology
O. S. Wang, Ecology
W. E. Green, FHI
Administrative Record
CH2M Correspondence Control
Environmental Portal, LMSI

cc w/o attach:
B. G. Erlandson, BNI
E. S. Aromi, CH2M HILL
L. E. Borneman, CH2M HILL
K. S. Tollefson, CH2M HILL
J. Cox, CTUIR
S. Harris, CTUIR
S. L. Dahl, Ecology
J. J. Lyon, Ecology
J. A. Bates, FHI
G. Bohnee, NPT
K. Niles, Oregon Energy
M. F. Jarvis, RL
A. W. Conklin, WDOH
R. Jim, YN

Attachment
05-ED-024

Nonradioactive Air Emissions Notice of Construction for Operation of the Integrated Disposal Facility

NONRADIOACTIVE AIR EMISSIONS NOTICE OF CONSTRUCTION FOR OPERATION OF THE INTEGRATED DISPOSAL FACILITY

Author Name:
Gary M. Crummel
EnergX, LLC for CH2M HILL Hanford Group, Inc.

CH2MHILL
Hanford Group, Inc.
Post Office Box 1500
Richland, Washington 99352

Contract No.: DE-AC27-99RL14047

INTRODUCTION

This application is submitted for approval in accordance with *Washington Administrative Code* 173-400, "General Regulations for Air Pollution Sources" for operation of the Integrated Disposal Facility.

The Integrated Disposal Facility is a new mixed low-level waste and low-level waste landfill that supports the Hanford Site environmental remediation activities. The Integrated Disposal Facility consists of an expandable, lined landfill in a series of near-surface disposal cells that will be developed in phases located in the 200 East Area on the Hanford Site. The Integrated Disposal Facility will consist of two disposal cells, Cell 1 and Cell 2, for the disposal of mixed low-level waste and low-level waste. Cell 1 will be utilized for mixed low-level waste consisting of immobilized low-activity waste packages from the Waste Treatment and Immobilization Plant, immobilized low-activity waste containers from the Demonstration Bulk Vitrification System, and mixed low-level waste generated by the operation of the Integrated Disposal Facility. Cell 2 will be utilized for the disposal of low-level waste. The Integrated Disposal Facility will function as follows:

It will provide an approved disposal facility for the permanent, environmentally safe disposition of the following waste forms:

- Vitrified immobilized low-activity waste packages from the Waste Treatment and Immobilization Plant
- Low-level waste
- Vitrified immobilized low-activity waste containers from the Demonstration Bulk Vitrification System
- Newly generated Integrated Disposal Facility operations waste

The facility will meet environmental requirements and be approved by the U.S. Department of Energy and the State of Washington, Department of Ecology.

Operations at the Integrated Disposal Facility are expected to generate fugitive emissions. These emissions will be generated from the handling and storage of waste containers prior to disposal, as well as from the handling and spreading of the soil lift layers as the trench is filled with waste containers. Operations at the Integrated Disposal Facility will cause particulate matter and fine particulate matter emissions to exceed the thresholds defined in *Washington Administrative Code* 173-400-110. Unmitigated particulate matter emissions estimate results are 12.10 tons/yr ($2.42x10^{+4}$ lbs/yr) and unmitigated fine particulate matter emissions are 4.19 tons/yr ($8.37x10^{+3}$ lbs/yr). A notice of construction application is required to be filed under *Washington Administrative Code* 173-400-110 because the emissions associated with the proposed activity were determined not to be exempt under *Washington Administrative Code* 173-400-110(5)(d). A notice of construction is not required to be filed under *Washington Administrative Code* 173-460, "Controls for New Sources of Toxic Air Pollutants" [WAC 173-460-030(1)(b) and

WAC 173-460-040]. Toxic air pollutants, as defined in *Washington Administrative Code* 173-460, from the Integrated Disposal Facility are not expected to exceed the small quantity emission rates defined in *Washington Administrative Code* 173-460-080, and the process is exempt as a minor process change.

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LIST OF TERMS

ABBREVIATIONS AND ACRONYMS

CFR	*Code of Federal Regulations*
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
Ecology	State of Washington, Department of Ecology
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
IDF	Integrated Disposal Facility
ILAW	immobilized low-activity waste
LLW	low-level waste
MLLW	mixed low-level waste
NEPA	*National Environmental Protection Act*
NOC	notice of construction
PM	particulate matter
PM10	particulate matter (nominally 10m and less)
RCW	*Revised Code of Washington*
SEPA	*State Environmental Policy Act*
TRU	transuranic
WAC	*Washington Administrative Code*
WTP	Waste Treatment and Immobilization Plant

UNITS

C	Celsius
cm/s	centimeters per second
F	Fahrenheit
ft^3	cubic feet
kg/m^3	kilograms per cubic meter
lbs/ton	pounds per ton
lbs/yr	pounds per year
m^3	cubic meters
mm	millimeters
mph	miles per hour
mrem/hr	millirem per hour
m/s	meters per second
tons/yr	tons per year

Table 1. Metric Conversion Chart

Into metric units			Out of metric units		
If you know	Multiply by	To get	If you know	Multiply by	To get
Length			**Length**		
inches	25.40	millimeters	millimeters	0.0393	inches
inches	2.54	centimeters	centimeters	0.393	inches
feet	0.3048	meters	meters	3.2808	feet
yards	0.914	meters	meters	1.09	yards
miles	1.609	kilometers	kilometers	0.62	miles
Area			**Area**		
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.092	square meters	square meters	10.7639	square feet
square yards	0.836	square meters	square meters	1.20	square yards
square miles	2.59	square kilometers	square kilometers	0.39	square miles
square feet	2.2957E-05	acres	acres	4.356E+04	square feet
acres	0.404	hectares	hectares	2.471	acres
Mass (weight)			**Mass (weight)**		
ounces	28.35	grams	grams	0.0352	ounces
pounds	0.453	kilograms	kilograms	2.2046	pounds
short ton	0.907	metric ton	metric ton	1.10	short ton
Volume			**Volume**		
fluid ounces	29.57	milliliters	milliliters	0.03	fluid ounces
quarts	0.95	liters	liters	1.057	quarts
gallons	3.79	liters	liters	0.26	gallons
cubic feet	0.03	cubic meters	cubic meters	35.3147	cubic feet
cubic yards	0.76456	cubic meters	cubic meters	1.308	cubic yards
Temperature			**Temperature**		
Fahrenheit	subtract 32, then multiply by 5/9ths	Celsius	Celsius	multiply by 9/5ths, then add 32	Fahrenheit

Engineering Unit Conversions (Lindeburg 1990)

1.0 FACILITY NAME AND LOCATION

The Integrated Disposal Facility (IDF) is located at:

U.S. Department of Energy, Office of River Protection
Hanford Site
200 East Area Tank Farms
Richland, Washington 99352

The IDF is located in the Hanford 200 East Area on a 170-acre parcel located north of 1st Avenue and south of 4th Street, between the Plutonium-Uranium Extraction Plant and the 200 East Area Power Plant. The easternmost boundary of the IDF is approximately halfway between Canton Avenue and Baltimore Avenue, with the southern boundary at 1st Street.

Figure 1 is a map of the Hanford site and Figure 2 is a map of the IDF (DOE/RL-2003-12, *Hanford Facility Dangerous Waste Permit Application, Integrated Disposal Facility)*.

The coordinates of the IDF are as follows:

Table 2. Facility Location

Latitude	Longitude
46°33'20"N	119°31'24"W

Figure 1. The Hanford Site

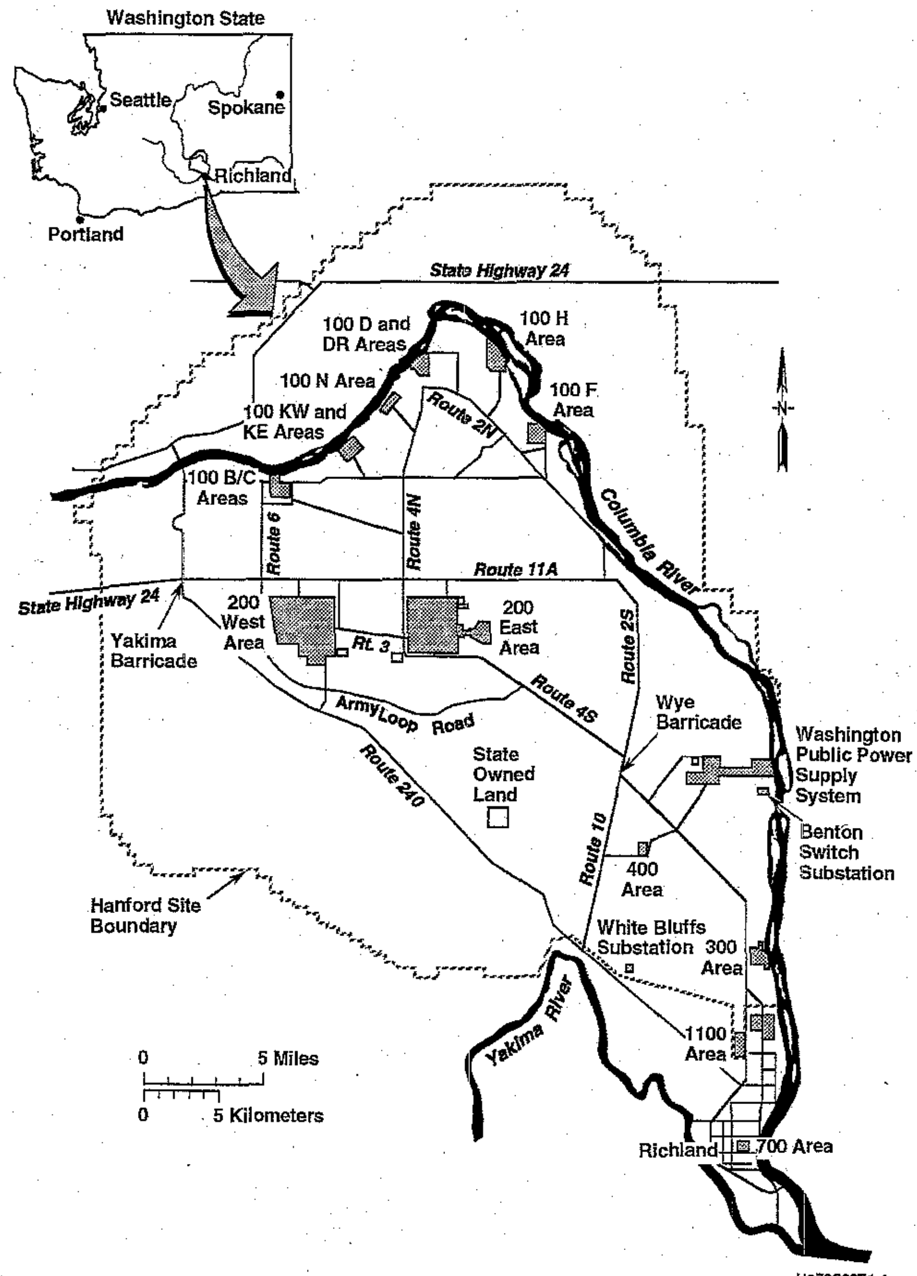
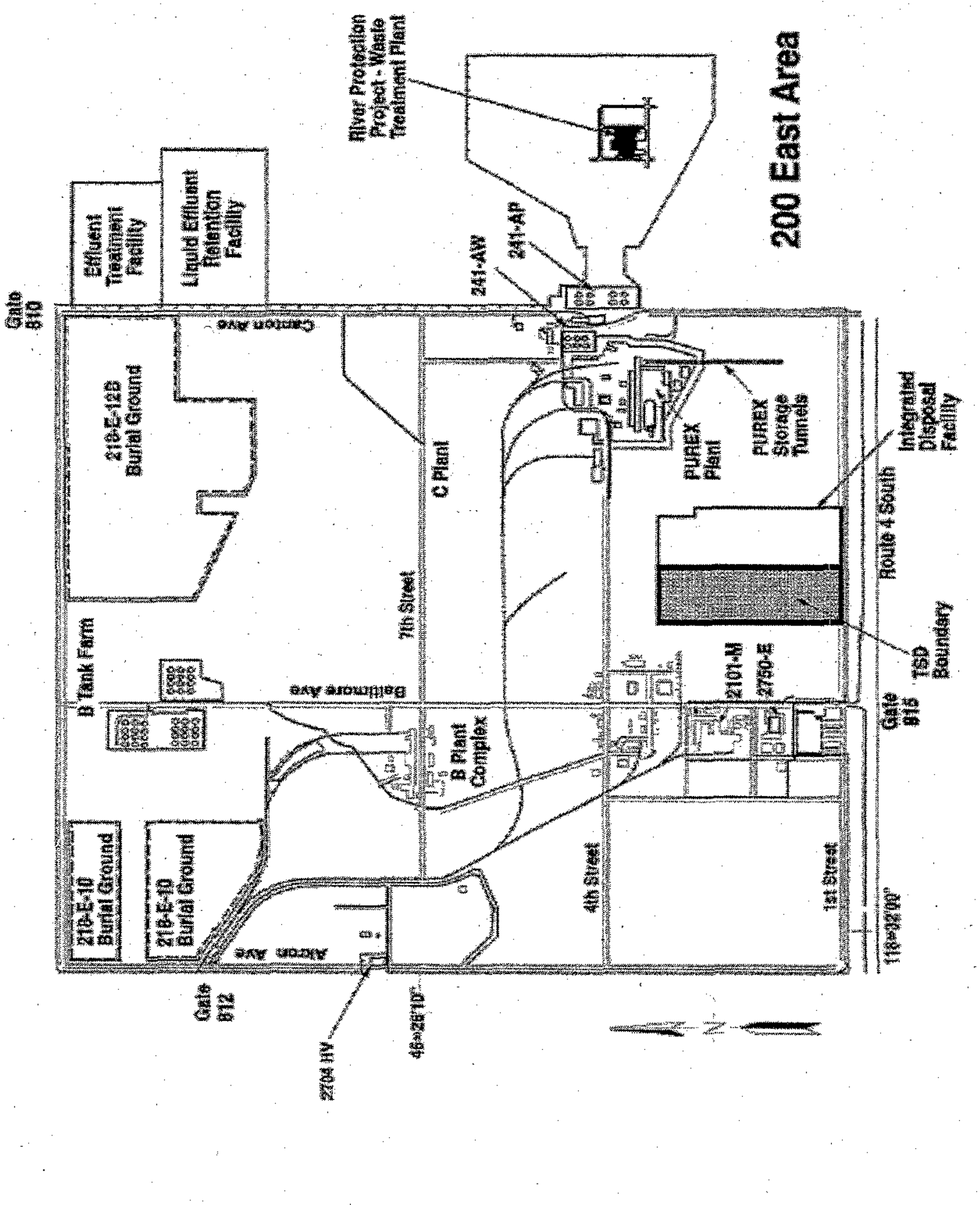


Figure 2. Integrated Disposal Facility on the Hanford Site



2.0 RESPONSIBLE MANAGER

R. J. Schepens, Manager
U.S. Department of Energy, Office of River Protection
Post Office Box 450
Richland, Washington 99352-0450
(509) 376-6677

3.0 PROPOSED ACTION

The U.S. Department of Energy (DOE), through the Office of River Protection, is constructing the Waste Treatment and Immobilization Plant (WTP) to treat Hanford Site tank waste. Immobilized low-activity waste (ILAW) produced by the WTP is to be permanently disposed of via near-surface disposal on the Hanford Site. To address ILAW disposal, the Immobilized Tank Waste Storage and Disposal Program created the IDF. In its original conception, known as Project W-520, the facility was to handle ILAW packages only and consist of a network of individual trenches, developed in phases over the course of the ILAW package generation and disposal. This concept was updated to allow other waste forms to be disposed at the IDF, thus integrating disposal of several waste types and sources into a single facility.

Included in the IDF scope are ILAW package transportation, receipt, unloading, placement in a disposal cell, and periodic backfill of the disposal cell. Also included are receipt, unloading, placement, and periodic backfill of ILAW from the Demonstration Bulk Vitrification System, newly generated IDF operations waste, and low-level waste (LLW) from Hanford Site sources.

The proposed action is to operate the IDF as a mixed low-level waste (MLLW) and LLW landfill in support of the Hanford Site environmental remediation activities. The IDF consists of structures, systems, and components necessary for onsite transportation of ILAW to the designated disposal cell and subsequent long-term ILAW isolation in a safe, environmentally compliant manner. The IDF includes disposal cells, leachate handling and storage facilities, and infrastructure improvements. The IDF will consist of two disposal cells, Cell 1 and Cell 2, for the disposal of MLLW and LLW. Cell 1 will be utilized for MLLW waste consisting of ILAW packages from the WTP, ILAW containers from the Demonstration Bulk Vitrification System, and MLLW generated by the operation of the IDF. Cell 2 will be utilized for the disposal of LLW.

The IDF disposal mission components are as follows:

- Receive compliant WTP ILAW packages, Demonstration Bulk Vitrification ILAW containers, and newly generated IDF operations waste, and LLW.

- Transport the ILAW packages in a designed or procured transportation system to the IDF.

- Provide an approved, permanent disposal facility for the long-term, safe disposition of WTP ILAW packages, Demonstration Bulk Vitrification System ILAW containers, and newly generated IDF operations waste that meets environmental protection requirements, as dictated by the DOE and the State of Washington, Department of Ecology (Ecology).

- Provide an approved, permanent disposal facility for the long-term, safe disposition of LLW that meets environmental protection requirements as dictated by the DOE.

- Operate the IDF during receipt of WTP ILAW packages, Demonstration Bulk Vitrification System ILAW containers, newly generated IDF operations waste, and LLW, and secure the packages in preparation for long-term disposal.

- Provide for package retrieval, as necessary, during landfill operations.

- Provide for a disposal facility closure technique that stabilizes the IDF and protects the environment and the public from inadvertent exposure.

4.0 STATE AND NATIONAL ENVIRONMENTAL POLICY ACTS

Under *Revised Code of Washington* (RCW) 43.21C, the *State Environmental Policy Act* (SEPA), and *Washington Administrative Code* (WAC) 197-11, "SEPA Rules," Ecology requires government agencies to consider the environmental impacts of a proposal before making decisions. A proposal exists when an agency is presented with an application. An environmental review of the actions identified in this notice of construction (NOC) application was conducted with the preparation of the *National Environmental Policy Act* (NEPA) and Title 10, *Code of Federal Regulations* (CFR), Part 1021, "National Environmental Policy Act" (10 CFR 1021) documentation for the Hanford Site and Tank Waste Retrieval Systems. Existing environmental documentation can be used to meet all or part of an agency's responsibilities under SEPA as provided in WAC 197-11-600. In addition to NEPA and SEPA documentation, there have been performance assessments developed in support of this project, which are available to the agency.

Ecology and the DOE co-prepared DOE/EIS-0189, *Tank Waste Remediation System, Hanford Site, Richland Washington, Final Environmental Impact Statement*. The activities described in this NOC (IDF operations) were analyzed in the Environmental Impact Statement (EIS) and associated Tank Waste Remediation System EIS Record of Decision (62 FR 8693, "Record of Decision: Final Environmental Impact Statement: Disposal of Hanford Defense High level Transuranic and Tank Wastes, Hanford Site, Richland WA") was issued in February 20, 1997.

5.0 CHEMICAL AND PHYSICAL PROCESSES

The IDF will provide for disposal of two types of waste: LLW and MLLW. MLLW includes ILAW (WTP ILAW and Demonstration Bulk Vitrification System ILAW) and newly generated IDF operations waste.

MLLW and LLW cells in the IDF have equally sized ultimate capacities of 450,000 m^3 ($1.59x10^{+7}$ ft^3) each, for the full IDF build out capacity of 900,000 m^3 (3.18 $x10^{+7}$ ft^3) (RPP-21633, *Preliminary Closure Plan for the Integrated Disposal Facility).* The IDF is expandable up to the full build out capacity. Expansion is dependent upon waste generation and waste generation forecasts. Leachate generation and associated management of the leachate are minimized by the expansion approach.

Both ILAW and LLW are expected to be disposed of in the IDF in approximately equal quantities of 450,000 m^3 ($1.59x10^{+7}$ ft^3) each, for the full IDF build out capacity of 900,000 m^3 (3.18 $x10^{+7}$ ft^3) (RPP-21633). Newly generated waste for IDF operations estimated volumes for a year are considered insignificant based on associated activities as compared to other waste volumes and types.

5.1 CHEMICAL

5.1.1 Low-Level Waste

Low-level radioactive waste is not spent nuclear fuel, transuranic (TRU) waste, high-level radioactive waste, byproduct material (as defined in Section 11e.(2) of the *Atomic Energy Act of 1954*), or naturally occurring radioactive material (DOE 435.1, *Radioactive Waste Management).* Both contact-handle and remote-handle LLW will be disposed at the IDF.

LLW Category I: This waste contains radioactivity not classified as spent nuclear fuel, TRU waste, or high-level waste. LLW Category I waste also meets the radionuclide limits for Category I waste defined in HNF-EP-0063, *Hanford Site Solid Waste Acceptance Criteria.* This waste may be comprised of either contact-handle or remote-handle waste considered low-activity waste with very low concentrations of long-lived radionuclides.

LLW Category III: This waste also contains radioactivity not classified as spent nuclear fuel, TRU waste, or high-level waste. In addition, it exceeds the radionuclide limits for Category I waste and meets the Category III limits defined in HNF-EP-0063. This waste may be comprised of either contact-handle or remote-handle waste considered moderate-activity to high-activity waste with low to moderate concentrations of long-lived radionuclides, in a stabilized form that minimizes subsistence for a period of 1,000 yrs.

5.1.2 Mixed Low-Level Waste

MLLW is a dangerous, extremely hazardous, or acutely hazardous waste that contains LLW. Contact-handle MLLW has a dose rate equal to or less than 200 mrem/h and contains radioactivity not classified as spent nuclear fuel or TRU waste. Remote-handle MLLW has a dose rate greater than 200 mrem/h and contains radioactivity not classified as spent nuclear fuel, TRU waste, or high-level waste.

5.1.3 Newly Generated Integrated Disposal Facility Operations Waste

Newly generated IDF operations waste is potentially dangerous, mixed, or LLW generated from the operations of the IDF that could include personal protective equipment, rags, waste material from the maintenance of equipment or vehicles, and waste generated at the leachate waste treatment facility that is returned to the IDF for disposal.

5.1.4 Low-Level and Mixed Low-Level Waste Containers and Packaging

The packages for waste shall meet applicable federal transportation regulations under Title 49, CFR container requirements for the hazard class/division of the waste, except that packaging for onsite transfers under an approved package-specific safety document might be allowed where cost or technical constraints make the use of a U.S. Department of Transportation (DOT) compliant package unfeasible. Outer containers shall be in good condition, with no visible cracks, holes, dents, bulges, pit or scale corrosion, or other damage that could compromise container integrity, in compliance with WAC 173-303, "Dangerous Waste Regulations". Minor external surface rust that can be sanded or brushed off will be acceptable. Containers having some pit or scale corrosion could be acceptable for storage provided the integrity of the container is confirmed.

MLLW generated from IDF operations will consist of 208 liter drums, medium boxes, small boxes, long equipment containers, and other containers. MLLW is defined as dangerous or hazardous waste in WAC 173-303, and therefore should be disposed in Cell 1.

LLW will be shipped primarily in 208 liter drums, 322 liter drums, other drums, MB-V boxes, medium boxes, small boxes, and other containers. LLW is not a dangerous or hazardous waste as defined in WAC 173-303, and therefore should be disposed in Cell 2. However, because the volume of remote-handle LLW is expected to be small, remote-handle LLW may be disposed in Cell 1 along with remote-handle MLLW. This would avoid the need to set up remote handling operations in both Cell 1 and Cell 2, and will provide greater flexibility for LLW disposal operations in Cell 2.

5.1.5 Immobilized Low-Activity Waste

WTP – ILAW: MLLW includes the low-activity waste fraction of the Hanford Site tank waste that is immobilized in a glass matrix at the WTP.

Other ILAW Streams – Demonstration Bulk Vitrification System: MLLW that contains the low-activity fraction of the Hanford Site tank waste immobilized in a glass matrix is produced by the Demonstration Bulk Vitrification System.

ILAW Containers and Packaging: The ILAW package shall be compatible with crane lifting and movement. The package shall be equipped with lifting and other handling apparatus designed to allow safe lifting, movement, and stacking of the packages when fully loaded. The package shall maintain its integrity during handling, transportation, and lifting during disposal at the IDF.

The ILAW packages are stainless steel cylinders that have been filled with vitrified low-activity waste, which is physically similar to molten glass, then sealed and cooled. These packages will be remote-handled. The Demonstration Bulk Vitrification System vitrification containers, also known as vitrification boxes, are filled with material similar to the material in the ILAW packages. The ILAW and Demonstration Bulk Vitrification System packages will be disposed in Cell 1.

5.2 PHYSICAL PROCESS

5.2.1 Facility

The IDF consists of an expandable, lined landfill in a series of near-surface disposal cells that will be developed in phases located in the 200 East Area on the Hanford Site. The landfill will be divided lengthwise into two distinct cells, Cell 1 for disposal of MLLW and Cell 2 for disposal of LLW. The IDF is designed to provide an approved disposal facility for the permanent, environmentally safe disposition of ILAW, newly generated IDF operations waste, and LLW, that meets the environmental requirements and is approved by the DOE and Ecology, as shown in Figure 3 (H-2-*830828, IDF Cells 1 and 2 – Site and Access Plan, Integrated Disposal Facility Design Drawing Set, February 2004*).

The IDF is designed for ILAW package transportation, receipt, unloading, emplacement in a disposal cell, and periodic backfill of the disposal cell. Also included are receipt, unloading, emplacement, and periodic backfill of Demonstration Bulk Vitrification System vitrification containers, newly generated IDF operations waste, and LLW from Hanford Site sources. In the initial phase of the IDF, the volume of remote-handle LLW is projected to be very small. Rather than set up a separate remote-handle operation for this small volume of LLW, remote-handle LLW may be placed in the cell with remote-handle MLLW.

Disposal cells are installed in a sequential manner and are aligned within the disposal site in a north-south orientation to minimize impact on the aquifer beneath the site. The cells have separate leachate collection, handling, and storage systems to maintain waste separation, as shown in Figure 4 (H-2-830830, *IDF Cells 1 and 2 – Grading and Drainage Plan, Integrated Disposal facility Design Drawing Set, February 2004*).

Figure 3. Integrated Disposal Facility Cells 1 and 2 – Site and Access Plan

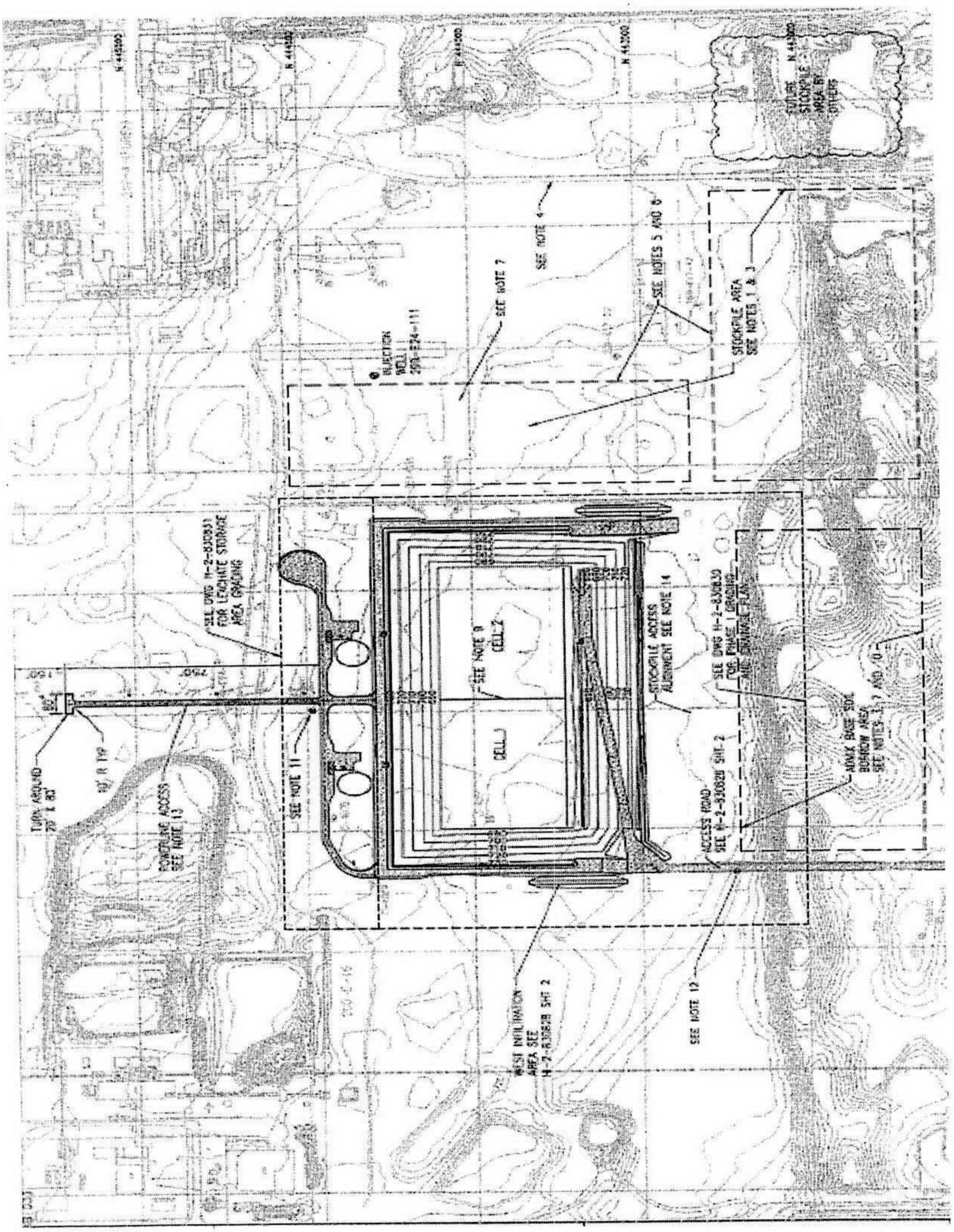
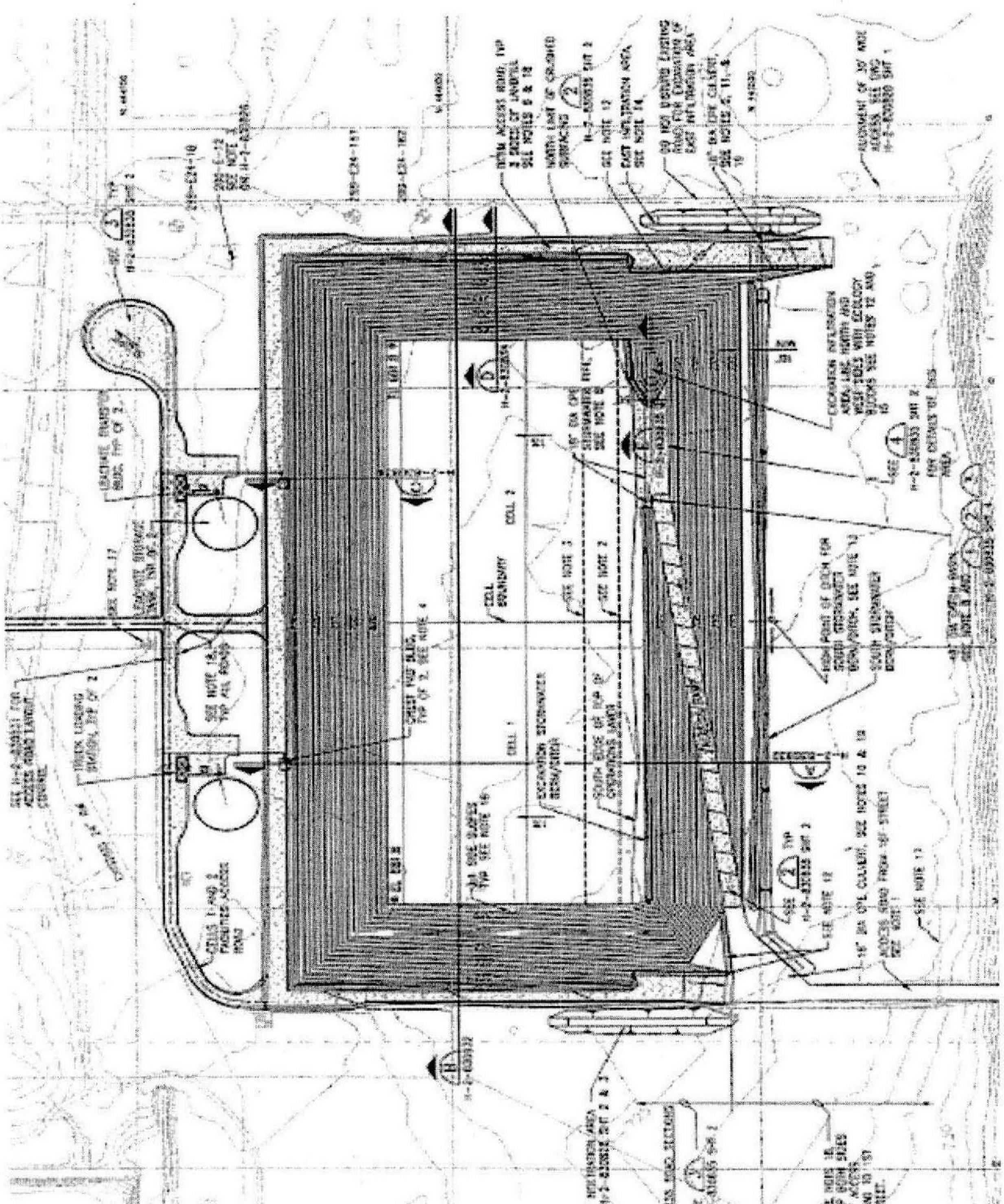


Figure 4. Integrated Disposal Facility Cells 1 and 2 – Grading and Drainage Plan



Two cells will be constructed in the first phase of the IDF, Cell 1 (west half) and Cell 2 (east half). Each cell is approximately 3.2 hectares (8 acres) in size, and when fully developed, the completed IDF will occupy approximately 25 hectares (62 acres). Subsequent phase development of the IDF will connect to the southern edge of Cells 1 and 2 such that the bottom grades are continuous between cells.

Support facilities, such as changing rooms, a lunchroom, and offices, will be provided for IDF personnel. Changing facilities for male and female personnel will be furnished with lockers, showers, restroom facilities, benches, and both clean and dirty laundry storage. The building also will contain office space and a control room, and is planned to be a radiologically clean facility.

5.2.2 Transport Operations

ILAW: The ILAW packages will be transported from the WTP and Demonstration Bulk Vitrification System to the IDF disposal site by the onsite U.S. Department of Transportation (DOT) compliant transportation system. The recommended mode of transport is a commercially available tractor/trailer combination capable of hauling ILAW packages in a DOT compliant shielded overpack. The configuration required will depend on the total weight and weight distribution relative to the axles to ensure the axle load limitations for roadway use are not exceeded.

LLW and MLLW: Various transport vehicles will be used to transport other wastes to the IDF. Commercially available tractor/trailer combinations typically will be used for LLW. LLW will be transported from various locations within the Hanford Site. Container sizes and shapes will vary but are expected to be mostly rectangular or drums of standard sizes. The timing and frequency of delivery to the IDF will vary, depending on operations and waste generation rates from the facilities where these wastes are generated. Transport to the IDF site for disposal will be coordinated with IDF transport operations to avoid conflicts or disruptions to IDF transport schedules, which will take precedence.

5.2.3 Receiving Operations

Upon arrival at the IDF, the loaded transporter will proceed through the disposal site gate and stop at the receiving station. The receiving station will be provided by the operations contractor.

At the receiving station, the shipping documents will be verified and the packages will be inspected. The operation concepts for the arrival activity will include:

- The truck driver will present shipping documents to facility operations personnel at the receiving station. A shift supervisor or quality control inspector will verify that the shipping documents are acceptable.

- After shipping documents are verified and the transporter passes inspection, the loaded transporter will be released to travel to the full trailer staging area for cooling, as needed.

Cool-Down Staging Area – ILAW: When the ILAW packages are received for transportation, they may still be at elevated temperatures. Because of possible elevated temperature, operations restrictions will be in place during transportation and prior to disposal in the IDF. Once the ILAW package is received at the IDF, the full trailer will be staged in a designated area within Cell 1 over the bottom liner in a place where trailer storage will not interfere with other IDF operations. This area will be moved from time to time, to avoid interference with the waste disposal operations.

5.2.4 Waste Placement

ILAW: After the ILAW package has cooled sufficiently, the trailer will be moved to an appropriate unloading position in Cell 1. Once in position, a crawler crane will be used to move the ILAW package from the transportation container into the designated disposal location within the disposal cell.

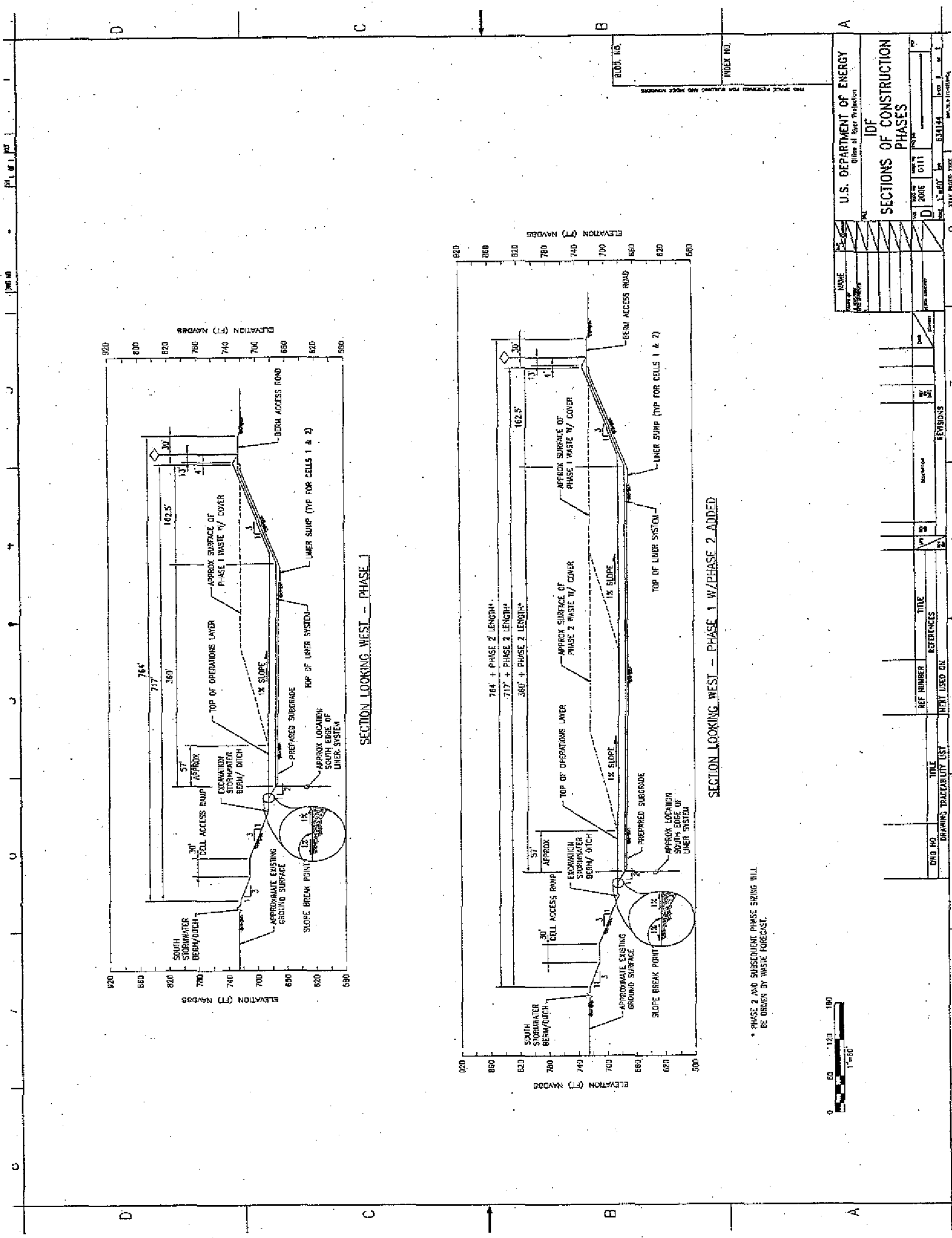
Periodically, after emplacement of approximately 81 ILAW package, the crawler crane must move to a new unloading station. Void-fill operations will be performed by a mobile crane after the crawler crane moves to a new unloading position.

LLW and MLLW: Unloading and placement of remote-handle MLLW and LLW will be done using a crane. Unloading and placement of contact-handle MLLW and LLW will be done using a crane or other appropriate equipment.

General Waste Placement and Layer Construction Procedures: The IDF configuration is based on four layers with a uniform height of 3.3 m (10.8 ft) (2.3 m [7.5 ft] ILAW package plus 1 m [3.3 ft] operations layer). Waste containers other than the ILAW packages will be variable height and will be placed in the 3.3 m (10.8 ft) high layers to achieve best use of space. Containers may be stacked on top on each other within each layer, if adequate soil cover is provided over the containers. Additional waste container stability analyses will have to be done by the operations contractor to verify waste placement and backfill stability for stacked containers. Containers that have a height greater than the 3.3 m (10.8 ft) layer height will be allowed to project out of the top of the layer. In such cases, it may be necessary to mound cover soil around the individual projecting containers to provide sufficient cover for shielding until they are completely covered by subsequent layers.

Because of the large area available for waste disposal in each cell, flexibility to relocate filling operations to another area within each cell will exist if an event occurs that causes operations to temporarily halt placement of ILAW packages or other waste containers at the current working position. This will allow waste container placement to continue while the situation that caused the operations to cease is resolved. See Figure 5 (H-2-830832, *IDF Cells 1 and 2 – Grading and Drainage Sections, 200 East Area Integrated Disposal (IDF) Detailed Design Drawings, February 2004*).

Figure 5. Integrated Disposal Facility Cross Section Dimension



ILAW: Two basic configurations were developed. Both make use of ecology block shield walls to shield the crane operator from exposure to the ILAW packages, with one using a temporary shield wall and the other using a permanent shield wall. Both of the basic ILAW package configurations include two variations. One variation is a grid pack arrangement of the ILAW packages, and the other variation is a tight pack arrangement.

Temporary Shield Wall Configuration: The ILAW package configurations that use a temporary shield wall will require that cover soil be placed over and around the ILAW packages prior to removing the shield wall. This soil cover will have to include the side of the ILAW packages facing the temporary shield wall so that after the wall is removed, the soil will provide the shielding for equipment operators and other operations personnel.

Permanent Shield Wall Configuration: By leaving the ecology block shield wall in place, the wide area between the ILAW packages and the shield wall for the cover soil to slope to the ground can be eliminated. The ILAW package configurations that use a permanent shield wall will allow ILAW packages to be placed up close to the wall, thereby making better use of the available space in the landfill.

Grid Pack and Tight Pack Arrangements: With the grid pack array, the ILAW packages will be placed in a close packed square arrangement. The grid pack array consists of four packages in the array, which is square in shape with a base dimension of slightly over 0.6 m (2 ft). With the tight pack array, the ILAW packages will be placed in a close packed triangular arrangement. The tight pack array consists of three packages in the array, which is triangular in shape with a height dimension of approximately 0.5 m (1.5 ft).

LLW and MLLW: Packaging emplacement configurations will depend on opening size and volume of interstitial spaces between LLW and any MLLW containers from IDF operations, and on configuration of the containers and the placement of the containers relative to one another. The placement of the containers will be carefully planned to efficiently pack the containers into the smallest volume possible, and to avoid large interstitial spaces.

5.2.5 Backfill Operations

The general approach to calculating backfill quantities uses a volume of fill to waste ratio of 1.5 to 1.

Radiation exposure assessment evaluations have determined that 0.5 m (1.5 ft) of soil cover placed over the ILAW packages with a crane prior to operation of equipment on the cover soil will provide adequate radiation shielding to equipment operators. The surface of the initial 0.5 m (1.5 ft) layer will be smoothed and leveled with a bulldozer to facilitate subsequent compaction and placement of the final lift.

After completion of the partial placement of the operations layer with the mobile crane, placement of the operations layer to the full 1 m (3.3 ft) depth will be completed, using a loader, dump truck, bulldozer, and compactor. The specific movements and activities of earthmoving equipment will be based on disposal cell configuration plans and elevation monuments established prior to initiating a new layer.

Compaction of the initial 0.5 m (1.5 ft) of the operations layer and placement of the remainder of the operations layer will not take place in the active array in which packages are being placed. Rather, the remainder of operations layer placement will take place in the previous array of ILAW packages so that there will be a placed and partially covered array of ILAW packages in place to stabilize and support the bulldozer. In addition, compaction of the initial 0.5 m (1.5 ft) of operations layer should not take place until all the voids between the permanent shield wall and the ILAW packages have been filled, and the initial 0.5 m (1.5 ft) of the operations layer has been placed in the active array of ILAW packages to provide shielding from the ILAW packages for the bulldozer operator. Compaction of the first 0.5 m (1.5 ft) layer of cover soil placed by the mobile crane and smoothed by the bulldozer should be accomplished with a vibratory roller. The vibrations of the compactor should help to fill voids that may have occurred during interstitial space filling by promoting cover soil to flow into the voids. As cover soil is moved into the voids below, additional soil placement will be required to replace the migrating material. This material should be the same low moisture content, low fines content sand from the onsite soil source as that used for interstitial fill. The remaining thickness of cover fill, up to the full 1 m (3.3 ft) thickness, will be placed by a bulldozer operating on top of the layer and compacted with a vibratory roller. The soil for this upper layer should include a higher fines content of up to 25 percent, and should be placed and compacted at or slightly below optimum moisture content.

In general, the loader, which will be stationed at the soil stockpile, will fill a dump truck. The dump truck will deliver cover soil to a location near the package array to be covered. The bulldozer then will spread the soil over the package array to the full 1 m (3.3 ft) depth.

A water truck will be provided for compaction and dust control. The truck will be operated as needed to spray water for compaction and to suppress dust by driving to a location safe for the operator to spray water over the cover material being compacted. In addition to dust control and compaction within the trench, an operations dust control plan will be developed to cover other areas within the boundary of the IDF.

A temporary rain curtain may be used to control the amount of clean stormwater run-off that enters the leachate collection system. The rain curtain can be used in areas where no ILAW packages have been placed or in the areas where ILAW packages and the full 1 m (3.3 ft) operations layer have been placed. The rain curtain would be removed prior to placing additional waste in the area that it covered.

5.2.6 Leachate Handling Systems

The Leachate Handling Systems shall be designed to segregate MLLW leachate generated in Cell 1 from the LLW leachate generated in Cell 2. The Leachate Handling System shall be designed to manage the leachate generated from a 25-year, 24-hour storm event collected over the entire footprint of the landfill.

The Leachate Handling System design shall also comply with the following technical requirements:

> The landfill shall control water that contacts waste through physical barriers and collection through the leachate collection system. This system shall collect, pump, and store any water that migrated through the landfill and shall provide systems for loading leachate into transport trucks. Leachate meeting waste acceptance criteria shall be transported by truck for storage and treatment at a treatment facility. Any leachate not meeting waste acceptance criteria will be handled on a case-by-case basis and will be handled, stored, and disposed in accordance with federal and state regulations.

Figures 6 and 7 on the following pages provide more details on the leachate system and the transfer from collection system to tanks and from the tanks to the tanker truck (DOE/RL-2003-12).

Figure 6. Integrated Disposal Facility Leachate Collection and Recovery System

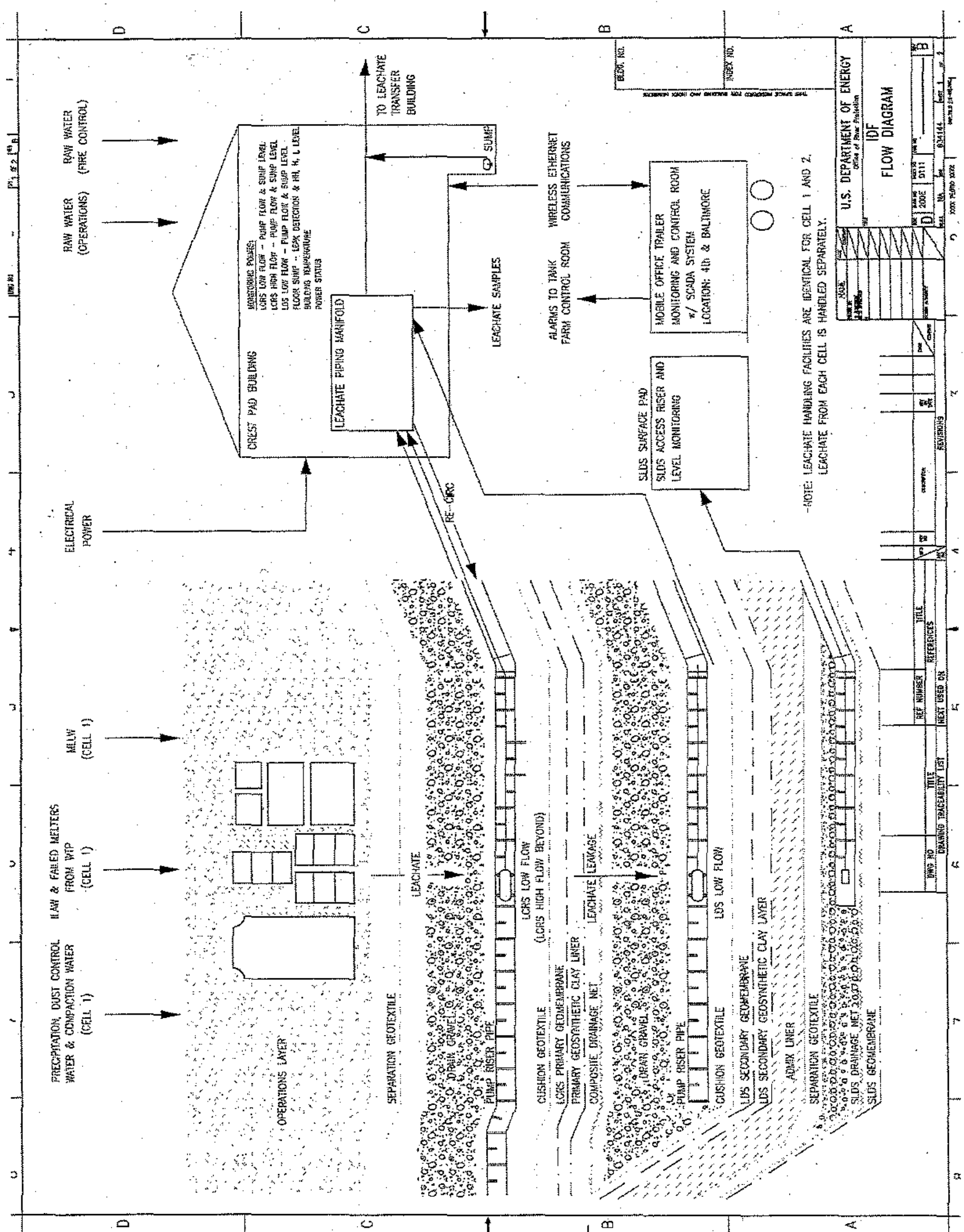
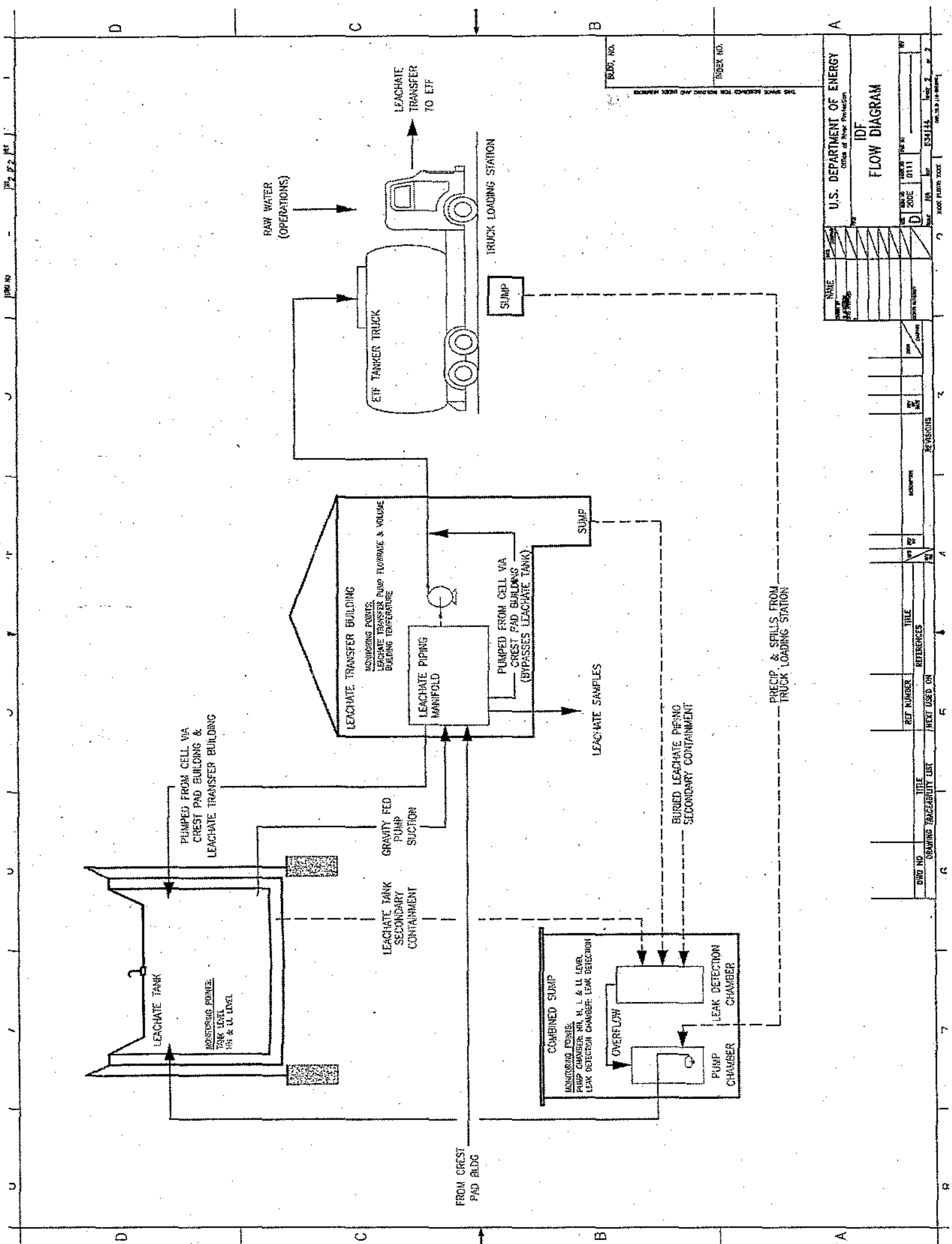


Figure 7. Integrated Disposal Facility Leachate Collection and Transfer Operations



6.0 PROPOSED CONTROLS

Particulate matter (PM) emissions will be controlled via a dust control plan. The dust control plan may include some or all controls for fugitive dust in the Hanford Site Air Operating Permit Department off Ecology Publication Number 00-05-006 (Ecology 2001), such as periodic watering of excavations, backfill, haul roads, and other disturbed areas that show signs of blowing dust. Soil stabilization products may also be used to mitigate wind and water erosion of areas disturbed by operations. An operations dust control plan will be developed similar to the dust control plan used during construction activities.

7.0 AIRBORNE EMISSIONS MONITORING SYSTEMS

The calculated emissions resulted in the identification of criteria pollutants PM and fine particulate matter (PM10) during IDF operation. Emission monitoring at the IDF is not proposed, as emissions are expected to be fugitive emissions. The controls for fugitive dust are detailed in Section 6.0. All other pollutants were calculated below the thresholds listed in the regulations, and therefore no monitoring is proposed.

8.0 EMISSIONS ESTIMATES

Operations at the IDF are expected to generate fugitive emissions. There are no active ventilation systems in the design, and only the leachate holding tanks have an engineering point source that will be passively ventilated to the atmosphere. Fugitive emissions will be generated from the handling and storage of waste containers prior to disposal and the handling and spreading of the soil lift layers as the trench is filled with waste containers. Operations at the IDF may cause PM and PM10 emissions to exceed the thresholds defined in WAC 173-400, "General Regulations for Air Pollution Sources." Criteria emissions estimates are summarized in Table 3. These estimates are explained in the sections that follow.

An NOC is not required to be filed under WAC 173-460, "Controls for New Sources of Toxic Air Pollutants," (WAC 173-460-030(1)(b) and WAC 173-460-040). Toxic air pollutants, as defined in WAC 173-460, from the IDF are not expected to exceed the small quantity emission rates defined in WAC 173-460-080, and the process is exempt as a minor process change.

Table 3. Criteria Emissions

Chemical Name	WAC 173-400-110 Threshold (tons/yr)	Unmitigated Emissions (tons/yr)	Unmitigated Emissions (lbs/yr)
PM	1.25E+00	1.21E+01	2.42E+04
PM10	7.50E-01	4.19E+00	8.37E+03

8.1 PARTICULATE MATTER EMISSIONS ESTIMATE

PM emissions from operations at the IDF were estimated using equations and methods contained in U.S. Environmental Protection Agency (EPA) AP-42, *Compilation of Air Pollutant Emission Factors, Stationary Point and Area*, as described below:

- PM emissions from waste covering activities were estimated using Section 13.2.4 for "Aggregate Handling and Storage Piles."
- PM emissions from transport of the waste packages and the aggregate cover into the IDF were estimated using Section 13.2.2 for "Unpaved Roads."
- PM emissions for compacting the waste aggregate cover were estimated using Section 13.2.3, "Heavy Construction Operations," Table 13.2.3-1, "Recommended Emission Factors for Construction Operations," and Table 11.9-1, "Emission Factor Equations for Uncontrolled Open Dust Sources at Western Surface Coal Mines."
- PM emissions for wind erosion of the aggregate storage pile were estimated using Section 13.2.5, "Industrial Wind Erosion."

The results of the PM emission estimates are given in Table 4.

Table 4. Integrated Disposal Facility Particulate Matter Estimates

	Unmitigated tons/yr		Mitigated tons/yr		[1]Quality Rating
	PM	PM10	PM	PM10	A
[2]Annual Aggregate Use	5.39E-01	2.55E-01	1.08E-01	5.09E-02	A
[3]Travel on Unpaved Roads	9.59E+00	2.46E+00	1.92E+00	4.93E-01	C
[4]Compacting	1.94E+00	1.46E+00	3.89E-01	2.91E-01	B,D
[5]Aggregate Storage Pile Wind Erosion	2.31E-02	1.16E-02	3.47E-03	1.73E-03	None
Total	1.21E+01	4.19E+00	2.42E+00	8.37E-01	NA
WAC 173-400-110 Threshold	1.25E+00	7.50E-01			

[1] The AP-42 emission factor rating is an overall assessment of how good a factor is, based on both the quality of the test(s) or information that is the source of the factor and on how well the factor represents the emission source.
[2] These parameters and the calculation are provided in Appendix A.
[3] These parameters and the calculation are provided in Appendix B.
[4] The parameters and this calculation are provided in Appendix C.
[5] The parameters and this calculation are provided in Appendix D.

9.0 REFERENCES

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Appendix A

PM Emissions for IDF Waste Covering Operations

The quantity of particulate emissions generated by the drop operation used to cover the waste in the IDF was calculated using the following equation from EPA AP-42, Section 13.2.4:

$$E = k \times 0.0032 \times \frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \text{ (lbs/ton)} \qquad \textbf{(A-1)}$$

Where:

E = emission factor (in pounds of soil released per ton of soil dropped)
k = particle size multiplier (dimensionless)
U = mean wind speed (mph)
M = material moisture content (%)

The particle size multiplier in the equation, k, varies with aerodynamic particle size range. For IDF waste covering activities, PM emissions were calculated for particles of 30 µm or less and PM10 emissions were calculated for particles of 10 µm or less. AP-42 provides a value for k equal to 0.74 for PM and 0.35 for PM10. The results of the equation can be considered as having a quality rating of A if the other ranges shown in Table A-1 are applicable:

Table A - 1. Applicable Ranges of Source Conditions for Equation A-1

Silt Content (%)	Moisture Content (%)	Wind Speed (mph)
0.44 – 19	0.25 – 4.8	1.3 – 15

AP-42, Section 13.2.4
Note: An AP-42 emission factor quality rating of A means excellent.

A moisture content of 1.78 percent was used in this calculation. This value came from sample number C3177-45, which was taken from borehole C3177, 299-E24-21, located just to the northeast of the site, south of the old steam line and on the east boundary of the IDF, according to an e-mail from S. P. Reidel to G. M. Crummel, "Soil Moisture," (Reidel, S. P., 2004-12-01).

An average silt content of 8.02 percent was noted from five sets of soil classification data from ENVIROTECH taken at the IDF during its initial construction OPS Sample (East Stockpile 1-5), *Soil Classification*. The samples were taken between September 13, 2004, and October 2, 2004. The silt content was determined from the percent passing through a number 200 sieve, with a sieve size of 0.075 mm. WHC-EP-0883, *Variability and Scaling of Hydraulic Properties for 200 Area Soils* defines silt as between 0.02 mm. and 0.002 mm.

A wind speed of 14.95 mph was used. This wind speed was derived from the 10 year average highest daily wind speed recorded at the Hanford Weather Station at an elevation of 15.2 m (50 ft) and comes from an e-mail from K. W. Burk to G. M. Crummel, "RE: Wind Information," (Burk, K. W., 2004-12-06). The 15.2 m (50 ft) average wind speed was adjusted to an estimated wind speed at 10 m (32.8 ft) using an equation in EPA, AP-42, Section 13.2.5.

The annual amount of soil dropped was determined from RPP-15479, "Project Definition Criteria for the Integrated Disposal Facility," which estimated that about 1.5 m^3 (or 52.97 ft^3) of soil will be used for every 1 m^3 (or 35.31 ft^3) of waste placed into the IDF. In addition, RPP-21633 states that the full IDF build out capacity is $9.00x10^{+5}$ m^3 ($3.18x10^{+7}$ ft^3). From this, it is calculated that $1.35x10^{+6}$ m^3 ($4.77x10^{+7}$ ft^3) of soil will be used to cover the IDF waste during a 28-year operating life. An annual average of $4.82x10^{+4}$ m^3 (1.70E+06 ft^3) of soil will be used to cover the IDF waste.

An average soil density value of $1.75x10^{+3}$ kg/m^3 ($1.09x10^{+2}$ lbs/ft^3) was used. This was derived from five sets of soil data taken by ENVIROTECH at the IDF during its initial construction OPS Material (Stockpile 1-5), *Standard Proctor*. The samples were taken between September 13, 2004, and October 21, 2004.

Mitigated emissions were calculated using an emission reduction value of 80 percent. This is the average of the 70 to 90 percent emission reduction cited as estimated in AP-42, Section 11.19.1, "Sand and Gravel Processing," for spray systems at transfer points and on material handling operations.

Table A - 2. Equation Variables

M = percent moisture content	1.78
U = mean wind speed in mph - 10-yr average	14.95
k_{30} = particle size multiplier	0.74
k_{10} = particle size multiplier	0.35

Table A - 3. IDF Annual Aggregate Use Parameters

		Volume		Weight	
		m³	ft³	lbs	tons
		C	D=C*[100/(2.54*12)]³	E=D*A_d	Vat=E/2000
IDF Full Build-out Capacity [Vw]		9.00E+05	3.18E+07		
Aggregate Cover Multiplier [m]	1.5				
Projected Aggregate Fill Volume [V_c = Vw * m]		1.35E+06	4.77E+07		
IDF Operating Life (yrs) [a]	28				
Annual fill - based on a 28 year operating life. [V_a = Vc/ a]		4.82E+04	1.70E+06	1.86E+08	9.30E+04
Aggregate Density (lbs/ft³) [A_d]	109				

RPP-21633, states that the full IDF build out capacity is 900,000 m³ (3.2E+07 ft³).
RPP-15479, estimates that about 1.5 m³ of soil will be used for every 1 m³ of waste placed in the IDF.

Table A - 4. Particulate Matter Emissions for Aggregate Handling

		Unmitigated		Mitigated
	lbs/ton	lbs	tons	tons
	B	C=B*Vat	D=C/2000	E=D*(1-P_m)
E_{30} = PM emission factor (lbs/ton)	1.16E-02	1.08E+03	5.39E-01	1.08E-01
E_{10} = PM10 emission factor (lbs/ton)	5.47E-03	5.09E+02	2.55E-01	5.09E-02
Percent Mitigation [P_m]				80%

Example calculation:

for PM, unmitigated emissions:

$$E_{30} = k_{30} \times 0.0032 \times \frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \ (lbs/ton)$$

$$E_{30} = 0.74 \times 0.0032 \frac{\left(\frac{14.95}{5}\right)^{1.3}}{\left(\frac{1.78}{2}\right)^{1.4}} = 1.16 \times 10^{-02} \ lbs/ton$$

$$1.16 \times 10^{-02} \ \frac{lb}{ton} \times 9.30 \times 10^{+04} \ tons = 1.08 \times 10^{+03} \ lbs$$

$$1.08 \times 10^{+03} \ lbs \times \frac{1}{2000} \ tons/lbs = 5.39 \times 10^{-01} \ tons$$

for PM, mitigated emissions:

$$5.39 \times 10^{-01} \ tons \times (1 - 0.80\%) = 1.08 \times 10^{-01} \ tons$$

Appendix B

PM Emissions for Travel on IDF Unpaved Roads

PM emissions from transport of the waste packages and the aggregate cover into the IDF were estimated using the following equation from AP-42, Section 13.2.2, "Unpaved Roads":

$$E = k \times (s/12)^a \times (W/3)^b \qquad \textbf{(B-1)}$$

Where:

E = size-specific emissions factor (lb/VMT)
VMT is vehicle mile traveled
s = surface material silt content (%)
W = mean vehicle weight (tons)
k = particle size constant
a = particle size constant
b = particle size constant

The particle size multiplier in the equation, *k*, varies with aerodynamic particle size range. For IDF waste covering activities, PM emissions were calculated for particles of 30 µm or less and PM10 emissions were calculated for particles of 10 µm or less. The variables *a, b, and k* vary with particle size as described in Table B-1 below:

Table B - 1. Constants for Equation B-1

	30 µm	10 µm
a	0.7	0.9
b	0.45	0.45
k	4.9	1.5

AP-42

In this calculation, a mean vehicle weight of 52 tons was used. The silt content used in this calculation was taken from Job No. 04-192, Work Order 24721, Sample No. 240532, *Integrated Disposal Facility Sieve Analysis Test Results*. This was the percent passing a 0.075 mm sieve from the sample identified as Job No. 04-192, Work Order 24721, Sample No. 240533, *Integrated Disposal Facility Sieve Analysis Test Results*. The number of annual miles traveled, 2656, was determined using the following reasoning:

> The unpaved travel distance to and from Cell 1 for the ILAW packages is approximately two miles. The combined weight of five ILAW packages is estimated at 48 tons (96,000 lbs). Approximately 35 ILAW packages per week will be produced, and with each trailer holding five packages, a minimum of seven trips per week will be required.
>
> The unpaved, round trip travel distance for the dump trucks carrying soil to cover the ILAW packages up to a depth of 1 m (3.3 ft) is estimated to be two miles. As previously mentioned, after every 81 ILAW packages are placed in IDF, about every 11 to 12 days, the packages will be covered. Each 1 m (3.3 ft) soil layer placed by dump truck will require 10 truck loads. Since 11 to 12 day intervals occur approximately 30 times per year, the number of annual trips by truck will be about 300.

Since less information was available for transport of other types of waste to the IDF, the unpaved distance traveled and number of trips needed per week was assumed to be the same as for ILAW.

Mitigated emissions were calculated using an emission reduction value of 80 percent. This is a field tested PM10 control efficiency, cited in AP-42, Section 13.2.2, "Unpaved Roads," for use of chemical dust suppressants applied at regular intervals of two weeks to one month.

Table B - 2. Equation B-1 Constants/Variables

k_{30} = particle size multiplier	4.9
k_{10} = particle size multiplier	1.5
s = surface material silt content (%)	5
W = mean vehicle weight (tons)	52
a_{30}	0.7
a_{10}	0.9
b_{30}	0.45
b_{10}	0.45

Table B - 3. Unpaved Road Use Parameters

Transport trip travel distance (miles) [Mt]	2
Round trip transport distance for dump trucks (miles) [Md]	2
Number of ILAW transport trips per year [Ni=7*52]	364
Number of other waste transport trips per day [No=7*52]	364
Number of dump truck trips per year to cover ILAW [Ndi =10*30]	300
Number of dump truck trips per year to cover other waste [Ndo =10*30]	300
Annual travel distance (mi/yr) [Ma=Ndo*Md+Ndi*Md+No*Mt+Ni*Mt]	2,656

Table B - 4. Particulate Matter Emissions for Unpaved Road

		Unmitigated		Mitigated
	lbs/VMT	lbs/yr	tons/yr	tons/yr
	B	C=B*Ma	D=C/2000	E=D*(1-P_m)
E_{30} lbs per vehicle mile traveled (VMT)	9.58E+00	2.55E+04	1.27E+01	2.55E+00
E_{10} lbs per vehicle mile traveled (VMT)	2.46E+00	6.54E+03	3.27E+00	6.54E-01
Percent Mitigation [P_m]				80%

Equation B-1 can be extrapolated to annual average uncontrolled conditions (but including natural mitigation and precipitation) under the simplifying assumption that annual average emissions are inversely proportional to the number of days with measurable (more than 0.254 mm [0.01 inch]) precipitation as follows:

$$E_{est} = E \times [(365 - P)/365] \qquad \textbf{(B-2)}$$

Where:

E_{est} = annual size-specific emission factor extrapolated for natural mitigation, lb/VMT
E = emission factor from equation B-1
P = number of days in a year with at least 0.254 mm (0.01 in) of precipitation

Figure 13.2.2-1 of AP-42 gives a geographical distribution for the mean number of "wet" days for the United States. For the Hanford Site, a total of 90 days is given. Results of this calculation are displayed in Table B-5 below:

Table B - 5. Particulate Matter Emissions for Unpaved Road using Equation B-2

	Unmitigated	**Mitigated**
E_{est} = E (365-90)/365	**tons/yr**	**tons/yr**
PM	9.59E+00	1.92E+00
PM10	2.46E+00	4.93E-01

Example calculation:

for PM, unmitigated emissions:

$$E_{30} = k \times (s/12)^a \times (W/3)^b = 4.9 \times (5/12)^{0.7} \times (52/3)^{0.45} = 9.58\ lbs/VMT$$

$$9.58\ lbs/VMT \times 2{,}656\ VMT = 2.55 \times 10^{+04}\ lbs/yr$$

$$2.55 \times 10^{+04}\ lbs/yr \times 1/2000\ tons/lb = 1.27 \times 10^{+01}\ tons/yr$$

for PM mitigated emissions:

$$1.27 \times 10^{+01} \times (1 - 80\%) = 2.55\ tons$$

for PM, unmitigated emissions accounting for precipitation:

$$1.27 \times 10^{+01}\ tons/yr \times (365 - 90)/365 = 9.59\ tons/yr$$

Appendix C

PM Emissions for IDF Compacting Activities

PM emissions for compacting the waste aggregate cover were estimated using the following equation from AP-42, Section 13.2.3, "Heavy Construction Operations", Table 13.2.3-1, "Recommended Emission Factors for Construction Operations", and Table 11.9-1, "Emission Factor Equations for Uncontrolled Open Dust Sources at Western Surface Coal Mines."

$$E = \frac{5.7 \times (s)^{1.2}}{(M)^{1.3}} \qquad \textbf{(C-1)}$$

Where:

E = emissions factor expressed in pounds per hour of compacting
s = surface material silt content (%)
M = material moisture content (%)

PM10 emissions are 0.75 times PM emissions.

An 8.02 percent silt content was used in this calculation. This was the same value used for the aggregate handling calculation shown in Appendix A.

The moisture content used in this equation was 1.78 percent (also discussed in Appendix A) for the first 0.5 m (1.5 ft) and 15.42 percent for the rest of the 1 m (3.3 ft) cover. The 15.4 percent moisture content was the average of the Optimum Compacting Moisture Content cited in OPS Material (Stockpile 1-5), *Standard Proctor*.

Two separate emission factors were determined using these different moisture contents. These two emission factors were then multiplied by the appropriate ratio of the partial soil cover depth to the complete 1 m (3.3 ft) depth. The results were then added together to acquire an appropriate emission factor in pounds per hour.

The number of annual hours of compacting was determined based on the earlier discussion that a finished 1 m (3.3 ft) layer of cover soil will be produced approximately 30 times per year. It is estimated that compaction of each soil layer will take about four hours. An equal number of hours is assumed for compacting the soil cover for the other wastes. This indicates a total annual number of 240 compacting hours.

Mitigated emissions were calculated using an emission reduction of 80 percent. This is the average of the 70 to 90 percent emission reduction cited as estimated in AP-42, Section 11.19.1, "Sand and Gravel Processing" for spray systems at transfer points and on material handling operations.

Table C - 1. Equation Variables

	First 18 in.	Next 21.6 in.
M is moisture content (%)	1.78	15.42
s is material silt content (%)	8.02	8.02
$E_{10} = 0.75 * E_{30}$		

Table C - 2. Compacting Operations Parameters

hrs per day [H= 4*2]	8
days per yr [Dy = 365/12]	30
hrs per yr [Hr = Dy*H]	243

Table C - 3. Particulate Matter Emissions from Compacting Operations

			Unmitigated			Mitigated
	lbs/hr first 18 in	lbs/hr next 21.6 in	Total lbs/hr	lbs/yr	tons/yr	tons/yr
	B	C	D=(B*18+C*21.6) /(39.6)	E=D*Hr	F=E/2000	$G=F*(1-P_m)$
E_{30} lbs/hr	3.28E+01	1.98E+00	1.60E+01	3.89E+03	1.94E+00	3.89E-01
E_{10} lbs/hr	2.46E+01	1.48E+00	1.20E+01	2.91E+03	1.46E+00	2.91E-01
Percent Mitigation [P_m]						80%

Example PM unmitigated calculation:

for the first 18 in:

$$E_{30} = \frac{5.7 \times (s)^{1.2}}{(M)^{1.3}} = \frac{5.7 \times (8.02)^{1.2}}{(1.78)^{1.3}} = 3.28 \times 10^{+01} \ lbs/hr$$

for the next 21.6 in:

$$E_{30} = \frac{5.7 \times (s)^{1.2}}{(M)^{1.3}} = \frac{5.7 \times (8.02)^{1.2}}{(15.42)^{1.3}} = 1.98 \ lbs/hr$$

for the total - all 3.3 ft (39.6 in):

$$(3.28 \times 10^{+01} \times 18 + 1.98 \times 21.6)/39.6 = 1.60 \times 10^{+01} \ lbs/hr$$

$$1.60 \times 10^{+01} \ lbs/hr \times 240 \ hr = 3.89 \times 10^{+03} \ lbs/yr$$

$$3.89 \times 10^{+03} \ lbs/yr \times 1/2000 \ tons/lb = 1.94 \ tons/yr$$

for PM mitigated emissions:

$$1.94 \ tons/yr \times (1 - 80\%) = 3.89 \times 10^{-01} \ tons/yr$$

Appendix D

PM Emissions from IDF Aggregate Storage Pile Wind Erosion

PM emissions for wind erosion of the aggregate storage pile were estimated using the following equation from EPA AP-42, Section 13.2.5, "Industrial Wind Erosion":

$$E = k\sum_{i=1}^{N} P_i \qquad \textbf{(D-1)}$$

Where:

E = emissions factor for wind-generated particulate emissions expressed in g/m^2 of material disturbed
k = the particle size multiplier
N = number of disturbances per year
P_i = erosion potential corresponding to the observed (or probable) fastest mile of wind for the i^{th} period between disturbances

The variable k varies with particle size as shown in Table D-1:

Table D - 1. Aerodynamic Particle Size Multipliers for Equation D-1

	30 um	10 um
k	1.0	0.5

$$P = 58 \times \left(u^* - u_t^*\right)^2 + 25 \times \left(u^* - u_t^*\right) \qquad \textbf{(D-2)}$$

$$P = 0 \text{ for } u^* \le u_t^*$$

Where:

u^* is the friction velocity (m/s)
u_t^* is the threshold friction velocity (m/s)

The threshold friction velocity was estimated using the procedure in EPA AP-42, Section 13.2.5 and Table 13.2.5-1, "Field Procedure for Determination of Threshold Friction Velocity." The percent passing sieve data provided in OPS Sample (East Stockpile 1-5), taken at the IDF by ENVIROTECH, was used in EPA Procedure AP-42. The procedure requires the use of sieve numbers 5, 9, 16, 32, and 60. The soil sample data provided percent passing for sieve numbers 4, 16, 40, 100, and 200. This data was used to estimate percent passing (using a linear assumption) for the correct EPA required sieve sizes. The threshold friction result from use of this method was 0.62 m/s. See Table D – 3 for details.

To estimate erosion emissions from aggregate storage piles the following additional EPA equations were used:

$$u^* = 0.1 \times u_s^+ \qquad \textbf{(D-3)}$$

Where:

u_s^+ = the corresponding surface wind speed distribution

$$u_s^+ = \frac{u_s}{u_r} \times u_{10}^+ \qquad \textbf{(D-4)}$$

Where:

u_s = surface wind speed
u_r = approaching wind speed
u_{10}^+ = the fastest mile wind speed for the period of interest from the wind speed instrument reading height (z), corrected to a height of 10 m

$$u_{10}^+ = u^+ \times \frac{\ln(10/0.005)}{\ln(z/0.005)} \qquad \textbf{(D-5)}$$

Where:

u^+ = the fastest mile wind speed for the period of interest from the wind speed instrument reading height (z)
a typical roughness height of 0.5 cm (0.005 m) has been assumed
z = height of the wind speed instrument reading in m

For aggregate piles with a height-to-base ratio of 0.2, the results shown in Table D-2 were achieved in wind tunnel tests:

Table D - 2 Aggregate Pile u_s/u_r Distribution

	bottom of pile facing and opposing approaching wind	**between bottom and top of face approaching wind**	**top of circular pile**	**top of oval pile**	**short side of oval pile from 20 to 40 degrees parallel with approaching wind**
u_s/u_r	0.2	0.6	0.9	0.6	1.1

AP-42, Table 13.2.5-3 and Figure 13.2.5-2

For aggregate piles with a height-to-base ratio which exceed of 0.2, results have shown that erosion of the frontal face is of the same order as on the top. This is assumed to be the case in this calculation. It is also assumed that the aggregate pile is oval. Consequently, u_s/u_r is assumed to be 0.6 in this calculation.

For this calculation, ten years worth of maximum daily wind speed data were obtained from the Hanford Weather Station (Burke, K. W., 2004-12-06). Since these values were taken at a height of 15.2 m (50 ft), these readings were adjusted to 10 m using the equation above. In this equation, z was substituted for 15.2 m.

Appropriate calculations were done on this wind data to arrive at results for $u^* - u_t^*$ that were greater than zero. Each of these values was then used in the equation for P (Equation D-2). The individual values for P were added together and divided by ten years to arrive at a value that was used in the equation for E (Equation D-1).

The area of the disturbance used to determine the final erosion emissions was estimated by dividing the total annual aggregate handled ($4.82\text{x}10^{+4}$ m^3) by the total number of annual disturbances (30). The total number of aggregate disturbances was based on covering the ILAW packages every 11 to 12 days. The area of the disturbance was estimated assuming that the area would be the 2/3 root of the volume disturbed.

Mitigated emissions were calculated using an 85 percent emission reduction. This is the average of the 80 to 90 percent emission reduction cited as estimated in AP-42, Section 11.19.1, "Sand and Gravel Processing," for spray systems used to reduce loading and wind erosion from storage piles of various materials.

Table D - 3 Determination of Threshold Friction Velocity ut*

Sample ID			OPS-05	OPS-04	OPS-03	OPS-02	OPS-01				
Sample Date			10/21/04	10/7/04	9/29/04	9/22/04	9/13/04				
Sieve No.	Sieve Size	Extrapolation Quantity	% Passing	% Passing	% Passing	% Passing	% Passing	Average % Passing	% makeup	u_t^*	u_t^* Resultant
	mm									cm/s	cm/s
	B	$C=(B_{i-1}-B_i)/(B_i-B_{i+1,2})$	D	E	F	G	H	I= Average (D:H) $I_i=(I_{i-1}+I_{i+1,2}*C_i)/(C_i+1)$	$J=I_i-I_{i+1,2}$	K from AP-42, Table 13.2.5-1	L=K*J
3/8 in	9.5		100	98.9	98.4	100	98	99.1			
No. 4	4.75		100	96.4	96.3	99.1	97.7	97.9			
No. 5	4	0.27						93.3			
No. 9	2	3.35						81.2	5.0	100	499
No.16	1.0		88.2	64.7	64.3	86	77.6	76.2	44.4	76	3376
No.32	0.5	6.67						31.7	15.1	58	877
No.40	0.425		15.1	20.9	24.1	33.1	32.2	25.1			
No. 60	0.25	1.75						16.6	4.8	43	208
No. 100	0.15		4	8.5	8.8	22.2	15.4	11.8	3.8		
No. 200	0.075		2.8	4.6	5.6	16.7	10.4	8.0	8.0		
								Sum	81.2		62*
								u_t^* Resultant (m/s)			0.62

OPS Sample (East Stockpile 1-5).
*The value of 62 cm/s was arrived at by dividing the sum of the u_t^* resultant values by the sum of the % makeup values (81.2).
u_t^* resultant (m/s) is u_t^* resultant (cm/s) converted from cm/s to m/s.

Table D - 4 Aggregate Pile Wind Erosion Assumptions and Parameters

Assumption: Aggregate pile is oval and that the height-to-base ratio exceeds 0.2	
Annual volume of aggregate disturbed (m^3/yr)- from annual aggregate handling [Vad]	4.8E+04
Annual number of disturbances- from compacting days per year [N]	30
Volume of individual aggregate disturbance (m^3) [V_n = Vad/N]	1.59E+03
Area of individual aggregate disturbance (m^2) [$A_i = (V_n)^{2/3}$]	136

Table D - 5 Particulate Matter Emissions for Wind Erosion

		Unmitigated		Mitigated
	g/m^2	lbs/yr	tons/yr	tons/yr
	B	C=B*A_i*2.2/1000	D=C/2000	E=D*(1-P_m)
Sum of P	1.55E+02			
E_{30}	1.55E+02	4.62E+01	2.31E-02	3.47E-03
E_{10}	7.73E+01	2.31E+01	1.16E-02	1.73E-03
Percent Mitigation [P_m]				85%

Example calculations:

A maximum daily wind speed of 43 mph was recorded on February 6, 1999, at 1.8 m (5 ft) (Burk, K. W., 2004-12-06). Using the equation for u_{10}^{+} above, this amounts to 40.8 mph at 10 m (32.8 ft) (18.2 m/s at 10 m.).

$$u_s^+ = \frac{u_s}{u_r} \times u_{10}^+ = 0.6 \times 18.2 = 10.9$$

$$u^* = 0.1 \times u_s^+ = 0.1 \times 10.9 = 1.09$$

$$P = 58 \times \left(u^* - u_t^*\right)^2 + 25 \times \left(u^* - u_t^*\right) = 58 \times (1.09 - 0.62)^2 + 25 \times (1.09 - 0.62) = 25.4$$

The summation for a ten year average resulted in a value for P equal to 155 (see Appendix E). Therefore:

$$E_{30} = k \times \sum_{i=1}^{N} P_i = 1.0 \times 155 = 155 \times 10^{+02} \cdot g/m^2$$

$$1.55 \times 10^{+02}\ g/m^2 \times \left(136\ m^2/yr\right) \times \left(2.2\ lbs/kg\right) / \left(1000\ g/kg\right) = 4.62 \times 10^{+01}\ lbs/yr$$

$$4.62 \times 10^{+01}\ lbs/yr \times 1/2000\ tons/lb = 2.31 \times 10^{-02}\ tons/yr$$

Mitigated emissions would be calculated as follows:

$$2.31 \times 10^{-02}\ tons/yr \times (1 - 85\%) = 3.47 \times 10^{-03}\ tons/yr$$

Appendix E

Maximum Daily Recorded Wind Speed and Wind Erosion Calculations

Table E - 1 Maximum Daily Windspeed (11 Sheets)

		u_{10}^{+}		u_s/u_r	u_s^{+}	u*	u* - ut*	P (g/m^2)
Date	**Wind Speed (mph)**	**Wind Speed (mph)**	**Wind Speed (m/s)**					
	B	**C= B* Ln(10/0.005)/ Ln(15/0.005)**	**D= (C/60/60)* 5280 *12*2.54/100**	**E**	**F=E*D**	**G=F*0.1**	**H= G-0.62**	**I=58*H^2+25*H**
12/1/1994	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
12/18/1994	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
2/12/1995	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
2/17/1995	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
2/19/1995	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
3/4/1995	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
3/9/1995	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
3/18/1995	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
3/31/1995	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
4/24/1995	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
5/6/1995	33	31.3	14.0	0.6	8.4	0.84	0.23	8.575
5/17/1995	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
5/25/1995	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
6/5/1995	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
6/10/1995	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
6/26/1995	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
7/2/1995	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
7/3/1995	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
7/6/1995	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
7/12/1995	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
7/14/1995	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
7/21/1995	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
7/23/1995	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
7/28/1995	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
7/29/1995	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
8/5/1995	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
8/12/1995	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
8/21/1995	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
8/23/1995	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
9/30/1995	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
10/3/1995	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
10/10/1995	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
10/18/1995	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
11/8/1995	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
11/28/1995	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
11/29/1995	36	34.2	15.3	0.6	9.2	0.92	0.30	12.819
12/1/1995	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
12/2/1995	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
12/4/1995	32	30.4	13.6	0.6	8.1	0.81	0.20	7.311

Table E - 1 Maximum Daily Windspeed (11 Sheets)

		u_{10}^+		u_s/u_r	u_s^+	u*	u* - ut*	P (g/m²)
Date	Wind Speed (mph)	Wind Speed (mph)	Wind Speed (m/s)					
	B	C= B* Ln(10/0.005)/ Ln(15/0.005)	D= (C/60/60)* 5280 *12*2.54/100	E	F=E*D	G=F*0.1	H= G-0.62	I=58*H^2+25*H
12/12/1995	39	37.0	16.6	0.6	9.9	0.99	0.38	17.741
12/13/1995	36	34.2	15.3	0.6	9.2	0.92	0.30	12.819
1/3/1996	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
1/15/1996	34	32.3	14.4	0.6	8.7	0.87	0.25	9.915
2/9/1996	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
2/20/1996	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
2/22/1996	34	32.3	14.4	0.6	8.7	0.87	0.25	9.915
2/23/1996	36	34.2	15.3	0.6	9.2	0.92	0.30	12.819
3/15/1996	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
3/16/1996	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
4/12/1996	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
4/16/1996	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
4/23/1996	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
5/18/1996	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
5/22/1996	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
5/26/1996	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
5/27/1996	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
6/15/1996	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
6/16/1996	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
6/17/1996	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
7/3/1996	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
7/4/1996	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
7/9/1996	32	30.4	13.6	0.6	8.1	0.81	0.20	7.311
7/16/1996	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
7/28/1996	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
8/1/1996	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
8/3/1996	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
8/4/1996	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
8/11/1996	31	29.4	13.2	0.6	7.9	0.79	0.17	6.121
8/30/1996	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
8/31/1996	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
9/3/1996	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
10/4/1996	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
10/13/1996	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
10/14/1996	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
11/6/1996	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
11/17/1996	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
12/5/1996	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
12/31/1996	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304

Table E - 1 Maximum Daily Windspeed (11 Sheets)

		u_{10}^+		u_s/u_r	u_s^+	u*	u* - ut*	P (g/m^2)
Date	Wind Speed (mph)	Wind Speed (mph)	Wind Speed (m/s)					
	B	C= B* Ln(10/0.005)/ Ln(15/0.005)	D= (C/60/60)* 5280 *12*2.54/100	E	F=E*D	G=F*0.1	H= G-0.62	I=58*H^2+25*H
1/1/1997	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
1/23/1997	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
2/17/1997	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
2/19/1997	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
2/26/1997	33	31.3	14.0	0.6	8.4	0.84	0.23	8.575
3/9/1997	33	31.3	14.0	0.6	8.4	0.84	0.23	8.575
3/16/1997	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
3/26/1997	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
3/28/1997	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
3/30/1997	41	38.9	17.4	0.6	10.4	1.04	0.43	21.398
4/3/1997	38	36.1	16.1	0.6	9.7	0.97	0.35	16.025
4/16/1997	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
4/20/1997	34	32.3	14.4	0.6	8.7	0.87	0.25	9.915
4/30/1997	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
6/15/1997	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
6/17/1997	31	29.4	13.2	0.6	7.9	0.79	0.17	6.121
6/21/1997	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
6/28/1997	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
7/5/1997	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
7/9/1997	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
8/7/1997	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
8/14/1997	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
8/26/1997	35	33.2	14.9	0.6	8.9	0.89	0.28	11.329
9/15/1997	31	29.4	13.2	0.6	7.9	0.79	0.17	6.121
9/17/1997	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
9/26/1997	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
10/2/1997	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
10/3/1997	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
10/4/1997	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
10/9/1997	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
10/29/1997	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
10/30/1997	37	35.1	15.7	0.6	9.4	0.94	0.33	14.385
12/27/1997	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
2/8/1998	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
3/16/1998	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
3/26/1998	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
4/15/1998	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
5/6/1998	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
5/20/1998	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566

Table E - 1 Maximum Daily Windspeed (11 Sheets)

		u_{10}^{+}		u_s/u_r	u_s^{+}	u*	u* - ut*	P (g/m²)
Date	Wind Speed (mph)	Wind Speed (mph)	Wind Speed (m/s)					
	B	C= B* Ln(10/0.005)/ Ln(15/0.005)	D= (C/60/60)* 5280 *12*2.54/100	E	F=E*D	G=F*0.1	H= G-0.62	I=58*H^2+25*H
5/21/1998	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
6/13/1998	32	30.4	13.6	0.6	8.1	0.81	0.20	7.311
6/15/1998	32	30.4	13.6	0.6	8.1	0.81	0.20	7.311
6/18/1998	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
7/27/1998	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
8/14/1998	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
8/15/1998	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
8/25/1998	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
10/8/1998	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
11/12/1998	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
11/13/1998	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
11/15/1998	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
11/20/1998	32	30.4	13.6	0.6	8.1	0.81	0.20	7.311
11/21/1998	32	30.4	13.6	0.6	8.1	0.81	0.20	7.311
11/22/1998	31	29.4	13.2	0.6	7.9	0.79	0.17	6.121
11/23/1998	33	31.3	14.0	0.6	8.4	0.84	0.23	8.575
11/24/1998	33	31.3	14.0	0.6	8.4	0.84	0.23	8.575
11/26/1998	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
12/1/1998	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
12/2/1998	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
12/26/1998	38	36.1	16.1	0.6	9.7	0.97	0.35	16.025
12/27/1998	32	30.4	13.6	0.6	8.1	0.81	0.20	7.311
1/11/1999	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
1/14/1999	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
1/16/1999	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
1/27/1999	31	29.4	13.2	0.6	7.9	0.79	0.17	6.121
1/28/1999	34	32.3	14.4	0.6	8.7	0.87	0.25	9.915
1/29/1999	38	36.1	16.1	0.6	9.7	0.97	0.35	16.025
2/1/1999	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
2/2/1999	41	38.9	17.4	0.6	10.4	1.04	0.43	21.398
2/4/1999	37	35.1	15.7	0.6	9.4	0.94	0.33	14.385
2/5/1999	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
2/6/1999	43	40.8	18.2	0.6	10.9	1.09	0.48	25.356
2/7/1999	36	34.2	15.3	0.6	9.2	0.92	0.30	12.819
2/17/1999	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
2/22/1999	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
2/24/1999	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
2/25/1999	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
2/28/1999	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007

Table E - 1 Maximum Daily Windspeed (11 Sheets)

		u_{10}^{+}		u_s/u_r	u_s^{+}	u*	u* - ut*	P (g/m^2)
Date	Wind Speed (mph)	Wind Speed (mph)	Wind Speed (m/s)					
	B	C= B* Ln(10/0.005)/ Ln(15/0.005)	D= (C/60/60)* 5280 *12*2.54/100	E	F=E*D	G=F*0.1	H= G-0.62	I=58*H^2+25*H
3/3/1999	34	32.3	14.4	0.6	8.7	0.87	0.25	9.915
3/26/1999	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
3/27/1999	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
3/29/1999	32	30.4	13.6	0.6	8.1	0.81	0.20	7.311
4/7/1999	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
4/8/1999	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
4/20/1999	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
5/1/1999	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
5/6/1999	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
5/12/1999	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
5/20/1999	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
5/25/1999	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
5/31/1999	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
6/3/1999	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
6/4/1999	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
6/5/1999	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
6/18/1999	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
6/22/1999	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
6/23/1999	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
7/1/1999	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
7/7/1999	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
7/14/1999	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
7/23/1999	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
7/24/1999	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
7/28/1999	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
7/29/1999	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
8/11/1999	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
8/29/1999	31	29.4	13.2	0.6	7.9	0.79	0.17	6.121
8/30/1999	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
9/6/1999	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
9/9/1999	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
9/23/1999	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
9/24/1999	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
9/25/1999	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
10/8/1999	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
10/28/1999	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
10/31/1999	34	32.3	14.4	0.6	8.7	0.87	0.25	9.915
11/3/1999	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
12/2/1999	34	32.3	14.4	0.6	8.7	0.87	0.25	9.915

Table E - 1 Maximum Daily Windspeed (11 Sheets)

		u_{10}^+		u_s/u_r	u_s^+	u*	u* - ut*	P (g/m²)
Date	Wind Speed (mph)	Wind Speed (mph)	Wind Speed (m/s)					
	B	C= B* Ln(10/0.005)/ Ln(15/0.005)	D= (C/60/60)* 5280 *12*2.54/100	E	F=E*D	G=F*0.1	H= G-0.62	I=58*H^2+25*H
12/6/1999	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
12/12/1999	32	30.4	13.6	0.6	8.1	0.81	0.20	7.311
12/13/1999	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
12/14/1999	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
12/15/1999	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
12/17/1999	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
12/18/1999	35	33.2	14.9	0.6	8.9	0.89	0.28	11.329
1/8/2000	32	30.4	13.6	0.6	8.1	0.81	0.20	7.311
1/9/2000	34	32.3	14.4	0.6	8.7	0.87	0.25	9.915
1/14/2000	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
3/14/2000	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
3/18/2000	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
4/4/2000	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
4/13/2000	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
4/22/2000	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
5/3/2000	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
5/9/2000	32	30.4	13.6	0.6	8.1	0.81	0.20	7.311
5/10/2000	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
5/16/2000	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
5/17/2000	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
5/24/2000	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
5/26/2000	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
5/27/2000	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
6/12/2000	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
6/14/2000	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
6/18/2000	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
6/30/2000	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
7/1/2000	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
7/14/2000	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
7/31/2000	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
8/9/2000	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
8/10/2000	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
9/8/2000	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
9/30/2000	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
11/4/2000	32	30.4	13.6	0.6	8.1	0.81	0.20	7.311
12/15/2000	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
12/17/2000	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
3/10/2001	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
3/13/2001	40	38.0	17.0	0.6	10.2	1.02	0.40	19.532

Table E - 1 Maximum Daily Windspeed (11 Sheets)

		u_{10}^{+}		u_s/u_r	u_s^{+}	u*	u* - ut*	P (g/m²)
Date	Wind Speed (mph)	Wind Speed (mph)	Wind Speed (m/s)					
	B	C= B* Ln(10/0.005)/ Ln(15/0.005)	D= (C/60/60)* 5280 *12*2.54/100	E	F=E*D	G=F*0.1	H= G-0.62	I=58*H^2+25*H
3/19/2001	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
3/25/2001	31	29.4	13.2	0.6	7.9	0.79	0.17	6.121
4/17/2001	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
4/28/2001	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
4/29/2001	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
4/30/2001	32	30.4	13.6	0.6	8.1	0.81	0.20	7.311
5/4/2001	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
5/14/2001	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
5/16/2001	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
5/19/2001	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
5/23/2001	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
5/28/2001	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
6/1/2001	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
6/2/2001	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
6/3/2001	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
6/14/2001	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
7/4/2001	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
7/5/2001	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
7/12/2001	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
7/24/2001	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
8/3/2001	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
8/17/2001	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
8/18/2001	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
8/22/2001	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
9/5/2001	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
9/6/2001	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
9/25/2001	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
10/8/2001	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
10/12/2001	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
10/23/2001	41	38.9	17.4	0.6	10.4	1.04	0.43	21.398
10/26/2001	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
10/31/2001	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
11/14/2001	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
11/29/2001	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
12/1/2001	34	32.3	14.4	0.6	8.7	0.87	0.25	9.915
12/4/2001	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
12/13/2001	39	37.0	16.6	0.6	9.9	0.99	0.38	17.741
12/14/2001	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
12/16/2001	36	34.2	15.3	0.6	9.2	0.92	0.30	12.819

Table E - 1 Maximum Daily Windspeed (11 Sheets)

		u_{10}^{+}		u_s/u_r	u_s^{+}	u*	u* - ut*	P (g/m^2)
Date	Wind Speed (mph)	Wind Speed (mph)	Wind Speed (m/s)					
	B	C= B* Ln(10/0.005)/ Ln(15/0.005)	D= (C/60/60)* 5280 *12*2.54/100	E	F=E*D	G=F*0.1	H= G-0.62	I=58*H^2+25*H
12/17/2001	32	30.4	13.6	0.6	8.1	0.81	0.20	7.311
1/7/2002	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
1/12/2002	37	35.1	15.7	0.6	9.4	0.94	0.33	14.385
1/20/2002	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
1/23/2002	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
1/24/2002	33	31.3	14.0	0.6	8.4	0.84	0.23	8.575
1/25/2002	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
1/31/2002	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
2/8/2002	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
2/19/2002	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
2/21/2002	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
2/22/2002	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
3/5/2002	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
3/11/2002	38	36.1	16.1	0.6	9.7	0.97	0.35	16.025
3/12/2002	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
3/31/2002	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
4/1/2002	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
4/13/2002	34	32.3	14.4	0.6	8.7	0.87	0.25	9.915
4/14/2002	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
5/5/2002	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
5/13/2002	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
5/14/2002	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
5/19/2002	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
5/21/2002	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
5/29/2002	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
6/7/2002	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
6/9/2002	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
6/18/2002	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
6/26/2002	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
7/3/2002	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
7/7/2002	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
7/19/2002	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
7/25/2002	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
7/26/2002	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
7/28/2002	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
7/30/2002	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
8/1/2002	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
8/10/2002	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
8/14/2002	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566

Table E - 1 Maximum Daily Windspeed (11 Sheets)

		u_{10}^+		u_s/u_r	u_s^+	u*	u* - ut*	P (g/m^2)
Date	Wind Speed (mph)	Wind Speed (mph)	Wind Speed (m/s)					
	B	C= B* Ln(10/0.005)/ Ln(15/0.005)	D= (C/60/60)* 5280 *12*2.54/100	E	F=E*D	G=F*0.1	H= G-0.62	I=58*H^2+25*H
8/15/2002	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
8/17/2002	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
8/19/2002	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
8/20/2002	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
8/29/2002	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
9/1/2002	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
9/19/2002	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
10/10/2002	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
10/12/2002	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
10/29/2002	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
12/15/2002	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
12/16/2002	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
12/27/2002	42	39.9	17.8	0.6	10.7	1.07	0.45	23.339
12/31/2002	36	34.2	15.3	0.6	9.2	0.92	0.30	12.819
1/2/2003	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
1/3/2003	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
2/16/2003	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
2/20/2003	36	34.2	15.3	0.6	9.2	0.92	0.30	12.819
2/21/2003	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
3/5/2003	40	38.0	17.0	0.6	10.2	1.02	0.40	19.532
3/6/2003	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
3/11/2003	34	32.3	14.4	0.6	8.7	0.87	0.25	9.915
3/12/2003	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
3/13/2003	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
3/20/2003	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
3/21/2003	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
3/22/2003	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
3/26/2003	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
4/9/2003	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
4/10/2003	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
4/13/2003	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
5/15/2003	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
6/10/2003	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
6/13/2003	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
6/18/2003	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
6/19/2003	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
6/29/2003	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
7/3/2003	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
7/7/2003	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566

Table E - 1 Maximum Daily Windspeed (11 Sheets)

		u_{10}^{+}		u_s/u_r	u_s^{+}	u*	u* - ut*	P (g/m^2)
Date	Wind Speed (mph)	Wind Speed (mph)	Wind Speed (m/s)					
	B	C= B* Ln(10/0.005)/ Ln(15/0.005)	D= (C/60/60)* 5280 *12*2.54/100	E	F=E*D	G=F*0.1	H= G-0.62	I=58*H^2+25*H
7/12/2003	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
7/23/2003	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
8/7/2003	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
8/16/2003	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
8/19/2003	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
9/11/2003	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
9/12/2003	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
9/19/2003	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
10/8/2003	34	32.3	14.4	0.6	8.7	0.87	0.25	9.915
10/12/2003	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
10/16/2003	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
10/17/2003	32	30.4	13.6	0.6	8.1	0.81	0.20	7.311
10/20/2003	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
10/22/2003	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
10/28/2003	38	36.1	16.1	0.6	9.7	0.97	0.35	16.025
10/30/2003	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
11/10/2003	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
11/17/2003	31	29.4	13.2	0.6	7.9	0.79	0.17	6.121
11/18/2003	41	38.9	17.4	0.6	10.4	1.04	0.43	21.398
11/19/2003	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
11/22/2003	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
1/29/2004	29	27.5	12.3	0.6	7.4	0.74	0.12	3.969
1/30/2004	36	34.2	15.3	0.6	9.2	0.92	0.30	12.819
3/5/2004	36	34.2	15.3	0.6	9.2	0.92	0.30	12.819
3/9/2004	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
3/18/2004	34	32.3	14.4	0.6	8.7	0.87	0.25	9.915
3/24/2004	34	32.3	14.4	0.6	8.7	0.87	0.25	9.915
3/26/2004	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
4/20/2004	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
4/23/2004	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
4/27/2004	36	34.2	15.3	0.6	9.2	0.92	0.30	12.819
5/10/2004	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
5/21/2004	28	26.6	11.9	0.6	7.1	0.71	0.10	3.005
5/30/2004	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
6/5/2004	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
6/10/2004	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
7/2/2004	26	24.7	11.0	0.6	6.6	0.66	0.05	1.304
7/7/2004	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
7/25/2004	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566

Table E - 1 Maximum Daily Windspeed (11 Sheets)

		u_{10}^{+}		u_s/u_r	u_s^{+}	u*	u* - ut*	P (g/m2)
Date	Wind Speed (mph)	Wind Speed (mph)	Wind Speed (m/s)					
	B	C= B* Ln(10/0.005)/ Ln(15/0.005)	D= (C/60/60)* 5280 *12*2.54/100	E	F=E*D	G=F*0.1	H= G-0.62	I=58*H^2+25*H
8/14/2004	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
9/1/2004	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
9/4/2004	27	25.6	11.5	0.6	6.9	0.69	0.07	2.117
9/18/2004	25	23.7	10.6	0.6	6.4	0.64	0.02	0.566
11/2/2004	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
11/24/2004	30	28.5	12.7	0.6	7.6	0.76	0.15	5.007
							Sum	1,549
						10-yr Average		155