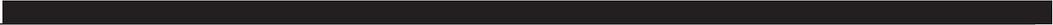




3M Company
St. Paul, Minnesota



Addendum to the Feasibility Studies for the Oakdale, Woodbury and Cottage Grove Sites, Minnesota

April 2008



**ADDENDUM TO THE FEASIBILITY STUDIES
FOR THE
OAKDALE, WOODBURY AND COTTAGE GROVE SITES
MINNESOTA**

April 2008

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1. BACKGROUND

In early 2008, the 3M Company (3M) submitted to the Minnesota Pollution Control Agency (MPCA) three Feasibility Study (FS) reports to address the presence of perfluorochemicals (PFCs) at the Oakdale Site, the Woodbury Site, and the Cottage Grove Site (collectively referred to as the Minnesota Sites). The FS Reports were prepared and submitted to the MPCA in accordance with the Settlement Agreement and Consent Order (Agreement) between MPCA and 3M, which became effective on May 22, 2007. The reports are listed as follows:

- *Feasibility Study for the Oakdale Site, Oakdale, Minnesota* (Oakdale FS Report) – Submitted by 3M on January 28, 2008.
- *Remedial Investigation/Feasibility Study for the Woodbury Site, Woodbury, Minnesota* (Woodbury RI/FS Report) – Submitted by 3M on February 18, 2008.
- *Feasibility Study for the Cottage Grove Site, Cottage Grove, Minnesota* (Cottage Grove FS Report) – Submitted by 3M on March 13, 2008.

In letters dated March 13, 2008 and April 4, 2008, the MPCA approved the Oakdale and Woodbury FS Reports, respectively, with modifications. Specifically, the MPCA requested that additional information be provided concerning the final disposal location and handling of non-hazardous PFC-containing soil. In discussions with the MPCA, they indicated they would request a similar analysis for the remaining FS Report for Cottage Grove. Hence, 3M has directed Weston Solutions, Inc. (WESTON®) to prepare this addendum that would be applicable for inclusion in each of the three FS Reports.

1.1 PURPOSE

The purpose of this addendum is to provide a description of the off-site disposal locations reviewed and considered, along with the recommended facility. Each facility evaluated was based on non-hazardous PFC-containing soil acceptance criteria. In the event that non-PFC constituents (e.g., VOCs, etc.) are encountered during excavation and cause the soil to be unacceptable at the selected disposal facility, MPCA will be informed and any alternate disposal facility selected will be handled on a case-by-case basis. While this



scenario is expected to involve a limited volume of soil, if any, it will be fully addressed in the Remedial Design document for each site.

In each of the three FS Reports, all three of the soil alternatives evaluated involved excavation of PFC-containing soil and off-site disposal. The following facilities were considered for off-site disposal of the excavated PFC-containing soils:

- SKB Environmental (SKB) Landfill in Rosemount, Minnesota.
- Veolia Environmental Services Rolling Hills Landfill in Buffalo, Minnesota.
- Peoria Disposal Company Landfill in Peoria, Illinois.

Additionally, off-site incineration was considered for destruction of PFCs in the excavated soils. The Veolia Environmental Services (Veolia) incinerators in Sauget, Illinois, and Port Arthur, Texas were evaluated. The 3M Cottage Grove incinerator was also considered, but it is not permitted or designed to handle bulk PFC-containing soils in the quantities expected for this project and therefore was not included in the evaluation. For purposes of comparing the disposal options, it was assumed that approximately 125,000 cubic yards (equivalent to approximately 190,000 tons) would be excavated from the three sites. At this time, this volume is consistent with the estimated volumes based on the MPCA staff recommended alternatives for the Oakdale and Woodbury Sites. As more data are collected from the Woodbury and Cottage Grove Sites, this volume could increase or decrease.

1.2 ORGANIZATION OF THE ADDENDUM

This addendum to the FS is organized into the following sections consistent with the FS organization:

- **Section 1 – Background.** Contains background information and purpose of the addendum.
- **Section 2 – Off-Site Facilities.** Contains a description of the off-site disposal and incineration facilities that were considered in the FS.
- **Section 3 – Comparison of Off-Site Facilities/Technologies.** Contains a comparison of the off-site facilities/technologies with respect to implementability, long-term effectiveness, short-term effectiveness, and cost.
- **Section 4 – Recommendation.** Contains the recommendation for the off-site facility.

2. DESCRIPTION OF OFF-SITE FACILITIES

2.1 SKB ENVIRONMENTAL LANDFILL

SKB owns and operates an industrial waste landfill in Rosemount, Minnesota. The distance between SKB and the Minnesota Sites ranges from approximately 14 to 21 road miles.

SKB is a commercial landfill that provides disposal for non-hazardous industrial solid waste and municipal solid waste (MSW) incinerator ash. The landfill was constructed in 1992 as a state-of-the art disposal facility that meets or surpasses the federal¹ and state regulations for industrial solid waste landfills (SKB, 2008). At a minimum, Subtitle D landfills include a primary flexible membrane liner (FML) (at least 60-mil thick for a high density polyethylene [HDPE] liner) underlain by at least 2 feet of compacted soil with a hydraulic conductivity of no more than 1×10^{-7} centimeters/second (cm/sec), as well as a leachate collection system above the FML. The SKB Landfill includes a multiple liner system with two independent, and redundant, leachate collection systems. Specifically, the primary 80-mil HDPE liner is underlain by a secondary 60-mil HDPE liner, which is underlain by a tertiary liner of compacted clay and soil. One leachate collection system is located above the primary liner, and the other is located between the primary and secondary liners. Collected leachate is treated at a publicly-owned wastewater treatment plant (WWTP) adjoining the site (SKB, 2008).

SKB has indicated to 3M that they can accommodate the volume of soil that would be excavated from the three Minnesota Sites and that it would be their intent to construct a separate disposal cell/vault within the landfill for the PFC-containing material. SKB would construct a separate cell by installing an additional synthetic liner (80-mil HDPE) to isolate PFC-containing material from other industrial solid waste within the landfill. This cell would be above the three-liner system described previously and would have a

¹ Subtitle D of the Resource Conservation and Recovery Act (RCRA)



new additional 80-mil liner. Within the cell, leachate would be collected and treated separately from other landfill leachate. Current plans are for the cell leachate to be transported for treatment at the 3M Cottage Grove facility. The leachate may be treated in either the existing WWTP at the 3M Cottage Grove facility, or a new treatment system may be installed to treat the leachate at the Cottage Grove Site. When the cell is filled, it would be covered with an impermeable cap to provide isolation and containment of the PFC material. The design and operation of the cell would be done in a manner to minimize leachate generation.

2.2 VEOLIA ENVIRONMENTAL SERVICES ROLLING HILLS LANDFILL

Veolia Environmental Services owns and operates a landfill (Rolling Hills Landfill) in Buffalo, Minnesota. The distance between the landfill and each of the three Minnesota Sites ranges from approximately 57 to 69 road miles.

The Rolling Hills Landfill is a commercial landfill that provides disposal for non-hazardous industrial solid waste. The landfill was constructed in 1993. It includes a single composite liner (60-mil FML and 2 feet of clay) and a single leachate collection system located above the liner (Veolia, 2003). It is expected that the Rolling Hills Landfill can accommodate the volume of soil that would be excavated from the three Minnesota Sites because it reportedly has operating capacity for another 5 years (ending in 2013); this information would be confirmed with the landfill. As with SKB, a separate cell with leachate collection and treatment could be included for isolation of the PFC-containing soils.

2.3 PEORIA DISPOSAL COMPANY LANDFILL

Peoria Disposal Company owns and operates a landfill (PDC Landfill) in Peoria, Illinois, that has been used in the past by 3M for disposal of other waste material. The distance between the landfill and each of the three Minnesota Sites is approximately 460 miles.

The PDC Landfill is a RCRA-permitted commercial waste disposal facility that provides secure disposal for hazardous waste and complies with RCRA Subtitle C landfill design



and operating standards. At a minimum, Subtitle C landfills include a primary liner with a leachate collection system above it and a secondary liner (at least 3 feet of compacted soil with a hydraulic conductivity of no more than 1×10^{-7} cm/sec) with a leachate detection and collection system between the primary and secondary liners. Information from their literature indicates that the PDC Landfill includes two 80-mil HDPE, one 60-mil HDPE, bentonite, and 3-foot clay liners and leachate detection and collection systems (Peoria Disposal Company, 2008). Although PFC-containing soils are not hazardous wastes, the PDC Landfill was considered as a potential disposal location to evaluate the range in types of landfills that would be approved to accept the excavated soils. This landfill could accept materials that may not be approved for disposal at SKB or the Rolling Hills Landfill due to non-PFC constituents.

Literature indicates that the PDC Landfill active cell C-4 has a reported capacity of 2.6 million cubic yards with 600,000 cubic yards remaining. It is uncertain whether it can accommodate the volume of soil that would be excavated from the three Minnesota Sites because the expected volume would be significant compared to the remaining capacity of the active landfill cell. Technical details would need to be confirmed by further discussions with PDC about the excavation schedule and the specific waste material that would be disposed at the landfill.

2.4 VEOLIA INCINERATORS

Veolia Environmental Services (Veolia) owns and operates two commercial hazardous waste incinerator facilities, which are located in Sauget, Illinois, and Port Arthur, Texas. Both facilities can accept bulk solids such as excavated soils; however, how much available capacity each facility would have to handle bulk soils with no Btu value, in the near-term, is unknown.

The Sauget, Illinois facility is located approximately 570 miles from the Minnesota Sites. At this facility, Veolia operates two fixed-hearth, dual-chamber feed incinerators and one rotary kiln incinerator with a combined thermal throughput of 86 million British thermal



units per hour (Btu/hr). The capacity of the combined units is reportedly 30,000 tons/year (approximately 80 tons/day) (Veolia Environmental Service, 2008).

The Port Arthur, Texas facility is located approximately 1,200 miles from the Minnesota Sites. It has a Toxic Substances Control Act (TSCA) permit to incinerate waste containing PCBs greater than 50 ppm as well as a RCRA permit to incinerate hazardous waste. At this facility, Veolia operates a rotary kiln incinerator with a thermal throughput of 150 million Btu/hr. The capacity of the unit is reported to be 60,000 tons/year (approximately 165 tons/day) (Veolia Environmental Services, 2008).

3. COMPARISON OF OFF-SITE FACILITIES/TECHNOLOGIES

In compliance with the Agreement, each of the four off-site options that were evaluated for the FS would provide a comprehensive and effective long-term response that protects public health and welfare and the environment through excavation, engineered isolation and containment of PFCs, or excavation and destruction of PFCs. The following sections contain a comparison of each option with respect to long-term effectiveness, implementability, short-term effectiveness and cost. This comparison is summarized in Table 3-1.

3.1 LONG-TERM EFFECTIVENESS

Incineration of excavated soils would provide long-term effectiveness because the PFCs in soils would be destroyed. All three landfill options would provide long-term effectiveness in meeting the requirement of the Agreement for the isolation and containment of PFCs; this is based on the landfill design, including liners and leachate collection systems. SKB would provide additional isolation compared to the current configuration of Rolling Hills Landfill through construction of a separate cell, as well as a separate leachate collection system with subsequent treatment of leachate. The SKB Landfill currently meets and surpasses the Subtitle D federal and state requirements for disposal of non-hazardous industrial waste. The PDC Landfill is subject to more stringent RCRA Subtitle C requirements for hazardous wastes. It is important to note that PFC-containing soils are not regulated under RCRA, that is, they are not hazardous wastes. Thus, disposal at PDC would involve co-mingling of hazardous wastes at the PDC facility with non-hazardous PFC-containing soils. Co-mingling of hazardous wastes with PFC-containing soils could make leachate treatment technically challenging. While SKB and PDC are subject to different regulatory design and permitting requirements, a technical comparison of the current SKB Landfill, plus a separate cell, and the current PDC Landfill indicates that both landfills would operate and contain non-hazardous PFC-containing soils utilizing four composite liners and multiple leachate collection/leak detection systems.

**Table 3-1 Summary of Comparative Analysis of Off-Site Options
Minnesota Sites**

<i>Off-Site Option</i>	<i>Long-Term Effectiveness</i>	<i>Implementability</i>	<i>Short-Term Risks</i>	<i>Cost</i>
Off-Site Soil Disposal at the SKB Rosemount Landfill in Rosemount, Minnesota	<ul style="list-style-type: none"> This option would provide long-term effectiveness in meeting the requirement of the Agreement for isolation and containment of PFCs through liners and leachate collection systems. SKB would provide additional isolation compared to the current configuration of Rolling Hills through construction of a separate cell and a leachate collection system. The SKB Landfill currently meets and surpasses Subtitle D requirements. 	<ul style="list-style-type: none"> SKB would need to obtain approval to accept PFC-containing soils and these soils would be required to meet the landfill's preacceptance criteria. The facility has been designed and approved as an environmentally secure disposal option for PFC-containing waste. It is the closest facility to the Minnesota Sites (14 to 21 miles). 	<ul style="list-style-type: none"> Of the off-site options, this option would result in the lowest fuel usage and emissions because the SKB Landfill is the shortest distance from the Minnesota Sites (approximately 14 to 21 miles). Additionally, SKB would be the backfill source for the Oakdale and Woodbury Sites, which would reduce required truck trips. 	Lowest costs as the SKB Landfill is located closest to the Minnesota Sites and backfill can also be obtained at this location, which would reduce the number of truck trips required.
Off-Site Soil Disposal at the Veolia Rolling Hills Landfill in Buffalo, Minnesota	<ul style="list-style-type: none"> This option would provide long-term effectiveness in meeting the requirement of the Agreement for isolation and containment of PFCs through a liner and leachate collection system. 	<ul style="list-style-type: none"> Rolling Hills would need to obtain approval to accept PFC-containing soils and these soils would be required to meet the landfill's preacceptance criteria. It is located farther (57 to 69 miles) from the Minnesota Sites than SKB. 	<ul style="list-style-type: none"> Transportation of excavated soils to the Rolling Hills Landfill and backfill to the Minnesota Sites would result in approximately five times the fuel use and emissions as the SKB option because of longer hauling distance (approximately 57 to 69 miles) and the additional number of truck trips required for the backfill source. The longer haul distances also mean an increased risk of vehicle-related incidents while traveling on the roadways. 	Although tipping fees may be similar to SKB, there would be increased costs due to transportation.
Off-Site Soil Disposal at the Peoria Disposal Company (PDC) Landfill in Peoria, Illinois	<ul style="list-style-type: none"> This option would provide long-term effectiveness in meeting the requirement of the Agreement for isolation and containment of PFCs through liners and leachate collection systems. PDC is subject to RCRA Subtitle C requirements for hazardous wastes. However, PFC-containing soils are not hazardous wastes. Design would involve co-mingling of hazardous wastes and PFC-containing soils. 	<ul style="list-style-type: none"> Preacceptance approval from PDC would be required. Although the PDC Landfill may accept non-hazardous PFC-containing waste, it would have to agree to take the excavated soils. A significant portion of the remaining capacity of active cell C-4 would be used. This may not be conducive to ongoing scheduled landfill operations and the landfill may not be willing to accept non-hazardous material. Of the landfill options, PDC is located the farthest from the Minnesota Sites (approximately 460 miles). 	<ul style="list-style-type: none"> Transportation of excavated soils to the PDC Landfill and backfill to the Minnesota Sites would result in approximately 26 times the fuel use and emissions as the SKB option because of longer distance (approximately 460 miles) and additional number of truck trips required for the backfill source. The longer haul distances also mean an increased risk of vehicle-related incidents while traveling on the roadways. 	Tipping fees would likely be significantly higher for the PDC Landfill than SKB or Rolling Hills as it is a RCRA Subtitle C landfill and there would be increased costs due to transportation.
Off-Site Incineration of Soil at the Veolia Sauget, Illinois Incinerator or the Veolia Port Arthur, Texas Incinerator	<ul style="list-style-type: none"> This option would provide long-term effectiveness as the PFCs in soils would be destroyed. 	<ul style="list-style-type: none"> Incinerator capacities of 30,000 tons/year (Sauget) and 60,000 tons/year (Port Arthur) and pre-scheduled incinerator loads may make it difficult to accommodate approximately 190,000 tons of excavated soils from the Minnesota Sites. Considering incinerator capacity and other scheduled loads, it could take more than 10 years to incinerate all the soils. Of all the off-site options, the incinerator locations are the farthest from the Minnesota Sites (approximately 570 and 1,200 miles). 	<ul style="list-style-type: none"> This option would result in the greatest carbon footprint of the off-site options considering fuel usage and emissions as well as the energy required for incineration. <ul style="list-style-type: none"> The distances to the Sauget and Port Arthur incinerators from the Minnesota Sites are approximately 570 and 1,200 miles, respectively, with approximately 33 and 67 times (respectively) the fuel use and emissions as the SKB option. The amount of energy expended to burn non-hazardous soils is significant. Incineration would likely occur over many years (greater than 10). The longer haul distances also mean an increased risk of vehicle-related incidents while traveling on the roadways. 	Highest costs due to energy consumption, transportation distances, and RCRA Subtitle C requirements.



3.2 IMPLEMENTABILITY

The three landfill options would be more readily implemented than the incineration option. The limited capacities of the Veolia incinerators in Sauget, Illinois, and Port Arthur, Texas (30,000 and 60,000 tons per year, respectively) and pre-scheduled incineration load requirement would make it difficult to accommodate approximately 190,000 tons (assuming a density of 1.5 tons per cubic yard of soil) of excavated soils from the Minnesota Sites in a timely manner.

Assuming a 20 percent available capacity for both incinerators, up to 18,000 tons/year of PFC-containing soils could be treated. It would take more than 10 years to treat the total 190,000 tons of PFC-containing soil from the Minnesota Sites. Also, it is unclear whether the facility will accept this quantity and type of waste material. Further discussions with Veolia would be required.

With respect to the landfills, both SKB and Rolling Hills would need to obtain approval to accept the PFC-containing soils, and these soils would be required to meet the preacceptance criteria of each landfill. For PDC, preacceptance approval also would be required. A significant portion of the remaining capacity of PDC's active cell C-4 would be used. This may not be conducive to ongoing scheduled landfill operations for the service area, and the landfill may not be willing to accept a large volume of non-hazardous material.

Finally, the distance from the Minnesota Sites to the off-site facilities affects the implementability of each option. For instance, longer distances would mean longer travel time, more trucks, or slower excavation and hauling rate, resulting in a longer construction time. Considering distances, the SKB Landfill is the closest facility to the Minnesota Sites (14 to 21 miles), followed by Rolling Hills (57 to 69 miles), PDC (approximately 460 miles), Sauget incinerator (approximately 570 miles), and Port Arthur incinerator (approximately 1,200 miles).

3.3 SHORT-TERM EFFECTIVENESS

In comparing the off-site options for short-term effectiveness, consideration was given to the overall fuel consumption (i.e., carbon footprint, which is a measure of the amount of carbon dioxide emitted through the combustion of fossil fuels) and to exhaust emissions from trucking. Fuel use is generally proportional to emissions of greenhouse gases, and carbon dioxide is the most important greenhouse gas that is emitted in vehicle exhaust. Other exhaust emissions such as nitrogen oxides (NO_x), particulate matter (PM), carbon monoxide (CO), and volatile organic compounds (VOCs) are likely causes of carcinogenic and respiratory-related health effects (U.S. Federal Highway Administration, 2005). For the three off-site landfills, estimates were calculated for the amount of fuel that would be consumed and the resultant emissions from:

1. The truck transport of excavated PFC-containing soils from the Minnesota Sites to the landfill and return of the empty trucks to the site, and
2. The truck transport of an equal volume of soil backfill to each of the Minnesota Sites and return of the empty trucks to the borrow site.

Thus, each truckload of PFC material or soil backfill entails two truck trips.

For each of the landfill options, the following information was assumed and included in the calculations:

- Excavated Soil Truck Trips – The number of truckloads of excavated PFC-containing soil from the Minnesota Sites is summarized in Table 3-2 as follows:

Table 3-2 Estimated Volume and Number of Truckloads of Excavated Soil for the Minnesota Sites

Site	Cubic Yards of Excavated Soil	Number of Truckloads*
Oakdale	33,000	3,100
Woodbury	42,000	4,200
Cottage Grove	50,500	5,400
Total	125,500	12,700

* From FS Reports.

The resulting number of truck trips for the excavated soils is summarized in Table 3-3. It is important to note that for the SKB option, the landfill would provide backfill for the Oakdale and Woodbury Sites as discussed below. This would reduce the number of truck trips as there would be fewer empty trucks returning to these two sites.

Table 3-3 Number of Truck Trips for Disposal of Excavated Soil

Site	SKB Option	Rolling Hills Option	PDC Option
Oakdale	3,100	6,200	6,200
Woodbury	4,200	8,400	8,400
Cottage Grove	10,800	10,800	10,800
Total	18,100	25,400	25,400

- Backfill Truck Trips** – Backfill will be required to return clean soil to the excavation after PFC-containing soils are removed. It is assumed that the quantity of soil required for backfill is the same as the quantity removed. The source of the backfill used depends on the Site. Backfill for the Cottage Grove Site would be obtained at the Cottage Grove facility. For the Oakdale and Woodbury Sites, backfill would be obtained from an off-site borrow source. If the SKB option is used for disposal of the excavated soils, then backfill would be obtained at this location. Thus, for the Oakdale and Woodbury Sites, when a truckload of excavated soils is delivered to the landfill, it would return to the Site with a truckload of backfill; and, as shown in Tables 3-4 and 3-5, the number of truck trips is reduced when compared to the Rolling Hills or PDC options.

Table 3-4 Number of Truck Trips for Import of Backfill

Site	SKB Option	Rolling Hills Option	PDC Option
Oakdale	3,100	6,200	6,200
Woodbury	4,200	8,400	8,400
Cottage Grove	10,800	10,800	10,800
Total	18,100	25,400	25,400

Table 3-5 Total Number of Truck Trips (Disposal of Excavated Soil and Import of Backfill)

Site	SKB Option	Rolling Hills Option	PDC Option
Oakdale	6,200	12,400	12,400
Woodbury	8,400	16,800	16,800
Cottage Grove	21,600	21,600	21,600
Total	36,200	50,800	50,800

- Distance – The approximate distance from each of the landfills to the Minnesota Sites is as follows:
 - SKB – 14 to 21 miles
 - Rolling Hills – 57 to 69 miles
 - PDC – 460 miles

For the Cottage Grove Site, the distance to the backfill source is assumed to be 1 mile; and for the Oakdale and Woodbury Sites, the distance is assumed to be 25 miles.

Table 3-6 provides a summary of the estimated fuel usage and generated exhaust emissions for each landfill option based on the total number of truck trips (Table 3-5) and the associated distances. Considering the fuel usage and generated emissions, the SKB option results in significantly lower air emissions and the smallest carbon footprint. This landfill is located the shortest distance from the Minnesota Sites and has the lowest amount of fuel consumed and emissions produced. Transportation of excavated soils to the Rolling Hills Landfill and backfill to the Minnesota Sites would result in approximately five times the fuel use and emissions as for the SKB option. Transportation of excavated soils to the PDC Landfill and backfill to the Minnesota Sites would result in approximately 26 times the fuel use and emissions as for the SKB option. Longer hauls also mean an increased risk of vehicle-related incidents while traveling on the roadways.

The incineration options would incur a much greater carbon footprint than the landfill options because of the increasing distance from the Minnesota Sites and the energy

Table 3-6 Estimated Fuel Use and Emissions for the Off-Site Facilities

Landfill	Estimated Fuel Use ⁽¹⁾ (gallons)	Estimated Emissions ^(2,3) (lb)					
		VOC	CO	NO _x	PM-10 (Total)	PM-10 (Exhaust Only) ⁽⁴⁾	Total Exhaust Emissions ⁽⁵⁾
SKB	76,253	343	2,303	23,355	292	252	26,292
Rolling Hills	340,923	1,532	10,295	104,417	1,307	1,126	117,551
PDC	1,997,933	8,977	60,334	611,922	7,657	6,601	688,891
Sauget Incinerator	2,475,633	11,124	74,760	758,231	9,488	8,179	853,603
Port Arthur Incinerator	5,142,633	23,108	155,298	1,575,073	19,710	16,988	1,733,189

VOC - volatile organic compound

CO - carbon monoxide

NO_x - nitrogen oxides

PM - particulate matter

(1) Assumes 6 miles per gallon for an 18-wheel tractor trailer.

(2) Based on data provided in "Assessing the Effects of Freight Movement on Air Quality at the National and Regional Level," Prepared for the U.S. Federal Highway Administration by ICF Consulting (April 2005). Carbon dioxide (CO₂) is not included in the emissions because CO₂ is not regulated by the federal government and there is no air quality standard for CO₂. See below.

Rural Freeway Truck Emission Factors (grams/mile) Combination Diesel Truck					
Year	Constituent				
	VOC	CO	NO _x	PM-10	PM-10 (Exhaust Only)
2002	0.41	3.13	33.96	0.41	0.37
2010	0.27	1.44	12.39	0.17	0.13
2020	0.19	0.32	1.97	0.07	0.03

(3) Used the average of 2002 and 2010 estimated truck emissions.

(4) PM-10 (Exhaust Only) is a subset of PM-10 (Total).

(5) Sum of VOC, CO, NO_x, and PM-10.



required for incineration. The distances from the Sauget and Port Arthur incinerators to the Minnesota Sites are approximately 570 miles and 1,200 miles, respectively, and would result in approximately 33 and 67 times (respectively) the fuel use and emissions as for the SKB option. More importantly, the amount of energy expended to burn non-hazardous soils with no Btu value is significant. Incineration would likely occur over many years (greater than 10).

3.4 COST

A quantitative cost comparison was not prepared for each off-site disposal option because firm disposal quotes could not be obtained without more detailed discussion, but a qualitative analysis is presented in the following discussion. The incinerator options would result in the highest costs due to energy consumption (commercial incinerators are less interested in burning soil because it has no Btu value and contains moisture), transportation distances, material handling complexities for loading bulk soils into incineration units and compliance with RCRA Subtitle C requirements for hazardous waste. Of the landfill options, the PDC Landfill would result in the highest costs because of the transportation distance and higher tipping fees typically charged by Subtitle C facilities. The Rolling Hills Landfill option would result in lower costs because the transportation distance is less than that for the PDC Landfill, and Rolling Hills is an industrial waste landfill, which typically charge lower tipping fees than RCRA Subtitle C landfills. Although its tipping fees would be expected to be similar to the Rolling Hills Landfill, the SKB option would be expected to incur the lowest costs because it is located the closest to the Minnesota Sites and backfill could be obtained at this location, which would reduce the number of truck trips.



4. RECOMMENDATION

It is recommended that excavated PFC-containing soils from the Minnesota Sites be disposed at the SKB Landfill in Rosemount, Minnesota. In compliance with the Agreement, this off-site option would provide a comprehensive and effective long-term response that protects public health and the environment through engineered isolation and containment of PFCs. Any change in this recommended disposal location for purposes of handling unpermitted non-PFC constituents (e.g., VOCs, etc.) would be addressed on a case-by-case basis, while continuing to meet the objectives above.

The SKB Landfill has multiple liners and leachate collection systems to maintain and monitor wastes within the facility. Additionally, a cell would be constructed to isolate the PFC-containing soils and leachate from other industrial wastes. Specifically, the construction of the cell would include the placement of an additional 80-mil HDPE liner to separate the PFC-containing soils from other landfill waste, as well as the installation of a separate leachate collection system above the liner. The PFC-containing soils are not hazardous, and thus disposal in an industrial waste landfill that meets or surpasses the state and federal standards for RCRA Subtitle D landfills is protective of human health and the environment.

With respect to long-term effectiveness, the incinerator option would provide destruction of PFCs in the soils. However, limited incinerator capacity and scheduled incineration loads would likely result in a significantly longer implementation time on the order of 5 to 10 years compared to the landfill options. SKB and PDC Landfills both provide additional long-term effectiveness when compared to the current configuration of the Rolling Hills Landfill because of the additional liners and leachate collection systems.

Considering implementability, the landfill options would be more readily implemented than the incinerator option because of available capacity and shorter haul distance. Although SKB and Rolling Hills RCRA Subtitle D landfills would require approval from the state to receive PFC-containing soils, each landfill option, including the PDC RCRA



Subtitle C landfill, would require preacceptance approval from the landfill facility prior to shipment of PFC-containing soils to the landfill. The PDC Landfill, however, may not be willing to accept a large volume of non-hazardous material that would consume space normally used for hazardous waste.

With respect to short-term effectiveness and cost, SKB is the most favorable option. Of the evaluated off-site options, it is located the shortest distance to the Minnesota Sites. Additionally, SKB would also be a source of soils used as backfill for the Oakdale and Woodbury Sites. As a result, the implementation of this option results in the smallest carbon footprint (i.e., lowest fuel and energy consumption), lowest air emissions and lowest associated costs compared to the other off-site options.



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