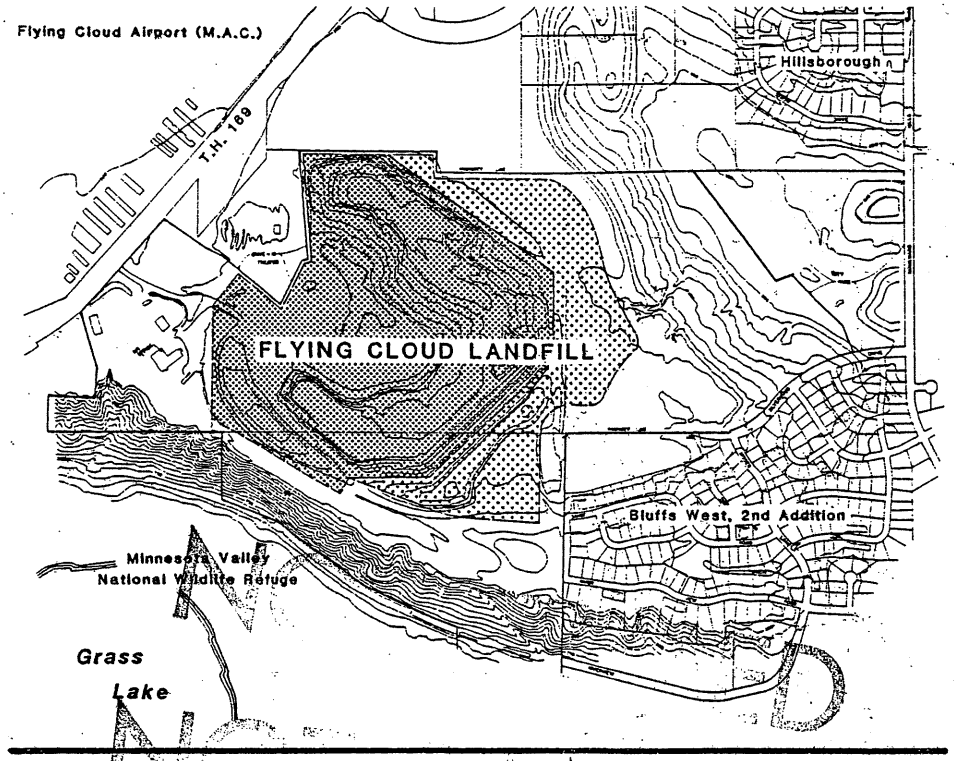
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Final
Environmental Impact Statement

Flying Cloud Sanitary Landfill Expansion



Prepared by: Metropolitan Council of the Twin Cities Area

Metropolitan Council
OF THE TWIN CITIES AREA

October 1984

Publication No. 12-84-118

FLYING CLOUD SANITARY LANDFILL EXPANSION
EDEN PRAIRIE, MINNESOTA

FINAL ENVIRONMENTAL IMPACT STATEMENT (FEIS)

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ABSTRACT: Woodlake Sanitary Services, Inc., a subsidiary of Browning-Ferris Industries, has proposed an expansion of the Flying Cloud Sanitary Landfill in Eden Prairie, Minn. The project consists of excavation of an adjoining 42.4 acres to a depth of 70 feet and raising the vertical elevation of the existing landfill by an average of five feet, to a maximum elevation 923 mean sea level (MSL) in the north central portion of the site. The FEIS describes and evaluates the potential impacts of the proposed project, mitigation measures to reduce or eliminate the impacts and alternatives to the project.

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EXECUTIVE SUMMARY

The Environmental Quality Board (EQB) has established a review process for projects that have the potential for significant environmental impacts. Under that process, an environmental impact statement (EIS) must be prepared if a landfill that accepts 100,000 cubic yards or more of waste per year is proposed to be expanded by 25 percent or more of its previous capacity. This report is the EIS for such a proposed expansion at the Flying Cloud Sanitary Landfill in Eden Prairie, Minn.

Woodlake Sanitary Services, a subsidiary of Browning Ferris Industries, the project proposer, wants to excavate to a depth of 70 feet on a 42.4-acre parcel of land just to the east of the existing landfill and increase the height of the existing landfill by an average of 5 feet (to a maximum elevation of 923 MSL in the north central portion of the site). A 15-foot berm will be constructed along the eastern project perimeter as part of the first stage of expansion.

The project's scoping decision document, required as a part of the environmental review process, identifies the issues that the FEIS must address. Those issues can be grouped under the headings of environmental impacts, land use concerns, employment/economics, and alternatives to the project.

ENVIRONMENTAL IMPACTS

Impacts on groundwater, surface water, vegetation and wildlife, air quality and noise levels are all discussed in the FEIS. The potential for landfill gas migration is evaluated, as is the potential for vector and pest problems, fire hazards and the issue of hazardous waste disposal.

The potential for groundwater quality impacts exists. Leachate produced at the Flying Cloud Landfill would contain a variety of metals and inorganic and organic compounds, possibly including trace amounts of volatile organic compounds. The leachate could be attenuated as it moves vertically beneath the site and then horizontally towards the Minnesota River Valley, but the effect on the leachate is difficult to predict with certainty. The potential for attenuation would be reduced under a worst-case scenario in which it is assumed that the silt layer is not present beneath the existing landfill site. (There is no data available confirming the presence of the silt layer.)

There is the concern that if the contaminants in the leachate, even in small amounts, affect private wells or public water supplies there would be public health impacts. There are four private business and residential wells downgradient and to the southwest of the project which could be affected as indicated by the estimated leachate plume. A number of mitigation measures which would minimize the impact on the wells are indicated. These include lining the horizontal expansion and foregoing the vertical expansion, frequent and comprehensive groundwater quality monitoring which would trigger other actions such as extending city water and moving the well to a safe area. The city of Eden Prairie's water supply wells are to the north and would not be affected because of the intervening distance and their upgradient location.

The increased leachate from the expansion would move vertically into the groundwater system below the site and then horizontally through the sandy layer or the Prairie du Chien bedrock formation to the Minnesota River Valley. The leachate would emerge in the Minnesota River, Grass Lake, marshes or local

seeps in the valley. This could take a matter of five to six months through the Prairie du Chien (assuming no silt layer) or many decades through the silt and sandy layer once the expansion reaches field capacity--an estimated 12 years. Leachate reaching the Minnesota River would be readily diluted to concentrations well below state surface water quality standards. Leachate which reaches the east arm of Grass Lake southwest of the landfill could exceed some state water quality standards under a worst-case scenario, assuming no runoff from the expansion site (5.9 inches annually of infiltration). Under optimum final cover conditions assuming 1.5 inches of infiltration and decreased volumes of leachate, the leachate concentrations emerging in the lake would be below state standards. Mitigation measures to reduce the impacts on the lake and wetlands, including the placement of a liner and collection system beneath the horizontal expansion, foregoing the vertical expansion, increasing the slopes of the final cover and increasing evapotranspiration are discussed. Corrective measures which might be utilized if the surface waters are affected are identified. These measures could disrupt the ecosystem of Grass Lake and the wetlands in the river valley.

Woodlake plans to control erosion and runoff by 1) directing some runoff to unfilled portions of the site and 2) using a detention pond with an outflow pipe that drains into the Minnesota River floodplain. The system should protect Grass Lake and the wetlands from erosion-related impacts. Mitigation measures such as directing runoff from the surge pond in the floodplain to the river could provide additional protection to the lake and wetlands.

The potential impacts on vegetation and wildlife could vary. The proposer's 42.4 acre horizontal expansion area is an abandoned agricultural field, and harbors no rare or unusual biota. Proposed surface water controls should adequately protect the habitats of the Minnesota River Valley from erosion-related problems.

The potential impact of leachate on the biota in the river valley would depend on the volume of leachate produced and the effect on attenuation and dilution. Under the worst-case scenario in which there is no runoff from the expansion site (5.9 inches of infiltration annually) leachate concentrations in the east arm of Grass Lake could exceed some state standards. Presumably, if this occurs, there could be impacts on the aquatic biota in Grass Lake and the river valley wetlands by direct uptake and the bioaccumulation of contaminants (metals and organics) through the food chain. There is also the potential for long-term bioaccumulation of leachate constituents which might be present at low levels or in trace amounts below state surface water standards. There are no federal or state standards for organics or some of the metals found in leachate. Mitigation measures to minimize the potential impacts on vegetation and wildlife are identified. If the lake and wetlands and the biota are affected, corrective measures would be complex and could disrupt the ecosystem and conflict with wildlife management purposes.

Air quality problems should be minor. Wind erosion can be controlled with mitigation techniques such as prompt revegetation of soil stockpiles with quick-growing grasses, mulching or vegetating of intermediate inactive fills areas, and watering of haul roads. Emissions from traffic are not expected to cause air quality violations.

Noise at nearby residential areas would be decreased by building a 15-foot high noise berm. The berm would lower potential noise levels by 12 dBA. During the berm construction, the initial phase of pit excavation and final fill/closure

activities, heavy equipment may cause short-term violations of state noise standards in the nearby residential areas. Noise may be a nuisance at other times in some areas.

Vectors such as rats have not been a problem in the past at the landfill, and are not expected to be a problem in the future. Daily cover of waste materials minimizes the attractiveness of the landfill to vectors. Maintenence of slopes to prevent ponding decreases the availability of mosquito breeding habitat.

The proposed expansion should not increase the potential for a fire at the landfill. One fire occurred in 1980 at the existing landfill, but the conditions that led to its formation have been corrected. Woodlake has currently initiated a number of informal procedures to prevent the deposit of burning waste and to control a fire in the unlikely event that one occurs. Formalization of these procedures in the operations plan for the expansion, training of company personnel, and education of other refuse company truck drivers would help lower the already small risk of fire.

The total volume of landfill gas that is produced at the Flying Cloud landfill will approximately double if the expansion is granted. The peak yearly production of gases, however, will only increase by about 50 mcf, reaching 650 mcf in 1994. Woodlake's proposed gas migration control system will include new monitoring probes and either a series of trench collectors or a well and header collection system. Measures that could increase the efficiency of the proposed system include more frequent gas probe monitoring, increasing the width of the buffer area, and constructing a secondary or back-up control system.

Hazardous waste disposal is prohibited at the existing landfill by state regulation and will also be prohibited at the expansion. Woodlake has adopted extensive procedures to prevent illegal disposal of large quantities of these wastes at the site; these same procedures should be adequate to protect the expansion. Small quantities of hazardous waste are found in household wastes; these may legally be deposited at the site.

LAND USE CONCERNS

The FEIS considered potential impacts from increased traffic, litter, fires, site visibility, and land use conflicts. It also investigated the compatibility of the proposed project with local and regional plans.

Future traffic levels generated because of the landfill will not significantly impact highway movement or increase the need for road capacity. Traffic growth generated by the facility will be minor compared to growth generated by other sources, such as commercial developments in the Hwy. 169--I-49 area. Furthermore, the traffic levels associated with the facility will comprise only a small percent of the overall traffic in the area. All trucks using the facility now, as well as larger trucks that may be in use in the future, conform to the per-axle load limits in effect on County Rd. 1 and Hwy. 169. Trucks using the landfill have rarely been involved in accidents. The addition of a sheltered left-turn lane and traffic control system at the landfill entrance could further reduce the potential for accidents.

Litter control has sometimes been a problem at the existing landfill and is expected to remain so if the expansion is granted. High winds and adverse winter weather, for instance, can increase off-site movement of litter and hinder clean-up operations. Some of the measures that help minimize the potential for

litter problems are enforcement of the proposer's litter control policies, increasing the buffer zone between the expansion and residential areas, and using protected sites in the landfill pit when high winds occur.

The proposed expansion will increase the visibility of the site by increasing final elevations and creating a 15-foot high landscaped noise berm. Berm construction will create a temporary visual impact. Once the berm is completed and revegetated, however, it will screen residential areas to the east from all landfilling activities except final filling and cover grading. The site will be visible to a portion of the city of Shakopee. In both of these cases, the intervening distance will minimize the impact. Landscaping the berm with tall trees or shrubs, increasing the berm's height, and planting trees along the river bluff would decrease visual impacts further.

Two large residential areas (Hillsborough and Bluffs West Second Addition), the Minnesota Valley National Wildlife Refuge and Recreation Area, and other scattered, public, residential and commercial/industrial uses are located near the project site. The potential impact on these uses would be minimal in most instances. The proposed 15-foot landscaped berm, the intervening distance, Woodlake's proposed controls for runoff, litter, landfill gas and wind erosion will minimize potential impacts. Mitigation techniques such as providing a back-up gas migration control system, increased vegetative screening, additional practices to control nuisances such as dust and litter, and measures to mitigate potential groundwater quality impacts downgradient of the expansion would further minimize the land-use impacts. The potential impact on the Hillsborough subdivision would be minimal due to its upgradient location, the 15-foot berm and intervening 1300-foot wide open buffer area. Bluffs West, because of its close proximity to the expansion could be impacted occasionally by litter, dust, odors and noise. Vacant lots in the western portion of Bluffs West would be as close as 200 feet from the expansion boundary. Existing, occupied residences would be 900 feet or more away. Maintaining a wider buffer zone between the expansion and the subdivision would minimize the potential impacts. Delaying residential construction on the close-in vacant lots, some of which have been purchased by Woodlake, until the landfill or the southeast portion of the expansion is completed and completing the souteast portion first would minimize the impact. The potential impacts on the Minnesota Valley National Refuge would be minimal. Transferring ownership of the river bluffs (owned by Woodlake) to the U.S. Fish and Wildlife Service or developing a cooperative management plan with the agency would provide long term protection of the bluff.

The northern section of the existing landfill site and the proposed expansion are in the approach zone for one of the Flying Cloud Airport's runways, raising two potential issues: 1) a bird-strike hazard, and 2) a hazard from the final elevations of the landfill and the berm. The final elevations of the landfill and the berm will be well within height restrictions imposed by the Federal Aviation Administration. Vegetation planted on the berm, however, could, at maturity, exceed the height restrictions. To prevent this occurrence, the proposer could simply avoid planting species that attain heights that would cause violations. Portions of the berm and landfill may, as proposed, meet the definition of prohibited structures as defined in the Flying Cloud Airport zoning ordinance. The proposed expansion will prolong the potential bird-aircraft conflict. However, the FAA does not object to the proposed expansion based on the lack of problems with the existing landfill. The proposer and the airport manager have worked closely in the past to prevent and/or correct problems.

The proposed horizontal expansion will be located in an area that is now designated for open space and low density residential development in the City of Eden Prairie's comprehensive plan. The area is zoned Ru-Rural. The approved planned unit development (PUD) for the current landfill would have to be amended by the city for the expansion.

The expansion is within the Metropolitan Urban Service Area (MUSA). It appears to present no conflicts with the Metropolitan Council's plans for regional transportation, regional open space areas, sewers, and surface water management. If the cooperation that now exists between the landfill operator and airport manager continues in the future, the project should not conflict significantly with the airports plan. Its consistency with the Solid Waste chapter of the Metropolitan Development Guide will be assessed during the permitting process, as will formal reviews of its consistency with the other regional plans.

EMPLOYMENT/ECONOMICS

The potential impact on property values, revenues, employment, and service demands were among the topics studied for the FEIS.

A number of potential landfill impacts may affect the market for property and eventually property values. Nuisance impacts during a landfill's operating life can include noise, odors, dust, litter, traffic and appearance. Longer term problems potentially include groundwater contamination and landfill gas migration. The magnitude of real or perceived impacts is largely a function of proximity to the facility and the success of available mitigating measures. Woodlake has proposed a number of measures to reduce or minimize impacts, including a 15-foot landscaped berm and litter, odor, dust, runoff and landfill gas migration controls. The FEIS has identified a number of additional mitigating measures to eliminate or minimize potential impacts, such as additional groundwater protection measures and monitoring, vegetative screening, litter and dust controls, and a back up gas migration control system. The total effect of these measures will be to minimize the impact on the surrounding property which in turn should protect the attractiveness of the area and value of the property. The impacts on many properties such as Hillsborough, the industrial/commercial property along County Rd. 1 and other individual residences to the northeast and southwest would be protected by the intervening open, buffer areas. The value of Bluffs West properties, particularly in the western portion, could be affected because of their close proximity and potential nuisances from noise, dust, litter and odor. Vacant lots owned by Woodlake are as close as 200 feet. Maintaining a wider buffer zone around the southeast portion of the expansion including the delay of residential construction on the closest vacant lots until the landfill or southeast portion is completed, and completing the southeast corner of the expansion first would minimize the potential impacts.

The primary sources of revenue from the landfill for various units of government are property and income taxes. Last year, Woodlake paid over $100,000 in property taxes on the existing landfill operations. The amount the company pays for property taxes will increase if the expansion is granted. The value and potential tax revenues from end uses developed on the land, following closure, would be extremely speculative. The type and value of the end use will be affected by such problems as settling and methane gas.

The existing landfill employs 10 to 20 people. Expansion will not affect the number of employees.

No change in the demands for urban services is anticipated. On-site potable water supplies, sewage and wastewater facilities, and stormwater management facilities are already in place. Woodlake could negotiate a contract with the city for fire protection services, however.

The company carries liability insurance to cover the costs of injuries to people and property. A surety bond will provide funds to the county in the event that the company violates its permit requirements or abandons the landfill. If post-closure problems occur, they could be remedied by the owner, the MPCA, or Hennepin County, depending on the nature of the problem and the willingness and/or ability of the owner to cooperate.

ALTERNATIVES

EQB rules require that the environmental impacts of the project be compared with other reasonable alternatives to the project. Design alternatives include the addition of a liner and leachate collection system beneath the horizontal expansion, foregoing the vertical expansion over the existing fill, changes in the final slope, methane recovery, on-site shredding and baling and noise berm changes. The addition of a liner and leachate collection system, which would be placed only beneath the 42.4 acre horizontal expansion, would minimize the increased volume of leachate which would move off site into the groundwater. A liner and collection system would provide long-term protection for Grass Lake, the wetlands and the associated biota as well as the Minnesota River. Assuming that it would not be feasible to line the vertical expansion over the existing fill because of settling, foregoing the vertical expansion would prevent the long-term movement of an increased volume of contaminants into the groundwater, Grass Lake and river. Changes in the slope would increase runoff and decrease potential leachate generation, but the increased visibility of the site would be a concern. Woodlake has studied the feasibility of installing a methane gas recovery system to provide energy for on-site purposes. Such a system would not necessarily prevent off-site gas mitigation. On-site shredding and baling would reduce the amount of space needed to dispose of a given volume of refuse in the expansion and could extend the life of the landfill. Shredding would assist in controlling potential problems such as litter and vectors, and would increase the concentration of leachate initially but decrease the concentration over the long run.

Three no-action alternatives were evaluated. The no-action alternatives include: use of existing landfills, new landfills and land disposal abatement. There are five existing landfills located in or close to Flying Cloud's service area. The capacity available at these landfills could last through the 1980s. If existing landfills were substituted for the expansion, there would be environmental impacts at the other five sites due to the increased rate of filling, increased service costs to the Flying Cloud service area and some increase in the cost of operating the other five landfills. The use of new landfill space is likely to be restricted. In accordance with the Waste Management Act of 1980 as amended, no new sites can be issued a permit without a certificate of need, approved by the Council, demonstrating that all other feasible and prudent alternatives to land disposal are being implemented. To date the Council has voiced a consensus of position that new landfills will be used only for the disposal of processed waste; no certificates of need would be issued for the land disposal of unprocessed waste. Processing includes the removal of recyclable materials and the removal or oxidation of organic material in mixed refuse.

Land disposal abatement or waste abatement measures can reduce the volume and change the composition of waste going to landfills. Waste abatement includes reducing the generation of waste at the source (office, factory and residence), separating the waste to permit the recovery of recyclable materials and waste processing to remove recylable materials and remove or oxidize organic material. Oxidation would be achieved by incineration, composting or other techniques. Only the residuals from waste processing would be landfilled. All of these methods would reduce the volume of refuse going to landfills and alter or remove the chemical and biological material in the waste being landfilled.

A reduction of the southeast portion of the horizontal expansion would maintain a larger buffer and mitigate potential impacts on the western portion of Bluffs West. A 1,000-foot setback could be maintained between the closest occupied house and the vacant lots which might be developed during the life of the project. This would result in a reduction of 214 acre-feet of capacity.

Limiting the proposed expansion, or a portion of it, such as the area above the existing fill to the disposal of processed waste, is an operational alternative which would minimize the environmental impact. Removing recyclables and biological material would minimize the impact of nuisances such as litter, odor, dust and noise on off-site areas, reduce or preclude the production of methane gas, and minimize leachate impacts.

Reversing Woodlake's proposed staging plan would minimize the impact on the Bluff's West residential area. Under this operational alternative excavation, filling and final cover placement would procede counter-clockwise from south to north. Completing the southeast corner of the expansion first and moving northward would move activities which are the source of potential impacts away from the Bluffs West area. This might reduce the concern over the proximity and extended life of the landfill.

BACKGROUND ...

EIS PREPARATION AND PERMIT APPROVALS

INTRODUCTION

The Minnesota Environmental Quality Board (EQB) has established rules to guide the environmental review of all projects that require governmental actions (6 MCAR 3.021-3.056). The rules specify when an environmental assessment worksheet (EAW) and environmental impact statement (EIS) are to be performed, what types of information they should contain, and who should have responsibility for preparing them.

Woodlake Sanitary Services, Inc., a subsidiary of BFI, proposes to expand the existing Flying Cloud Sanitary Landfill in Eden Prairie. According to the EQB rules, an EIS must be performed on this project because it would expand the previous capacity of a waste disposal facility that receives at least 100,000 cubic yards of waste annually by at least 25 percent (6 MCAR 3.039). The Metropolitan Council has been designated by the EQB as the responsible governmental unit (RGU) for the project; it must prepare and determine the adequacy of the EIS for the proposed expansion.

GENERAL EIS PREPARATION PROCEDURES

All RGUs must follow essentially the same general process, and meet the same timetables, when they prepare an EIS (Figure 1). Four documents are actually prepared during the EIS process--an EAW, a scoping document, Draft EIS (DEIS) and Final EIS (FEIS). The EAW briefly assesses the environmental effects that may be associated with a proposed project (6 MCAR 3.025). In this particular instance, the EAW also began the EIS scoping process and was used to solicit public comments on the proposed expansion.

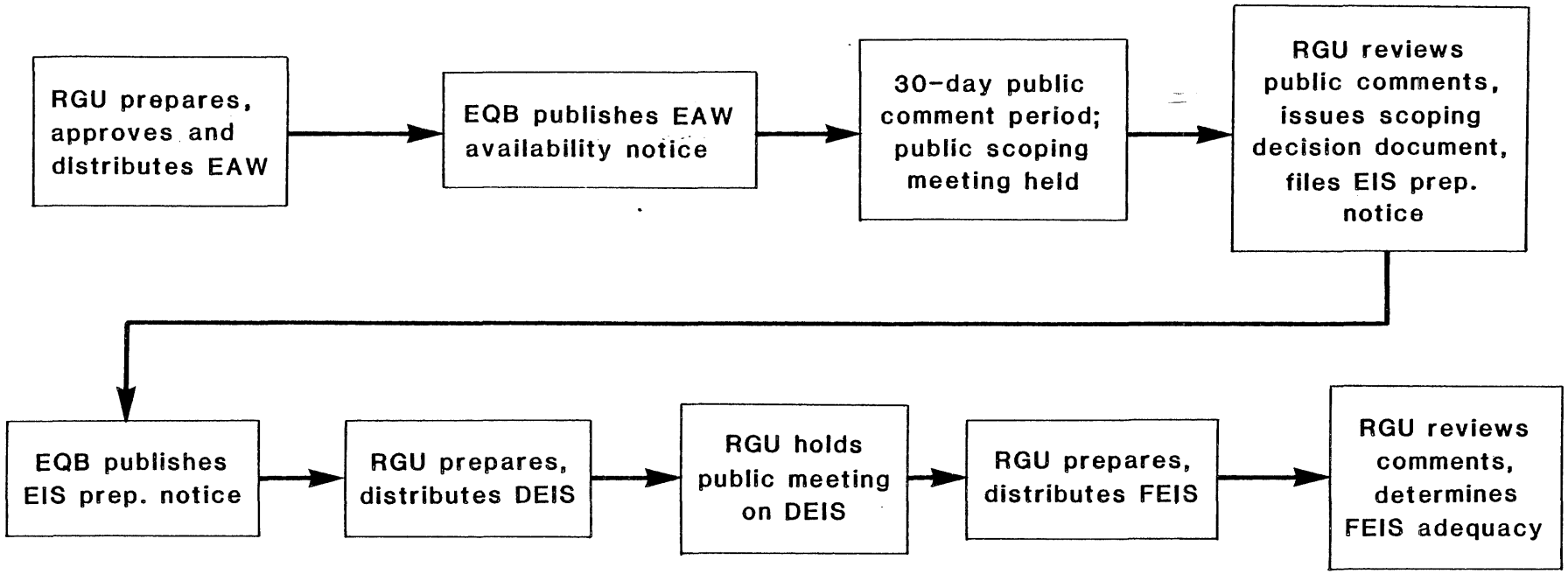
The EAW and the public comments are used as the basis for the scoping decision document. The scoping document is used to define the potential impacts to be evaluated during EIS preparation, and serves as the RGU's basis for determining the adequacy of the EIS. The scoping decision document, and thus the issues to be addressed in the EIS, cannot be amended unless: 1) the project proposer agrees, 2) substantial changes are made in the project; or 3) substantial new information arises that affects the impacts of the project or the availability of alternatives.

The EIS itself is a disclosure document meant to assist governmental units, project proposers, and other persons in evaluating projects with the potential for significant environmental impacts, alternatives to the proposed project and methods to reduce the project's adverse effects (6 MCAR 3.029). The EIS is not a document to justify a decision on a project, but, rather a guide which provides information to use in issuing or denying permits or approvals. (The actual review of permits for the expansion is a separate process.) The EIS must contain a project description, a list of needed governmental approvals, alternatives to the project, a discussion of the potential environmental, economic, employment and sociological impacts of the project, mitigation measures and a list of preparers.

STATUS OF THE FLYING CLOUD LANDFILL EIS PROCESS

In February 1982, WSS applied to the Minnesota Pollution Control Agency (MPCA) for a permit for the expansion of the Flying Cloud Sanitary Landfill. On July 15, 1982, the EQB designated the Council as the RGU for the preparation of the

Figure 1.
GENERAL PROCESS FOR A MANDATORY ENVIRONMENTAL IMPACT STATEMENT



RGU: Responsible Governmental Unit (for Flying Cloud, the Metropolitan Council is the RGU)
EQB: Environmental Quality Board
EAW: Environmental Assessment Worksheet
DEIS: Draft Environmental Impact Statement
FEIS: Final Environmental Impact Statement

EIS for the proposed expansion. On Feb. 10, 1983, the Council approved an EAW for the proposed expansion for the purposes of public review and set a public meeting for March 9, 1983 in Eden Prairie for discussion of the EAW and the scope of the EIS. Following the public meeting on March 24, 1983, the Council approved a scoping decision document for the proposed expansion which defines the impacts and alternatives to be evaluated in the EIS. The scoping decision document provides the basis on which the adequacy of the FEIS is determined by the Council. The scoping decision cannot be changed without the approval of WSS unless the project and potential impacts are changed substantially or substantial new information about the project is made known. On Dec. 8, 1983, the Council approved an amendment to the scoping decision reflecting the approval of an operational change which modified the proposed expansion as it was described for the scoping decision document. The operational change allowed the filling of an existing 90-foot excavation within the existing landfill which was to have been filled as part of the expansion.

The Council released the DEIS on April 12, 1984 and held a public meeting on May 23, 1984 in Eden Prairie to receive public comment on the scope and adequacy of the DEIS. The public record was held open until June 7, 1984 to receive additional comments, as required by the state environmental review regulations. Following the close of the public record the responses to substantive comments and appropriate changes in the text were prepared as part of the FEIS. A copy of the written comments and a summary of the public meeting are included in Appendix D. Following this the Council reviewed and approved the release of the FEIS for public review on Oct. 25, 1984.

An approximate calendar for the Council's determination of adequacy for the FEIS is presented in Table 1. Notice of the availability of the FEIS will be published in the EQB Monitor and local newspapers in the project area. The Council will review the FEIS and determine its adequacy consistent with the amended scoping decision approved by the Council on March 24, 1983 and the Minnesota Environmental Policy Act and Environmental Review Program rules (6MCAR 553.021-3.056). The Council will provide notification of its determination to all persons receiving copies of the FEIS and the EQB Monitor.

Table 1
TABLE OF EVENTS FOR METROPOLITAN COUNCIL REVIEW OF DRAFT EIS

	Date
Metropolitan Council Review and Release of FEIS for Publication and Public Review	Oct. 25, 1984
FEIS Availability Notice Published in EQB Monitor (Initiate public comment period)	Nov. 5, 1984
Metropolitan Waste Management Advisory Committee Review of FEIS for Adequacy	Dec. 11, 1984
Environmental Resource Committee Review of FEIS for Adequacy	Dec. 19, 1984
Metropolitan Council Review of FEIS for Adequacy	Dec. 27, 1984

GOVERNMENTAL PERMITS AND APPROVALS

Once the Council determines that the FEIS is adequate, the required permits and other approvals for the expansion will be reviewed and acted on by various governmental bodies. Under normal circumstances no final governmental decisions to grant permits or other required approvals, and no project construction can take place before the FEIS is declared adequate. The FEIS is intended to be used by governmental bodies in issuing or denying permits or approvals for the project and in identifying measures to avoid or mitigate adverse environmental effects.

Table 2 lists those approvals and other reviews that are known to be needed for the project, and which cannot be issued until the FEIS is declared adequate. Each of these permits has its own approval process. The issuing governmental units should be contacted for the details of these processes. Final decisions on these permits and approvals must be made within 90 days after the FEIS is determined to be adequate because information for them was gathered currently with EIS preparation (6 MCAR 3.031, subsection H.1.).

Under EQB regulations, a record of decision is required for certain permits and approvals indicating how each permitting unit of government used the EIS in its decision. These permits and approvals represent key decisions in determining whether the project will be approved or denied. The EIS must be used and a record of decision must be kept for four permits/approvals (Table 2). The EIS must be used by the MPCA in approving/denying a solid waste permit for the expansion, by the Council in its approval/denial of the state permit, Hennepin County in its decision to approve/deny a license amendment for the expansion and the city of Eden Prairie in approving an amendment to the current PUD. As indicated in Table 2, the City of Eden Prairie has several permits which it can issue for various phases of the expansion.

Table 2

KNOWN GOVERNMENTAL PERMITS AND APPROVALS AND OTHER REVIEWS NEEDED FOR THE FLYING CLOUD LANDFILL EXPANSION

PERMITS OR APPROVALS REQUIRING A RECORD OF DECISION	GRANTING AGENCY
Amendment to sanitary landfill permit SW-14	MPCA
Review and approval of landfill permit	Metropolitan Council
Amendment to sanitary landfill license	Hennepin County
Amendment to current planned unit develop-plan (PUD 70-1)	City of Eden Prairie

OTHER PERMITS OR APPROVALS	GRANTING AGENCY
Installation and operating air quality permits for landfill gas-flare	MPCA
Land alteration permit	Riley-Purgatory Creek Watershed District
Land alteration permit (landfill expansion berm and pipeline relocation)	City of Eden Prairie
Permit for construction in airport safety zone	City of Eden Prairie*

OTHER REVIEWS	GRANTING AGENCY
Review and comment to other permitting authorities	Lower Minnesota River Watershed District

*The city has not yet determined the full extent of its authority; other approvals are not clear.

EXISTING LANDFILL DESCRIPTION

LOCATION

Flying Cloud Sanitary Landfill is located in the City of Eden Prairie, Hennepin County, Minn. in the southwest portion of the Twin Cities Metropolitan Area (Figure 2). The site is located along a bluff overlooking the Minnesota River Valley (Figure 3).

OWNERSHIP AND PERMITS

The existing landfill is permitted under MPCA Amended Permit No. SW-14. It is also operated under a license with Hennepin County and the county's solid waste ordinance. Current and future use of the site is governed by PUD 70-1, issued by the City of Eden Prairie. The present landfill occupies an area of 105.6 acres.

The landfill is owned by Woodlake Sanitary Services, Inc., Eden Prairie, a subsidiary of BFI of Houston, Tex. Woodlake has owned the landfill since 1972. The previous owner was Waste Management, Inc.

ACCESS

The only direct access to the landfill is Hwy. 169, which is designated locally as Flying Cloud Dr. Hwy. 169 is located along the western perimeter of the site (Figure 2). Traffic destined for the landfill uses County Rds. 1 and 62 and Interstate Hwy. 494 to reach Hwy. 169.

SURROUNDING LAND USE

A variety of land uses surround the landfill and expansion area (see Land Use section for details).

North--The Flying Cloud Drive-In Theater and open land are located north of the site. The open land is owned by the Metropolitan Airports Commission (MAC). Much of the open land is located within the approach zones to the Flying Cloud Airport. Most of the MAC land is farmed. County Rd. 1 (Pioneer Tr.) and a scattering of commercial/industrial uses and residences are located north of the open land.

East--a marshy lowland and drainage basin lies east of the expansion area. Homeward Hills Park, a 33-acre city park currently being developed, is located at the eastern end of the lowland. A residential area, Hillsborough subdivision, is located to the northeast of the landfill.

Bluffs West Second Addition, a 243-lot residential subdivision, is located to the southeast of the landfill. The subdivision was approved in 1979 by the City of Eden Prairie. Although streets and utilities have been constructed, the lots in the western portion of the subdivision are undeveloped with one exception. Vacant lots lie 800 feet from the existing landfill. Woodlake has purchased a number of the closer lots which lie within 200 feet of the project.

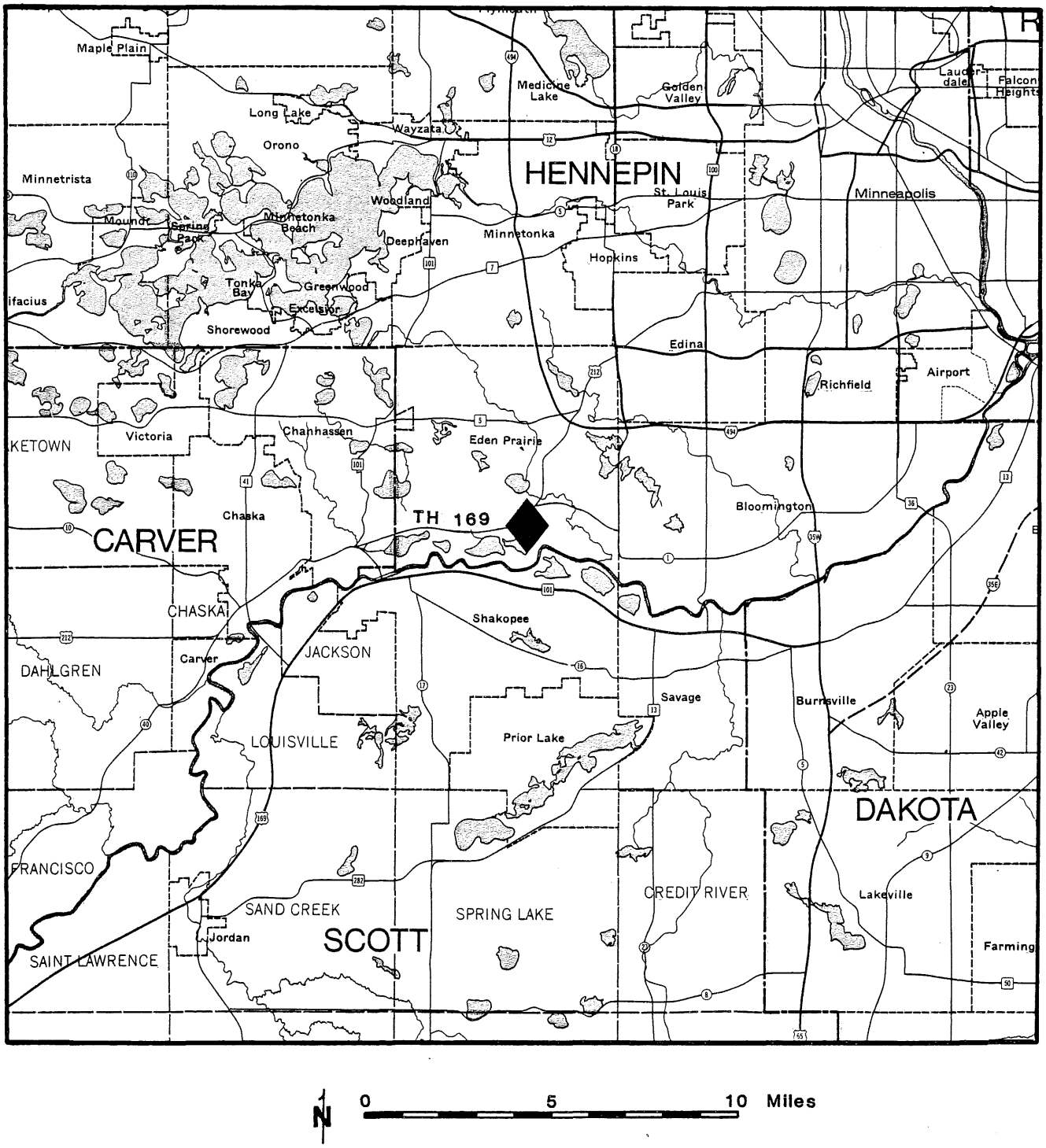
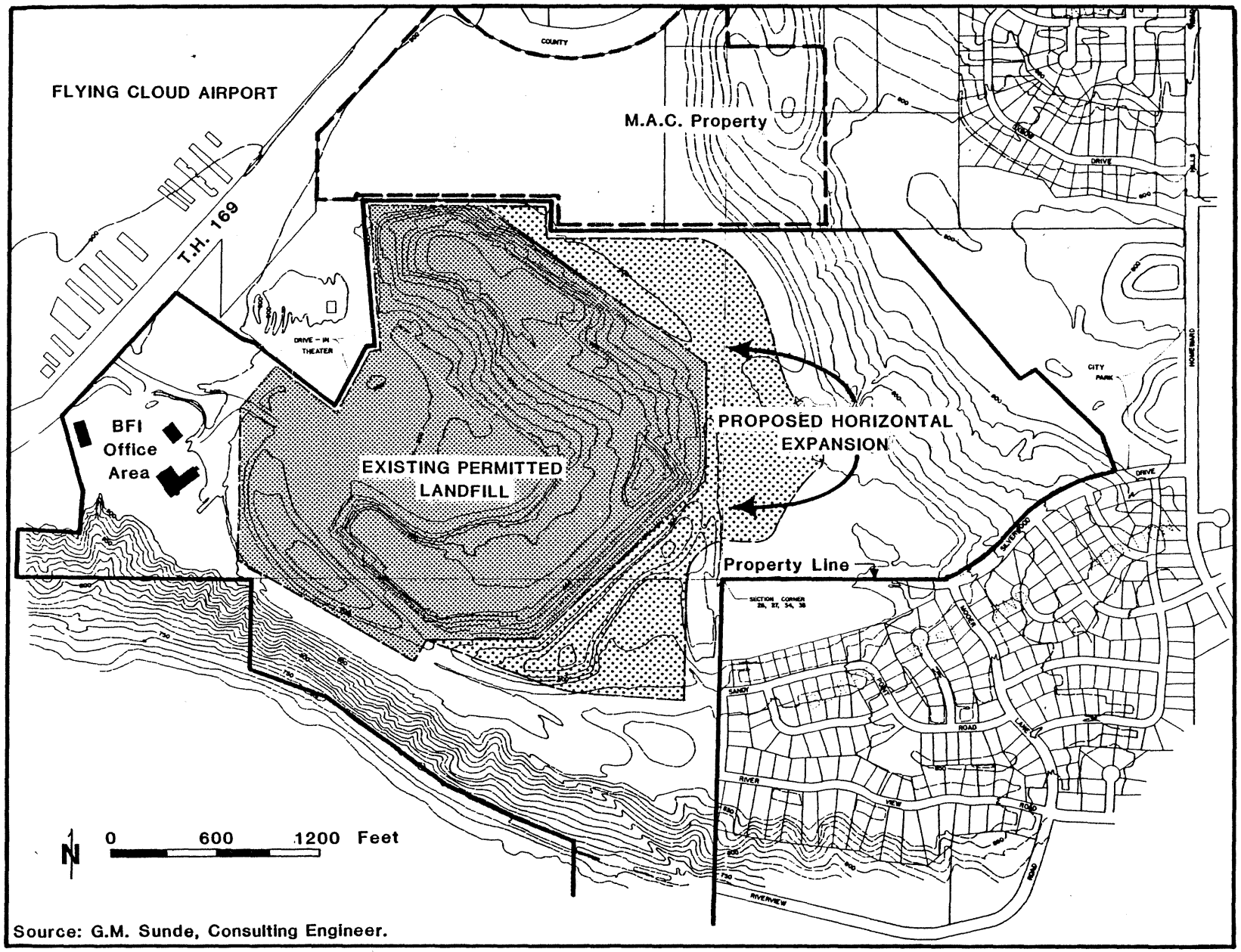


Figure 2.
GENERAL LOCATION OF FLYING CLOUD LANDFILL

Figure 3. EXISTING LANDFILL AREA AND PROPOSED EXPANSION



Source: G.M. Sunde, Consulting Engineer.

South--The Minnesota River valley is located south of the landfill. There is approximately a 170-foot difference in elevation between the river valley (at 700 feet MSL) and the top of the bluff (at 870 MSL). The river valley is three miles wide. The river valley immediately south of the landfill is located in the Minnesota Valley National Wildlife Refuge and Recreation Area. This land has not yet been purchased by the government, it is currently used for farming and private recreation. A farmstead is located along River View Rd. at the base of the river bluffs.

West--The existing landfill is bordered by Hwy. 169. The Flying Cloud Airport, owned by the MAC, is west of Hwy. 169. Airport related commercial facilities providing sales and service, including airplane maintenance and storage are located immediately west of the highway (Figure 4). BFI's regional office and Woodlake's offices, garages, storage sheds and truck parking areas are located just west of the landfill. A seasonal produce market and trailer house occupy lands to the southwest of the BFI office. A vacant house and a scenic overlook are southwest of the market along Hwy. 169.

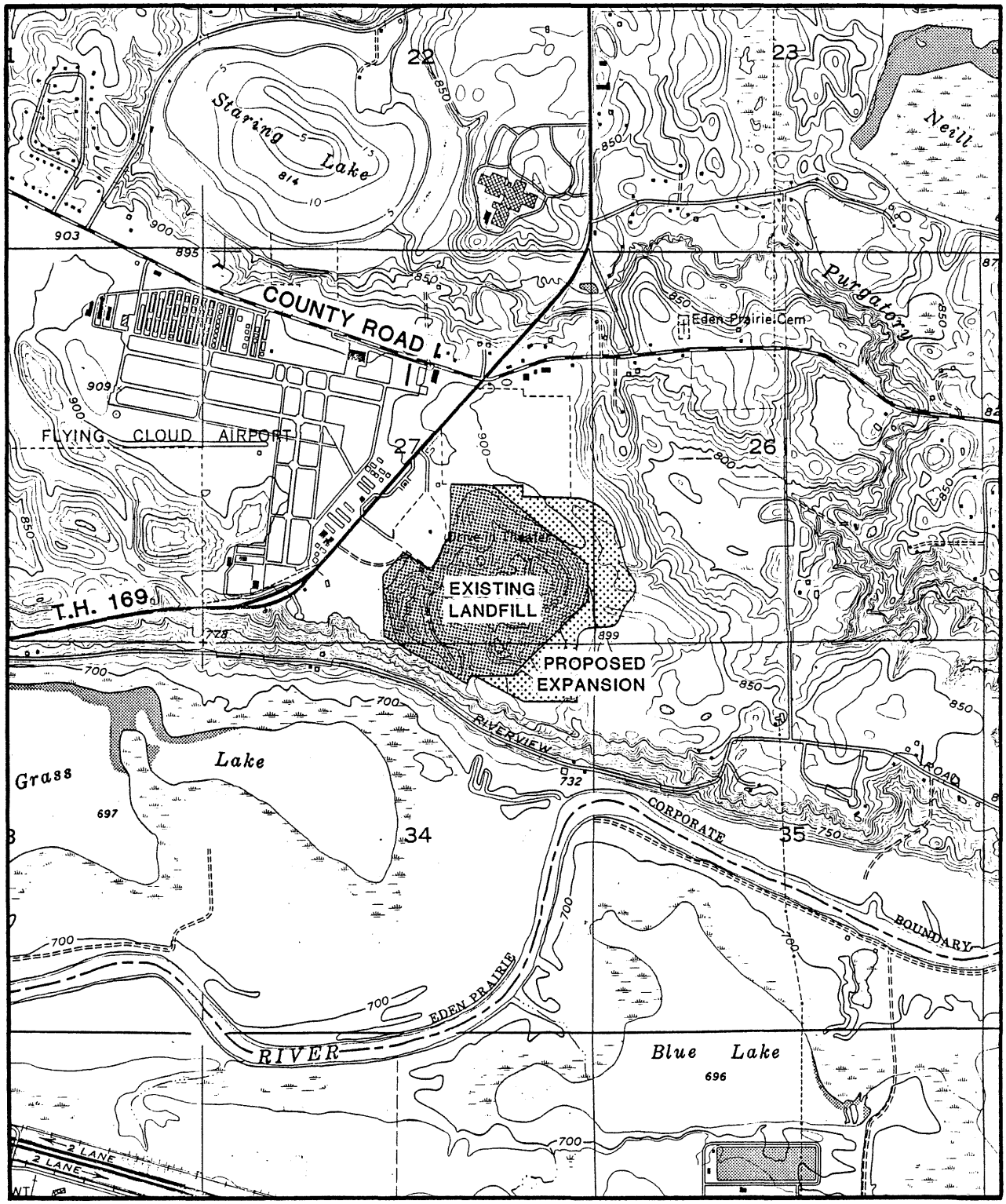
CAPACITY

The landfill was initially permitted by the MPCA in 1970. At that time the permit application estimated that the refuse capacity of the landfill was 5 million compacted yards (2.5 million tons), which was estimated to last for 12 years. The proposed maximum final elevation was 890 feet. The plan was to fill a natural 90-acre depression or "kettle."

In January 1983, the MPCA amended the original permit to clarify the extent and capacity of the landfill. In accordance with the recodified permit and a request that was granted in late 1983, the existing landfill is limited or restricted to the area defined as stage 3 of the facility staging plan. Disposal is limited to a maximum total of 4,209 acre-feet, leaving a remaining capacity of 1,074 acre-feet as of June 1, 1982. Alternatively stated, the remaining maximum air space, including the placement of cover material, is 1,342 acre-feet as of June 1, 1982. It is estimated that this capacity will be exhausted about February 1985. Figure 5 indicates the approximate final elevations to be achieved under the current permit.

Table 3 indicates the amounts of solid waste that have been deposited at the existing landfill to date. The amount of waste deposited has decreased in the last two years, probably due to the economic recession. Based on the remaining capacity (1,342 acre-feet) as of June 1, 1982 and assuming 1,000 gate pounds of refuse per cubic yard of filled air space, 3.6 million tons of refuse will be disposed of when the existing landfill in completed.

Figure 4.
AREA TOPOGRAPHY



Base Map Source: U.S.G.S.,
Eden Prairie 7.5 min. quad.

N 0 2000 4000 Feet

Figure 5.
FINAL CONTOURS UNDER PRESENT FILL PLAN

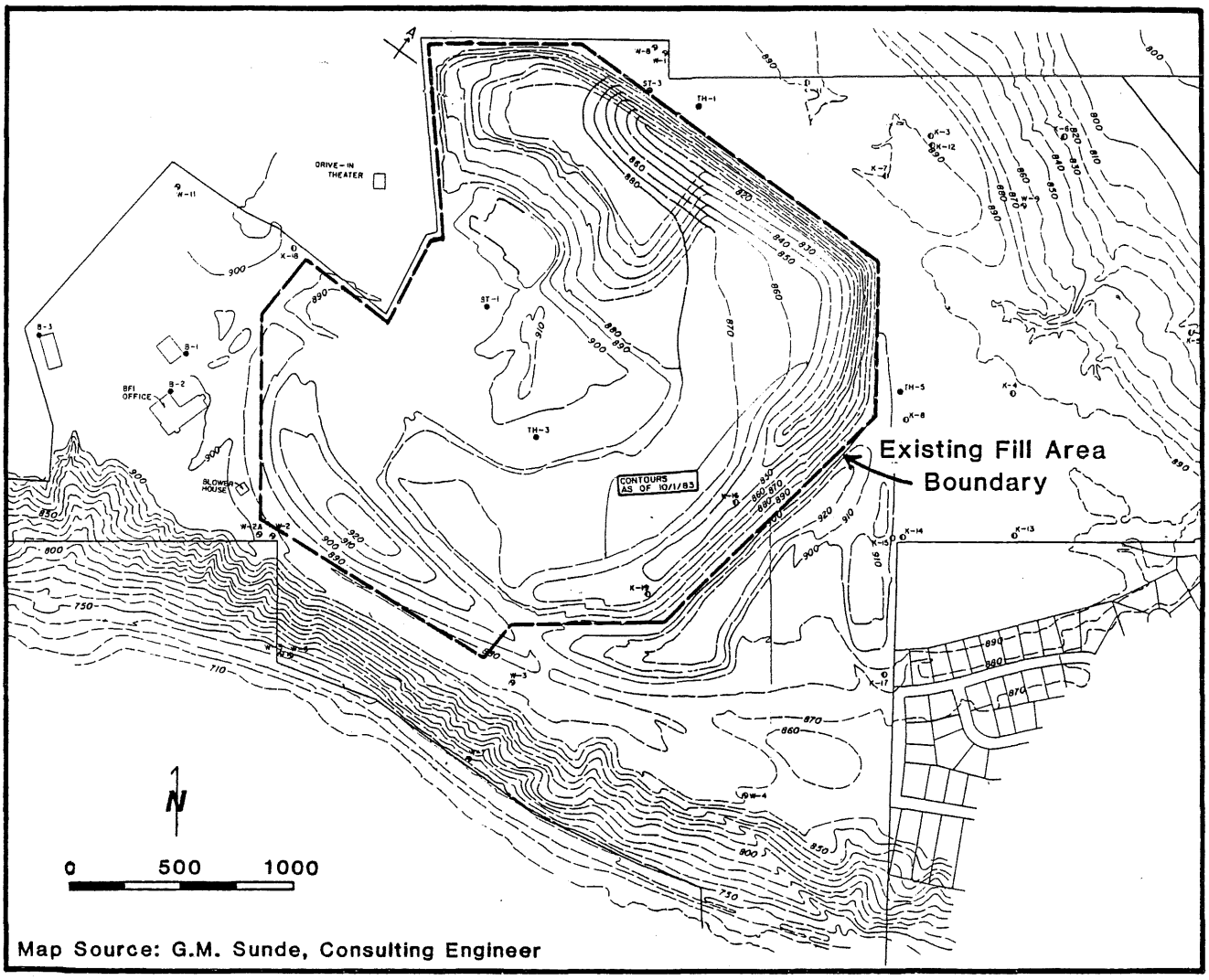


Table 3
REFUSE DEPOSITED IN FLYING CLOUD LANDFILL (ESTIMATED)

Year	Estimated Refuse Tons
1970 to Nov. 1972*	100,000
1973	181,000
1974	181,000
1975	181,000
1976	199,000
1977	265,000
1978	296,000
1979	338,000
1980	452,000
1981	362,000
1982	355,345

*Refuse deposited during 1970 to November, 1972, is estimated. Woodlake Sanitary Services did not take over the landfill permit until 1972.

Source: Woodlake Sanitary Services, Inc.

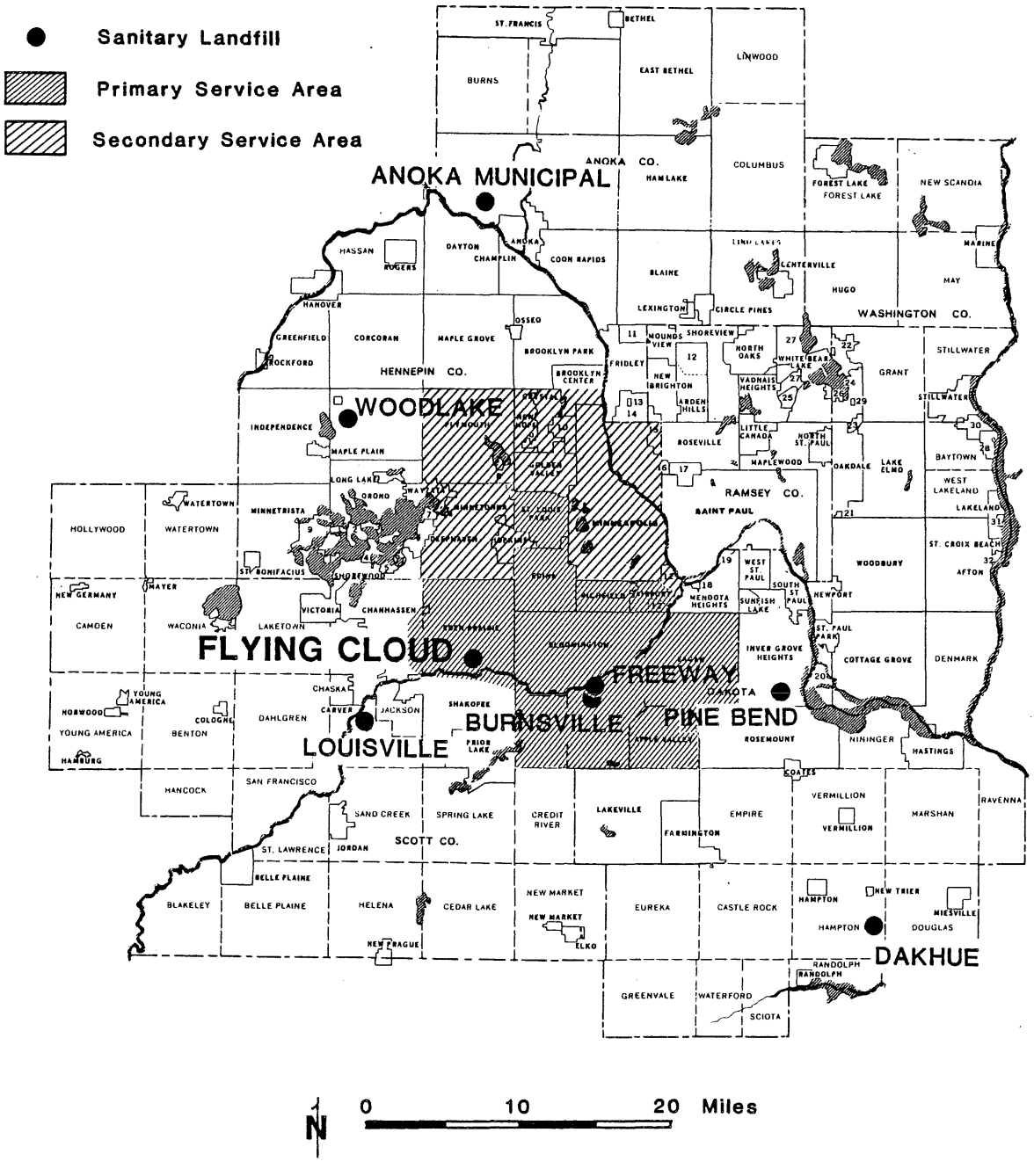
SOLID WASTE SERVICE AREA

The landfill services communities in southern and western Hennepin County and northern Dakota County (Figure 6). This includes commercial/industrial waste generators and residences in the City of Minneapolis and residences in Edina, Bloomington, Eden Prairie, Richfield and other communities. An estimated 25 percent of the solid waste produced in Hennepin County is disposed of at the landfill. Approximately 60 percent of the waste disposed of is commercial/industrial and 40 percent is residential. Sixty percent of the refuse disposed of is produced by WSS and BFI customers.

There is currently only one other landfill operating in Hennepin County. It is in Medina, approximately 30 miles to the northwest. Landfills in Burnsville and Inver Grove Heights (in northern Dakota County) and in Louisville Twp.(in Scott County) also serve Hennepin County (Figure 6). Communities in northern Dakota County are served by these same landfills, with the exception of the one in Louisville.

The landfill receives only mixed municipal solid waste. No hazardous or liquid wastes are accepted, in accordance with state regulations. The general composition of the refuse disposed of in Twin Cities Area landfills is indicated in Table 4.

Figure 6.
TWIN CITIES METROPOLITAN AREA SANITARY LANDFILLS AND FLYING CLOUD LANDFILL SERVICE AREA



Sources: Metropolitan Council, Woodlake Sanitary Services, Inc.

Table 4
COMPOSITION OF RESIDENTIAL AND COMMERCIAL SOLID WASTE, 1980
(Percent by weight)

	Percent of Net Waste Stream*	
Combustibles		
All paper	33.0%	
Newspaper		6.0
Books, Magazines		3.0
Office paper		9.0
Corrugated		9.0
Other		11.0
Plastics	3.7	
Rubber	1.9	
Leather	0.7	
Textiles	1.4	
Wood	3.6	
Food wastes	16.6	
Residential/Commercial		13.8
Manufacturing		2.8
Yard wastes	18.5	
Combustibles subtotal	79.4	
Noncombustibles		
All metals	9.3	
Ferrous appliances		4.0
Ferrous cans		4.2
Aluminum scrap		0.3
Aluminum cans		0.4
Other nonferrous		0.4
Glass	9.9	
Miscellaneous inorganics	1.4	
Noncombustibles subtotal	20.6	
Total	100.0%	

* Waste stream as disposed after material recycling.

Source: Metropolitan Council. Land Disposal Abatement: Options for Solid Waste Reduction and Recovery. 1981.

SITE OPERATIONS

Hours of Operation

The landfill is open 4 a.m. to 6 p.m. Monday through Friday and 7 a.m. to 3:30 p.m. on Saturday. BFI and Woodlake refuse trucks leave the site between 6 and 7:30 a.m. to drive to residential routes, and between 12 p.m. and 6 a.m. to drive to commercial routes. Daily cover and compaction activities continue for about one hour after the landfill is closed.

Equipment

A variety of heavy equipment is used on the site for handling and compacting the refuse and handling cover materials. This equpment includes:

Two Caterpillar D-8 dozers;
Three compactors (2 Caterpillar 826s, 1 Rex);
One No. 16 Caterpillar motor grader;
One 3,000 gallon tank truck for water;
One Omi-vac 600P truck mounted paper vacuum;
One Caterpillar D-3 dozer;
One pick up truck; and
One International tractor with mower.

The equipment is stored and maintained at a building adjacent to the office. BFI collection trucks and Woodlake refuse trucks are based at the site as well.

Personnel

As of July 1983, the following personnel were employed at the landfill: six full-time operators, two scale operators, one fill manager, and 2 to 10 laborers for litter pick-up and other miscellaneous work.

Operating Procedures

An attendant weighs each truck as it arrives, collects the dumping fee and directs the truck to the active fill area.

Solid waste is unloaded at two active fill areas or "working faces" at the landfill. One working face receives compacted refuse from commercial compactors and the second face receives demolition material and noncompacted refuse. The former refuse is compacted immediately by compactors. The total area of the working face varies from a minimum of 10,000 to a maximum of 30,000 square feet.

The waste is placed in lifts eight to 10 feet high. Each lift consists of several cells containing the solid waste deposited during a workday. Six inches of cover material is placed over each cell at the end of the day, as required by MPCA regulation. After each lift is completed, a new lift is started on top of it.

Approximately 200 to 400 cubic yards of cover material are used daily. Filled areas that will not receive additional material for more than 120 days are covered by an additional foot of intermediate cover material in accordance with MPCA regulations. Approximately 800,000 cubic yards of material is stored on the site for use as cover.

Portions of the existing landfill are nearly at final elevations and have received two feet of cover. These areas are located along the western edge of the landfill. The top six inches of cover consists of seeded topsoil.

In general, fill areas completed between April 15 and October 1 are seeded with grasses to provide vegetative cover within 30 days after application of cover and topsoil materials. Areas completed between October 1 and April 15 of the following year are covered and seeded by May 15. As of July 1983, the following portions of the landfill have some established vegetation (Table 5):

Table 5
VEGETATION ON EXISTING LANDFILL

Cover	Percent
Turf covered	36.8
Volunteer vegetation	4.0
Daily/intermediate cover (little vegetation)	47.2
Bare ground (no refuse)	12.0
	100.0

Source: G. M. Sunde, Consulting engineer to Woodlake Sanitary Services, Inc.

EXISTING ENVIRONMENTAL CONTROLS

A number of measures have been taken by the applicant to monitor and mitigate the potential environmental impact of the existing landfill. Some of these have been initiated in accordance with the conditions of amended permit SW-14. A summary of current procedures, practices and improvements at the present sites follows.

Air Quality Controls

Air quality monitoring is not required by the MPCA and Hennepin County because open burning is not permitted at landfills under state regulation. The placement of daily cover on the active fill area prevents adverse air quality impacts from decomposing refuse.

Woodlake was required to submit a Wind Erosion Control and Dust Emission Source Evaluation and Control Plan to the MPCA under the recodified permit. According to the terms of the permit, the plan must evaluate sources of dust emissions including on-site haul roads, cover stockpiles, excavation areas, active, intermediate and final fill areas and other earthern structures. It must evaluate various control methods, specifically, windbreaks, dust control sprays, surfacing haul roads, applying mulches, seeding or sodding earthen structures, intermediate and final fill areas, and revisions to the sequence of landfilling. Finally, the plan must recommend measures to reduce dust emissions at the existing landfill. The MPCA has reviewed and approved the plan.

There are soil stockpiles on site. The stockpiles contain final cover materials or excavated materials. The largest stockpiles are located at the southwest and southeast corners of the existing site (Figure 5). There is a lower stockpile placed over refuse in the southwest part of the site.

The stockpiled excavated soils are subject to wind erosion. To control this problem, Woodlake has seeded the long-term stockpiles. The large stockpile in the southwest corner was covered with topsoil in 1982 and seeded; the large stockpile in the southeast corner was covered and seeded in 1983. The lower stockpile is being used for daily cover. The area surrounding the stormwater detention pond was also covered with topsoil and seeded in the summer of 1983.

The first 1,200 feet of the roadway from Hwy. 169 to the landfill is bituminous surfaced, and so does not cause a fugitive dust problem. Another 1,200 feet of haul road was surfaced with reprocessed bituminous material in 1983. For the most part, unpaved haul roads to the landfill are sprayed daily with water to control dust in the spring, summer and fall.

Groundwater Quality

Woodlake follows company practice and state and local regulations to protect groundwater. Representatives of MPCA and Hennepin County inspect the landfill monthly and require correction of any conditions which may affect the groundwater quality.

MPCA regulations prohibit the disposal of hazardous waste materials, sludges and any liquids at sanitary landfills. Woodlake has adopted a program to identify and remove such wastes that may reach the site.

In accordance with MPCA regulations, Woodlake WSS must place six inches of daily cover over waste cells to minimize surface water infiltration. Completed areas must be covered with two feet of final cover to control infiltration. Surface water is directed away from filled areas to a detention pond in the southeast corner of the site or to uncompleted portions of the site.

Woodlake has constructed 12 groundwater quality monitoring wells (see Site Hydrogeology section for details). Three of these (W-9 through W-11) were constructed after January 1983 to meet the requirements of the recodified permit. Wells W-1, W-8 and W-11 are "background" wells, and measure groundwater quality upgradient from the landfill. Wells W-9 and W-10 monitor the water table to the east of the site. The remaining seven wells are downgradient of the landfill. In September 1984 MPCA gave permission to replace wells 1, 3 and 4 with new wells W-1A, W-3A and W-4A. Wells W-3A and W-4A are to be located closer to the existing landfill and proposed expansion. At the same time the MPCA approved a reduction in the frequency of monitoring for some parameters. Wells W-1 through W-11 are to be sampled once rather than three times a year, in April, and analyzed for the following parameters:

Alkalinity
Ammonia nitrogen
Arsenic, dissolved
Cadmium, dissolved
Calcium, dissolved
Chemical oxygen demand
Chloride
Chromium, total dissolved
Copper, dissolved
Dissolved, solids, total
Iron, dissolved
Lead, dissolved
Magnesium, dissolved
Manganese, dissolved
Mercury, dissolved
Nitrate plus Nitrite, as N
ph (field and lab)
Potassium, dissolved
Sodium, dissolved
Specific conductance
Sulfate
Suspended solids, total
Temperature (field)
Zinc, dissolved

Odor, color or sediment is to be noted. Additional testing for other parameters, including organics, may be required.

At least three of the wells, W-2a, W-3, W-4, W-5, W-7, W-10 and W-11 are analyzed in April and October for the following:

Benzene
Chloroform
Toluene
Ethylbenzene
Dichlorodifluoromethane
Trichloroethylene
Methylene chloride
Methyl chloride
Methyl bromide
Chlorobenzene
Trichlorofluoromethane
1,2 - dichlorethane
1,2 - dichloropropane
1,1 - dichloroethylene
1,3 - dichloropropene
Tetrachloroethylene
Vinyl chloride
1,2 - trans-dichloroethylene
1,1,1 - trichloroethane
1,1 - dichloroethane

These changes are consistent with the conditions contained in the recodified permit.

All water samples must be collected and analyzed by an independent laboratory. Water elevations in the monitoring wells and piezometers must be submitted to the MPCA along with the sample results. Woodlake maintains 11 piezometers on the site to measure the potentiometric head of the groundwater.

The recodified permit requires Woodlake to define the soils and hydrogeological conditions of the site and the present and future impact of the landfill on groundwater, private and public wells and surrounding surface waters. The MPCA has recommended that the initial report provide for monitoring frequencies consistent with agency guidelines.

Litter Control

Woodlake has adopted a litter control policy. As part of this policy, the landfill is surrounded by a six-foot high, chain-link fence, and policed daily to prevent the litter accumulation. Four portable litter fences (10 feet high) are used downwind of the active fill area and a snow fence is used at the top of the excavated area to capture windblown litter. From two to 10 employees check for and pick up litter on the site and surrounding areas. A truck-mounted litter vacuum is also used. According to the policy, disposal supervisors and operators ensure that adequate cover is available and placed over the waste deposit and that no litter is present at the active fill area at the end of each day's operations. The operations manager is to take extra measures when a high wind is expected, including moving the filling operation to a more protected area, using additional personnel for cover and wind screen placement, and for clean up after high winds cease. Areas that are subject to littering accumulation are inspected daily and cleaned up at the end of the working day. Following the spring snowmelt there is an intensive on- and off-site clean up of litter. A "hot line" has been established by Woodlake to receive complaints regarding litter problems. The manager responds to any calls regarding litter conditions.

Under the amended permit Woodlake must limit active filling to as small an area as practicable and provide portable and stationary control equipment to confine windblown litter to the site. All windblown litter must be collected and buried at the facility at the end of each day. The recodified permit also requires Woodlake to evaluate other control measures such as ceasing operations on windy days, establishing windbreaks, altering the phasing and height of filling and using additional litter screens and higher permitted fencing. The MPCA has reviewed and approved Woodlake's control plan.

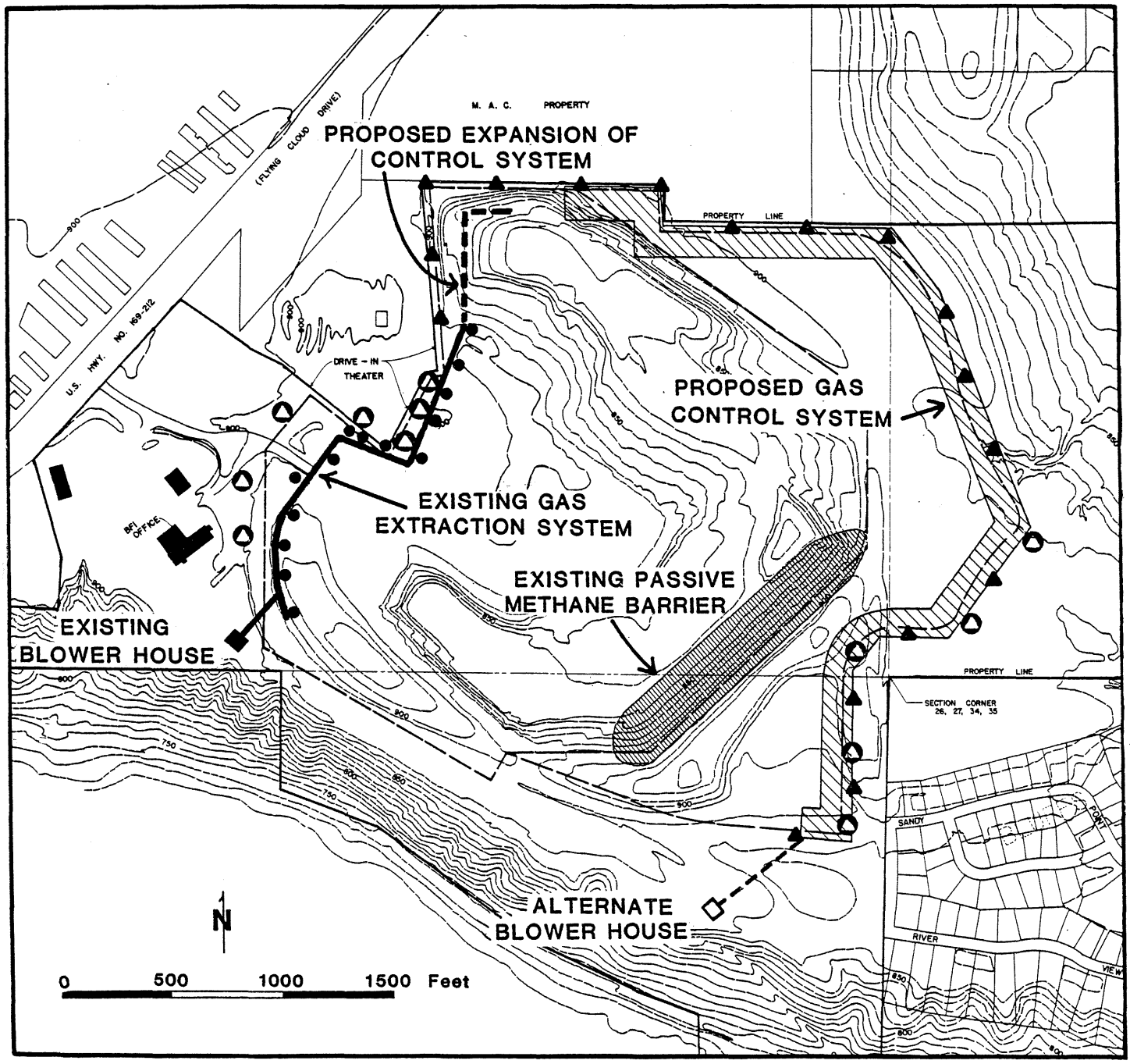
Landfill Gas Control

To control the production of landfill gases, including methane, and mitigate the potential impact on off-site land uses, Woodlake has constructed two separate migration control systems at the landfill. A clay barrier has been constructed along the southeastern perimeter of the fill area (Figure 7). The barrier is 1,500 feet long, 100 feet deep and at least 36 inches thick, and is placed at a slope of 2.5 to 1. The barrier is compacted at 95 percent Proctor density to achieve a maximum coefficient of permeability of 1×10^{-7} cm/sec throughout its depth. Its design induces gas to move upward into the air at the surface rather than migirating laterally into off-site areas.

Five methane probes have been installed along the south and southeast boundaries of the landfill to monitor methane. The probes are 200 feet apart and 200 feet from the property boundary. If significant methane migration is detected, the MPCA will require the construction of an active methane collection system.

An active methane collection-recovery system was constructed in 1981 along the west and southwest edges of the existing landfill (Figure 7). Fourteen gas extraction wells spaced approximately 150 feet apart are connected by a horizontal pipe just below the surface. A pump draws the gases into the wells from the landfill, and the gases are collected and flared or burned. The system is designed to recover the collected gases and use them for energy recovery if Woodlake decides this is feasible. Seven methane monitoring probes monitor the collection system's effectiveness. Monthly monitoring reports are filed with the MPCA.

Figure 7.
EXISTING AND PROPOSED METHANE CONTROL AND MONITORING SYSTEM



Base Map Source: G.M. Sunde, Consulting Engineer

- ● Existing Methane Wells
- ⬡ Existing Methane Probes
- ▲ Proposed Methane Probes

The permit requires Woodlake to file a post-construction and operations report to the MPCA. The report must provide a detailed description of 1) the existing control and monitoring system; 2) operation and maintenance procedures; 3) a monitoring and testing program; and 4) a contingency plan to be implemented if odor problems develop, methane concentrations exceed five percent (combustible levels) inside or outside the property boundary, or if power sources are interrupted. The report must also indicate a commitment to short- and long-term monitoring and system evaluation. The MPCA has reviewed the initial report and recommended that it provide for quarterly inspection, monitoring and maintenance of the collection system for five years after closure and following the initial five-year post-closure period.

Noise Control

Landfill equipment is inspected and maintained by Woodlake to insure proper operation of its noise control systems. Special mufflers suppress noise from the compactors.

Landfill equipment is not started until 5:30 a.m; however, the landfill opens at 4 a.m. In accordance with the recodified permit Woodlake must develop a report evaluating current and future noise levels and, suggesting measures to control these levels. The submittal date for this plan has been extended pending MPCA receipt and review of the noise portion of the EIS.

Surface Drainage/Erosion Control

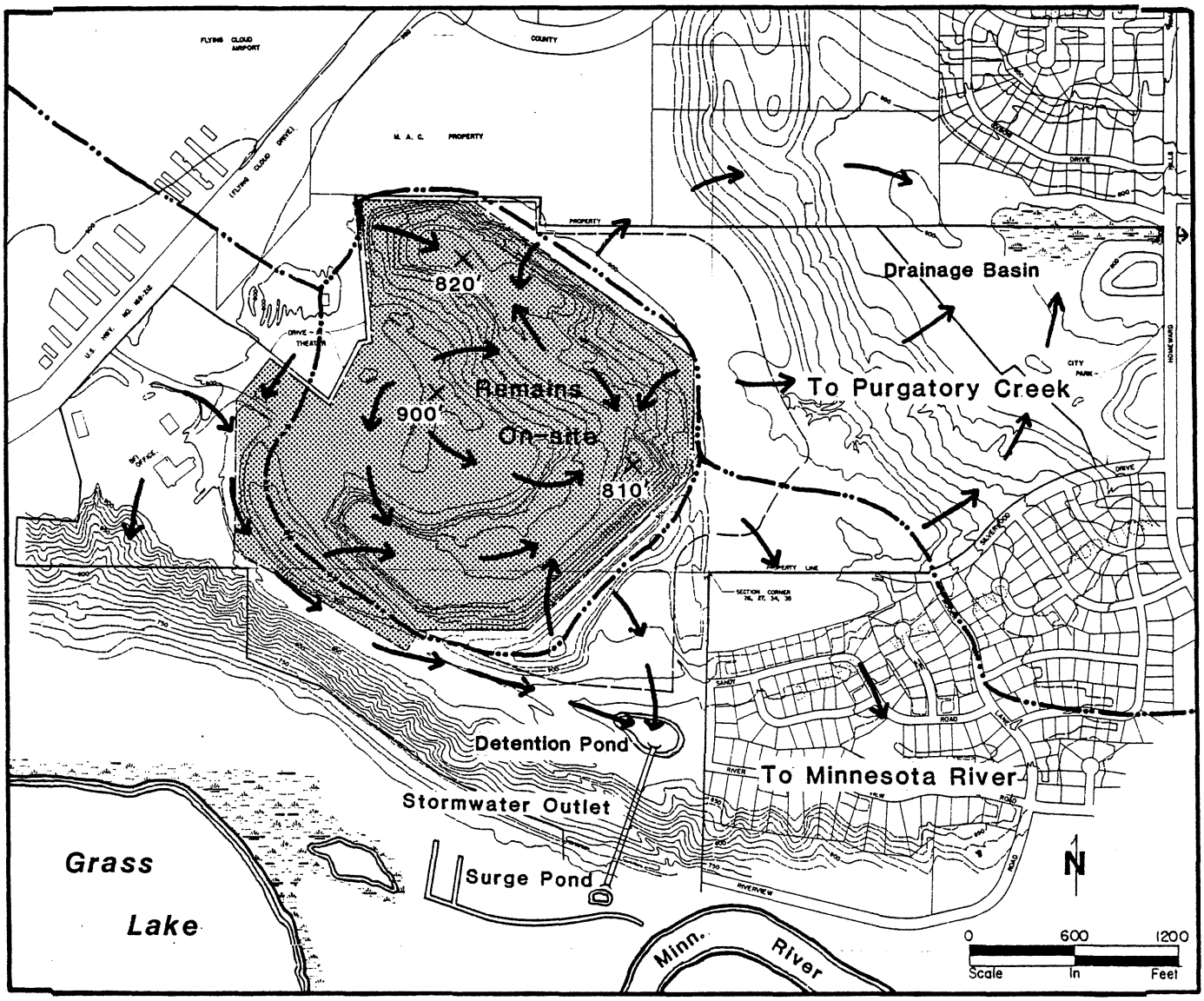
In 1979 a surface water drainage system was constructed to drain surface water off the completed or nearly completed areas of the existing landfill. This system directs runoff from the western and southwestern portions of the landfill and office/shop area to a drainage swale along the southern perimeter of the site. The swale directs the surface water to a detention pond at the southeastern corner of the site (Figure 8). The detention pond is designed to hold the runoff from a 100-year rainfall event. The pond is 15 feet deep, and currently holds over 20 acre-feet of water. The sandy soil underlying the pond allows water to gradually infiltrate the soil. A variable diameter pipe, placed 10 feet from the top of the detention pond, carries water underneath the bluff face to a surge pond in the river valley below Riverview Rd. The surge pond drains to the adjoining marshy area and abandoned ditches to the south. The runoff does not appear to drain to the Minnesota River. The detention pond also allows some sediment to settle out of the surface waters before it drains to the river valley. The pond is periodically cleaned. Surface waters on most of the existing landfill drain to the unfilled portions of the site and infiltrate the soil (Figure 8).

Upon completion of the existing landfill, the final contours will direct runoff to the north and east, as well as toward the drainage swale and detention pond.

To minimize the potential for erosion the applicant has seeded soil stockpile areas at the southwest and southeast corners of the site, the area around the detention pond and the western area where filling has been completed. Table 5 indicates the portions of the site which are presently vegetated.

In accordance with the amended permit, Woodlake is to submit a combined short-term (active filling) and long-term (closure and post-closure) soil erosion control and surface water drainage plan for MPCA approval. The plan is to control and eliminate gullying and erosion from intermediate and final cover areas and along the Minnesota River bluffs. The MPCA has approved the erosion control plan.

Figure 8.
EXISTING SURFACE WATER DRAINAGE



Base Map Source: G.M. Sunde, Consulting Engineer

Surface Water Drainage Divide

Direction of Flow

Vector Control

Rodents are controlled through a variety of practices including refuse compaction, placement of six inches of daily cover material and use of an extermination service.

Scavenging birds are active during a six-week period in the spring and fall. The birds are controlled through such means as the periodic discharge of an air cannon and shotgun blanks.

Visual/Aesthetic Control

The landfill along Hwy. 169 was landscaped in 1980-81. Trees and grass have also been planted in the area. Conifers approximately 15 to 20 feet in height are growing along the southeast boundary of the site, and partially screen the landfill from the Bluffs West Second Addition.

SECURITY/SAFETY MANAGEMENT

Fire Protection

Public fire protection is provided by the City of Eden Prairie. The closest fire station is located at Hwy. 169 and West 78, five to seven minutes away.

There are three on-site water wells which provide water to combat fires. Two of the wells are four inches in diameter and can supply approximately 40 to 50 gallons per minute; the third well is six inches in diameter and can supply 90 gallons per minute. A 3,000-gallon water truck is available to combat minor on-site fires. City water is available at the Bluffs West subdivision southeast of the proposed expansion and on County Rd. 1.

Security

A six-foot high chain link fence with barbed wire strands completely surrounds the landfill. Access to the site is provided only at the scale entrance building, and this is restricted by a gate. A locked gate controls access on the east side of the site.

Professional guard service is provided when company personnel are not present. Company personnel are present from 12 p.m. Sunday to 12 p.m. Friday and between 7 a.m. and 3 p.m. on Saturday.

Sanitary

Sanitary facilities are provided on the site for company personnel and other visitors by means of a septic tank. There are no city plans at the present time to extend public sewer services to the site.

CLOSURE

Hennepin County and MPCA regulations govern closure of the landfill. In accordance with the amended permit SW-14 the applicant must submit a closure plan within seven months for the existing landfill. The plan must include procedures for the inspection and maintenance of runoff control structures, vegetation, settlement, erosion controls, monitoring systems and other long-term management. It must also describe the final cover, grading, surface water control, settlement and erosion control, gas and water monitoring systems and other needs. An implementation schedule must be included. The MPCA has asked

that additional conditions for final cover materials be included in the initial report.

When the entire landfill reaches final elevation and refuse is no longer accepted, several measures must be taken by Woodlake within 30 days following termination.

1. Access to the landfill must be secured to prevent further disposal of waste.

2. Regular customers must be notified of closure. A notice must be posted at the security gate, and alternative sites must be listed. A closure notice must be published in a newspaper of general circulation in the service area.

3. The entire landfill must be covered with two feet of material including six inches of topsoil suitable for vegetative growth.

4. The site must be fertilized, mulched and seeded within 90 days after the placement of final cover. If adverse weather delays these activities, measures must be taken to minimize erosion.

5. The surface water drainage system must be completed.

Hennepin County and MPCA will then be notified so a final inspection may be completed and closure approved.

Within one month after the final closing, Woodlake must file and record a plat with the Hennepin County Registrar of Deeds. The description portion will indicate the location and type of deposited solid wastes and other details of the landfill. A registered engineer must certify that the landfill is closed in accordance with regulatory requirements and plan provisions specifically that the methane control and ground water monitoring systems are functional.

POST-CLOSURE OF EXISTING LANDFILL

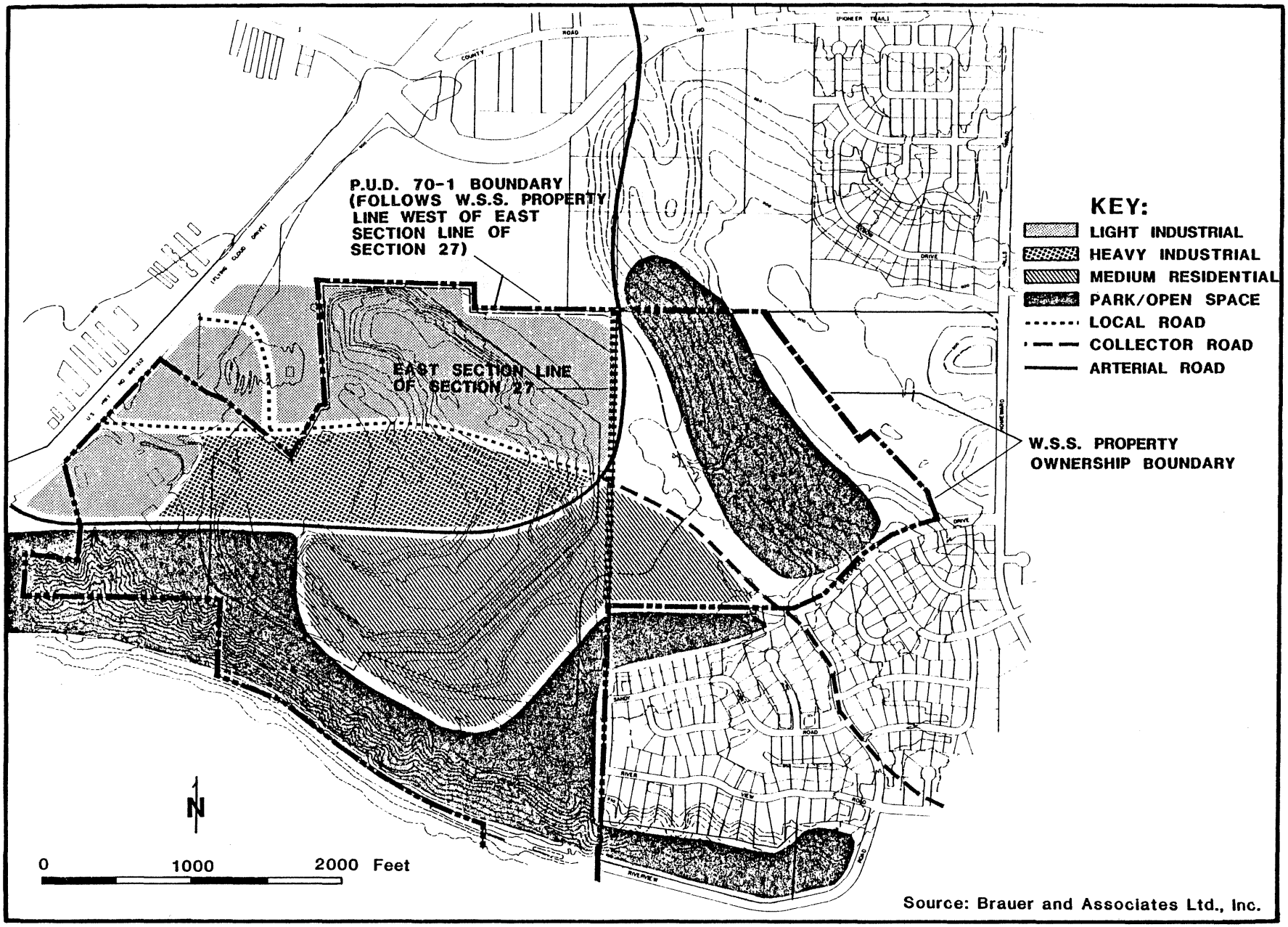
Following the approved closure Woodlake will continue to operate the ground water quality monitoring system for a regulated, but currently indeterminate period of time and will maintain the integrity of the final cover and vegetation. The methane gas control system will continue to be operated, maintained and inspected in accord with BFI corporate policies. The MPCA and Hennepin County will continue to inspect the site and receive groundwater quality monitoring reports. Woodlake will maintain general liability insurance on the landfill.

Woodlake must submit a specific closure and post-closure groundwater monitoring plan to the MPCA. It must also submit documentation including a guarantee by the parent corporation that demonstrates financial assurance for the proper operation, closure and long-term liability, care and monitoring of the facility. The documentation must include an inflation adjusted cost estimate for closure and long-term care and monitoring, a description of the financial instruments which assures proper operation, closure and long-term care of monitoring in accord with the permit. The MPCA has reviewed the initial plan and recommended that it be revised to include schedules for post-closure inspections of the site and the various control and monitoring systems.

END USE PLAN

The current, approved end use plan for the site provides for a variety of uses on the landfill and 65 adjacent acres (Figure 9). PUD-70-1, as approved by the City of Eden Prairie, calls for industrial development (100 acres) on the west and north, medium-density residential (40 acres) and 75 acres for park and open space use. PUD 70-1 also provides for the preservation of the river bluffs, a new local collector street parallel to the bluff and a relocated Flying Cloud Dr. Twelve acres were rezoned in 1973 to allow construction of BFI offices, garages and truck storage. Because of restrictions in the recodified permits, an elongated depression along the landfill's eastern perimeter will remain unfilled; this will alter the feasibility of land uses proposed for that area.

Figure 9.
P.U.D. 70-1 LAND USE PLAN



PROPOSED PROJECT

PROJECT CHARACTERISTICS

An application to expand the existing landfill was filed by Woodlake, with the MPCA in the form of an amendment to permit SW-14. The proposed expansion consists of three major components: 1) excavating and filling 42.4 acres of land to the east of the existing landfill; 2) filling of an elongated depression along the eastern perimeter of the existing landfill; and 3) expanding the final vertical elevation of the landfill to a maximum of 923 MSL (an average increase in final elevation of five feet) (Figures 10 and 11). The maximum elevation would occur in the north central part of the landfill. There would be no significant increase in the elevations at the northwestern, western and southern perimeters of the site. The expansion would add 5,644 acre-feet of capacity to the site, representing an additional seven years of fill capacity.

Four and one-half million cubic yards of materials will be excavated as part of the expansion. The horizontal expansion area will be excavated to an average elevation of 812 MSL (Figure 10). Approximately 500,000 cubic yards of the excavated material will be stored on site. Approximately 25 percent of the excavated materials will be used for daily and final cover and for berm construction. The remaining material will be gradually removed from the site.

EXPANSION STAGING

Initially a berm along the eastern and northern perimeter of the expansion site will be constructed and landscaped (Figure 12). On-site soil materials would be used. An existing ridge along the site boundary just west of Bluffs West Second Addition will be removed and replaced by the berm. Woodlake estimates it would take approximately three to four months of actual work time to construct the berm, but construction might take place over a 12-month period.

Excavation would be undertaken first in the northern corner and proceed southward in stages (Figures 13 and 14). The placement of refuse would begin as each area is excavated. The placement of final cover would proceed in the same direction, after the completion of refuse filling in each area. Excavated soils would be stockpiled along the southwest and southeast perimeters of the site and in the center of the existing landfill where the site is within 10 feet of final grade.

A Williams Brothers gas pipeline, which is located along the eastern edge of the existing landfill, would be relocated eastward out of the expansion area.

PROPOSED CAPACITY

The proposed project would add approximately 5,644 acre-feet or 9.1 million cubic yards of air space volume to the landfill. The following estimates of the remaining life of the landfill are based on Woodlake's assumptions that the amount of waste (in tons) received at the landfill will increase by 10 percent per year and that the inplace density of the waste will be 1,000 pounds per cubic yard of air space.

Figure 10.
PROPOSED EXCAVATION PLAN FOR EXPANSION AREA

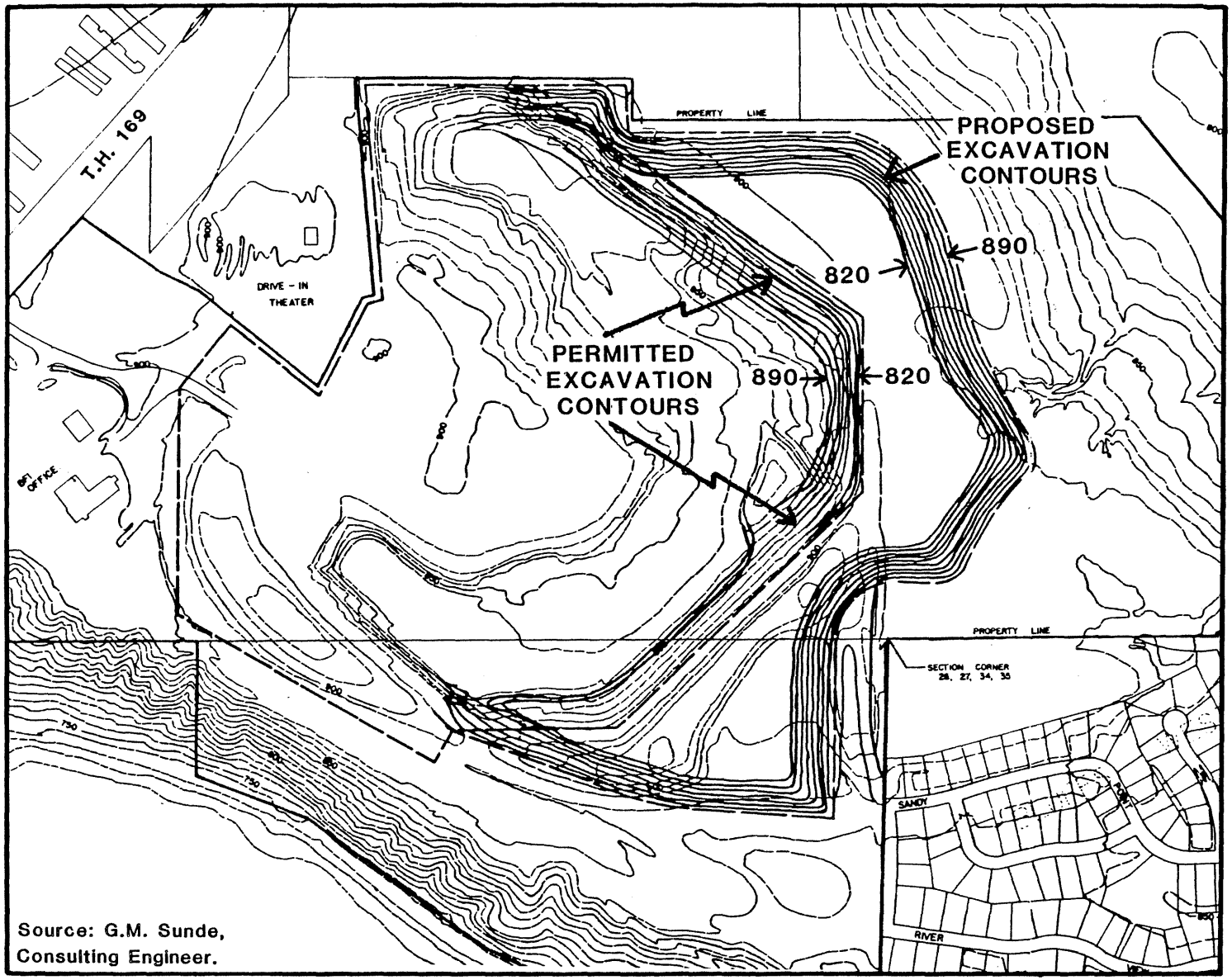
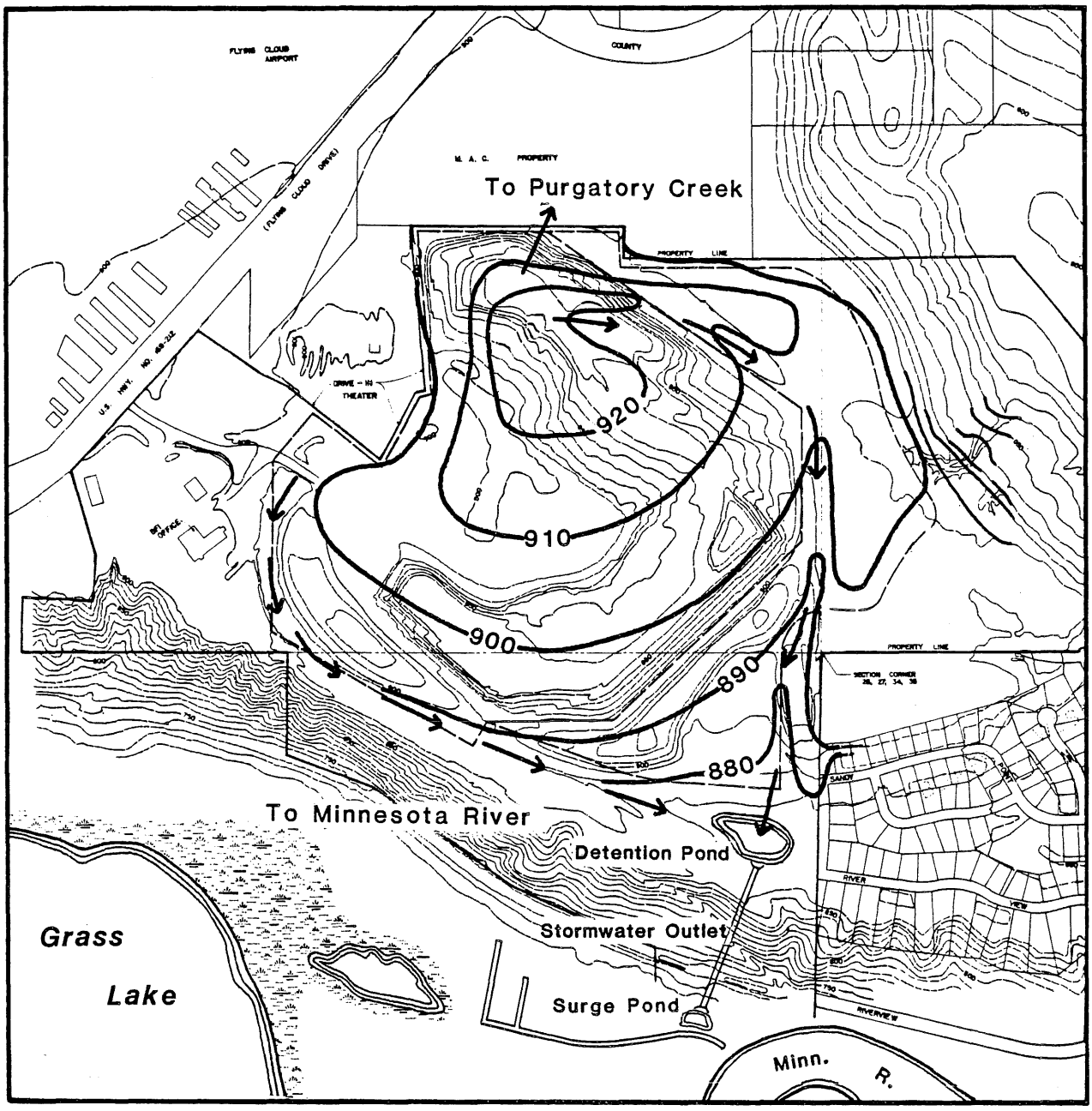


Figure 11.
FINAL CONTOURS WITH PROPOSED SITE EXPANSION



Source: G.M. Sunde, Consulting Engineer

N

→ Direction of surface water flow

0 600 1200
Scale In Feet

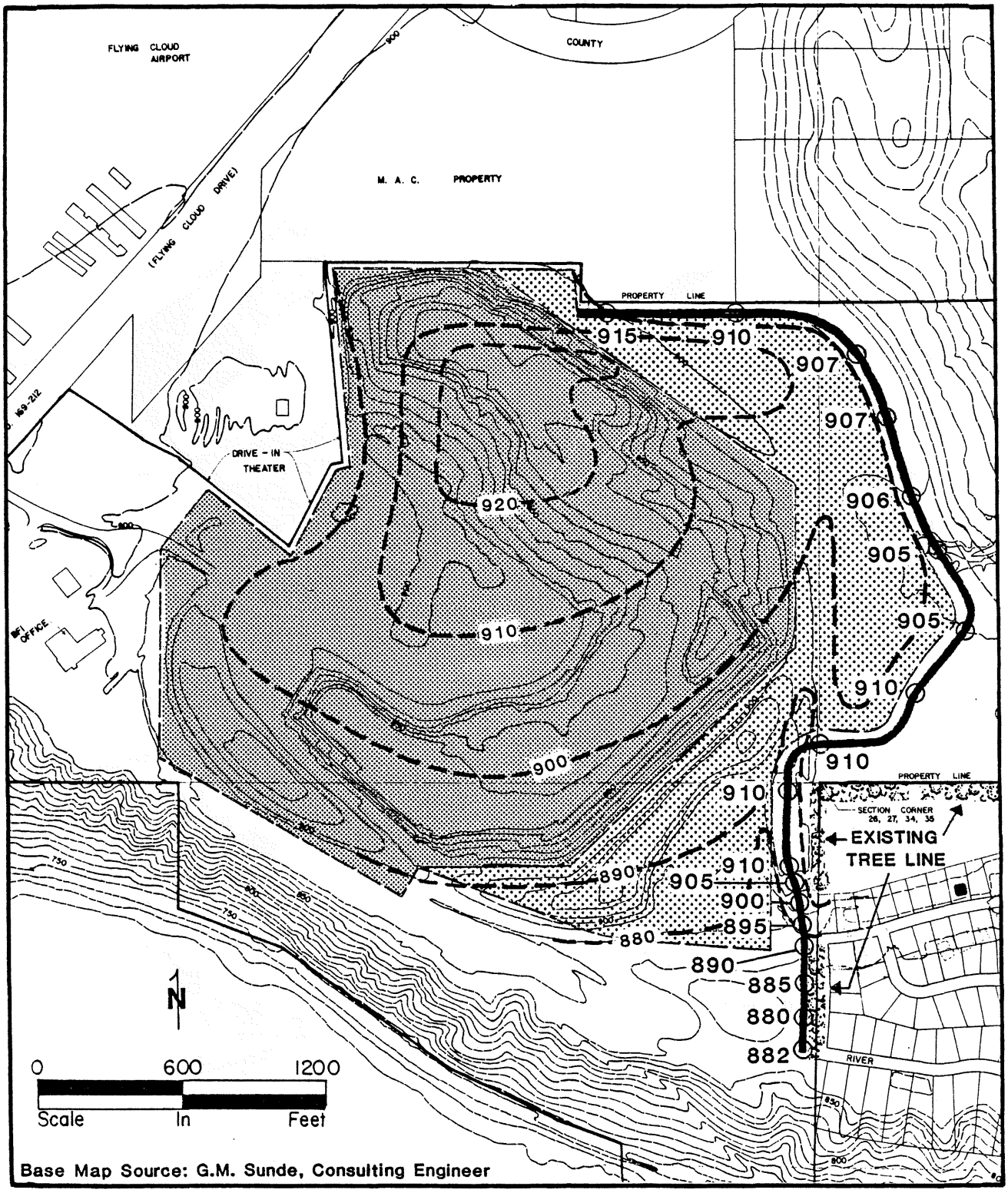
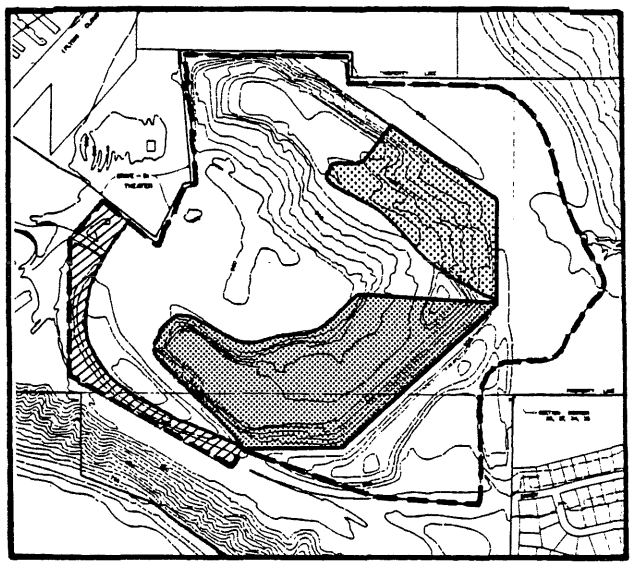


Figure 12. BERM ALIGNMENT

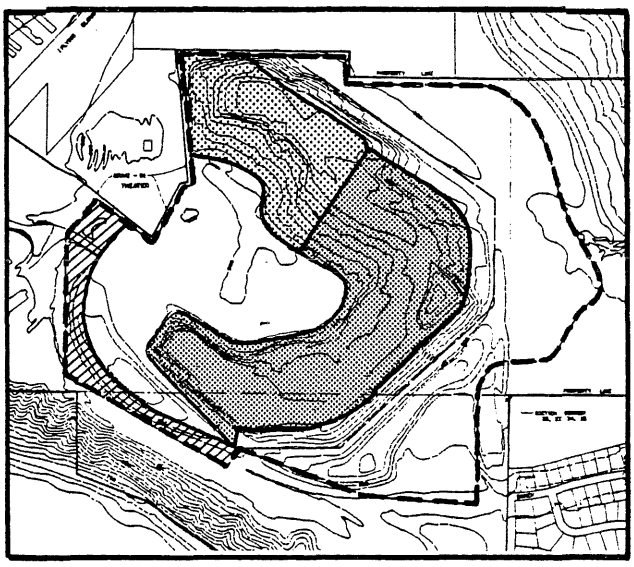
(BERM HEIGHT: 15 FEET)

Figure 13. EXPANSION PHASING PLAN

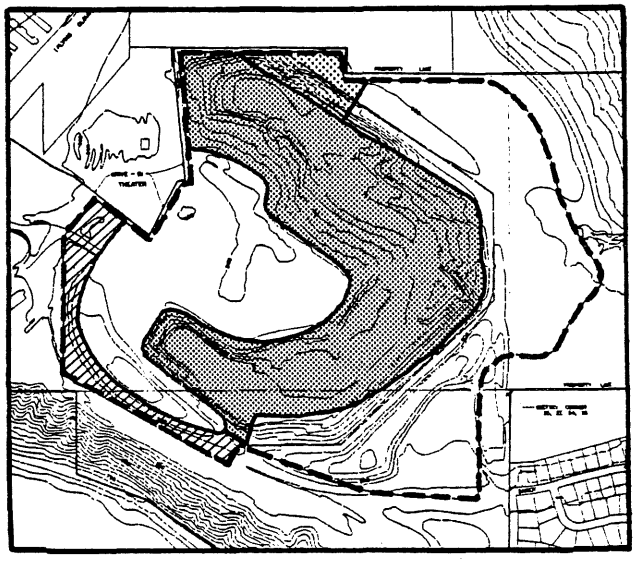
(STAGES 1-4)



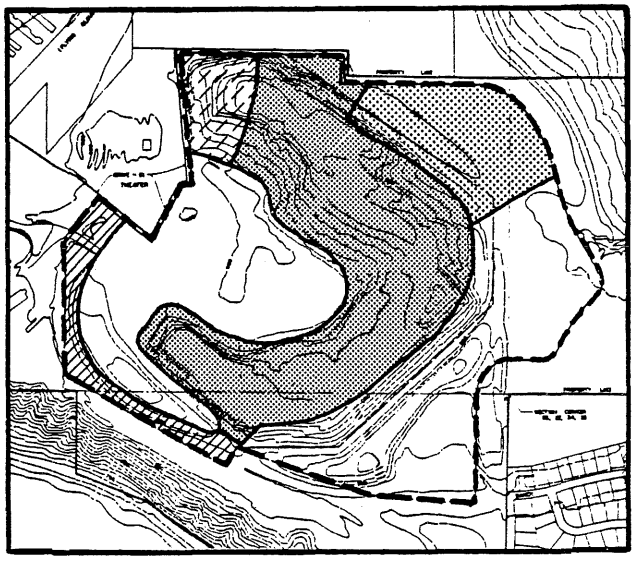
STAGE 1



STAGE 2



STAGE 3



STAGE 4

0 800 1600 Feet

N

Source: G.M. Sunde, Consulting Engineer

SOIL EXCAVATION AREA

MAJOR FILL AREA

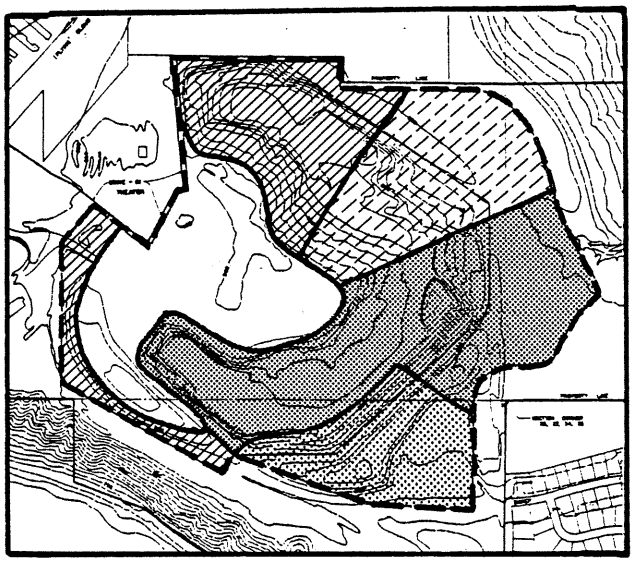
FINAL FILL AND COVER PLACEMENT IN PROGRESS

FILL COMPLETED

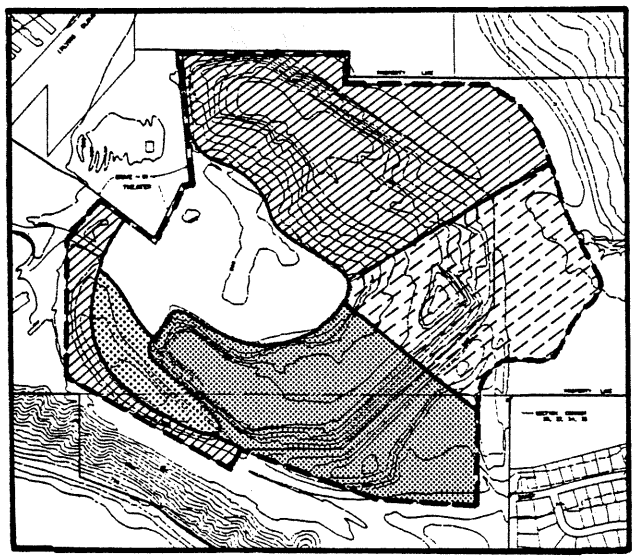
Figure 14. EXPANSION PHASING PLAN
(STAGES 5-8)



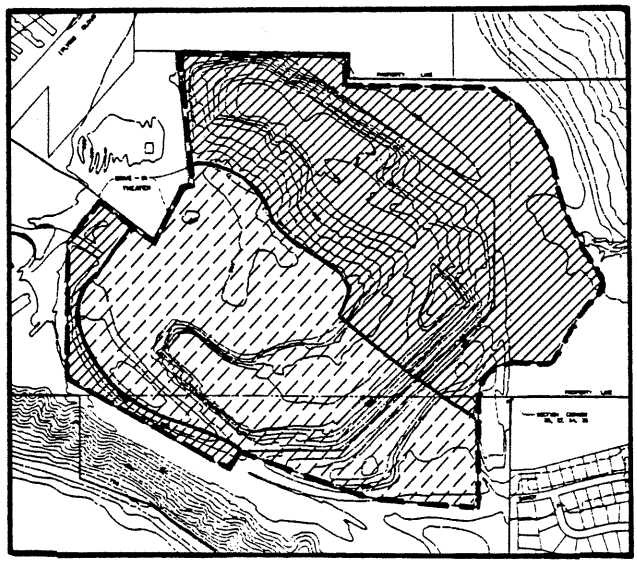
STAGE 5



STAGE 6



STAGE 7



STAGE 8

0 800 1600 Feet

N

Source: G.M.Sunde, Consulting Engineer

SOIL EXCAVATION AREA

MAJOR FILL AREA

FINAL FILL AND COVER PLACEMENT IN PROGRESS

FILL COMPLETED

Landfill	Remaining Life of Landfill (at 1,000 tons of waste/cu.yd.) of air space
Present remaining volume (refuse plus air space), 1,342 acre-feet under recodified permit (as of June 1982).	Approximately 2 years, 1 month (about February 1985)
Proposed expansion, 5,644 acre-feet	Approximately 7 years
Total remaining volume with expansion, 6,986 acre-feet	Approximately 9 years, 1 month (about February 1992)

Estimated project costs are:

Cost Item	Estimated Cost (1982 dollars)
General site excavation and seeding	$ 300,000
Pipeline movement	100,000
Berm landscaping and fencing	200,000
Groundwater quality monitoring system	75,000
Methane control system	200,000
Surface water drainage system modifications	30,000
Engineering costs	300,000
Total construction and related costs	$1,205,000

SITE OPERATIONS

The hours of operation, equipment, number of personnel and operating procedures are proposed to remain the same as at present.

PROPOSED ENVIRONMENTAL CONTROLS

Air Quality Controls

Woodlake proposes to implement a number of activities during the expansion to control fugitive dust. Water will be applied to roadway surfaces as necessary to control dust. As fill areas are completed the cover will be compacted, and revegetation will be undertaken promptly in accordance with MPCA regulations. Fast growing vegetative cover will be used.

Litter Control

Woodlakes's current measures to control litter will be extended to the expanded landfill. Control fences will be positioned around the working face and along the fence on the eastern perimeter to catch paper and other debris. Daily cover will be applied promptly. Employees will be assigned to inspect and clean up litter in areas on and off the landfill.

Groundwater Quality Protection

Groundwater quality upgradient, downgradient and in adjoining areas will continue to be monitored for the parameters discussed earlier. No additional monitoring wells or piezometers are proposed. The company's current plan to prohibit and control the disposal of hazardous waste will continue during the expansion.

Methane and Landfill Gas Control

Woodlake proposes to install either an active well and header system or a trench system along the entire eastern perimeter of the expansion area to intercept any migrating gas off-site. The system will be monitored constantly by probes. The control system will be installed in stages after the horizontal expansion area is excavated and before it is filled (see Landfill Gas section for details).

The collected gas will be transported to a motor/blower facility. A scrubber will remove excess moisture in the gas stream so as to protect the equipment from corrosion. The motor/blower will then draw off the gas to a flame arrestor and flare. The flare will be located at least 50 feet from the motor/blower and other structures (Figure 7). The gas will be flared for odor control, and it is not a safety measure.

The probes will be placed at several levels to measure methane concentrations and gas pressure. The system will also be inspected regularly and adjusted if necessary.

The existing passive clay control barrier along the southeast corner of the landfill will be removed during excavation of the expansion.

No control system is proposed along the south perimeter of the landfill which borders the bluffline (Figure 7).

The existing control system along the western perimeter of the landfill will be extended to ensure that potential methane gas migration from the additional fill placed in the north-central portion of the landfill is controlled. Five new wells similar to those already installed in the existing system will be constructed.

Noise Control

The proposer will construct a 15-foot high berm to reduce the noise impacts at adjoining lands (see Appendix C and Figure 12). Also, the landfill would be closed between 7 p.m. and 4 a.m. Equipment and vehicles used at the site will be inspected and maintained to minimize noise impacts. Setbacks along the perimeter of the landfill will be used to minimize noise impacts.

Surface Runoff/Erosion Control

Part of the expansion area drains at present into the low area to the east. Except for approximately 12 acres in the northeast portion of the expansion area which will continue to drain to the east, most of the precipitation will be detained on-site after the berm is constructed and the fill is completed. During fill operations runoff on the site will be directed to areas where refuse has not been deposited. The water will infiltrate the soil and/or

evaporate. As the existing landfill and expansion reach final elevations, runoff will be directed to drainage swales along the west and east perimeter outside the fill area and then to the detention pond in the southeast corner of the site (Figure 8). The pond will be increased to 32 acre feet capacity to handle runoff from a 100-year event for the expanded landfill. The pond will also serve as a settling pond to remove sediment from stormwater before it is discharged to the river valley. The runoff from the pond will continue to be discharged via pipe to the surge pond in the river valley where it will drain into adjoining marshy areas and abandoned ditches. The proposed berm and areas reaching final elevation will be planted with vegetative cover to minimize erosion. Erosion and gullying will be remedied if they occur.

Vector Control

The proposer will continue its present practice of disposing of refuse promptly and applying daily cover. An extermination program will be instituted when necessary.

Visual/Aesthetic Control

Woodlake originally proposed a seven-foot visual berm around the north and east perimeter of the expansion area. The height of the proposed berm has been increased to 15 feet (Appendix C). The completed berm will be planted with grass, shrubs and trees.

SECURITY/SAFETY PRECAUTIONS

No change in the existing fire, safety, security and sanitary procedures and facility is proposed. The proposer will extend the existing security fence around the entire expansion area.

Woodlake maintains general liablity and environmental impairment liability insurance coverage protecting against potential personal injuries and property damage which could occur incident to the operation of the landfill. In addition, an annually renewable performance/operations bond is maintained to insure the operation and closure for the landfill consistent with existing plans and County and Agency regulatory requirements.

The general or public liability insurance policy provides coverage against personal injury and property damage attributable to the operation of the landfill including loading and unloading, explosion, collapse, surface and underground operations, etc. Coverage is provided in excess of the limits specified in the county's ordinance for individual and aggregate damages. Automobile and truck public liability insurance is also provided governing owned and nonowned vehicles utilizing the site.

A performance/operations bond in the amount of $300,000 is provided to insure compliance of operations and closure consistent with the terms and conditions of the license, permit and applicable regulations. Under the bond, if the applicant fails or refuses to perform any of the operational requirements specified by the license, permit and applicable regulations, the county is authorized to correct the infraction or dereliction consistent with the regulatory requirements and receive reimbursement for expenses incurred from bond proceeds. Furthermore, the bond indemnifies the county for any and all losses, costs and charges which may occur incident to or because of any default by the

applicant in compliance with the operation and performance requirements. The bond is renewable annually and can be terminated following the transmission of 120 days advance notice. Landfill operations, however, cannot continue in the event that the requisite bond is not provided and maintained.

The landfill is also covered by an environmental impairment liability insurance policy procured by BFI. This policy provides coverage for property damage and personal injury liability attributable to nonsudden environmental accidents or impairments which occur at or eminate from the landfill. The types of environmnetal impairments covered include emission, discharge, dispersal, release, escape or seepage of smoke, vapors, soot, fumes, acid, alkalines, toxic chemicals, liquids or gases, waste materials and other pollutants. This insurance policy also provides reimbursement to BFI/Woodlake for clean up costs related to the removal, neutralization or clean up of any substance which has or could cause environmental impairment attributable to the landfill for which the company is liable. Currently coverage extends to $25 million per incident and $50 million aggregate. All costs and premiums related to this insurance are paid directly by BFI and indirectly from revenues generated by Woodlake from the operation of the landfill.

CLOSURE

A number of activities will take place during closure.

Under the proposed closure plan two feet of final cover consisting of clayey soils will be placed over each fill area. The final cover will be capable of supporting vegetative growth. Final cover will be placed within 90 days after closure, weather permitting, or as soon as appropriate weather allows such placement. Final cover will be graded, and short-term control measures will be used to minimize erosion and limit settlement. Final vegetative cover will be planted in the spring or fall planting seasons, consistent with the end use and landscaping plan for the site.

Following completion of all fill areas and establishment of final grades and elevations, the landfill will close. Regulating agencies must be notified before closure occurs so that the site can be inspected before personnel and equipment are removed. Within 30 days access to the site will be restricted by gates, fencing or other means, regular customers will be notified of the closing and a closure notice posted at the gate, a notice of closure published in a newspaper of general circulation, the landfill surface covered consistent with the landscaping plan, fine-grained soils placed for final cover, and the final grades and slopes established. Within 90 days after closure seeding, fertilizing and mulching take place in accordance with the final landscaping plan. Adverse weather may delay these activities.

A detailed description and a plat of the completed landfill will be recorded with the county Registrar of Deeds. The general type and location of waste will be described in these documents.

An independent registered professional engineer must certify that the landfill was closed in accordance with the closure plan. The regulatory agencies will review and approve the closure following receipt of the engineer's certification. These agencies include the city, the county and the MPCA.

If Woodlake proposes to close the landfill before the proposed expansion is completed, the company will notify the city, county and MPCA 120 days before the date of closure. Woodlake must then prepare an alternative closure plan and submit this to the permitting agencies 60 days before the date of closure. The plan must provide for erosion control, final grading, landscaping measures, the final cover to be used and include a schedule for completing these and other necessary activities.

POST CLOSURE

According to Woodlake's permit application, the landfill will be inspected and monitored following closure for 20 years or until such time as another public or private entity assumes this responsibility subject to the approval of the regulatory agencies. Woodlake will inspect the site and immediate environs at least every six months during the first 10 years, and at longer intervals thereafter. Leachate generation, the status of erosion, control measures, the condition of vegetation and methane movement gas will be evaluated. Woodlake will test ground water quality once every six months for the first five years after closure and every 12 months thereafter. Water will be tested for chlorides, pH, specific conductance, nitrates, nitrogen and chemical oxygen demand. The methane gas control system will be inspected at six month intervals.

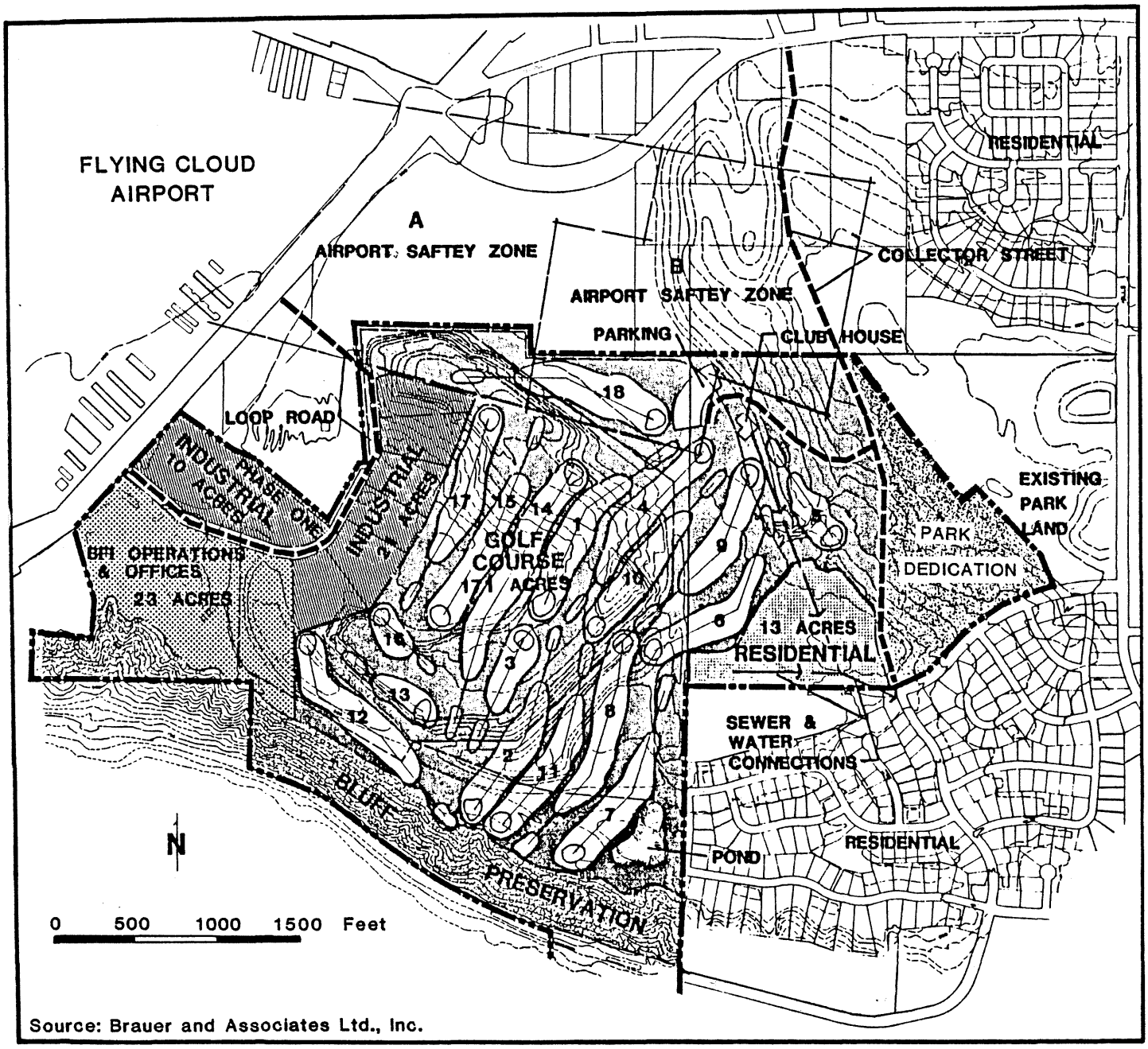
The final cover will be maintained consistent with the end use plan and final landscaping plan. Erosion problems will be corrected. The vegetative cover will be maintained, and vegetation will be replaced when dead or diseased. Records of the inspections and water quality tests will be available to regulatory agencies. Woodlake will submit a summary report of monitoring and care activities annually to regulatory agencies throughout the post-closure period. The agencies may choose to inspect the site.

Woodlake will maintain a $25,000 performance bond to ensure the performance of post-closure care and monitoring activities. The city and county will be designated as joint controllers of the bond fund which enables them to require the use of bond proceeds in the event that the applicant fails to perform required post-closure tasks. Woodlake will also maintain broad form liability insurance in the amount of at least $5 million against accident to persons and property. The insurance will be renewed annually for the specified post-closure period.

END USE PLAN

Woodlake has made a tentative proposal to the City of Eden Prairie to amend the approved planned unit development for the completed landfill (PUD-70-1) to include a golf course on most of the site, with a 13-acre residential area in the southeastern corner of the site. The river bluff and low area to the east of the site would be preserved as open space (see Figure 15). All of this property is owned by Woodlake.

Figure 15. PROPOSED END USE PLAN



Source: Brauer and Associates Ltd., Inc.

... POTENTIAL ENVIRONMENTAL IMPACTS ...

SITE HYDROGEOLOGY

This section is based on a technical report prepared on the hydrogeology of the Flying Cloud Sanitary Landfill by Morck entitled Hydrogeological Analysis of the Proposed Flying Cloud Sanitary Landfill Expansion April 1984 and evaluation by the Council staff of the information presented in the report in response to questions raised about the DEIS.

EXISTING ENVIRONMENT

Bedrock Geology

The bedrock structure beneath the Flying Cloud Sanitary Landfill is part of a shallow basin known as the Twin City Basin. The major bedrock aquifers are the Prairie du Chien-Jordan Group and the Mt. Simon-Hinckley Sandstones (2,3). These aquifers are all located beneath the landfill site (Table 6).

In the Minnesota River Valley, erosion of both the Prairie du Chien Group and the Jordan Sandstone has left a bedrock valley extending into the St. Lawrence Formation (4). Figures 16 and 17 show bedrock subcrop and a cross-section of the Minnesota River Valley through the landfill site.

Glacial Geology

The Wisconsin period glacial age, the most recent of four separate glacial ages in Minnesota, was critical in determining the present topography and soil types at the landfill site. The ice advances of the Wisconsin period deposited the yellowish-brown tills found beneath the site (5). As the ice retreated, sediment-laden runoff from the glacier flowed through the preexisting channel of the Minnesota River Valley. The sediment load from the runoff was deposited in the river valley. These deposits and outwash materials deposited by meltwater from the retreating glacier created the 900 feet MSL surface where the landfill is located.

As the glacier retreated further north it eventually formed Glacial Lake Agassiz near what is now the Red Lake area. The outlet for this lake was initially Glacial River Warren, which flowed through the Minnesota River Valley. This river eroded much of the previously deposited materials. It eventually formed a river valley deeper than the present Minnesota River Valley (6).

After Glacial Lake Agassiz found an outlet north to Hudson Bay, Glacial River Warren ceased to flow. The present day drainage area then began to supply water to the Minnesota River Valley. This slower and more sediment laden water has partially filled the valley and left the present day Minnesota River meandering through a valley much larger than what is required for present flow conditions (7).

The existing landfill is located in a surface depression or kettle created by the melting of a huge block of ice left behind by the glacier (Figure 18). The depression is approximately 800 feet MSL at its deepest point, or about 100 feet below the surrounding terrace (8).

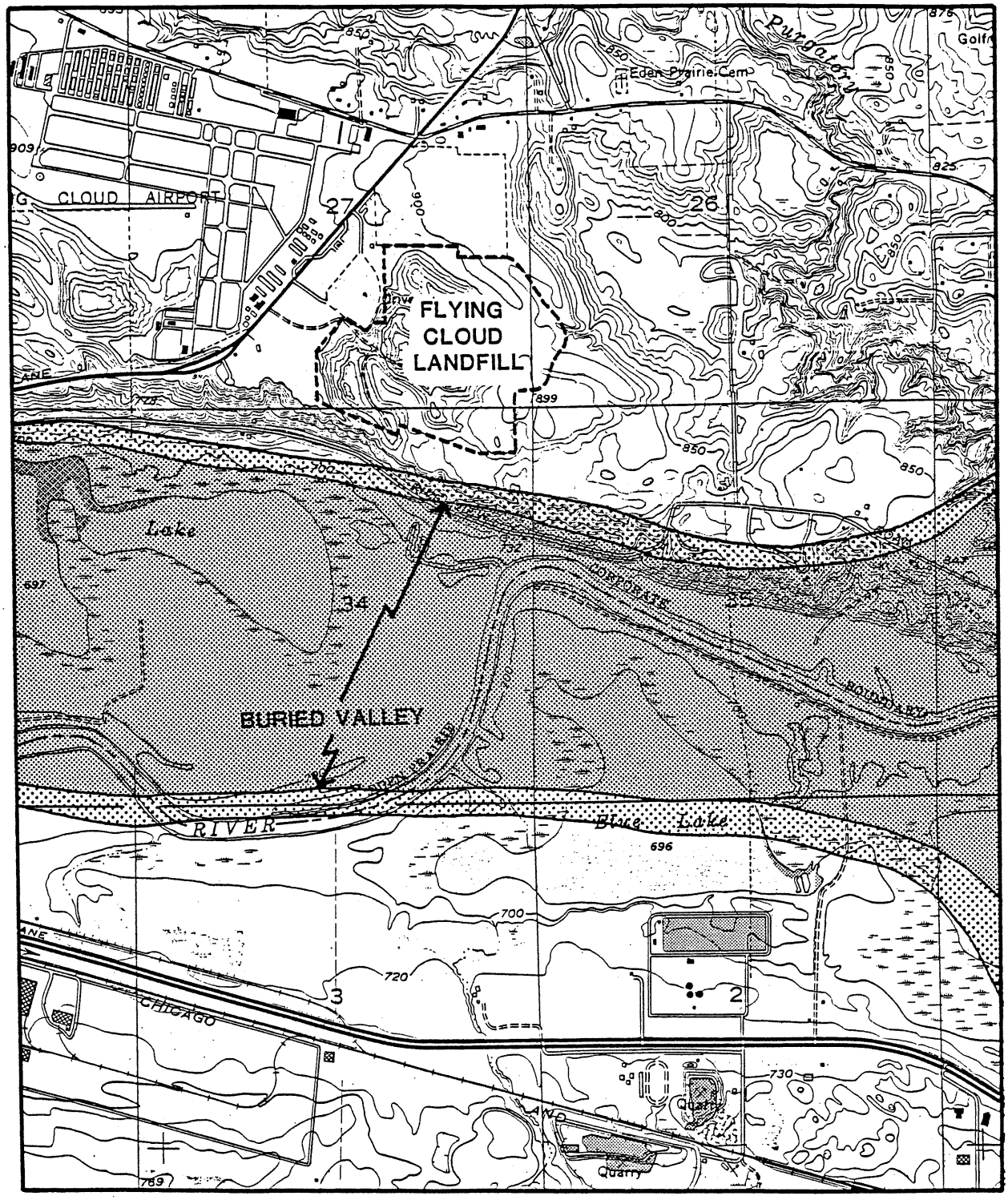
Table 6.

STRATAGRAPHIC COLUMN AT FLYING CLOUD SANITARY LANDFILL

System	Formation	MSL Elevation	General Description	Water-Bearing Characteristics
Quaternary	Alluvium and glacial till, outwash	890	Well graded coarse to medium sand, imbedded silt layer, lenses of silt, clay, glacial till	Some residential wells are finished in the drift aquifer
Ordovician	Prairie du Chien Group	650	Dolostone, buff, thin to thick bedded	Aquifer: high yields from fractures in dolostone and from
	Jordan Sandstone	575	Sandstone, light gray, medium to coarse grained, well sorted, poorly cemented	sandstone, principal aquifer of the Metropolitan Area
	St. Lawrence	485	Dolostone, gray to tan, silty to sandy	Confining bed
Cambrian	Franconia	430	Sandstone, greenish-gray, thin bedded, fine to coarse grained; upper aquifer is fine-grained sandstone	Aquifer: low yield Confining bed
	Ironton-Galesville Sandstone	300	Sandstone, light gray, poor to well sorted, fine to medium grained	Aquifer: medium to high yields
	Eau Claire	235	Sandstone, red, fine to medium grained, silty	Confining bed
	Mt. Simon Sandstone	150	Sandstone, light gray, fine to coarse grained	Aquifer: moderate to high yields, second most important
Pre-Cambrian	Hinckley Sandstone	0	Sandstone, tan, medium to coarse grained	aquifer of the Metropolitan Area

Source: Elevations based on G.M. Sunde, Hydrogeologic Analysis of the Flying Cloud Sanitary Landfill (1982). and descriptions and characteristics from R.E. Norvitch, Water Resources Outlook for the Minneapolis-St. Paul Metropolitan Area, Minnesota (1973).

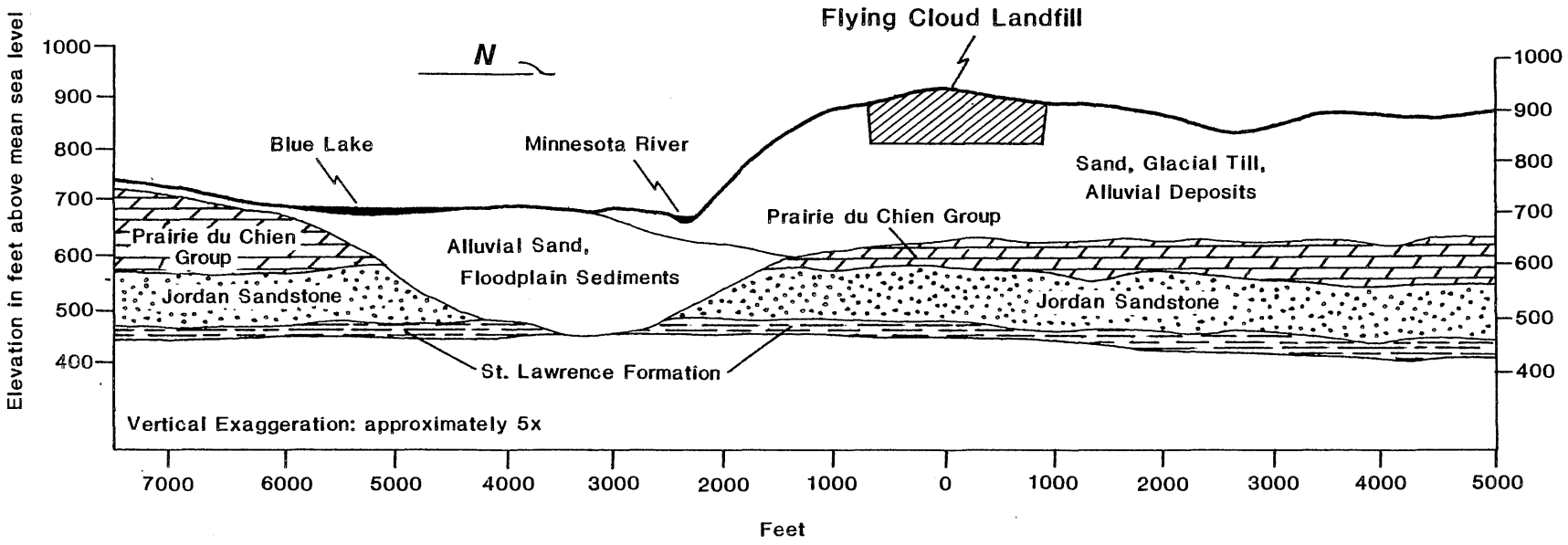
Figure 16. BEDROCK SUBCROP MAP



Source: G.M. Sunde, Consulting Engineer, Hydrologic Analysis of the Flying Cloud Sanitary Landfill (1982), p. 12.

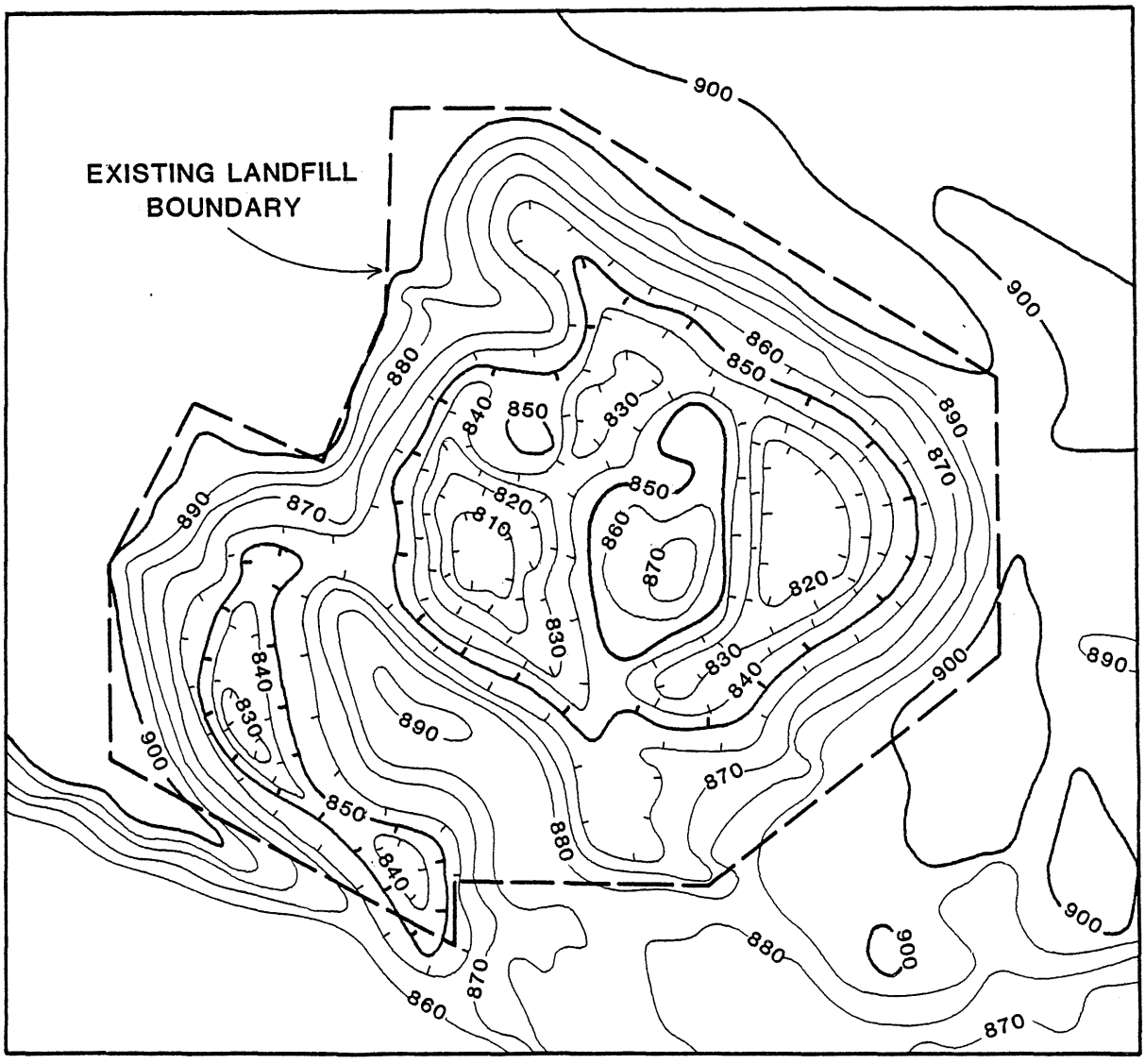
Figure 17. GEOLOGIC CROSS-SECTION

(N-S ON SECTION LINE AT WEST END OF BLUE LAKE)



Sources: GME Consultants, Inc.; G.M. Sunde, Consulting Engineer.

Figure 18. ORIGINAL CONTOURS



Source: U.S.G.S. 7.5-minute Eden Prairie quadrangle

Note: Contour interval = 10 feet; figures in feet above MSL.

Soils

From the surface of the river terrace at about 900 feet MSL to approximately 790 feet MSL are poorly graded sands or gravelly sands with little or no fine particles. Lenses of silty sands, silt, and clay also exist in this initial layer. From about 790 feet MSL to 693 feet MSL is an uneven layer of inorganic silts and very fine sands, silty and clayey fine sands, silt with lenses of inorganic clays, and sandy and silty clays. In addition, lenses of silty sands and clayey sands exist. These soils, hereafter referred to as the silt layer, have hydraulic conductivities in the range of 5.5×10^{-6} cm/sec, about three orders of magnitude less than the sandy layers. The silt layer thins out towards the west and south of the site; it is only 14 feet thick at wells W2 and W2a, compared to 96 feet at well W3, 74 feet at W4, and 90 feet at W8.

The presence of the silt layer beneath the depression has not been documented by soil borings. The deepest boring in the depression (TH3) goes to 760 feet MSL without detecting the silt layer. The approximate elevation of the silt layer in the area surrounding the depression is 790 feet MSL.

There are two possible explanations for this observation. The simplest explanation is that the silt layer does not exist beneath the depression. This is difficult to justify however, given the large hydraulic gradients that exist in the vertical direction. This is indicative of some underlying geologic formation that is highly resistant to flow.

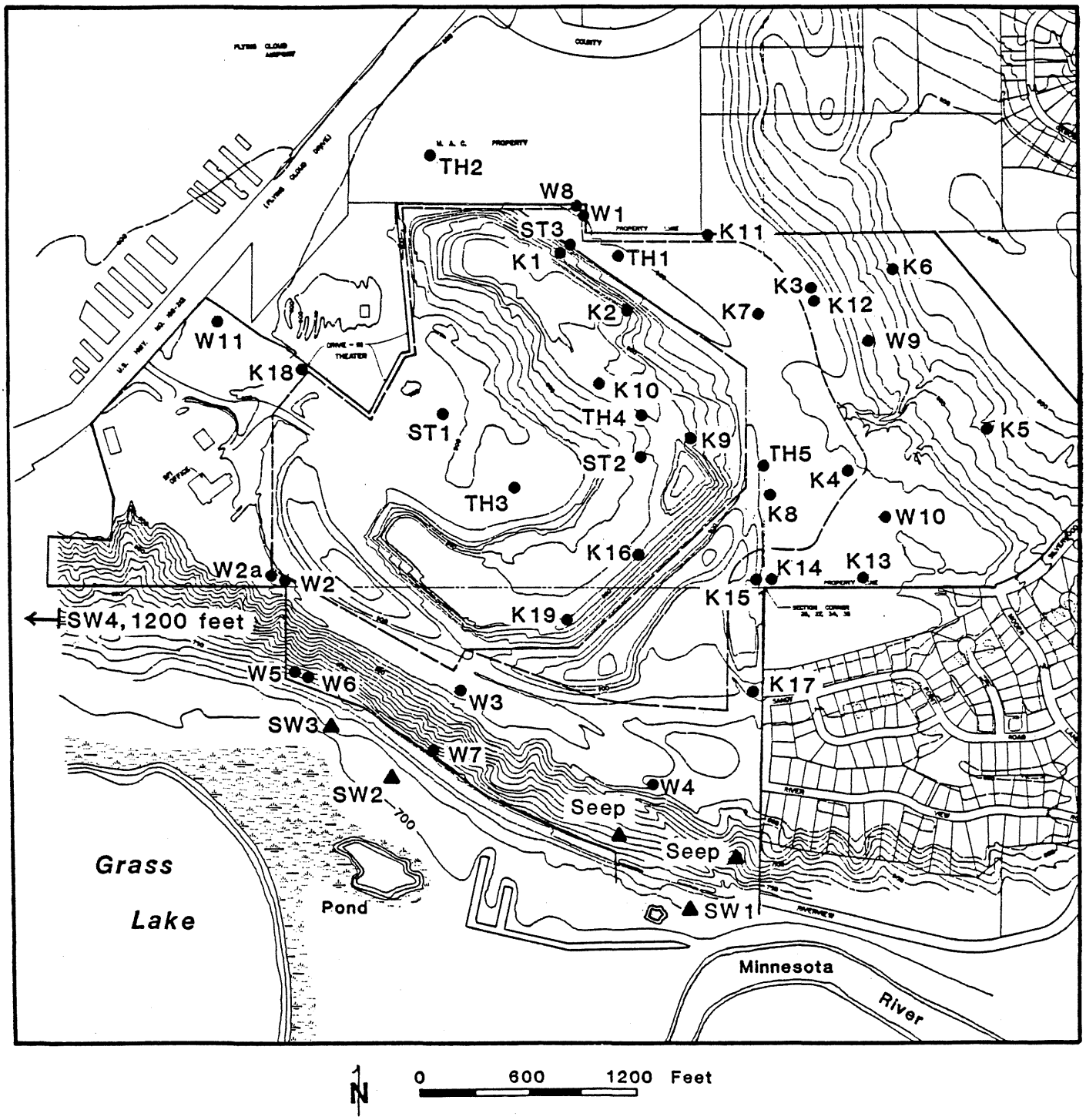
The other explanation assumes that the fine-grained soils that compose the silt layer were deposited on top of the ice block. The sandy soils of the outwash plain were deposited on top of the silt layer. As the ice block melted these soils settled and formed the present day kettle. This settling would have caused the silt layer to form a bowl-shaped depression centered beneath the kettle depression that forms the landfill site.

An exposure of the silt layer exists in the bluff above Riverview Rd. Along most of the bluff however the silt layer is not exposed. This is most likely a result of slumping of the overlying sandy materials along the slope. The seep shown in Figure 19 at the eastern end of the landfill flows over an exposure of glacial lobe till. The silt layer would be located above the till.

Additional data verifying the presence and conductivity of the silt layer beneath the depression is not available. Additional soil borings through the refuse would be necessary to obtain the soils data and the MPCA and Department of Health (DOH) have discouraged proposals to undertake this work in a discussion with their staff in July 1984. In accordance with state environmental review regulations, when the scientific data is unavailable, a worst-case analysis is to be included (6 MCAR 3.031D). A worst case analysis is included in the FEIS which assumes the silt layer is not present beneath the depression. The depression underlies most of the existing landfill and a portion of the horizontal expansion.

The presence of the silt layer under the proposed 42.4 acre horizontal expansion is confirmed by the soil borings and well logs from that area. An examination of this data below also shows that the top of the silt layer across the northern portion of the expansion site (transects H and J below) slopes to the west toward the existing landfill and to the south towards the river valley (transects B and C). (See Figure 17 Morck, Hydrogeological Analysis of the Proposed Flying Cloud Sanitary Landfill Expansion for transect locations.)

Figure 19.
LOCATIONS OF MONITORING WELLS, PIEZOMETERS, BORINGS, SPRINGS, AND SEEPS



Base Map Source: G.M. Sunde, Consulting Engineer.

● K18 – Monitoring well, piezometer, or boring

▲ SW1 – Open surface water seep used for sampling

The westward slope is fairly well defined by transect through the soils data. The north to south slope is less regular and appears to undulate (transects B and C). The surface of the silt layer across the southern portion of the expansion site appears to form a shallow trough sloping towards the river valley. The elevation of the northern rim of the depression is 798.7 feet MSL (K4) and the southern rim is at 781.1 feet (W4) at the bluff face. The eastern and western rims are at 791.6 feet MSL (K13) and 791.2 feet MSL (K16) respectively. The boring locations can be located geographically in Figure 19. Better data would help to define the extent of this trough or depression and its relationship to the movement of shallow groundwater.

Elevation of Top of Silt Layer on Horizontal Expansion Area

Transesct Monitoring Well, Piezometer or Soil Boring Locations

West to East Transects:

H	K7	K3	K12	
	790.6' MSL	791.7' MSL	793.2' MSL	
J	K8	K4		
	792.4' MSL	798.7' MSL		
K	K16	K15	K14	K13
	791.2' MSL	781.5' MSL	781.5' MSL	791.6' MSL

North to South Transects:

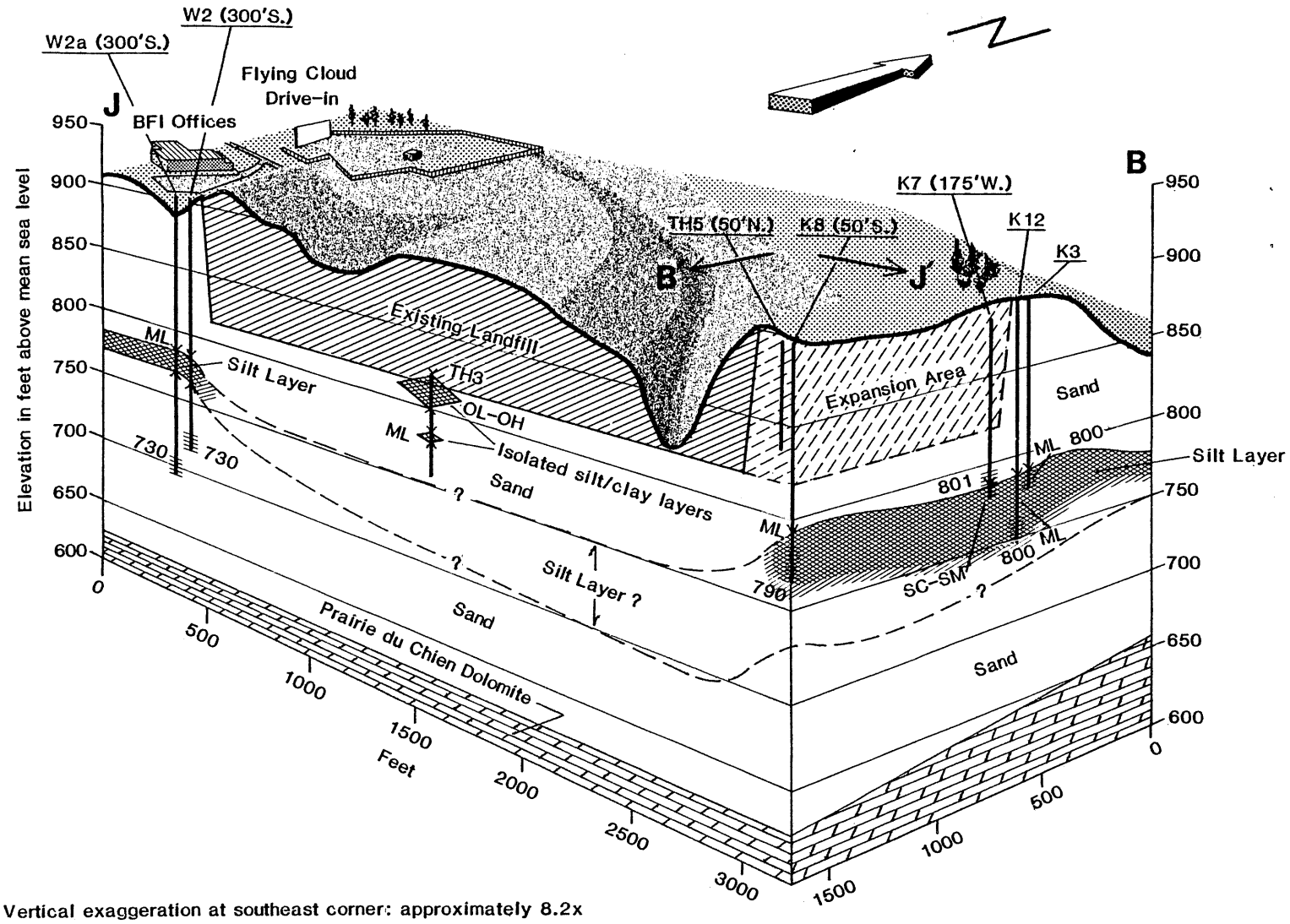
B	K3	K11	K8	K14	K15	K17
	791.7' MSL	793.2' MSL	792.4' MSL	781.5' MSL	781.5' MSL	785.3' MSL

C	K11	K9	W4
	794.9' MSL	Not detected	781.1' MSL

Figure 20 shows a three-dimensional view through the expansion area and the existing fill. The graphic generally shows the north-south undulation of the silt layer and the east-west slope towards the filled area.

The importance of this silt layer is that it could serve as a constraint to downward migration of leachate from the horizontal expansion area. This layer could be an integral part of a leachate collection system provided its character is properly documented. Obviously more data is needed to define the intracacies of the silt layer.

Figure 20.
GENERALIZED PERSPECTIVE GEOLOGIC CROSS-SECTION



Vertical exaggeration at southeast corner: approximately 8.2x

Groundwater

Flow Patterns

A strong hydraulic connection exists between the groundwater and the major rivers in the Metropolitan Area. Groundwater flows towards the major rivers in the Metropolitan Area and discharges naturally into them. This information is based on the ongoing groundwater monitoring program of the USGS. USGS monitoring wells indicate that the groundwater north and south of the Minnesota River near the project site moves toward the river valley. This is supported by the presence of seeps along the river valley (9).

The existing landfill and the proposed expansion are close to a discharge area for the Prairie du Chien-Jordan aquifer system and overlying glacial till. Percolating water will move predominantly downward through the silt layer and then horizontally to the river valley. Upon reaching the river valley, the flow direction will become upward as groundwater discharges into the valley marshes, Grass Lake and the Minnesota River (Figure 21).

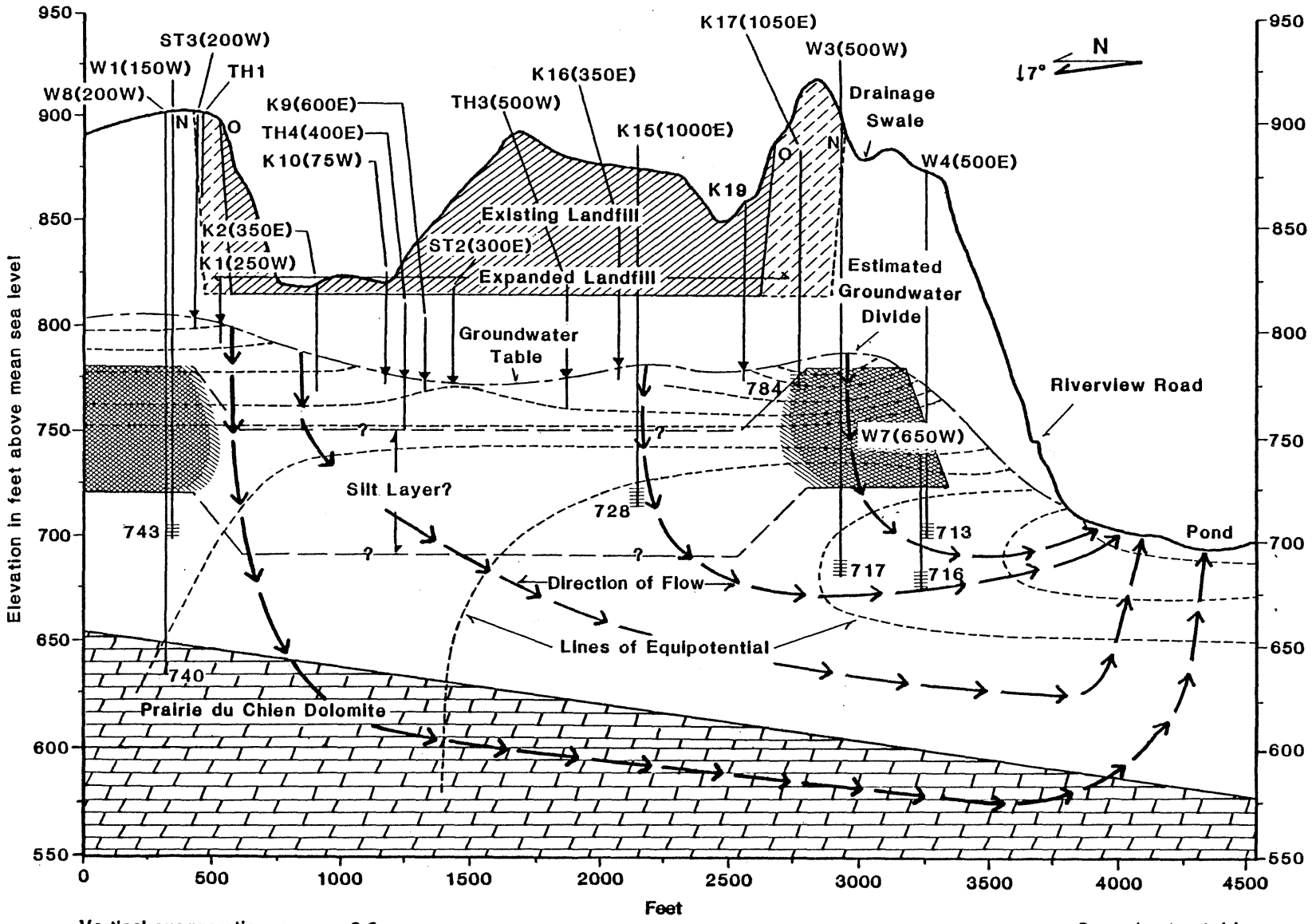
Figure 22 presents a plan view of the estimated shallow groundwater surface contours based on the point of first groundwater contact. In addition to the downward flow that is occurring, there is also a small horizontal gradient moving groundwater toward the center of the site. This movement is minor compared to the vertical flow. Groundwater flow on the eastern side of the divide will have an initial component of flow direction east-southeast before it moves downward and towards the river valley. This water could also eventually reach the Prairie du Chien-Jordan aquifer in the same manner as groundwater flowing toward the center of the site. How far this water will move to the east depends on the slope of the silt layer and how fast it is able to move downward through the silt layer before reaching the Prairie du Chien-Jordan aquifer.

Likewise, water percolating into the south side of the southern groundwater divide will flow south toward the Minnesota River. The flow pattern for water on the south side of this groundwater divide is down toward the Prairie du Chien-Jordan aquifer beneath the face of the bluff. This flow may also emerge on the bluff face in the form of seeps. Two seeps have been confirmed below the eastern end of the site (Figure 19).

The groundwater surface contours drawn in Figure 22 were based on fairly good data in the north and east areas of the site, but poor data in the center, south and west. The two data points (TH 3 and ST 1) that occur in the presently filled area were taken in 1970 and 1976, respectively, and used in this report for lack of better data. Figure 22 represents an estimate of the contours based on the fact that the first contact of the water table, when Well W-3 was drilled, was at an elevation of approximately 790 feet. The current recorded water level of approximately 717 feet is assumed in Figure 22 to be the pressure head at the depth of screening (670 feet).

A report prepared by G. Sunde for Woodlake in 1983 maps the contours differently, based on first contact with the water table, (10). The contour lines are discontinued along the southern edge or bluff where the data is unclear and limited. The lines imply more of a flow-through behavior to the southwest.

Figure 21. GENERALIZED GROUNDWATER FLOW PATTERN



Vertical exaggeration: approx. 8.2x

TH3(500W) Well designation (distance and direction from cross-section)

728 Potentiometric surface at well screen (in feet above MSL)

Groundwater table

Well screen

Extent of known silt layer

Figure 22.
ESTIMATED GROUNDWATER TABLE SURFACE CONTOURS



N

0 600 1200

Feet

788 Groundwater Table, elevation in feet above MSL.

Estimated Groundwater Divide

Base Map Source: G.M.Sunde, Consulting Engineer

The discrepancy in the drawing of contour lines, however, is not as important as the overall finding of the figures relative to shallow groundwater movement. Both figures show that a general shallow groundwater gradient exists to the southwest. Figure 22 shows some flow back from the near southwest, into the landfilled area, whereas Sunde's interpretation would have this water escaping without flow back through the fill.

Data are not available to make a convincing case for either shallow groundwater flow scenario and additional data cannot feasibly be collected, given the fact that the landfilled material would need to be drilled through. The staffs of both MPCA and MDH have verbally discouraged the idea of drilling through the landfill, suggesting that permission to drill would be denied because of the threat that the new conduit would create. The worst case scenario developed later uses the Figure 22 situation. Substitution of the Sunde interpretation would not alter, markedly, the results of this scenario.

Flow within the Prairie du Chien formation is mapped in the report for Woodlake by Sunde (1983), in a Hickok report prepared for the Metropolitan Airports Commission (11), and in regional groundwater studies by USGS (1973 and 1984) (12). Data from residential wells was used to establish general potentiometric lines to the east of the site. Potentiometric levels from the MAC study and from the monitoring of wells on the landfill site, establish the flow lines through the landfill site. The attached figure (Figure 23) reflects the potentiometric surface of the Prairie du Chien through the site. Flow in the dolomite is generally south-southwest. Regional groundwater flow maps prepared by the USGS show that the Prairie du Chien formation in the vicinity of the landfill discharges to the Minnesota River Valley at a potentiometric level of between 700-715 feet (13). Flow does not continue southward across the Minnesota River Valley.

Groundwater Levels

Variations in the potentiometric surface of the groundwater are monitored by periodic recordings of water levels in the monitoring wells and piezometers surrounding the landfill site. Most levels have stayed fairly constant (Table 7). Two notable exceptions were recorded at W1 and W4. These variations may be caused by leakage of water along the well casing to the well screen due to poor or non-existent grouting of the well. If this occurred the recorded potentiometric surface would correspond to the surface of the groundwater table. These two wells eventually sealed themselves then began recording potentiometric levels at the depth of the well screen rather than at the groundwater table.

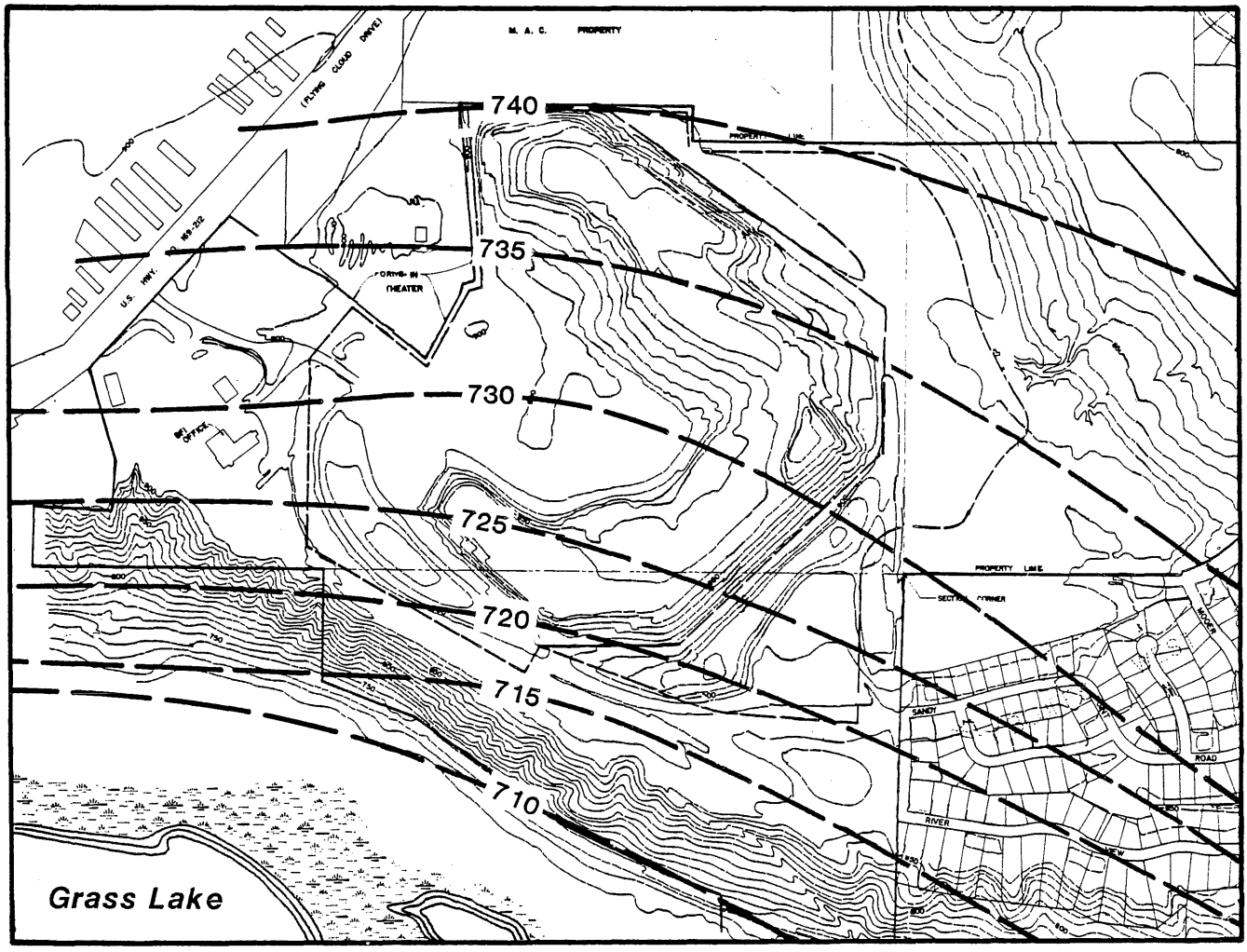
Groundwater Quality and Leachate Monitoring

Leachate is a solution of suspended and dissolved organic and inorganic material produced when water passes through refuse and extracts soluble material from it (14,15). It is leachate that contaminates groundwater aquifers and surface waters in areas of groundwater discharge.

The existing leachate monitoring system consists of 11 wells (Figure 19). Well W11 serves as a control near the groundwater table. Wells W9 and W10 monitor the shallow groundwater east of the site. Wells W1 and W8 are the control wells for the groundwater beneath the silt layer. The remaining wells (W2a-W7) are located down-gradient and are finished in the saturated sand layer or the Prairie du Chien dolomite.

Figure 23.

PRAIRIE DU CHIEN-JORDAN POTENTIOMETRIC LEVELS



Note: All figures in feet above mean sea level

Source: G.M. Sunde, Consulting Engineer.

N

0 800 1600'

Feet

— · 735 · — Prairie du Chien-Jordan Potentiometric Contours

Table 7.

SUMMARY OF WATER LEVEL MEASUREMENTS FOR
MONITORING WELLS AND PIEZOMETERS

	04/26/79	05/24/79	07/11/79	01/17/80	03/25/80	05/20/80	08/18/80	02/06/81	04/13/81	09/04/81	11/06/81	02/82	07/82	10/82	01/83	02/83	03/04/83	04/04/83	04/15-22/83	05/04/83
W1		788	789	785	785	787	786	784	786	786	786		779	777	778		743		744	746
W2	729	730	731	733	733	732	732	731	731	731	731						730		730	
W2a													729	730	731		730		730	731
W3	716	717	716	714	714	714	716	715	715	715	715		713	712	715		715		717	717
W4	745	762	762	738	738	759	758	758	760	760	760		716	715	716		715		714	719
W5													722	714	714		716		718	718
W6													716	715	715		717		719	720
W7													714	712	712		714		716	718
W8													740	739	740		740		741	739
W9																		791	791	790
W10																		790	790	789
W11																		799	799	798
K3												800					800		800	
K4												794					795		795	
K5													789				789		789	
K6													791				790		791	
K7													801				800		801	
K8													794				794		794	
K11													803				802		802	
K12																806	800		800	
K13																789	788			
K14															786		787		787	
K15																786	730		728	
K17															784		784		784	
K18															793		792		792	

Present groundwater quality as determined from the monitoring well program is summarized in Table 8. Chloride was chosen as an indicator of leachate because it is chemically unreactive in the groundwater environment (16). No obvious trends are apparent (Figure 24). However, it does appear from marked increases in chloride for W2 and W3 in late 1981 and early 1982 that some weak leachate could have moved through. The dip in middle 1982 appears to be relatively chloride-free groundwater moving through or a mistake common to all the analyses for that quarter.

In April/May 1982 a series of organic compounds were detected in trace amounts in some of the monitoring and private wells around the site (Table 9). In May 1982 trace quantities of one organic (trichlorofluromethane) were detected in four open seeps. The latest analysis (May 1984) of samples from several monitoring wells showed none of the earlier compounds, but detected small, but not quantifiable, amounts of two other organics--benzene and toulene. These monitoring wells are located downgradient (2A), upgradient (W-8 and W-9), easterly (W-10) and westerly (W-11) of the existing site.

The evidence is inconclusive as to whether or not the source of these organics is the landfill. There are other possible, but unverified, sources of organics in the area. If landfill leachate is the source, a number of other compounds, ions and trace elements would be expected to be found in higher concentrations. However, the MPCA has found volatile organics like toluene, methylene chloride, trichloroethylene, dichloroethylene, dichloroethane and benzene to be ubiquitous in municipal landfill leachate (17). Continued monitoring would help to determine whether the landfill is the source of the organics.

POTENTIAL LANDFILL IMPACTS

Groundwater Levels and Flow Patterns

When the landfill expansion is completed and at final contours, the surface configuration of the groundwater table can be expected to change. Groundwater table elevations surrounding the site may increase for three reasons. First, the permeability of the surrounding surface soils is not expected to change as a result of landfill activities. Thus, infiltration rates should remain the same and support the current water table levels. Second, the final cover over the landfill is required to have at least one foot of soil with a hydraulic conductivity of not more than 2×10^{-6} cm/sec, which is approximately three orders of magnitude less than the surrounding soils. Therefore, precipitation will be less likely to infiltrate through this soil and will runoff to the periphery of the site where it will infiltrate. Finally, the site's final slopes will promote runoff from the site to the surrounding surface. The end result will be a decrease of infiltration through the site and an increase of infiltration around the site. Even if runoff does not increase significantly, the less permeable final cover soil will slow percolation rates to the groundwater table beneath the site.

The proposer's expansion plan includes extending the boundaries of the existing landfill to the east. This expansion will extend across the groundwater divide that exists approximately 600 feet east of the current landfill boundary (Figure 22). The landfill expansion will alter the surface soil properties and topography and, therefore, infiltration and percolation rates, and thus the position of the divide. For the reasons mentioned in the previous paragraph the divide would likely shift to the east. However, it is unreasonable to expect that the divide will move far enough east to cause all groundwater

Table 8.

COMPILATION OF WATER QUALITY TEST RESULTS FOR
MONITORING WELLS AT FLYING CLOUD SANITARY LANDFILL

Date	Chemical Oxygen Demand mg/L	Chloride mg/L	Ammonia Nitrogen mg/L as N	Nitrate Nitrogen mg/L as N	Specific Conductance umhos/cm at 25° C.	pH
Well W-1						
04/26/79	211	16	0.56	--	462	7.8
05/24/79	93	14	0.16	--	594	7.7
07/11/79	31	16	0.26	--	660	7.7
01/17/80	10	23	--	3.5	345	7.4
03/25/80	38	13	--	2.31	341	7.2
05/20/80	53	12	0.26	2.10	320	7.4
08/18/80	49	14	--	2.05	442	7.5
10/13/80	45	12	--	0.77	410	7.4
02/06/81	31	11	--	1.42	314	7.4
04/13/81	98	10	0.01	--	360	7.2
09/04/81	42	10	--	0.46	420	7.3
11/06/81	58	9	0.16	--	315	6.9
02/17/82	53	4	--	0.44	461	7.8
04/13/82	28	2	--	0.46	430	7.5
07/20/82	40	5	< 0.10	--	500	7.6
10/05/82	< 10	8	< 0.10	--	490	7.3
01/21/83	10	6	< 0.10	--	500	7.5
05/04/83		7				
Well W-2						
04/26/79	65	13	0.17	--	1,180	6.5
05/24/79	8	16	0.10	--	1,260	7.6
07/11/79	35	18	0.14	--	1,452	6.7
01/17/80	24	19	--	3.50	850	6.6
03/25/80	116	23	--	2.37	1,000	6.3
05/20/80	114	40	0.55	2.44	1,200	6.3
08/18/80	233	39	--	1.49	1,600	6.4
10/13/80	157	28	--	1.39	1,400	6.3
02/06/81	300	29	--	2.17	1,070	6.5
04/13/81	550	28	1.27	--	1,200	6.4
09/04/81	66	37	--	0.71	1,200	6.2
11/06/81	79	35	0.18	--	790	5.9
02/17/82	29	28	--	0.92	1,330	6.5
04/13/82	160	6	--	1.74	1,200	6.6
Well W-2A						
07/28/82	4	2	< 0.10	--	590	7.3
10/04/82	<10	3	< 0.10	--	550	7.1
01/20/83	20	2	< 0.10	--	560	7.3
05/04/83		< 1				
Well W-3						
04/26/79	68	14	0.35	--	528	7.2
05/24/79	80	14	0.18	--	536	7.3
07/11/79	23	12	0.20	--	607	7.4
01/17/80	16	12	--	2.90	338	7.2
03/25/80	55	12	--	1.57	330	7.0
05/20/80	40	12	0.16	1.00	340	7.3
08/18/80	49	14	--	2.03	580	7.3
10/13/80	61	13	--	1.50	430	7.1
02/06/81	106	13	--	2.69	339	7.4
04/13/81	84	13	0.14	--	390	6.9
09/04/81	66	13	--	1.82	470	7.1
11/06/81	72	14	0.04	--	360	6.7
02/17/82	53	23	--	1.51	540	7.3
04/13/82	31	4	--	1.60	410	7.7
07/21/82	15	13	< 0.20	--	710	7.2
10/01/82	32	13	< 0.10	--	730	7.1
01/18/83	10	11	0.10	--	860	7.2
05/04/83		12				

Table 8 (cont.)

COMPILATION OF WATER QUALITY TEST RESULTS FOR MONITORING WELLS AT FLYING CLOUD SANITARY LANDFILL

Date	Chemical Oxygen Demand mg/L	Chloride mg/L	Ammonia Nitrogen mg/L as N	Nitrate Nitrogen mg/L as N	Specific Conductance umhos/cm at 25° C.	pH
Well W-4						
04/26/79	168	11	1.30	--	343	7.4
05/24/79	42	9	0.62	--	561	7.5
07/11/79	31	1	0.30	--	554	7.6
01/17/80	16	2	--	2.90	290	7.4
03/25/80	28	2	--	1.57	295	7.2
05/20/80	71	5	0.20	1.00	310	7.5
08/18/80	45	5	--	2.03	430	7.5
10/13/80	66	3	--	1.50	392	7.5
02/06/81	52	3	--	2.69	309	7.6
04/13/81	77	3	0.03	--	340	7.1
09/04/81	66	7	--	1.82	410	7.3
11/06/81	55	4	0.08	--	310	7.0
02/17/82	49	3	--	0.06	459	7.5
04/13/82	41	1	--	0.23	410	7.7
07/21/82	< 10	3	< 0.20	--	490	7.7
10/01/82	< 10	4	< 0.10	--	460	7.3
01/18/83	10	2	< 0.10	--	540	7.6
05/04/83		3				
Well W-5						
01/??/82	90	1	0.10	0.50	580	7.4
04/13/82	82	< 1	--	0.59	455	7.7
07/21/82	< 10	2	< 0.20	--	500	7.4
10/05/81	< 10	6	< 0.10	--	580	7.2
01/21/83	20	2	< 0.10	--	580	7.4
05/04/83		1				
Well W-6						
07/28/82	6	1	< 0.10	--	530	7.3
10/05/82	< 10	4	< 0.10	--	530	6.9
01/21/83	< 10	1	< 0.10	--	540	7.2
05/04/83		< 1				
Well W-7						
07/28/82	2	17	< 0.10	--	960	7.1
10/05/82	12	19	< 0.10	--	930	6.8
01/21/83	< 10	19	< 0.10	--	1,100	6.9
05/04/83		17				
Well W-8						
07/28/82	22	2	< 0.10	--	600	7.6
10/05/82	12	3	< 0.10	--	610	7.0
01/21/83	10	1	< 0.10	--	610	7.3
05/04/83		1				
Well W-9						
05/04/83		28				
Well W-10						
05/04/83		2				
Well W-11						
05/04/83		1				

Source: G.M. Sunde, Assessment of Soils, Geology and Hydrogeology for Flying Cloud Sanitary Landfill (Bloomington, MN, 1982). p. 66.

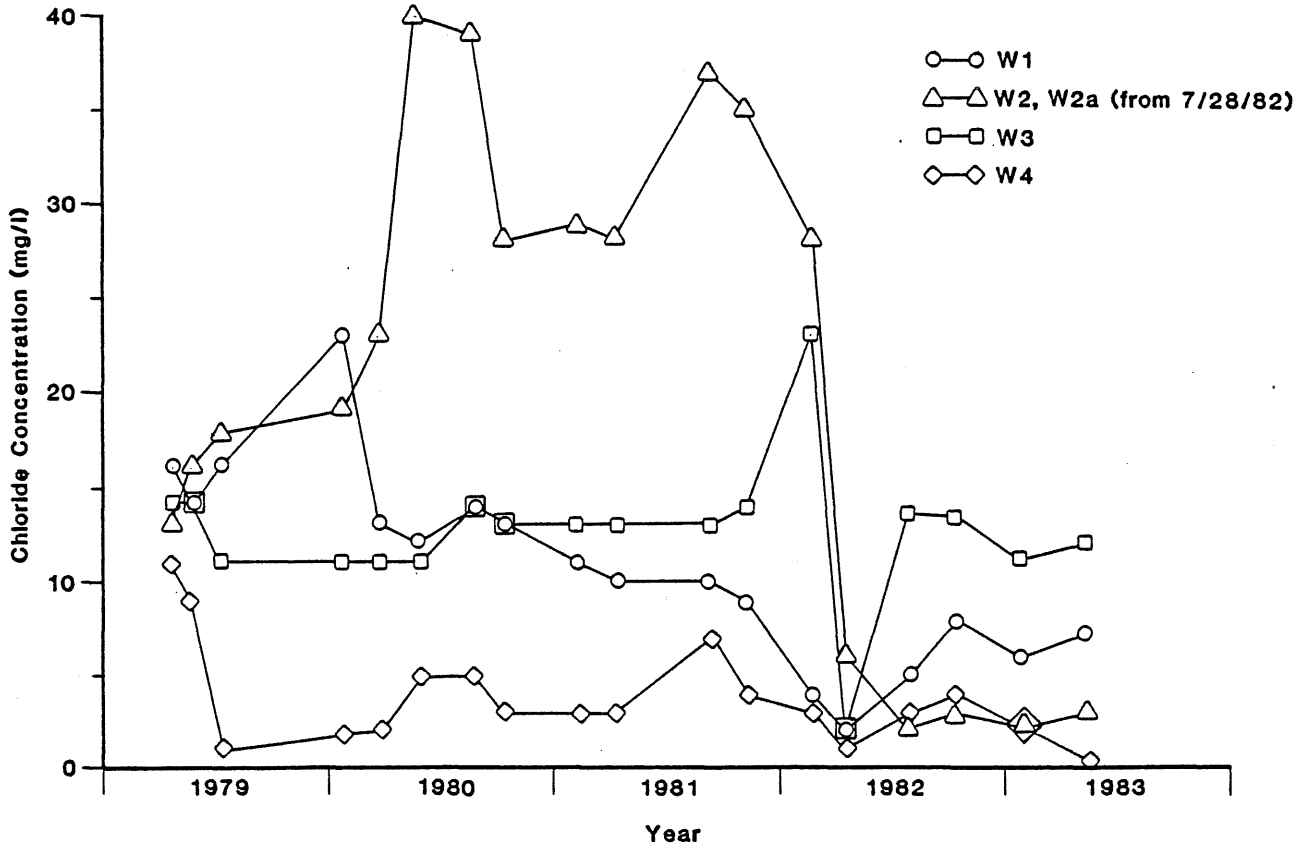


Figure 24. CHLORIDE CONCENTRATION CURVES

Source: Data plot from Table 8.

Table 9.
SUMMARY OF SELECT ORGANICS AT FLYING CLOUD LANDFILL, 1982-1984.
(parts per billion)

Well / Organic Compound	W1				W2				W2a				W3				W5				W6				W7				W8			
	1982[1]	May 1983	Oct. 1983	May 1984	1982[1]	May 1983	Oct. 1983	May 1984	1982[1]	May 1983	Oct. 1983	May 1984	1982[1]	May 1983	Oct. 1983	May 1984	1982[1]	May 1983	Oct. 1983	May 1984	1982[1]	May 1983	Oct. 1983	May 1984	1982[1]	May 1983	Oct. 1983	May 1984	1982[1]	May 1983	Oct. 1983	May 1984
Methylene chloride	D				238				-	0.1	1	-	D				D				-				50				-	0.1	1	-
Trichloroethylene	-				93				7	0.1	0.5	-	D				-				6				11				5	0.1	0.5	-
Tetrachloroethylene	-				72				-	0.1	0.5	-	-				-				-				3				-	0.1	0.5	-
Dichloroethane	-				18				-	0.1	0.2	-	D				-				-				3				-	0.1	0.2	-
Trichlorofluro-methane	-				18				3	0.1	0.4	-	D				15				3				6				2	0.1	0.4	-
Trichloroethane	-				13				-	0.1	0.8	-	D				D				-				2				-	0.1	0.6	-
Dichloroethylene	-				10				-	0.1	0.2	-	-				-				-				1				-	0.1	0.2	-
Benzene	-				-				-	0.1	0.7	D	-				-				-				-				-	0.1	0.6	D
Toluene	-				-				-	0.1	0.5	D	-				-				-				-				-	0.1	2.6	D

Well / Organic Compound	W9				W10				W11				SW1				SW2				SW3				SW4			
	1982[1]	May 1983	Oct. 1983	May 1984	1982[1]	May 1983	Oct. 1983	May 1984	1982[1]	May 1983	Oct. 1983	May 1984	May 1982	May 1983	Oct. 1983	May 1984	May 1982	May 1983	Oct. 1983	May 1984	May 1982	May 1983	Oct. 1983	May 1984	May 1982	May 1983	Oct. 1983	May 1984
Methylene chloride	-	0.1	1	-	-	0.1	1	-	-	0.1	1	-	-				-				-				-			
Trichloroethylene	-	0.1	0.5	-	-	0.1	0.5	-	-	0.1	0.5	-	-				-				-				-			
Tetrachloroethylene	-	0.1	0.5	-	-	0.1	0.5	-	-	0.1	0.5	-	-				-				-				-			
Dichloroethane	-	0.1	0.2	-	-	0.1	0.2	-	-	0.1	0.2	-	-				-				-				-			
Trichlorofluro-methane	-	0.1	0.4	-	-	0.1	0.4	-	-	0.1	0.4	-	12				14				11				11			
Trichloroethane	-	0.1	0.5	-	-	0.1	0.6	-	-	0.1	0.6	-	-				-				-				-			
Dichloroethylene	-	0.1	0.2	-	-	0.1	0.2	-	-	0.1	0.2	-	-				-				-				-			
Benzene	0.6	0.6	0.5	D	-	0.1	0.8	D	-	0.1	0.5	D	-				-				-				-			
Toluene	0.8	8.0	0.6	D	-	0.1	3.7	D	-	0.1	2.0	D	-				-				-				-			

[1] 1982 represents a mean value for April and May data.
D Detected but cannot be quantified.
- None detected.
All others not tested.

Sources: Minnesota Pollution Control Ageny; Woodlake Sanitary Services.

beneath the expanded landfill to flow toward the center of the site. The potential implications of the divide's movement are discussed in the section on leachate movement.

The effect of the expanded landfill on the Prairie du Chien-Jordan aquifer potentiometric surface and flow pattern should be insignificant. The principal recharge to the Prairie du Chien-Jordan aquifer occurs in the subcrop areas where the bedrock is in direct contact with the overlying glacial drift. This area is estimated to be 1,350 square miles (18). The surface area of the expanded landfill is 148 acres or 0.23 square mile and thus occupies less than .02 percent of the recharge area. There will be no impact on water levels in local wells.

Groundwater Quality

Leachate Volumes

The volume of leachate generated is a function of:

1) percolation,

2) precipitation

3) direct runoff

4) actual evapotranspiration; and

5) change in soil moisture storage.

Calculations to develop leachate volume estimates for this FEIS are presented in a separate technical report (19). Results of calculations are presented in Table 10. Total percolation is estimated to be 1.5 inches per year. This occurs predominantly during March and April, which is consistent with results obtained by other investigators (20).

To obtain a range of possible percolation rates, a separate set of calculations were made that assumed no direct runoff. This represents a worst case where all precipitation infiltrates into the cover soil. These calculations gave a result of 5.9 inches per year, again occurring predominantly in the spring. The approximate amount of leachate generated for the present site and the proposed expansion are found in Table 10.

Table 10
YEARLY VOLUMES OF LEACHATE GENERATED

	Surface Area	Percolation (in./year)	Volume of Leachate (acre-feet/year)
Existing site	105 acres	1.5 - 5.9	13.1 - 51.6
Proposed site	148 acres	1.5 - 5.9	18.5 - 72.8
Horizontal expansion area only	42.4 acres	1.5 - 5.9	5.4 - 21.2
Expansion area east of groundwater divide	8 acres	1.5 - 5.9	1.0 - 3.9

The above calculations are for the completed landfill expansion. Since the landfill will be in operation for about seven years prior to receiving its final cover, an estimate was also made of percolation values during this period. A percolation rate of 21.1 inches per year was derived for these intermediate conditions.

Percolation does not initially generate leachate, however, because the refuse is not at field capacity. The time needed to reach field capacity was estimated to be 12 years from the time of refuse burial (21).

Leachate Movement

Leachate generated by the landfill will enter the groundwater system according to the pattern discussed earlier. This movement will be predominantly vertical to the deep aquifer, horizontal toward the Minnesota River Valley, and then upward into the valley. Flow velocity is a function of hydraulic gradient, porosity and hydraulic conductivity.

Two analyses of leachate movement from the expansion are included in the FEIS. In the first analysis it is assumed that the silt layer is present beneath the depression underlying the existing landfill site and the horizontal expansion. Because data confirming the presence of the silt layer beneath the existing landfill is unavailable, a second, worst case analysis is also presented. For the purposes of the worst case analysis it is assumed that the silt layer is not present beneath the depression underlying the existing landfill site. The alternatives are explained in more detail below. Travel times and the approximate dates of arrival are presented for both the existing landfill which opened in 1970 and the proposed expansion which would begin in 1985. The purpose is to indicate the relationship of the two projects in terms of the timing and duration of leachate impacts on ground and surface waters.

The movement of leachate consists of two components--vertical and horizontal. Leachate will move vertically through the silt and saturated sand layers beneath the existing site and horizontal expansion. Under the worst case analysis, it is assumed that the silt layer is not present and the leachate will move vertically through only the sand layers. In both analyses the leachate could move either vertically to the 710 foot elevation, which is the elevation of the seep along the bluff face or deeper to the Prairie du Chien formation at the 640 foot elevation. At the 710 foot elevation the leachate could move horizontally emerging either in the form of seeps along the bluff and in the river valley or in the Minnesota River, Grass Lake or wetlands. Leachate moving deeper to the Prairie du Chien would move horizontally to the river valley emerging in the river, lake or wetlands.

In the first analysis the silt layer is assumed to be present beneath the existing landfill and horizontal expansion area. The estimated rate of vertical movement of leachate through the silt layer to the saturated sandy layer above the Prairie du Chien-Jordan aquifer is estimated at 0.03 feet/day or approximately 5.5 years to move through the estimated 60-foot silt layer (22). Vertical movement through the sandy layer is much more rapid. The vertical pore velocity based on a sand hydraulic conductivity of 3.7 feet per day and a porosity of 40 percent is estimated to be 9.1 feet per day (23). (The hydraulic conductivity and porosity values are based on very limited data with conductivity data from one boring TH5, in the horizontal expansion area (Figure 19).

Flow velocity in the bedrock aquifer is difficult to estimate since it depends on which matrix of the bedrock aquifer the water is moving through: the saturated sand and sandy soils above the Prairie du Chien dolomite, the Prairie du Chien dolomite itself or the Jordan sandstone. All three of these aquifer units are hydraulically connected, which means that water can move from one to the other. However, because of different hydraulic conductivities and porosities, the pore velocity of water in each matrix is different. Therefore, the rate of leachate movement toward the Minnesota River Valley depends on which matrix it is moving through.

Horizontal flow velocity in the saturated sand was estimated at 0.08 feet per day based on the hydraulic conductivity of sand reported for borings TH1 and TH2 (23). The horizontal porosity for the bedrock unit is a typical value for this formation in the region and is determined as a function of transmissivity and is estimated at 13.28 feet per day.

The flow rate calculations are estimates only. The values used to derive them are based on approximations and six soil sample analyses applied to the entire site. Homogeneity is assumed for the aquifers. This means that the soil or rock physical properties are assumed to be uniform throughout the area. Isotrophy, the condition where hydraulic properties of the matrix are equal in all directions, was also assumed.

The choice of hydraulic conductivities and aquifer unit the leachate moves through has an overriding impact on the time it will take for the leachate to reach the Minnesota River Valley. Table 11 summarizes travel times to significant points for the existing landfill and the expansion assuming the presence of the silt layer.

The second or worst case analysis is based on the assumption that the low permeability silt layer is not present beneath the depression or existing landfill. The layer does exist to various extents beneath the horizontal expansion area, but as explained earlier there is no data to verify its presence beneath the existing landfill site.

Removing the silt layer in the worst case analysis results in a far more rapid downward movement of water. The vertical pore velocity through the sandy layer is approximately 9.1 feet per day, as compared to a value of 0.03 feet per day for the silt layer. Estimating vertical travel times involves two vertical distances to fit into the two subsequent horizontal movement scenarios. A downward flow to elevation 710 feet or to the top of the Prairie du Chien at 640 feet. The travel time for water to move from the bottom of the landfill at 820 feet elevation to the 710 feet elevation is approximately 12 days. The time to travel to the bedrock would be about 20 days.

Vertical movement then would be substantially faster for the worst case analysis assuming the silt layer is not present--12 to 20 days versus 5.5 years. The implication of this is that once field capacity is reached in the expansion (approximately 12 years), any leachate generated could move quickly downward into the groundwater system.

Table 11
LEACHATE TRAVEL TIME AND ARRIVAL DATE ESTIMATES[1]

Point	Distance from Center of Site (Feet)	Total Travel Time (vertical plus horizontal) Saturated Sandy Soils (Years)	Prairie du Chien (Years)	Approximate Date[2] of Arrival Saturated Sandy Soils	Prairie du Chien
Existing Landfill (Assuming silt layer present.)					
Well W3	1,400	54	6	2036	--[3]
710 MSL Contour	2,400	88	6	2070	1988
Grass Lake	2,700	98	6	2080	1988
Minnesota River	3,000	109	6	2091	1988
Proposed Expansion (Assuming silt layer present).					
Well W3	1,400	54	6	2051	--[3]
710 MSL Contour	2,400	88	6	2085	2003
Grass Lake	2,700	98	6	2095	2003
Minnesota River	3,000	109	6	2106	2003
Proposed Expansion (Worst case no silt layer present).					
Well W3	1,400	48	0.34	2045	1997
710 MSL Contour	2,400	82	0.55	2079	1998
Grass Lake	2,700	92	0.61	2089	1998
Minnesota River	3,000	103	0.67	2100	1998

[1]These are gross estimates only and do not necessarily encompass the entire range of values. They are provided to illustrate possible time frames.
[2]Based on initial refuse emplacement in 1970 for the existing landfill and 1985 for the expansion and 12 years to reach field capacity.
[3]Well W3 is not finished in the Prairie du Chien.

Two estimates for horizontal movement time are analysed under the worst case analysis. The first is horizontal movement in the saturated sand layer under the landfill. The horizontal pore velocity in the sand is estimated at 0.08 feet per day based on the reported hydraulic conductivity of sand reported for TH1 and TH2. Horizontal flow from the center of the landfill to the 710 foot contour along the bluff face would be a total of 2,400 feet, and would, therefore, take 30,000 days. The total including the vertical movement would be 30,012 days or about 82 years after field capacity at the expansion is reached. Horizontal flow to Grass Lake through the sandy layer, 2,700 feet, would be a total of 33,762 days or 92 years, and flow to the Minnesota River, 3,000 feet, would be 37,512 days or 103 years. These values are based on only two field measurements of hydraulic conductivity and are subject to substantial error.

The second horizontal movement of leachate under the worst case analysis would be flow in the Prairie du Chien Dolomite. The horizontal pore velocity for this formation typically occurring in the Metropolitan Area (25) is determined as a function of transmissivity, and totals 13.28 feet per day, substantially faster than similar flow in the saturated sands. Again, this is a literature figure, but it is reflective of the formation as it occurs in the region. Horizontal flow from the center of the landfill to the bluff line at elevation 710 would be 200 days or 0.55 year, well over two orders of magnitude faster than through the sand layer. Flow to Grass Lake would be 223 days or 0.61 year, and to the Minnesota River would be 246 days or 0.67 year.

The results of the worst case analysis for the expansion are summarized in Table 11. Well W3 is calculated as an intermediate point in the horizontal flow toward the valley. The table indicates that under the worst case assumption (no silt layer) leachate could move more quickly both vertically and horizontally with the result that leachate could reach the river valley and the Minnesota River and Grass Lake much sooner. Assuming that the silt layer is not present beneath the existing landfill would reduce the vertical travel time by approximately 5.5 years. Assuming that the leachate could move down to and horizontally through the Prairie du Chien formation to the river rather than horizontally the saturated sand layer could reduce the travel time by approximately another 50-100 years. Assuming the silt layer is not present and that leachate will move through the Prairie du Chien aquifer, leachate could reach Grass Lake in 0.61 year compared to six years if the silt layer were present or approximately 1998 (assuming 12 years for the expansion to reach field capacity and begin producing leachate). Assuming the silt layer is present and the leachate would move horizontally through the sandy layer it could take as long as 98 years for the leachate to reach Grass Lake or approximately 2094. These estimates indicate a need for long-term monitoring at the expansion particularly in the Prairie du Chien and the need for prompt action if leachate is detected in the Prairie du Chien. Under worst case assumptions leachate could impact the groundwater and the Minnesota River and Grass Lake much sooner.

At present there is only one monitoring well, Well W6, located in the Prairie du Chien downgradient from the landfill. Table 8 shows very little data for W6, but the data collected does not indicate the presence of leachate. The implication of this is that the worst-case scenario is not being met for the existing landfill. Data do not exist to explain why the worst case has not occurred, but the possibilities might include the presence of some thickness of silt; diversion of leachate flow away from Well W6; lack of sufficient time to reach field capacity; or an incorrect assumption on horizontal flow velocities. The apparent presence of leachate in Well W2, and the possible presence of contaminants in other shallow wells in the sand layer (Tables 8 and 9) would tend to support the impression that flow beneath the landfill is not a simple matter. Better data on horizontal flow velocities at other locations on the site would perhaps provide a better idea on how leachate seems to be moving in the sand layer.

The leachate that percolates down to the groundwater table on the east side of the eastern groundwater divide will flow toward the low area west of Homeward Hills Rd. The horizontal flow velocity in the sands above the silt layer in this area was estimated at 0.145 feet per day (26). In the 5.5 years it takes for leachate to flow through the 60 feet of silt under this area, the horizontal flow would be only 290 feet at the above velocity. This indicates that the leachate would likely reach the Prairie du Chien aquifer and begin a south-southwesterly migration before reaching the Bluffs West area, about 600 feet southeast of the eastern extent of the expansion.

As leachate moves with the groundwater it tends to spread out in a three-dimensional plume (27). Figure 25 gives an example of both a continuous source contaminant plume and a slug source contaminant plume.

The extent of dispersion of the leachate plume from the site is difficult to predict because of the difficulty in determining an accurate dispersion coefficient.

Figure 26 presents the estimated core zone of the expected plume. The direction of the plume has been reoriented from that shown in the DEIS. The revised direction of the plume reflects the direction of regional drift and bedrock groundwater flow which is further to the southwest than indicated in the DEIS. Figure 26 is a revised estimate of the extent of the plume with minimum and maximum dispersion lines. The minimum dispersion line represents a four percent longitudinal distance, and the maximum dispersion line was arrived at by multiplying the former value by a factor of 10 to account for errors, heterogeneities and unknown conditions and represents a conservative estimate of the maximum dispersion (28). The line, L, extends from the northern edge of the landfill to the elevation 710 contour in the river valley. The core zone contains the lateral extent of landfilling under the expansion.

The revised plume in Figure 26 changes the potential impact core such that well No. 68 and the other private residential wells in the Bluffs West area to the southeast will be out of and farther from the impact area, but the BFI office wells (Nos. 82 and 83) and the Cooley residential well (No. 76) are in the maximum likely dispersion plume. The drive-in theater well is located at the edge of the core zone of the plume. The revised plume swings slightly towards Grass Lake, but away from the Bluffs West residential area to the southeast.

Leachate Composition

In general, three phases of leachate production exist, controlled primarily by products of microbial reactions (29). Phase I occurs under aerobic or oxygenated conditions when large quantities of organic acids and carbon dioxide are produced. The ability of water to dissolve materials such as metals, carbonates, nitrates and phosphates is increased under the acidic conditions. Conductivity during this time will be very high due to the relatively high levels of inorganics initially dissolved. Phase II is associated with the first stage of anaerobic decomposition and is characterized by low pH, high chemical oxygen demand (COD), high conductivity, and continued high volatile acid production. Phase III occurs during second stage anaerobic decomposition when methane-producing bacteria become more predominant and decompose the volatile acids to methane and carbon dioxide. This leads to a fall in COD and a rise in pH. Second stage anaerobic decomposition may take decades to complete.

Leachate composition during any phase of production will depend on solid waste composition, landfill age, and physical, chemical and biological activities within the fill (30,31). Typical leachate composition is listed in Table 12.

Some hazardous organics could be leached from the existing and expanded site. The type of hazardous organics that may be leached are dependent upon the composition of refuse in the site. Since the disposal of hazardous wastes in sanitary landfills is prohibited, the source of any hazardous organics would be domestic or industrial solid waste and would likely exist in only very small quantities. Residues from empty cans and bottles of cleaners, paints, cosmetics, deodorizers, pesticides, medicines, petroleum products and polish could be sources of small quantities of hazardous waste.

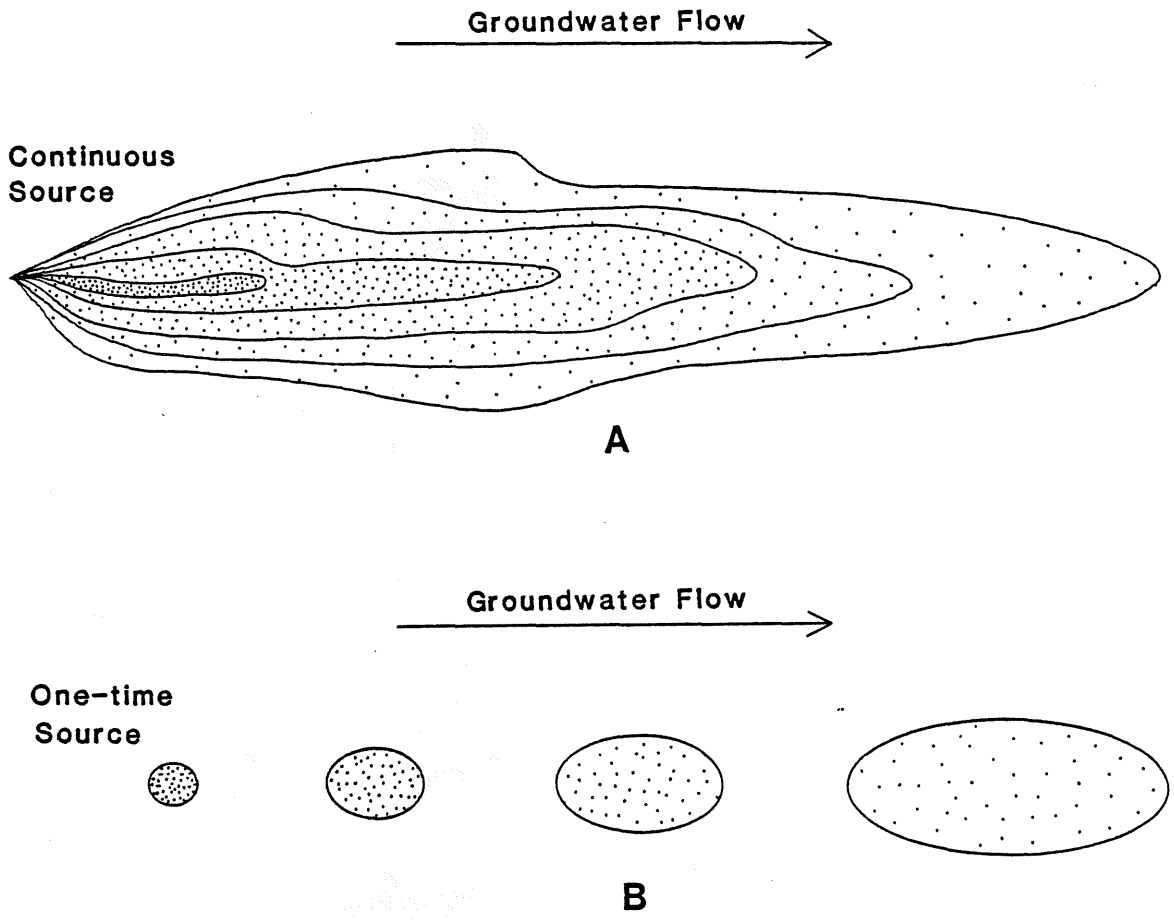
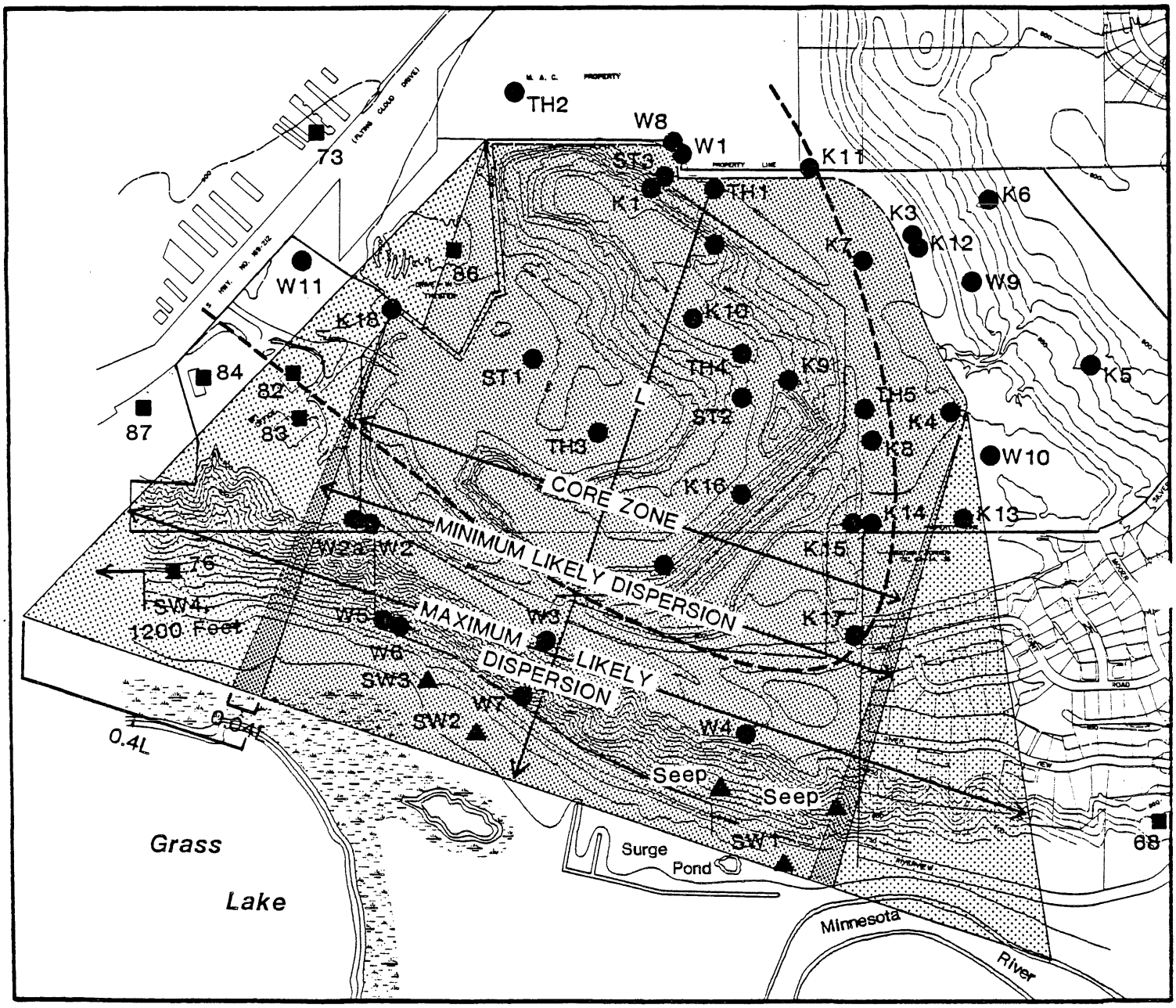


Figure 25.

THE DEVELOPMENT OF A CONTAMINATION PLUME FROM A CONTINUOUS POINT SOURCE (A); THE TRAVEL OF A CONTAMINANT SLUG FROM A ONE-TIME POINT SOURCE (B).

Source: C.W. Fetter, Jr., Applied Hydrogeology (Columbus, Ohio: Charles E. Merrill Publishing Co., 1980) p. 341.

Figure 26.
ESTIMATED DISPERSION OF LEACHATE PLUME



Base Map Source: G.M. Sunde, Consulting Engineer.

Table 12.
LEACHATE COMPOSITION

Parameter	Range of Values: Landfills and Test Lysimeters*	Typical Landfill	MPCA Standards for Minnesota River** (Interstate Class 2C, 3B, 4C)
pH	3.7 - 8.5	7.5	6.5 - 9.0
Total carbon-mg/l	715 - 22,350	350	
BOD_5-mg/l	9 - 55,000	120	
COD-mg/l	0 - 9,000	800	
Acidity-mg/l as $CaCO_3$	0 - 9,590	185	
Alkalinity-mg/l as $CaCO_3$	0 - 10,900	3,400	
Hardness-mg/l as $CaCO_3$	0 - 22,800		250
TS-mg/l	1,000 - 45,000	4,400	
TDS-mg/l	0 - 42,300	4,270	
Tannin-like compounds-mg/l	78 - 1,278	4,270	
Chloride-mg/l	34 - 2,800	2,300	100
Cyanide-mg/l	0 - 0.11		0.02
Flouride-mg/l	0 - 2.13	0.27	
Nitrogen-NH_3-mg/l-N	0 - 1,106	427	0.04
Phosphorous-mg/l PO_4	0 - 154	3.8	
Sulphate-mg/l	1 - 1,826	5.3	
Sulphide-mg/l	0 - 0.13		
Calcium-mg/l	5 - 4,000	170	
Magnesium-mg/l	16.5 - 15,600	100	
Potassium-mg/l	2.8 - 3,770	490	
Sodium-mg/l	0 - 7,700	800	
Arsenic-mg/l	0 - 11.6	0.038	0.01
Aluminum-mg/l	0 - 122	0.27	
Barium-mg/l	0 - 5.4	0.08	
Beryllium-mg/l	0 - 0.3	0.025	
Boron-mg/l	0.3 - 73	4.5	
Cadmium-mg/l	0 - 0.19	0.0037	
Chromium-mg/l	0 - 33.4	0.053	0.05
Copper-mg/l	0 - 10	0.024	0.01
Iron-mg/l (total)	0.2 - 5,500	24	
Lead-mg/l	0 - 5.0	0.054	
Manganese-mg/l	0.06 - 1,400	0.6	
Mercury-mg/l	0 - 0.064		
Molybdenum-mg/l	0 - 0.52		
Nickel-mg/l	0.01 - 0.8	0.069	
Titanium-mg/l	0 - 5.0		
Vandaium-mg/l	0 - 1.4		
Zinc-mg/l	0 - 1,000	0.5	

Source: Figures for test lysimeters and typical landfill from R.D. Cameron, "The Effects of Solid Waste landfill Leachates on Receiving Waters", AWWA Journal (March 1978) and MPCA Standards from Minnesota Code of Agency Rules, Rules of the MPCA, Criteria for the Classification of the Interstate Waters of the State and the Establishment of Standards of Quality and Purity (6 MCAR 4.8015, Sept. 1982).

An MPCA study found volatile organics (VOC) to occur commonly in leachate and contaminated groundwater samples from some Minnesota landfills (32). Concentrations of VOC's were as high as several hundred parts per billion in some cases. The MPCA also found some of the VOCs to be highly mobile.

Trace metals are pollutants that could also exist in leachate from the expanded site. In a study of five mixed municipal sanitary landfills, several trace metals were found to consistently exceed EPA drinking water standards (33). These included lead, selenium and mercury. Cadmium and chromium were found to vary widely in concentration from site to site.

Leachate Attenuation

Attenuation of leachate occurs by many possible mechanisms (34). Important physical properties of the soil and groundwater system that can attenuate leachate are diffusion, dispersion and physical sorption. Important chemical mechanisms are precipitation/dissolution, sorption, complexation, ion exchange and oxidation/reduction (redox) reactions. These chemical reactions either remove or add material to the solution by precipitating it out of solution, dissolving it into solution, adsorbing it to or desorbing it from a soil particle surface or by reacting it with other compounds in a manner that changes the solubility or surface charge of the compound of interest. Many biological reactions also take place depending on temperature, pH, and the presence or absence of oxygen to reduce the organic content of the leachate.

Because the soil/leachate environment is so complex no model can adequately simulate all the processes that occur. General trends can be delineated, however. The trends of various major categories of pollutants are summarized in the following paragraphs (35).

The pH of leachate is generally acidic (less than pH 7), especially in the early life of the landfill. The pH tends to increase as leachate passes through the soil primarily because of reactions with carbonate and sulfide materials. The redox condition is usually reducing, which means there is a tendency of elements and compounds to accept electrons. The redox level is primarily controlled by soluble sulfides produced in the landfill. Alkalinity of the leachate is controlled by precipitation/dissolution reactions with calcite in the soil.

Organics such as carbohydrates, fatty acids and amino acids are influenced primarily by bioconversion, surface adsorption and metal-organic complexation reactions. These factors can either increase or decrease the organics in the leachate depending on site specific conditions.

Major ions like calcium, sodium, carbonate, sulfate and chloride are regulated by ion exchange and solubilization effects. Chloride and sodium are relatively unattenuated while calcium and potassium are moderately attenuated.

Nutrients such as nitrates and phosphates are attentuated on the basis of their chemical structure. Ammonia-nitrogen is susceptible to adsorption while nitrate-nitrogen is fairly mobile. Phosphorus migration is controlled mainly by solubilization, sorption and biological effects. Alkalinity has a dominant effect on soluble phosphate levels.

Trace chlorinated hydrocarbons like pesticides and solvents are most influenced by adsorption phenomena. Clay minerals and iron and manganese hydrated oxides

are the most effective adsorbing surfaces. The extent of adsorption has been found to be dependent on the organic content of the soil matrix and the octanol-water coefficient (K_{ow}) of the particular organic compounds (36). The octanol-water coefficient is a measure of a compound's preference for water as a solvent. Higher levels of adsorption occurred with higher organic content and higher K_{ow} values. K_{ow} values less than 1,000 indicated a readily transported organic (37). An example of this type of organic would be trichloroethylene (TCE), a ubiquitous man-made organic solvent (38). Volatile organics generally dissipate (or volatilize) when exposed to the environment from the subsurface.

Biodegradation of some trace organics may occur if high enough concentrations occur to support a minimum level of microbial activity (39). This level is much higher for anaerobic conditions than for aerobic. In the saturated groundwater conditions of interest here, anaeorbic conditions exist.

Trace metals include chromium, lead, mercury, nickel and zinc, among others. Their migration is very complex. Primary influences are solubilization, adsorption, complexation and dilution. Properties of the soil, the leaching solution and the particular metal are important in determining the extent of migration (40). Clay soils and those containing iron hydrous oxides have been found to be most effective in attenuating trace metals. High pH values in the leachate are also effective because they promote the formation of insoluble compounds by trace metals. The degree of mobility varies with these more mobile metals including chromium, mercury and nickel. Less mobile were lead and copper; mobility of arsenic, beryllium, cadmium, selenium, vanadium and zinc varied with conditions. Indications of arsenic, chromium, zinc and antimony were found in some or all of the seeps downgradient of the landfill. The levels found in the May 1982 sampling were above detection levels but below drinking water standards. Metals data were also collected from monitoring wells in April and May 1982 by MPCA, BFI and PACE Laboratories. Several metals were detected by MPCA in April, but subsequent sampling by BFI and PACE in May showed the levels predominantly below detection levels.

Some authors have concluded that geologic materials that form subsurface soils are important in determining the influence of leachate on groundwater (41). They feel that formations containing active clay minerals are significant in reducing pollutant levels because of increased adsorption and surface chemical reactions.

The conditions at the Flying Cloud Landfill site will allow some attenuation to occur. Hydrodynamic dispersion will cause dilution. The silt layer thought to exist beneath the site should provide a good medium for adsorption and ion exchange because it is composed of clays and silts. In addition to its chemical properties the layer also slows the groundwater velocity and thus increases detention time of the leachate in the soil. Increased detention time allows greater opportunity for precipitation, oxidation and reduction (redox), complexation and biological reactions to occur, which further enhances attenuation of the pollutants previously discussed. Although the soils data indicates the silt layer exists beneath the horiziontal expansion area, there is no data which verifies the presence of the silt layer beneath the depression where the existing landfill is located. If there is no silt layer it is likely that little attenuation of pollutants from the expansion will occur as the leachate moves vertically from the existing landfill. A worst case analysis reflecting this situation is included in a later section.

Impact on Private and City Wells

Some small private residential and business wells exist within one mile of Flying Cloud Landfill (Figure 27). They are pumped intermittently at low rates, and so will not significantly alter existing groundwater flow patterns.

The BFI wells (Nos. 82 and 83) and the Cooley residential well (No. 76) are located in the revised, estimated leachate plume (Figure 27). They are finished in the Prairie du Chien and take their water at a level lower than where leachate would be expected if it moves horizontally through the saturated sand layer. However, leachate could migrate downward into the Prairie du Chien. The drive-in well (No. 86) is also within the estimated plume. The depth of this well is not known. Of particular concern is the potential for consumption of water contaminated by very low levels of trace organics and metals. This problem is further addressed in the mitigation section.

The Eden Prairie municipal well field is located approximately three miles to the northwest of the landfill. The expanded landfill will not affect the municipal well field since it is outside of the zone of influence of the wells and, in any case, composes only a very small fraction of the recharge area for the aquifer in which the wells are finished in. To determine if the expanded landfill could affect the water quality of the well field, the wells' zone of influence was calculated using the maximum developed pumping rate (Figure 28). The closest point of the zone of influence to the expanded landfill site is 12,000 feet.

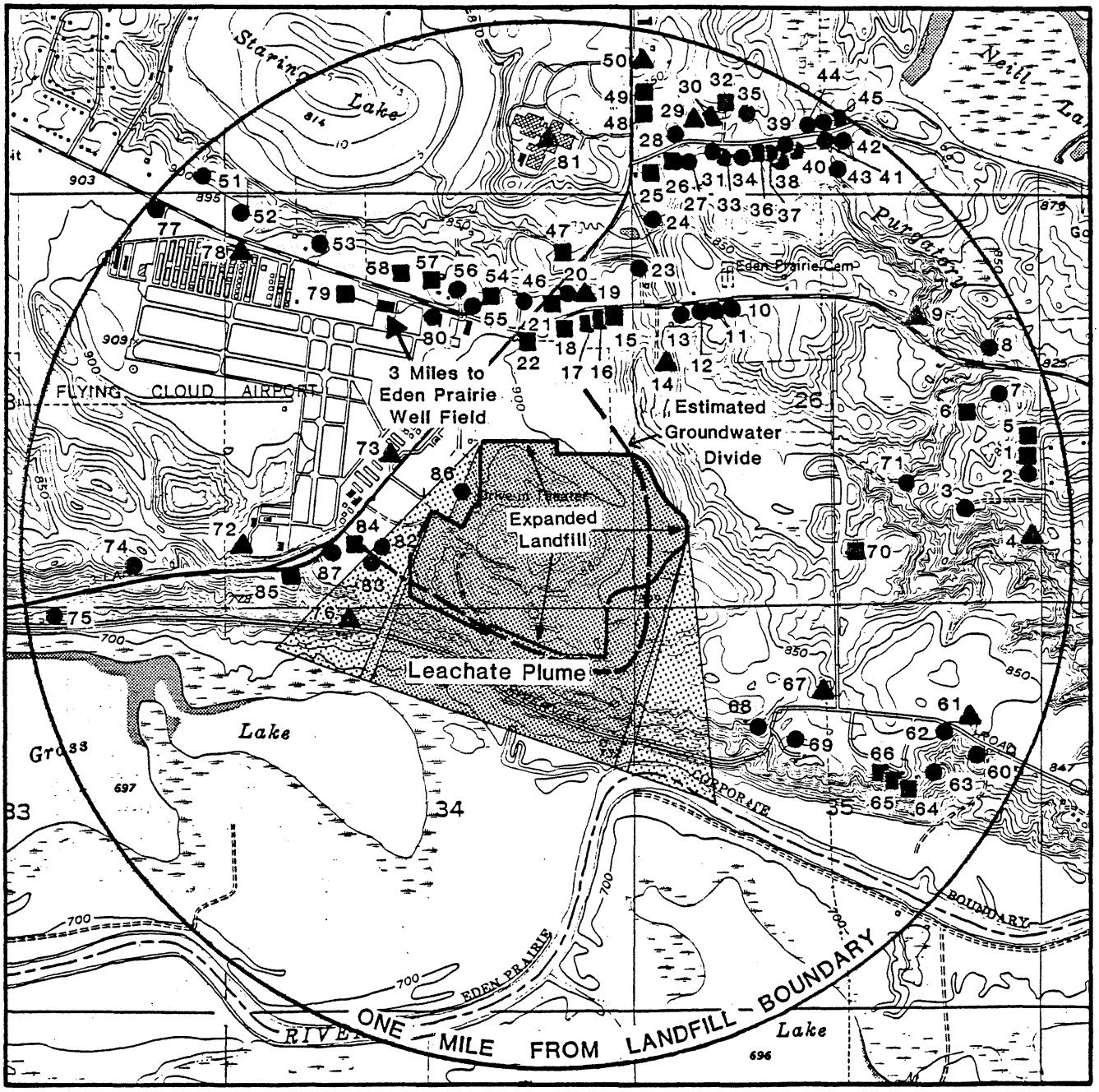
Another method to investigate whether or not the expanded landfill is within the municipal well field zone of influence is by assuming steady-state radial flow. This type of flow exists after long periods of continuous pumping. By this method, a drawdown of 310 feet at the well site would be necessary to extend the zone of influence to the expanded landfill site. The maximum recorded drawdown shown in the literature is 133 feet (42).

Potential Impacts on the Minnesota River Valley/Grass Lake

The leachate plume will eventually discharge into the Minnesota River Valley. The actual area of discharge is difficult to predict, but the greatest impact would occur if leachate emerged prior to reaching the river. (Volatile organics would dissipate in the air.) Leachate emerging in the river would be readily diluted. Since dilution would be less it is assumed that the leachate will discharge below the 710 feet MSL contour and be diluted into the marshland waters and Grass Lake. The one question is: whether this input of leachate will cause the surface water quality to be degraded to the point of exceeding the MPCA water quality standards for Grass Lake? Grass Lake is classified 2B, 2C, 3B, 3C, 4A and B, 5 and 6, which designates the lake as suitable to permit the propagation and maintenance of cool or warm water sport or commercial fishes and for aquatic recreation of all kinds including bathing (6 MCAR 4.8014). Other related issues are addressed in the Surfce Water and Vegetation and Wildlife sections.

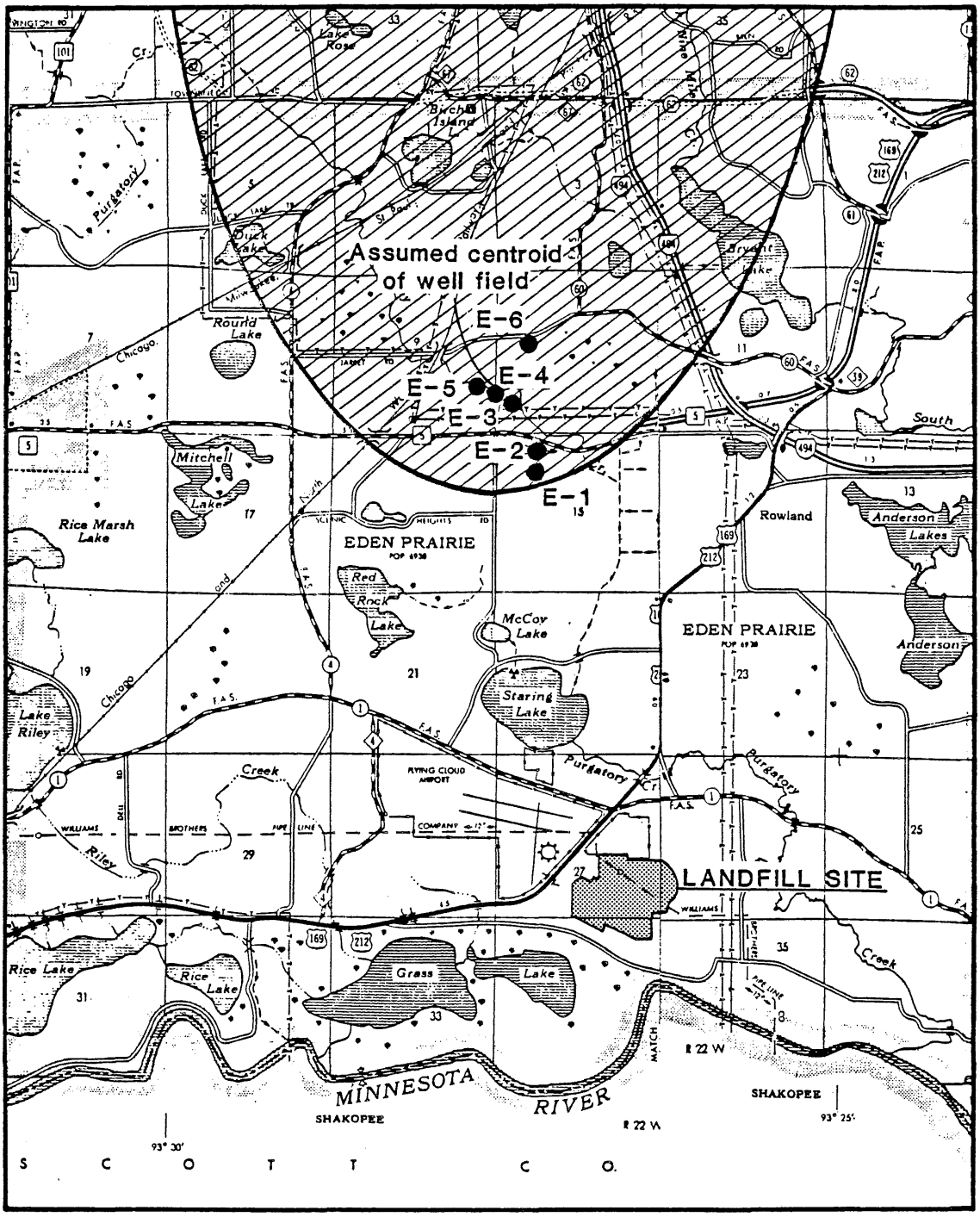
To examine this question, maximum possible concentrations of chemical constituents in the marsh and Grass Lake were determined by the mass balance method. In this method a well mixed "reactor," the marsh and Grass Lake, is assumed. By accounting for all inflows such as runoff, precipitation on the lake and groundwater flow and all outflows such as evaporation and surface outflows the concentrations of the chemicals in the reactor can be estimated.

Figure 27.
WELLS WITHIN ONE MILE OF LANDFILL AND EXTENT OF LEACHATE PLUME



Source: G.M.Sunde, Assessment of Soils, Geology and Hydrogeology for Flying Cloud Sanitary Landfill (Bloomington, Mn., 1983) p. 3.

Figure 28.
ZONE OF WELL INFLUENCE FOR THE CITY OF EDEN PRAIRIE WELL FIELD



Base Map Source: Minnesota Dept. of Transportation

0 1 2 Miles

N

The chemical constituents used as examples were chosen because they are considered highly mobile (chloride and chromium) and/or can be compared to MPCA standards (cadmium and copper). Cadmium was selected because of the possibility of its presence as noted in recent monitoring of the stormwater detention system at the landfill. (See response to the letter from Charles Moos, June 4 1984, Appendix E.) Nickel is not considered in the FEIS as it was in the DEIS because of the lack of an MPCA standard. Two concentrations for the chemicals in leachate are used in the mass balance method due to the wide variability of literature values (Table 13). Extremely concentrated values for the chemicals found in leachate as shown on the upper end of the ranges shown in Table 12 were not used. These values would be expected to occur less frequently. However, it should be kept in mind when reviewing the mass balance results or estimates of the impact on Grass Lake that the concentrations of contaminants in the leachate could vary substantially.

A worst case analysis was developed to assess the potential impact on Grass Lake. It is assumed that there would be no attenuation of leachate before it reaches the lake. This is consistent with the previous worst case assumption that there is no silt layer beneath the existing landfill site. It is also assumed that all the leachate would be discharged to the east arm of Grass Lake and would be mixed in that portion of the lake. (There is an east arm and west arm to Grass Lake, the two areas being separated by a narrows and marsh. Figure 4.) Two analyses are included based on the previously estimated volumes of leachate produced by the expansion (Table 10). One estimate assumes an annual percolation of 5.9 inches or no direct runoff and the other assumes an annual infiltration of 1.5 inches per year.

The basic approach used in the water balance method as described in the hydrogeological report was followed. The revised configuration in the estimated plume affects the analysis in that the front assumed to discharge towards Grass Lake is 3,200 feet wide. The east arm of the lake receives a surface inflow from the 148 acre landfill expansion plus 358 surrounding acres. The runoff from the surrounding 358 acres is approximately 5.5 inches a year based on general Soil Conservation Service runoff values for the region and on runoff data collected by the Council. Runoff from the 148 acre landfill under the worst case scenario would be zero assuming 5.9 inches of water per year infiltrating the landfill (Table 10). These runoff figures result in an inflow of (Qi) of 0.27 cfs. The outflow (Qo) determined by the water balance method is 1.20 cfs. The results are presented in Table 13.

The revised Table 13 shows that assuming no attenuation of leachate and 5.9 inches per year of percolation, water quality standard violations could occur in the east arm of Grass Lake for chloride and copper. Values for chromium and cadmium are substantially below the standard. Assuming a worst case cadmium surface inflow level of 0.14 mg/l, as measured on one occasion in a seep pipe, a concentration of 0.039 mg/l is reached in the east arm of the lake. This level does exceed the standard. Incidentally, the 0.14 mg/l was found on a single isolated occasion from a seep pipe and was most likely an errant value.

Assuming a percolation rate as low as 1.5 inches per year under optimum conditions results in a substantally reduced impact in comparison to state standards. Substituting the 1.5 inches in place of the 5.9 inches per year would change the value of leachate production in Table 10 as well as the value of the inflow volume (Qi). Assuming an optimum condition for percolation would yield a leachate producton value of 18.5 acre-feet per year and thus a new value for

Table 13
MASS BALANCE RESULTS FOR GRASS LAKE-EAST ARM
(All concentrations mg/l)

Chemical Constituent	Chemical Concentrations * Groundwater	Water Inflows Surface Water	Leachate		Grass Lake East Arm Outflow Maximum Infiltration[1]	Minimal Infiltration[2]	MPCA Surface Water Quality Standard (mg/l)	MDH Drinking Water (mg/l)
Chloride	1.7	18	2300	1500	132[3] - 200[3]	39 - 57	100	--
Chromium	0	0	0.053	0.18	.005 - .015	.001 - .004	0.05	0.05
Cadmium	0	0	0.0037	--	.0004	.001	0.01	0.01
Copper	0	0	0.024	0.22	.002 - .019[3]	.005	0.01	--

[1]Assumes 5.9 inches infiltration annually.
[2]Assumes 1.5 inches infiltration annually.
[3]Exceeds standard.

* Source: Groundwater Concentrations from R.E. Norvitch, Water Resources Outlook for the Minneapolis-St. Paul Metropolitan Area (1973). Surface Water Concentrations from G.W. Sunde, Assessment of Soils, Geology and Hydrogeology for Flying Cloud Sanitary Landfill (1983). Leachate Concentrations from R.D. Cameron, "The Effects of Solid Waste Landfill Leachates on Receiving Waters", AWWA Journal (March 1978) and S. Reed, Typical Leachate from Municipal Refuse (Solid and Hazardous Waste Div., MPCA).

leachate flow rate of 0.026 cfs. Based on 5.5 inches of runoff from 358 acres surrounding the landfill and 9.9 inches (5.5 plus 4.4 inches) from the 148 acre landfill site yields a new surface inflow (Qi) of 0.395 cfs. As a result the estimated concentrations of the chemicals would be reduced (Table 13).

The results indicate that minimizing infiltration and maximizing runoff would greatly decrease the concentration of leachate reaching Grass Lake. The concentrations for all four chemicals are below state water quality and drinking water standards. A final cover over the expansion site consisting of at least one foot of fairly impermeable cover soil, as required by the MPCA, and final grades would reduce infiltration and increase runoff.

The results are estimates of the potential impact on the east arm of Grass Lake water quality. Assuming a worst case with no attentuation of leachate constituents reaching the east arm of the lake, no runoff from the landfill and using typical leachate concentrations the concentrations could exceed some MPCA water quality standards for surface waters. However, as the analysis indicates, limiting the amount of percolation at the landfill expansion under optimum conditions could minimize the production of leachate and the concentration of leachate reaching the east arm of the lake and reduce the potential impact below MPCA standards.

It is necessary to point out that the results in Table 13 are based on the assumption that the leachate is completely mixed in Grass Lake and the marsh. This is a reasonable assumption given the shallow depth of the lake (on average 1.5-2.0 feet). A lake of this depth is likely to turn over, be influenced much by wind, and therefore and mix frequently. Where the leachate emerges into the valley such as the seeps there could be a higher local concentration similar to the leachate values in Table 13; and at these points the surface water quality standards may be exceeded.

Impacts at the Minnesota River would be minimal. The historical recorded low flow for the river is 79 cfs (43). If all the leachate were to discharge into the river, it would amount to only 0.5 percent of the low flow and by dilution alone would be brought well below existing MPCA standards. However, these contaminants could add to the long term accumulation of these chemicals from other sources.

There is the possibility of undesirable trace metals like cadmium and chromium and trace organics like pesticides accumulating through the biological food chain. Aquatic plants have been found to accumulate trace metals to very high levels in their tissues, with submerged plants reaching higher levels than floating plants. Subtoxic concentrations cause differences in competition between plant species and influence plant community stability because of the high sensitivity of invertebrates. Thus, while leachate from the landfill may not cause water quality standards to be exceeded, there is the possibility that it may affect the biota in the river valley. Further analysis of these impacts is contained in the Vegetation and Wildlife section.

Under the worst case scenario in Table 13 the east arm of Grass lake would exceed the levels of the same chemicals in the Minnesota River. However, under the second scenario in Table 13 (1.5 inches of infiltration) the water quality of the Minnesota River would exceed the levels in the lake. The USGS takes water quality measurements bi-monthly at Jordan, Minn. upriver from the landfill site. Recorded values for those chemical constituents listed in Table 13 from water year 1982 are as follows:

Cadmium	up to 002 mg/l
Chloride	7-48 mg/l
Chromium	up to 0.030 mg/l
Copper	.006-.014 mg/l

Since the Minnesota River floods Grass Lake and the associated marsh area about once every two years, it also has the potential for similar impacts on the biota. Leachate reaching the lake from the landfill expansion could increase the potential for such impacts by adding to the concentrations of metals and other contaminants. This issue is discussed in more detail in the Surface Waters and Vegetation and Wildlife sections.

Data for metal concentrations in the Minnesota River water are were also collected bi-monthly by the MWCC. Metals concentrations are sampled annually. In 1982 the median (and ranges) values at river mile 3.5 on the Minnesota River (lower end, Bloomington) were:

Concentrations in River Water in mg/l:

Copper	.0039 (.002-.012)
Cadmium	.0003 (0-.008)
Chromium	.0022 (0-.008)

Concentrations in River Sediment in mg/g:

Copper	.008
Cadmium	.0017
Chromium	.017

Under the worst-case scenario (maximum infiltration) as presented in Table 13, the concentration of chromium in Grass Lake would exceed the median 1982 Minnesota River concentration as measured by MWCC. The same would be true for cadmium. The 1982 river level of copper would fall within the range of the two values derived in Table 13 for the worst-case scenario.

Sediment metal concentrations in the west arm of Grass Lake were collected in a one-time sample by the U.S. Fish and Wildlife Service (FWS) in 1981. The results follow:

Concentrations in Grass Lake Sediment (mg/g)

Copper	.022 mg/g
Cadmium	.0008 mg/g
Chromium	.014 mg/g

Comparing these field data with MWCC's Minnesota River sediment data above shows that the level in Grass Lake is higher for copper, but less for cadmium and chromium. The metals in the sediment analysis can be expanded beyond the three metals covered to take advantage of some additional data. The following comparison can be made between U.S. FWS 1981 data on Grass Lake sediment and MWCC 1982 data on Minnesota River sediment:

Concentrations in Sediment:

Chemicals	Minnesota River	Grass Lake (West Arm)
Arsenic	.0043 mg/g	.0067 mg/g
Mercury	.00005	.00004
Zinc	.0345	.0767
Lead	.0087	.0250
Nickel	.0104	.0292

These data show that with the exception of mercury the level of metals in Grass Lake sediments greatly exceeds the value in the Minnesota River. Caution must be exercised because of the small amount of data and the very small concentrations detected.

Data were also collected by MWCC from common carp at river mile 1.0 near the mouth of the Minnesota River. The data is reported for fillets (F), livers (L) and kidneys (K) follow. Tissue concentration is reported as ug/g wet weight.

Copper	Cadmium	Chromium
F 0.51	F 0.05	F 0.01
L 4.65	L 0.66	L 0.04
K 2.92	K 6.93	K 0.17

Samples of black bullhead remains were taken by the FWS in Grass Lake in 1980. The exact methodology used to sample the fish is not reported by FWS, but the following data are reported for two of the three metals noted above:

Cadmium

Grass Lake No. 1	Less than 0.01 ug/g
Grass Lake No. 2	Less than 0.01 ug/g

Chromium

Grass Lake No. 1	0.16 ug/g
Grass Lake No. 2	Less than 0.10 ug/g

A further comparison can be done similar to that done for metals in sediment. The following data are also available from MWCC for the river and FWS for Grass Lake (west arm) in ug/g of tissue:

Concentrations in Fish Tissue (ug/g)

	Minnesota River	Grass Lake (West)
Arsenic	F less than 0.05 L less than 0.06 K less than 0.07	No. 1 -- 0.07 No. 2 -- 0.03

Mercury	F 0.14 L less than 0.10 K 0.14	No. 1 -- 0.03 No. 2 -- 0.03
Lead	F less than 0.019 L 0.40 K 0.37	No. 1 -- 0.24 No. 2 -- 0.10
Nickel	F 0.278 L 0.085 K 0.539	No. 1 -- 0.10 No. 2 -- 0.10

Again the data are variable according to which metal is considered.

Overall, the metals data from the MWCC, U.S. FWS and the worst-case scenario are variable. It is not possible to make a conclusive statement on the metals other than that there appear to be metals present in Grass Lake to approximately the same extent as the Minnesota River. A cause-effect relationship cannot be established for the presence of metals in the lake, since the source could be river overflow, Riley Creek, groundwater or overland runoff.

Continued monitoring of metals in the fish and lake sediments would remove the uncertainty shown by this metal data, it would seem prudent to do some monitoring of metals in fish and sediment. This aspect of sampling should be put into the overall monitoring program spelled out in the permit. The first round of information seems to be available from FWS for the lake.

Human Health Impacts

Human health could be affected if people consume groundwater from wells contaminated with landfill leachate. As indicated earlier in the Site Hydrogeology section, landfill leachate may contain a variety of potential contaminants depending on the composition of the refuse. Trace metals and organics, two classes of contaminants which are a public health concern have been found in leachate. The concern is that even small amounts (parts per billion or less) of the substances could have long-term or chronic health effects. Some of the contaminants are thought to be carcinogenic. Many compounds cannot be tasted or easily detected even at high concentrations. The U.S. EPA has established a list of priority pollutants organized in 20 groups--metals, pesticides, etc. Acute and chronic criteria are designated for many of the pollutants (see Appendix C). Some of these substances are found in leachate.

As Figure 26 indicates, several private wells to the southwest of the project are located in the estimated leachate plume. Several mitigation measures are discussed below which would eliminate the potential impact on these wells. If proper mitigative measures are taken and adequate monitoring of groundwater is performed, there would be no detrimental human health effects from leachate in the groundwater system.

SUMMARY

In summary, leachate produced at the Flying Cloud Landfill would contain a variety of metals and inorganic and organic compounds, possibly including trace amounts of volatile organic chemicals. The leachate generated at the landfill will be attenuated by physical, chemical and biological processes as it

migrates, but the specific nature and degree of attenuation is difficult to predict with certainty. Certain of the leachate components will be adsorbed by the soil system underneath the site. The potential for attenuation of leachate would be reduced under a worst-case scenario in which it is assumed that the silt layer is not present beneath the existing landfill site. Other components would migrate into the underlying groundwater system below the site which moves southwest towards the Minnesota River Valley. Leachate would move vertically through the silt and saturated sandy layer and the horizontally through the sandy layer or through the Prairie du Chien bedrock formation. The leachate could emerge in the Minnesota River, Grass Lake or marshes in the valley. This movement could take five to six months through the Prairie du Chien (assuming no silt layer) or many decades through the silt and sandy layers. In either case, the expansion will increase the volume of leachate produced and, during which, ground and surface waters (in the river valley) could be affected by leachate. Leachate affected groundwater becomes significantly diluted as it reaches the Minnesota River. Leachate which reaches the east arm of Grass Lake would produce concentrations below state water quality standards under optimum cover conditions which minimize infiltration at the expansion and encourage runoff. Under a worst-case scenario, assuming no runoff, leachate concentrations in the east arm of Grass Lake could exceed some state water quality standards. There is the other concern that trace metals and organics and other leachate contaminants could impact the aquatic biota and wildlife in Grass Lake and the river valley wetlands through the bioaccumulation of these contaminants through the food chain. These impacts are examined further in the Vegetation and Wildlife section.

MITIGATION ACTIONS

Mitigation of Impacts on Residential/Business Wells

The revised leachate plume (Figure 26) indicates that a number of business and residential wells southwest of the expansion could be impacted. Residential wells in the Bluffs West area to the southeast of the expansion are further removed from the revised plume and not likely to be affected. Because of the likelihood of leachate migration, its nature and content, mitigation measures are identified by area and type of use.

Southwest

There is one residential well--the Cooley well or No. 76--and two BFI/Woodlake wells within the estimated leachate plume southwest of the proposed project. The proposed expansion is not likely to alter the lateral extent of the plume in this area. The expansion would not alter the western boundary of the landfill; additional refuse would be placed on top of the existing fill (see Figures 13 and 14). Therefore, the proposed expansion would likely continue to follow the same pattern produced by the existing landfill.

The Cooley well, No. 76, is approximately 1,000 feet from the southwest corner of the landfill. The well is finished in the Prairie du Chien at approximately 605 feet MSL. Assuming a worst-case--that there is no silt layer beneath the depression--leachate could move vertically into the Prairie du Chien and then as it moves toward the river, intercept the Cooley well. Possible measures to avoid or mitigate potential impacts from the landfill on this well include:

1. Minimizing the potential impact of the expansion at the source would involve foregoing the vertical expansion above the existing landfill. Because the existing fill will continue to settle, placing a liner and collector system under the vertical expansion over the existing landfill does not appear to be possible. The integrity of the liner and collection system could not be maintained. Moreover, these measures would not protect the well from the potential impact of the existing landfill.

2. Establishing a frequent monitoring and/or comprehensive groundwater quality monitoring to ensure thorough, early detection of leachate in the groundwater and the migration of leachate impacted groundwater. Additional monitoring wells upgradient of the Cooley well would provide earlier detection of contaminants. Detection of contaminants would trigger the following:

    a. Moving the well to a safe location if the property extends out of the plume or constructing a deeper well.

    b. Purchase of the property. (The property is located in the Wildlife Refuge.)

    c. Exending city water along Hwy. 169 from County Rd. 1.

    d. Bringing in bottled water for drinking and cooking needs as an interim measure.

Two BFI/Woodlake wells, for office and shop, (Nos. 82 and 83) are located in the estimated leachate plume in the maximum dispersion zone. The wells are finished in the Prairie du Chien at the 603 foot MSL and 592 foot MSL elevations. Assuming a worst case, leachate could enter the Prairie du Chien and intercept the wells. Possible mitigation measures would include:

1. Placing a liner and collection system under the vertical expansion above the existing landfill does not appear to be possible because of the impact of settling on the integrity of the system. Foregoing the vertical expansion would protect the wells, but it would not address the potential imacts from the existing landfill.

2. Frequent monitoring and comprehensive groundwater quality monitoring of the wells including a new monitoring well upgradient of the wells to provide early detection of contaminants. Detection of contaminants would trigger the following:

    a. Extension of city water along Hwy. 169 from County Rd. 1.

    b. Construction of new wells at a greater distance from the landfill and at a deeper level in the bedrock aquifers.

    c. Hauling bottled water as an interim measure.

Northwest

The Flying Cloud drive-in well (No. 86) is located in the center of the drive-in property. The well is located approximately 250 feet from the edge of the existing landfill boundary. Because this well is located on the edge of the core zone of the expected plume, the well could be affected by leachate. (The depth of the well is unknown.) Possible mitigation measures to minimize potential adverse effects from the landfill include:

1. Foregoing the vertical expansion would protect the well, but it would not minimize the potential impact from the existing landfill. Placing a liner and collection system under the vertical expansion over the existing fill does not appear to be possible because of the settling of the existing fill.

2. More frequent and/or comprehensive groundwater quality monitoring. Additional monitoring (monthly) of Well No. 86 during the period when the theater is in operation would increase the detection capability of the monitoring system. Installation of a nest of monitoring wells upgradient of the drive-in well. Detection of contaminants in the well would trigger the following corrective measures:

   a. Construction of a new water supply well for the Flying Cloud Drive-In finished at a considerably lower elevation than at present or at a greater distance from the landfill boundary and outside the plume.

   b. Extension of the city water supply system to the drive-in along Hwy. 169 from County Rd. 1.

   c. Hauling in bottled water as an interim measure.

Mitigation of Impacts on Minnesota River

Groundwaters affected by leachate and migrating to the Minnesota River would have a minimum impact. Leachate contaminants which might be discharged into the river would be adequately diluted even at low flow by the natural mixing of the river. Assuming a worst case--no attenuation of leachate--there would be minimal impact on the river. No mitigation measures specifically addressing the river impacts are necessary. Those measures discussed in the section addressing the mitigation of the impacts on Grass Lake would have the secondary effect of further reducing any impacts on the river.

Liner and Leachate Collection System

Placement of a liner and collection system beneath the expansion would minmize the migration of leachate from the project site to Grass Lake, the Minnesota River and into the private wells southwest of the site. Placing a liner of clay, man-made membrane or a combination of both beneath the project or taking advantage of the silt layer known to exist beneath the horizontal expansion area would prevent leachate from migrating downward and then horizontally towards the river valley. Placing a liner under the expansion located over the existing landfill does not appear to be effective. Settling of the existing fill would disrupt the integrity of the liner and collection system.

Placing a liner under the 42.4 acre horizontal expansion would result in a reduction of the leachate leaving the site. As a result the reduced volume of leachate leaving the site would be that produced by the existing fill as represented by the "existing site" volumes indicated in Table 10 assuming little leachate escapes through the liner and collection system. Table 10 does not indicate a separate estimated volume of leachate produced by the vertical expansion over the existing landfill. This portion of the project would not increase the volume of leachate since the same amount of surface water would infiltrate both the expansion and existing landfill refuse as it moves downward. However, the vertical expansion would extend the period of peak leachate generation and increase the magnitude of contaminants potentially produced during the life of the project. The existing landfill would continue to generate

13.1 to 51.6 (worst case) acre-feet per year of leachate after field capacity is reached (1982). This does not address how long leachate will continue to flow, since this is difficult to estimate. It could be several decades. Table 11 indicates that leachate could impact receiving waters until the mid-twenty-first century depending on the rate of movement from the site.

If the above scenario is assumed, some further estimates can be made about the water quality impacts if a liner and collection system were installed under the horizontal expansion. Again, assuming that 51.6 acre-feet (worst case) of leachate per year will continue to be generated, some comparisons with the results in Table 13 can be made. The only input figure to the equations that will change is the quantity of leachate (Q_l). The new flow rate for leachate will be 0.073 cfs (as opposed to the previous value of 0.102 cfs). Calculating the concentrations of chemicals in the lake (C_o) leads to new values as noted in the following table.

	Concentrations in Grass Lake-East Arm (mg/l) Lined Horizontal Expansion		MPCA Surface Water	MDH Drinking Water
	Maximum Infiltration[1]	Minimal Infiltration[2]	Standard	Standard
Chloride	101-146	28.40	100	--
Chromium	0.003-0.011	0.001-.003	0.05	0.05
Cadmium	0.0002	0.0001	0.01	0.01
Copper	0.001-0.013	0.004-0.004	0.01	--

[1]Assumes 5.9 inches infiltration of existing landfill.
[2]Assumes 1.5 inches infiltration of existing landfill.

This calculation shows that installing a leachate/collection system under the horizontal expansion could result in substantial improvement in the worst case. The chloride values still exceed the standard, but one of the assumed typical leachate concentrations results in only a 1.0 mg/l exceedance which is negligible. The exceedance for copper that was seen previously in Table 13 still exists, but again it is reduced substantially to a negligible value (0.0003 mg/l) over the standard. The values for cadmium and chromium are similarly lowered, but they are below the standard under the previously used assumption. The first scenario above under "maximum infiltration" assumes 1.5 inches of infiltration moving through the existing landfill. The reduction in infiltration assumes that under optimum conditions a less permeable cover would reduce infiltration at the existing landfill. As the table above indicates, a liner and collection system would reduce the concentrations of leachate mixed in Grass Lake. The potential impacts of leachate contaminants are discussed in the Vegetation and Wildlife Section.

Foregoing the vertical expansion would also minimize the movement of additional leachate off the project site. Although a specific value cannot be arrived at to estimate the reduction, it can be evaluated qualitatively. Foregoing the vertical expansion would reduce the magnitude of the contaminants potentially moving from the site over the life of the project, and therefore, the concentrations of the leachate impacting Grass Lake. Expanding the fill vertically above the existing landfill could extend the period of leachate generation and the period of peak production. This would extend the period during which leachate could affect the groundwater, Grass Lake and marshes. Foregoing the expansion would cause leachate production at the existing landfill to peak and gradually diminish as the landfill ages.

Limiting the vertical expansion to processed waste only would also minimize the impact on groundwater. Removing the chemical and biological contaminants through recycling and oxidation, for example, incineration, leaving only inert materials would eliminate most leachate production.

Reduction of Leachate Produced

One important measure for reducing the undesirable effects of leachate on groundwater is to reduce the amount of leachate produced by decreasing percolation. Percolation can be reduced by decreasing runoff and evapotranspiration.

A two percent slope (two-foot rise for 100-feet horizontal distance), which is the minimum required for final cover by the MPCA, is likely inadequate to counteract the effects of settling. Settling creates depressions that act as ponding areas for precipitation. These ponding areas reduce runoff and promote infiltration. To counteract the effects of settling, a steeper slope for the final cover would be helpful. A slope of five or six percent should alleviate the tendency for ponding. However, a uniform six percent slope would require a final elevation of about 1,000 feet in the peak fill area compared to the proposed final elevation of 923 feet MSL. However, a final contour design utilizing ridges and drainage swales could achieve a 6 percent slope over much of the active fill area. Whatever the final slope, yearly or more frequent inspection and maintenance of the site by filling depressions and revegetating denuded areas would help reduce infiltration.

Increasing evapotranspiration can also reduce percolation. Evaporation can be increased by planting vegetation with known high water consumption. Meadow grass uses 22-60 inches per year, for instance, while deciduous trees use only 7-10 inches per year (44). Grasses like Smooth Brome, tall Fescue and Trefoil have been used successfully (45). Other commmonly used grasses include Canary and Deer tongue varieties. Commonly used shrubs include Bristly locust, Indigo bush, and Autumn-olive (46).

Whatever species of plants are selected, a prompt seeding as soon as possible after final cover is in place for each phase would be useful. The site could be mulched with hay or straw to protect the seeds during germination and reduce erosion until the plants establish themselves (47).

Groundwater Monitoring

The objective of post-closure monitoring during the operation of the landfill and post closure is to detect the movement and concentration of contaminants in groundwater moving away from the landfill site. Monitoring is not a mitigation measure by itself. It is a means to trigger other mitigation or corrective measures. To meet this objective, monitoring wells must be carefully placed to maximize their probability of detecting any leachate movement.

One or two background monitoring wells are needed to establish baseline values for the chemical constituents of interest. Background monitoring wells are placed upgradient of the landfill site. Concentrations of chemical constituents measured here represent levels found in groundwater uncontaminated by landfill leachate. These values are compared with the concentrations from monitoring wells downgradient of the landfill. If the downgradient monitoring wells have significantly higher values, it can be assumed leachate is contaminating the groundwater.

Monitoring wells placed at several different distances downgradient would monitor the progress of the contaminated groundwater. They could also be located across the entire plume front including the area affected by plume dispersion. If contaminated groundwater is detected near the outside edge of the dispersion plume, additional monitoring wells could be installed further out to determine if contaminated groundwater has moved outside the expected plume boundaries.

The depth at which the monitoring wells are finished is also important. If a monitoring well is finished at a poorly chosen depth, it would be possible for the contaminated groundwater plume to pass either over or under the well screen. To reduce this possibility, monitoring wells are commonly nested in one location. Nesting refers to the grouping of two or more wells close together, but each well finished at a different depth. This significantly reduces the possibility of contaminated groundwater moving past a point without being detected. Currently there is only one well downgradient of the landfill which is finished in the Prairie du Chien. In view of the potential for movement of leachate through the Prairie du Chien formation additional monitoring in this formation could provide more adequate detection.

In addition to monitoring wells, certain naturally occurring surface water bodies can be made part of a monitoring system. Such waters could be springs, ponds, lakes and streams located downgradient of the landfill and in expected groundwater discharge areas. This type of monitoring would detect surface water contamination and provide information on contaminated groundwater movement.

Monitoring should continue for as long as the landfill can be expected to generate significant amounts of leachate or as long as the monitoring results continue to show significant levels of groundwater contamination. Deep landfills require longer periods of time to stabilize (48). The Flying Cloud Landfill is very deep. Therefore, monitoring for a longer period after closure than normal would be prudent unless previous montoring results indicate that significant groundwater contamination has ceased. Estimates of leachate migration indicate that it could be several decades before leachate might reach Grass Lake.

Monitoring should be frequent enough to provide sufficient opportunity to detect contaminants in groundwater. Normally a quarterly monitoring schedule is followed, although the requirement for monitoring in the winter quarter has been deleted by the MPCA due to sampling problems caused by the weather.

The chemical constituents monitored should be those that exist in leachate significantly above background levels and are highly mobile in the subsurface environment. The MPCA has established a list of such constituents.

Corrective Measures for Grass Lake

If monitoring of groundwater and surface waters, particularly Grass Lake, indicates that leachate concentrations moving from the landfill may pose a risk to public health, water quality or biota, corrective measures would be taken. Any corrective measures would be subject to the approval of MPCA. Once the refuse is in place in the expansion it would not be feasible to line the expansion area. Further filling could be stopped at the landfill. Measures would be limited to protecting the public from contaminated groundwater and minimizing the impact on Grass Lake and the wetlands in the river valley.

The mitigation section above indicates number of measures which could be applied to private residential and business wells including extending city water service, the buy-out (and relocation) of affected residents, and construction of deeper wells.

Corrective measures for Grass Lake would be more complex and could disrupt the lake ecosystem and conflict with wildlife management purposes. A detailed study of the lake and the lake ecosystem would be necessary to design an appropriate mitigation/corrective program. Some potential corrective measures follow: the installation of barrier wells upgradient to remove contaminated groundwater before it reaches the lake, dredging the lake bottom to remove contaminated sediment, flushing the lake and physical-chemical sealing of the lake bed. Each of these could negatively affect the lake ecosystem. Barrier wells might reduce the inflow of groundwater to the lake through the natural springs altering the vegetation at the lake. Dredging or sealing the lake bottom would disrupt the benthic or lake bottom organisms which serve as the food supply for other micro-organisms in the lake on which fish and waterfowl depend. Flushing the lake could change its temperature, water quality and vegetation and interrupt plant and animal life cycles. Pumping the water for flushing from the river could be concern depending on the river water quality. Removal of pollutants via dredging or barrier wells could create other disposal problems and environmental concerns. For example, the wastewater collected in the barrier wells might require some treatment before it is disposed.

End Land Use

Prudent final uses of the Flying Cloud Landfill site would prevent disruption of the final cover and reduce total percolation through the refuse. The preliminary proposal by Woodlake to develop a golf course could significantly increase the amount of percolation through the refuse and subsequently the amount of leachate generated (49). The increased percolation results from irrigation of golf course greens and fairways. Because the soils on the site are well-drained, much of the water applied for irrigation would percolate down to the refuse. Likewise, any land use where lawn sprinkling is a practice such as maintained parkland would increase percolation.

Construction activities would disrupt the final cover. In addition, poor bearing capacity of surface layers and uneven settlement over a long period of time could preclude the building of permanent structures over the actual fill site. It could be as long as 100 years before the site is capable of adequately supporting any type of heavy structure.

The landfill site could be developed as open space in conjunction with the proposed Minnesota River Wildlife Refuge. By planting the site with some of the grasses and shrubs previously mentioned and allowing them to grow naturally an area suitable for wildlife habitat could be created.

There are low-density commercial/light industrial uses which might require little or no heavy construction. Long-term, limited settling may be less of a problem for these uses. For example, the outdoor storage of equipment or supplies awaiting sale or shipment or commercial recreation development might be suitable end uses. Small on-site buildings, if necessary, could be designed or located to protect them from settling. A joint evaluation by the city and Woodlake could be undertaken to determine the constraints posed by settling and the potential interim and long-term uses.

SURFACE WATER

Any construction activity, including landfilling, carries with it the potential to affect surface water bodies by increasing runoff volumes, erosion and sedimentation. Landfills also have the potential to affect surface waters by changing the volume and quality of groundwater inflows. Off-site water bodies can be affected as well as those on-site.

EXISTING ENVIRONMENT

Several surface water bodies and wet areas are present on or near the Flying Cloud landfill. They include an on-site detention pond, a surge pond in the river valley, Grass Lake, the Minnesota River, Purgatory Creek, Riley Creek and a wet meadow; a portion of the meadow is used as a stormwater drainage basin in accordance with the city's drainage plan (Figure 29). Grass Lake is divided into east and west arms by a narrow neck of land and marsh.

Three major watersheds occur near the site: Riley Creek, Purgatory Creek and the Middle Minnesota River. Riley Creek receives runoff from areas west of the landfill, and flows through the west arm of Grass Lake to the Minnesota River. Purgatory Creek flows east of the existing site into the Minnesota River. Most of the existing active landfill is self-contained; the remainder of the site and expansion area drains to the Minnesota River and Purgatory Creek (Figure 29).

The Minnesota River frequently overflows into Grass Lake. Based on a lake elevation of 696 feet the river would begin to flow into the lake when the river reaches a flow rate of 6,500 cubic feet per second (cfs). Historic river data indicates that this condition occurred 31 out of 32 years from 1950 to 1981 (50). Inflow has occurred during snowmelt in the spring and at other times in the summer and fall after periods of high precipitation and runoff. It has occurred more than once in some years.

Although inflow occcurs frequently on an annual basis, the period or duration is relatively short. From 1950 to 1981 the number of days the river reached a flow of 6,500 cfs ranged from 0 to 168 days. However, the annual average was 59 days (51).

Inflow from the river does not always result in flow through the lake from west to east. Flow through the lake occurs when the river level reaches an elevation of 703 feet. The elevation of 703 feet was reached during 22 of the years between 1950 and 1981. This conditions lasted an average of 18 days per year (52).

The data suggests that although some mixing and possibly replacement of lake water could occur, most of the time, the lake is not affected by the river because there is no overflow or flooding.

The quality of the surface water bodies is quite variable (Tables 14 and 15).

Figure 29. SURFACE WATER FEATURES

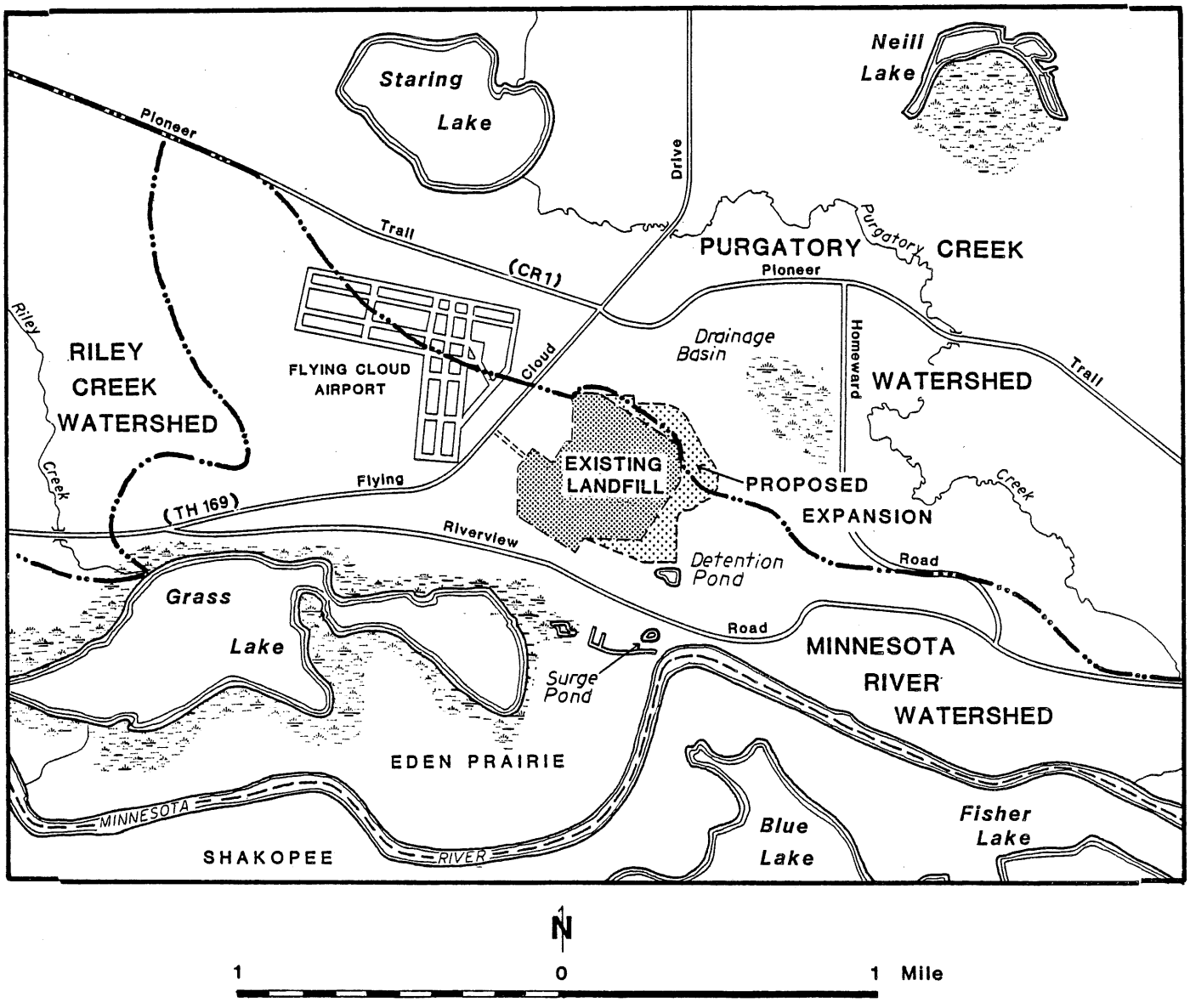


Table 15
EXISTING SURFACE WATER QUALITY[1]

Water Body	Discharge (cfs)	Suspended Solids (mg/l)	Chlorides (mg/l)	Specific Conductance (mmho/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/l)	Nitrates (mg/l as N)	Total Phosphorus (mg/l as P)
Minnesota River[2]	380-12,400	7 - 615	28 - 54	699 - 1260	.20 - 180	7.2 - 12.0	0.4 - 12[5]	0.10 - .790
Riley Creek[3]	N.A.[6]	~1 - 19	13 - 29	495 - 580	1.4 - 9.5	8.7 - 12.0	2.0 - 2.6	0.02 - 0.69
Purgatory Creek	2.0-25.8	~1 - 102[4]	17 - 47	400 - 620	3.4 - 2.3	7.6 - 12.6	0.2 - 1.2	~0.01 - .23

[1]All data except Purgatory Creek discharge rates are for 1981; the Creek discharge rates are for calendar year 1980, and were measured about 1 mile northwest of Riverview Road
[2]Sampled near Jordan, Minnesota during water year 1981
[3]Sampled at Trunk Highway 169-212 during calendar year 1981
[4]All quality parameters sampled at Riverview Road during calendar year 1981
[5]Included NO_2 + NO_3
[6]N.A. means data was not available

Sources: 1980 and 1981 Engineer's Annual Report, Riley-Purgatory Creek Watershed District, prepared by Barr Engineering Co., Minneapolis, MN; Water Resources Data for Minnesota Water Year 1981, Vol. 2. Upper Miss. and Mo. River Basins. USGS, St. Paul, MN.

Table 14
MAXIMUM CONCENTRATIONS OF SELECTED METALS
IN THE MINNESOTA RIVER, 1982
(River Mile 3.5, East Bloomington)

Metal (dissolved)	Concentration (mg/l)	Range (mg/l)
Arsenic	0.0039	0-0.0041
Cadmium	0.0003	<0.0001-0.0084
Chromium	0.0022	<0.0010-0.0079
Copper	0.0039	0.0019-0.0123
Lead	0.0024	<0.001 0.0355
Mercury	<0.0002	<0.0002

Source: 1982 River Quality Report-Summary Volume. Metropolitan Waste Control Commission, St. Paul, Minnesota.

Existing Minnesota River quality is generally poor; the river is turbid, generally has a high amount of suspended and dissolved solids, and regularly violates water quality standards for parameters such as turbidity, conductivity, and hardness (53). Riley Creek and Purgatory Creek, in contrast, only occasionally violate water quality standards other than those for fecal coliform (54). No reliable data on the quality of water in Grass Lake was found; however, it is expected to be better than that in the Minnesota River because it is fed primarily by groundwater.

Data on the general characteristics of Grass Lake is available (Table 16), as is limited data on pollutant levels in its sediments and fish was presented in the Site Hydrogeology section.

Table 16
CHARACTERISTICS OF GRASS LAKE

Size	467 acres
Substrate	Organic material over mud
Percent open water	25
Average depth	1.5 feet where vegetated 2.0 feet in open water

Source: U.S. Fish and Wildlife Service. "A Survey of Potential Contaminants in Fish and Sediments from Lakes on the Minnesota Valley National Wildlife Refuge." Aug. 1981.

Generally, sediments in the lake are considered to have moderately elevated levels of arsenic, high levels of manganese, and low levels of other metals tested (55). Only low levels of organics and metals have been found in bullheads, however, the Fish and Wildlife Service feels that bioaccumulation could be a problem in the future (56). Some possible sources of the contaminants are Riley Creek and the Minnesota River groundwater and overland runoff.

The MPCA has classified Grass Lake as 2B, 2C, 3B, 3C, 4A and 4B which designates the lake as suitable for the propagation and maintenance of cool or warm water sport or commercial fisheries and all types of aquatic recreation for which the waters may be suitable, including bathing.

At the present time, only the on-site detention pond and a surge pond in the Minnesota River Valley receive runoff from the landfill (Figure 8). The surge pond drains into the adjoining marshy area and abandoned ditches to the south. It does not appear to drain into the Minnesota River. Runoff from the completed portions of the fill, as well as much of Woodlake's office and shop area, are directed in drainage swales to the detention pond. This pond has a capacity of 20 acre-feet and is designed to handle a 100-year rainfall. As the pond fills, water flows through a 42-inch corrugated metal outlet pipe to a buried variable-diameter pipe, where it is carried beneath the bluff to the south side of Riverview Rd. Water can flow at 30 cfs into a constructed surge pond (57). Runoff from uncompleted portions of the fill are directed to unfilled portions of the landfill pit and allowed to infiltrate. If the expansion does not occur, runoff will be directed eastward as well as toward the pond when final contours are reached under Woodlake's present permit (Figure 30).

Runoff from current landfill operations appears to have little effect on off-site water bodies. On-site runoff and erosion are controlled by the stormwater control system. Runoff is released at a controlled rate at the base of the bluffs, after a portion of the suspended materials have had a chance to settle out in the detention pond. Prior to the time the stormwater control system was installed, a washout of the bluff occurred during a heavy rainfall in 1978. Waste materials and eroded soil from the bluff washed into Grass Lake. The stormwater control system should prevent such incidents from happening in the future.

Erosion problems have occurred along the bluffs southeast and southwest of the landfill. Specifically, the areas south of Woodlake's parking lot and south of the detention pond have eroded noticeably. The company has been required to regrade the areas and place topsoil and sod over them.

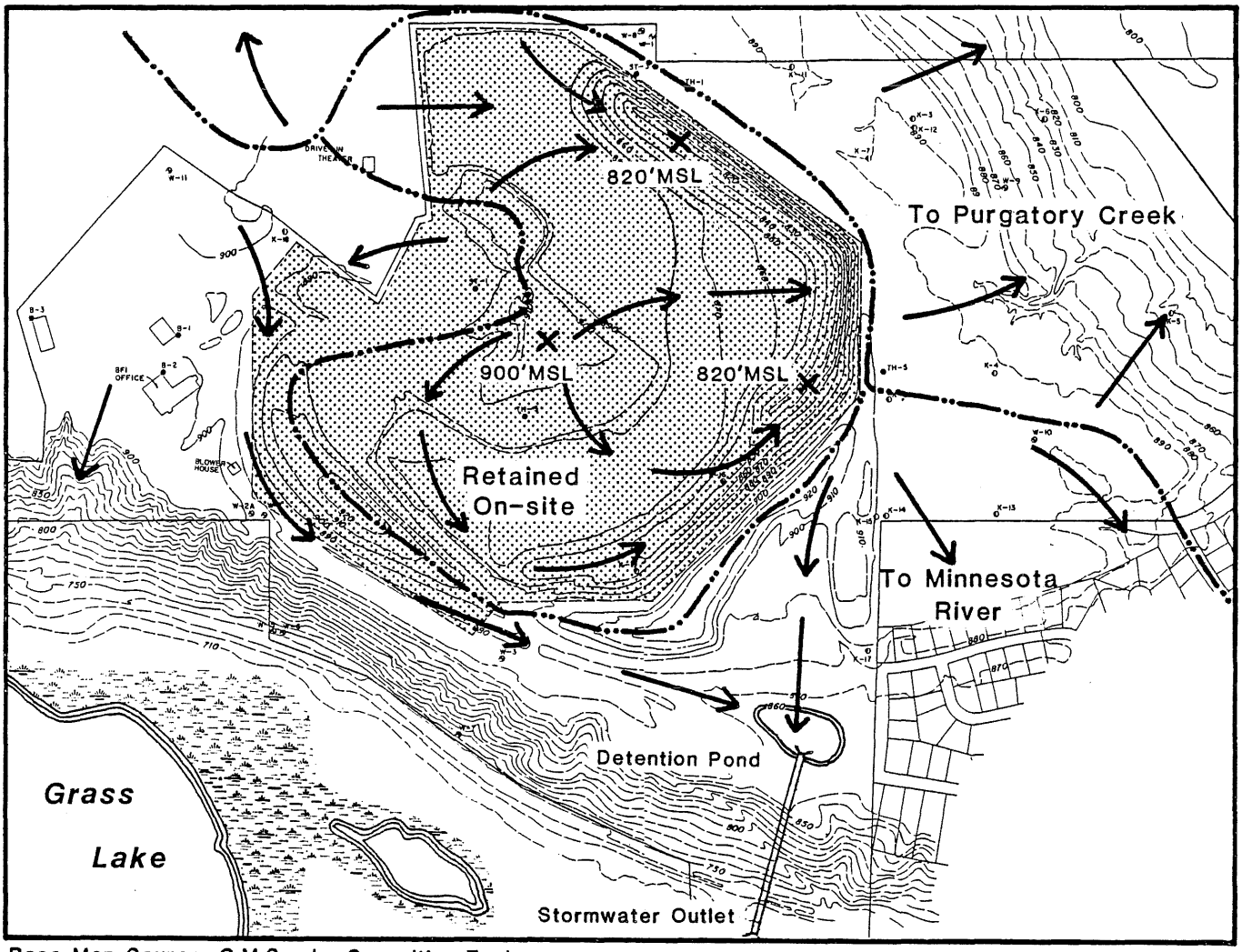
Leachate has apparently not reached any of the nearby surface water bodies; however, several of the groundwater monitoring wells south of the existing fill have shown evidence of contamination. Variable sampling procedures, analysis, and well depths make it difficult to draw any conclusions about the groundwater monitoring results, however. Details about groundwater monitoring can be found in the Site Hydrogeology section of the FEIS.

In 1982, trichlorofluoromethane, arsenic, chromium, mercury, phenol, zinc, and antimony were found at barely detectable levels in four surface water seeps at the base of the bluff. It is unclear whether these compounds indicate leachate contamination; the presence of additional compounds would be expected if leachate were present. Furthermore, methodological errors or laboratory contamination could have resulted in false readings.

POSSIBLE IMPACTS: ALTERED WATER BUDGETS AND WATER QUALITY DUE TO RUNOFF CHANGES

The proposed expansion will alter the water budgets of nearby surface water bodies to some extent. Changes in the runoff portion of water budgets can be of concern for two reasons: they may change the volume of runoff reaching water bodies, and they may change the quality of runoff reaching water bodies.

Figure 30.
SURFACE WATER DRAINAGE
UNDER CURRENT AMENDED PERMIT



Base Map Source: G.M.Sunde, Consulting Engineer

Surface Water Drainage Divide

Direction of Flow

N

0 500 1000 1500 Feet

The expansion area is currently covered by grasses and herbaceous plants. This cover will be removed during construction, causing the volume of runoff to increase and infiltration and evapotranspiration to decrease. Initially, the extra runoff will be carried to the drainage basin east of the site, where it could infiltrate, evaporate, or be carried into Purgatory Creek. After the proposed visual and noise berm is constructed and vegetated, and as pit excavation begins, runoff from the horizontal expansion area will infiltrate or evaporate on-site. As the expansion reaches final contours, most runoff will be directed to the on-site stormwater pond. During storms with over one inch of rainfall, the pond's outlet pipe will carry water to the surge pond in Minnesota River Valley (Figure 30). Storms of one inch or more could be expected approximately once a year.

Woodlake has proposed several measures to control runoff, erosion and sedimentation. Development of the landfill site will be staged. While the fill is under construction, cover material stockpiles will be covered with topsoil and turf (58). Gullies and rapidly eroding areas will be planted with vegetation (59). Runoff from uncompleted portions of the fill will be directed to unused portions of the landfill, while that from completed portions will be directed to the detention pond. Short-term erosion control measures will also be implemented as each phase of the landfill is completed (60). Within three months after the landfill is closed, and after final cover is placed, the land surface will be seeded, fertilized and graded (61). (MPCA regulations require, however, that final cover be placed within one month after closure, and that the finished surface then be immediately covered with topsoil and seeded (62). Areas terminated in the winter are to be covered with topsoil and seeded immediately in the spring.) Woodlake proposes to inspect the fill every six months for 10 years to ensure that vegetation is surviving and to assess erosion and sedimentation (63).

Effects on the Off-Site Drainage Basin

Small changes in the volume and quality of water reaching the drainage basin east of the site are expected. This site currently has a storage capacity of 36 acre-feet (64). Initially, increased runoff caused by removal of vegetation and construction of the berm will increase flows to the marshy area. Runoff quality will decrease because of erosion during berm construction.

Runoff quality from construction sites is typically low, primarily because of a high concentration of suspended materials. Table 17 gives examples of the quality of runoff generated by two construction sites in the Twin Cities Metropolitan Area. These sites were sampled as part of a nonpoint source pollution study in the Twin Cities Metropolitan Area (65). The Iverson site was at the inflow to a detention pond draining a subdivision construction area, while the PDQ-Valley View Rd. sampling location was in a storm sewer that drained a multifamily residential area with some construction activity. Table 18 shows, in general terms, the relative rates of soil erosion associated with various land uses, including construction.

Table 17
FLOW-WEIGHTED MEAN CONCENTRATIONS AND RANGES OF
CONCENTRATIONS FOR WATERSHEDS WITH CONSTRUCTION ACTIVITY

		mg/l							(ug/l)		
Site		TSS	VSS	COD	TKN	N/N	TP	Cl	Pb	ZN[1]	Cr[1]
Iverson	M	740	244	38	1.24	0.07	0.62	0.5	20.0	235	255
	R	17-26,610	0-2,640	1-597	1.0-29.2	0.05-2.45	0.20-13.1	1.0-66	8-310	28-530	9-1,120
PDQ	M	768	89	146	5.07	0.72	1.39	29	136.0	141	31.4
	R	17-8,210	5-860	32-1,505	0.50-22.8	0.05-3.1	0.12-8.4	0.5-3,600	5-1,260	25-620	1-270

[1]Not flow weighted.
M = Mean
R = Range

Source: Oberts, May 1982, Water Resources Management Nonpoint Source Pollution Technical Report

TSS: total suspended solids
VSS: volatile suspended solids
COD: chemical oxygen demand
TKN: total Kjeldahl nitrogen
N/N: nitrate/nitrite
TP: total phosphorus
Cl: chloride
Pb: lead
Zn: zinc
Cr: chromium

Table 18
REPRESENTATIVE RATES OF EROSION FROM VARIOUS LAND USES

	Metric Tons/ sq km/year	Tons/ sq mi/year	Relative to Forest = 1
Forest	8.5	24	1
Grassland	85	240	10
Abandoned Surface Mines	850	2,400	100
Cropland	1,700	4,800	200
Harvested Forest	4,250	12,000	500
Active Surface Mines	17,000	48,000	2,000
Construction	17,000	48,000	2,000

Source: U.S. Environmental Agency, Methods for Identifying and Evaluating the Nature and Extent of Non-Point Source Pollutants, Oct. 1973.

Woodlake estimates that actual berm construction will take about three to four months, however, berm completion may take place over a one year period. Revegetation of the berm will begin taking place about one and 1/2 months after the berm is started (66). This will include tree planting and reseeding with grasses. After good vegetative growth is established, runoff volumes will decrease and runoff quality increase. As the fill is brought to final grades, runoff volumes will increase again as water on the northern portion of the site is directed to the drainage basin. Table 19 compares runoff volumes to the basin before and after the expansion for the 100-year, six-hour rainfall event. Appendix A contains details on how these numbers were calculated.

Table 19
RUNOFF FLOWS TO THE OFF-SITE STORMWATER DRAINAGE BASIN
BEFORE AND AFTER THE LANDFILL EXPANSION*

	Acreage Draining to Basin	Runoff Volume (acre-feet)
Before expansion	20.8	1.58
After fill completion	10.8	1.71-2.14**

* SCS runoff curves from the Hydrology Guide for Minnesota were used in these calculations.

** The smaller number assumes hydrologic soil group C; the larger, group D. Final cover soils for the landfill site should fit into hydrologic soil group D (soils with very slow infiltration rates). However, improper placement of the soils, channeling, and erosion could result in higher infiltration rates and lower runoff rates than expected. For these reasons, both estimates are included for all runoff figures in this chapter.

Despite the fact that the acreage draining to the basin decreases, runoff volumes increase slightly. This occurs because the final cover soils for the fill are less permeable than existing soils. Furthermore, the final vegetative cover on the landfill will probably not be as effective at preventing runoff as that currently on the horizontal expansion site for several years.

The Metropolitan Council study found that total pollution load is primarily determined by runoff volume (67). Because the increase in runoff volume to the drainage area is small, the overall impact of the expansion on water quality is also expected to be small, provided that no unusual contaminants enter the runoff.

Effects on the Minnesota River and Grass Lake

Small changes in the water budget and water quality of the Minnesota River may occur because of runoff and erosion associated with expansion. These changes should be insignificant, however.

Minnesota River and Grass Lake water quality should not be affected by the construction activities and erosion associated with berm building and initial excavation. The drainage basin to the east of the site, as well as the on-site detention pond, will trap most eroded materials and act as storage ponds for additional runoff.

Significant runoff- and erosion-related changes in the Minnesota River and Grass Lake are not expected during fill operations or after closure if proper maintenance of Woodlake's stormwater control system is practiced. This system now includes drainage swales, a 20 acre-feet capacity detention pond, a pond outlet pipe with a capacity of 30 cubic feet per second (cfs) and a surge pond that drains overland to the adjoining marshy area and to the abandoned ditches to the south. The capacity of the detention pond will be increased to 32 acre-feet if the expansion is granted.

Runoff from the completed landfill, after vegetation is reestablished, should be about .16 to .20 acre-feet/acre of land for the 100-year, six-hour storm. Before vegetative cover is established, however, runoff will be about .28 to .31 acre-feet/acre of land.

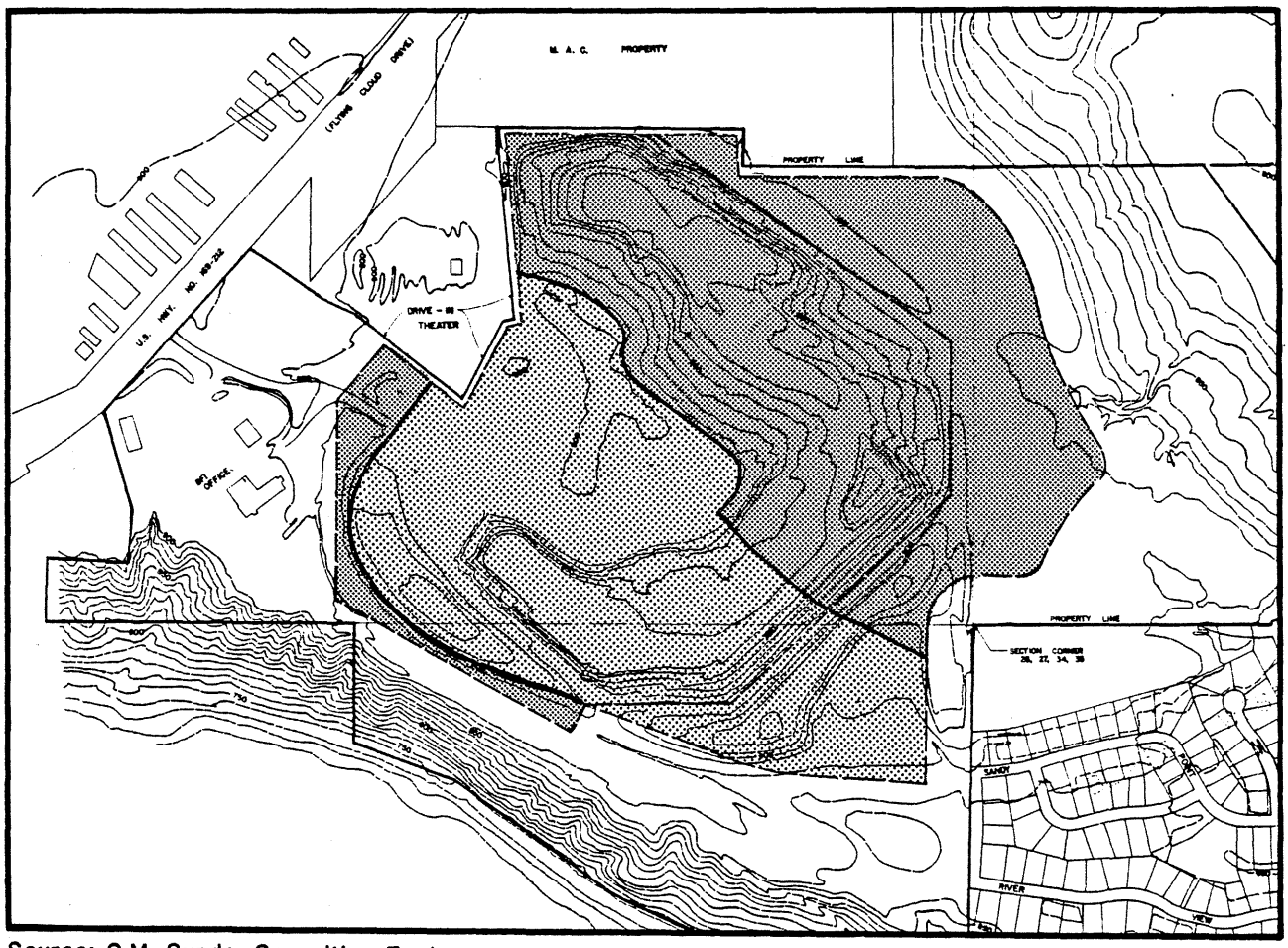
Stage 8 of the proposed landfill expansion plan will have the largest area of unvegetated soils, approximately 65.0 acres (Figure 31). During this stage of the expansion, runoff volumes will be approximately 37.9 to 40.7 acre-feet to the on-site detention pond during the 100-year storm. Higher volumes of runoff could occur when spring snowmelt occurs over frozen ground.

POSSIBLE IMPACTS: LEACHATE MIGRATION

In addition to being affected by runoff from the landfill, surface water bodies can be affected by leachate migration. Leachate formation and movement are discussed in detail in the Site Hydrogeology section of the FEIS. This section highlights the information on leachate as it relates to surface water quality.

The direction of leachate movement from the landfill will be the same as the water in the aquifer. In the vicinity of the Flying Cloud Landfill, groundwater flows in the deep aquifer are toward the Minnesota River. Flow patterns in the shallow water table are also toward the river, however, some flow to the east could occur while it moves vertically and then towards the river. Based on groundwater flow directions, it initially appears that the city's drainage basin, Grass Lake and the Minnesota River have the potential to receive leachate.

Figure 31. STAGE 8 COVER PLAN



Source: G.M. Sunde, Consulting Engineer.

N

0 600 1200

Scale In Feet

FINAL FILL AND COVER PLACEMENT IN PROGRESS

FILL COMPLETED

Effects on the Off-Site Drainage Basin

Leachate should reach the bedrock aquifer before it reaches the basin (see Site Hydrogeology section). Because flow gradients in the bedrock aquifer are toward the river, any leachate that reaches the bedrock aquifer in this area will be directed toward the river rather than the basin.

Effects on Grass Lake

Some leachate from the landfill will probably reach Grass Lake. Groundwater flow gradients are toward the lake and its surrounding marshy areas as well as the Minnesota River. Furthermore, the lake serves as a discharge area for groundwater.

The estimated volume of leachate generated per year at the landfill would range from about 19 acre-feet/year to 73 acre-feet/year. The low estimate was derived from runoff estimates based on the SCS Curve Number Method assuming 1.5 inches of infiltration, while the high estimate was calculated assuming that no runoff occurs and 5.9 inches infiltration. Leachate from the proposed expansion is estimated to initially reach the lake as early as 1997 assuming the worst case, however, the exact volume that will reach it is unknown.

The composition of the leachate will change as it travels from the landfill to the lake. A number of chemical, physical and biological processes will attenuate, or weaken, the leachate. These processes are not fully understood, therefore, it is impossible to predict the exact composition of the leachate as it reaches the lake. Also, assuming the worst cases--that the silt layer is not present beneath the existing landfill--the effect of attentuation could be reduced.

Despite the fact that the exact volume and composition of leachate reaching Grass Lake is unknown, maximum pollutant concentrations can be estimated (see Site Hydrogeology section).

The concentrations in the east arm of Grass Lake could exceed some MPCA standards for surface water quality assuming a worst case in which there is no runoff from the landfill. It is also assumed that there is no attentuation or dilution of leachate in the groundwater. Standards for chlorides and copper would be exceeded, but the estimated concentration of cadmium and chromium would be below the state standards (Table 13). Estimates of the lake impact assuming a low volume estimate of leachate indicate that the concentrations of all four chemical would be below standards. This estimate assumes that under favorable conditions there would be only 1.5 inches of infiltration in the landfill expansion.

Periodic overflow or flooding of Grass Lake by water from the Minnesota River may temporarily reduce leachate parameter concentrations in the lake water. As previously noted the river backflows into the lake nearly every year and that some flow through has occurred in about two of every three years. Flow through conditions could cause the lake water to be replaced and cause a temporary change in water quality. (See the Site Hydrogeology section.)

Although river overflow or flow through might affect lake water quality temporarily, these conditions would have minimal impact on pollutants in the lake bottom. For example, metals discharged to the lake in the leachate would be bound to sediments and settle to the bottom. The velocity of the river as it

overflows the lake would be low which would minimize the potential for scouring of the lake bed. At high water or flood levels the Minnesota River slows significantly as it moves through the wide floodplain in which Grass Lake is located. In the flood fringe area in which the lake is located, the velocity of water flow would be significantly less than that in the river channel. According to a model developed by the U.S. Army Corps of Engineers to simulate river velocities during a 100-year flood the velocities in the Grass Lake area would range from 0.90 to 0.94 ft/sec. The velocity in the river channel for the same area would range from 2.55 ft/sec to 2.73 (68). (A 100-year flood would be representative of worst case flood levels for the floodplain.) According to a report prepared by the U.S. Soil Conservation Service flow velocities would have to exceed 2.0 ft/sec to erode silty clay and 2.5 ft/sec. to erode clay soil (69). The bed of Grass Lake is characterized as organic material over mud. The mud is likely to consist of silty and clay soils. Some of this sediment is likely to be deposited by the river due to the lower velocity and settling of soil particles carried by the river.

While pollutant concentration estimates are useful, it is not possible to state that no changes to Grass Lake will occur. There is a possibility, for instance, that some substances (such as metals or some organic compounds) could accumulate in the sediments or bioaccumulate in the food chain. Other substances may be toxic or harmful to vegetation or animal life in the lake at very low concentrations. Furthermore, concentrations of some substances may violate water quality standards during periods of low lake outflows. This fact may be of importance if the FWS begins managing lake levels. The drawing down of wetlands to a dry or nearly dry state may be used as a management tool to stimulate nutrient release in the form of food plants useful to wildlife during subsequent reflooding. Drawing down the level of Grass Lake could increase the concentration of leachate contaminants in the water. The plan of the FWS for the Upgrala unit recommends that an additional water control structure be added at the outlet to Grass Lake. Drying of marsh bottoms to release nutrients could also release the contaminants bound in the sediment.

Leachate concentrations could exceed state standards where it emerges in localized surface waters such as seeps and marshes before it flows to Grass lake and is diluted to a greater extent. Volatile organics would dissipate in the air.

Effects on the Minnesota River

Effects on the Minnesota River should be minimal. Flows in the river are great enough to dilute the concentrations of pollutants to low levels below MPCA surface water quality standards. The record low flow of 79 cfs, for instance, is 18 times greater than the outflow used to compute pollutant concentrations for Grass Lake (see Site Hydrogeology section). Typical flows are even higher (Table 20). The seven-day duration, 10-year low flow, for example, is over twice the minimum recorded flow.

Table 20
MINNESOTA RIVER DISCHARGE CHARACTERISTICS

Parameter	Discharge (cfs)
Mean*	3,380
Maximum recorded*	117,000
Minimum recorded*	79
100-year flood*	115,000
10-year flood*	48,400
Seven-day duration, 10-year low flow	168
Seven-day duration, two-year low flow	350

* Near Jordan, Minnesota.

Sources: Water Resources Data for Minnesota Water Year 1981. Vol. 2 Upper Miss. and Mo. River Basins. USGS, St. Paul, MN.; Baseline Environmental Inventory, Twin Cities Metropolitan Area. Hickok and Assoc., et al. Dec. 1977; Final EIS, Freeway Sanitary Landfill, Metropolitan Council. 1981.

Although the estimated concentration of pollutants which might reach the river would be below MPCA standards due to dilution, the metals, organics and other pollutants might add to the pollutants from other sources. Or small amounts of the contaminants could have cumulative, long-term effects on river quality. There are no state or federal standards for many of the metals and organics.

SUMMARY OF POTENTIAL IMPACTS

Runoff

The proposed expansion will change the amount and quality of runoff reaching the city's drainage basin east of the site, the Minnesota River and Grass Lake, however, these changes should not be significant. Increases in runoff volume to the city's drainage basin will be small. Proper maintenance of Woodlake's stormwater control system will help ensure that Grass Lake and the Minnesota River are protected by controlling runoff rates and quality.

Leachate

The city's drainage basin, Grass Lake and the Minnesota River have the potential to be affected by leachate. The potential for leachate to reach the basin is very low because any leachate should move vertically toward the bedrock aquifer and horizontally toward the river before it could surface in the basin. Leachate could reach Grass Lake. Assuming a worst-case analysis leachate concentrations in Grass Lake could exceed MPCA surface water quality standards for some paramters. Under favorable conditions for runoff on the expansion site the concentrations would be below these standards. Accumulation of some substances, such as metals, could potentially occur in the sediments or vegetation. Effects on the Minnesota River should be negligible due to dilution. However, there could be long-term accumulation of pollutants such as metals adding to those from other sources which might impact the biota.

MITIGATION TECHNIQUES

Runoff Impacts

Potential runoff, erosion and sedimentation impacts appear to be limited to the site itself, the drainage basin east of the landfill, and the Minnesota River. With proper management, these impacts should be minimal.

Similar control techniques could be during berm construction, landfill construction and landfill closure. Runoff volumes and erosion can be controlled by small-scale staging development of the landfill and establishing vegetative cover on the berm and landfill as soon as possible. Mulching, scarifying and contouring bare slopes would also reduce runoff and erosion problems. Woodlake already plans to implement some of these measures. For instance, the fill will be brought to final grades in several stages. As a portion of the fill reaches final elevation, it will be seeded.

The on-site detention pond is critical in controlling erosion and sedimentation impacts. By detaining runoff and releasing it at a controlled rate in the surge pond in the Minnesota River Valley, it will help prevent additional erosion of the bluffs south of the site area and minimize the amount of sediment and other pollutants carried to the marshy area and abandoned ditches south of the surge pond. Periodic removal of accumulated materials in the on-site pond will ensure that it performs these functions as intended. (Woodlake now cleans the pond about once every two years, after a delta begins forming at its inlet side.)

Installation of a perforated riser pipe and a baffle weir are two ways to improve the pond and further decrease the potential for impacts. The perforated riser pipe would increase the efficiency of the pond with respect to particle settling, while the baffle weir would help keep pollutants such as oil from leaving the pond.

An overflow channel, to be constructed from the surge pond to the Minnesota River could also help minimize impacts. By channeling flows to the river, potential stormwater impacts on Grass Lake and its surrounding wetlands could be avoided. Flows in the river should be sufficient to dilute any erosion-related contaminants.

After the landfill is closed, maintenance of the on-site surface water control system would help minimize infiltration and control erosion and sedimentation. Maintenance of adequate vegetative cover would also help, as would periodic regrading to cover depressions that can form as the waste materials settle.

Leachate Impacts

One way to mitigate the potential impacts associated with leachate is to minimize its formation. Woodlake has proposed final slopes of at least two percent. Higher slopes, however, would further decrease ponding, infiltration and leachate generation, and increase runoff. Good vegetative cover would decrease percolation by increasing evapotranspiration. Once leachate is formed it could be prevented from moving off-site by lining the horizontal expansion and installing a leachate collection system. Foregoing the vertical expansion over the existing landfill or limiting filling in this area to processed waste would prevent leachate formation in this portion of the expansion. The Site Hydrogeology section should be reviewed to obtain more details on leachate control and corrective actions for Grass Lake.

VEGETATION AND WILDLIFE

EXISTING CONDITIONS:

Existing Landfill and Proposed Expansion Area

The existing 105 acre landfill site is a highly disturbed area. Only about 40 percent of the landfill area has received final cover and been seeded with grasses (70). Some old slopes and soil stockpiles have volunteer vegetation or have been seeded by the proposer. The remaining portions of the landfill, including the active borrow and fill areas, are not vegetated.

Most of the proposed 42.4-acre horizontal expansion area is a grassland overlooking a wet meadow and stormwater detention area (Figure 32). A line of trees follows a portion of BFI's property line, as well. At one time, the expansion area was cultivated. Now it exhibits the characteristics of a typical "old field": it has been invaded by grasses and weedy species, as well as an occasional shrub or tree.

Council staff surveyed the horizontal expansion area on July 12, 13 and 15, 1983 to identify plant species. Nine quadrats, each 10 feet in diameter, served as sampling locations (Figure 33). Staff recorded the species present in each quadrat, and estimated percent cover for each species. Staff also noted species that were present outside of the quadrats (see Appendix B for field data and details of sampling procedure). On July 15, staff from the Minnesota DNR Heritage Program also surveyed the site.

Generally speaking, leafy spurge (Euphorbia esula), brome grass (Bromus inermis), sweet clovers (Melilotis alba and M. officinales), and Kentucky blue grass (Poa pratensis) dominated in terms of percent coverage. These species are common on disturbed areas such as abandoned agricultural fields. No unique, rare or endangered plant species were encountered; a few scattered native prairie species were found. The DNR states that "The site does not harbor any rare plant species or native plant communities..." and it "has little scientific or natural area significance" (Page 71, Appendix C).

Off-Site

Lands north of the proposed expansion area are currently used as open space. The Metropolitan Airports Commission keeps the lands open or under cultivation because they are in the approach zone for the Flying Cloud Airport.

A type II wet meadow with some characteristics of a Type III wetland lies to the east of the site (72). This wet meadow is not a protected wetland. Portions of it are used as a stormwater detention pond. Reed canary grass (Phalaris arundinacea), willows (Salix spp.), alders (Alnus spp.), and cattails (Typha spp.) are among the plants that can be found in or near this wet meadow (73).

To the south of the proposed expansion site is the Minnesota Valley National Wildlife Refuge and Recreation Area. The Refuge and Recreation Area is quite large, covering over 9,000 acres along the Minnesota River. The bluffs south of the site (owned by Woodlake), as well as the floodplain of the Minnesota River, are included as part of the designated Upgrala (Upper Grass Lake Area) Management Unit in the Refuge and Recreation Area (Figure 34).

Figure 32.
GENERAL CLASSES OF VEGETATION NEAR FLYING CLOUD LANDFILL

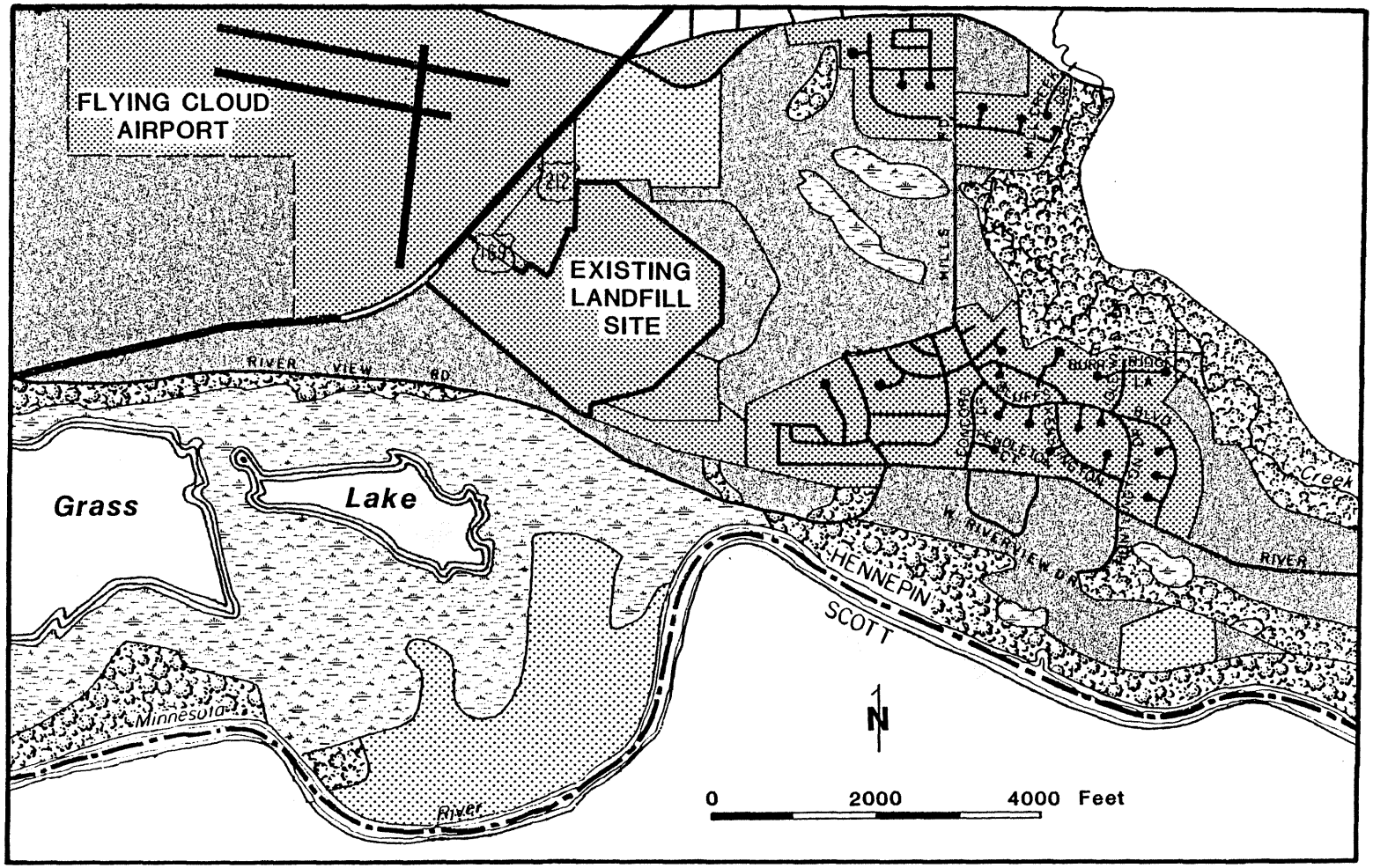
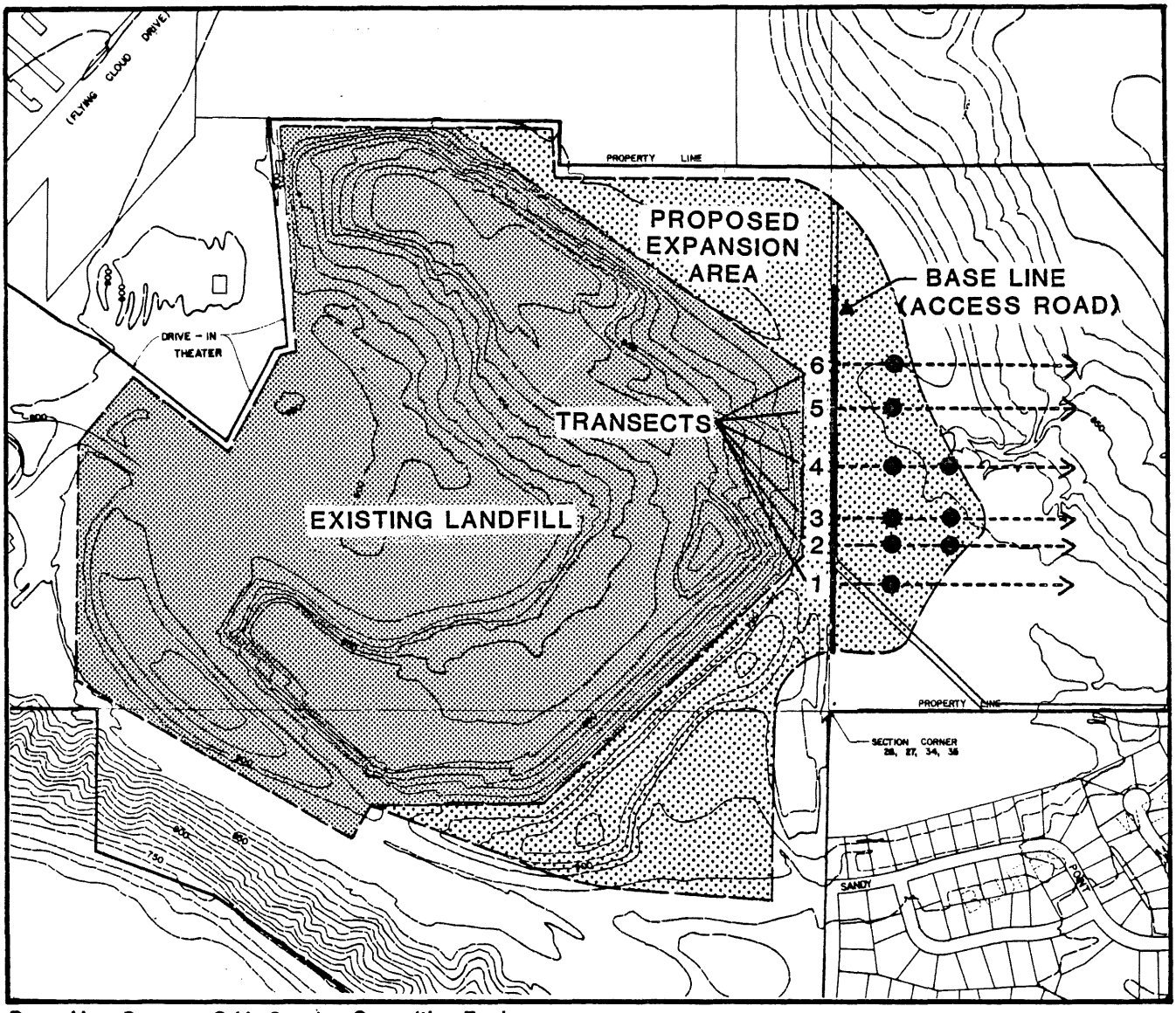
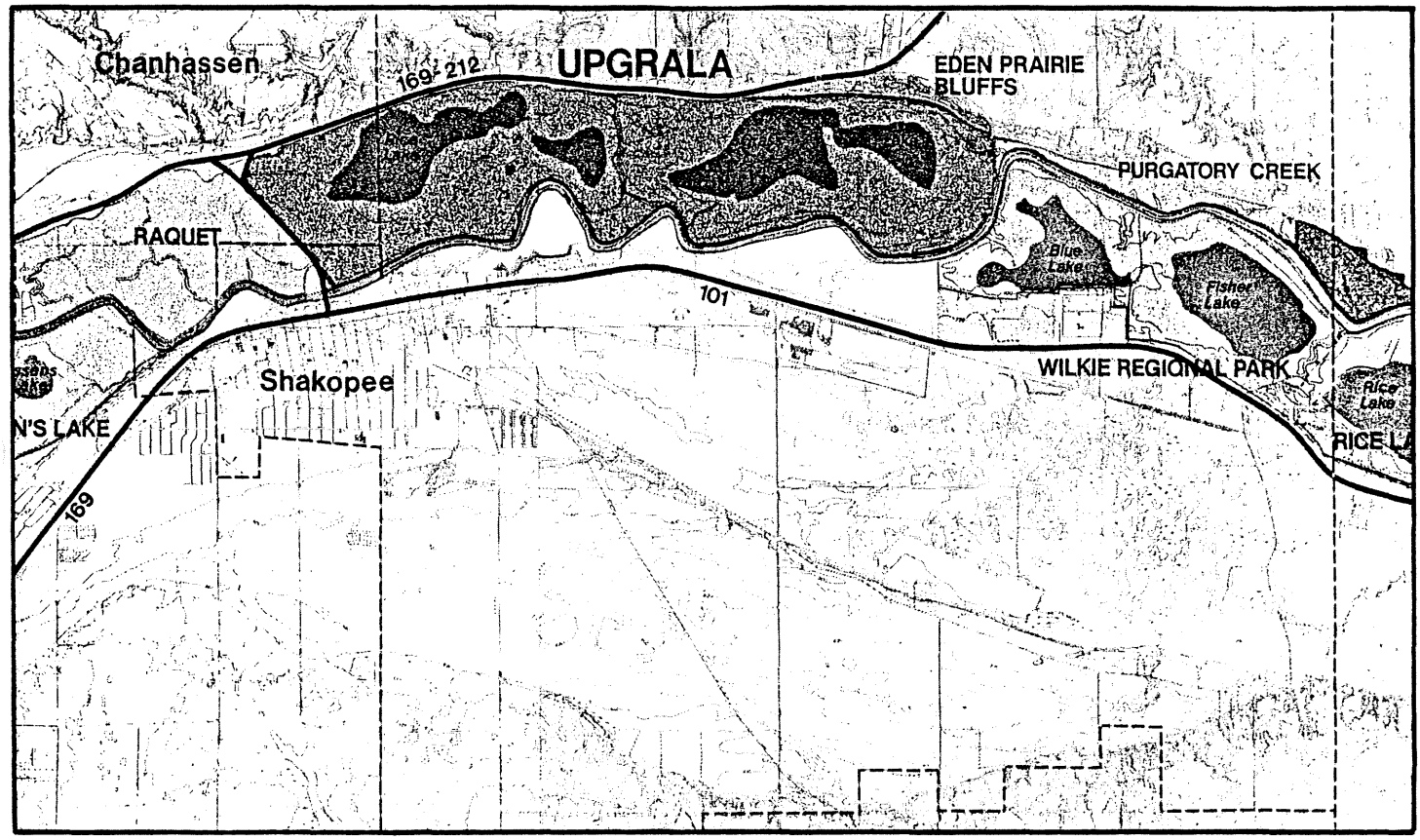


Figure 33.
LOCATION OF SAMPLING QUADRATS



Base Map Source: G.M. Sunde, Consulting Engineer

Figure 34.
UPGRALA UNIT OF THE MINNESOTA VALLEY NATIONAL WILDLIFE REFUGE



Source: U.S. Dept. of the Interior, Final EIS, Minnesota Valley National Wildlife Refuge, May 1982.

The U.S. Fish and Wildlife Service sees the major goals for the Refuge and Recreation Area as recreation, wildlife management and vegetation management. The Service's overall goal is "To preserve the valuable natural and cultural resources of the lower Minnesota River Valley while providing wildlife-oriented recreation and educational opportunities for a broad spectrum of the population..." (74). Its preferred management alternative would develop the Upgrala area south of the proposed landfill site as shown in Figure 35. Management of the floodplain would primarily be to increase wildlife diversity and hunting opportunities; on the bluffs, to protect slope and prairie vegetation. As of yet, however, lands in the Upgrala Unit have not been acquired by the Service. The land around Grass Lake is owned by private individuals.

Grass Lake, a type IV inland wetland, is a prominent feature in the Upgrala Unit. The lake covers 467 acres. Only about 25 percent of its area is open water; 75 percent has emergent vegetation during some part of the year. The lake is shallow; its average depth ranges from 1.5 feet in the areas with vegetation to 2.0 feet in the open water areas (75). The lake has a west arm and east arm, divided by a narrow neck of land and marshy area. The east arm is much smaller with a water surface area of approximately 166 acres.

Vegetation and animal surveys were conducted in the Refuge and Recreation Area from November 1978 to December 1979 (76). Two bird inventories, as well as small mammal trapping and counts of muskrat houses, occurred southwest of the proposed landfill expansion area. Because of an extended period of flooding, the floodplain inventories are restricted. Furthermore, the severe winter of 1978-79 depressed the bird count.

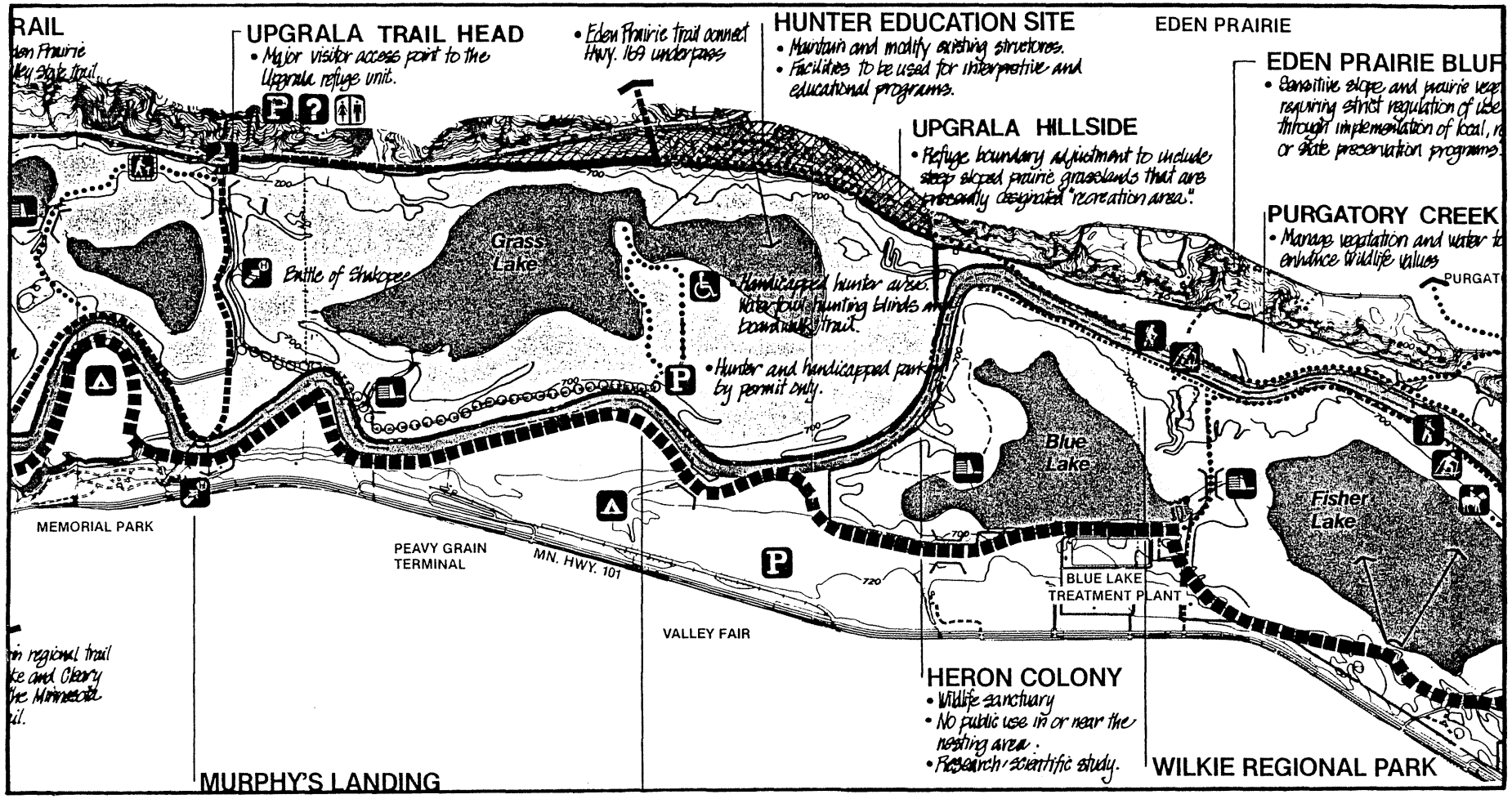
The bird transects south of the landfill covered three habitats: prairie slopes, a wet meadow edge and a floodplain forest; one transect followed Riverview Rd. The dry prairie slope had the lowest breeding bird population (158/100 acres) of the entire valley survey while the wet meadow had the highest (938/100 acres). Migrating waterfowl were censused on Grass Lake, also. On some survey days, over 1,500 ducks could be seen. Some waterfowl species only rest Grass Lake before continuing their migration, but certain species nest at the lake and feed on the vegetation and microorganisms in the lake. Several rare birds, including Whistling Swans, Orchard Orioles and Rusty Blackbirds have been seen in the vicinity. Observers have also seen Bald Eagles nearby.

In the small mammal trapping effort, two mammals, the western harvest mouse (Reithrodontomys megalotis) and the deer mouse (Peromyscus leucopus), were found only on the bluffs below the fill. This is significant because the harvest mouse is rarely found in the Metropolitan Area. The Upgrala slope area where it occurred is one "of the most critical areas in the valley" because of its habitat value and threats from all-terrain vehicles (77).

Counts of muskrat houses revealed that Grass Lake provides habitat for a number of these animals. The western arm of the lake had over 450 houses, while the eastern had nearly 300.

Vegetation in the Refuge and Recreation Area below the landfill has been classified by using aerial photographs. The bluffs are covered by a dry grassland. Much of the Upgrala unit surrounding Grass Lake is covered by emergent plants, wet meadow, floodplain forest, or agricultural land (78). The predominant vegetation in the western arm of Grass Lake is sedges (Carex spp.) while sedges and cattails (Typha spp.) are both present in large amounts in the eastern arm. Bulrushes may exist in the deeper portions of the Lake.

Figure 35. PROPOSED UPGRALA UNIT MANAGEMENT SCHEME



Source: U.S. Dept. of the Interior, Final EIS, Minnesota Valley Wildlife Refuge, May 1982.

Summary: Existing Habitat Values

The landfill expansion area itself appears to have no unique habitat values. A portion of the expansion will occur over the existing highly-disturbed landfill site. The remainder will occur in an old field area that harbors no unusual plant communities.

Off-site areas to the north and east do not appear significant in terms of habitat value. MAC maintains a portion of these lands as open space or agricultural land. The eastern area consists of a wet meadow that is managed primarily for its stormwater retention, rather than habitat, values.

The Refuge and Recreation Area does have significant value as habitat. The wet meadows south of the landfill site harbored the largest breeding bird population recorded in the Fish and Wildlife's surveys. Grass Lake is used extensively by waterfowl, as well as by a sizable muskrat population. Two small mammals, the deer mouse and the western harvest mouse (which is rare in the Metropolitan Area), were only found in the Upgrala Bluffs area in the wildlife surveys.

POTENTIAL IMPACTS

Background

Nature of Pollutant Impacts

Pollutants in general can manifest their presence in plants and animals in several ways. They may cause immediately noticeable, or acute, effects, such as mortality. They may cause more long-term, or chronic, effects, such as a lowered resistence to disease. In some cases they may cause no apparent effect until some critical threshold is reached in the organism. This critical level may be attained after exposure to the substance in the air or water, or after uptake or assimilation of the substance from soil, sediments, or food sources.

Routes of Impacts

There are a number of routes by which a pollutant can enter and be assimilated by an organism. Uptake can occur through surface areas such as the skin of animals or the roots or leaves of plants. It can occur via the respiratory or digestive tracts. Certain pollutants tend to increase their concentration in organisms through the food chaing from herbivores to carnivores, respectively; this process is called biomagnification or bioaccumulation. Once a pollutant has entered an organism, it may tend to accumulate in a particular part of the organism.

Parameters of Concern in Landfill Leachate

Table 12 lists many of the substances that have been found in landfill leachate. Generally, these sustances can be divided into the following major catagories: biochemical oxygen demand (which is a measure of organic matter), inorganic nutrients, organics and heavy metals.

BOD and inorganic nutrients are of concern because of their ability to enrich lakes and rivers. If the input of BOD or nutrients is high, it can accelerate the eutrophication process in lakes, and/or decrease oxygen levels in the receiving waters. As lakes become more eutrophic, they change in many ways. For instance, they tend to have more frequent blue-green algae blooms and their associated plant and animal communities change to species that compete better in lower oxygen, higher nutrient environments.

Organic substances can contribute to high BOD levels. Some can also be toxic or harmful to many forms of aquatic life. Certain organics are not easily biodegradable, and can bioaccumulate.

Some heavy metals, such as lead, mercury, and cadmium present concerns because of their toxicity. They, like some of the organics, have a propensity to bioaccumulate.

The toxicity of substances in leachate to have effects on biota depends on a wide variety of factors. These factors include the concentraton of the substances; the mixture of the substances; the chemical form of the substances and the environmental conditions. Many substances must be present above a certain concentration to present a problem; the effects of some substances are aided or diminished by the presence of other substances; and some substances may be found in compounds that are "biologically unavailable", that is, that cannot be taken up by organisms. For instance, inorganic mercury is relatively insoluble, but it can become methylated by microorganisms and thus become available, especially in anaerobic (non-oxygenated) environments. The life stage and general condition of the potentially affected organism, as well as the duration of exposure, can also influence the magnitude and character of any impact. Finally, the characteristics of the receiving water body, such as its pH, buffering ability, sediment redox potential, oxygen concentration, chemical regime, and physical characteristics will affect the potential for biological problems.

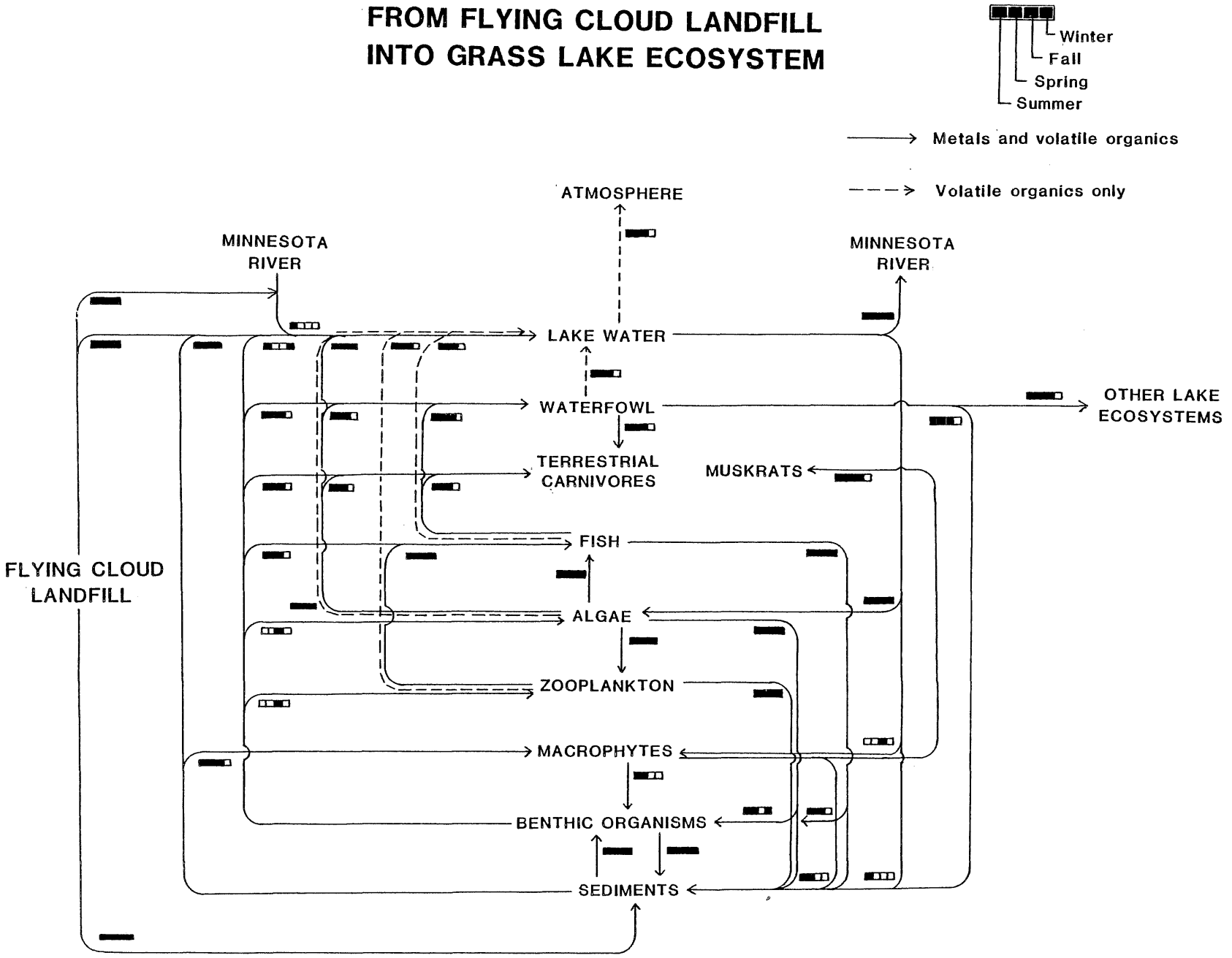
The potential for leachate to effect biota will also vary with the season of the year. Seasons affect a water body's temperature regime and the availability of light, which in turn can affect the characteristics of biological productivity, the species of plants and animals present, and the availability of oxygen, nutrients, and other chemicals. Figure 36 illustrates on a conceptual basis how chemicals could cycle in Grass Lake, and thus how the pathways of pollutant transport in the lake, could change during different seasons of the year. The figure assumes that the pollutant can bioaccumulate,and that low oxygen or anoxic conditions prevail in the winter. The diagram is general and based on hypothetical conditions, not specific data from Grass Lake. It should be used, therefore, only to obtain a general idea of possible pollutant movement, not as a definitive model of actual conditions. This general diagram is used because detailed data on the Grass Lake ecosystem is not available. It is known that fish, waterfowl, and muskrats live in or use the lake, and that the Minnesota River frequently floods it for relatively short periods.

On-site Impacts

The proposed expansion will remove the grassland on the 42.4-acre horizontal expansion site. This loss, however, is not felt to be significant because there are no rare, endangered, or unique plants or plant communities on the site (79). Any animals that do live in the old field will be displaced or destroyed if the expansion occurs, however.

The horizontal expansion site is dominated by such common plants such as blue grass, clover, brome grass and leafy spurge. These species are often found on abandoned agricultural lands. After the fill is completed, a similar grassland could be established if the site is not developed. Recolonization by animal species similar to those now occupying the site could occur as well. Reuse of the site for habitat and passive recreation for instance, as a grassland laced with footpaths, could be a suitable end use (see Site Hydrogeology section).

Figure 36.
GENERAL MOVEMENT OF POLLUTANTS FROM FLYING CLOUD LANDFILL INTO GRASS LAKE ECOSYSTEM



Off-site Impacts

The MAC's land and the meadow and drainage basin to the east will not be directly disrupted because of the expansion. No leachate and only a limited amount of surface runoff is likely to reach either of these areas (see Site Hydrogeology and Surface Water sections). Noise from landfill construction and operations could possibly disturb some species of animals and cause them to relocate elsewhere. It should be pointed out, however, that neither of these two areas is currently managed for habitat and wildlife values.

Impacts on the Refuge and Recreation area are less clear. There will be no direct loss of habitat: the expansion is over 250 feet from the edge of the bluffs. The existing drainage pipe under the bluff and the surge pond in the valley will remain in place, however, impacts from runoff should be negligible (see Surface Water section) because of the controlled rate of outflow from the pipe and prior settling of particles in the on-site detention pond.

Indirect impacts on vegetation and animals have the potential to occur, however. Animals from the Refuge could potentially use the landfill as a source of food. It should be noted that, with the exception of gulls, this has not been a problem at the existing site. Continued use of daily cover, as required by MPCA regulations, should also minimize its occurrance at the expansion.

Worst-case modeling indicates that MPCA surface water quality standards for chlorides and copper could be exceeded in the east arm of Grass Lake (see Site Hydrogeology section). The state water quality standards for the lake are intended to protect its fish and wildlife; if the standards are exceeded, it can be presumed that some effects on the lake's biota could occur. Table 13 compares the results of the modelling effort with the state standards.

Even when state water quality standards are not violated, it is possible that impacts on Grass Lake and marshland aquatic communities may occur. State standards for most organic compounds and some heavy metals do not exist. The EPA has promulgated a number of guideline criteria that can be used to develop state standards for metals and organic compounds. The criteria take into consideration the concentrations at which impacts have been noted, as well as the potential for the substance to bioaccumulate. The criteria that could be used to protect fish and wildlife are listed in Appendix D. In some cases,the Agency did not feel that sufficient information was available to develop criteria; in those cases it reports the lowest concentrations at which a biological effect has been discovered.

Substances such as heavy metals could also accumulate in the lake's sediments, rather than the lake water. Benthic organisms, as well as aquatic plants, could take up the pollutants from the sediments. Algae and other organisms could take up pollutants from the water. The pollutants would then be available to higher animals such as waterfowl, or could be released into the water column when the plants or animals die. The pollutants could also be released directly into the water from the sediments if reducing conditions prevail.

Where the leachate emerges into the valley there could be higher local concentrations before dilution occurs, for example, in the seeps. (Volatile organics would dissipate in the air.) Impacts on the aquatic communities could occur in these areas.

MITIGATION TECHNIQUES

Techniques to minimize impacts on biological communities could focus on reducing the attractiveness of the landfill as a food source; and reducing the potential for contaminated surface and groundwater to reach sensitive water bodies.

The attractiveness of the fill as a food source can be decreased in several ways. (See Flying Cloud Airport section also). As mentioned above, placement of daily cover as required by MPCA regulations will help keep the attraction of the fill to a minimum. Daily cover helps prevent odors that could attract animals, and makes the garbage inaccessible for some species. Keeping the working face of the fill small will accomplish the same objectives: odors will be minimized and the majority of the waste materials will be inaccessible. Scaring animals, such as gulls, with an air cannon can also be a temporary deterrent.

Numerous methods are available to reduce the amount of contaminated surface and groundwater reaching sensitive water bodies where it could impact vegetation, fish and wildlife. The proposer plans to control runoff and sedimentation by using a designed stormwater management system. Important features in the system are an on-site detention pond and a stormwater outlet pipe. The detention pond will slow down stormwater runoff, thus allowing some suspended materials to settle in the pond rather than on Refuge lands. The detention pond's outlet pipe will release a controlled rate of stormwater at the base of the bluff to control erosion. This system, as well as measures that could improve it, are more fully described in the Surface Water section.

Contaminated groundwater inflows can be controlled by minimizing infiltration. Fine-grained final cover soils with permeabilities of at least 10^{-6} cm/sec will help in this regard, as will quick establishment of vegetation on completed sections of the fill and maintenance of adequate slopes. Off-site migration of leachate could be controlled by installing a liner and leachate collection system beneath the proposed horizontal expansion. Foregoing the vertical expansion over the existing fill or limiting the expansion to processed waste would minimize the production of leachate. Lining this portion of the expansion may not be possible because of the settling occurring in the existing fill. The Site Hydrogeology section discusses these options further.

Periodic monitoring could help ensure that any leachate movement will be detected before it reaches the lake. Remedial measures could then be taken to help prevent extensive movement of leachate to the lake. However, assuming a worst-case scenario leachate could reach the lake in a matter of months once the fill reaches field capacities.

It would be useful to sample the water, vegetation and wildlife, and sediments in Grass Lake and the wetlands around the lake. Such a sampling program could help: 1) to determine existing conditions; 2) to detect the presence of leachate; and 3) to detect changes in the lake's and wetlands' habitats that are occurring now and that could occur in the future.

Currently, very little information is available on the chemistry and biology of Grass Lake. The lake and its associated wetlands are known to serve as habitat for numerous migrating waterfowl and muskrats; however, little information is available on the specific qualities and characteristics of the lake and wetland habitats. No reliable information on the chemistry and microbiology of the lake's waters, and little on the lake's sediments and fish, is available.

Information on macroflora is limited as well. This data is needed, however, if existing conditions in the lake are to be characterized and a gauge provided for evaluating possible future changes that might be attributable to the landfill.

Woodlake could work with the MPCA, the U.S. Fish and Wildlife Service and the current owners of the lake to design and/or implement a monitoring program. Initially, the monitoring program could provide baseline information on the characteristics of the lake and its associated plant and animal communities. On-going monitoring could be conducted to determine what changes are occurring in those communities. Should it appear that certain changes in the lake's and wetlands' habitats could be caused by leachate contamination, Woodlake could be asked to support a more intensive program to evaluate whether, in fact, leachate is the probable cause of the changes.

If leachate contamination does occur in Grass lake and its surrounding wetlands, the MPCA will ask the proposer to assess its significance and recommend remedial measures. The agency will also approve or disapprove any proposed plan of action. Remedial measures could conceivably include flushing the lake, dredging of contaminated sediments, installation of barrier wells in the valley to remove and treat contaminants in the groundwater, or alteration of landfill final cover or contours to decrease infiltration. The specific remedies chosen would depend on the nature and magnitude of the contamination problem, its expected effects, and the costs and expected effectiveness of the techniques. Some of these measures possibly would disrupt the lake ecosystem and conflict with wildlife management purposes. For instance, barrier wells could divert groundwater from the lake and thus possibly affect the water levels and habitat value of the lake. See Site Hydrogeology section for more details. In summary, the corrective measures probably would be too expensive and distruptive.

HAZARDOUS WASTE

EXISTING CONDITIONS

The disposal of hazardous wastes in a sanitary landfill, except in the amounts that are normally found in household wastes, is prohibited by MPCA regulations (34 MCAR SW6). Materials which are considered hazardous are defined by the MPCA and include substances which are corrosive, flammable, reactive or toxic. These regulations also bar disposing of liquids, sewage sludges, raw animal wastes and septic tank pumpings in landfills. The MPCA investigates reports of suspected violations. Occasionally, a landfill operator may be required to attempt to retrieve improperly disposed hazardous substances.

The MPCA and the Hennepin County Department of Environment and Energy inspect Flying Cloud Sanitary Landfill periodically. There have been no violations of MPCA regulations concerning prohibited wastes.

Woodlake has adopted extensive procedures for preventing the disposal of hazardous waste at the landfill because of the high costs associated with liability. All of Woodlake's waste disposal contracts with commercial and industrial generators state that hazardous substances are prohibited and that the disposer assumes liability for all such waste, whether inadvertently or intentionally disposed. Signs explaining unacceptable wastes are posted at the entrance. Flying Cloud does not accept waste packaged in barrels or drums, the types of containers most likely to contain hazardous wastes, without proper authorization. In order to dispose of waste in these containers, the generator must first submit a sample of the material along with a chemical analysis and a statement of the exact quantity to be placed in the landfill. The sample is analyzed at BFI's Houston lab and copies are submitted to the MPCA and to Hennepin County. Both agencies must approve the disposal before the material is accepted at the landfill.

Incoming waste is monitored at the entrance and at the working face, where questionable materials and containers are removed by trained employees. The landfill is surrounded by a six-foot high chain-link fence topped with barbed wire. Access is thus limited to the scale entrance building which can be restricted by a locked gate. Professional guard service personnel are on duty 24 hours a day, seven days a week, when company personnel are not present. These security measures help prevent illegal dumping from occurring after operating hours.

POTENTIAL IMPACT AND MITIGATION MEASURES

It is not expected that the proposed expansion will increase the potential for the disposal of large quantities of hazardous waste at the site. Woodlake's procedures for preventing the disposal of large quantities of hazardous waste at the site should be adequate. State and federal regulations established in 1980 require the tracking of hazardous waste disposal and should gradually improve the protection of sanitary landfills from the disposal of such substances. Small quantities associated with household refuse will continue to be disposed of at the landfill. The small quantities are difficult to detect and separate from incoming waste materials received at the landfill. A fuller discussion of these substances is provided in the Site Hydrogeology section.

AIR QUALITY

EXISTING ENVIRONMENT

Air quality near the Flying Cloud Landfill depends on a number of factors, including climate, activities in the area and activities at the landfill.

Climate affects air quality by controlling wind direction, wind speed, precipitation and temperature. Each of these influence pollutant dispersal, travel direction, and in some cases, generation. In the Twin Cities Area, prevailing winds are generally from the northwest except during summer, when they are from the south and southeast (Figure 37 and Table 21). Average monthly wind speeds are highest in April and lowest in August. Average monthly temperatures near the landfill range from 12.8°F in January to 73.1° in July; the yearly average temperature is approximately 45°F (80).

Table 21
AVERAGE MONTHLY WIND SPEEDS AND DIRECTIONS, MINNEAPOLIS-ST. PAUL

Month	Mean Wind Speed (mph)	Prevailing Direction
Jan.	10.4	NW
Feb.	10.5	NW
March	11.3	NW
April	12.2	NW
May	11.2	SE
June	10.4	SE
July	9.2	S
Aug.	9.1	SE
Sept.	9.8	S
Oct.	10.4	SE
Nov.	10.9	NW
Dec.	10.3	NW
Annual	10.5	NW

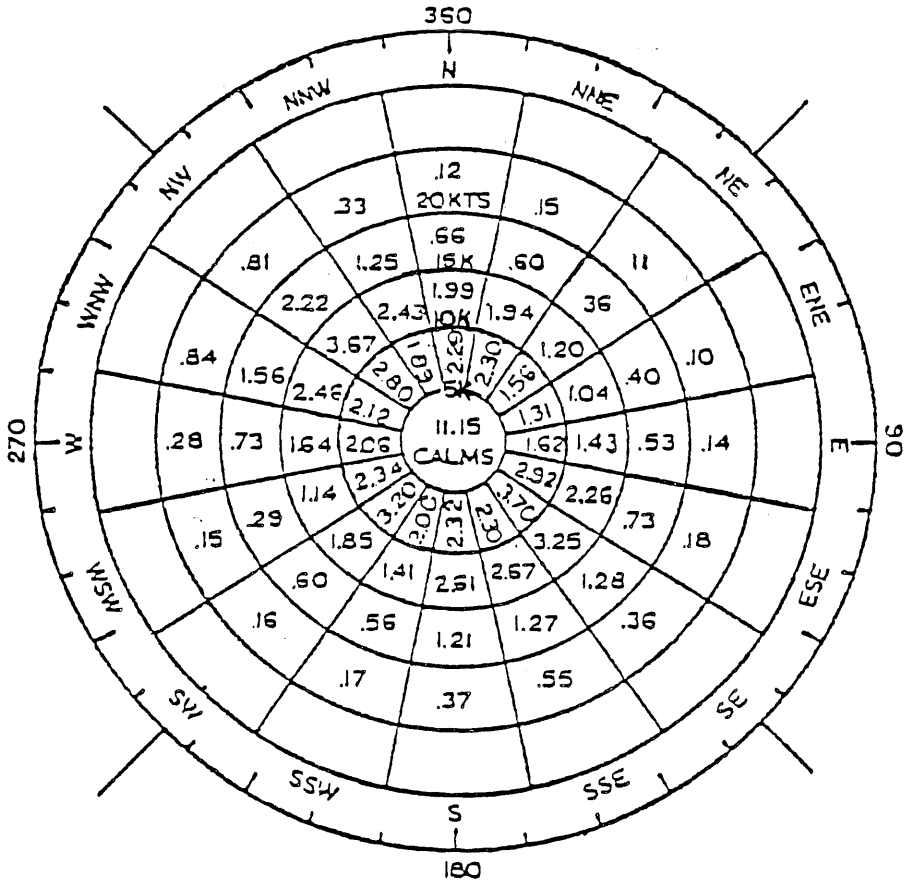
Source: U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. Local Climatological Data: Summary with Comparative Data. Minneapolis-St. Paul, Minnesota. 1982.

Existing activities near the landfill will contribute pollutants to the air. Industrial activities, such as aggregate mining, will generate particulates. Other activities, such as agriculture, construction and traffic also will generate particulate and gaseous pollutants.

Because the existing landfill is a construction activity, it can be a source of pollutants. Gaseous emissions from landfill equipment and arriving trucks will contribute some pollutants, as will wind erosion of unvegetated areas such as unpaved roads, excavated areas, and some landfilled areas. (The landfill can also generate odors as waste decomposes; this potential is discussed in the Landfill Gas section.)

Figure 37. WIND ROSE

TWIN CITIES METROPOLITAN AREA



Source: Metropolitan Airports Commission

Overall, the landfill's contribution to local air pollution appears minor at this time. Truck traffic to the landfill comprises only three percent of the total daily two-way traffic and 22 percent of the truck traffic on Hwy. 169. Cars and other smaller vehicles coming to the landfill represent only 1.4 percent of the total daily traffic on Hwy. 169 (81).

Wind erosion has occasionally been a problem at the existing site; however, the proposer is taking steps to decrease this problem. In 1981, the company began a policy of establishing vegetative cover on soil stockpiles (82). Presently, about 38 percent of the landfill has been seeded, partially to prevent wind erosion (83). A portion of the site's access road has been paved recently, and unpaved roads are regularly watered to keep dust generation to a minimum.

POTENTIAL IMPACTS: WIND EROSION

The proposed expansion carries a risk of wind erosion and dust generation. Wind erosion can be expected from unvegetated soil stockpiles and landfilled areas. Erosion and dust generation will also occur during berm construction and landfill excavation, and along unpaved access roads.

Excavated material and final cover material will both be stockpiled on site. At a maximum, 1 million cubic yards of excavated material (out of a total of 4.5 million cubic yards) and 250,000 cubic yards of imported cover material will be stockpiled, unvegetated for a time, on site (84). The cover material stockpiles will be located at the southeast and southwest perimeters of the site, and in the center of the existing fill where the site is within 10 feet of final grade (85). The sandier excavated material will be removed from the site or stockpiled below grade (86). From 200 to 400 cubic yards of material is used for daily cover; this and additional soil will be exposed for a time and thus be susceptible to wind erosion (87). The over 400,000 cubic yards of soil used during berm construction will also be exposed until vegetation is established.

Table 22 presents particle size distribution data for soil borings that were taken on the landfill site.

Table 22
SOIL PARTICLE SIZE DISTRIBUTION

Boring	Depth (ft).	Less than 01mm	.01-.05	.05-.1	.1-1.0	Greater than 1.0
ST1	4.0-5.5	0	0	4	74	22
ST1	18.5-20	0	0	16	76	2
ST2	18.5-30	0	0	4	96	0
ST5	13.5-15.0	0	0	4	88	8

Source: Greeley and Hanson, Eng. Eden Prairie, Mn. Waste Management, Inc. Proposed Sanitary Landfill. Appendix A: Soil Borings. Feb. 1970.

Most of the particles are between .05mm (5 um) and 1.0mm (1,000 um) in diameter, and can be classified as sands. Sand particles between .1mm and .5 mm generally move by saltation (a bouncing motion), while those larger than .5mm move by surface creep (rolling on the surface of the ground) (88). Generally, particles over .84 mm in diameter are not eroded by the wind. Any small clay- or silt-sized particles will most likely move by suspension in the air.

The sandy loam soils on the expansion site are inherently susceptible to wind erosion. Any sandy particles that move from the western portion of the landfill site by saltation or surface creep will encounter the excavated landfill pit and be deposited, rather than migrate off-site. As the landfill is brought closer to final grade, the pit will no longer be present to act as a deposition area, and the potential for eastward off-site movement of the sandy soils will increase. Sandy soils exposed during berm construction will also have the potential to migrate off-site.

The fine-grained final cover soils present the greatest potential risk of off-site migration problems. Many of the particles in the final cover soils will be small enough to become suspended. Once they are suspended, they could easily travel off-site into areas such as the neighborhoods to the east. Woodlake's plans to vegetate soil stockpiles, however, should substantially reduce the potential for erosion of these soils.

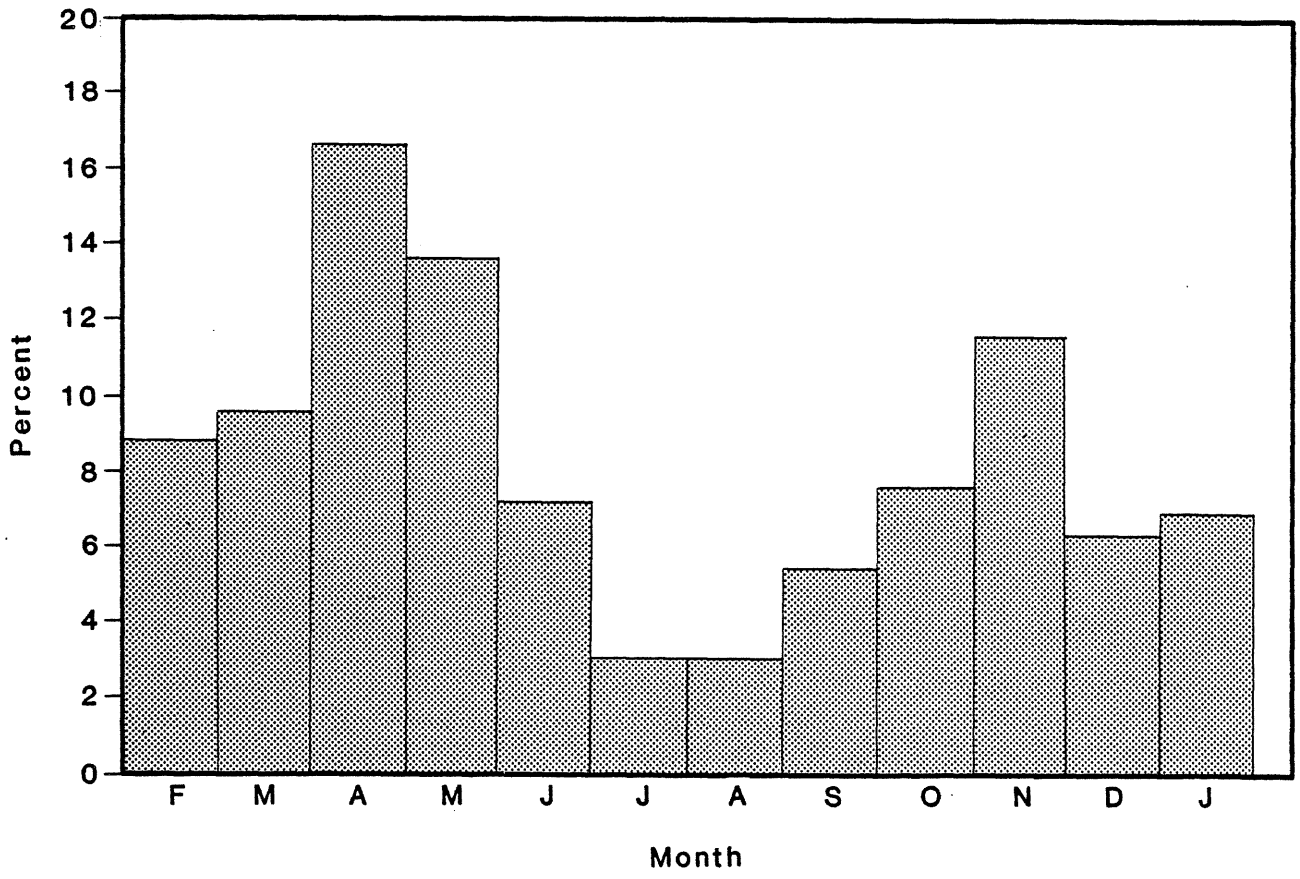
For soil particles to be eroded by the wind, a minimum critical windspeed, called the threshold velocity, must be reached. This velocity will vary, depending on factors such as soil texture, structure, moisture content, and cloddiness. As a general rule, however, the threshold velocity can be defined as winds in excess of 12 miles per hour at one foot above the ground surface (89). Only winds above the threshold velocity have enough energy to erode soil particles. In the Minneapolis area, winds exceed 10 knots (11.5 miles per hour) more than 50 percent of the time (Figure 33).

The direction of the prevailing erosive winds varies somewhat from the direction of the general prevailing winds. The prevailing erosive winds come from the northwest or west-northwest during all months of the year but July and August (90). During these two months, erosive winds have no prevailing tendency. March, April, May and November have the most frequent erosive winds, while few such winds occur in July and August (Figure 38).

If it is assumed that snow cover will prevent erosion from the end of November to the end of April, then winds will only be a problem for seven months of the year, from May through November. During those months, approximately 52 percent of the annual erosive winds occur. (Twenty-five percent of the annual erosive winds typically occur in two months--May and November.) If snow cover and freezing conditions are not present during the winter months, or if soils are hauled in during the winter and are not protected, the potential for problems will extend over a longer period of time.

Based on the prevailing wind erosion direction, land uses to the southeast and east-southeast of the landfill site have the greatest probability of being affected by fugitive suspended dust. This area includes a portion of the Bluffs West subdivison. Workers in the landfill pit will be affected by settling soil particles, as well.

Figure 38.
PERCENT OF ANNUAL EROSIVE WINDS OCCURRING EACH MONTH



Source: U.S. Soil Conservation Service

Health Effects of Wind Erosion

No serious health impacts should be associated with migration of sand particles. Sand particles do not generally present serious respiratory problems because they are not inhaled into the lungs; they are large enough to become captured in the nasal passages and expelled (91).

If substantial erosion of the fine particles occurs, some health problems could occur. From a respiratory standpoint, particles less than .01mm (10 um) in diameter are of the most interest because they can be inhaled deeper into the respiratory tract (92). They include clay-sized particles and some silt-sized particles. Particles between .005mm (5 um) and .002mm (2 um) can settle in the middle respiratory tract, and may reach and become lodged in the lungs. The percentage of particles that penetrate to the lungs and which are retained there is at a maximum for particles between .001mm (1 um) and .002mm (2 um).

In summary, only a very small fraction of the soil particles on-site appear to be in the size range that could become lodged in the middle or lower respiratory tract. When final cover is placed on the landfill, however, the potential for health problems could temporarily increase because of the soil's fine texture.

As mentioned before, Woodlake is taking steps to decrease the potential for wind erosion on the existing landfill site. Similar actions are also proposed for the landfill expansion. Vegetation of the landscape berm will begin when about one-half of its length is completed (93). Seeding of areas in the fill with final cover will also be conducted. Roads and trails will be wetted with water as needed. For 10 years after the fill is closed, Woodlake will inspect the site every six months to determine the status of the vegetative cover, and to revegetate if necessary.

MITIGATION OF WIND EROSION

The proposer's mitigative measures include: 1) prompt revegetation of disturbed areas and soil stockpiles with quick-growing species; 2) "short-term erosion control" measures; 3) addition of water to roads; and 4) vegetation of the proposed berm on the eastern portion of the site (94).

Prompt revegetation of disturbed areas with quick-growing species can be an effective mitigation measure. The U.S. Soil Conservation Service recommends several ways to increase the effectiveness of this measure (95). The first is to mulch when the ground is seeded; the mulch will provide some interim protection before the vegetation is established. The second is to use seed mixtures that contain species such as perennial rye for temporary cover; these species can become established within 30 to 45 days after initial seeding. A third is to dormant seed areas after November 1, even if vegetative growth will not start until spring; if the areas are already seeded, the vegetation will become established earlier in the year than if seeding is conducted only in the spring. (Currently, Woodlake seeds areas finished between October 1 and April 15 by May 15; the company does not practice dormant seeding.) (96)

The proposer has not specified what other "short-term erosion control" measures it will undertake when prompt revegetation is not feasible. Generally, these measures could include mulching and netting, addition of chemicals to cement soil particles, addition of water, and roughening of the soil surface. Many of these techniques can also be used to decrease water erosion problems.

Short-term erosion control measures and adequate vegetative cover will be especially important during April, May, and November because these months have the most frequent occurrences of erosive winds (Figure 38). Large-scale excavation activities, berm building, placement of final cover soils, and new stockpiling of final cover could be avoided during these months to further decrease the potential for erosion. Watering of unvegetated areas could be undertaken during windy periods as well.

Addition of water to access roads could be an effective way to minimize dust generation and erosion from that source (97). Other techniques include adding chemicals such as calcium carbonate to sandy soils, and paving the roads.

The fourth general mitigative measure that the proposer has planned for the expansion is planting of trees and bushes on the eastern perimeter berm. This is not felt to be a sufficient wind-erosion control measure because: 1) the plantings will not protect the landfill site itself, and 2) a windbreak in that location could actually increase off-site dust problems by depositing particles in the residential neighborhoods to the east of the site.

POTENTIAL IMPACTS: AIR POLLUTION FROM TRAFFIC

Minnesota regulates four pollutants from transportation sources: hydrocarbons, oxides of nitrogen, carbon monoxide (CO) and lead.

Hydrocarbons and oxides of nitrogen are of concern because they interact in the presence of heat and sunlight to form ozone. Ozone is a pollutant that causes regional scale, rather than localized, air pollution problems.

The proposed project will produce no significant change in the amount of annual regional emissions of hydrocarbons and nitrogen oxides. The traffic volumes associated with the project are extremely small when compared with regional traffic volumes.

CO, in contrast, is a pollutant with localized, not regional, impacts. Except for confined areas like a downtown central business district, high concentrations exist only within a few hundred feet of very heavily traveled roadways or locations of extreme traffic congestion.

The U.S. EPA's Carbon Monoxide Hot-Spot Guidelines (EPA-450/3-78-033) were used to assess whether there was a potential for project traffic to generate CO levels approaching ambient standards (98). The Guidelines have very conservative assumptions about wind speed, dispersion and atmospheric stability, wind angle, and roadway capacities to test for the potential for high carbon monoxide concentrations immediately adjacent to the roadways studied. Because the method is so conservative, sites which pass the screening procedure can reasonably be expected to have air quality that meets standards; sites which fail the test may still have acceptable air quality, but require a more detailed evaluation to make that determination.

For the proposed Flying Cloud expansion, the maximum point for potential traffic congestion would be the unsignalized intersection of Hwy. 169 and the landfill access. The screening procedure in the Guidelines shows this as not being a potential location where standards would be violated. The Guidelines' verification technique was used to develop an estimate of the maximum eight-hour average CO concentration. If the additional traffic from the expansion were

present today, the maximum eight-hour concentration for a receptor 50 meters from the intersection would be 4.2 ppm, well within the state and federal standard of 9.0 ppm.

Current projections are for a substantial decline in traffic volumes on Hwy. 169 over the next decade once a new Hwy. 212 is developed. However, if this project is not developed while the landfill is operating, CO levels would not exceed standards for the modelled receptor site. Under this scenario, the maximum 8-hour concentration would be 6.4 ppm.

The lead concentration in air has declined dramatically in recent years due to the shift to leadfree fuels. A Federal Highway Administration method (based on FHWA memorandum 1-31/78) for estimating lead concentrations caused by traffic indicates that traffic volumes in 1986 must be higher than 80,000 ADT for lead levels to be even a fifth of the 1.5 ug/m^3 standard. Much of the traffic drawn to the facility will be diesel fueled and so is not a lead source. Other traffic volumes are too low to emit significant amounts of lead.

MITIGATION OF TRAFFIC IMPACTS

Any action that will decrease the volume of traffic going to the landfill site will also decrease the potential for air quality impacts. Factors that promote good traffic flow will also decrease the potential for impacts. For instance, a sheltered left-turn lane could be expected to improve traffic flow and there by decrease air pollutant concentrations.

In any case, the amounts of regulated pollutants near the landfill are not projected to violate or closely approach state standards. Because of this, the need for mitigative actions is not great.

LANDFILL GAS

Gas is produced in a sanitary landfill as microbes decompose solid waste. Methane and carbon dioxide are the primary gases produced, although a variety of trace constituents also occur.

Several potential problems are associated with the generation of landfill gas. If methane accumulates in sufficient concentrations (five to 15 percent) in an enclosed space an explosion may occur. Gas generation may also result in unpleasant odors and have adverse effects on vegetation.

Because of the hazards which may result, landfill gas must be monitored. EPA regulations (40 CFR 257.3-8(a)), stemming from the Federal Resource Conservation and Recovery Act, require that the methane concentration at the landfill boundary not exceed the lower explosive limit (five percent by volume). MPCA regulations state that decomposition gases shall not be allowed to migrate laterally from a landfill.

BACKGROUND

Decomposition Process

Bacteria break down the organic components of municipal solid waste into chemically simple materials. Gases are among the final products of this process.

In a landfill, decomposition proceeds through an aerobic (oxygen-requiring) and an anaerobic (oxygen-deficient) phase. The aerobic phase begins within hours after waste is placed in the fill. The chief by-products of this phase of decomposition are carbon dioxide and water vapor. Heat is also produced; temperatures inside a landfill may reach 140^0 to 150^0 F. (99). Aerobic decomposition may last from a day to several months, depending on refuse moisture content and the amount of oxygen initially present.

When virtually all oxygen has been depleted, anaerobic bacteria, heretofore present in the soil and refuse as spores, are able to function. During the first stage of anaerobic decay, bacteria reduce complex organic material to carbon dioxide, hydrogen and volatile organic acids (such as acetic acid). Methane-producing bacteria degrade the organic acids to methane and carbon dioxide. After a year or more methane is produced at a steady rate.

The aerobic and anaerobic stages of decomposition are distinct processes, however, in the actual landfill environment they occur simultaneously. Waste is buried throughout the life of a landfill, so refuse deposited a week ago may be undergoing aerobic decomposition while that placed in the fill several years before may be generating methane. In addition, refuse composition, compaction and moisture content vary widely within a single landfill. Aerobic conditions may persist for years in pockets of porous, less densely compacted waste, or near the surface where oxygen can infiltrate.

Landfill Gas Composition

Methane and carbon dioxide are the primary gases generated within a landfill. Figure 39 illustrates their changing concentrations as decomposition proceeds through the aerobic and anaerobic phases. While oxygen is present the concentration of carbon dioxide steadily increases. No methane is generated, since

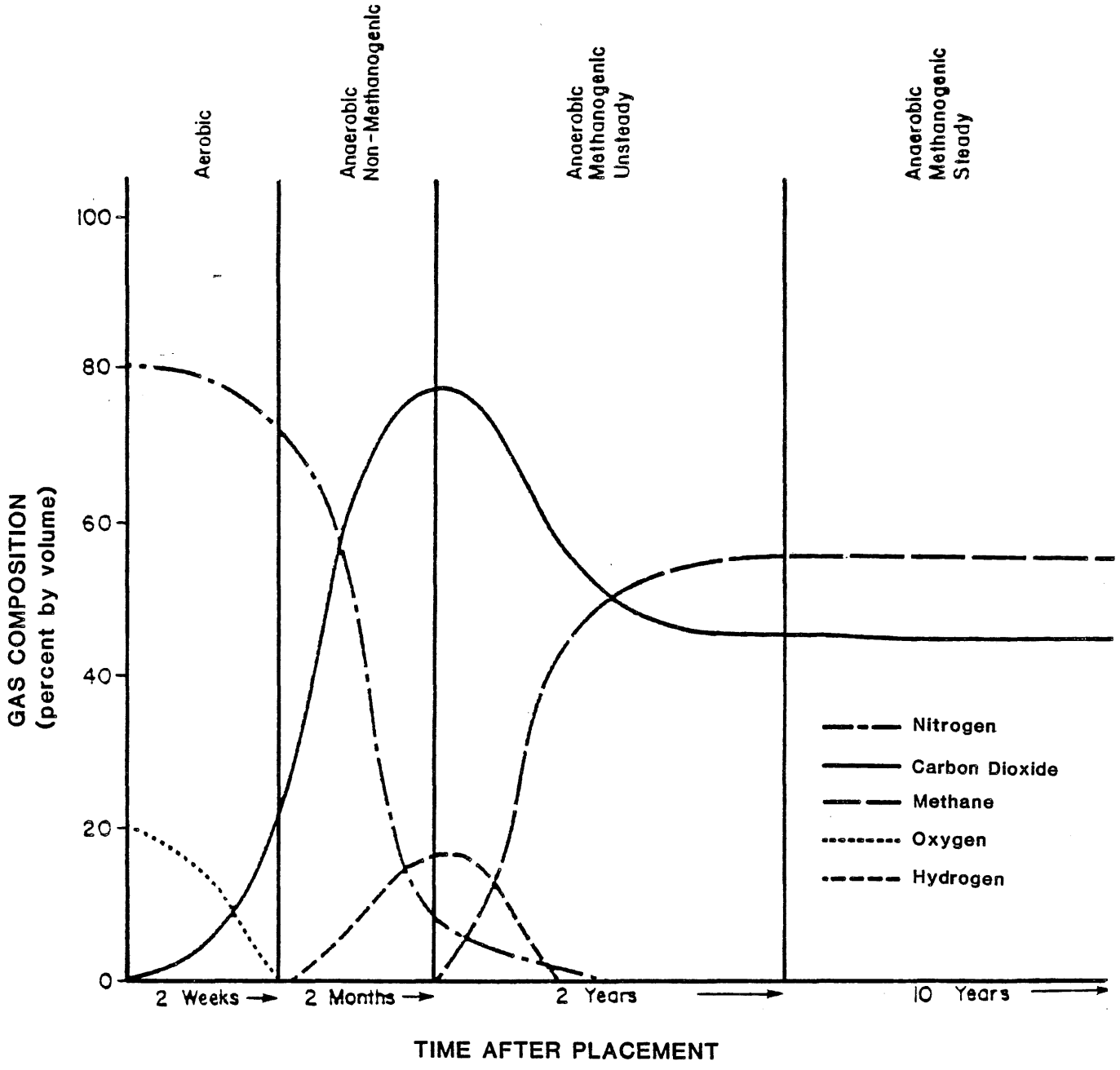


Figure 39.
TYPICAL GAS COMPOSITION DURING REFUSE DECOMPOSITION

Source: Modified from Farquhar and Rovers, 1973

oxygen is lethal to methane-forming bacteria. During the first stage of anaerobic decomposition, carbon dioxide production continues, and some hydrogen is generated. As bacteria degrade organic acids, methane and carbon dioxide are produced. Theoretically, these gases should occur in equal amounts, but actual concentrations are closer to 55 to 60 percent methane and 40 to 45 percent carbon dioxide (100).

Among the minor constituents usually found in landfill gas are nitrogen, ammonia, inert gases (such as argon), and hydrogen sulfide. The escape of hydrogen sulfide, which is produced by bacteria, is limited because it reacts with metallic ions in leachate to form insoluble metal sulfide precipitate (101). Argon and some nitrogen enter the landfill through diffusion from the atmosphere. Ammonia and the remaining nitrogen are by-products of biological processes.

Other trace constituents include hydrogen, low-weight hydrocarbons (for example, propane, butane, ethylene), phosphine, nitrous oxide, volatile fatty acids (for example, butyric acid), mercaptans, and a variety of others (102, 103). Reserve Synthetic Fuels, a company that extracts methane for energy, has detected over 60 trace constituents in sanitary landfill gas (104). Mercaptans, sulfer-containing compounds with structures analagous to alcohols, are of particular interest because of their unpleasant odor. Like hydrogen sulfide, however, they readily form precipitates with metal ions; they are usually present in escaping gas only in parts per billion (105).

Although no local information is available, health-endangering pollutants, including toxic and carcinogenic substances, have been detected in sanitary landfill gas at other locations in the U.S (106, 107). These contaminants are the results of chemical reactions, perhaps between substances brought into solution during the acidic (aerobic) phase of decomposition, and volatilization of chemicals present in solvents, thinners, oils and lubricants. However, these chemicals are considered hazardous wastes and their disposal in sanitary landfills in quantity is illegal. Some potential for toxic gas generation exists, however, because small quantities of hazardous chemicals can be disposed of as part of normal household wastes. If these materials are well mixed throughout the landfill, the concentration of the gases generated from them should be extremely low.

Volume and Rate of Production

The quantity of landfill gas generated is dependent on solid waste composition and the level of microbial activity. Generally, the more biodegradable material (food and yard wastes, paper, etc.) contained in disposed refuse, the more gas will be produced. Microbial activity is a function of moisture, temperature, pH, the availability of nutrients and the presence of oxygen and toxic substances. Given landfill conditions, only about 75 percent of all organic material will actually be converted into gas (108). Gas generation seems to reach a peak within two to 10 years after waste has been deposited, although some gas may be produced for more than a century (109).

Gas Migration

Gases move through refuse and soil as a result of pressure, concentration and density gradients. Bulk movement of gases results when air pressure and pressure in the refuse and surrounding soils are not uniform. Flow occurs in the direction of decreasing pressure. For example, when barometric pressure is

lower than gas pressure in the landfill, there will be a net movement of gas into the atmosphere. Diffusive flow is a result of differential concentrations of a particular gas. Net migration will occur from a region in which the gas is present at high concentrations to areas where concentration is lower. It is by this mechanism that methane may move from landfill to surrounding soils, even if gas pressure is uniform. Pressure-induced gas flow, or convection, and diffusion are independent of one another and, under some conditions, may lead to gas flow in opposing directions. This can become important in the design of migration control systems. However, in most cases convective and diffusive flow of landfill gas occur in the same direction (110). Movement due to density gradients results as gases separate vertically in an air column according to molecular weight. Methane is less dense than most components of air and, unless blocked by frozen or rain-saturated materials or cover soil of low permeability, moves upward through the refuse pile and cover material into the atmosphere.

The degree to which lateral gas migration will occur is dependent mainly on soil and refuse permeability to gas flow, degree of saturation and the amount of vertical venting. Large-grained soils have a greater volume of open space available for gas exchange and are more permeable to gas flow than small-grained soils. As pore space becomes smaller, both the rate and the volume of gas flow decreases. Migration will thus occur more readily and at a faster rate through gravel and sandy soils than through silt, clay or densely compacted refuse (111). Since liquids are more dense than gases, large volumes of water percolating downward may trap gases near the bottom of a landfill. Gas pressure will increase, inducing horizontal migration. A clay cap of low permeability will also increase lateral gas flow by impeding vertical venting and causing a buildup in gas pressure. MPCA regulations require such a final landfill cover in order to miminize leachate production, and hence, indirectly increase the probability of lateral landfill gas migration.

If lateral migration occurs, landfill gas will move below the soil surface until it reaches either a natural or artificial path to the atmosphere. Sand, gravel, cracks in rock or frozen cover material and leaks in utility pipes or sewer tunnels can all act as vents. Without detailed, site-specific information, it is not possible to make accurate predictions about the direction and extent of horizontal migration, nor about where gases will accumulate off-site.

Potential Effects of Landfill Gases

The chief hazard associated with the production of gases at landfills involves methane. Methane is explosive in concentrations between five and 15 percent by volume if oxygen is present. These concentrations only occur within a landfill during the first part of the methane-producing phase of decomposition. After this, methane concentrations are much higher. However, through lateral migration, methane may accumulate in explosive concentrations inside an on-site or nearby building or other enclosed space.

Another gas, carbon dioxide, can cause problems by dissolving in water to form a weak acid. This causes an increase in the corrosiveness of the water and thereby increases the solids content of leachate. Acidic leachate may lower the pH of the groundwater.

Some components of landfill gas may also damage plants by displacing oxygen in soil around the roots. Depending on the plant species involved, concentrations as low as five percent may be harmful (112). Carbon dioxide in the root zone

is directly toxic to all plants at concentrations of 60 percent or more, and to some species in concentrations of less than 10 percent (113). Although methane is not directly poisonous to vegetation, its presence encourages the growth of bacteria which deplete the oxygen supply. Hydrogen sulfide may contribute to plant stress or mortality by killing necessary soil fauna, such as angleworms. Other trace gases are very unlikely to accumulate to concentrations that would be toxic to plants.

Unpleasant odors may also result from refuse decomposition. One potential source of odor is aerobic decay of easily putrescible wastes, such as food, which have not yet been buried. Oderous gases also result from the anaerobic decomposition of organic waste. These include hydrogen sulfide, ammonia, mercaptans and various other trace constituents. Odors may also be caused by the vaporization, either directly or through chemical processes occurring at the disposal site, of various waste components.

EXISTING LANDFILL: GAS PRODUCTION AND CONTROL

Methane Production and Migration

The total methane production for the currently permitted landfill has been estimated for three possible scenarios (Table 23). Case I represents the maximum potential volume of gas which could be generated; Case II is based on consideration of incomplete (75 percent) biodegradation of refuse; Case III is a more conservative estimate which attempts to reflect actual landfill conditions, such as the occurrence of some aerobic decay due to oxygen inflow and the escape of some organic material in leachate. The calculations assume that 3.59 million tons of refuse will be in place at the end of the current permit, compacted to 1,000 lb./cubic yard. The composition of the waste is assumed to correspond to the average for the Twin Cities region (Table 4) with a moisture content of 30 percent of saturation.

Table 23
POTENTIAL METHANE VOLUME FOR PERMITTED LANDFILL

	Potential Methane Volume (billions standard cubic feet)
Case I	28.7
Case II	21.6
Case III	7.2

Source: Walter J. Maier, Assessment of Landfill Gas Generation, Control Methods and Hazards; Flying Cloud Landfill, October 1983.

The gas generated at Flying Cloud has been analyzed. Currently methane gas concentration is approximately 40 percent by volume. Methane concentrations should level off at approximately 50-60 percent by volume (114). Figure 35 illustrates the changes which occur in the typical proportions of major components of landfill gas over time. Maximum rates of production are expected to occur during the first two to 10 years, with production continuing at diminished rates for 50 to 150 years.

Methane monitoring began on the west side of the landfill in 1980. Waste near the western edge of the landfill was then four years old and had been covered with two feet of soil and low permeability lime sludge to minimize moisture infiltration. Tests indicated that methane was migrating to adjacent soils in significant concentrations. Methane was also detected around the concessions bulding of the Flying Cloud drive-in, but its source is disputed. A migration control system was installed in response to these monitoring results (115).

Migration Control

Two basic approaches to gas migration control are in general use at landfills (116). A low permeability barrier may be constructed to prevent gas from escaping beyond the perimeter of the landfill, or gas may be vented through either a passive or induced exhaust system. A combination of these methods is frequently used.

Impermeable barriers are placed at or just beyond the landfill boundary to block gas flow. Materials used include clay, asphalt, plastic, rubber and other synthetic materials.

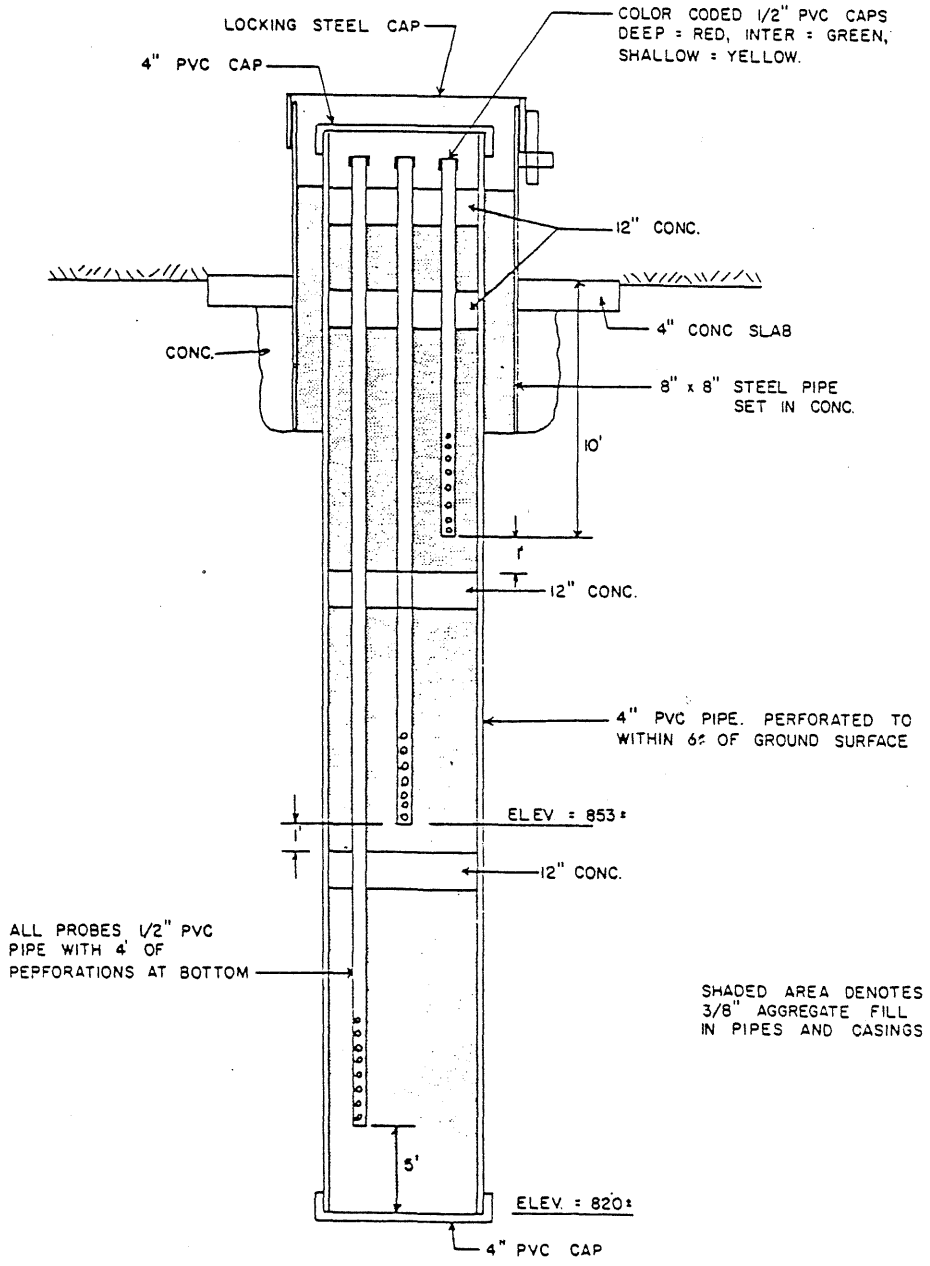
Gravel-filled trenches or wells along the landfill perimeter can function as a passive ventilation system by intercepting laterally migrating gas and providing a low-resistance path to the atmosphere. If there is sufficient soil moisture, the effectiveness of this type of system may be enhanced by the presence of methane-consuming bacteria. These methylotrophs cannot survive in an anaerobic landfill, but could live near a vent system that admits air to the soil. A gravel-filled trench backed by an impermeable membrane is a frequently used combination.

In a typical forced ventilation system, gas is collected in wells spaced at intervals along the landfill perimeter. Wells are drilled to a bottom seal (for example, bedrock or a low permeability soil layer), perforated pipe is inserted and connected to a central pipeline, and the well is back-filled with pea-gravel. Gas is then moved by suction to a motor-blower complex where it is collected for use as fuel, vented to the atmosphere or burned to control odor. A similar system using pipes laid in gravel-filled trenches may also be used for gas collection.

The methane control system at Flying Cloud is currently composed of a series of monitoring probes, a passive-control clay barrier along a portion of the southeastern perimeter of the landfill and an active-control well and header system along the western edge (Figure 7). The clay barrier was constructed in 1980. The active control system was installed in December 1981 and was put into operation in March 1982 (117).

There are 12 permanent gas monitoring probes on the site. Seven of these are located to the west of the active control system and five are to the east of the clay berm. Probes are spaced 200 feet apart and are in native soils 200 feet from the edge of the property line. Each probe allows subsurface sampling of methane concentrations and gas pressure at deep, intermediate and shallow depth (for example, 10, 30 and 50 feet) (Figure 40). Additional probes have been installed in and around the drive-in theater concessions building on a temporary basis. All probes are sampled monthly and a report is submitted to the MPCA (118).

Figure 40. MULTI-LEVEL METHANE PROBE



Source: Woodlake Sanitary Service, Inc.

According to the current permit, the passive methane barrier is constructed of a heavy clay soil compacted at 95 percent Proctor density to a permeability of 1×10^{-7} cm/sec. It runs for approximately 1,500 ft. along the southeastern landfill boundary and is 100 feet deep by 3 feet thick. The barrier comes in contact with refuse for about 1,200 feet of its length and 20 feet of its height. Laterally migrating gas is blocked and vents upwards to the atmosphere. Five probes to monitor the effectiveness of the clay barrier were installed in March 1983. Some gas readings were recorded immediately after their construction, but were attributed to fumes from the glue used to attach the PCV pipes (119). Since then, monitoring reports show zero gas readings to the east of the barrier.

The active control system consists of 14 collection wells, or drop pipes, spaced 150 feet apart (Figure 7). The wells are 36 inches in diameter and are drilled through either native soil or refuse. They vary in depth according to the depth of refuse at each location. All wells can be separately regulated and are connected by an eight-inch diameter PVC header-pipe that leads to a scrubber and motor/blower complex pump. The header is attached to the well with a slip joint which prevents cracking as the surrounding refuse settles. Between each well, the header pipe is arched to a three to four percent slope to allow condensate to flow back into the wells. Each week, the system is shut down for several hours to allow drainage and to prevent clogging of the pipes (120).

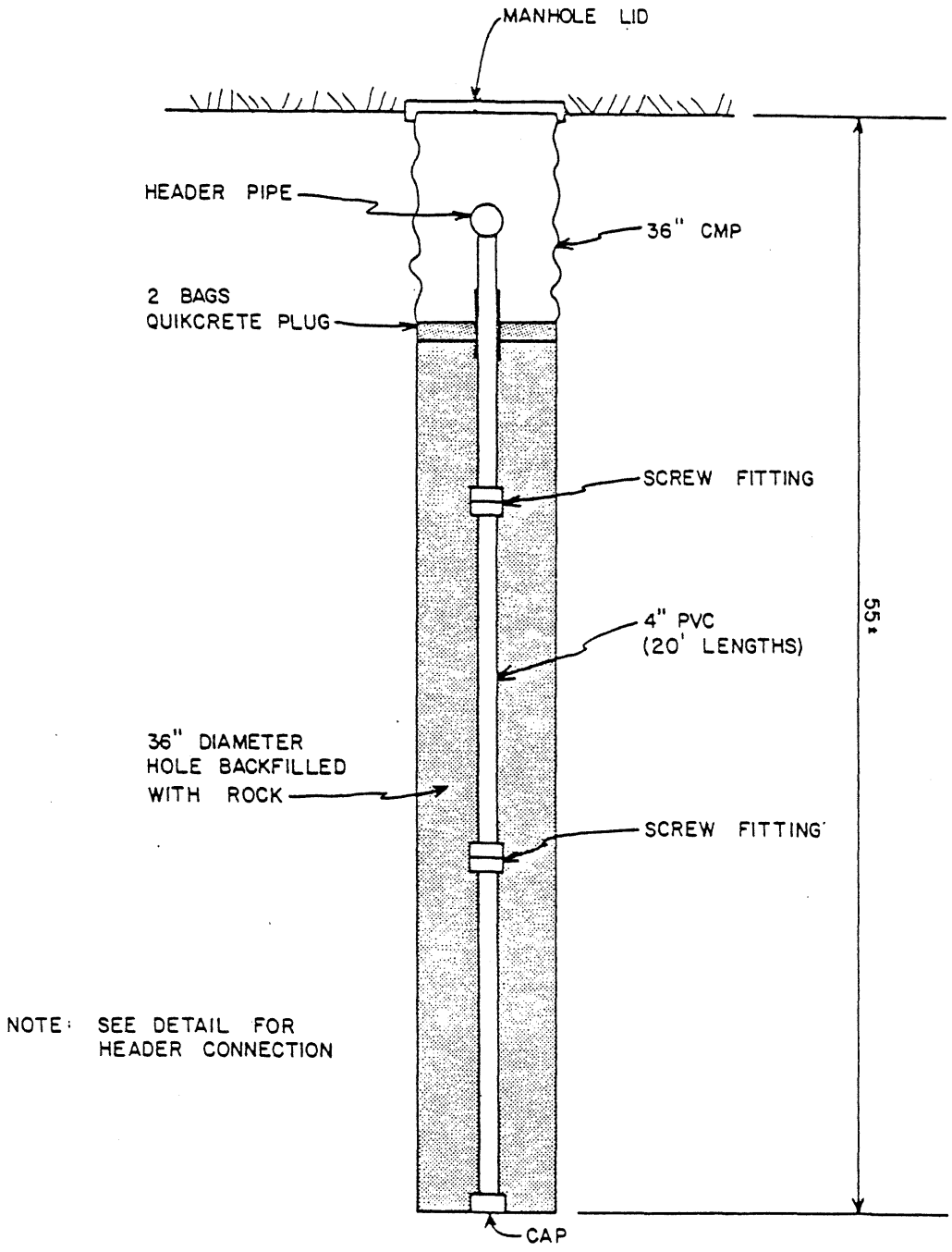
The motor/blower and scrubber are located in a building near the landfill offices. The building is equipped with an exhaust fan which is activated before entrance, and has heat and lighting designed to resist explosion. The switching equipment for the system is mounted nearby outside (121).

In order to prevent corrosion of the motor/blower equipment, gas is first pulled through a scrubber. Gas velocity is reduced, causing moisture droplets and soil particles to condense and drop into a drain. To date, an insignificant volume of condensate has been collected and no special disposal practices have been followed (122). The gas is then pulled through the pump and blown through a 10-inch diameter stainless steel flare located approximately 50 feet from the pump building, where it is burned continuously. Figure 42 is a conceptual diagram of the active methane control system.

Sporadic readings of significant gas levels (explosive range or greater) have been recorded to the west of the active control system. In May 1983, the pump was replaced with a larger capacity model. With one exception (June 1983) readings from the seven western gas probes have since been zero (123).

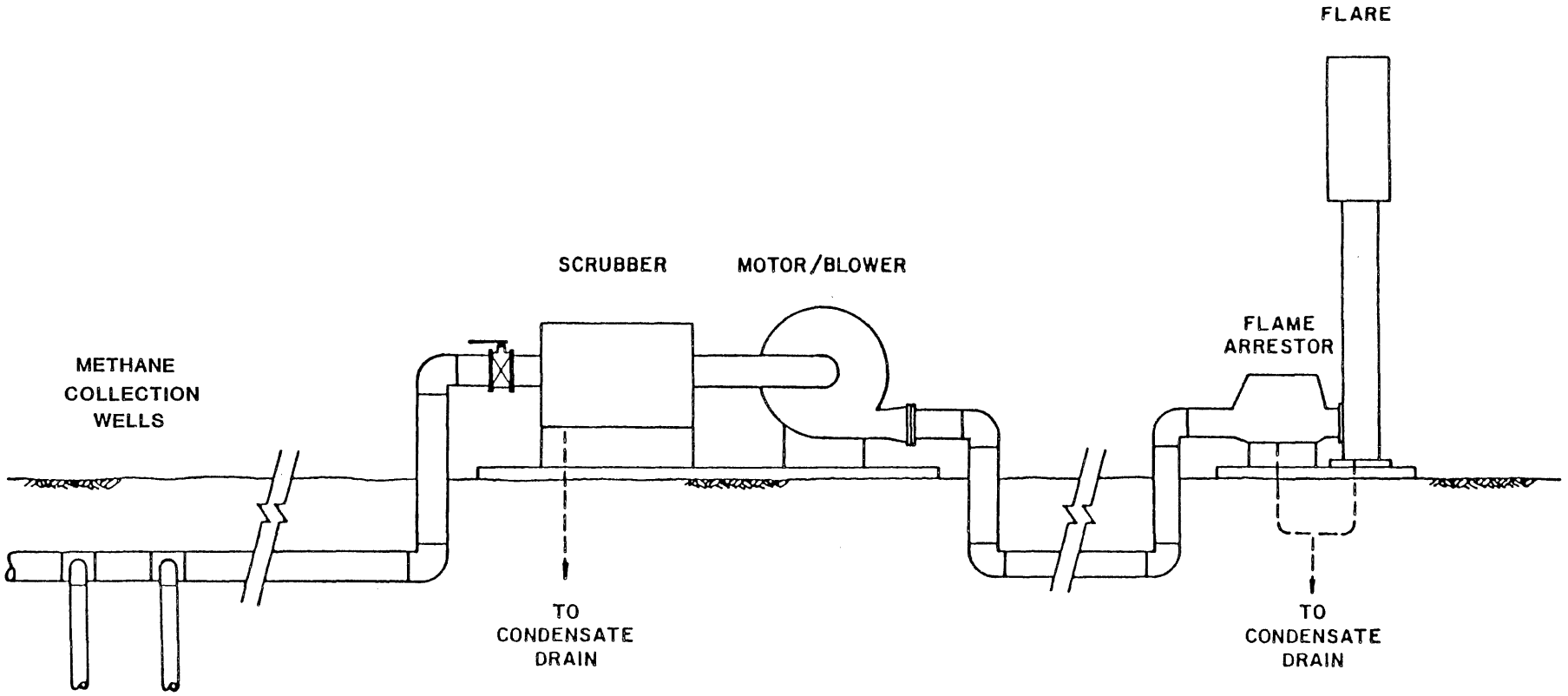
Six temporary probes were installed in and around the drive-in theater concessions building in June 1982. Methane concentrations within the explosive range were detected at these probes. Special monitoring was periodically conducted on drive-in property around the concessions building and the theater's septic tank, located approximately 200 feet to the south. The tests showed significant methane concentrations surrounding the septic tank, but little or no gas near the landfill boundaries. A leaky septic tank was thus suspected as the source of the methane around the drive in. However, after the installation of the new pump, no methane readings above the lower explosive limit have occurred at the six probes near the concessions building. The monitoring of methane around the drive-in through June 1984 indicated that no significant level of methane has been detected acccording to Woodlake reports filed wih the MPCA. Monitoring inside the concessions building through April 1984 indicates the same results. (Woodlake has not had access to the building since April 1984.)

Figure 41. METHANE COLLECTION WELL



Source: Woodlake Sanitary Service, Inc.

Figure 42.
ACTIVE METHANE CONTROL SYSTEM
(Conceptual)



Source: EMCON Associates

Odor Control

Two types of odor control are practiced at the site. Application of daily cover material helps limit odors from aerobically decaying refuse at the surface of the landfill. Cover soil also serves to contain odors resulting from vaporization of volatile wastes near the surface. Oderous gases which may be generated by anaerobic decay deeper within the landfill are controlled in the same manner as methane. If such gases are present, they are drawn to the collection wells and through the header pipe to the flare. All collected gas is burned to destroy odorous components.

PROPOSED EXPANSION: GAS PRODUCTION AND CONTROL

Gas Production

The proposed expansion will add approximately 4.5 million tons of refuse to the landfill. With this addition, a total of 8.14 million tons will be in place when the facility closes. Table 24 gives the estimated volumes of methane which will be produced in the expansion area and in the completed landfill if the expansion is granted. Cases I, II and III again represent different decomposition scenarios.

Table 24
POTENTIAL METHANE VOLUME FOR EXPANDED LANDFILL

	Potential Gas Volume (Billions Standard Cubic Feet)	
	Expansion Area	Total Expanded Landfill
Case I	36.4	65.0
Case II	27.3	48.8
Case III	9.10	16.3

Source: Walter J. Maier, Assessment of Landfill Gas Generation, Control Methods and Hazards; Flying Cloud Landfill, October 1983.

The proposed expansion will approximately double the volume of gas which will be generated over the life of the landfill. Estimated rates of methane production for the currently permitted landfill, the expansion area and the total expanded landfill are illustrated in Figure 43. This figure is based on calculations made from Case III potential methane volume estimates as shown in Table 24. The calculations assume that the expansion area will be filled to a final capacity of 4.5 million tons at a rate of 0.5 million tons of refuse per year, except for the final two years in which 0.75 million tons are assumed. These fill rates are simplifications, made for calculation purposes, of estimates provided by Woodlake and quoted in the Project Description section of this EIS. Refuse placement in the expansion area is assumed to begin in early 1985 and to be complete by early 1992.

Gas generation in the currently permitted landfill will be decreasing as that in the expansion area is reaching a maximum. Thus, the proposal probably will not result in a significant increase in the magnitude of the methane production peak over what would be expected if the expansion were denied (about 650 mcf per year as compared with 600 mcf for the existing landfill). However, Figure 43 shows that the expansion will extend the period of time over which large volumes of methane will be generated. If the expansion is not approved, gas generation in the existing landfill will peak around 1984. With the expansion, generation will not peak until approximately 1994. According to the estimates presented in Figure 43, the expanded landfill will be producing at least 100 mcf of methane per year more than what would be generated in the existing landfill alone for each of approximately 20 years (1987-2007). For example, in 1994 around 650 mcf could be expected, as opposed to 200 mcf if the expansion were not permitted. The expansion would thus extend the period of time over which the landfill could need monitoring for escaping gas.

Extent of Gas Migration

The distance, speed and direction of gas migration from a landfill are dependent on local variations in soil permeability, degree of compaction and moisture content. Other variables include precipitation, temperature, barometric pressure and the location of the water table. The clay cover which must be added after landfill closure to minimize moisture infiltration has a low permeability to gas flow. Thus, vertical ventilation will be decreased, resulting in an increase in pressure and a greater propensity for lateral gas migration. Accurate modeling of gas flow is difficult due to spatial and temporal differences in the variables. Some generalizations, however, can be made based on the information that is available.

Refuse depth in the completed landfill will average 80 feet extending from the surface (900 feet MSL) to 820 feet MSL. The soil surrounding and underlying the landfill from the surface to approximately 790 feet MSL is generally composed of poorly graded or coarse sandy loam (see Site Hydrogeology section). This material has a relatively high porosity and will easily allow off-site gas migration and vertical venting.

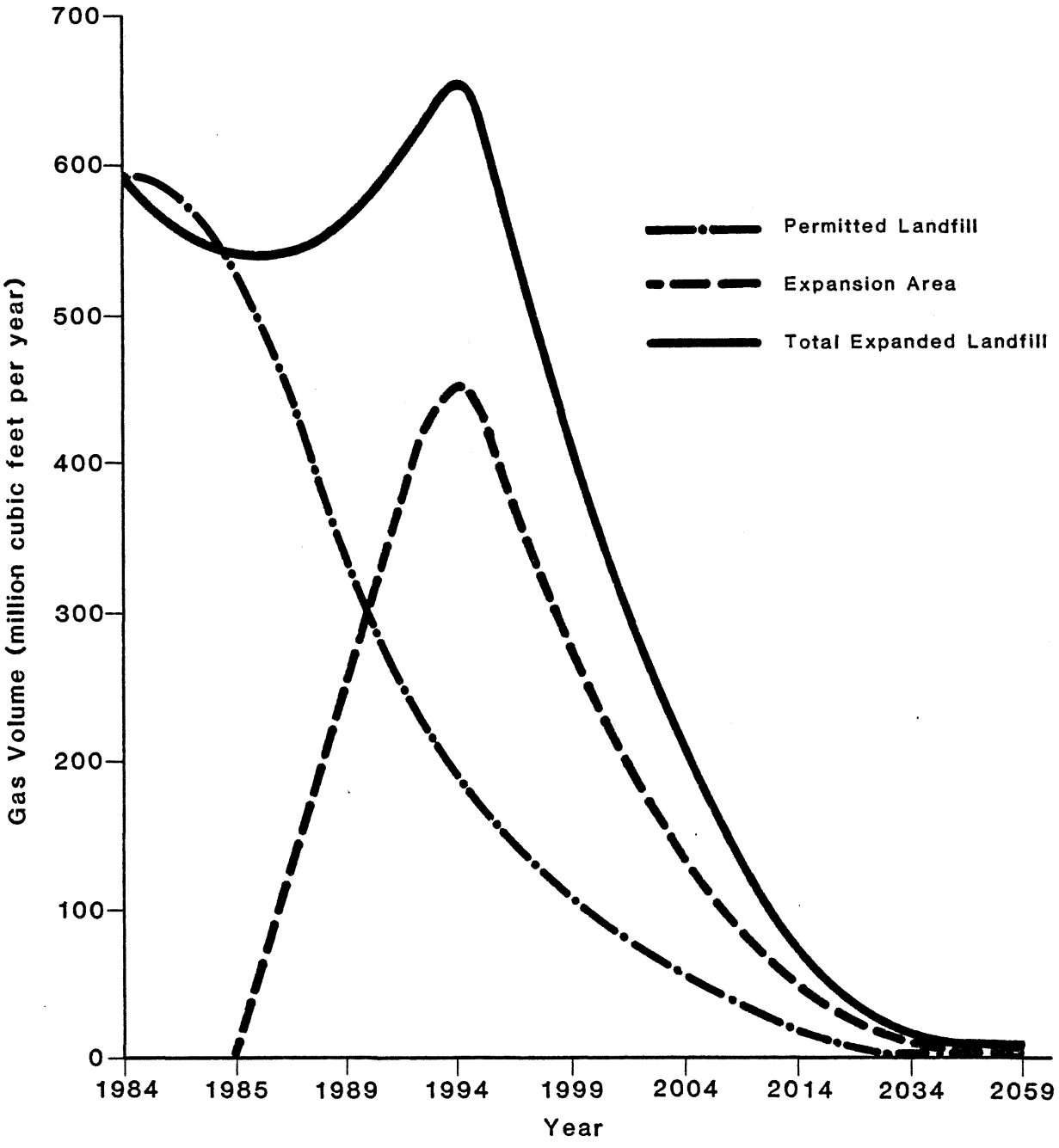
Several models allow general predictions about the distance and direction of significant methane concentrations. Detailed migration models require site-specific data concerning soil porosity and permeability, landfill gas composition, pressure gradients and the rate of gas production. However, based on field observations, the Canadian Environmental Impact Directorate developed the following simple relationship, applicable in coarse-grained soils:

$$D = 10 \times H$$

where: D = distance of migration of lower explosive limit of methane (five percent by volume) from edge of refuse
H = depth of refuse (121).

This model indicates that explosive concentrations of methane could occur at distances of up to 800 feet in all directions of Flying Cloud Landfill if no control system were employed. This distance could be increased by the presence of frozen cover material, lenses of clay soil, saturated soils, a clay cap or other factors which limit vertical migration or cause a build-up in gas pressure.

Figure 43.
ESTIMATED RATES OF METHANE PRODUCTION



Adapted from: Walter J. Maier, Assessment of Landfill Gas Generation, Control Methods and Hazards, Flying Cloud Landfill. October, 1983 (Table 5).

The rate at which landfill gas migrates through soil or refuse is largely dependent on the medium's porosity and degree of saturation. Gas will travel most rapidly through coarse, dry soils since they provide a large volume of continuous pore space. Speed of migration will vary at a single landfill according to season and amount of precipitation and will probably not be constant in all directions of the site.

Proposed Methane Control System

The expanded methane control system at Flying Cloud includes new monitoring probes along the northwestern, northern and eastern borders and an extension of the existing well and header control system on the western edge of the landfill (125) (Figure 7). Woodlake has also proposed two possible control systems on the landfill's eastern edges; the final choice will be made on the basis of specific site considerations and maintenance requirements.

Seventeen new monitoring probes will be installed at approximately 200-foot intervals along the property lines. The probes will be located in native soil near the edge of the refuse and will be of a design similar to those already in place. Each probe will allow sampling at deep, intermediate and shallow depths.

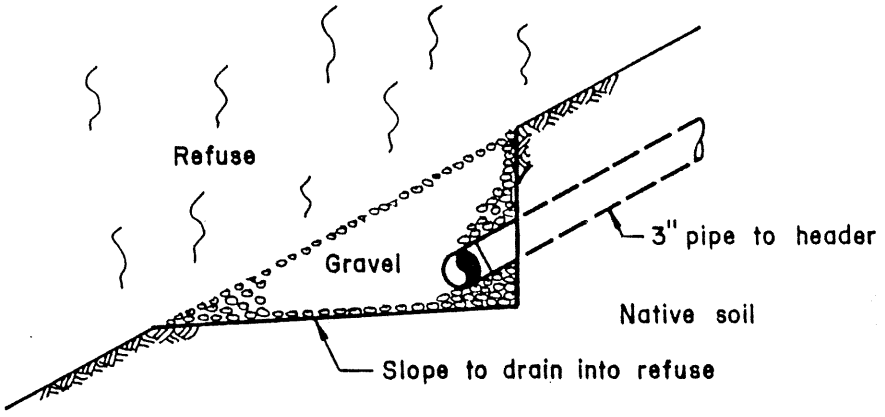
Five new gas collection wells are proposed along the western and northwestern landfill boundaries. These wells will be of the same type as those already in operation and will be connected to the same header pipe and pump complex. Each well will have a flow rate control valve which can be adjusted from above ground. The new wells will also be constructed with a sampling port near the control valve where methane concentration and pressure can be measured (Figure 41). The existing pump system should have sufficient capacity to operate the additional wells. However, supplemental equipment will be installed if necessary.

Woodlake has proposed that either a series of trench collectors or a well and header system similar to that on the western boundary be installed along the eastern perimeter. The location of the proposed trench collection system is shown in Figure 7. If collection wells are constructed they will be located in the same area, probably spaced 150 feet apart.

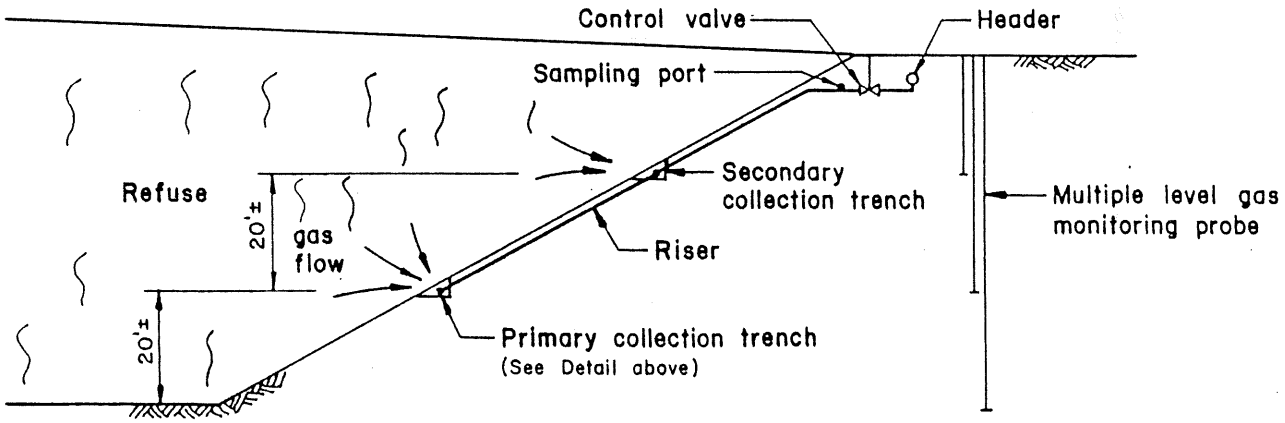
The proposed trench collection system would consist of a series of perforated PVC pipes laid in gravel-filled trenches (Figure 44). The trenches would be dug in native soil along the boundary of the refuse. PVC riser pipes would connect the collection trenches to a header pipe located near the landfill property boundary. The riser and header pipes would either be placed in, or supported by, native soil. Primary and secondary collection trenches would be installed in segments along the edge of the fill area before refuse is placed behind them. The primary trench would be placed 20 feet above the base of the landfill and the secondary trench would begin 20 feet higher. Each segment of pipe would be 180 feet long and the pipe segments would be spaced 20 feet apart. The pipe segments in the primary and secondary trenches would be staggered as shown in Figure 45. Installation of the trench system would begin along the southeastern boundary of the site, near the western edge of the Bluffs West subdivision. The secondary trench would be constructed along the rest of the border only if operating experience proved it necessary.

The alternate proposal for gas control on the eastern side of the landfill is a well and header system similar to the present one. In the new system, however, the header pipe would probably be placed above ground to allow easier maintenance (126). Insulated polyeurethane (PVC) tubing would be used to prevent freezing.

Figure 44.
METHANE TRENCH COLLECTION SYSTEM
(CROSS-SECTION)



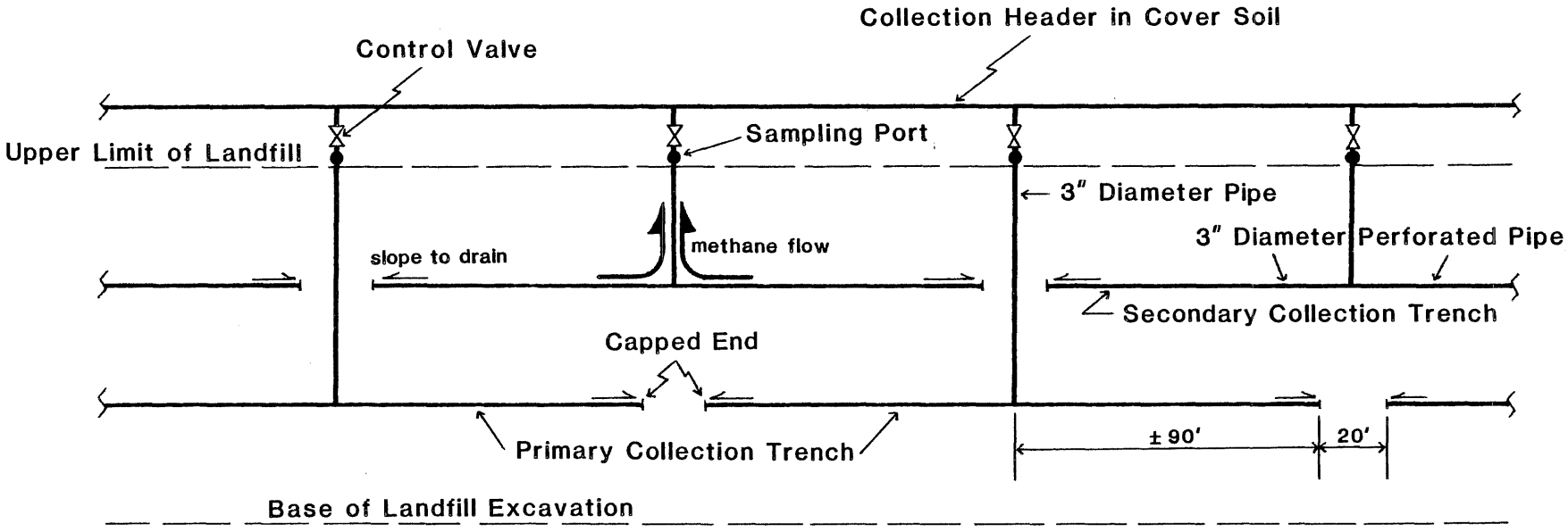
Typical Collection Trench Detail



CROSS SECTION
Typical Collection Trench System

Source: Browning Ferris Industries, Inc.

Figure 45. METHANE TRENCH COLLECTION SYSTEM



Source: Browning Ferris Industries, Inc.

Gas from either system would be transported through the header pipe to a scrubber and motor/blower complex where it would be flared for odor control. The existing motor/blower complex may be enlarged to handle gas from both the eastern and western collection systems, or a new pump may be installed on the eastern side. The tentative location for a new pump building is shown in Figure 7.

Active well systems and trench vent systems are subject to several potential problems. If the area of influence does not extend to an impermeable bottom layer (for example, bedrock, groundwater), the possibility exists for gas migration beneath it. Trench fill material may be infiltrated by water or sediment and may clog and become less permeable. As refuse undergoes uneven settling, cracking of pipes may occur or the slope necessary for proper drainage of condensate may be lost. In order to correct these types of problems, the trench system would need to be shut down and excavation could be necessary. Access to trench pipes for routine maintenance purposes may also be difficult and problems may arise in accurately locating the nonfunctioning trench segment. In an active well system, well backfill may become clogged, well and header pipes may crack or slip during settling, or the slope of the header pipe may be altered, resulting in partial or complete blockage. Gas may seep below wells which are not dug to an impermeable layer.

In order to function effectively, both systems must establish overlapping areas of influence. If overlap is lost, gases may seep between wells or staggered trench barriers. Loss may occur either as a result of an inadequate motor/blower capacity or from fluctuating levels of gas production. Some studies have shown that methane migration is sporadic and may exhibit wide variation over a few hours. If the volume of migrating methane increases and the capacity of the control system remains constant, the areas of influence will decrease in size and overlap may be lost (127).

In general, active trench vent systems and well and header systems are considered to be roughly equivalent in effectiveness (128). The well and header system proposed for Flying Cloud, however, may have some advantages over the trench system. Landfill personnel will have had experience in its operation, since it will be similar to the existing control system. Also, if the header pipe is installed above ground, access for maintenance will be considerably simplified.

EMCON Associates of California have evaluated the potential for gas recovery for fuel at Flying Cloud Landfill and have proposed three alternate designs for a recovery system (129). Since methane becomes mixed with oxygen and nitrogen as it moves away from the fill area, these systems do not attempt to collect laterally migrating gas. Instead, they make use of methane which would otherwise diffuse vertically into the atmosphere. According to EMCON's report, Alternative 1 calls for 40 vertical wells to be installed throughout the landfill interior after final refuse height has been reached. Alternative 2 makes use of a series of horizontal trench collectors arranged in a concentric pattern. Alternative 3 is similar, but trenches are arranged radially. Both Alternative 2 and 3 must be installed in an intermediate stage of refuse placement. All three designs are located to minimize interference with the migration control system. Although Woodlake has expressed interest in methane recovery at Flying Cloud, field tests have not been done and all plans are tentative.

Adequacy Of Proposed Control System

The proposed gas migration control system must be able to limit methane escape at the landfill boundary to less than five percent by volume for a period of at least 20 years, and perhaps for much longer. In order to perform this basic function, the system must have a radius of influence adequate to intercept escaping gas, a monitoring component able to detect fluctuations in methane production, a method of adjusting the motor/blower complex accordingly and adequate capacity to handle maximum possible generation. A regular and frequent post-closure maintenance and monitoring schedule, contingency plans for system failure and a back-up system of some type would help protect nearby development.

Some general comparison of different methods of migration control is possible based on modeling and operating experience. As a rule, active control systems, such as those proposed by Woodlake, are more effective than passive methods like the ventilation trench or clay barrier (130). Although the design is not as well proven, forced recharge systems, which operate by pumping air into the trench rather than extracting it, are apparently more effective in limiting migration than the proposed system. In addition, since a forced recharge system creates a positive pressure barrier which drives methane back into the landfill, the threat of methane buildup along the landfill perimeter is reduced (131). Although a well and header extraction design is apparently the most commonly employed active control system, the most effective method presently available seems to be a vertical trench dug to bedrock or groundwater and backed by a low permeability membrane. Gas would either be extracted using negative pressure flow or, preferably, pushed back into the landfill by recharge pumping (132). Such a design would be considerably more expensive than Woodlake's proposal.

Woodlake has proposed that methane monitoring tests be conducted once a month around the perimeter of the landfill. Since effective control is dependent on feedback from monitoring wells more frequent monitoring would be useful, particularly near Bluff's West. Methane migration appears to occur in a sporadic, highly variable pattern, rather than as a constant flow. Since monitoring probes do not continuously record gas levels, but give only a single reading for the time at which the probe is sampled, monitoring results do not necessarily represent the maximum, or even the average, gas flow past the probe. If leakage were occurring, it could potentially go undetected for 30 days, since sampling will be done only once a month, or perhaps longer if readings do not coincide with times of peak migration.

Monitoring probes will be spaced approximately 200 feet apart. Because of spatial and temporal variations in the physical parameters that control gas migration, it cannot be stated with certainty that this spacing will allow detection of all migrating gas.

A comparison of the proposed monitoring procedures with those followed at Anoka Sanitary Landfill is useful because of the site's resemblance to Flying Cloud. The Anoka site, located in the northern portion of the Twin Cities region, is surrounded by sandy soil, and uses a well and header control system of design similar to the proposal; it is in closer proximity to a residential area than is Flying Cloud Landfill, however. Methane monitoring is conducted twice per week during warm, dry weather. Since the liklihood of gas migration is increased by cold or wet conditions, monitoring is done at least every other day between October 1 and May 1. Probes are also sampled every other day for a

week following heavy rainfall at other times of the year. Anoka Landfill monitoring probes are spaced 100 feet apart along the property line nearest the residences, with additional probes located between the property line and the fill area (133). These procedures demonstrate that frequent monitoring is operationally realistic.

Given the long period of time during which the control system must be functional, breakdowns of some sort seem likely. Interruptions to operation could be caused by power failures, vandalism, accidents, equipment malfunctions, blockage or cracking of pipes and clogging of trenches or wells. Woodlake has not proposed a backup method which could be relied upon in the event of a failure of the main system nor detailed what would be done if migration were to occur in spite of control efforts.

Equipment breakdowns can be minimized by establishing a regular and frequent equipment inspection routine over the life of the control system. Wells and trenches cannot be inspected visually, but could be checked indirectly on a regular basis. The extraction system could be shut down, the vault box checked for settlement or water entrapment, the butterfly valves inspected for operability and the pressure capacity of each well tested. If a problem is detected, further testing may be necessary to determine its location, and excavation may be required to correct it. If above-ground piping is used, it could be inspected for cracks, tears in insulation and adverse sloping which might cause blockage. In the event of a power outage of a day or more, an emergency generator could be obtained to keep at least the wells nearest Bluffs West in operation. Monitoring could be conducted during the outage to check for migration.

Woodlake has proposed an extension of the existing control system to the north, but has suggested no other measures to limit migration at the western border (Figure 7). Although monitoring has detected no gas since June 1983, monthly readings may not accurately reflect fluctuations in migration.

No control or monitoring measures have been proposed for the southern boundary of the site. The river bluffs to the south are a proposed part of the Minnesota River Valley National Wildlife Refuge and are valuable as wildlife habitat and recreation area. Although landfill gas migration to the bluffs poses no threat to human safety, vegetation stress is a possibility, particularly following closure. Without monitoring probes, such damage would be the first indication that gas is accumulating. To date, however, there is no evidence of vegetative stress even though refuse has been buried near the southern edge of the fill for several years.

Only methane probes are proposed along the northern boundary of the horizontal expansion area (Figure 7). Since property immediately to the north of the site is vacant and the small commercial/residential strip is over 1,000 ft. from the fill area, monitoring alone appears to be adequate unless extensive migration is detected.

The measures proposed to control odor seem generally adequate, although the close proximity of the flare for the eastern control system to Bluffs West may allow odors to reach the residential area in the event of leakage or incomplete combustion. Since prevailing winds during the summer months blow from the south and southeast, odors from the active fill area should not normally become a nuisance in the eastern residential developments. However, the potential for odor problems exists on calm days or when winds are from the north or west. Nuisances to drive-in customers from landfill odor are expected to be minimal, since daily cover should be in place by normal business hours.

Woodlake has not discussed the detection or control of toxic gases.

The proposal to collect landfill methane for use as a fuel, if implemented, will not eliminate the need for a migration control system. In order to avoid pulling air into the landfill and degrading the heating value of the methane, a recovery system must limit extraction to a rate somewhat below that of generation. Thus, the potential for diffusive flow of methane across landfill borders is not eliminated (134).

PROPOSED EXPANSION: SUMMARY OF POTENTIAL EFFECTS OF LANDFILL GASES

A fire and explosion risk from migrating methane is among the potential problems associated with landfill gas from the expansion. Odors and stressed vegetation are other potential problems.

Effects on Residential and Commercial Areas

The chief concern arising from the generation of gas at Flying Cloud Landfill is the potential for hazards to nearby residents from fire or explosions produced by methane accumulation. Two residential areas, Hillsborough and Bluffs West, are located to the east of the proposed expansion area. Table 25 lists the approximate closest distance of each subdivision to the eastern boundary of the currently permitted landfill and the expansion area.

Table 25
DISTANCE TO RESIDENTIAL AREAS

	Distance from Existing Landfill (feet)	Distance from Proposed Expansion Area (feet)
Bluffs West		
Vacant lots (River View Rd.)	1,200	500
Vacant lots (Sandy Point Rd.)	800	200
Occupied Houses	1,400	900
Hillsborough		
Occupied Houses	2,100	1,300

Vacant lots in the undeveloped portion of Bluffs West are within the predicted range of significant lateral methane migration (800 feet) from both the existing and expanded landfill. Occupied houses are as close as 900 feet. If methane travelled as far as the subdivision, it could then accumulate to explosive levels (5 to 15 percent by volume) in basements, sewers, or other enclosed spaces. Sparks from machinery, matches, cigarettes, or other open flames could ignite an explosion.

The Hillsborough residential area would be 1,300 feet from the expanded landfill, and therefore should not experience methane problems. In addition, the sandy soils and sloping topography between the site and Hillsborough will allow venting of methane. Lastly, the wetland area between Hillsborough and the site will serve as an effective barrier to methane migration due to the proximity of the water table to the surface.

Landfill gas generation may result in odors becoming a nuisance to nearby residents. The presence of hydrogen sulfide, mercaptons and other less common trace decomposition gases could cause this problem. The proposed methane collection system is designed to control odors from trace gases by burning the gases rather than simply venting them to the atmosphere.

Odors from decay of easily putrescible wastes at the landfill surface will be limited through the application of daily cover soil. Table 21 indicates that the prevailing winds blow from the south or southeast from May through October and from the northwest during the November to April period. Thus, during the hottest months of the year when odors can be assumed to be most intense, the landfill is generally downwind from the residential areas. However, leakage from the gas flare or certain weather conditions could result in odors reaching the housing developments.

Areas to the west will probably not be greatly affected by gas migration from the eastern horizontal expansion area. Since gas will move most easily through the sandy soil to the east rather than through compacted refuse, any off-site migration from the horizontal expansion area will probably be eastward.

Most of the vacant land to the north is currently being farmed. Although there is some potential for crop stress, no safety threat exists. The small commercial/residential strip north of the property is over 1,000 feet from the expansion area. The risk of methane accumulation there is minimal. Methane has been detected near the drive-in concessions building, but its source is disputed.

Effects on the Minnesota River Valley Bluffs

It is assumed that landfill gas will migrate through the sandy, coarse-grained soil south of the site towards the Minnesota River Valley. Since there will be no development between the landfill and the river, no structures will be present to serve as sites of methane accumulation. Laterally migrating methane which reaches the bluff face should vent to the atmosphere, therefore, no control system is proposed.

Vegetation along the river bluffs may be adversely affected by migrating gas, however. Plant death due to gas has been recorded at up to 800 feet from a landfill, although severe damage seems to occur more often at distances of 100 feet or less (135). Most commonly, landfill gases themselves are not directly toxic to plants, but accumulate in the root zone and exclude oxygen or encourage the growth of harmful bacteria. Higher soil temperatures are also frequently associated with the presence of landfill gas and may be harmful to vegetation (136).

The river bluffs are approximately 100 feet from the existing landfill. The expansion proposal allows for a greater setback, leaving at least 200 feet between the edge of the landfill and the bluffs. No monitoring has been done along the southern border of the site, so it is uncertain that gas from the existing fill is reaching the bluff. However, no vegetation damage has yet been observed. Since sandy soil is generally well aereated, it is possible that diffusion of oxygen from the atmosphere to the soil has been sufficient to prevent landfill gases from building to harmful levels (that is, approximately 20 to 60 percent). When the clay cover is added following closure of the landfill, gas migration rates will probably increase, perhaps resulting in higher landfill gas levels in the soils and a greater probability of plant stress.

Effects on Post-Closure End Use

The gas generation lifetime of the landfill will probably exceed 50 years and may be longer than a century; however, the estimated rate of production falls off significantly after 2004. In any case, the effects of landfill gas and methane control equipment must be taken into consideration in the choice of a final use for the site.

The golf course, which has been proposed by Woodlake as an end use for the site, will require irrigation. If more water percolates through the refuse because of the irrigation greater methane generation could occur, perhaps resulting in a need for increased control equipment capacity. Since the rate of gas production in the landfill could increase, the risk of methane migration to residential areas would also be greater if the control system is no longer adequate. Choice of a final land use, such as a golf course, which could result in greater gas generation should be avoided unless the control system is designed to manage the increased gas production.

If a well system with an above ground header pipe is constructed on the eastern border, this portion of the site will be incompatible with any active use. Piping will also need to be protected from vandalism. During the years that the monitoring and control system must remain active, portions may need to be excavated for maintenance purposes. Land use should be planned to allow for this type of disruption.

The development of permanent structures on the closed landfill should be avoided initially since vertical venting may result in methane accumulation under buildings. If, after a period of time, monitoring indicates that gas generation levels are acceptable, buildings could be erected. Special monitoring and venting devices or building design may be necessary for each structure. Precautions may also need to be taken to prevent explosions during excavation and construction. Since sewers and utility pipes are potential sites of methane accumulation, they should not cross the site until monitoring shows acceptable levels of methane production.

Special care will need to be taken in planning the final vegetative cover for the site. A number of factors have been identified as having adverse effects on landfill vegetation. They include: lack of soil cover, insufficient moisture, poor quality cover material, poor planting practices, lack of care and landfill gas contamination (137). Several studies have been conducted which gauge the suitability of various plant species to the landfill environment, including their tolerance to landfill gases (138, 139). The results of these studies should be useful when decisions are made about plant species to be used in the final cover.

MITIGATION

Modifications to Woodlake's proposed gas control system are discussed below.

A number of modifications to the proposed system could increase its effectiveness. For instance, incomplete combustion could allow some gas to escape from the flare for the eastern collection system. Moving the flare farther from Bluffs West would increase dilution and thus decrease the potential for exposure of residents to detectable trace gases and odors.

Increased gas probe monitoring would provide a more accurate picture of gas movement. All probes could be sampled at least weekly. The probes near Bluffs West and the drive-in could be sampled two to three times per week. Such frequent monitoring would increase the liklihood of detecting and controlling gas control leaks before significant off-site migration occurred. Additional probes near the residential area could also be considered in order to reduce the possibility of undetected migration. According to the estimates given in Figure 39, it would be wise to monitor for at least 20 years following closure.

If the source of methane accumulations in the concessions building of the drive-in is determined to be the landfill, Woodlake could undertake several measures to mitigate the resulting hazards. These include installing a secondary method of control behind the existing well and header system or fitting the concessions building with protection features such as automatic methane sensors linked to an alarm, exhaust fans or an impervious membrane surrounding the cellar of the building (140). Similar measures now help protect the BFI office building.

The distance between occupied residences, vacant lots, and the expanded landfill could be increased to allow a greater area for vertical venting of gases. This could be accomplished by either temporarily restricting or delaying new development in the vacant portion of Bluffs West, or by reducing or eliminating the southeastern portion of the expansion area. A setback of 700 to 1,000 feet, in addition to the control system on the perimeter, should reduce the risk to residents.

Undeveloped lots are located within 800 ft. to the east and southeast of the expansion area. Woodlake has purchased a number of the closer lots, and could delay the development of those lots. However, vacant lots owned by a private developer are located along River View and are also within 800 feet of the expansion. Delaying the development of these lots could have other impacts (see Property Values section). Housing development could resume when monitoring indicates that migration is adequately controlled or that methane generation has fallen to safe levels.

It is unlikely that methane gas would migrate around the southeast end of the proposed control system towards Bluffs West. Additional monitoring probes placed along the southern perimeter would identify the movement and any accumulation of the gas. If migration is indicated, additional monitering probes could be installed closer to Bluffs West.

The above approach might not mitigate the potential for impacts on nearby occupied residences (which are as close as 900 ft.) or the potential for accumulation of methane gas in the utilities lines in the western portion of Bluffs West. Elimination of, or a reduction in, the southeastern corner of the expansion could be a more effective approach in these instances.

A secondary control system, such as a passive control barrier or ventilation trench, could be constructed as a backup to Woodlake's proposed system. In the event of leakage or failure of the active control system, methane would be intercepted by the backup control method. This measure is probably only necessary along the southeastern edge of the landfill near Bluffs West, because of the close proximity of lots and utility lines. A passive control barrier could be constructed from compacted clay or synthetic materials and would be similar to the existing barrier. It would serve to confine methane leaking past the primary control system. To be effective, such a barrier should be placed

between the active control system and the monitoring probes and should extend at least to maximum refuse depth (approximately 80 feet). A ventilation trench would function by providing a low-resistance vertical path to the atmosphere. It would consist of a trench several feet wide dug to the bottom of the refuse column and filled with coarse gravel. Although such a secondary control system would reduce the risk of off-site gas migration, it would require maintenance to reduce the potential for leakage.

The well-aerated sandy soils on the project site and the setbacks of the existing landfill and proposed expansion from the river bluffs should provide for the natural diffusion of landfill gas before it affects the bluff vegetation. If the vegetation appears to be affected during the landfill operations or following closure, gas probes can be installed along the bluffs to determine whether landfill gas concentrations are the cause. If necessary, a control system can be installed to prevent gases from reaching the river bluffs. Replanting of the affected bluff areas should prevent erosion of the steep slopes. The U.S. Fish and Wildlife Service could be contacted to obtain technical advice regarding the appropriate types of vegetation.

NOISE/VIBRATIONS

INTRODUCTION

Expansion of the Flying Cloud Sanitary Landfill could change noise levels at and around the proposed site. Berm construction, landfill excavation, daily landfilling operations and traffic are all possible sources of noise increases.

To help quantify potential changes in noise levels, the Council entered into an interagency agreement for a noise impact study to be prepared by specific staff members of the City of Bloomington (Environmental Services) and the MPCA. That work is reported by Kelso and Nelson in Noise Assessment Expansion of Flying Cloud Sanitary Landfill, April 1984. This report is hereby incorporated by reference as a part of this EIS. The study's methodology, results and suggestions for noise control are outlined in this chapter.

Noise Concepts and Measurements

The noise study's results are best understood if several important concepts and measurements are understood first. One major concept is that of "noise" itself. Generally, "noise" is defined as "unwanted sound." This definition is somewhat tenuous because the perception of a sound as "unwanted" can vary among receivers. Nevertheless, state regulations that control "noise" levels are in place. They were primarily developed to protect public health and safety. These regulations were used in the study as the primary basis against which to evaluate potential changes in noise levels.

A number of sound, and therefore noise, characteristics can be measured. Sound pressure is the most basic and common measure. It is measured in decibels on a scale ranging from 0 to 200.

Basic fundamentals regarding decibels are:

1. The decibel is a man-made unit where zero dB corresponds to the threshold of human hearing.

2. If you double the energy (decibels), your result is three additional decibels, for example 80 dB + 80 dB = 83 dB.

3. It takes an increase of 10 decibels before the average person perceives the sound to be twice as loud.

4. It takes an increase of about two to three decibels before the average person perceives any noticeable increase in loudness.

Frequency and wavelength are two additional sound characteristics that can be measured. Frequency is the number of times pressure variations occur each second. It is measured in hertz (Hz). (In past years, frequency was measured in cycles per second.) The distance traveled for each pressure variation of a sound wave is called wavelength. As an example, the rumble of thunder is of low frequency and long wavelength whereas a high-pitched whistle is of high frequency and short wavelength.

Sound energy, frequency and wavelength can be recorded on a variety of instruments in a variety of ways. The most commonly used instrument is a sound level meter (SLM).

One SLM attachment allows sound to be "A-weighted." "A-weighting" represents the human ear's response to sound energy in that it filters out certain low and high frequency sounds which the human ear cannot hear. A-weighted decibels are reported as dB(A), rather than dB.

A-weighted measurements can be reported as real time measurements or as statistical descriptors. In the first instance, the dBA level recorded at a particular instant in time is reported, or several instantaneous measurements are averaged together and reported as an average dBA level. In the second instance, noise is monitored for one hour and the noise levels recorded for each fraction of the hour (L_x) are reported. For instance, an L_{10} noise level represents the dBA level reached or exceeded for 10 percent (six minutes) of the hour. An L_{50} noise level represents the dBA level reached or exceeded during 50 percent (30 minutes) of the hour.

Another meter attachment allows "octave band analysis." In octave band analysis, the decibel levels associated with different frequencies of sound can be recorded. The sound frequencies are grouped into octave bands, each representing an interval in the sound spectrum where frequency doubles, for the analysis. For instance, an octave band could be designated from 100 to 200 Hz, with the center of the band at 150 Hz.

STUDY METHODOLOGY

The consultants monitored activities at the landfill site and noise levels at the nearest residential receiver for several hours on May 5, 16 and 18, 1983 (Figure 46). Ambient or background noise levels were recorded on all three days. On May 18, incoming refuse trucks, landfill equipment, and daytime ambients with no landfill operation were also monitored. The information collected was used to describe existing noise levels with and without the landfill operation.

RESULTS

Existing Noise Levels: No Landfill Operations

Ambient noise levels 100 ft. east of BFI's property line by Sandy Point Rd. in the Bluffs West subdivision are well below the MPCA's NAC-1 day and night limits (Table 26). The NAC-1 limits apply to residential areas, such as the Bluffs West and Hillsborough subdivisions. Other limits have been developed for commercial and industrial areas (Table 27).

Table 26
AMBIENT NOISE STANDARDS AND MONITORING RESULTS FOR MAY 18

	Day		Night	
	L_{10}	L_{50}	L_{10}	L_{50}
NAC-1 limits	65	60	55	50
Monitored levels	50	42	44	39

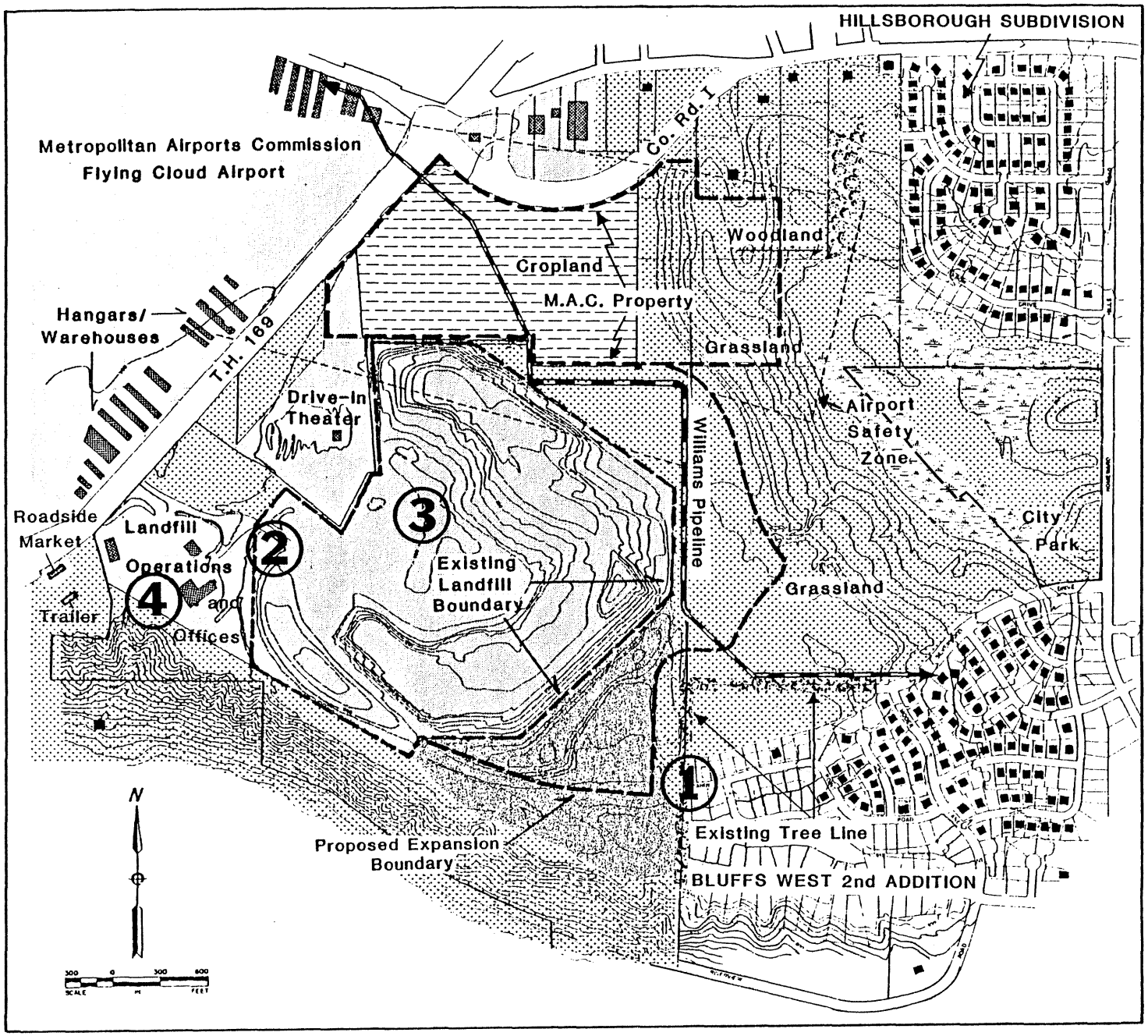


Figure 46.
MONITORING LOCATIONS

- Single-family Residence
- Airport/ Commercial/ Industrial
- Marsh

Source: G.M. Sunde, Consulting Engineer

Table 27
MPCA AMBIENT NOISE LIMITS dba

Noise Area Classification (NAC)	Day (7 a.m. - 10 p.m) L_{10}	Day (7 a.m. - 10 p.m) L_{50}	Night (10 p.m - 7 a.m.) L_{10}	Night (10 p.m - 7 a.m.) L_{50}
NAC-1 (Residential areas)	65	60	55	50
NAC-2 (Commercial areas)	70	65	70	65
NAC-3 (Industrial areas)	80	75	80	75

The major contributors to the daytime ambient readings were aircraft from the Flying Cloud and MSP International Airport, highway traffic, birds, rail traffic, and river traffic. Truck traffic, rail traffic and river traffic were also major nighttime noise sources.

Average A-weighted measurements substantiate the L_{10} and L_{50} monitoring data. Daytime readings indicated a noise level of 48 dBA, while the nighttime average was 46 dBA.

A low ambient level, from 30 to 45 decibels, indicates the virtual absence of any human activity. This is particularly true for outdoor measurements. Medium ambient sound levels, from 45 to 55 decibels, are commonly recorded in quiet residential areas. High ambient sound levels, from 55 decibels and above, are typical of heavily industrialized areas, major transportation corridors and downtown metropolitan areas.

The results of octave band analysis are shown in Table 28. Octave band measurements help determine whether any noise peaks of unusual strength exist at certain frequency centers. Such peaks contribute the most to the overall sound level. Therefore, a properly designed noise control program would reduce those frequencies to achieve the maximum noise reduction.

Table 28
AMBIENT OCTAVE BAND DATA, MAY 18
(Average dB)

	Frequency (Hz) 31.5	63	125	250	500	1K	2K	4K	8K	16K
Day (2-3 p.m.)	63.7	59.2	56.2	46.5	45.0	36.7	31.5	25.5	24.0	--
Night (3-4 a.m.)	55.5	54.0	52.5	42.0	40.5	35.2	26.2	23.7	23.0	23.0

The ambient octave band data show the typical pattern of declining noise levels as frequency increases.

Existing Noise Levels With Current Landfill Operations

The monitoring team recorded noise levels while the landfill was operating to assess whether or not current operations contribute substantially to the ambient noise levels (Table 29) in the area near the landfill.

Table 29
A COMPARISON OF AMBIENT NOISE LEVELS WITH AND WITHOUT LANDFILL OPERATIONS

	Day (dBA)		Night (dBA)		Average (dBA)	
	L_{10}	L_{50}	L_{10}	L_{50}	Day	Night
With operations	55	43	42-45	39	51	44-47
Without operations	50	42	44	39	45	46

The daytime readings were influenced by an earthmover (or scraper) operating, at the landfill. The peak noise level recorded from the scraper was 84 dBA 100 feet from the nearest residential receptor. The duration of the scraper's activities was long enough to increase the L_{10} reading from 50 to 55 dBA.

Nighttime noise measurements were quite similar whether the landfill was open or not. The monitoring team was able to detect when morning activities began at the landfill, however, the sounds were not sufficient to influence the statistical descriptors or the average dBA levels.

Octave band data allows further analysis of the significance of the landfill as a noise source (Table 30).

Table 30
OCTAVE BAND DATA, LANDFILL OPERATIONAL, MAY 18
(average dB)

	Frequency (Hz)									
	31.5	63	125	250	500	1K	2K	4K	8K	16K
Day (1-2 p.m.)	63.7	61.5	55.5	48.0	45.0	38.2	33.0	26.2	27.0	--
Night										
(4:30-5:30 a.m.)*	55.2	55.2	54.5	41.0	38.0	37.2	27.5	25.2	24.5	23.0
(5:40-6:40 a.m.)	53.7	51.5	52.2	41.7	38.0	35.0	29.7	29.0	23.0	23.0

* Approximate

Nighttime octave band readings from 5:40 to 6:40 a.m. were actually lower for most frequencies than readings while the landfill was closed (Tables 28 and 29). This finding can be explained by decreases in railway and highway traffic volumes in the surrounding area from 5:40 to 6:40 a.m. The readings from 4:30 to 5:30 a.m. are within 2.5 decibels of nighttime readings taken in Table 28.

The daytime data follows the same trend. The greatest variances occur at 63 hz (2.3 dB) and 8K (3.0 dB). Slight variations occur in other frequency centers but the data remains more indicative of a quiet background rather than a major noise source.

The present location and level of landfill operations then, have only a minor influence on the sound spectrum. To emphasize this point, compare the octave band monitoring data with the octave band limit enforced in several states for

stationary sources of continuous noise (Table 31). (The State of Minnesota has not adopted any criteria to date.) In every instance the data for the Flying Cloud site are below the criteria.

Table 31
COMPARISON OF OCTAVE BAND CRITERIA TO MEASURED OCTAVE LEVELS
(dB)

Frequency (Hz)	Comparative Octave Limit Criteria	Landfill Operative (1-2 p.m.)	Landfill Shut Down (2-3 p.m.)
31.5	72	63.7	63.7
63	71	61.5	59.2
125	65	55.5	56.2
250	57	48	46.5
500	51	45	45
1 K	45	38.2	36.7
2 K	39	33	31.5
4 K	34	26	25.5
8 K	32	27	24

In addition to evaluating ambient noise levels while the landfill was operating, the monitoring team recorded data on: 1) refuse trucks during passbys and loading/unloading; and 2) landfill equipment.

Twenty-two refuse trucks representing four body types (front-loaders, side-loaders, rear-loaders and roll-offs) were included in the pass-by analysis (Tables 32 and 33). The octave band data showed high noise levels at low frequencies, slight peaks in the middle frequencies, and falling levels at higher frequencies. This pattern reflects the exhaust system and engines as dominant noise sources. All four types of trucks had similar decibel readings.

Table 32
A-WEIGHTED AVERAGE DECIBEL READINGS
FOR REFUSE TRUCK PASSBYS AT 50 FEET

Type	dBA
Roll off	82.1
Rear loader	79.2
Front loader	78
Side loader	82.2
Total BFI	80.7
Total other	80.5

Table 33
OCTAVE BAND REFUSE TRUCK PASSBY DATA AT 50 FEET
(Average dB)

	Frequency (Hz)									
	31.5	63	125	250	500	1K	2K	4K	8K	16K
Roll-offs	74	79.5	81.5	78.5	75.5	72	69	61.5	53.5	47.7
Rear loaders	72.6	80.3	82.4	79.4	72.9	67.7	68.2	60	56.8	47.5
Front loaders	71	80.7	82.2	80.7	74	69.5	67.2	61.2	54.5	47
Side loaders	71	83	80	86	77	71	71	57	54	44

Graders, bulldozers, compactors and refuse compactor hydraulic systems were the subject of stationary monitoring tests (Tables 34 and 35).

Table 34
STATIONARY OCTAVE BAND MEASUREMENTS AT 50 FEET

Frequency (Hz)	Compactors dB	Graders dB	Dozer dB
31.5	74.5	72	90
63	81	87	90
125	93	84	87
250	92	72	78
500	88.5	79.5	84
1 K	81	72	63
2 K	76.5	75	--
4 K	69	69	--
8 K	63	60	--

Table 35
AVERAGE A-WEIGHTED DECIBEL READINGS FOR LANDFILL EQUIPMENT AND REFUSE TRUCK HYDRAULIC SYSTEMS

Landfill Equipment (Stationary)	dBA	Refuse Trucks Hydraulic Systems	dBA
Compactor	88	Total (all trucks) average	71.8
Grader	85	BFI (trucks only) average	71.8
Dozer	88	Other average	74.0

The heavy landfill equipment used to place and compact refuse and cover will be the dominant noise source at the landfill, both under routine and worst case conditions. One of the reasons for this is that the heavy equipment normally operates at three-fourths of its maximum rated horsepower; the refuse trucks, on the other hand, will be restricted to low speeds according to Woodlake's requirements.

All the vehicles tested are in compliance with regulations established for heavy equipment. Under MPCA rule NPC-4, no vehicle over 10,000 gross vehicle weight shall produce greater than 86 dBA in speed zones 35 miles per hour or less.

The Society of Automotive Engineers has established a maximum 88 dBA limit for heavy vehicles during stationary tests. Both the Rex and dozer are at the maximum permissible level. Since the octave band studies established the Rex equipment and dozers as the dominant sources their positioning and location will play a critical role if the landfill is expanded.

The hydraulic systems tested will exert only a minor influence on noise levels because of the much louder engine and exhaust noise created by the heavy equipment. When operated side by side in a routine manner, the engine noise from heavy equipment will mask the noise of the hydraulic systems.

Potential Noise Levels Associated With Expansion

The expansion could change noise levels in the surrounding area during berm construction, landfill excavation, and landfill operation (refuse and cover compaction). Landfill equipment, construction equipment and traffic could contribute to the noise levels. The landfill boundaries will be extended eastward bringing construction and landfill activities in closer proximity to residential and other land use areas.

Possible noise levels during berm and landfill construction can be estimated by looking at a possible construction scenario. If four bulldozers were used to construct the noise berm, noise levels would temporarily increase to 94 dBA at point 'A' 50 feet away (Table 36). Putting the bulldozers behind a 15-foot high, properly designed noise berm would decrease that noise level to 82 dBA. The same vehicles 100 feet below grade in the landfill pit would raise noise levels at point A to only 57 dBA. The exposed wall or face of the pit would act as a mitigating device and reduce noise levels significantly.

Table 36
POTENTIAL NOISE LEVELS ASSOCIATED WITH LANDFILL ACTIVITIES

Equipment Location	dBA Level at Point A
On noise berm	94
Behind noise berm	82
100 feet below grade	57

The table illustrates several points. First, noise berm construction will likely result in the highest noise levels from the landfill for nearby receptors. Second, the berm, if properly constructed, can decrease noise levels significantly. Third, the elevation of the equipment in the landfill pit will greatly affect dBA levels.

The potential impacts on sensitive noise receptors in the area surrounding the proposed expansion can be assessed from the information in Table 37 and Figure 47. Since the exact number of vehicles present at the expanded landfill at any one time is unknown, the estimated noise impacts at varying distances from the source are indicated.

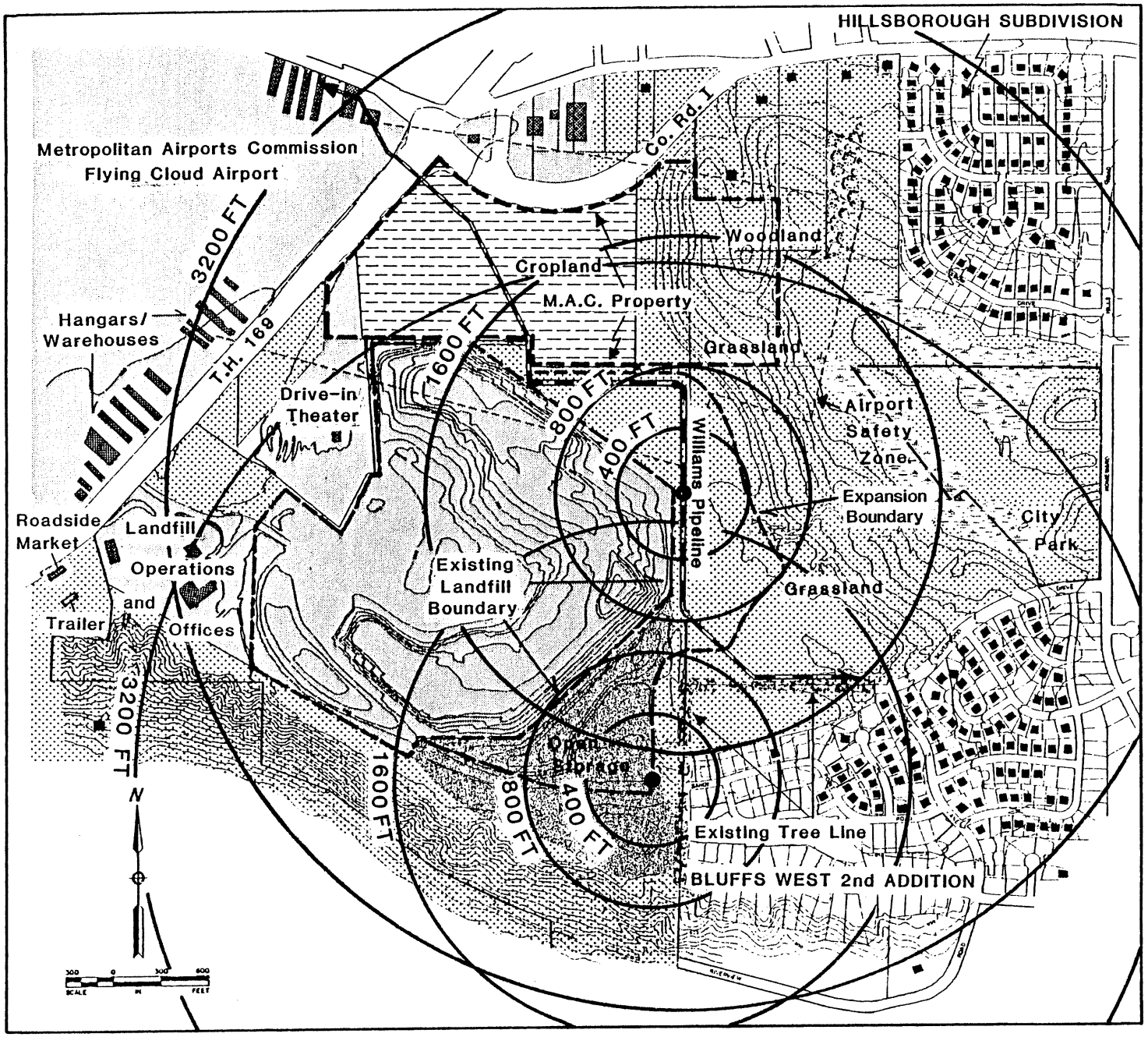


Figure 47.

DISTANCES FROM LANDFILL NOISE SOURCES

- Single-family Residence
- Airport/ Commercial/ Industrial
- Marsh

Base Map Source:
G.M. Sunde, Consulting Engineer.

Table 37
PROJECTED NOISE IMPACTS AT POTENTIAL RECEIVERS
dBA

Number of Vehicles	400 ft.	800 ft.	1600 ft.	3200 ft.
		NO BERM[1]		
1	70	64	58	52
2	73	67	61	55
4	76	70	64	58
8	79	73	67	61
16	82	76	70	64
		AFTER BERM COMPLETION[2]		
1	58	52	46	40
2	61	55	49	43
4	64	58	52	46
8	67	61	55	49
16	70	64	58	52
		EXCAVATED TO 90 FT.[3]		
1	53	47	41	36
2	56	50	44	39
4	59	53	47	42
8	62	56	50	45
16	65	59	53	48

1. Represents at grade (direct transmission of noise).
2. Represents at grade (transmission behind a 15 ft. berm).
3. Represent transmission at 90 feet below grade.

Note: Base sound level is 88 dBA for each vechical.

Noise levels during berm construction will temporarily exceed state daytime limits for receivers within 800 feet of the landfill property line and possibly as far as 1,600 feet, depending on the distance, line of sight and number of pieces of construction equipment. This includes the vacant and developed western portion of the Bluffs West subdivision. Residents in Hillsborough and Bluffs West further than 800 feet from the property line may experience temporary noise nuisance (a 10 dBA or greater increase) depending on the number of pieces of equipment and distance. These impacts will be temporary. Woodlake estimates it will take three to four months of actual work time to construct the berm, depending on the weather.

Once the berm is complete, all other expansion activity will take place behind it. The noise generated during the excavation and filling behind a 15-foot high berm will be reduced significantly if the berm is of the proper slope, height and mass (Table 37). A 7-foot berm would not be high enough to reduce the noise of equipment at grade.

After the berm is constructed there could be some noise impacts on the surrounding area for a short time. During excavation, filling and closure within 15 feet of the surface, noise levels could exceed state limits in some close-in residential areas, and some residents could experience nuisance levels of noise. This would apply particularly during activity in the horizontal expansion area which is closer to noise sensitive residential areas. During some periods, equipment will be close to the surface and at or above the top elevation of the 15-foot berm (see Figure 47). The duration of the impact will depend on the time required to complete the excavation and filling of the areas. Houses within 800 feet of the project boundary could experience noise levels above state limits if a large number of construction or landfill equipment, e.g. eight or more are in use on the site. Residents within 1,600 feet could experience a nuisance if a large number of pieces of equipment are active on the site.

Noise will be significantly reduced when equipment stacks are below the elevation of the berm. No potential noise impacts are expected from this phase of the expansion.

Commercial/industrial land uses to the north and the airport facilities to the west would not be affected by noise violations. State noise limits for these uses are less stringent than for residential development (see Table 27).

Because of the distance and change in elevation the proposed expansion will not have a noise impact on the Minnesota Valley National Wildlife Refuge and Recreation Area to the south.

POTENTIAL IMPACT OF EQUIPMENT VIBRATIONS

The heavy equipment (buldozers, compactors and trucks) involved in the proposed expansion of Flying Cloud Landfill could produce vibrations which might be annoying to residents or cause minor structural damage.

The body is an excellent vibration receptor, but a poor vibration measuring device; most people can feel vibrations at levels that are one-tenth of that necessary to cause minor structural damage to residential construction. Most of the published literature refers to damage thresholds for plaster/gypsum board walls and windows--typically the weakest parts of residential construction.

The severity of ground vibration is dependent upon the rate of movement of the ground being shaken. The rate is most commonly expressed in inches per second (particle peak velocity). The Federal Highway Administration (FHLWA) has set 0.1 inch per second as a maximum threshold to prevent damage to average residential construction from long-term vibrations of the type which might be produced at the landfill. According to a Mn/DOT study on human reactions to vibration intensities, this level is most often perceived as unpleasant and has the same subjective effect as vibrations caused by slamming a door or jumping on the floor (141).

Earthborn vibrations usually attenuate quite rapidly, since they are absorbed by the soil. Studies done on vibration intensities caused by construction equipment indicate that, whereas heavy trucks and bulldozers can cause vibrations nearing 10.0 inches per second at the source, ground attenuation usually causes this level to drop to below the FHWA safety limit at approximately 20 feet from the source--while still being perceived as annoying. Under normal

conditions, vibrations from construction activity fall to around 0.01 inch per second (or one-tenth of the threshold limit) between 100 and 200 feet from the activity.

Heavy equipment activity at the proposed expansion would be within 200 feet of vacant residential lots in the Bluff's West. However, these lots are owned by Woodlake. The nearest existing occupied house is 900 feet away, and the nearest vacant lot owned by a developer is 500 feet from the proposed expansion boundary. Steady-state vibrations of the type caused by heavy equipment travelling over these distances should fall below the damage threshold. Also, equipment activity would be at these distances for a relatively short time. Most of the activity would be at greater distances on other portions of the site. The potential impact on structures and annoyance to residents would be minimal.

SUMMARY

Existing Conditions

1. Monitored L_{10} and L_{50} noise levels near the existing landfill site are below state limits for all noise area classifications.

   a. Present operations have little or no effect on the ambient level.

   b. Some noise generated from the landfill is audible, such as back up alarms, but this noise does not register on sound level meters because it is below the ambient level.

   c. Occasional operation of heavy equipment on the landfill border does cause an increase in the ambient level. Sustained heavy equipment use on the border could exceed the MPCA daytime L_{10} standard for the closest residential receiver, depending on the duration and number of vehicles in use.

2. Present noise levels are predominantly affected by transportation sources such as freeways and railways.

Possible Future Conditions

1. Noise levels during berm construction may temporarily exceed state noise standards for nearby residential receivers in Bluffs West. Residents in Hillsborough and more distant than 800 feet in Bluffs West may experience a temporary nuisance (10 dBA increase in noise).

2. An acoustically designed 15-foot high noise berm, would be an effective way to decrease noise levels from the landfill once the berm is completed.

3. Noise levels and impacts during landfill operation will vary, depending partially on the distance of equipment from the top of the noise berm. Noise levels during excavation and filling near the surface may exceed state standards at close-in portions of Bluffs West and result in a nuisance in portions of Hillsborough and more distant portions of Bluffs West subdivisions.

MITIGATION MEASURES

Equipment Operation and Maintenance

Exhaust systems on trucks and other equipment will be the major noise sources during berm construction, and could also influence noise levels after the expansion is operating. Proper maintenance of this equipment will help control noise levels. Equipment modification (such as the addition of mufflers) could help decrease noise levels. Enforcing low speed limits near the facility will also help. Enforcement of the city's noise ordinance can control and limit these impacts as well.

Facility Layout and Design

At least two features of the proposed expansion's layout and design could be used to minimize noise impacts. The first is a noise berm. The second is alteration of the expansion's boundaries.

A properly designed noise berm could decrease sound levels at any given point by 12 dB, as illustrated in the construction example above. The exact level of noise reduction will depend on the berm's height, width, slope and mass. Permitting agencies can specify the berm requirements as part of their permitting processes.

Altering the expansion boundaries could decrease noise impacts by increasing the distance of the landfill from the nearest noise receptors. Theoretically, noise levels will decrease six dB for each doubling of distance from a noise source. Reducing the expansion at the southeast corner would provide some mitigation for nearby residences in Bluffs West during berm construction and near-surface excavation and filling/closure activities.

Facility Operating Practices

Everyday operating rules can decrease the potential for noise impacts. Restrictions on operating hours could decrease noise impacts by avoiding nighttime hours. The number of pieces of equipment used at any one time in constructing the berm could be limited to decrease noise levels. Construction of the berm could be programmed during the late fall to early spring when the impact on outdoor activities in residential areas would be less. However, this may necessitate greater care to control wind erosion. The city of Eden Prairie's noise ordinance could be used to control the impact of operating practices.

VECTOR AND PEST CONTROL

BACKGROUND

A sanitary landfill can sometimes attract disease vectors and other pests that may pose health, safety and nuisance threats. Problem species include rats, flies, mosquitoes, birds and field rodents.

Rats are occasionally brought to a landfill in refuse trucks. They could breed in the landfill or feed. The species present in the Twin Cities area is the Norway rat (Rattus norvegicus). Other rodents, for example, the whitefooted deer mouse (Peromycus leucopus) may also be attracted from surrounding field or wilderness areas by the availability of food (142).

A study conducted in 1978 concluded that landfills do not seem to be conducive to the growth of rat populations (143). Normal operations cover and compact refuse too quickly for it to be used for nesting. Landfill environs also offer little shelter for rats. This study tentatively concluded that rodents were not entering the landfill from surrounding areas to a significant degree, probably due to the small home ranges of most rodent species. Although information was limited, the rate of rat dispersion from the landfill seemed to be low.

Mosquitoes will be attracted to a landfill if potholes, depressions, water-filled containers, or other standing water is available to serve as hatcheries for eggs. In addition to the nuisance they pose, some mosquitoes transmit the encephalitis virus. Flies are attracted by uncovered food wastes, also. Birds which can flock to a landfill to feed, may present a safety threat to aircraft (see Flying Cloud Airport section.)

EXISTING CONDITIONS

Disease vectors and pests have not presented long-term problems at the existing Flying Cloud landfill. Surface water controls and sandy soils discourage ponding, and thereby discourage mosquito breeding. Six inches of daily cover and compaction at the landfill (required by MPCA rules) discourage flies, rats and other pests that could otherwise feed on the refuse.

According to MPCA and Hennepin County records, violations of daily cover rules have occurred in the past at the existing site, however. Such violations have on occasion contributed to temporary pest problems. One violation of vermin control was recorded by the MPCA during its monthly visits in 1980, and one violation occurred in 1982.

On some occasions a professional exterminator has been hired by the proposer to control rodent populations at the landfill. The Minnesota River Valley does not appear to be a source of pest rodent species at the landfill (144).

POTENTIAL IMPACTS

Although the expansion may extend the life of the landfill for another seven years, the proposed expansion should not greatly increase the potential that residents will be exposed to pests or disease vectors.

Daily cover of the fill material and compaction of wastes will continue. Surface water control measures should also continue to minimize ponding (see Surface Water section). If necessary, Woodlake could again use rodent control services.

MITIGATION

As mentioned above, adequate and prompt daily cover is a good method to minimize the attractiveness of the landfill to pests. MPCA rules require six inches of daily cover at the landfill, however, violations of these rules have occurred. More frequent inspections of the expanded landfill site could help insure that such violations are not long standing and, therefore, that conditions are not conducive to vector propagation. Use of a rodent control service will also help control pest populations.

FIRE HAZARDS

BACKGROUND

The burning of wastes is prohibited at sanitary landfills, but accidental fires do occasionally occur. The most common cause is deposition of hot or smoldering wastes on the working face (145). Spontaneous combustion of such things as paint residues, brush and tree materials and yard clippings within a buried refuse cell may also occur. Heat for this type of reaction is generated through the decomposition process. Temperatures as high as 160°F have been measured within a landfill (146). Application of daily cover is the most commonly used fire prevention method. The practice of cell construction, used at Flying Cloud, is also effective in fire control. This method of waste deposition separates each day's refuse from others with a layer of soil which impedes the spread of internal fires (147).

Fires on the working face which are too large to be contained with a fire extinguisher are usually removed from the active fill area, spread out and covered with earth or sprayed with water. Underground fires are usually excavated, then treated in the same manner (148). All landfill vehicles carry fire extinguishers for use in equipment fires. Some may have automatic fire sensing and suppression systems.

EXISTING ENVIRONMENT

Flying Cloud Sanitary Landfill has had one major fire in its operating history. (This is the only known major fire at a Metropolitan Area sanitary landfill in the last decade. There are currently nine operating landfills in the Metropolitan Area.) In January 1980, a fire began about 30 feet below the surface in the south-central portion of the landfill and burned for 10 days before being extinguished. The fire was centered in a concentrated area of buried elm trees which had been disposed of during the peak of the Dutch Elm disease outbreak. The burning material was excavated and with the assistance of the Eden Prairie Fire Department and fire departments of adjoining communities, irrigation pipes were brought to the site and used to supply city water from a main north of the landfill along County Hwy. 1.

Since the 1980 fire, changes in operating procedures have been made at the landfill to reduce the fire hazard. Tree materials larger than four inches in diameter are no longer accepted for landfilling. Instead, they are chipped and used for such things as bike path cover material. Yard clippings and smaller tree and bush materials are mixed with general wastes before being placed in the landfill. In addition, the landfill has also acquired a 3,000 gallon water truck which can be used in the event of small fires. A 10,000 gallon elevated tank can be used to rapidly fill the truck. Water for this purpose is supplied by three wells on the property. Two wells provide 40 to 50 gallons per minute and the third provides 90 gallons per minute.

The Eden Prairie fire marshall believes that these wells are not adequate to control major fires at the landfill. To obtain a larger supply of water, would require the extension of the city water line from County Hwy. 1 along Hwy. 169 (149).

Minor fires can be smothered with dirt which is available on-site. Landfill equipment on the working face is equipped with two-way radios for emergency communication. As mentioned earlier, the daily refuse is landfilled in individual cells which act to impede the spread of underground fires.

In the event of another major fire, the Eden Prairie Fire Department will again assist. In addition to the city water line at Hwy. 1, water is now available at a closer location in Bluffs West Second Addition to the southeast of the landfill. Hydrants are located on Sandy Point Rd. and Silverwood Dr. The nearest fire station is located at Hwy. 169 and West 78, five to seven minutes away. A new fire station is proposed at Hwy. 169 and County Hwy. 1, but construction is not scheduled at this time. The fire department is currently staffed by volunteers.

Landfill equipment fires have not been a problem at Flying Cloud. Vehicles do not have automatic fire sensors, but all carry fire extinguishers. There have been no major fires either underground or on the working face since 1980. Although hot wastes have been received on occasion, they have been detected at the active fill area and isolated before causing a problem. Woodlake has advised refuse truck drivers and personnel how to handle hot wastes to prevent fires in the fill area.

POTENTIAL IMPACT AND MITIGATION

Although the proposed expansion would extend the life of the landfill another seven years, it is not expected to increase the potential for fire hazards. Major fires have been a rare occurrence at landfills in the Metropolitan Area. Although one major fire has occurred at the Flying Cloud Landfill, the conditions which sustained the fire have been corrected. As a preventative measure, Woodlake monitors refuse at the working face of the landfill to insure that burning materials are not buried with other refuse. Drivers are instructed not to dump hot waste in the working fill area. All equipment in the landfill carries fire extinguishers. A water truck, low-capacity wells and water storage tank on the site can be used to control and extinguish minor fires before they become a major problem. Cover material is available to smother fires which might occur.

The applicant and its personnel have established a number of informal procedures to prevent the landfilling of hot or burning refuse and control or extinguish fires on the site (150). For example, drivers are directed not to drive into the fill area with hot waste. However, there is no written procedure for drivers and other personnel to follow to prevent and control fires. There is also no written procedure for involving the Eden Prairie Fire Department in controlling and extinguishing fires at the landfill.

The operations plan for the landfill expansion could define fire prevention, control and fighting procedures for operating personnel. The plan could include procedures for coordination with the Eden Prairie Fire Department. Company personnel and drivers could be trained to carry out the procedures. Other refuse company truck drivers could also be made aware of these procedures.

... SOCIOECONOMIC AND OTHER POTENTIAL IMPACTS ...

LITTER CONTROL

BACKGROUND

Litter control is a common problem at landfills because of the type and large quantity of materials handled, the methods of handling refuse and the exposure to the elements. A significant amount of the residential, commercial and industrial refuse handled at a sanitary landfill consists of paper and other lightweight materials. Thirty-three percent of the refuse disposed at a typical landfill in the Metropolitan Area is paper (Table 4). The handling of refuse increases the potential problem. Refuse is brought to the landfill in large trucks and dumped at the working face of the landfill. Some of the refuse comes already compacted, which assists in holding the lighter weight materials at the site. Other unconsolidated refuse is dumped by private individuals and other commercial haulers and must be compacted at the site by special equipment. While the refuse is being handled or placed in the landfill, the material is exposed to wind and other weather conditions which makes the task of managing and retrieving the litter a constant problem for landfill operators.

Litter is generally a nuisance and an aesthetic or visual problem rather than an environmental problem. If litter is not controlled on the landfill site, the wind will eventually carry some of the material off the site where the nuisance and visual impacts will effect nearby properties and neighborhoods. The problem becomes more costly to resolve for the operator as the material must be picked up and returned to the landfill.

EXISTING ENVIRONMENT

Past Litter Problems

The MPCA inspects the site at least once a month throughout the year and records the results of these inspections. Litter control has been a problem at the Flying Cloud Landfill. Table 38 lists recorded violations at the landfill.

Table 38
REPORTED VIOLATIONS OF LITTER CONTROL AT FLYING CLOUD SANITARY LANDFILL

1975	April September - exposed refuse
1976	January, April
1979	April
1980	January, March, July
1981	December - litter control
1982	August, September, December - debris exposed November - blowing debris
1983	January, March, May - blowing debris

Source: MPCA records

Other violations may have an impact on litter control. For example, the placement of adequate daily cover is one of the principal methods for controlling litter. If cover is not placed promptly and adequately, paper and other light weight materials can be picked up by the wind and carried to other portions of the landfill site or surrounding properties.

Hennepin County also inspects the landfill monthly. Several times during 1982 and 1983 debris and litter were observed in various portions of the landfill site by county personnel. Both MPCA and Hennepin County inspection reports indicate that company crews have been observed on several occasions picking up the litter.

There are other reports of occasional litter problems associated with the existing landfill. Local residents have reported that litter has been blown off the site to the north towards County Rd. 1 and east towards Homeward Hills Rd. The Minnesota Department of Transportation has reported that refuse has occasionally blown onto Hwy. 169 (Appendix C). The landfill operator has picked up the material or reimbursed the state for pick-up work.

Woodlake's Control Procedures

Woodlake has instituted a broad plan to control and minimize the problem of litter. The plan involves extra equipment, personnel and operations. In general, the plan includes the placement of a six-foot, chain-link fence around the landfill, a snow fence around the operations area and portable wind screens at least 10 feet high downwind from the active fill face to trap wind-blown litter. All are to be cleaned to maintain their effectiveness. The disposal and covering of refuse at the active fill area are to include the following: 1) modifying the location, direction and times of dumping, assuring that adequate cover is available and can be immediately placed over the waste; 2) ensuring that all waste has been covered with the proper amount of soil; and 3) ensuring that no litter condition exists at the end of the working day.

The operations manager at the landfill is responsible for undertaking measures that will mitigate the potential for littering when high winds are expected. For example, the operations manager can take such measures as moving the working faces to a location less susceptible to windy conditions, assigning additional personnel to assist with moving fences and cover activities, closing the landfill early (giving two hours notice to haulers) and engaging appropriate personnel for clean up after the high wind conditons have passed.

On- and off-site areas that are potentially affected are inspected daily; these include major haul routes and adjoining properties. Woodlake has hired a specific person to carry out this inspection and established a phone number to handle such problems. (See letter from Rodney B. Kager, Woodlake Services Inc., dated April 19, 1983, Appendix C). Littered areas are to be cleaned up by the end of the working day. An annual clean-up on and off the site is implemented following the spring snow melt when ground conditions are favorable.

Many of the past litter control problems occurred during the winter and spring months. During these months low temperatures, higher than average wind speeds, ground moisture and precipitation are more likely to affect the efficiency and effectiveness of litter control.

POTENTIAL IMPACTS

The proposed expansion would extend the life of the landfill an estimated seven years and, therefore, also extend the potential for litter control problems. The proposed project if approved would also expand the active fill area eastward, and place it closer to residential areas. During stages seven and eight, landfilling activity in the expanded areas would be closest to the Bluffs West subdivision (Figure 14).

Woodlake now has a generally comprehensive set of procedures as part of the operating plan for controlling litter on and off the site. The plan includes limiting the amount of refuse being blown about the working face, the placement of fences around the working face and landfill to trap blowing litter, inspecting on- and off-site areas and picking up litter by the end of the working day. The landfill can be, and has been, shut down during extremely windy conditions to avoid problems.

Despite Woodlake's litter control procedures, it is likely that there will be some occasions when litter may be a nuisance in areas off the site. The large volumes of lightweight material handled at the landfill, the methods of handling the material (for example during unloading and compacting), the exposure of refuse to the weather, rapid changes in wind speed and direction, the difficulty of performing outdoor work during the winter and early spring and the close proximity of residential areas indicates it would be impossible to entirely avoid litter problems. Woodlake's procedures should minimize the problem of litter blowing off the landfill, but it may occur. Despite Woodlake's plan to inspect and clean up on- and off-site areas, there will be some delays during severe weather conditions in implementing this policy.

The landfill pit will provide some shelter from the wind, but strong winds could blow litter from exposed refuse up and over the sloping walls. As each stage of the fill approaches the final fill elevation, the active fill area will be more exposed to the wind. (Final fill elevations will be up to 20 feet above the surrounding surface elevations.) This will be most important during stages seven and eight, which are closest to the Bluffs West subdivision.

The snow fence around the landfill area, the chain-link fence around the property and the berm will trap some litter. However, these fences are six feet or less in height and do not afford much protection. The 15-foot vegetated berm will trap some litter, but the berm slopes (3:1) will not trap litter as effectively as a vertical barrier.

Close-in property and owners may occasionally experience the nuisance of litter being deposited on their land. The Bluffs West subdivision is most likely to be affected by the occasional nuisance of litter because it is within 200 feet of the expansion and downwind during a significant portion of the year. It is a residential area, and people would be sensitive to litter and delays in picking it up.

The prevailing wind is from the northwest in the late fall, winter and early spring (Table 20). (Northwest winds do occur at other times but less frequently.) The Bluffs West area would be downwind from the expansion area more frequently during these months. The average wind speed is somewhat higher during these months varying from 10.4 to 12.3 mph, compared to 9.1 to 11.3 in the spring to early fall months (Table 20). Colder temperatures, snow cover and wet grounds would probably impede litter control and pick up in the fall, winter and early spring increasing the probability of it being blown off-site.

During the late spring-summer-early fall period the prevailing wind is from the south and southeast. Litter blown off the site would be scattered onto the vacant airport property and Hwys. 169 and 1 to the north.

An existing row of conifers 15-20 feet high and running north-south and east-west between the Bluffs West subdivision and the expansion could have two effects. The trees will trap some litter and will also act as a windbreak. As the wind passes over the trees the velocity will be reduced. Any litter being carried by the wind could drop in the residential areas downwind (Figure 3). The line of conifers has several gaps which would reduce its effectiveness in stopping litter. The east-west row does not extend far enough eastward to protect all of the Bluffs West area from litter carried along by northwest winds.

The Hillsborough subdivision to the northeast is less likely to be affected than the Bluffs West Area. Prevailing winds do not blow towards this area. The nearest residence would be 1,300 feet from the expansion and separated by a wide, low open area. Litter is more likely to settle in this area first. Much of this intervening property is owned by Woodlake.

MITIGATION MEASURES

Litter control is a problem common to all landfills. The available data indicates it has been an occasional problem at the Flying Cloud Landfill in the past. Woodlake has adopted a generally comprehensive set of operating procedures controlling litter which can take care of the problem most of the time. There will still be some occasions when litter cannot be controlled due to the large quantities of paper and other lightweight materials handled, the methods of unloading and landfilling refuse and the exposure to the severities of the weather. As a result, adjoining properties will experience an occasional nuisance from litter and delays in cleaning up the material. The off-site areas most likely to be affected are located in Bluffs West subdivision and undeveloped areas north of the landfill.

The most effective means for reducing these impacts is enforcement. Woodlake's control program includes operational practices which appear to control most of the important aspects of the problem. Day-to-day implementation of the control plan and monitoring of its effectiveness is the company's responsibility.

Woodlake's litter control plan could be included in the operation plan for the proposed expansion. The MPCA and Hennepin County could then require that the company implement the plan. MPCA regulations (SW-6) already require that windblown material be confined to as small an area as practicable and collected and returned to the area each day.

The City of Eden Prairie has an adopted nuisance ordinance (Ch. 11.03, sub. 4G) which it can apply in general to the control of solid waste materials, debris, refuse or garbage on private property, but it may not apply specifically to landfills. A more specific city ordinance would give the city more effective control of any litter problem.

There are other mitigative measures which could be taken to improve the control plan and provide additional protection to adjoining properties particularly in the Bluffs West area and north of the landfill. A wider protective buffer zone

could be maintained between the expansion and Bluffs West subdivision by limiting the southeast corner of the expansion or delaying residential development in the vacant western portion of the subdivision until filling is completed near there. The size of the active fill area or cell could be reduced to the smallest workable area and daily cover applied immediately during periods of high winds. Clearly marked, protected sites in the fill area could be designated which would be used during high wind velocity. Cover material stockpiles on the site could be located to act as a windbeak to reduce the velocity of the wind across the active fill areas. A full-time, year-round position for inspecting on- and off-site areas for litter problems could be created. The height of proposed fencing around the perimeter of the expanded fill area on the east and southeast could be increased to 12-15 feet to trap windblown litter. The fence could be constructed on the landfill side of the proposed berm to trap litter before it is blown over the berm. Woodlake's control plan could include specific language stating that litter blown from the working area will be collected by the end of the working day. Bushes and trees could be closely planted along and on top of the berm to catch litter. Additional conifers could be planted in the gaps in the existing tree line along the southeast property line to improve its effectiveness in trapping litter. Additional conifers could be planted along the eastern and northern perimeters of the expansion area to catch litter before it is blown onto adjoining properties. Conifers, in contrast with deciduous trees, will provide dense foliage throughout the year. Tree and plant species selected for planting on the berm and along the perimeter of the northern boundary should be carefully selected. The height of these species at maturity should not infringe on the airport approach zone.

VISUAL IMPACTS

BACKGROUND

The proposed project would produce topographical and physical changes on the landfill site that would be visible from the surrounding area. The expansion would involve vertical and horizontal alterations to the site. A 15-foot high berm would be constructed along the eastern and northeastern perimeter of the 42.4 acre horizontal expansion area and a 70-foot deep "pit" would be excavated in stages behind the berm to provide a portion of the additional landfill capacity. The proposed vertical elevation allowed under the current permit would also be changed. An elongated pit along the eastern edge of the site, which cannot be filled under the current permit would be filled, and the elevation of the entire site would be increased an average of five feet from the original proposed final elevations. The final elevations would vary from 880 feet MSL in the southeast corner and 890 feet in the northeast corner to 923 feet MSL in the north central portion (Figure 48).

This analysis evaluates the visual impact of these physical changes on the surrounding area. Five cross-sections representing the views of the site from adjoining land uses were prepared using topographic information supplied by G.M. Sunde (consulting engineer to Woodlake), and C. R. Winden Inc., (land surveyors for Orrin Thompson, a housing developer in the Bluffs West Second Addition). The cross-sections were chosen based on the proximity of the use to the project and the potential sensitivity of these uses to visual impacts. The cross-sections are as follows (Figure 48):

One, A-A´, from the Hillsborough Subdivision, which is northeast of the site, to examine any potential visual impacts on the upper (Travis Rd.) and lower (Oxbow Dr.) residential levels;

Three from Bluffs West, Second Addition, a residential area lying immediately southeast of the landfill expansion, to examine potential visual impacts on the developed and the developing sections of the subdivision (B-B´, C-C´ and D-D´); and

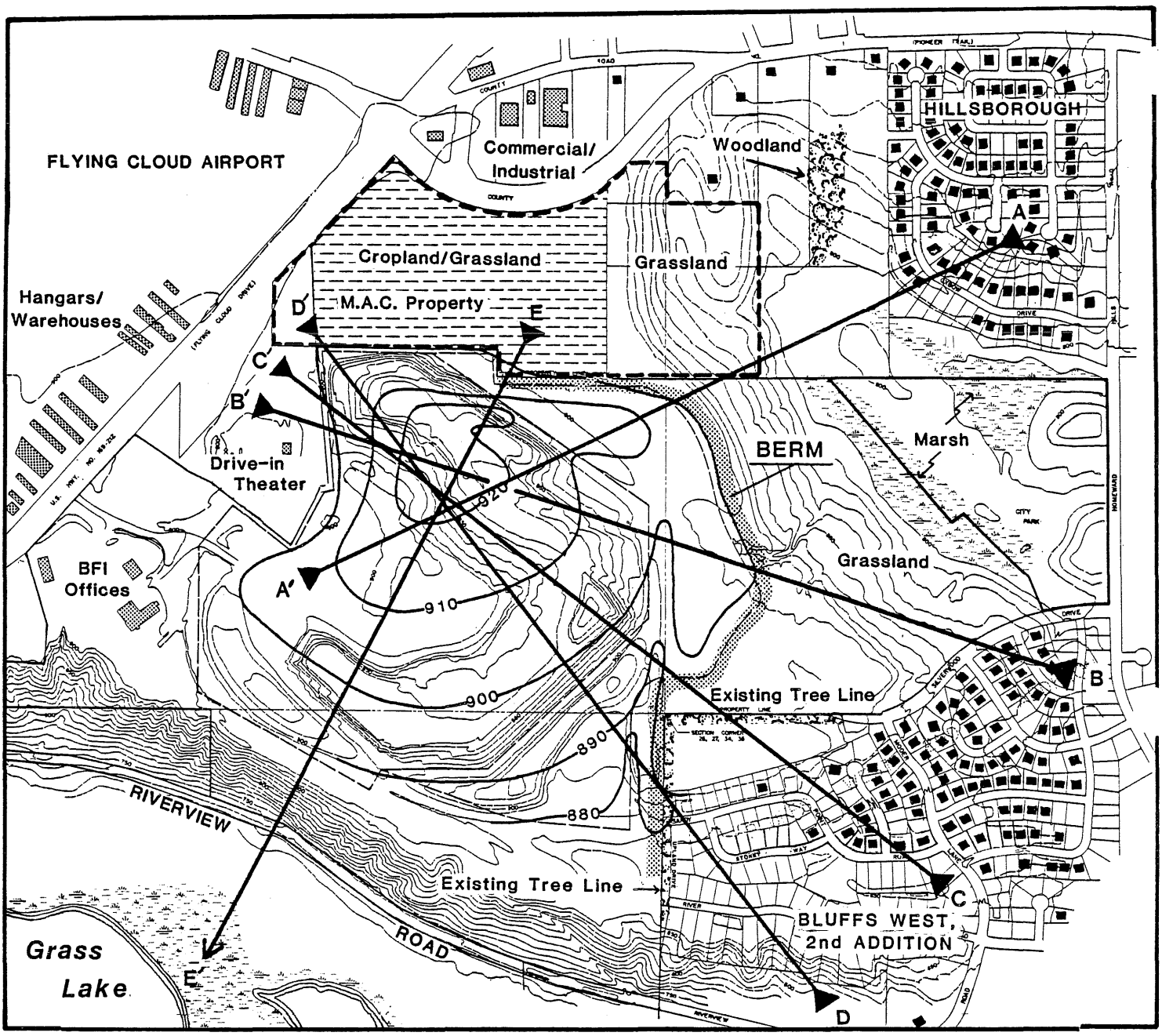
One from across the Minnesota River to the south to examine impacts on the Minnesota Valley National Wildlife Refuge and Recreation Area.

The potential visual impacts on the commercial/industrial areas and Flying Cloud Airport to the north and west of the landfill are also discussed at the end of this section.

POTENTIAL VISUAL IMPACTS

Hillsborough Subdivision

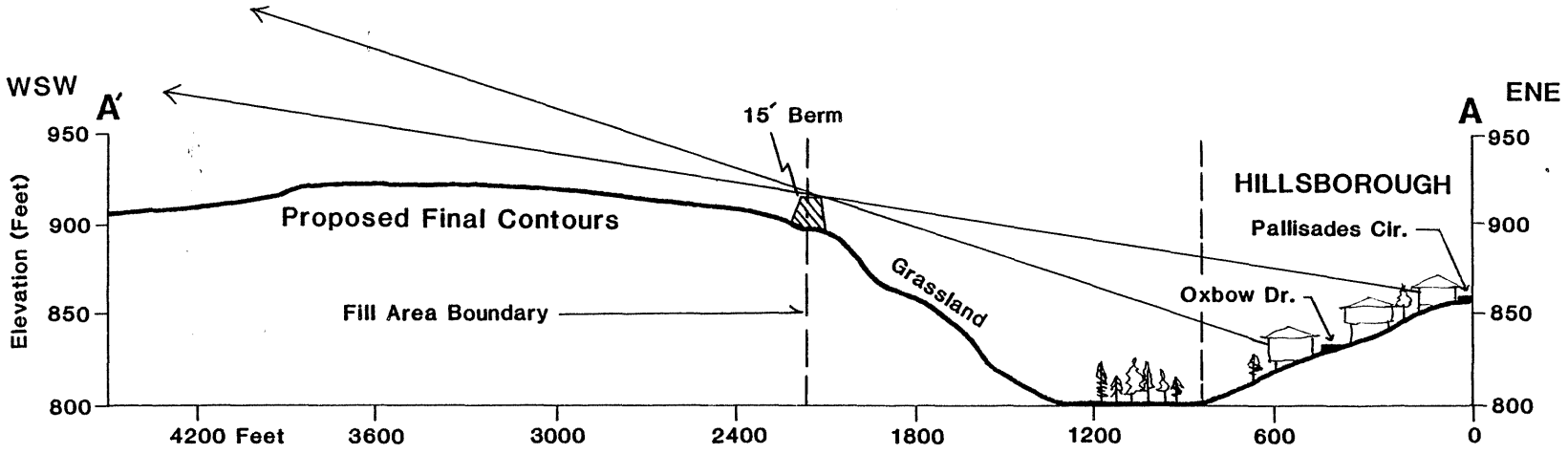
Several stages of the proposed project would be viewed from houses in the Hillsborough Subdivision to the northeast of the project. Cross-section A-A´ (Figures 48 and 49) represents the view from the Hillsborough Subdivision, across the intervening open low-lying marshy area, to the highest peak elevation of the proposed fill area at 923 feet MSL.



Base Map Source: G.M. Sunde, Consulting Engineer

Figure 48.
CROSS-SECTION LOCATIONS

Figure 49.
CROSS-SECTION A-A′ FROM THE HILLSBOROUGH SUBDIVISION TO PEAK ELEVATION OF LANDFILL



For Illustration Only

Vertical Exaggeration: 6x

The Hillsborough Subdivision is developed on a slope which faces south and west toward the landfill. The upper level of the residential area follows Travois Rd. at 860-870 feet MSL, and the lower level follows Oxbow Dr. at 800-830 feet MSL. The low, marshy area between the landfill and Hillsborough is located at 800 feet MSL.

Distances from the edge of the expansion area range from 1,300 feet to the backyards of houses facing Oxbow Dr. to approximately 3,000 feet at the intersection of Homeward Hills Rd. and Pioneer Tr. It is approximately 2,500 feet from the backyards of houses at the edge of Hillsborough to the highest elevation of the proposed fill and 1,300 feet to the edge of the proposed berm from the nearest residence.

The northeastern edge of the expansion area facing Hillsborough will increase from a current elevation of 892-900 feet MSL to 900 feet MSL. The proposed 15-foot berm will extend above the landfill perimeter from elevation 907-915 feet MSL (Figure 12).

Berm construction would be in full view of residences along Oxbow Dr. and Travois Rd. However, it is estimated that it would require only three to four months of construction time to complete the berm; after its completion, all landfill activity would occur behind it. (Weather conditions may delay the completion of the berm.) The visual effect of the construction activity would be relatively short-lived.

Although the completed berm would be visible, the physical change as viewed from Hillsborough would be relatively minor. The berm would be located along the top of a slope which rises 90 feet above the low-lying grassy area at a distance of more than 1,300 feet from the nearest residences. At that distance, the berm would appear to be approximately two inches high along the horizon.

The 15-foot berm should screen most of the fill activity from houses on the upper level of Hillsborough (860 feet MSL) and from all the houses at lower elevations (Figure 49). Some filling and grading activity may be visible above the 15-foot berm from higher elevations in Hillsborough during the fill and final cover placement stages along the northeastern boundary of the expansion area and in the highest fill area (Stages 5 through 7 of the proposed expansion). Line-of-sight calculations from the second story of a house at elevation 860 feet MSL in Hillsborough indicate a berm elevation of 910 feet MSL would screen landfill activity up to an elevation of 927 feet MSL, or four feet above the highest proposed landfill elevation. Since the construction equipment used to place and compact refuse and grade the surface is eight to 10 feet high, construction equipment activity could be visible at the northeast perimeter where the difference between the berm and fill elevations is seven to 10 feet and on the highest elevation in the north central part of the site. However, this activity would be 1,300 feet or a quarter of a mile or more from residences in Hillsborough, which would reduce the visual impact.

Establishing a vegetative screen by planting shrubs or small trees on the berm or taller trees in front of it would screen all landfill activity from the Hillsborough Subdivision and provide a natural appearance. Conifers would provide year-round screening.

Bluffs West Second Addition

Because of its proximity to the project, the Bluffs West Second Addition could also be visually affected by the expansion. Because of the size and proximity of the subdivision, three representative views or cross-sections were analyzed: B-B´, C-C´ and D-D´ (Figure 48).

The first of the cross-sections B-B´ (Figures 48 and 50), represents the view from the developed eastern area of Bluffs West parallel to Silverwood Dr. to the highest point of the fill area at 923 feet MSL. The perimeter of this area lies from 1,000 feet at the intersection with Mooer Ln. to approximately 2,100 feet at the intersection with Homeward Hills Rd. from the edge of the expansion. A grassy area and upward slope separates the residences from the expansion. The open area is 1,400 feet in width along the cross-section.

Unlike the Hillsborough Subdivision, this portion of Bluffs West slopes downward to the southeast away from the landfill or from 15-80 feet below the present elevation of the landfill expansion area.

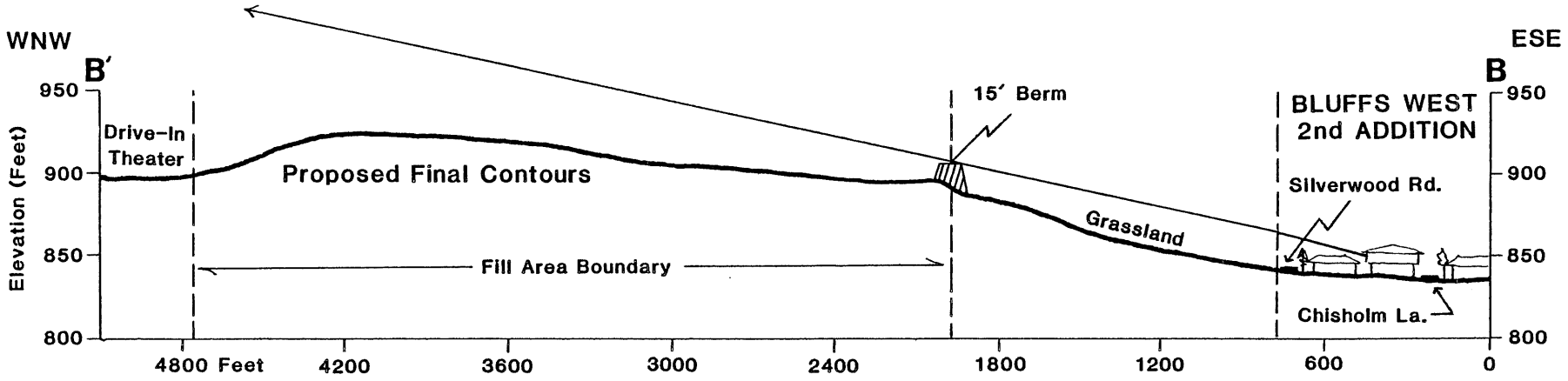
A portion of the landfill expansion extends to near the perimeter of the upland which runs northwest-southeast and has no existing shrubs or trees to block the view to the nearest houses along Silverwood Dr. These houses, combined with the downward slope away from the landfill and existing neighborhood vegetation, obscure most of the view of the landfill from residences to the south and southeast of Silverwood Dr. Hence, the most critical view along B-B´ would be from houses along Silverwood Dr. These houses face the side streets rather than Silverwood, which would reduce the potential impact. However, the landfill would be in view from front and backyards.

A 15-foot berm would sufficiently screen the line-of-sight along B-B´ such that all fill activity in the highest landfill area (923´ MSL) would be hidden from view (Figure 50). However, filling and equipment activity at the eastern perimeter of the expansion would be seen. A 15-foot berm would rise to elevation 905 feet-910 feet MSL, which is five to 10 feet above the final elevation. Some fill activity along the edge of the expansion during the latter phase of stages 6 and 7 of the proposed phasing plan would be visible for awhile until complete from along Silverwood Dr. The establishment of a year-round vegetative screen on the berm or in front of it would screen this activity.

The second cross-section, C-C´, represents the view from the western edge of the developed portion of Bluffs West. Houses are located 900 feet (along the Winter Pl. cul-de-sac) to 2,200 feet (Mooer Ln. and Riverview Rd.) from the expansion. The area slopes downward and away from the landfill from 890 feet MSL north of the lots along Sandy Pt. Rd. to 850 feet MSL along the top of the Minnesota River valley bluff. At the northern edge of the subdivision along this cross-section, is a short, steep slope rising approximately 20 feet to the surface elevation in the expansion area (see Figure 51). Approximately 500 feet north and northwest, between the slope and the edge of the landfill expansion, is a line of conifers standing 15-20 feet high (Figure 12). There are several gaps in the tree line. The proposed 15-foot berm would rise to 910 feet as it crosses cross-section C-C´.

Line-of-sight calculations indicate that the landfill and related filling or grading operations would be effectively screened from the view of residences along the developed stretch of Sandy Point Rd. and Winter Place west of Mooer Ln. by the existing 20-foot-high slope and the tree line. The proposed 15-foot

Figure 50.
CROSS-SECTION B-B′ FROM DEVELOPED AREA OF BLUFFS WEST TO PEAK ELEVATION OF LANDFILL

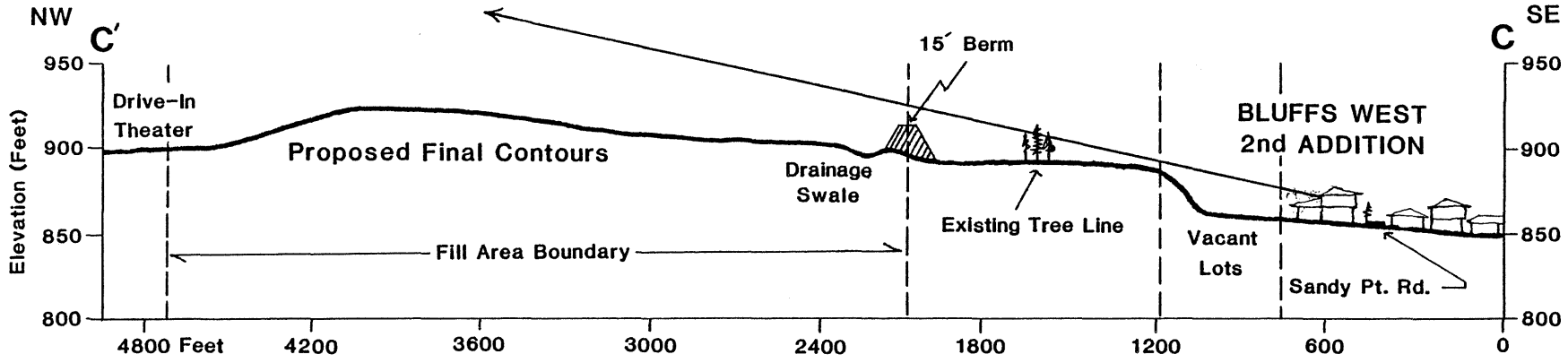


For Illustration Only

Vertical Exaggeration: 6x

Figure 51.

CROSS-SECTION C-C′ FROM WESTERN EDGE OF DEVELOPED AREA OF BLUFFS WEST TO PEAK ELEVATION OF LANDFILL



For Illustration Only

Vertical Exaggeration: 6x

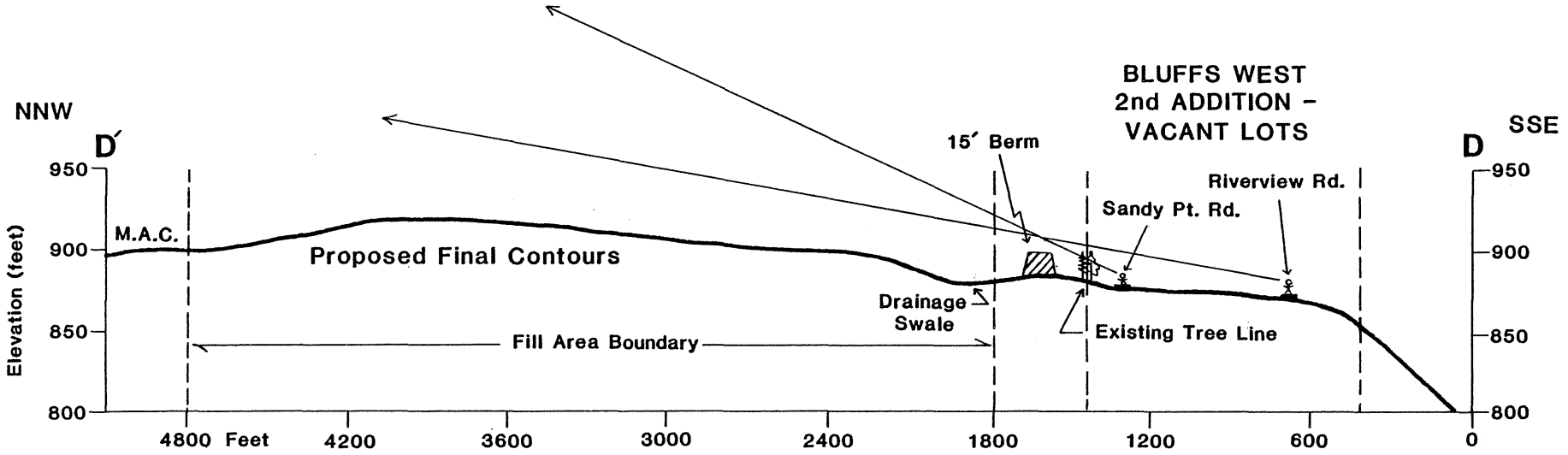
berm would provide additional screening. The planting of shrubs and trees along or in front of the berm would not be necessary due to the existing tree line, but additional trees could be planted in the gaps to the completely screen the berm.

The third cross-section from the Bluffs West Addition, D-D´ (Figure 52), represents one view of the proposed expansion from the vacant Sandy Point Rd. area. Houses at the western edge of the subdivision would be located 200 feet from the expansion and next to the berm. Houses along the planned alignment of River View Rd. would be as much as 2,200 feet distant. Houses at the western end of River View Rd. would adjoin the detention pond area. No additional filling is proposed by the pond. The subdivision slopes away from the landfill, from approximately 872 feet MSL at the northwestern corner to 860 feet MSL at the top of the Minnesota River bluff. A broken line of conifers 15-20 feet high follows Woodlake's property line to the west of the vacant lots. An existing ridge 20-25 feet high rises along the western and northwestern boundary of the subdivision between the expansion and the tree line. This ridge will be graded down to approximately 880-890 feet MSL before a berm is constructed. The 15-foot berm would rise to 910 feet MSL northwest of the development (near section corner 26, 27, 34, 36) and slope down to approximately 880 feet MSL near the western end of the River View Rd. alignment.

Figure 52 shows views of the landfill from along Sandy Point Rd. and River View Rd. assuming the construction of a 15-foot berm (along X-section D-D´ = 905 feet MSL). Line-of-sight calculations along D-D´ indicate that the northern or highest portion of the landfill would have to rise to approximately 960 feet MSL, compared to the proposed 923 feet MSL, to be visible from a second story window at River View Rd. and to approximately 1,040 feet MSL to be visible above the 15-foot berm from a second story window at the western end of Sandy Point Rd. The intervening houses would screen the view from houses constructed farther east along River View Rd. which would also be farther away from the berm, and hence have a slightly lower line-of-sight. Additional screening of the landfill and berm would be provided by the line of conifers to the north and west of the Sandy Point area if additional trees were planted in the gaps.

The western edge of the vacant portion of Bluffs West is in the most critical location because of the close proximity to the expansion. Many of these lots have been acquired by Woodlake. (See Land Use and Property Values sections.) The nearest lots are 200 feet from the expansion, and platted lots along Upland Dr. would face the 15-foot berm. However, expansion activity in the area adjoining the subdivision border would be limited. Most of the area would be occupied by the stormwater retention pond. The capacity of the pond may be increased to handle runoff from the expansion, but there will be no fill activity in the area (Figure 3). An existing 20-25 foot-high ridge located between the pond and the vacant subdivision will be graded down to 880-890 feet MSL to allow construction of the berm. The berm will extend south as far as River View Rd. A low drainage swale will be constructed along the landfill side of the berm to drain the expansion area surface. The excavation and fill activity will occur behind the completed berm. The final elevation of the completed fill west of the berm will range from 875-890 feet MSL or 10 to 15 feet below a 15-foot berm which would screen most landfill activity. The existing line of 15-20 foot conifers runs north-south in front of the berm, but it only partially screens the berm and landfill because of gaps in the trees.

Figure 52.
CROSS-SECTION D-D′ FROM UNDEVELOPED AREA OF BLUFFS WEST TO PEAK ELEVATION OF LANDFILL



For Illustration Only

Vertical Exaggeration: 6x

Houses which would be constructed along Upland Dr. and at the end of Sandy Point and River View Rds. would be constructed at approximately elevation 870 feet MSL with a second story view at approximately 885 feet. A 15-foot berm would be adequate to screen the landfill from view at ground elevation. The 15-foot berm would block the view of operations up to 885 feet MSL, however, operations farther west and northwest of the houses at or above 890 feet MSL could be visible from second story windows. Shrubs along the berm or trees in front of the berm of sufficient height would screen this activity. Planting conifers in the gaps in the existing line of trees would serve some of this purpose. Planting shrubs and trees and landscaping the berm would provide a more natural view for houses along Upland Dr. facing the berm.

Minnesota Valley National Wildlife Refuge/Minnesota Valley Trail

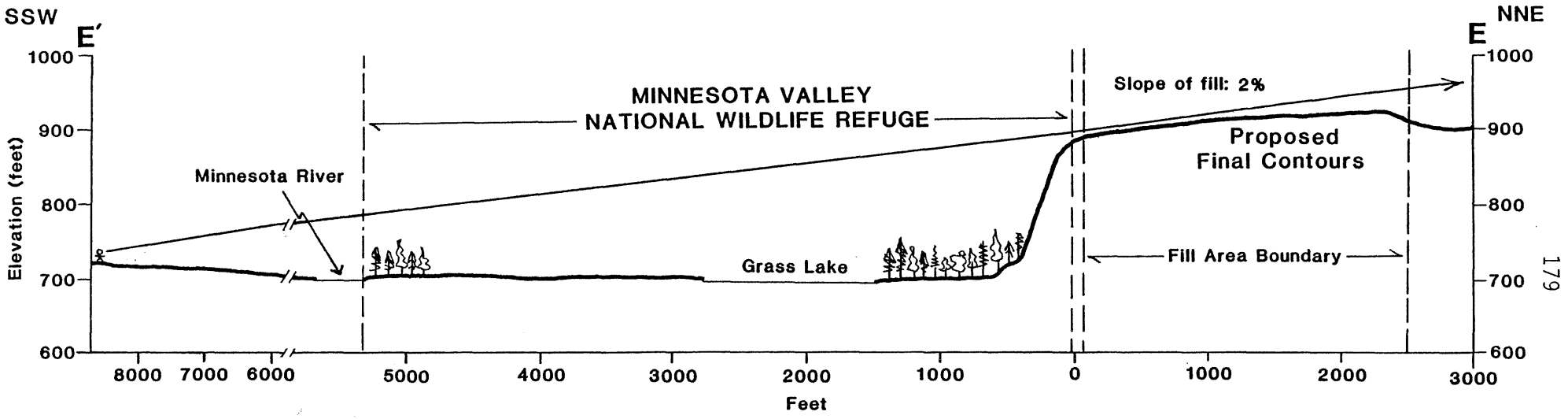
Because of the prominent location of the landfill along the Minnesota River valley bluffs, the proposed project could potentially effect views from within the valley and the National Wildlife Refuge and Recreation Area particularly around Grass Lake. The Refuge boundary extends to the top of the bluff on the landfill property at approximately 870-880 feet MSL, but the land is still under title to Woodlake. Below the bluff the National Refuge boundary generally follows the river floodplain and includes the valley lands and wetlands such as those in the Grass Lake area. The land around Grass lake is still in private ownership.

Although the Refuge boundary extends to the top of the bluff adjoining the landfill, the nearest planned active public use would occur on a proposed year-round recreational trail along Riverview Rd. below the landfill near the base of the bluff at approximately 730 feet MSL. Most public use is planned for areas along the river valley. These uses include hunting, interpretation and education. The valley around Grass Lake is currently used primarily for private recreation such as hunting, picnicking and skiing, and farming.

Because of the difference in elevation between the landfill at 890-920 feet MSL and the river valley at 700 feet MSL, the intervening edge of the bluff and the setback of the expansion area from the edge of the bluff, the proposed expansion would not be visible from the trail along the bluff and much of the river valley and National Refuge and Recreation Area. Cross-section E-E´ (Figure 53) represents one view of the landfill from the river valley and the Refuge. The Minnesota River floodplain lies at approximately 700 feet MSL, which is 190 feet below the edge of the landfill.

The average slope of the landfill along E-E´ is approximately two percent from the 920-foot contour to the 890-foot contour on the completed landfill and the edge of the bluff at 880 feet MSL. Projecting the two percent slope south along E-E´ over the bluff and river valley to the point at which it first intersects the valley defines the approximate point at which the landfill would initially be visible from the river valley. The projected line E-E´ extends for approximately 8,500 feet before it intersects the valley floor at 720 feet MSL. (This does not take into account the presence of trees along the valley floor which would provide additional screening.) This point is located south of the river in Shakopee along Hwy. 101. It is possible that some construction activity related to final fill and cover placement could be seen from the southern extreme of the Refuge during stages 6, 7 and 8 of the proposed expansion. There is no proposed berm or vegetation along the river valley side of the expansion which would screen these activities. However, at a distance of more than one mile the impact would be minimal.

Figure 53.
CROSS-SECTION E-E′ FROM LANDFILL ACROSS THE MINNESOTA RIVER FLOODPLAIN



For Illustration Only

Vertical Exaggeration: approximately 5.5x

Figure 54 indicates a "view line" of the landfill along the entire Minnesota River valley, using the same line-of-sight calculations developed for cross-section E-E'. The shaded area represents the approximate area within which views of the landfill would be obstructed or screened because of the river bluff. Again, the calculations do not take into account any intervening buildings or vegetation. The landfill would be screened from view from most of the Wildlife Refuge and Recreation Area, except for small areas directly east and west of the Blue Lake Wastewater Treatment Plant. These areas are located more than one mile from the landfill and this would futher reduce any visual impact. Some activity might be visible from within the shaded area during the final fill and cover placement in those stages where most of the activity takes place at the southern edge of the expansion, but the distance would minimize the impact.

The establishment of trees and shrubs along the southern perimeter of the landfill and bluff line would further screen the view from the valley and Refuge, and provide a natural appearance consistent with the purposes of the Refuge.

The planned Minnesota Valley Trail is located south of the Minnesota River. Part of the trail is located outside of the Minnesota Valley National Refuge and Recreation area (Figure 54). According to DNR staff, the segment of the trail south of the proposed landfill expansion may be developed during the life of the expansion. The potential visual impacts on the trail would be similar to those for the Refuge. The proposed expansion would not be visible from much of the trail alignment (Figure 54). The river bluff south of the expansion screens it from view. The portion of the trail which would not be screened would be at least one mile from the expansion. The placement of daily and intermediate cover on the refuse would minimize the visual effects of fill activites. Equipment activity might be visible, but the distance would minimize the impact on trail users. The establishment of trees and shrubs along the top of the bluff would completely screen any view.

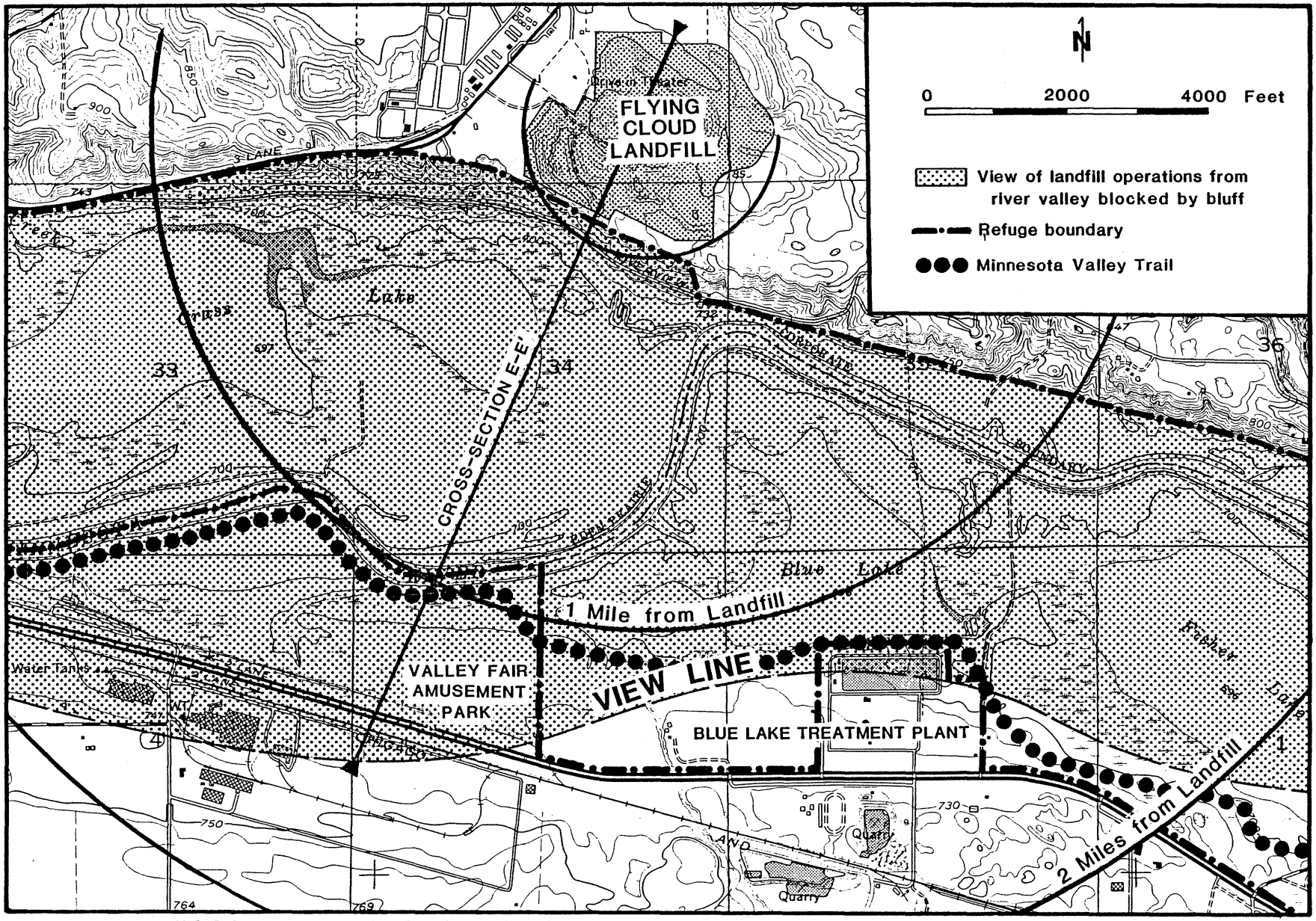
Other Visual Impacts

Flying Cloud Airport is northwest of the landfill and separated from it by Hwy. 169. Although activities at the higher elevations of the landfill (approximately 910 feet MSL and above) would be visible from the airport, the visual impact would be minimal because of the nature of the airport facilities along Hwy. 169. They include runways and taxiways and airplane maintenance and storage facilities.

The Flying Cloud Drive-In adjoins the landfill site on the northwest. Although landfill operations above 900 feet MSL would be visible a short distance away, there would be little impact because of the night pattern of theater operations. This activity would be short-term until final fill and cover placement are completed.

Scattered commercial/industrial land uses are located along County Hwy. 1 (Pioneer Tr.) to the north. These uses are separated from the landfill by the highway and the open land reserved by the MAC. The landfill would rise 23 feet above the open land in the north central area. The proposed berm along the eastern half of the northern extent of the landfill would partially screen landfill operations, but the upper elevations on the western extent would be visible. The commercial/industrial uses are approximately 1,000 feet north of the landfill and across the highway which would minimize the visual effect of the landfill expansion. The nature of the commercial/industrial land uses would also minimize the impact.

Figure 54.
VISUAL IMPACT OF THE FLYING CLOUD LANDFILL ON THE MINNESOTA VALLEY NATIONAL WILDLIFE REFUGE



Base Map Source: U.S.G.S. 7.5-minute Eden Prairie quadrangle

Five isolated single-family residences lie north-northeast of the landfill expansion area along Pioneer Tr., at distances from 1,300 to 2,300 feet from the expansion boundary (Figure 48). Elevations of the houses range from 860-870 feet MSL or 30-40 feet below the landfill. The intervening trees and shrubs partially screen the view of the landfill from the four more distant houses.

Line-of-sight calculations from these residences (assuming a second-story view approximately 15 feet above ground level) indicate that, with the 15-foot berm, landfill equipment activity could be visible to the farthest of the houses at elevation 865-870 feet MSL houses once the vertical expansion reaches 914-917 feet MSL in the north central portion assuming 10 feet for equipment height. A vegetative screen at least eight feet high placed on top of the berm should sufficiently obscure all views of fill and cover placement activity from the four residences. This would bring the total screen height to approximately 923 feet MSL--the same as the proposed peak elevation of the landfill at the western end of the proposed berm.

The 15-foot berm would rise to approximately five feet above the proposed final fill elevation along the northern edge of the expansion; hence, some fill and cover placement activity would be visible for a short period at the edge of the expansion area during stages 5-7--particularly near the northeast corner where the expansion reaches the edge of the 890 feet MSL upland. However, the nearest residence is more than a quarter of a mile distant from the visible portion of the expansion.

The western end of berm along the northern boundary of the landfill is approximately 1,050 feet east of the western edge of the landfill. Any view of landfill operation from the five houses at the western terminus of the berm is blocked below elevation 915 feet MSL by the bluff. Consideration might be given to extending the berm or planting a line of trees at least 300 feet farther west than currently proposed. A western continuation of a berm and/on screen of at least 23 feet combined height would assure complete screening. Screening of this extent and height would not conflict with height restrictions in the airport approach zone.

A 33-acre city park, currently being developed, is located directly east from the expansion at or below elevation 800 feet MSL and at a distance of approximately 1,350 feet from the expansion boundary. Between the park and expansion lies the low-lying swale and grassland which slopes upward to elevation 890' MSL at the expansion boundary. Line-of-sight calculations from Homeward Hills Rd. across to the area of the highest proposed landfill elevation indicate that the landfill would have to expand vertically to at least 960' MSL for any fill activity in the peak area to be visible from the park (the edge of the upland on which the landfill is located effectively blocks the view of this area of the landfill from the park).

A 15-foot berm due east of the park along the landfill would rise to 905-907 feet MSL--five to seven feet above the proposed final fill elevation at the edge of the expansion; hence, equipment involved in fill and cover placement activity at the edge of the expansion area during stages 6 and 7 would be partially visible from the park for a short time. The distance (1,350 feet) between the park and landfill would minimize the visual effect.

Woodlake originally proposed to construct a seven-foot berm. An analysis of this structure indicates that it would be less effective than the 15-foot berm in screening the expansion from the surrounding development.

END USE PLAN IMPACTS

Woodlake has presented a preliminary proposal to develop the expanded landfill as a golf course adjoining small industrial and residential areas (Figure 9). These developments would be visually compatible with adjoining developments. The small residential area adjoins the Bluffs West Second Addition and the industrial development would adjoin the outdoor theater and Woodlake/BFI office and garage area. The golf course would adjoin the Minnesota Valley National Wildlife Refuge and would be visually compatible with the natural character of the Wildlife Refuge. Woodlake's preliminary proposal includes the preservation of the bluff and the dedication of additional park land adjoining the city park to the east. These uses would be visually complementary to the Refuge and park.

MITIGATION MEASURES

The proposed expansion would result in physical changes to the existing and expanded landfill site which would be visible from the adjoining area. The construction of the proposed 15-foot berm around the northeastern, eastern and southeastern perimeter would be the first and most significant physical change. The construction time for the berm would be short--an estimated three to four months, and result in a temporary visual impact. The completed berm would be visible from surrounding lands, but the visual impact would be minimal because of the intervening distance to the other land uses and the low height of the berm. Due to its proximity, the berm would be more noticeable in the western portions of Bluffs West. However, there is an existing ridge of simlar height west of Bluffs West which the berm would replace.

Once the 15-foot berm is complete, most of the physical changes and activities related to the expansion would be screened by it, with two exceptions. Final fill and cover grading would reach elevations close to that of the berm. The construction equipment used in these activities is high enough to be seen for a period along the perimeter of the expansion from houses in Hillsborough and the western portions of Bluffs West. The intervening distance would minimize the impact from Hillsborough and western portions of Bluffs West, but the activity would be in view. Landfill activity in the highest, north central portion above 890 feet MSL could be visible from the second story of future residences in the vacant portion of Bluffs West.

The view of the proposed project would be screened from most of the Minnesota River valley and National Wildlife Refuge by the intervening bluff with the exception of a relatively narrow corridor over one mile away along Hwy. 101 in the city of Shakopee. The bluff would also screen the view from much of the planned Minnesota Valley Trail. The intervening distance would limit the effect of the visual changes and fill activities.

The visual impact of the 15-foot berm and activities which would still be visible above the berm could be mitigated by landscaping the berm with trees and shrubs of adequate height. Increasing the height of the berm would also screen activities at the perimeter of the fill area. This would screen activity that would otherwise be visible above the berm and minimize the impact on surrounding land uses. Tall trees planted in front of the berm or shrubs planted along the berm would serve this purpose. Shrubs planted on the berm would have to be 9 to 10 feet above the highest elevation of the berm to screen the landfill

activity from all residential and park land uses. Also, additional trees could be planted in the gaps in the existing row of conifers west and north of Bluffs West to completely screen the expansion and provide a more natural appearance. Planting trees and shrubs along the river bluff would provide some additional protection for the limited portions of the Wildlife Refuge and planned Minnesota Valley Trail which are affected by the project. Year-round screening would be more effective. Pine, spruce and other conifers would be appropriate for this reason.

HIGHWAYS

BACKGROUND

Haul Routes

The Flying Cloud Sanitary Landfill is located along Hwy.169 (Flying Cloud Dr.) south of County Hwy. 1. Hwy. 169 provides the only direct access to the site (Figure 55).

Hwy. 169 north of the landfill is also the primary haul route and provides a direct link between I-494 and the landfill entrance. This route carries about 87 percent of the annual landfill traffic, and Hwy. 169 from the south carries one percent (Figure 55) (151).

Hwy. 169 is also a major local and regional highway which provides access to the expanding employment and commercial service centers in the I-494 area and other regional centers. The highway is also a significant truck route linking the Metropolitan Area with the agricultural areas and communities in southwestern Minnesota. In 1981, according to the Minnesota Department of Transportation (Mn/DOT) traffic counts, 15 percent (2,369 of 16,132) of the vehicles (both directions) using Hwy. 169 adjoining the landfill were trucks (152). This does not include panel and pick-up trucks. It does include refuse trucks. Currently, there are 538 daily refuse truck trips in and out of the landfill representing only 23 percent of the highway's truck trip volume.

County Hwy. 1 (Pioneer Tr.) is a secondary haul route to the landfill. County Hwy. 1 intersects Hwy. 169 just north of the landfill entrance. An additional 10 percent of the landfill traffic comes from the east using County Hwy. 1, and from the west, two percent (Figure 55).

These approaches will continue throughout the life of the Flying Cloud Landfill due to the concentrated distribution of urban population areas to the north and east of the site.

Existing Traffic Levels

Hourly Capacities

According to Metropolitan Council data, the average hourly capacity level for any one link along Hwy. 169 is 1,100 vehicles per hour with the network operating at level "C" or better (153). Under ideal conditions on a multilane rural highway such as Hwy. 169, the capacity level is 1,400 vehicles per hour in both directions, with the network operating at a level of service "D" or better (140). The existing capacity level for County Hwy. 1 westbound (from Pioneer Tr. and Homeward Hills Rd.) and eastbound from Staring Ln. to Hwy. 169 is 1,100 vehicles per hour (155).

Daily Capacities

The daily capacity level for Hwy. 169 is 24,000 vehicles per day (156). This level of capacity will change by late 1986 to 40,000 vehicles daily due to programmed Mn/DOT improvements for two 2-lane sections of Hwy. 169: 1) beginning just north of County Hwy. 1 and ending just south of the entrance to Hennepin County Vocational-Technical Center; and 2) beginning approximately at the intersection of Hwy. 169 and Anderson Lake Pkwy., and extending approximately one mile northward (Figure 56) (157).

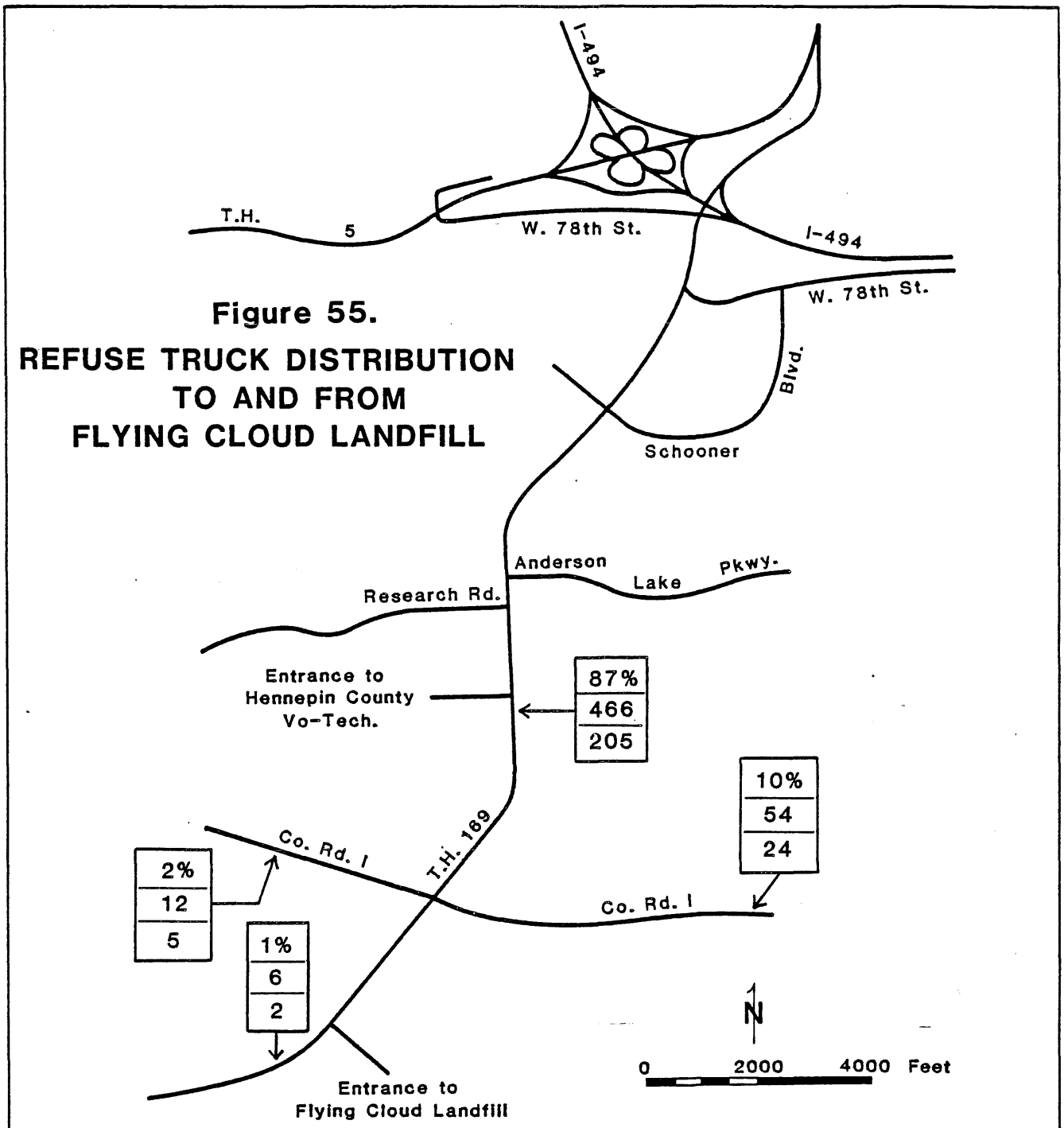


Figure 55.
REFUSE TRUCK DISTRIBUTION TO AND FROM FLYING CLOUD LANDFILL

XX% — Percent of truck traffic to/from landfill
XX — No. of trucks to/from landfill
XX — No. of other vehicles to/from landfill (estimated)

Sources: Survey conducted by applicant, 12-23-81 to 1-1-82; Strgar-Roscoe, Inc., Traffic Analysis for Proposed Expansion to Flying Cloud Landfill, 1982.

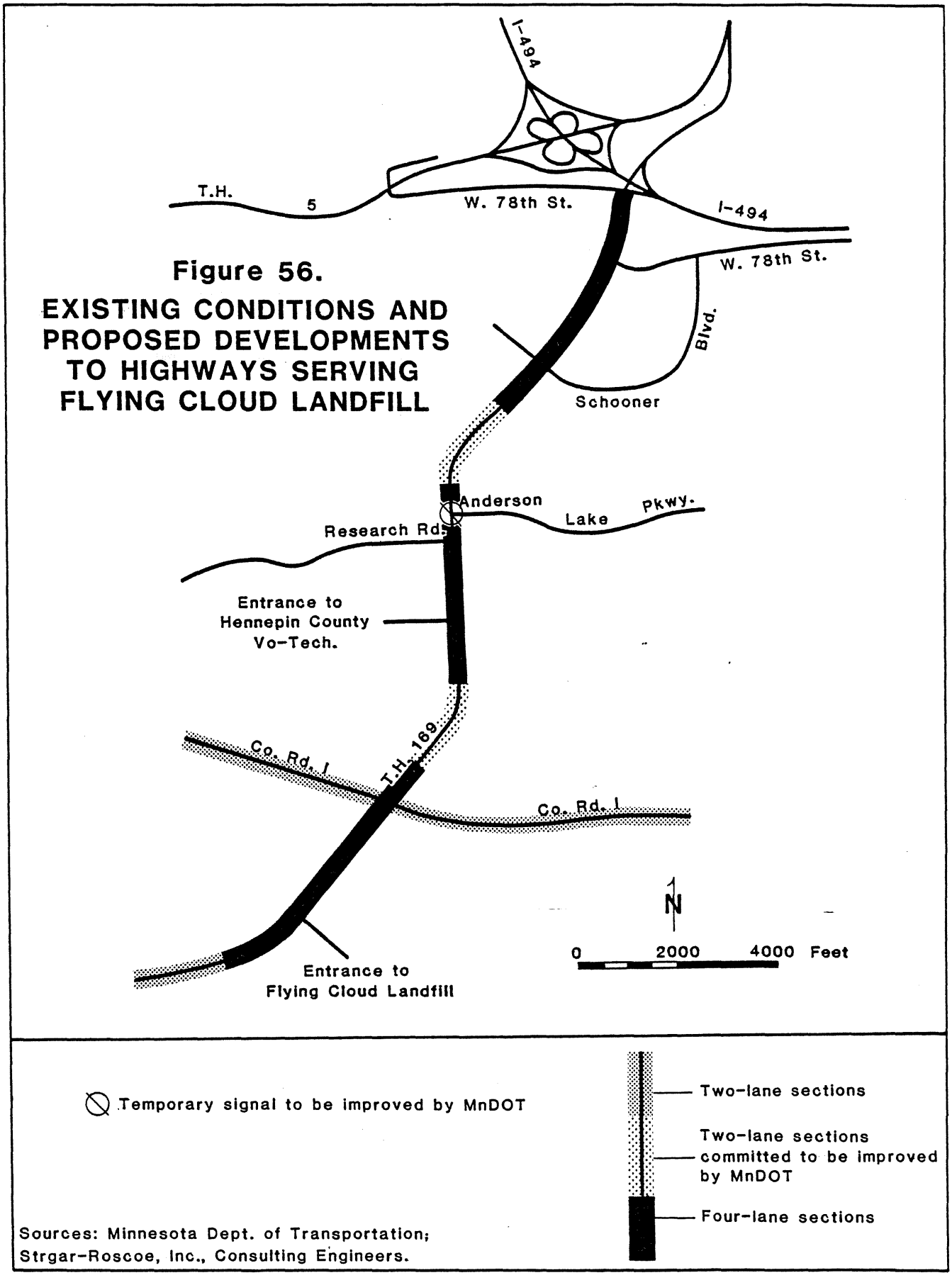


Figure 56.
EXISTING CONDITIONS AND PROPOSED DEVELOPMENTS TO HIGHWAYS SERVING FLYING CLOUD LANDFILL

Sources: Minnesota Dept. of Transportation; Strgar-Roscoe, Inc., Consulting Engineers.

At present, the daily capacity level for County Hwy. 1 both east and west of Hwy. 169 is 7,000 vehicles daily, with the potential to reach 10,000 vehicles daily with the highway operating at level of service "D" or better (158).

For the most part, Hwy. 169 is a four-lane highway from the interchange at I-494 to south of the landfill (with the exception of the two 2-lane sections). County Hwy. 1 on both sides of Hwy. 169 is a 2-lane highway (Figure 52). It should be noted, however, that Hwy. 169 at the entrance to the landfill was not originally designed to be a four-lane roadway, that is, does not have the proper shoulder width, but it has been operating as such without any major impediments to the flow of traffic (159).

Present average daily traffic (ADT) counts vary along the various segments of Hwy. 169. The link that serves the entrance to the Flying Cloud Landfill had an ADT volume of 16,132 vehicles daily in 1981. County Hwy. 1 east of Hwy. 169 has an ADT volume of 3,800 vehicles daily, while its ADT west of Hwy. 169 is 4,150 vehicles daily (Figure 57) (160).

Existing Landfill Traffic Volume

Currently, 538 refuse trucks enter or leave the landfill on a daily basis. In addition to the trucks that service the landfill, 236 daily trips to/from the landfill are produced by other vehicles (that is, personal autos/pick-up trucks etc.) (161). In order to evaluate the impact of the landfill expansion, it is assumed that the same travel patterns exist for the "other vehicles" as for the refuse trucks; in other words, 87 percent of the other vehicle traffic comes from I-494, 10 percent comes from the east on County Hwy. 1, two percent comes from the west on County Hwy. 1, and 1 percent comes from the south on Hwy. 169). Based on this distribution, approximately 205 "other vehicles" use Hwy. 169 to/from I-494; 24 to/from "other vehicles" use County Hwy. 1 east of Hwy. 169; five "other vehicles," use County Hwy. 1 west of Hwy. 169; and two "other vehicles," use Hwy. 169 south of the landfill entrance.

Added together, the existing refuse truck trips to/from the landfill (538) and "other vehicle" trips to/from the landfill (236) equal total traffic to/from the landfill, or 774 trips daily. This is equal to only five percent of the present average daily traffic on Hwy. 169 adjoining the landfill. Total traffic to/from the landfill is equal to two percent of the traffic on County Hwy. 1 east of Hwy. 69 and less than one percent of the traffic west of Hwy. 169.

IMPACTS DUE TO LANDFILL EXPANSION

Future Traffic Levels

Future capacity along Hwy. 169 is expected to reach 40,000 vehicles daily by 1986. The Metropolitan Council's 1990 projected traffic volume along Hwy. 169 near the entrance to the landfill is 19,920 vehicles daily (1990 is close to the applicant's estimated 1992 completion date for the landfill expansion) (Figure 58) (162). The 1990 estimate for County Hwy. 1 east of Hwy. 169 is 5,500 vehicles daily; west of Hwy. 169 the forecasted ADT is 6,000 vehicles daily. The latter estimates are based on the Metropolitan Council's projected 45 percent increase in traffic in the traffic corridor served by TH 169, Hwy. 1 and related routes. (The forecasts do not consider the impact of the construction of a new Hwy. 212. A construction date for this facility is not firm at this time. If Hwy. 212 is completed before 1990, the number of vehicles using Hwy. 169 would decrease substantially.) The growth in traffic will be due primarily to increased commuter traffic and the continued development of employment and commercial centers in the I-494 area.

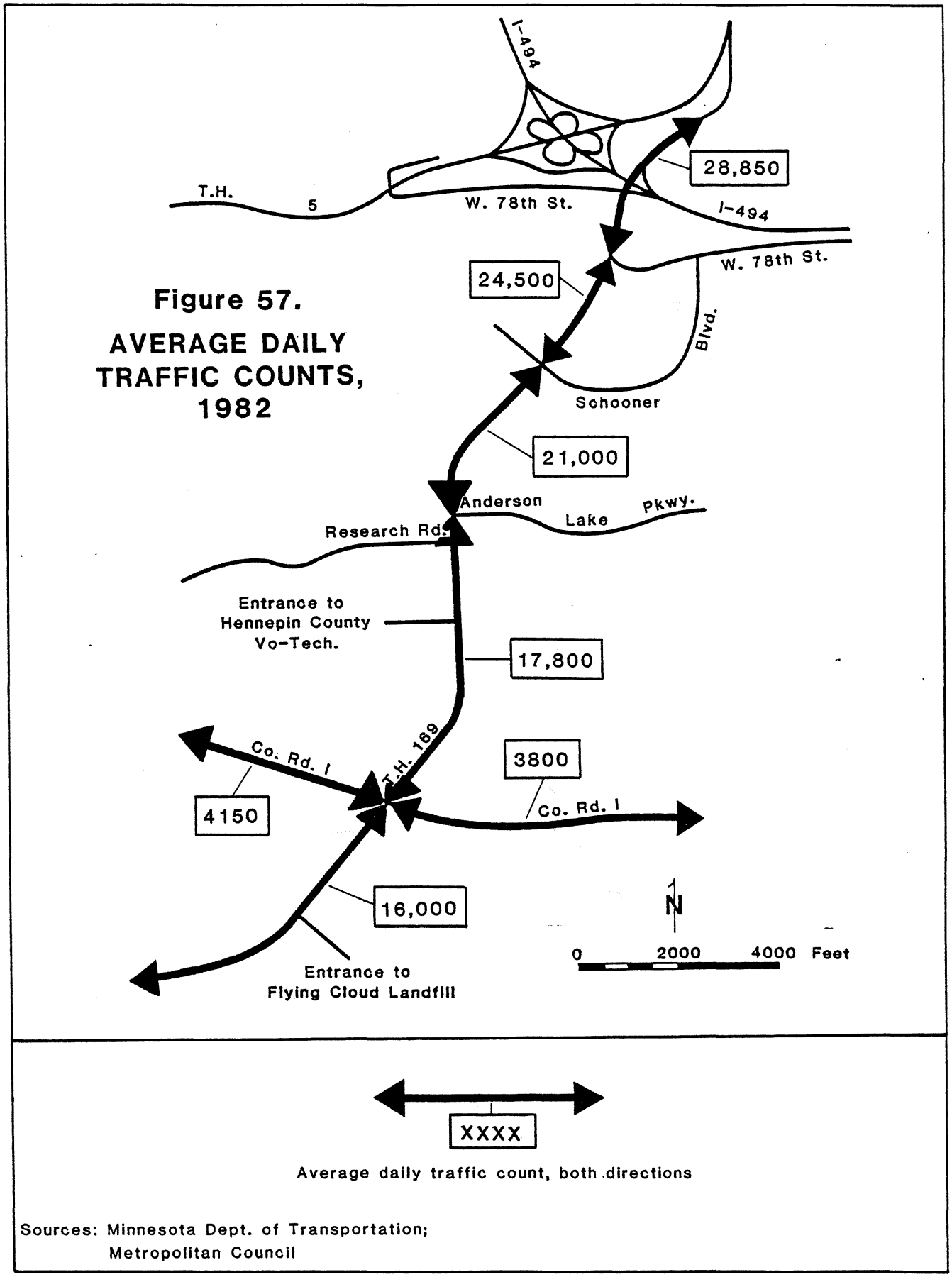


Figure 57.

AVERAGE DAILY TRAFFIC COUNTS, 1982

Sources: Minnesota Dept. of Transportation;
Metropolitan Council

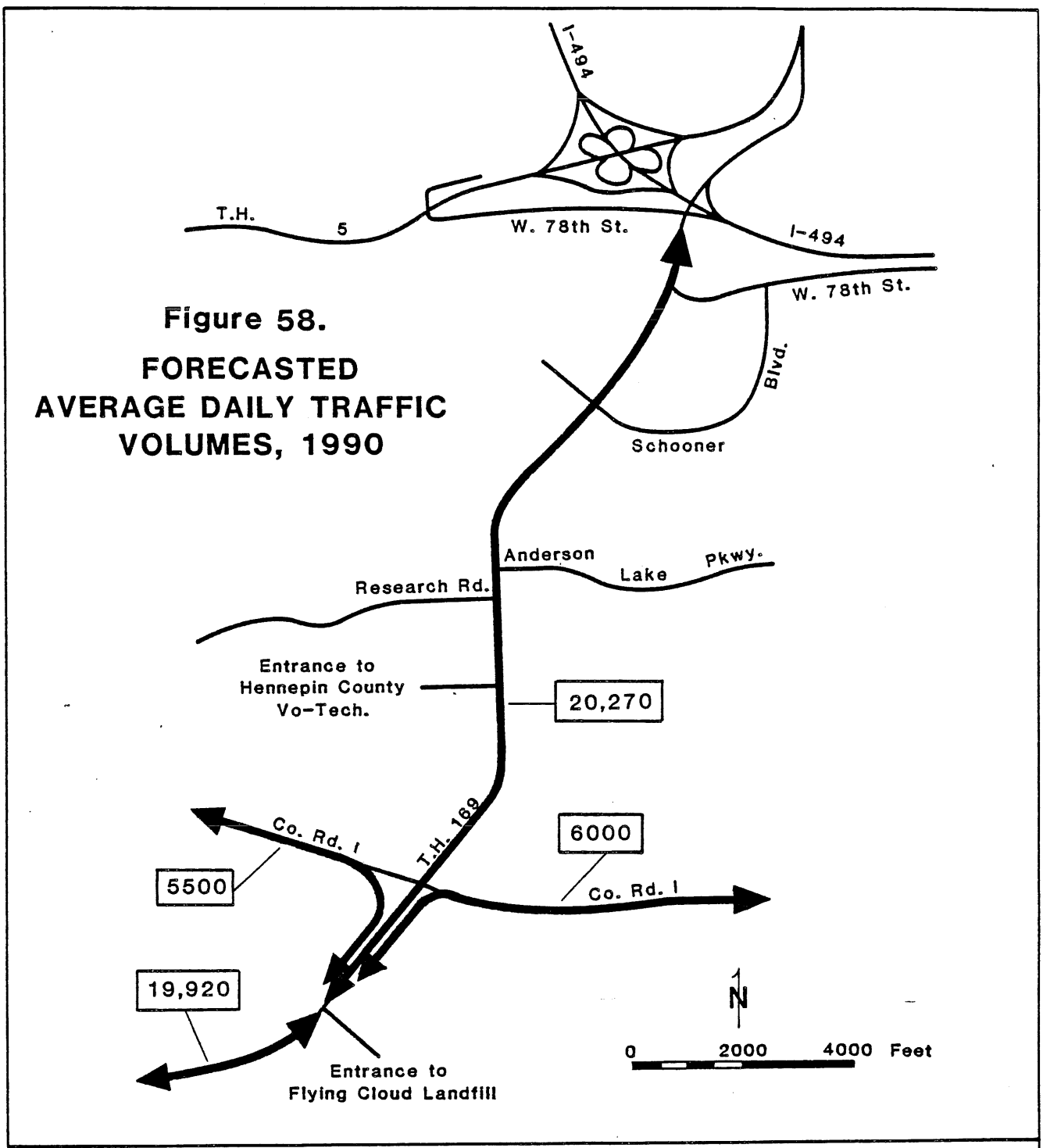


Figure 58.

FORECASTED AVERAGE DAILY TRAFFIC VOLUMES, 1990

Source: Metropolitan Council

Woodlake has developed three scenarios of the expansion and associated potential increases in landfill traffic. Under the first scenario, the refuse deposited and number of truck trips would increase by 10 percent for each of the next three years and by eight percent per year until the landfill closes in 1992. Under the second and third scenarios, 15 and 20 percent increases in the refuse deposited and number of truck trips, respectively, are projected (Table 39). Because of the increased tonnages, the landfill would close earlier than 1992. These projections are reasonable for the purposes of evaluating the highway impacts of the proposed landfill expansion. From 1976 through 1982, the average annual increase was 13.2 percent. In actuality, the tonnage deposited at the landfill decreased in 1981 and 1982. Also, larger refuse trucks are being used increasingly by the applicant which means more refuse can be handled with fewer truck trips. If this trend continues, increases in tonnage may not produce similar increases in truck traffic.

The truck trips in each of the three scenarios do not include other vehicle trips to/from the landfill. Refuse truck trips equal 70 percent of the landfill traffic according to Woodlake's traffic analysis report. To determine the potential impact of the expansion on highway capacity, the projected totals for refuse trucks were increased by 30 percent to account for other vehicles (Table 39).

Table 39
ESTIMATED TOTAL TRAFFIC TO/FROM
THE FLYING CLOUD LANDFILL*

Year	Scenario 1	Scenario 2	Scenario 3
1982	774	774	774
1983	846	885	923
1984	931	1,018	1,108
1985	1,005	1,170	1,330
1986	1,086	1,346	1,595
1987	1,173	1,548	1,915
1988	1,266	1,780	2,298
1989	1,368	2,048	2,757**
1990	1,477	2,354**	--
1991	1,595	--	--
1992	1,723**	--	--

*Total traffic includes refuse trucks and "other vehicles" (personal auto/pick-ups). Truck trips noted in Table 1, "Update to Traffic Analysis for Flying Cloud Landfill," memorandum to Rodney Kager from James Benshoof, May 3, 1983, were expanded by 30 percent to estimate all trips to and from the landfill.

**Landfill is closed.

The potential impact of the landfill expansion on traffic levels can be analyzed by comparing the peak traffic year estimate for each scenario with the 1990 traffic forecasts and capacities for Hwy. 169 and County Hwy. 1.

The peak traffic estimate for each scenario would occur in the final year of landfill operation (Table 39). Total traffic for 1992 under scenario one would equal only 9 percent (1,723 vehicles) of the projected traffic in 1990 for Hwy. 169, 12 percent (2,354 vehicles) for scenario two and 14 percent (2,757 vehicles) for scenario three. In comparison to the current Hwy. 169 capacity of 24,000 vehicles and the 1985-1986 improved capacity of 40,000 vehicles, the estimated peak traffic for each scenario is not significant. Assuming the proportion of landfill traffic using County Hwy. 1 will remain the same in the future, there will be 257 trips from the east and 28 trips from the west in 1989 for scenario three. This represents less than one percent of the 1990 traffic forecast for either portion of County Hwy. 1.

The potential impact of the landfill expansion traffic on traffic volumes along Hwy. 169 and County Hwy. 1 during the peak hours (7:30 to 8:30 a.m. and 4:30 to 5:30 p.m.) would also be relatively minor. As Figure 59 indicates, the busiest period for traffic at the landfill is between 9 a.m. and 3 p.m., when refuse trucks are arriving to unload or leaving the site to pick up a second load. The peak hour for refuse truck traffic occurs around 11:30 a.m. This period occurs between the overall a.m. and p.m. peak hours.

As Figure 59 also indicates, the refuse truck traffic is currently a small percentage of the total traffic on Hwy. 169 at any given time between 5 a.m. and 9 p.m. Adjusting the numbers upward by 30 percent to include all the vehicles to/from the landfill and adding increased traffic due to the landfill expansion would not make an appreciable difference.

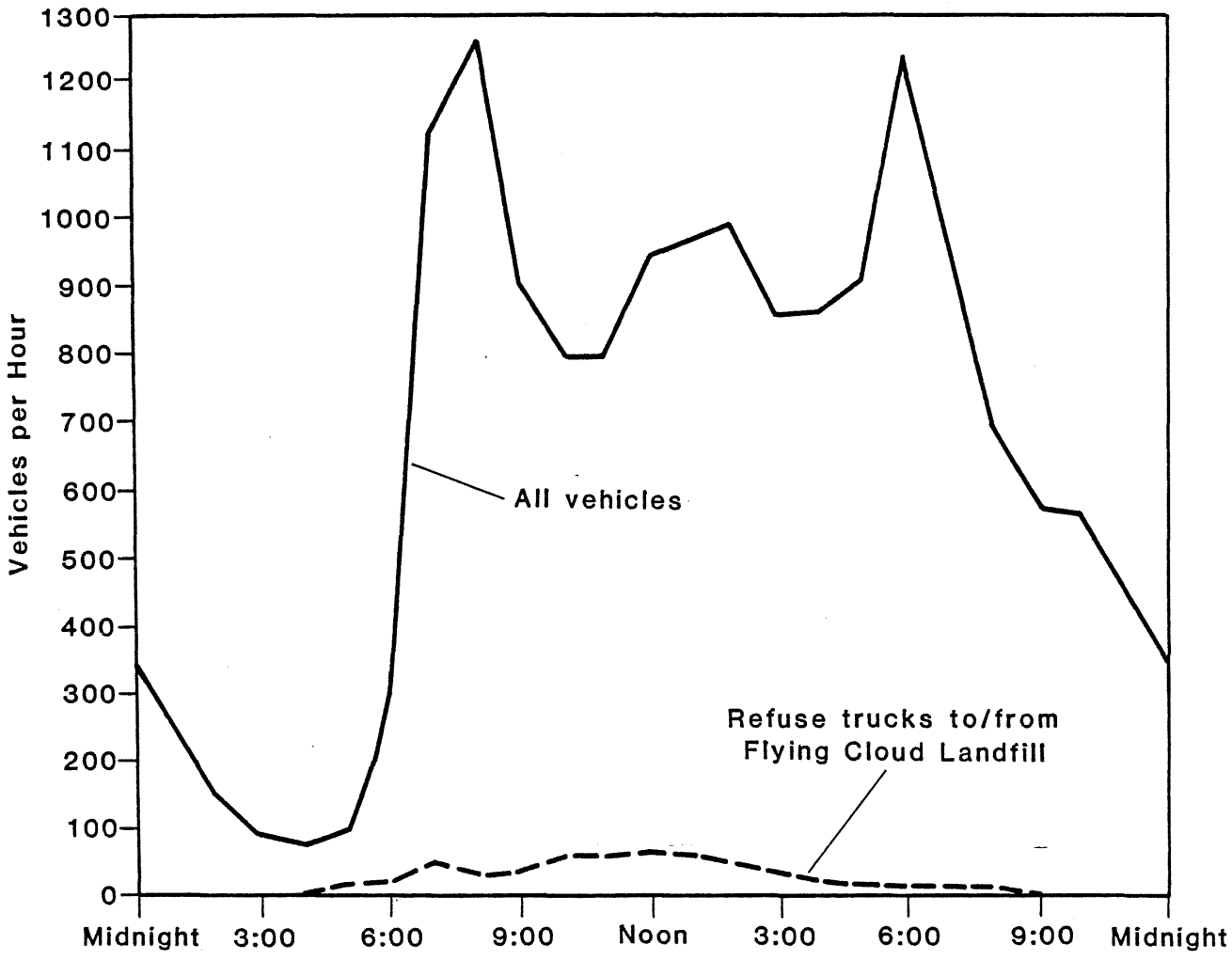
The traffic numbers during any one hour are not significant in terms of the traffic using Hwy. 169 or County Hwy. 1. In 1989, under scenario three (the highest forecast), the a.m. peak is estimated to be 138 vehicles (five percent of the 2,751 vehicles to/from the landfill). These 138 vehicles would represent nine percent of estimated peak-hour traffic in 1990 on Hwy. 169. The impact of this traffic is similar if the estimated hourly capacity of Hwy. 169 (1,100-1,400 vehicles) is used for comparison. The landfill traffic would equal 10-13 percent of the hourly capacity.

As the analysis indicates, traffic generated by the landfill expansion will have little effect on peak-hour traffic movement on local highways. Other major traffic generators in the I-494 interchange area and elsewhere in the region will be more significant in determining future traffic flow along Hwy. 169 and County Hwy. 1.

Existing and future landfill traffic activity will not have a significant impact on the existing or future highways serving the landfill. Most of the traffic growth will be due to other development in the area, such as the expanding commercial development in the I-494/Hwy. 169 area, which will generate traffic for work, shopping and other purposes. This supports the conclusion of Mn/DOT as presented in its review of the EAW for the proposed expansion (Appendix C).

Figure 59.

HOURLY DISTRIBUTION OF EXISTING TRAFFIC VOLUMES



Sources: For all vehicles: Minnesota Dept. of Transportation.
For refuse trucks: Woodlake records.
Graphic: Strgar-Roscoe, Inc.

Highway Loads

In the State of Minnesota, there is a 80,000 pound maximum gross vehicle weight limit on interstate and primary arterials. These highways are referred to as designated routes or 10-ton (per axle) routes. Most county highways have a maximum 73,280 gross vehicle weight limit and are referred to as nondesignated route or nine-ton (per axle) routes (163)

Hwy. 169 is classified as a 10-ton (per axle) seasonal restricted highway. During harsh climate conditions, the maximum gross vehicle weight on Hwy. 169 is reduced to 73,280 pounds or a nine-ton (per axle) route (164). This restriction is imposed to preserve the physical condition of the highway. The nine-ton route restriction is lifted on May 15, the effective date when spring road restrictions are lifted (165).

County Hwy. 1 is a nine-ton (per axle) year-round highway with no restrictions attached (166).

At present, the physical condition of both Hwy. 169 and County Hwy. 1 is considered to be fully operable, meaning there are no hazardous operating conditions (that is, potholes, cracks, etc.), or destruction of the load carrying capacity by vehicles using the roads (167).

At present, most of the trucks that deposit refuse at the Flying Cloud Landfill are two-axle trucks. The loaded carrying capacity of the present trucks ranges from 28,000 lbs. to 39,000 lbs. (168). This range in weight depends heavily on the distance in feet between axle centers (169). The new larger trucks that service the landfill are three-axle trucks with a loaded carrying capacity ranging from 41,000 lbs. to 51,000 lbs. The third axle of these new larger vehicles are tandem axles--axles that are usually raised and not in use unless the load requires their usage (170). Distance in feet between axle centers and the number of consecutive axles also have a major impact on the carrying capacity of the larger more compact efficient trucks.

Both the present trucks and the new larger trucks on a per axle basis conform to the designed load limits of both Hwy. 169 and County Hwy. 1. The weights of both the old and new landfill trucks will be within the acceptable range of the nine-ton and 10-ton (per axle) weight classification even during the seasonal restriction.

Highway Safety

Only partial data regarding accidents is available, but the limited data that is available appears to indicate that landfill traffic has not been a significant factor in determining highway safety. Due to the system of vehicle accident classification used by the Eden Prairie Public Safety Department, Mn/DOT and the Hennepin County Bureau of Public Service, complete landfill-related accident data could not be obtained. Trucks involved in accidents are recorded, but the type of truck is not noted (that is, refuse trucks).

Landfill officials were contacted for accident data who referred to their traffic analysis report (171). In the report, "analysis was performed to determine the accident experience that relates to refuse trucks." The analysis found:

> During a five-year period (1976-1980), 445 accidents occurred on Hwy. 169 from County Hwy. 60 to south of the Flying Cloud Landfill site. Approximately 870 vehicles were involved in these accidents and only 11 (no more than two in any one year) of the involved vehicles were Woodlake operated trucks.

The report concluded that "Woodlake trucks comprise 1.3 percent of the vehicles in accidents." The analysis involves only Woodlake trucks, which accounts for 59 percent of the truck traffic to the landfill.

Woodlake's traffic analysis report also noted that the general accident rates along Hwy. 169 for 1976-1980 are lower or similar to the rates for similar highway segments in District 5 of the Mn/DOT (Hennepin, Carver, Scott and a portion of Anoka Counties). The rate for the portion of Hwy. 169 at the landfill is significantly lower--1.3 accidents per million vehicle miles versus 6.6 on similar highway segments in the district (Figure 60). Although this data does not relate specifically to landfill traffic, it does suggest that the segment of Hwy. 169 most likely to be affected by the landfill is relatively safe despite the landfill.

Staff attempted to contact seven other major refuse haulers who use the landfill. Four indicated there were no accidents involving their trucks, and one hauler indicated one mishap in July 1983. The other two haulers could not be contacted.

Data on accidents involving types of vehicles other than refuse trucks, such as panel trucks or private autos which also use the landfill was not available.

The Eden Prairie Police Department was contacted to determine its view of highway safety along Hwy. 169 near the landfill. A Police Department representative suggested that Hwy. 169 should be a divided highway from I-494 to south of the landfill to improve safety and potentially reduce accidents. He stated that Hwy. 169 is a very heavily traveled route and that indirectly the design of the highway creates potential safety hazards particulary the curve south of the landfill entrance. He stated that the northbound traffic (specifically trucks) come around this curve traveling at a high velocity and, due to the incline, curve, width of the highway and landfill entrance, along with the speed of the vehicle, a potential safety hazard exists. Landfill traffic, which primarily comes from the north, must turn left across the path of this traffic.

Mn/DOT recently conducted a survey of accidents along Hwy. 169 from County Hwy. 1 to a point one mile south (see Mn/DOT letter in Appendix C). This segment includes the entrance to the landfill. The study included the period from Jan. 1, 1981 to the present. Only one accident involving property damage can be attributed to the landfill access according to Mn/DOT. However, the data does not include how many accidents may have been indirectly affected by southbound trucks turning left into the landfill. Mn/DOT believes that accidents will increase as more trucks use the entrance (Appendix C).

Woodlake's traffic consultant indicated concern regarding the design of the entrance to the Flying Cloud Landfill. As stated earlier, the entrance operates as a four-lane highway even though it was not originally designed to do so. If landfill traffic increases, the present distribution of landfill trips remain the same (more than 95 percent of the landfill traffic is from the north), and the expected increase in the total highway traffic volume occurs,

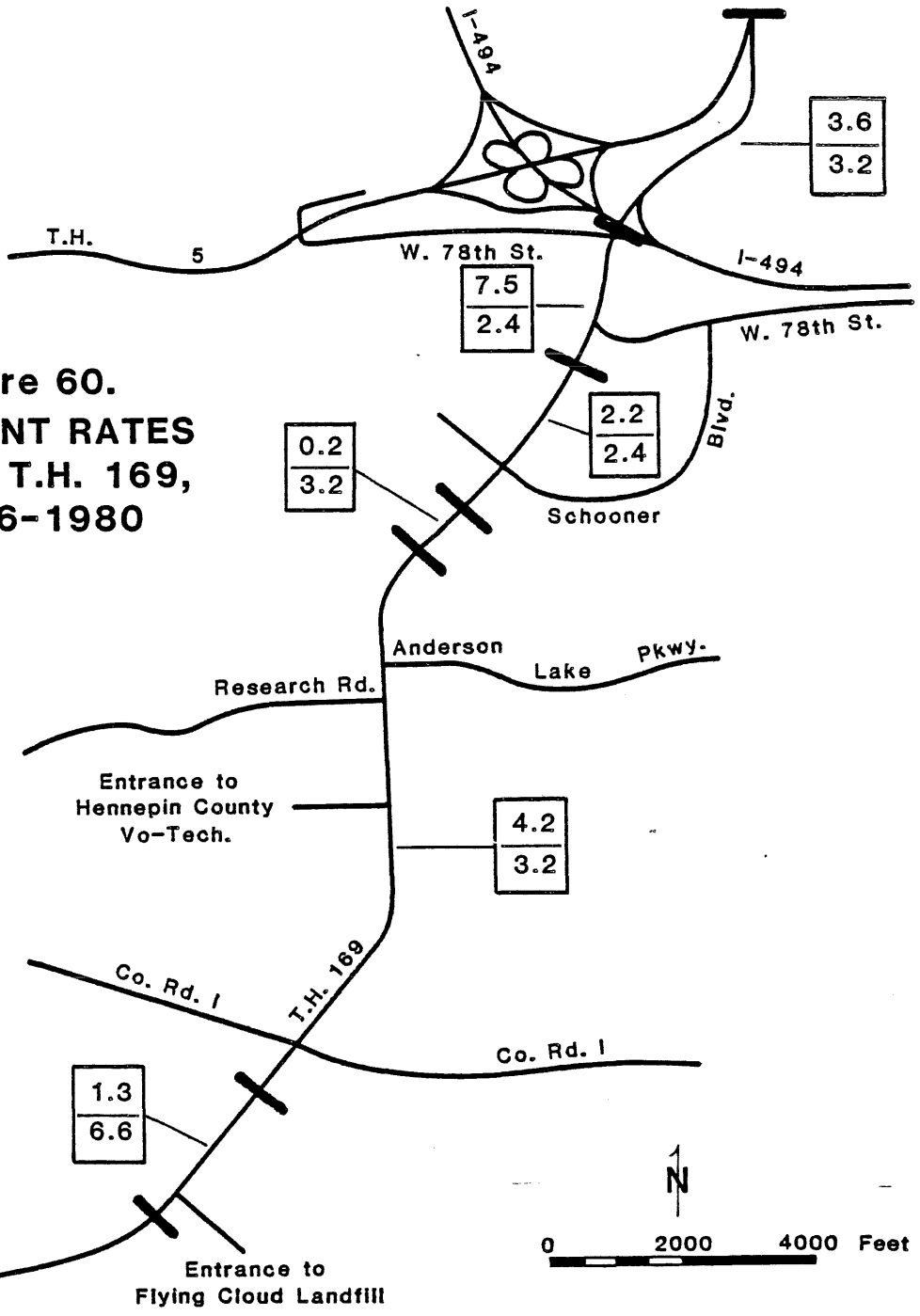


Figure 60.
ACCIDENT RATES ALONG T.H. 169, 1976-1980

X.X — Accidents per million vehicle miles

X.X — Average accidents per million vehicle miles for similar segments in District 5

Sources: Strgar-Roscoe, Inc.;
Minnesota Dept. of Transportation.

landfill traffic turning into the site may be a hazard to northbound through traffic while impairing the vision of left-turning vehicles from the landfill and southbound through traffic. Therefore, improvements to the physical layout of the entrance to the landfill from the north may be useful. Woodlake's consultant recommended that a sheltered left-turn bay be added to serve traffic approaching the landfill from the north to maintain the current safety record of refuse trucks (172).

END USE HIGHWAY IMPACTS

The end uses being considered by Woodlake for the landfill site include a 170-acre, 18-hole golf course, 13-acre residential area, 31-acre industrial area and 39-acre local park. Not all of the uses would be served by Hwy. 169. The residential area adjoins the Bluffs West subdivision and would probably be served by local streets extended from that subdivision. The impact would be minimal and similar to any residential expansion or addition to Bluffs West. The park would probably be served by Homeward Hills Rd., which would be adequate in capacity.

The golf course and industrial area would be served by Hwy. 169. Based on average rates of trip generation for such uses an average of 3,400 daily trips could be generated. This is based on averages of 9.1 and 60 trips per acre of golf course and industrial development, respectively (173). The average number of daily trips (3,400) would be higher than the estimated number of total trips under all three growth scenarios for the landfill. However, the improved daily capacity of Hwy. 169 (40,000 vehicles) would be adequate to serve these uses. When the new Hwy. 212 is completed, traffic on Hwy. 169 will decrease, making additional capacity available to end uses on the landfill site.

CONCLUSIONS/MITIGATION

The landfill expansion would have little effect on the overall volumes of traffic using the highways--Hwy. 169 and County Hwy. 1--serving the site. The capacities of these roadways are sufficient to serve the landfill expansion traffic until it closes in 1992.

Available data indicates that the landfill is not affecting the safety of highway traffic on Hwy. 169 and Hwy. 1. However, it appears that the landfill expansion could result in an increased potential for accidents at the landfill entrance. This is due to the alignment of Hwy. 169, which reduces the sight distance from vehicles apporoaching from the south, the continued growth of through traffic on Hwy. 169 and the increased truck and other traffic turning left into the landfill.

The increased potential for accidents could be mitigated by the installation of a traffic control system at the landfill access and redesign of the entrance to the landfill to include a sheltered left-turn bay to serve landfill traffic from the north. The sheltered left turn would protect through traffic and vehicles turning left into the landfill.

REGIONAL PLANS

The Metropolitan Council was established by the state Legislature in 1967 for the purpose of coordinating the economic and efficient development of the seven-county Metropolitan Area. Through its Development Guide, the Council coordinates planning and development of the "metropolitan systems" of transportation, airports, wastewater treatment, and open space for the seven-county Area. The Council's Development Framework sets general development policy for regional development.

The Council has other major planning responsibilities originating in state or federal legislation. Examples include air quality planning for control of pollutants from mobile sources; in solid waste management, the Council's role is as the key agency in establishment of a long-range plan for management of this complex, potentially conflicting, multi-jurisdictional issue. Pursuant to Subtitle D of the federal Resource Conservation and Recovery Act, the Council is the agency designated as being responsible for solid waste management planning in the Metropolitan Area. This role was substantially enhanced by the Minnesota Legislature in 1980 by passage of the Waste Management Act. It requires the Council to revise its solid waste policy plan to circumscribe the amount of new landfill capacity which will be developed in the region in this century based on a plan for maximum implementation of feasible and prudent alternatives to land disposal of municipal solid waste.

The following sections discuss the proposed project in context of Council policy for solid waste management, development framework and each of the metropolitan systems.

IMPACT ON REGIONAL DEVELOPMENT FRAMEWORK PLAN

The Council has adopted a Development Framework plan to guide the orderly and economic development, public and private, of the Metropolitan Area. This plan designates general areas for future urban services and development defined as the MUSA and rural service areas. In accordance with the Metropolitan Land Planning Act, all local governments are required to prepare comprehensive plans in conformity with metropolitan system plans.

Most of the City of Eden Prairie is located within the MUSA. The southwest corner of the city is located outside the MUSA and is designated as a rural service area in the Development Framework. Provision of metropolitan urban services such as transit or interceptor sewers is to be limited to the area within the MUSA.

Eden Prairie is considered a developing suburban community according to the Development Framework. The landfill and proposed expansion are located within the MUSA as defined in the city's adopted comprehensive plan (Figure 59). Thus, the proposed project is not inconsistent with the Development Framework.

IMPACT ON REGIONAL SOLID WASTE PLAN

The Council must review and approve the issuance of an MPCA solid waste permit before the project can proceed (M.S. 473.823). Projects are evaluated for consistency with the regional solid waste policy plan. The permit application for the Flying Cloud landfill expansion will be reviewed against the policies and criteria as contained in that plan. The permit review is a separate process

from the preparation of this EIS and will begin only after the Council determines the EIS is adequate and there is sufficient information to commence the permit review. The EIS must be used as an available information resource as part of the Council's permit review.

In response to the Waste Management Act of 1980, the 1981 regional Solid Waste Management Policy Plan is being amended. Drafts of the revised plan are expected to be available by early fall 1984. The proposed expansion will be reviewed against the policy plan in place at the time of the project review.

In its objectives and policies, the existing solid waste policy plan shifts the emphasis in regional solid waste management from land disposal to waste reduction. The plan states that the Council will consider waste reduction as the practice having the greatest potential for improving solid waste management, followed in order of preference by source separation, waste processing and utilization and, lastly, land disposal. Waste reduction targets the industrial, commercial and residential source or generator with programs designed to reduce the amount of material discarded. Source separation means the waste generator sets aside materials that can be recycled such as glass, paper and metal. Waste processing and utilization includes reduction of the waste volume or conversion of waste to a usable form such as energy.

The policy plan indicates that these various management practices will not replace the need for final waste disposal sites including land disposal, but the Council's objective is to reduce the region's dependence on sanitary landfills. Landfilling and storage should be considered only after it has been determined that other waste management practices are not feasible. The decision to use land disposal is to be based on the finding that the environment will not be significantly threatened. The plan contains criteria for evaluating solid waste facilities including landfills.

The 1981 policy plan indicates that approximately 65,000 acre-feet of landfill space is needed to meet the maximum disposal need of the Region to the year 2000, about five times the total capacity in the region authorized under existing MPCA permits. However, these figures represent a worst-case situation. They do not consider the beneficial impact of the Council's emphasis on waste reduction, source separation or resource recovery programs to reduce land disposal. The Council's Land Disposal Abatement report (1981) estimates that 68 to 90 percent of the waste generated annually in the region could be diverted away from landfills by the year 2000 due to recycling and high-technology resource recovery systems such as trash-burning furnaces.

The revision of the regional solid waste plan, now being prepared, will strengthen the policy orientation toward land disposal alternatives. It will be a regional abatement plan with specific standards for county resource recovery and waste reduction and separation programs. The plan will essentially be a development schedule for implementation of a comprehensive program of waste management alternatives. Hand-in-hand with the abatement plan will be a reduced estimate of the amount of new land disposal capacity needed in the region. New landfills will require a certificate of need showing that all feasible and prudent alternatives to land disposal are being implemented.

The proposed expansion raises a number of policy issues. These are summarized here, but they cannot be resolved as part of EIS preparation. Some will be addressed during the review of the project by the appropriate permitting authorities; some will be dealt with through development of the Council's revised Solid Waste Management Policy Plan.

The current policy plan emphasizes the need to reduce solid waste volumes and the need to reduce the region's dependency on landfills. The amended policy plan now being developed will continue that emphasis in accordance with the state Waste Management Act and will indicate how those objectives are to be achieved by implementing agencies.

The proposed Flying Cloud Landfill expansion will continue to make land disposal capacity available and convenient to the region for another seven years. Landfilling, because it does not reflect the true costs of solid waste management is relatively low cost and will continue to be an attractive practice for solid waste disposal. Because of this, expansion of the landfill without integration as part of Hennepin County's comprehensive plan for solid waste management could reduce the pressure for waste disposal abatement and also affect the feasibility of specific private and public proposals for abatement projects now being developed.

However, the expansion could provide additional capacity that the region will need in the long run. Some solid waste material must be landfilled and more operating capacity will be needed in the forseeable future. Specifically the expansion could provide some of the additional landfill capacity each county must provide through new sites to meet the region's needs through the year 2000. In short, the proposed expansion could reduce the total number of new sites needed.

IMPACT ON REGIONAL TRANSPORTATION PLAN

The proposed project is consistent with the regional transportation plan. As the section concerning potential highway impacts indicates there will be adequate capacity in the regional highway system in the project area to handle the increased vehicular traffic generated by the landfill.

IMPACT ON REGIONAL OPEN SPACE PLAN

The proposed project is consistent with the regional Recreation Open Space Policy Plan. There are no regional parks or reserves which are affected by the proposed expansion. The closest regional open space, James Willkie Park Reserve, is across the Minnesota River to the southeast. (The Minnesota Valley National Wildlife Refuge, which is directly south of the project is not part of the regional system. The potential impact on the facility is analyzed in the Land Use section of the EIS.) A regional trail corridor is proposed along Purgatory Creek which lies east of the project and Homeward Hills Rd. It would not be affected by the expansion.

IMPACT ON REGIONAL AIRPORTS PLAN

Aviation Policy 4 states that:

> Land use surrounding an airport in the metropolitan system should be compatible with the role and function assigned to that airport; where incompatiblility exists, affected agencies and jurisdictions should jointly participate in developing a program to mitigate the incompatibility.

In the past, the relationship and coordination between the operator of the Flying Cloud Landfill, the manager of the Flying Cloud Airport and other state and local agencies in resolving conflicts has been a good example of this policy.

The landfill is immediately adjacent to the airport, an important minor airport in the metropolitan system. Primarily the airport services small business aircraft users and at least three small business jets which are based at the facility.

Although landfills appear to be a compatible land use adjacent to airports, they have the potential to be a hazard to safe airport operation. Landfills can attract birds, creating the potential for bird/aircraft strikes. In addition to the potential for strikes, jet engine ingestion of a 10- to 20-pound bird can result in total engine failure and a crash. As indicated in the Airport section, the Flying Cloud Airport and the landfill have co-existed for many years.

The success of this colocation is tied to the combined efforts of the landfill operators, the airport, the community, the aircraft users and the FAA. As a result of the on-going cooperative effort of all parties, the potential for bird strikes has been minimized by controlling use of the landfill, discouraging bird nesting and other activities and coordinating bird/aircraft flight advisories. Assuming the on-going cooperation willcontinue during the expansion, the proposed expansion would not be inconsistent with the regional airports system.

IMPACT ON REGIONAL WATER QUALITY MANAGEMENT PLAN

As proposed, the project would not affect regional wastewater interceptors or treatment facilities. Leachate collection and treatment is identified as a potential mitigative measure (see Hydrogeology section); if implemented,special arrangements would be required between the operator and the MWCC to ensure proper effluent management. The project is located within the 1990 sewer service area as defined in the City of Eden Prairie comprehensive plan. Accordingly, extension of sewer service for proposed end uses of the site is not in conflict with regional water quality management policies.

IMPACT ON REGIONAL SURFACE WATER MANAGEMENT PLAN

The proposed system for managing surface water runoff from the site is consistent with regional policies for surface water management. The applicant's onsite stormwater detention pond and surge pond in the river valley will allow for infiltration of runoff, limit the rate of runoff and provide time for the settling of suspended materials minimizing the impact on Grass Lake and the Minnesota River.

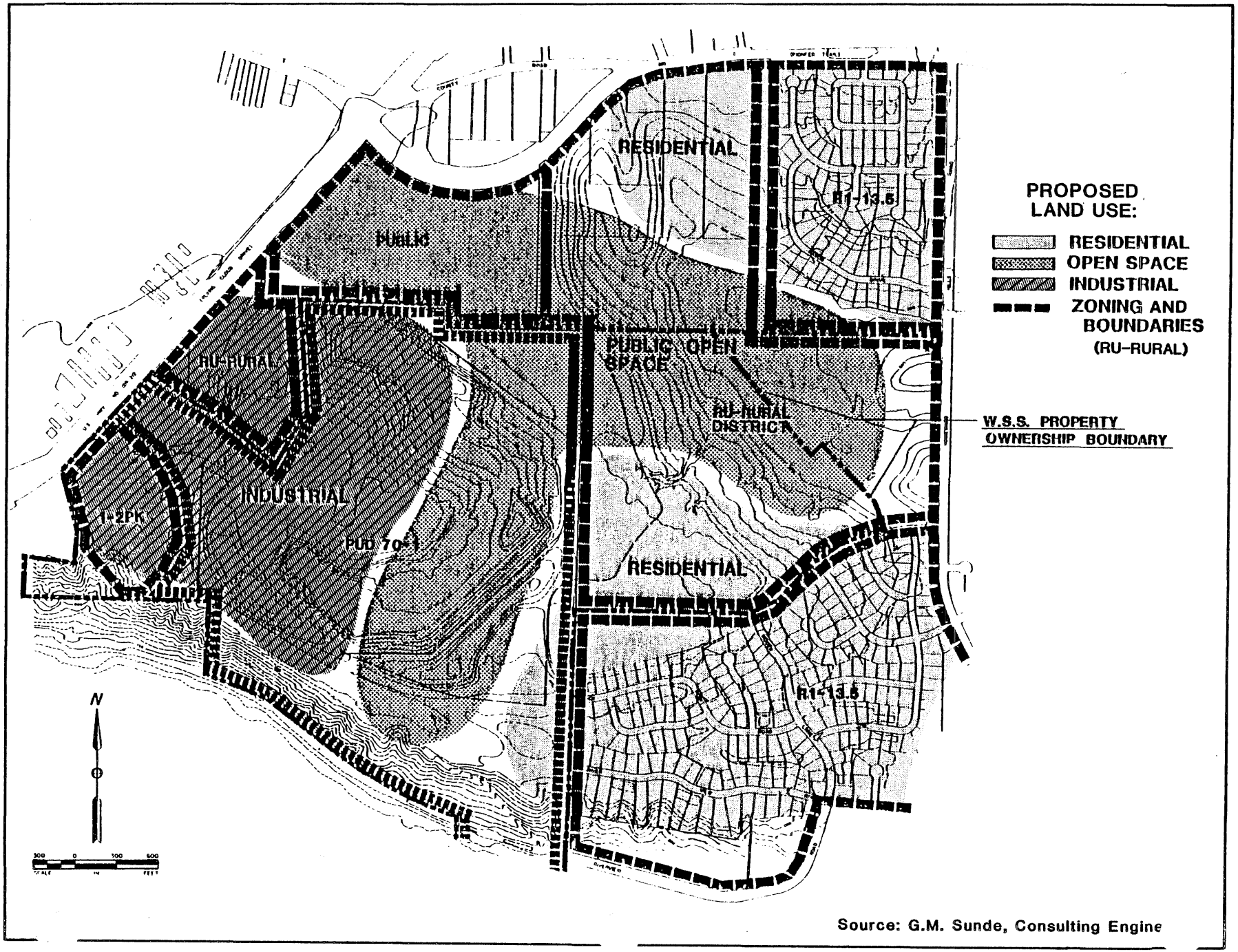
LOCAL PLANS/ZONING

The City of Eden Prairie's adopted comprehensive plan designates the existing landfill for industrial and public open space (Figure 61). The proposed horizontal expansion area is designated for public open space and low-density residential uses.

The proposed horizontal expansion would be located in an area zoned RU-Rural. The approved planned unit development (PUD 70-1) that includes the existing landfill would have to be amended by the City to include the expansion. An amendment has been submitted to the city by Woodlake.

The City will determine the consistency of the proposed project with its zoning and comprehensive plan and determine the need for any amendments when it reviews the proposed project.

Figure 61. EXISTING ZONING AND GUIDE PLAN LAND USE



Source: G.M. Sunde, Consulting Engine

LAND USE

INTRODUCTION

The potential impact of the proposed expansion on the surrounding land use--existing and future--is best determined by analyzing the potential side effects of the project and how these impacts in turn might affect land use. Many of the potential impacts have been examined in other sections of the EIS, and the conclusions as to the possible effect on existing and future land use are summarized here. The purpose of this section is to determine where these conflicts might occur, their significance and mitigation measures to minimize them.

GENERALIZED LAND USE--HWY. 169/I-494 CORRIDOR

The project is located in the southeast quadrant of the City of Eden Prairie, an area which is in transition. The Hwy. 169/I-494 corridor which surrounds the landfill is changing from rural use to a diversity of urban land uses (Figure 62). At the juncture of I-494 and Hwy. 169 a major commercial retail/service and employment area is developing. The Eden Prairie Center, a regional shopping center, anchors this development. At the southern end of the corridor is the broad, undeveloped Minnesota River Valley.

Although much of the land west of Hwy. 169 between the river and I-494 remains open, there are several major uses. Along the west side of the highway is the Hennepin Technical Center, a post-high school vocational education center serving students in southern Hennepin County. The soon-to-be-relocated 190-acre Northrop King Research farm occupies a site north of the school at Research Rd. The city is presently reviewing a proposed 250-300 acre recreation cultural complex for the area just north of the farm. Across from the landfill to the west is the Flying Cloud Airport, a minor regional airport occupying 566 acres and operated by the MAC.

East of Hwy. 169 and north of Hwy. 1 several residential developments and small commercial uses have been developed. The area east of the landfill to the City of Bloomington boundary generally contains scattered residential subdivisions, open space and undeveloped land. The Purgatory Creek Valley lies approximately 1/2 mile to the east of the landfill. Several single-family and multifamily housing developments have been developed or are under development east of the landfill and beyond the Creek valley to the city boundary.

South of the landfill lies a major natural feature--the broad Minnesota River valley. The valley is approximately three miles wide. The river valley bluffs along the north edge are approximately 200 feet high. These bluffs form the southern boundary of the landfill site. The river valley lands are undeveloped or in agricultural production. Most of the valley is subject to periodic flooding.

The city's comprehensive plan recommends the continued development of a variety of land uses along the I-494-Hwy. 169 corridor, including high- and low-density residential, regional and neighborhood commercial, industrial, sports facilities, vocational education and public open space. The plan recommends residential development--low density with scattered medium density, for the area east of the landfill to the city boundary (Figure 63).

Figure 62.

GENERALIZED LAND USE IN THE VICINITY OF FLYING CLOUD LANDFILL

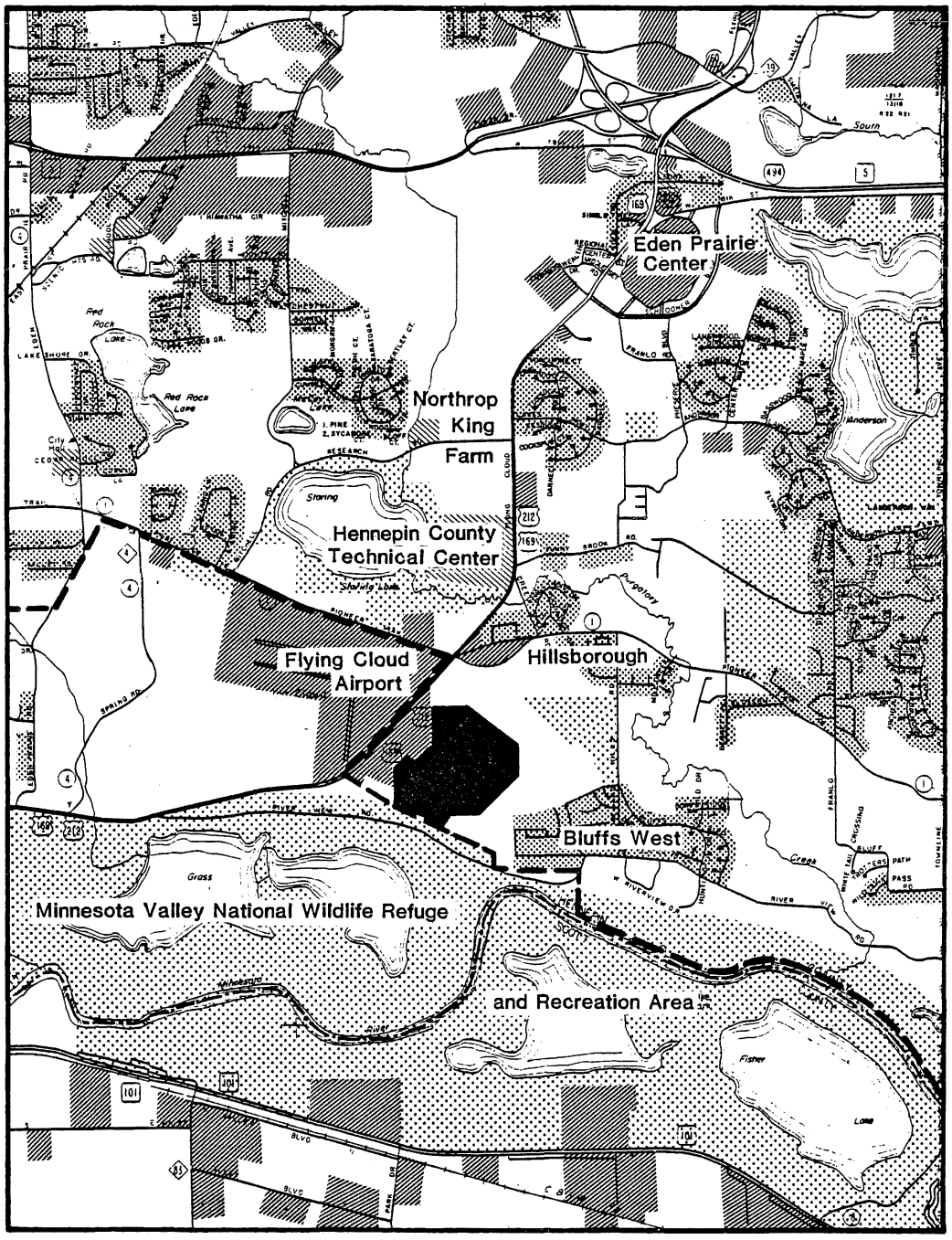


Figure 63.
EDEN PRAIRIE GUIDE PLAN, 1982



Source: City of Eden Prairie

SURROUNDING LAND USE--Existing Land Use

North

The existing land uses surrounding the landfill and proposed expansion area are diverse (Figure 64). The Flying Cloud Drive-In Theater and open land owned by the MAC, which is leased for growing crops, are located to the north. The MAC limits the use of the land to maintain a safe approach to the airport (Figure 66). Relocated County Rd. 1 is north of the MAC property. Small commercial/ industrial uses and scattered single-family residences are located along the highway to the north and northeast.

East

Land to the east is undeveloped or in residential use. Much of this is owned by the proposer (See Property Values section). The land slopes downward to the east from the edge of the proposed expansion area, from approximately 890-800 ft. MSL. A grassy and marshy lowland lies at the base of the slope. A 33 acre proved city park, Homeward Hills, is being developed at the eastern end of the lowland (Figure 64). The proposer's property includes most of the undeveloped slope east of the landfill and the lowland around the park. The city and proposer are currently negotiating a transfer of additional Woodlake-owned land for the expansion of the park.

Two extensive single-family, residential subdivisions are located east of the proposed project. Hillsborough, located to the northeast, overlooks the marshy lowland. The subdivision contains approximately 100 houses and, with the exception of a few lots, is fully developed. The land rises from 800 ft. MSL at the southern edge of the subdivision along the lowland to 880 ft. in the north. (The elevation of the project is approximately 890 ft. MSL.) Hillsborough is separated from the project by the undeveloped lowland. The nearest existing house is approximately 1,300 feet distant from the expansion.

Bluffs West Second Addition, a 243-lot subdivision, is located to the southeast. The subdivision slopes from west to east from 890 to 810 ft. MSL in the northeast corner and to 840 MSL in the southeast corner. Most of the subdivision is located at an elevation below that of the proposed project.

Bluffs West has been partially developed since the city approved the plat in 1979. Most of that development has occurred in the eastern one-half. More than 100 houses have been constructed or lots sold. Thirty-nine houses have been sold since Jan. 1, 1983, including 10 at the western edge of the developed area, according to a representative of the developer (174). Streets and utilities have been constructed in the western section of Bluffs West, with the exception of Riverview Rd. along the edge of the river bluffs. The developer is delaying new sales in this area pending a decision on the proposed expansion. A completed, but vacant house is located on Sandy Point Rd. Riverview Rd. west of Mooer Ln. has been platted but not constructed. During 1983 Woodlake acquired 39 of the platted lots including the vacant house and the outlot in the vacant, western portion of Bluffs West from the developers (see Property Values section).

Most of the homes and vacant lots in Bluffs West are now or will be served by public sewer and water. However, according to city records, 11 residences in the eastern portion of the subdivision continue to be served by private wells. (See Site Hydrogeology section.)

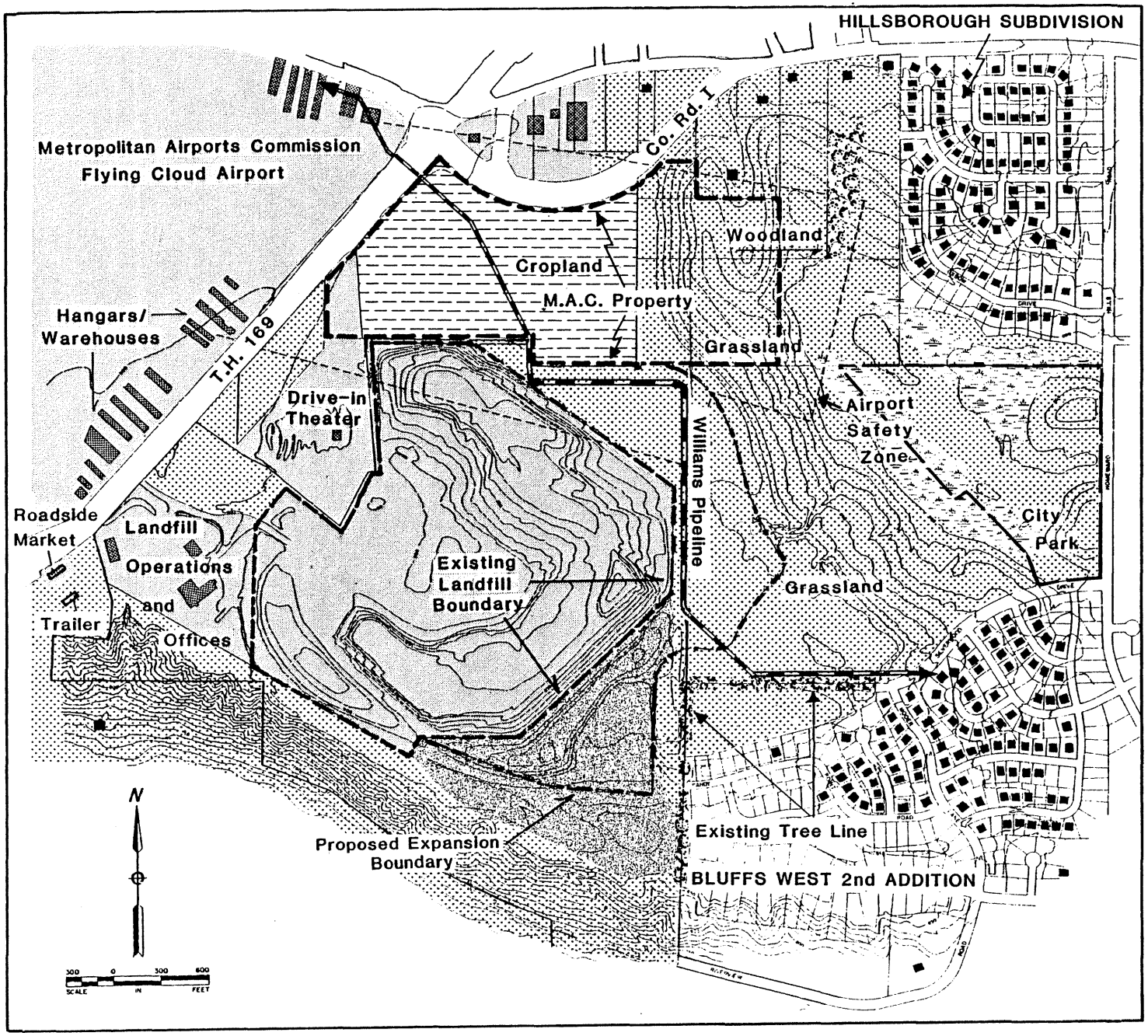


Figure 64.
EXISTING LAND USE

- Single-family Residence
- Airport/ Commercial/ Industrial
- Marsh

Source: G.M. Sunde, Consulting Engineer

Portions of Bluffs West are located closer to the proposed expansion than Hillsborough. Vacant lots on Sandy Point Rd., now owned by Woodlake, would be as close as 200 feet from the boundary of the expansion area (compared to 800 feet from the existing landfill). The closest vacant lot along Riverview Rd., still owned by the subdivision developer, would be 500 feet from the southeast corner of the expansion. The closest occupied residence in the developed, eastern portion would be approximately 900 feet from the expansion.

A 12-inch underground pipeline owned by the Williams Pipeline Company traverses the proposed eastward expansion area. This segment of pipeline would be relocated along the eastern perimeter of the expansion (Figure 65).

South

The Minnesota River Valley is located south of the landfill and proposed expansion. There is approximately a 170-foot elevation difference between the river valley at (700 feet MSL) and the edge of the bluff top (at 870 feet). Much of the valley land is currently used for agricultural purposes and private recreation such as hunting.

The lands and wetlands along the valley have been included in Minnesota Valley National Wildlife Refuge and Recreation Area established by the U.S. Congress (Figure 34). The Refuge portion is administered by the U.S. Fish and Wildlife Service. The valley area south of the landfill is included in the Upgrala (Upper Grass Lake) management unit of the Refuge (Figure 35). The river bluff, which is presently part of the landfill property, is included in the Upgrala unit. The purpose of the Upgrala unit is to manage the vegetation and water to enhance wildlife values, manage for wildlife oriented public use and establish a biological food production program to benefit wildlife (175). Because of its extensive wetland complex, the Upgrala unit has been a focus for migratory birds and related public uses. These uses will continue. According to the master plan for the Refuge, hunting, trapping, wildlife observation and minor environmental education activities will be maintained in the Upgrala unit. A hunter education facility and site is proposed along Riverview Rd. near the base of the bluff utilizing existing structures. The road will be part of a secondary trail for hiking, skiing, bicycling and horseback riding.

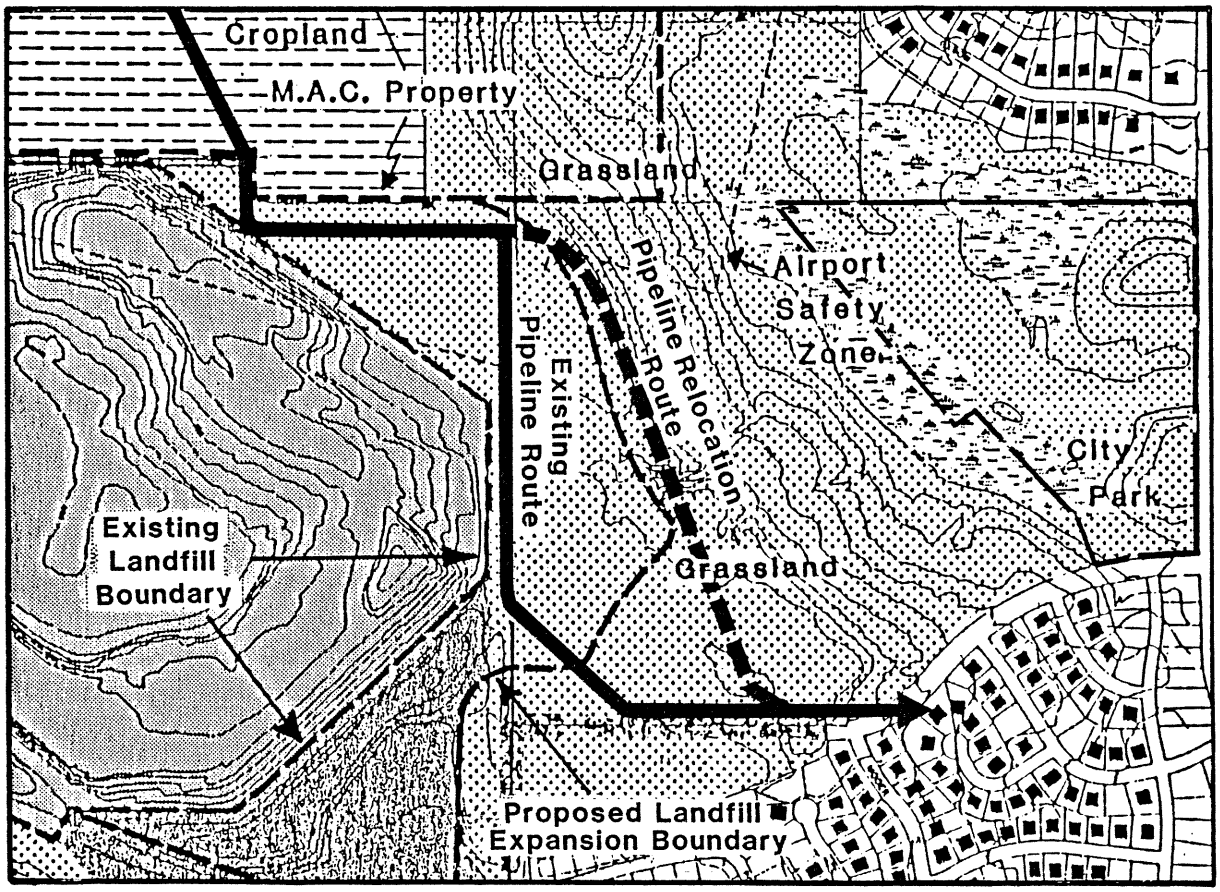
Due to a lack of federal funds the Fish and Wildlife Service has not been able to acquire any lands in the eastern portion of the Upgrala unit around Grass Lake. All the land remains in private ownership. There is no schedule for acquiring land around Grass Lake or the bluff face.

West

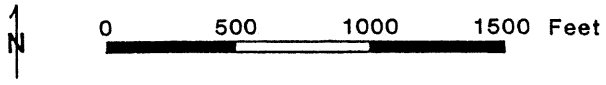
Hwy. 169 and the 566-acre Flying Cloud Airport border the landfill on the west. Airport related uses providing sales and service, including airlane maintenance and storage, are immediately west of Hwy. 169 (Figure 64). Because of the special nature of the potential impacts, these issues are examined in a separate section of the EIS. (See the Flying Cloud Airport section.)

A seasonal roadside market and related trailer home occupy land to the southwest of the landfill along Hwy. 169. A public scenic overlook is to the southwest of the market along Hwy. 169, and a vacant house is south-west of the overlook. The vacant house is being acquired by MAC because of its proximity to the southern approach to the airport (176). A single-family home and out-buildings are located near the bottom of the bluff on Riverview Rd., approximately 1,000 feet to the southwest of the project boundary. The house is located in the area designated as part of the Minnesota Valley Refuge.

Figure 65.
GENERALIZED PIPELINE RELOCATION ROUTE



Base Map Source: G.M. Sunde, Consulting Engineer



FUTURE LAND USE

According to the city's adopted comprehensive plan expanded residential development and public open space would be encouraged in the future in the areas adjoining the project (Figure 63). Recommended public open space areas would include the MAC property and extend east to include the lowland and city park. Much of this land is now owned by MAC and Woodlake. (As previously mentioned, the city is currently negotiating with the proposer to dedicate additional public open space land adjoining the undeveloped city park.) Low density residential development would extend westward along County Rd. 1 from the Hillsborough subdivision. This area is presently occupied by five residences on large parcels.

Residential development would also be expanded east of the landfill site, according to the comprehensive plan. This would be accomplished by extending or expanding the development of Bluffs West to the north. Much of this expansion would occupy land owned by Woodlake. In 1979 the developer of Bluffs West Second Addition had plans for a third addition which would extend north into the area designated for new residential development.

The city's comprehensive plan designates the Minnesota River Valley and the bluffs south of the landfill as public open space. This recommendation is consistent with the plan for the National Wildlife Refuge.

POTENTIAL LAND USE IMPACTS

Residential Land Use Impacts-Hillsborough Subdivision

The potential impacts on Hillsborough subdivision are likely to be minimal. Although the horizontal expansion would be closer than the existing landfill, the closest house would still be approximately 1300 feet from the expansion boundary. The grassy slope and low wet meadow area located between the project and Hillsborough would serve as a natural buffer to minimize any land use impact. The proposed 15-foot berm and some landfill operations during the final filling phases would be visible, but the intervening distance (1300 feet or greater) would minimize the potential impact.

Residences in Hillsborough could experience some noise impacts. These impacts could be minimized by increasing the height of the berm and adopting other suggested mitigation measures. There could be some noise impacts above state standards during the construction of the berm, but these would be temporary and relatively short (three to four months or less) in duration. Noise impacts during the initial pit excavation (after the berm construction) and final fill/closure stages would not exceed state standards, but they could reach nuisance levels (a greater than a 10dBA increase over the current level) in portions of the subdivision. Again, these would be relatively short-term.

Potential ground and surface water impacts would not affect Hillsborough. The intervening low area directs runoff away from the subdivision, and groundwater flow is away from the subdivision towards the river valley.

The prevailing winds from the northwest and south would carry dust, odor, and litter away from or past Hillsborough. The intervening open buffer area and the proposer's control measures would provide added protection from these nuisances on those infrequent occasions when the wind is from the southwest. Additional mitigative measures to control litter, odors and erosion are discussed in the appropriate sections of the FEIS. These would reduce these nuisances.

Methane gas could migrate off-site through the sandy soils towards Hillsborough. However, the nearest houses are more than 1,300 feet from the expansion and the open buffer area provides an area within which natural venting of the gas could take place. The proposer has also proposed a control and monitoring system along the eastern edge of the expansion to protect Hillsborough. Additional measures to mitigate the potential hazards from methane are discussed in the Landfill Gas section.

Residential Land Use Impacts-Bluffs West Subdivision

The Bluffs West subdivision has the greatest potential to be impacted due to its close proximity to the horizontal expansion area, particularly if the landfill operates for another seven years. Vacant lots, acquired by Woodlake, in the western portion would be as close as 200 feet from the edge of the expansion. Existing houses in the developed eastern portion, are more distant; the nearest occupied house would be approximately 900 feet away. Platted, vacant lots still owned by the subdivision developer along Riverview Rd. would be as close as 500 feet.

The potential impacts on Bluffs West include visual impacts, noise, methane gas migration, groundwater contamination and nuisances including litter, odor and dust. Surface runoff related to the expansion would not affect Bluffs West, since it will be retained on the site or drained to the river valley. The increase in runoff into the area around the landfill would be minimal. Highway access to the project will be from Hwy. 169 and will not affect Bluffs West.

Public water service is available to all of Bluffs West, and most residences are connected. However, potential groundwater impacts are a concern to the 11 residences in the eastern portion served by private wells. The chances of these wells being affected is minimal. The leachate plume is expected to move southwest and not disperse as far as the private wells. (See the Site Hydrogeology section for more details.)

Bluffs West, particularly the close-in western portion, may be affected occasionally by nuisances from the expansion, including litter, odor and dust. The impacts should be minimal. The proposer's plans to control litter and wind erosion should minimize the impact (see Proposed Project section). The placement of daily cover on refuse as required by state regulation should minimize odors. The additional mitigative measures discussed in the EIS should also reduce the potential problem. (See the Litter Control, Air Quality and Landfill Gas sections).

However, the western portion of Bluffs West is close to and downwind from the expansion. The prevailing wind is from the northwest from November to April. Also, prevailing erosive winds--those in excess of 12 miles per hour--come from the northwest or west-northwest during all months but July and August. Areas of the project will be exposed at times and fine-grained soils used in final cover and sandy soils particles could migrate on occasion into the Bluffs West area. The occasional off-site effects from litter, odor and dust could therefore affect existing and potential residences in Bluffs West, particularly in the western portion which is as close as 200 feet from the expansion.

Because of the proximity to the horizontal expansion potential, the noise produced during the life of the project could have an impact on portions of Bluffs West particularly the western portion. The impact would vary depending on the

number of vehicles involved, the distance to the source and duration of the activity. Noise generated during the construction of the 15-foot berm may have temporary impacts (Table 37). Existing and future residences within western and eastern Bluffs West (within 800 feet and possibly as distant as 1,600 feet) could experience noise levels at times which may exceed daytime state standards during the contruction of the berm. Residents at a greater distance in eastern Bluffs West could experience nuisance levels. However, these impacts will be of short duration--three to four months--until the berm is finished. The nighttime standard could also be exceeded if construction were to begin before 7 a.m.

Once the berm is finished, noise impacts from excavation and filling activity would be reduced significantly in Bluffs West. The berm and the face of the pit would attenuate the noise. However, existing and future residences in western Bluffs West could experience noise impacts above state daytime standards or nuisance levels during the initial excavation of the pit and again during final fill/closure as activity reaches an elevation 15 feet below the berm. These impacts would occur during stages 5 through 8 in the southeast corner of the horizontal expansion area. Depending on the number of vehicles, residences within 800 feet could receive levels above the state daytime or nighttime standard. Other residences within 1,600 feet could experience nuisance levels. The impacts would be short term, that is, during the initial excavation phase and final fill/closure of the top 15 feet of the horizontal expansion. Once the activity is completed in the southeast corner or activity is more than 15 feet below the ground or berm elevation, the noise impacts would diminish. However, residences within 800 feet of the southeast boundary may also experience temporary short-term nuisance levels (more than a 10 decible increase) during the period when excavation and filling is up to 90 feet below grade (Table 37). These affects could occur over a longer period because of the amount of fill capacity involved. Once the activity is completed in the southeast corner the impacts would diminish.

Cities can regulate landfill activity under their general authorities to regulate for the general health, safety and welfare of the public. City ordinances can be applied to control the effects of noise, dust, litter and odor. The City of Eden Prairie has a general ordinance to regulate nuisances including noise and litter, but the standards and in some cases the methodology do not specifically apply to the regulation of landfills. In the case of noise, the standards should be revised to reflect the more commonly used state noise standard measurements.

Because of its close proximity, the physical changes produced by the expansion would be the visible in portions of Bluffs West. Because of intervening residences and a decline in elevation away from the project to the southeast, the view of the project from the interior of the subdivision would be screened, particularly in the developed eastern portion. Existing residences along the northern perimeter of Bluffs West and future residents in the western portion would have a view of the expansion site because of proximity, lack of screening in some instances, and street layouts. Most of the project would be screened by the proposed construction of the 15-foot landscaped berm around the landfill and the existing line of 15 to 20-foot conifers along the southeast corner of Woodlake's property to the west and north of the western portion of Bluffs West. However, due to the proximity of the final fill and cover elevations near the top of the 15-foot berm, the height of landfill construction equipment and gaps in the row of conifers some of the landfill activity might be visible from portions of Bluffs West-along Silverwood Dr., Upland Dr. and the lots

fronting on Sandy Point Rd. These views could be screened by filling in the gaps in the existing line of conifer trees at the southeastern edge of the proposer's property and planting shrubs or trees of a sufficient height along the top of the berm. (These impacts and mitigation measures are explained in more detail in the Visual Impact section of the FEIS.)

The project could have the most significant potential impact on the western portion of Bluffs West. Although the berm and landscaping could screen much of the project, the proximity of the project just west of Bluffs West could be perceived by potential home buyers as a strong negative factor, regardless of how small the potential impacts might actually be. Buyer concern for potential impacts from noise, dust, litter and odors could contribute to this perception. Whereas Hillsborough is "separated" by a 1,300 foot buffer zone, the project boundary will be as close as 200 feet to vacant lots owned by Woodlake and 500 feet to lots vacant along Riverview Rd. owned by the subdivision developer. This may affect the desirability or attractiveness of the western portion of Bluffs West for housing. If the proximity is a significant negative factor to many buyers, future residential development may be delayed or halted until after closure of the project, the southeast portion of the expansion is completed or the impacts are no longer of concern to the developer or buyers. Or the developer might be pressured to reduce the price range of the new housing to attract a larger number of potential buyers or "compensate" buyers for the proximity to a landfill. The purchase of many of the lots close to the project by the proposer may have been in recognition of this potential impact. Acquisition of the close-in vacant lots by Woodlake would minimize the conflicts, but vacant lots along Riverview are within 500 feet of the expansion boundary. The Property Values section of the FEIS discusses this aspect of the proximity of the project to Bluffs West.

The potential migration of methane gas from the expanded landfill could be a concern because of the proximity of Bluffs West. Many of the vacant lots in the western portion of the subdivision are within or close to the area which could be affected by methane gas migration from the expansion. An existing residence along the edge of the eastern, developed portion of the subdivision is approximately 900 feet from the expansion boundary. The sewer and water lines are in place in the vacant, western portion of Bluffs West. Construction activities and enclosed structures in this area could be subject to the hazard of fires and explosions if the gas migrates off-site.

Woodlake has proposed two alternative methane control systems with a monitoring system along the eastern perimeter of the expansion to prevent off-site gas migration. Should the proposed control system fail, there is no back-up system. Because of its close proximity, the Bluffs West subdivision could be affected. Acquisition of the closest lots by Woodlake would reduce the potential effect, but the vacant lots along Riverview Rd. are within 500 feet.

There are several measures which could mitigate the potential impact on the subdivision. These measures include providing a back-up control system and a wider buffer zone between the project and the closer portions of Bluffs West. These are discussed in detail in the Landfill Gas section of the FEIS.

Other Residential Impacts

The impact on other scattered residences in the area would be minimal. This includes impacts on the five residences along County Rd. 1 to the northeast, one residence to the southwest below the bluff and the trailer house and associated roadside market on the roadside market to the southwest (Figure 64).

The trailer house (Schmidt residence and roadside market) is located along Hwy. 169 approximately 1,000 feet away, and is separated from the project by the proposer's office and operations area. These uses would screen the trailer house from potential visual impacts and minimize noise impacts. Groundwater flow is to the southwest towards the river valley, but the expected leachate plume should not impact the trailer home well even when multiplied by a factor of 10 to account for errors. The direction of prevailing winds, generally from the northwest and south, is also away from the trailer site. This would minimize potential nuisances such as litter, odors and dust.

The Cooley residence to the southwest is located approximately 1,000 feet from the landfill and 150 feet below the landfill's elevation along Riverview Rd. Runoff, visual changes, nuisances and noise impacts would have minimal impact on this residence because of its elevation and location. The Cooley well (No. 76, Figure 26) is located within the estimated leachate plume. Measures to minimize the impact on the well are discussed in the Site Hydrogeology section. (The residence may be acquired in the future by the Fish and Wildlife Service as a program center for the Wildlife Refuge.)

The house (Peterson) on Hwy. 169 to the southwest of the trailer home and market is to be acquired by the MAC and demolished because of its proximity to the airport runway approach from the south. There would be minimal impact on the five residences along County Rd. 1 because of their distance from the project. The closest residence is more than 1,300 feet from the edge of the project. Much of the open area between the project and the residences is owned by the MAC and will remain open. Although the project would be visible, the proposed berm and the distance would minimize the visual impact. Runoff and groundwater movement would be away from these residences. Increased noise levels during the construction of the berm, excavation of the pit and final fill/closure activities in the northeast area of the expansion would not exceed state standards, but noise may sometimes be a nuisance at the closest residence. The other residences are too distant to be affected. Because of the distance from the expansion the potential impact of methane gas migration should be minimal. The proposed control systems and discussion of mitigation measures would provide added protection to these residences (see Landfill Gas section).

Future Residential Land Use Impacts

The city's comprehensive plan recommends expanded residential land use east of the landfill and to the north or west of the Hillsborough area (Figure 59). The horizontal expansion would occupy a portion of this area and delay residential development until after the landfill is closed. The remaining area between the expansion and Bluffs West would be close to the landfill expansion and its attractiveness or desirability for residential development could be affected during the operation of the project. However, Woodlake owns all of the land designated for new residential development and has no plans, currently, for the development of that area.

Future, more intensive residential development, west of Hillsborough, on the large parcels may experience some limited impacts, but the distance separating it from the expansion would minimize the impacts. Much of the intervening area is owned and will be maintained as open space by MAC. This area and the other open space area recommended in the city's comprehensive plan would provide a buffer zone. There may be an occasional nuisance from increased noise levels and dust and litter when the prevailing winds are from the south, but these

would be minimal. The landscaped 15-foot berm and the buffer zone would minimize the visual impacts. Groundwater movement and surface runoff would be away from the residences and have no impact. The mitigation measures discussed in the Landfill Gas section would minimize the potential impact on future residential development.

Commercial/Industrial Land Use Impacts

There are several commercial/industrial land uses which could be impacted by the expansion--the Flying Cloud Drive-In to the northwest, the commercial-industrial strip along County Rd. 1 and the seasonal, roadside market to the southwest, (Figure 64).

The impact on the roadside market would be minimal. The market is approximately 1,000 feet away and is separated from the project by Woodlake's office and operations area, which would screen and minimize any potential visual impact. The existing gas control system and the distance to the project would minimize the potential impact from the methane gas migration.

The potential impact on the commercial/industrial strip along County Rd. 1 would be minimal. These uses are more than 1,200 feet away. The distance and the 15-foot berm should minimize the visual impact of the project. Groundwater movement and surface runoff would be away from these uses. Because of the nature of the uses and their distance from the project, potential noise impacts would be minimal. There could be some increased traffic along County Rd. 1, due to the landfill, but this traffic would be a small percentage of the total highway use. There could be an occasional nuisance due to dust and litter due to the prevailing south and southeast winds between May and October, but the impact on these uses would be minimal.

The potential impact on the drive-in theater would also be minimal. Because of the seasonal and nighttime pattern of activity associated with the drive-in there would be little conflict between it and the expansion. Because of this pattern, the visual changes, noise generated, increased traffic and other potential nuisances would have minimal impact. Surface runoff would not affect the drive-in. The prevailing south and southeast winds between May and October may result in an occasional nuisance from odor, dust and litter at the drive-in during its most active months. The proposer's control plans for these problems would minimize the impact on drive-in. Special monitoring of the well used at the drive-in would be prudent because of its location relative to the expected leachate plume. There are several possible measures to prevent or correct any potential contamination of this well. These would minimize the land use impact. These are discussed in the Site Hydrogeology section.

The concessions building at the drive-in is close to the landfill boundary and could be affected by methane gas migrating from the project. Woodlake has installed a control system and monitoring system along the border of the existing landfill. Continued, frequent monitoring of the situation around the building and adjustments in the control system should eliminate the problem. If this proves to be insufficient, the installation of a backup control system such as a passive control barrier or ventilation trench would minimize the potential of future gas build up (Landfill Gas section).

City Park Impacts

A 35-acre city park is being developed to the east of the project along Homeward Hills Rd. (Figure 64). Visual impacts would be minimized by the landscaped berm, the intervening open area and the difference in elevation. The closest edge of the park would be more than 1,200 feet away, and the park is located in the low, wet meadow at an elevation approximately 100 feet below that of the top of the proposed berm. No leachate and only a limited amount of surface runoff would reach the park site or the city designated drainage basin within the park. Because the park site is downwind from portions of the expanded landfill, from November to April when the prevailing winds are generally from the northwest, the park may be affected occasionally by litter, dust and odors. However, Woodlake's control plans, the additional mitigative measures discussed in the EIS and the intervening distance to the project boundary would minimize the problem.

The park site could be affected by noise from the landfill. During the construction of the berm noise, levels could exceed state standards depending on the number of pieces of construction equipment in use. However, the impact would be temporary (three or four months) until the berm is complete. After the berm is completed, noise impacts would be reduced, but park users may experience a nuisance from landfill noise (more than a 10dBA increase) during the initial stages of excavation and final fill/closure along the eastern portion of the landfill. However, these phases will be active for a relatively short period during the life of the project. The impact would depend on the number of pieces of equipment active in the construction. During the time when the fill operations are deep in the excavation (more than 15 feet below the surface) the noise impacts will be attenuated by the wall of the pit.

Pipeline Relocation

A 12-inch pipeline, owned by the Williams Pipe Line Company, traverses the horizontal expansion area (Figure 65). The pipeline will be relocated by the company along the edge of the upland east of the expansion (Appendix C).

The pipeline, which carries liquid petroleum products such as gasoline and fuel oil, will be relocated approximately four feet below the final grade of the land along a new alignment. Upon completion of the new line the welds will be x-rayed and the line pressure tested. The existing line will be shut down and any remaining product drained into transport trucks to prevent any spills. After the existing line is emptied, it will be cut at both ends and the new section will be connected to the main route. The connection will take approximately one day. The abandoned line will be removed from the site. No state permits are required since the relocation involves less than one mile of pipeline. The company may have to apply for a land alteration permit from the City of Eden Prairie due to the excavation. The impact on surrounding land uses will be minimal-primarily visual and short-term during the relocation. The portion of the main line which traverses the MAC property to the north and Bluffs West subdivision to the southeast will not be involved in the relocation. Once vegetation is reestablished along the route there will be no visible affects.

City regulations (Chap. 11.55) require the submittal of a grading, drainage and planting plan for all land alterations and control of dust, noise and nuisances. These requirements would minimize the impact of the relocation.

Minnesota River Valley/Wildlife Refuge Impacts

The impact on existing land uses (farming and private recreation) in the river valley and future land uses in the Minnesota River Valley and National Wildlife Refuge and Recreation Area would be minimal. The expansion will not require any physical alteration of areas within the valley or lands in the designated Wildlife Refuge and Recreation Area, including the river bluff. The vertical expansion of the present site will maintain the current setback of 100 feet or more from the bluff, and the 42.4 acre horizontal expansion would be set back 250 feet or more from the bluff. A storm drain beneath the bluff face is already in place and will not be altered for the expansion.

The City of Eden Prairie has adopted regulations for the protection of steep slopes of over 12 percent which would apply to the excavation of the river bluff or any activity on the bluff requiring the procurement of a building or land alteration permit. Any development on the bluff requires city review and approval.

Since the bluff below the project is included in the Wildlife Refuge a transfer of ownership or development rights by the proposer to the U.S. Fish and Wildlife Service may assure long-term protection of the bluff. A cooperative agreement between Woodlake and the F&WS to manage the bluff consistent with the purposes of the plan for the Refuge would also protect the bluff.

Noise, dust, odors, and litter and other nuisances will not have a significant affect on the valley or Wildlife Refuge. Woodlake's proposed controls for these nuisances, the prevailing south and northwest winds, the setback from the bluff and difference in elevation would minimize the potential impact of these nuisances.

Although no berm or screening is proposed along the southern boundary of the landfill, the expansion would be visible from only a small portion of the river valley and Refuge. This limited area is located more than one mile from the project south of the river which would minimize any visual effect. The bluff and difference in elevation between the elevation of the landfill and river valley provide a natural screen for the valley and Refuge. The impacts and mitigation measures are discussed in the Visual Impacts section.

As indicated in the discussion of landfill gas impacts, gas from the landfill could migrate south and affect the bluff vegetation, particularly once the final cover is in place. If the gas is of a high concentration, and accumulates in the root zone, the gas could exclude oxygen or encourage the growth of bacteria harmful to vegetation. Because the sandy soils of the bluff are subject to severe erosion, the loss or stress to vegetation could have a severe impact. No controls are proposed along the bluff side of the landfill by Woodlake. The sandy soils along the bluff may provide adequate diffusion to prevent gas concentration. However, placement of a monitoring system along the edge of the landfill and the placement of a control system along the top of the bluff if a concentrated build-up is indicated would minimize the problem. This concern and mitigation measures are discussed in the Landfill Gas section.

A worst-case analysis of the leachate concentrations reaching Grass Lake indicates that state water-quality standards could be exceeded for some parameters. Also leachate from the expansion could have a long-term effect on Grass Lake and the associated wetlands. These changes could affect the plant and animal life through habitat alterations. There is some potential for the long-

term accumulation of trace metals and trace organics from the leachate through the biological food chain in the marshes and lake. This could eventually affect the stability of the biological communities and alter the habitat value and the animal life over the long term. Although unknown long-term chronic impacts on the biota in the Grass Lake area are possible, based on the existing information, it appears that the impacts would be negligible if proper operating and mitigating measures are used at the project. These concerns, mitigating techniques and proposed monitoring objectives are discussed in the Site Hydrogeology, Surface Waters and Vegetation/Wildlife sections.

The impact of runoff from the project site on the valley land use and the Refuge will be minor. Most eroded materials will be removed from the runoff in the on-site detention pond before the water drains to the surge pond on the proposer's property in the river valley. The impact of the runoff from the pond which drains to the adjoining marsh areas and abandoned ditches to the south would be minimal. Directing all the runoff to the river would provide additional protection for Grass Lake and the adjoining wetlands.

End Use Plan Impacts

Preliminary end-use proposals for a golf course, a 13-acre residential area in the southeast corner, industrial development along the eastern edge, preservation of the river bluff and 32 acres of park dedication across the eastern end of Woodlake's property would be compatible with adjoining land uses. For example, the golf course or any public open space use would adjoin the Wildlife Refuge to the south and protect the airport approach zone to the north. The 13-acre residential area would adjoin Bluffs West. However, depending on the timing of this development, extra measures would have to be taken to insure that this development is protected from methane gas. Much of the site is within 800 feet of the border of the expansion, the approximate distance affected by methane gas migration. Delaying construction in the residential area until monitoring, indicates that the proposer's control system is adequate to maintain the methane gas concentration around the site at a safe level would avoid the problem.

The problem of settling the prevention of infiltration to minimize leachate and methane gas production may limit the use of the site following closure. Heavy construction would penetrate the final cover which is designed to minimize infiltration and be subject to the hazards of settling. Passive open space uses which might be the least affected by settling would be compatible with the existing, adjoining land uses particularly the Wildlife Refuse to the south. Light industrial/ commerical uses which would involve little or no heavy construction such as open storage might not be affected by some settling. These types of uses might be compatible with the addjoining uses if adequate screening and adequate buffer areas are provided along the Wildlife Refuge and Bluffs West residential area. A detailed study possible by the city and Woodlake could be useful in determining the feasibility and type of post-closure development in the interim and long-term, and when that might occur.

MITIGATION

The potential impacts of the expansion on surrounding land uses in many instances would be minimal or temporary. These impacts would be minimized by the proposed 15-foot landscaped berm, the various control plans proposed by Woodlake, the distance separating many of the land uses from the project, such

as the Hillsborough subdivision, and the additional mitigative measures suggested in the FEIS. The landscaped berm would minimize the visual and noise impacts to a great extent. The proposer's plans and the additional mitigation measures identified in the FEIS to control runoff, litter, erosion/dust, odors and methane gas will minimize the potential impacts on the surrounding land uses. There may be occasional nuisances from dust, litter or odor to the east/southeast or north of the site due to the prevailing wind pattern. Noise levels may exceed state standards or create a nuisance in the surrounding residential areas during some phases of the project, that is, during berm condition, the initial excavation of the pit and final fill/closure at each stage of the horizontal expansion depending on the amount of construction equipment. The noise impacts would continue for a short period during each phase. Local ordinances can be adopted to control noise, litter and other nuisances associated with landfill operations.

Contaminants such as metals and organics in the leachate produced from the expansion could have a long-term effect on the biota in Grass Lake and marshes. The potential impacts and mitigation measures are discussed in detail in the Vegetation and Wildlife section.

Because of the increased proximity to the expansion, the western portion of Bluffs West is the area most likely to be affected. There are several measures which could be utilized to minimize the potential for impacts. A number of specific measures directed towards noise, methane gas, litter, visual, dust and odor control are discussed in the appropriate sections of the FEIS. Delaying the construction of houses on the close-in vacant lots owned by Woodlake until the landfill is in the closure phase or the southeast corner of the expansion has been completed could minimize the potential impacts on new residential development. Retaining a buffer zone between the edge of the expansion and vacant lots along Riverview Dr. and occupied houses would minimize the impact of nuisances including litter, dust and noise. Landscaping and managing the vegetation in the buffer zone would maintain the attractiveness of the area. Completing the southeast corner of the expansion first and moving northward counterclockwise would minimize the length of the time during which land use in Bluffs West area might be affected. Once the southeast corner is completed and the potential impacts have diminished, the construction of housing could proceed on vacant lots in Bluffs West.

Long-term protection could be provided for the river bluff adjoining the project. This could be achieved by a transfer of title or development rights to the bluff from Woodlake to the U.S. Fish and Wildlife Service. A cooperative management agreement between Woodlake and the U.S. Fish and Wildlife Service for the management and protection of the bluff consistent with the objectives of the Refuge master plan would be another possible protective device.

FLYING CLOUD AIRPORT

BACKGROUND

Flying Cloud Airport is located immediately to the northwest of the landfill. Airport property lines extend across Hwy. 169 (Flying Cloud Dr.) and adjoin landfill property along its northern border (Figures 66 and 67). Use of this land is restricted by the Metropolitan Airports Commission to protect the approach zone to the airport. The land is currently leased for cropland.

The airport is owned and operated by the MAC and is classified as a minor general aviation facility according to the 1990 Metropolitan Airports System Plan. The airport is at an elevation of 905 feet above mean sea level (MSL) and occupies 565.6 acres. In 1982 there were a total of 145,718 operations and 615 aircraft based at Flying Cloud, making it one of the most active in the Twin Cities region (177). Only small, private aircraft use the facility, specifically single-engine and light, twin-engine, piston aircraft, and occasional small business jets. The airport is used for instruction, recreation and corporate traffic. There are no plans to expand the runways or to upgrade the airport's classification.

The airport has three runways and a system of associated taxiways and aprons (Figure 66). The southernmost of the two parallel east-west runways (9R-27L) was recently lengthened to 3,900 feet and now handles virtually all jet, nighttime and bad weather operations, as well as most twin-engine and instructional flights. Runways 27L and 27R, northwest of the landfill, and runway 18 to the south receive the most traffic due to the prevailing westerly wind and the airport's operations plan. Aircraft land and take off into the wind, so many approaches and departures are directed over the Minnesota River valley. Definite flight patterns for an airport used by small, private planes are difficult to establish, particularly when instruction is also occurring. Flight paths depend to a great extent on aircraft type, weather conditions, wind speed and velocity and the skill of the pilot. During the summer, easterly and southerly winds prevail for short periods, and runways 9R, 9L and 18 are more frequently used.

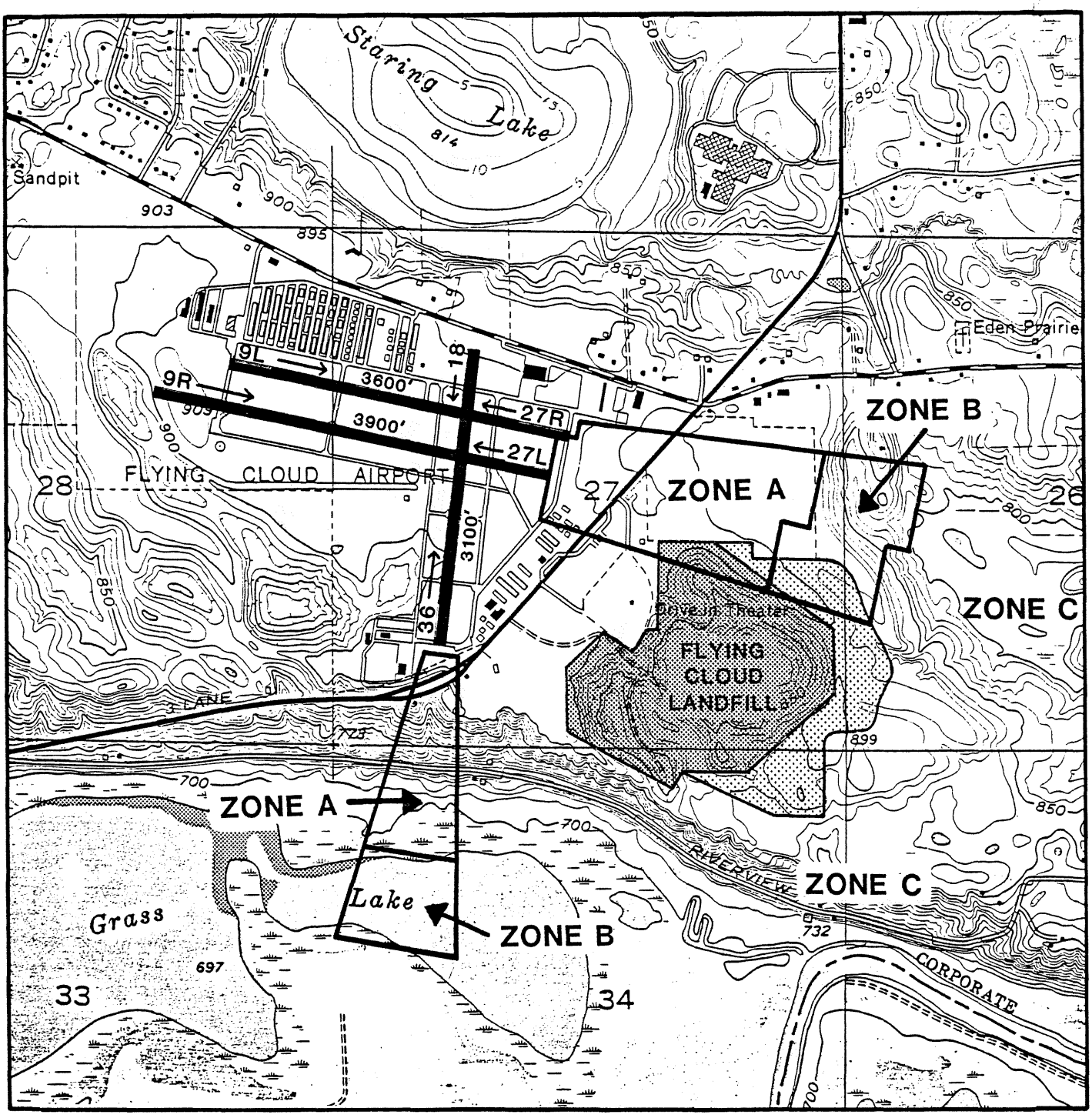
The airport has an FAA Airport Traffic Control Tower in operation 15 hours a day (from 7 a.m. to 10 p.m.) Its airspace control zone covers a five-mile radius and extends from the surface to 14,500 ft. MSL. Only runway 9R is equipped with instrumentation and approach lighting for nighttime and bad weather flights (178).

POTENTIAL CONFLICTS WITH LANDFILL AND BERM ELEVATIONS

The northern sections of the existing landfill and proposed expansion area are located in the approach zone of runway 9R/27L (Figure 67). This close proximity of the project raises two potential safety problems. The possibility that the elevation of the landfill and berm along the eastern perimeter of the expansion area may constitute a hazard to aircraft operations in the approach zone; and the potential for collisions of aircraft with birds attracted to the landfill as a feeding ground. The compatibility of the landfill's end use with airport operations could also be an issue.

The landfill expansion plan recommends an increase in the total elevation of the landfill to a maximum of 923 MSL and for the construction of an earthern berm along the northern and eastern perimeters of the expansion area (Figures

Figure 66.
FLYING CLOUD AIRPORT AND LAND USE ZONES



Base Map Source: Enlargement of U.S.G.S. 7.5-minute Eden Prairie quadrangle

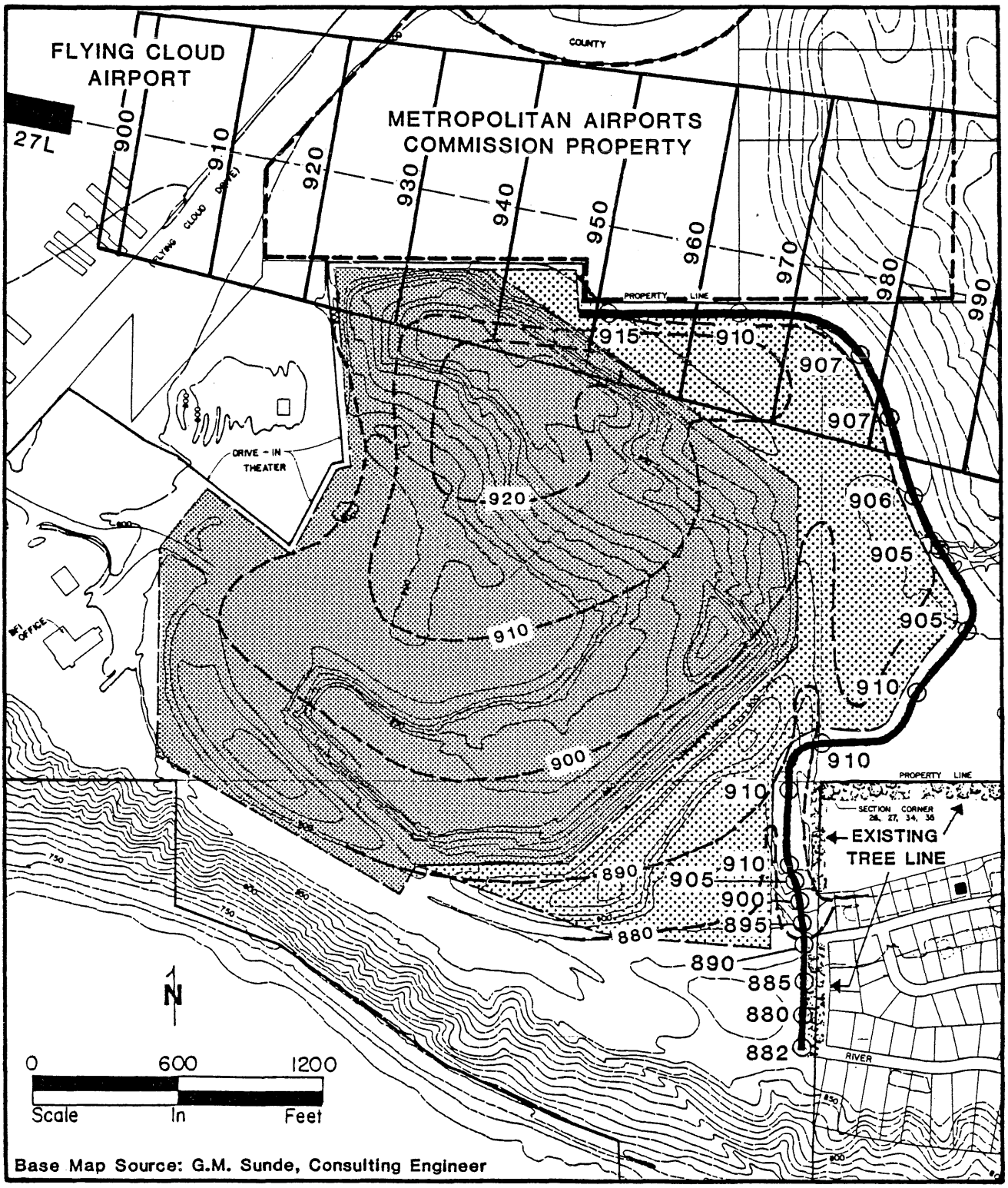
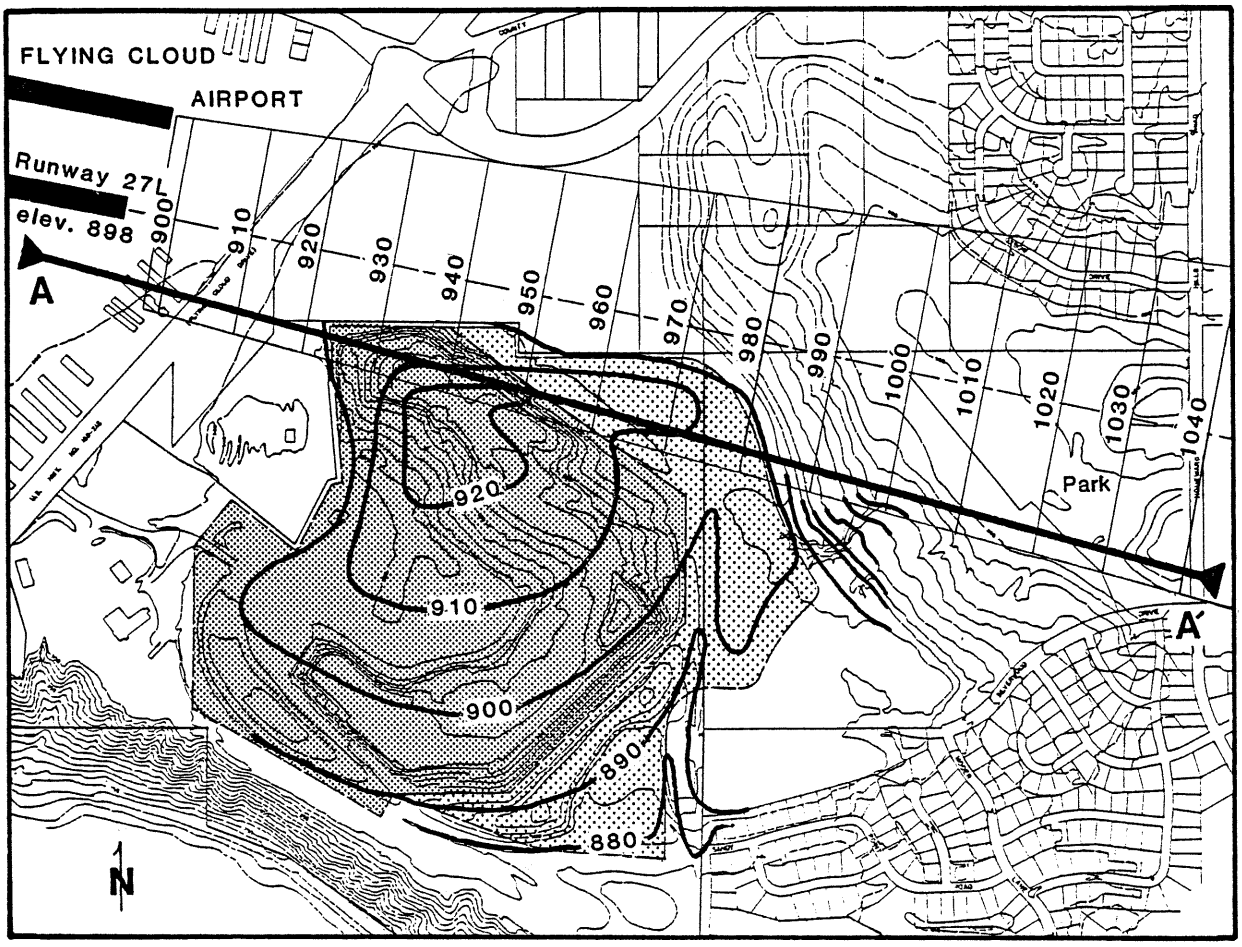


Figure 67.

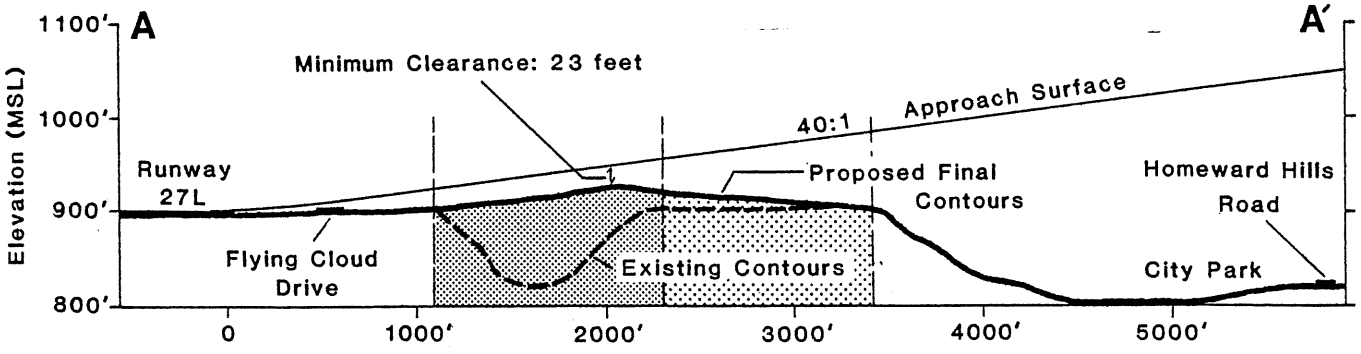
BERM ALIGNMENT AND APPROACH SURFACE TO RUNWAY 27L

(BERM HEIGHT: 15 FEET)

Figure 68.
PROPOSED FINAL CONTOURS AND APPROACH SURFACE FOR RUNWAY 27L



Sources: G.M. Sunde, Consulting Engineer (Base Map);
Federal Aviation Admin., Mpls.



Vertical Exaggeration: 5x

67 and 68). Woodlake proposes to construct a 15-foot landscaped berm, which would provide ground noise buffering as well as screening (see Appendix C). The placement of the berm is illustrated in Figure 67. The approximate elevation of the berm was obtained by adding the height of the berm to the underlying surface elevation except along the southern portion. The existing ridge would be removed before the berm is constructed along the southern alignment.

A portion of the berm, beginning at the eastern boundary of the expansion area and continuing along its northern border, is a concern because of its location within the approach zone of runway 9R/27L, where specific FAA structural height restrictions apply. These restrictions insure obstruction free areas for aircraft approach and departure (Figure 67). The elevation of the western end of the proposed berm should be entirely below 950 ft. MSL. The central portions must be constructed below 960 to 970 ft. MSL, and the eastern portion should not exceed 980 ft. MSL. Equipment will be operating along the top of the berm during its construction, but this will be temporary. Woodlake estimates the berm will be completed in three to four months. If trees are planted on the berm, they must meet these restrictions at mature height.

The final elevation of the northern perimeter of the landfill expansion area ranges from approximately 900 to 920 ft. MSL or from 20 to 80 feet below the approach zone height restrictions depending on the exact location (Figure 68). The final elevation of the top of the 15-foot berm would range from 907 to 915 ft. MSL, or from 35 to 73 feet below the height limits, depending on the specific location. The berm and expansion final elevations would be well below the approach zone height restrictions.

The berm is to be planted along the top and outer slope with an unspecified mix of coniferous and deciduous vegetation (see Appendix C). Depending on the species used, it is possible that trees along either a 7-foot (the berm height originally proposed by Woodlake) or 15-foot berm could extend above restricted height. For example, the red pines (Pinus resinosa) along the southeastern sections of the landfill property line may reach 80-85 feet at maturity. If this species were planted at the base of the berm, final elevation of portions of the screen could reach 985 ft. MSL and, as such, might constitute hazards to aircraft in the approach zone.

An additional problem posed by a vegetated berm in the approach zone is the possiblity that it may attract birds to the area. Nesting, feeding and resting areas would be available in the vegetation.

Mn/DOT has established minimum standards for the zoning of public airports as to air space, land use safety and noise sensitivity. (14 MCAR SS 1.3016). In the Metropolitan Area, these restrictions are to be implemented consistent with local comprehensive plans through the adoption of a local airport zoning ordinance. MAC and the City of Eden Prairie have established a joint airport zoning board which has an adopted airport zoning ordinance.

The ordinance establishes three land use safety zones--A, B and C--in relation to the airport and each runway (Figure 66) (179). Mn/DOT regulations require that standards be established for each zone to restrict uses which may be hazardous to the operational safety of aircraft to limit population and building density in the runway approach areas, and to create sufficient open space so as to protect life and property in case of accident. In general, uses which interfere with airport to aircraft communications, reduce visibility, result in glare or otherwise endanger aircraft operations are prohibited in zones A, B

and C. Zone A prohibits buildings, temporary structures, exposed transmission lines or other similar above-ground land use structural hazards, permitted uses are restricted to those that will not create, attract or bring together an assembly of persons. Zone B limits but does not prohibit development. Each use must be on a site of not less than three acres, and uses are not to attract a population that would exceed 15 times that of the site acreage. Public or semi-public places of assembly such as schools are prohibited.

The northern portion of the proposed landfill expansion and berm would be located in Zones A and B (Figure 66). The proposed expansion and operations would not result in any interference with airport communications, produce glare or otherwise interfere with safe airport operations. The project would not result in a concentration of population within zones A, B or C. Only a few persons related to construction, filling operations and refuse hauling would be on the site at any one time. A portion of the excavation and fill area would be located in Zones A and B, but the use would be temporary and short term. The excavation and filling would be completed in the first stage of the expansion.

The berm and expanded landfill would occupy a larger portion of Zone A than the existing landfill, and they may meet the definition of prohibited structures as defined in the Flying Cloud Airport zoning ordinance (180). That portion of the berm in Zone A could be lowered or eliminated. The excavation and filling would be a temporary and short-term use of the land in zone A. However, that portion of the fill area in Zone A could be reduced to ground level or eliminated if it is determined to be a hazard. Zone B standards do not appear to affect the construction of the berm or the landfill expansion.

According to the airport zoning ordinance no material change in the use of land and no strucutre shall be erected, altered or otherwise established in any zone unless a permit is applied for and granted by the City of Eden Prairie zoning administrator. (There are exceptions for locations greater than 4,200 feet from the end of the runway, however, this would not affect the landfill or berm.) Any person wishing to erect or increase the height of any structure, permit the growth of a tree or use property not in accordance with the regulations may apply to the Board of Adjustment established by the MAC for a variance from the regulations. Variances are allowed when the literal application or enforcement of the regulations would result in practical difficulty or unnecessary hardship and the relief granted would not be contrary to the public interest but do substantial justice and be in accord with the spirit of the ordinance. Conditions may be attached by the Board of Adjustment (181).

The proposer will have to apply for a permit to the City of Eden Prairie zoning administrator for a permit to construct the landfill expansion and berm,or to plant and trees as part of a landscaping plan. The proposer may also be required to seek a variance from the Board of Adjustment to permit construction of the berm and landfill in zone A.

Mitigation Measures

Although there appears to be adequate clearance between the proposed expansion and berm and the approach zone surface elevations, there are some additional measures which could reduce the potential for conflicts further. Only a short section of the proposed berm along the northern edge of the expansion area poses a potential hazard to aircraft. Because airport property and a highway are located to the north, all of this section would not be necessary in screen-

ing the landfill operations or mitigating noise impacts on these uses. It could, therefore, be reduced in length. If some screening is desired, a lower berm could be constructed, such as the original 7-foot berm, and then seeded only with grassy vegetation and low shrubs, or low shrubs could be planted along the boundary in place of the berm. Such a berm would not violate height restrictions, but periodically mowing it during the landfill operation and post-closure by Woodlake would discourage birds from using it as a nesting or feeding ground. Planting grass would help to avoid attracting birds and to insure that approach zone height restrictions are maintained.

The portion of the berm and landfill expansion located in Zone A may conflict with the Flying Cloud Airport zoning ordinance. The berm could be lowered or eliminated in this zone.

POSSIBILITY OF BIRD-AIRCRAFT COLLISIONS

Nationally, the collision of birds with aircraft is a relatively frequent occurrence, and has been expensive and occasionally fatal. The FAA has estimated that 1,200 to 1,400 bird strikes occur in the United States annually, at a cost of more than $20 million (182). Despite the application of daily cover, landfills near airports often increase the risk to aircraft by attracting birds that feed at the site (183).

Since over 62 percent of all bird strikes occur below 500 feet (150m), high-risk conditions around airports exist during take-off, climb-out, approach and landing (184). The FAA has issued guidelines, adopted by the U.S. EPA in 1979 as standards for solid waste disposal facilities, (EPA 40 CFR Part 257) establishing a danger zone around airports based on this fact. For an airport such as Flying Cloud, which is used by both piston-type and small business jet aircraft, the FAA recommends that no waste disposal facility be located closer than 10,000 feet (FAA Order 5200.5). Beyond this distance, aircraft are generally flying at altitudes higher than 500 feet. The expansion is approximately 1,000 feet from runway 9R-27L and is thus within the potential danger zone.

In order to minimize noise and risk to residential areas, as much traffic as possible is directed over the Minnesota River Valley to the southeast. As a consequence, many of these aircraft pass over or near the existing landfill. The airport also has a great deal of 'touch and go' activity due to its flight training operations. These practice flights maximize the amount of time spent in landing and taking off and thus, increase the potential bird hazard.

Actual strikes have occasionally occurred. For example, in October 1982, a Cessna jet flew through a flock of seagulls during take-off after having been warned by the tower that the birds were on the runway. Several birds were hit and ingested, and the plane made a precautionary landing at the Minneapolis-St. Paul International Airport (185).

The potential for bird strikes reaches its peak for several weeks during the spring and fall migratory periods. Few problems are experienced at other times of the year. The size of the flocks and the exact timing and duration of the presence of migratory birds varies from year to year. Usually, however, the birds can be expected just after the ice melts in the spring. During the summer, most fly farther north to breed, then return in the fall and move on again when the ice begins to form.

Scavenging gulls are most often responsible for the hazard to aircraft, although waterfowl from the Minnesota River Valley have occasionally been a problem. The species commonly found in the Flying Cloud area during migratory periods is the Herring Gull (Larus argentatus) (186). To a lesser extent, the Ring-billed Gull (L. delawarensis) and Franklin's Gull (L. pipixcan) are present also. The Herring Gull has extended its range and now breeds to a limited degree along the Minnesota River, so some gulls remain throughout the summer. The bulk of the birds, however, are migrants. In the spring, the Herring Gull is most abundant from mid-March through April, and the Ring-billed Gull during April and May. Franklin's Gull is rarely present. During the fall, Herring Gull migration to the area peaks in October and November; the Ring-billed Gull's from mid-September to mid-October and Franklin's Gull's from late September to late October.

Gulls have a distinctive 'feeding flight' that attracts others of their species to the area. During peak seasons, they may mass in flocks of more than 500 near the landfill, especially around the active fill region. These birds also land on the eastern end of runway 27L, particularly in the fall when the heat-retaining pavement is attractive to them. Airport personnel have noted that the birds often rest on the runway when they are flushed from the landfill and fly back towards the landfill after being frightened from the airport (187).

Because it provides habitat for gulls during migratory layovers and breeding habitat for the Herring Gull population, the Minnesota River Valley would probably create some bird hazard at Flying Cloud even if the landfill were not present. However, the problem is compounded by the concentrations of gulls sometimes drawn to the immediate area to feed on waste materials.

The landfill expansion plans will probably not result in an increase in the potential for bird strikes. In general, the active fill area will not be closer to the runways, nor will it lie more directly in airport flight paths than it has in the existing landfill. Also, the first areas to be completed will be those closest to the runway. However, the current hazard level will be extended over the landfill's new operating life an estimated seven years.

Mitigation Measures

A sanitary landfill in the near vicinity of an airport is usually judged by the FAA to be an incompatible land use (FAA Order No. 5200.5). However, if an effective bird control program is pursued and the potential for strikes is reduced, the FAA may approve its operation (188). Responsibility for preventing bird strikes at Flying Cloud is shared by the airport and the landfill.

During the operation of the existing landfill the operator and Flying Cloud airport manager have worked closely to prevent conflicts and correct problems as they develop. Personnel from the two organizations communicate frequently regarding bird activity which may affect the airport and develop joint efforts to discourage bird activity in the area. Because of this relationship and program the FAA has withdrawn its protest over the proposed expansion (see Appendix C).

A number of techniques to deter birds from flocking in the vicinity of an airport or landfill have been attempted with varying degrees of success. Daily cover of the working face reduces the attractiveness of the landfill as a feeding ground, but is not always sufficient to keep the birds away entirely (189). Methods used to frighten them from the area include fireworks, radio-

controlled model aircraft, trained falcons, flashing lights and tape recorded distress and predator warning calls (190). Scarecrows have also been used, as well as automatically-fired propane cannons, blank shells from shotguns, and teleshot, a noise-making device which discharges at approximately 200 ft. above the ground. None of these techniques permanently dispells birds or even works temporarily under all conditions. Teleshot is probably the most effective but is prohibitively loud if there are residences nearby (191). Firing blank shotgun shells into groups of circling or loafing birds usually works well also, but requires constant effort.

Another method found to be partially effective against seagulls at a California landfill involves stretching a thin steel wire between poles placed around the working area. The poles are 40 ft. high: safely above equipment, but low enough to prevent gulls from flying under the wires. The gulls, which normally glide into the landfill, are required to perform a difficult aerial manuveur that they find uncomfortable in order to avoid the wires, and so they learn to keep away from the landfill. Landfill staff claim that the birds are not injured (192). Other birds do not seem to be discouraged by the wires.

When other measures are inadequate to control the situation, the birds may be shot. This is particularly effective against gulls, nationally the most common problem at landfills, since these birds flee the area in distress if a dead member of their species is present. Both propane cannons and shotgun shell blanks are used at the landfill when birds congregate. Flying Cloud also has a license from the U.S. Fish and Wildlife Service to shoot gulls, but this has never been done (193).

Avitrol, a poison applied to bread squares, can be used on occasion. Since the poison acts quickly and most of the flock is driven from the site by the distress calls of the dying birds, only a fraction of the flock is killed. Avitrol has no secondary effects, so a dead bird may be safely eaten by a predator (194).

When birds are seen flocking on or near a runway (usually 27L or R) at Flying Cloud Airport the control tower issues a 'cautionary advisory' to pilots alerting them to the hazard. They then have the option to use a different runway (195). In addition, the airport dispells birds with shotgun shell blanks. The FAA also recommends that aircraft use their landing lights at all times when within 10 miles of an airport since birds have been found to take evasive action at 660 to 980 ft. (200 to 300 m) from approaching lights (196).

Because high-risk bird hazard conditions at Flying Cloud are largely limited to brief periods in the spring and fall, a combination of bird control methods used promptly and diligently and continued cooperation between the airport and landfill operators should be sufficient to keep risks within acceptable limits. The FAA Airport District Office has expressed the view that the bird hazard situation at Flying Cloud has been adequately controlled (see letter, Appendix C).

POTENTIAL CONFLICTS WITH END USE

End use plans for the landfill site could be restricted by the airport zoning ordinance. Much of the the present landfill and expansion area is located within Zone C and portions of the northern section fall within Zones A and B (Figure 66). The criteria for these zones, FAA height restrictions, and the city's comprehensive plans and zoning regulations would be considered when the

decision on final use of the site is made. For example, residential development and other above-ground structures would be prohibited in Zone A. Seasonal agricultural uses, wildlife habitat, outdoor recreation (nonspectator), parking, and other open space uses would be suitable in Zone A. Zone B limits the density (building area, population density and site area) of any potential end use, and places of public assembly such as schools are prohibited. This would still permit the development of a variety of land uses including commercial, industrial and open space. Zone C would permit most end uses as long as the associated activities of that use do not conflict with the safe operation of the airport.

The city's current approved planned unit development plan (PUD-70-1) for the existing landfill provides for light industrial development in Zone A (Figure 9). Land use is not designated for the 42.4 acre-expansion area in the current PUD-70-1 plan since the plan applies only to the existing landfill.

The proposer has tentatively proposed a golf course as the end use for much of the completed landfill site. Such a facility would be compatible with airport operations and the safety zones.

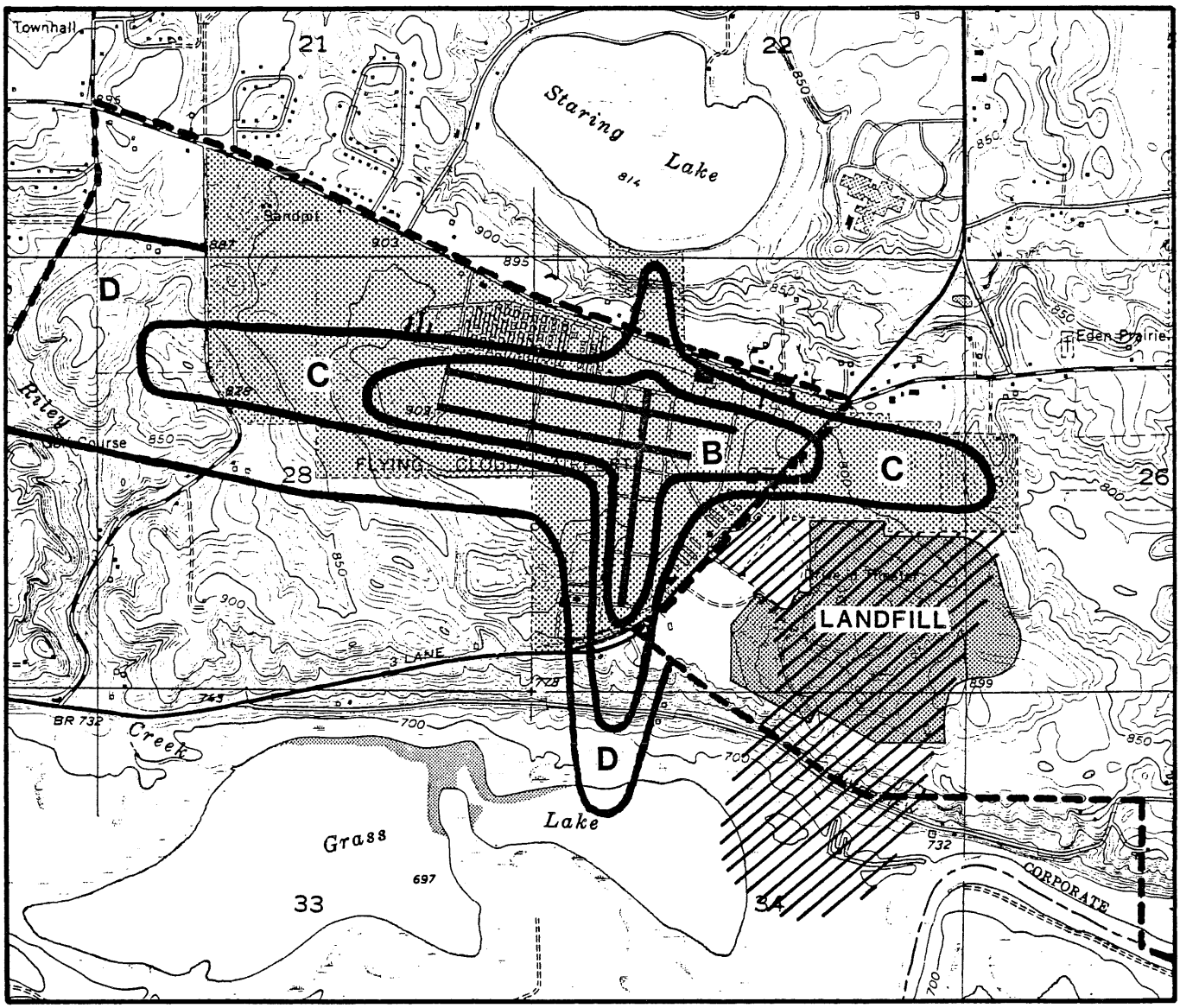
The Metropolitan Council has recently established Land Use Compatibiity Guidelines for areas adjoining airports for the purpose of minimizing conflicts between community land use plans and zoning and aircraft noise (197). The Guidelines affect land use in specific zones as impacted by annualized aircraft arrival/departure traffic noise. Application of noise zone (D) at minor airports, as shown in the Guidelines, does not apply within the Metropolitan Urban Service Area (MUSA); the rationale being that the area within the MUSA is "developed." The existing landfill and proposed expansion are located within the MUSA and the Council's Guidelines would not apply (see Figure 69).

The existing landfill and expansion area are located along and beneath aircraft overflight tracks (Figure 69). Aircraft using Flying Cloud Airport will frequently depart and approach the main east-west runways from the south over the river valley and the landfill site to avoid the residential areas east of the landfill. These patterns are considered to be too transient in time and place to require land use changes. However, the "temporary" noise impacts can annoy people and interrupt outdoor activities.

Including noise sensitive land uses in the end use plan for the landfill and expansion sites would create possible conflicts with airport activity. The proposed golf course on the site would have several advantages compared to residential development. The persons using a golf course are there voluntarily and for a short time and are few in number compared to residential development. In contrast, aircraft noise could be disruptive to the residents' use of yards, patios and decks. A golf course would also be more compatible with the annualized aircraft noise impact zone at the eastern end of the main east-west runways (Figure 69).

The current approved planned unit development for the existing landfill recommends residential development for a portion of the site. Discouraging residential development as part of the end use plan would minimize conflict with the future use of the airport. In general, commercial, industrial and other types of public open space uses such as parks would be more compatible end uses for the completed landfill.

Figure 69.
FLYING CLOUD AIRPORT AIRCRAFT NOISE ZONES



Base Map Source: U.S.G.S. 7.5-minute Eden Prairie quadrangle

Mitigation Measures

Revisions to the proposer's end use plan and future amendments to the city's PUD-70 plan for the completed landfill site could avoid the development of noise sensitive land uses on that portion of the landfill in the overflight activity impact area. Residential uses could be discouraged in both plans; commercial, industrial and public open space uses which are less noise sensitive could be planned for that portion of the impact area. Residential uses could be developed for the eastern portion of the completed site outside the impact area (Figure 69).

The proposer's revised end use plans and city's amended PUD-70 plan could also designate the development of uses along the northern portion of the landfill which would be compatible with the airport zoning ordinance. The end use of the landfill site in Zone A could be limited to public open space or other open uses such as agriculture, wildlife habitat or parking. End uses in Zone B could be used for similar open uses or other commercial, and industrial development of a density consistent with the Zone B requirements.

PROPERTY VALUES

BACKGROUND

Property values reflect the preference of the market (buyers and sellers) for certain locational characteristics as well as the features and amenities of the property. Locational preferences are influenced by a variety of things such as proximity to employment, shopping, transportation, schools and open space; site aesthetics; and cultural values. The price buyers are willing to pay for location, particularly for residential property, may also reflect the distance or remoteness of undesirable features such as odors, noise, congestion, dust and visual blight. Over time property values adjust up or down to reflect what buyers are willing to pay in view of the desirable or undesirable features of a given location. Presumably the values of property in close proximity to undesirable features would decline, because of of the undesirable effects perceived by the market. Of course, if the positive features of a location outweigh the negative, values may increase or there may be no change.

In the case of landfills there are a number of potential impacts which may affect the market for property and eventually property values. Nuisance impacts during a landfill's operating life can include noise, odors, dust, litter, traffic and appearance. Longer term problems potentially include groundwater contamination and landfill gas migration. The magnitude of real or perceived impact is largely a function of proximity to the facility and the success of available mitigating measures. In contrast, following facility closure, end uses carefully planned and designed can be compatible with neighboring land uses with a potential for at least a neutral effect on property value.

There are a number of unique aspects to landfills which could modify their impact on property values. Landfills are a temporary or interim use of land, the duration depending on their available capacity and the rate of use. Once the landfill is completed it will be closed and put to another use. If the landfill is perceived of as a temporary use or limited to a specific time period, property owners and buyers could see an end to the use and any temporary, negative aspects. The property value impacts may be less of a concern and have less of an impact in this situation. The planned end use may also have a positive effect which could offset the temporary negative aspects. If the proposed end use is an attractive residential area, a park or other recreational facility, the host community, property owners and buyers might be willing to tolerate any short-term negative effects in view of the longer term benefits.

In a study of four landfills in the Los Angeles Metropolitan Area, the value of residences closest to the facilities and with a full view were higher in value (198). This was explained by the fact that a botanical garden had been developed on a completed portion of the landfill, and a golf course was planned for the remainder.

Controls proposed by the landfill owner or mitigation measures required by permitting agencies would also reduce the potential for property value impacts. Mitigation measures to minimize such side effects as noise and odor and to screen the view of the landfill activity would reduce the effect on the surrounding property and its value.

The effect of all these considerations on property values is complicated by the varying perceptions of property owners and buyers. Mitigation measures may reduce the impacts to a minimum, but individuals may still believe that a landfill will affect property values.

The limited research which has been published on the impact of landfills or property values has been inconclusive. The Los Angeles study cited earlier concluded that there was no significant detrimental effect. Property value data (sales price and assessed value) was correlated with related housing and neighborhood characteristics and selected landfill related variables including distance to the landfill, view of the landfill, degrees from the prevailing wind and distance to the landfill access route. The study cautions against applying the results to other landfill sites because of the unique conditions at each landfill.

A more recent study published in 1982 examined the impact on both residential development and property values in Pennsylvania (199). Ten sites were selected from various parts of the state and compared to the land use activity in four other control areas. The results indicated that there were no adverse effects on residential development. Between 1976 and 1981 the rate of residential development within one-half mile of the sites was higher than in the area within one mile of the sites and in the four control areas. However, there was some evidence to indicate that within one-half mile of the landfills handling larger amounts of waste (500 tons or more daily), both the rate of construction and the number of house and lot sales were significantly less than the rates around landfills handling 300 tons of waste or less per day. In regard to the sale of residential property and vacant lots there was not enough data at any site to provide a basis for an analysis of the impacts.

In the case of one landfill in Montgomery County, Penn. there was sufficient sales data to evaluate some aspects of the impacts. In this instance the proximity to the landfill was not a significant factor in determining the price. Other characteristics of the houses and vacant lots were more important, such as age and square feet of living area. However, the cross-sectional samples were small. Also, observations within the one mile distance were generally at a greater distance for each of the five years. Less development and fewer sales occurred within the one-half mile distance from the landfills handling over 500 tons per day. If properties closer in were affected to a greater extent, the available data would not reflect this impact.

The Metropolitan Council's report, Compensation and Mitigation: Dealing with the Adverse Impacts of Solid Waste Disposal Facilities, 1982 concluded that property values might be adversely affected (200). Homeowners near a landfill may have difficulty selling their property, and if it is sold, they may have to take a loss. Undeveloped land near a waste disposal facility may also lose its value as potential residential or commercial property. The study also concluded that few conclusive studies have investigated the impacts on property values.

Local and county assessors indicated to the Council's staff that there was a lack of data in regard to this issue and as yet "no evidence has been produced that shows whether property values will decrease near a landfill." Local assessors indicated that the assessed value of houses have not been reduced because of their proximity. The assessors did note that landfill access routes would affect adjoining property values if it were not a major traffic route. Properties with unobstructued views of the landfill would also be affected.

The study also concluded that proximity to a landfill is only one factor in selling or buying a house; other factors such as access to schools and other services may outweigh the former in the minds of residents or buyers.

In one recent local instance, Washington County property values have been affected by a former landfill--the Lake Jane Landfill in the City of Lake Elmo (201). Estimated values of properties where wells were contaminated or potentially affected by contaminants from the former landfill were reduced. Property values were reduced by 50 percent at two houses where the wells were undrinkable or completely contaminated. At approximately 30 houses property values were reduced by 30 percent. Traces of the chemicals were found in the wells of the houses or the wells were located in the expected path of the contaminants moving through the groundwater. According to the County Auditor's office other properties located close to the path of contamination may be affected also because of the "scare effect." Only properties affected or potentially affected by groundwater contamination have been involved in the reductions to date. Properties close to the landfill but upgradient have not been involved in the reductions to date.

EXISTING LANDFILL/PROPERTY VALUES

The Flying Cloud Landfill has been operating since 1972. Since that time the general value and attractiveness of the area surrounding the landfill has been maintained. Residential development in the surrounding area continued to occur particularly in areas in close proximity to the landfill. The Bluffs West Second Addition, which is as close as 800 feet from the existing landfill, was approved by the City of Eden Prairie in 1979. Development of the eastern portion of Bluffs West continued even after the proposed expansion became public knowledge. Between January 1983 and February 1984, 33 new houses in the eastern portion of the subdivision were sold (202). Nine of these were along the eastern or closest edge to the existing landfill. The Hillsborough subdivision also developed during the late 1970s. However, it is over 1,000 feet from the present landfill boundary.

BFI prepared a sttdy of the impact of several of its lanndfills on local residential property values in 1983 (203). The study examined the impact of four BFI landfills in various parts of the U.S., including Flying Cloud. The average residential property values for the area around Flying Cloud Landfill and a similar residential, control area in the City of Plymouth were compared for a period of six years before and five years after the development of the landfill. The study concluded that the value of residential property in the landfill area had not declined, the direction and rate of change in values was not affected and the area has become more residential since the landfill opened. The trends in residential values compared to those in the Plymouth control area did not change.

The study conclusions should be qualified because of the methodology and data used. The data covered the period 1964 to 1975. Thus, information about the closest and most recent subdivisions--Bluffs West and Hillsborough--was not included. The statistical study area which includes the landfill is extensive and includes many residential areas more than a mile from the site. This might statistically skew the results; potential impacts on close-in areas might appear more significant if the data were drawn from a smaller area. Furthermore, the study does not appear to account for changes in the characteristics of the houses, such as increased floor area, which could have a significant effect on assessed values.

Assessment data for 1983 provided by the City Assessor's Office, Eden Prairie, indicates that the housing in Hillsborough and Bluffs West would probably be considered middle-income. Almost 75 percent of the houses in Hillsborough had an assessed market value between $70,000 and $89,999. Ten of the houses had assessed market values over $90,000. In Bluffs West 54 percent of the housing had assessed values ranging from $70,000 to $89,999. Thirty-five percent of the houses or 28 units in Bluffs West had assessed market values over $90,000.

An appraiser in the assessor's office of the City of Eden Prairie indicated that it would be difficult to determine if the existing landfill has affected residential property values since the landfill opened before the residential development occurred. The past development of the surrounding residential areas has been comparable in general to similar residential areas elsewhere despite the presence of the landfill. It also noted that the improved operation of the landfill in the last five years may have had an impact, also. The value of the lots sold more recently for new housing in Bluffs West had been reduced (204). This may have been due to the landfill, but it could also be due to the general conditions of the housing market at the time, awareness of the proposed landfill expansion, the developer's desire to complete the development or other factors.

In the Metropolitan Council's report Recommendations for Dealing With Adverse Impacts of Solid Waste Disposal Facilities, 1983 a representative of the developer of Bluffs West noted "buyer resistence" of prospective house buyers because of the nearby landfill. However, sales of the houses were proceding at a pace comparable to those at other locations. The sales representative did not discern a loss in property values for houses located close to the landfill. According to the representative the large buffer zone ameliorates the negative perceptions of buyers (205). (Both Hillsborough and Bluffs West are separated by open areas from the present landfill boundaries.)

POTENTIAL IMPACTS

Assessing the potential impact on property values around the proposed project is a complex task. There are many other outside factors which affect the market for and the value of property in the local area. These outside factors could modify or outweigh the impact of the landfill. These factors are positive and negative. Among the other potential positive factors are such things as the proximity to the employment, shopping and service opportunities in the I-494/Hwy. 169 area, the good highway access and closeness to the Minnesota River Valley. Among the possible negative factors would be the proximity to the Flying Cloud Airport and its associated activity. A major approach to the airport passes over or close to property around the landfill.

Woodlake has proposed a number of control measures to reduce or minimize the impacts of the design, construction, and operations of the project. The FEIS has identified a number of other mitigating measures to eliminate or minimize the potential impacts. The total effect of these measures will be to minimize the impact on the surrounding property which in turn should assist in protecting the attractiveness of the area and the value of property.

End use plans and their implementation may affect property values. Woodlake's preliminary end use proposal for the project site recommends the development of industry, housing, a golf course and a park (Figure 15). The golf course, housing and park would probably have a positive effect on property values, particularly residential, and these uses would adjoin Hillsborough and Bluffs

West subdivisions. However, Woodlake estimates that it would take seven years to complete the landfill which would delay the development of its end use plan or any other potential end uses. If the landfill and end use plan could be completed in less time, the potential negative effects on property values might be reduced and the positive effects of an end use plan be realized sooner.

Hillsborough Subdivision Properties

The potential impact on property values in the Hillsborough subdivision is likely to be minimal. The 1,300 foot wide buffer, the 15-foot berm, Woodlake's proposed control measures and the location of the subdivision relative to the landfill would eliminate or minimize visual or nuisance impacts on the subdivision; hence, there should be no adverse effect on property values. Potential impacts such as increased noise would be temporary in duration. The phases of the expansion which would be closest to the Hillsborough area would be the first to be undertaken and completed (Figures 13 and 14). Potential surface water and groundwater impacts would not affect Hillsborough because of its upgradient location. Prevailing winds, which are from the south and southeast or the north and northwest, would minimize the potential for nuisances from litter, dust and odors. Proposed control systems and the 1300 foot wide buffer would provide added protection. The buffer zone should provide the necessary protection from the hazard of potential methane gas migration from the project; however, there may be some perception that the hazard will exist. The mitigation measures discussed in the Landfill Gas section of the FEIS should further minimize this potential problem.

Bluffs West - Second Addition Properties

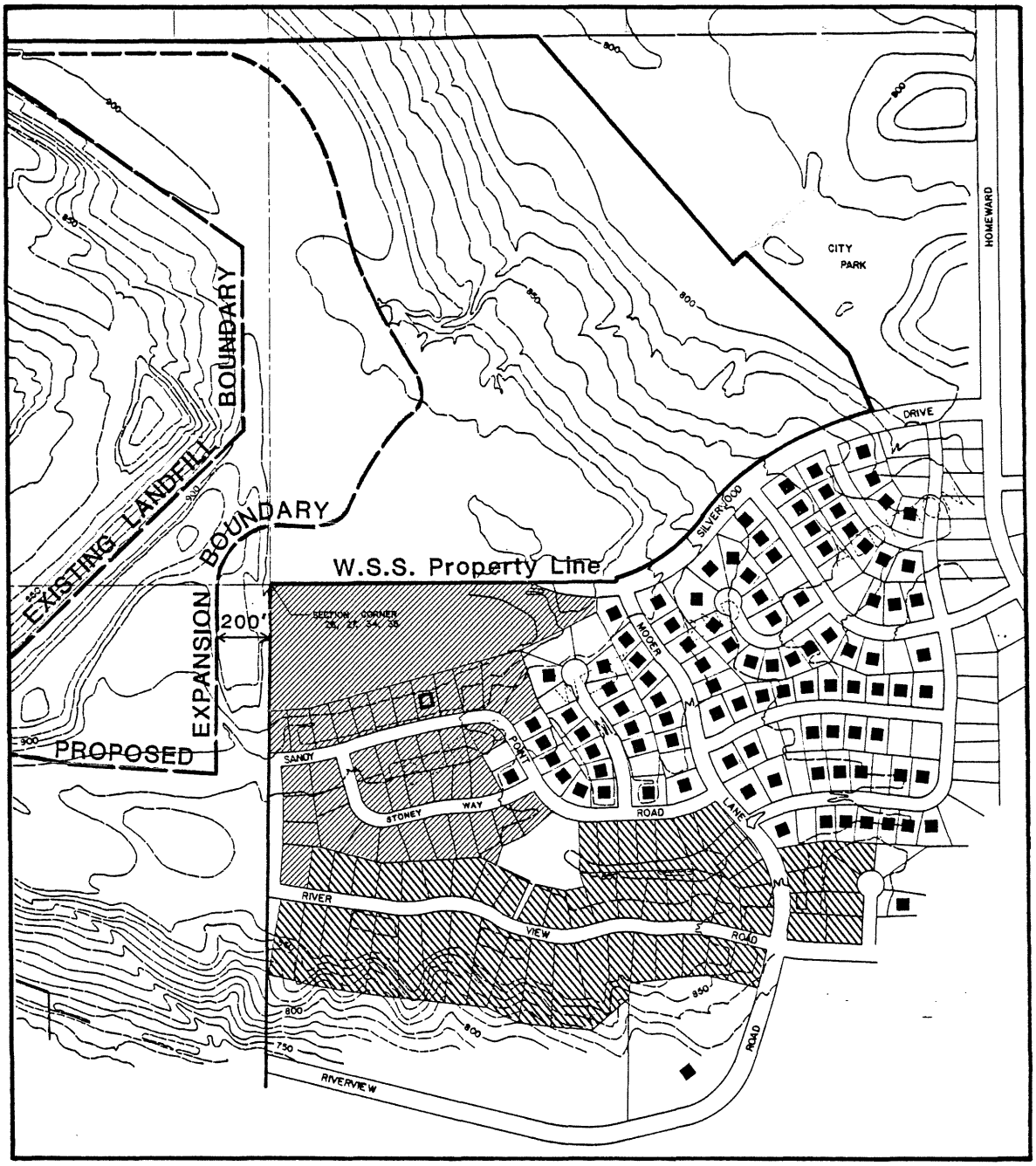
There are three groups of properties in Bluffs West (Figure 70). The owners of individual houses and lots represent the largest group. These are located in the eastern portion of the subdivision. Woodlake owns 39 lots (including a vacant house) and an outlot in the vacant western portion. These were acquired in 1983. The lots have been platted and streets and utilities are in place. The third group of properties is owned by the original land developer. These are located along Riverview Rd. west of Mooer Lane. The street and utilities have not been constructed in this area. The developer is delaying the improvements and lot sales pending the approval of the expansion (206). These lots are the most valuable because of their location along the top of the bluff.

Because of their close proximity and extended life of the landfill, the values of vacant lots and houses in Bluffs West, particularly those in the western portion, could be affected by the expansion. The acquisition of vacant lots by the proposer in 1983 may be in response to this potential impact. Vacant lots on Sandy Point Rd., acquired by the proposer, would be 200 feet from the expansion boundary (compared to 800 feet from the existing landfill). The closest lot on River Rd. would be approximately 500 feet southeast of the expansion (compared to 1,200 feet currently). Existing occupied houses would be as close as 900 feet compared to 1,400 feet from the existing boundary.

Because of the extended life of the landfill and its increased proximity the concerns of buyers and property owners for increased noise, nuisances such as litter, odors and dust, methane gas hazards, and visual impacts could increase significantly over those produced by the existing landfill.

Figure 70.

PROPERTY OWNERSHIP IN THE UNDEVELOPED SECTION OF BLUFFS WEST, SECOND ADDITION



Lots owned by Woodlake Sanitary Service

Lots owned by single developer

■ Houses owned by individuals

□ Vacant house

N

0 500 1000 Feet

Sources: Base Map: G.M. Sunde, Consulting Engineer; Data: Hustad Development Corp., Woodlake Sanitary Service, Orrin Thompson Homes.

Many of these potential impacts will be minimized by the design of the project, the control measures proposed by Woodlake and the mitigation measures discussed in the FEIS. However, the concern that the proximity and nuisances during the life of the project will impact property values could remain. The existing trees along the proposer's property line and the proposed 15-foot berm will screen the expansion, but the berm will also be a visible reminder of the landfill's presence. Woodlake's control measures for litter, odor and dust will minimize problems, but existing houses and vacant lots would be closer, and would be downwind from the expansion during the late fall, winter and early spring and at other times when the wind is from the northwest. Thus, there could be occasional nuisances. Once the berm is completed, it will minimize noise impacts. However, because of the proximity of the expansion, noise impacts could exceed state standards for residential areas or result in a nuisance in the vacant portion of Bluffs West. This could occur during the berm construction, initial site excavation, and during final fill/cover placement in the southeast area of the expansion, depending on distance and the number of pieces of construction equipment. These will be temporary or short-term impacts, but they could add to the perception of the presence of the landfill. The perception of these impacts and nuisances among property owners and buyers could affect the value of the vacant lots and existing houses along the eastern and northern edge of Bluffs West since there are no structures between these houses and the expansion.

The potential hazard of migrating gas could be a concern which would also impact the value of vacant lots and existing houses within or close to the area potentially affected by gas migration (an estimated distance of 800 feet). Woodlake has proposed monitoring and control systems to minimize the hazard. Additional mitigation measures discussed in the Landfill Gas section of the FEIS, including the construction of a back-up system would further minimize the potential impact. However, this concern could continue until the proposed monitoring has established there is no hazard associated with the expansion. This may affect the market for the closest existing houses and vacant property in the western portion of Bluffs West.

There are 11 houses in Bluffs West served by private wells according to city records, but the estimated leachate plume would move towards the southwest away from the private well locations (Figure 26). This would mitigate the potential impact on the wells and property values.

The value of vacant lots in the northwest corner of Bluffs West that are owned by Woodlake are among the properties most likely to be impacted due to their proximity. If the value of these lots decreases, these costs would become a part of the proposer's costs of developing the expansion. Private, individual lots would not be affected unless the proposer sells individual lots during the life of the project. Retaining ownership of the lots until the closure is complete or the expansion has developed to a point where the potential property value impacts would not be significant would allow Woodlake to minimize the loss in value or benefit from increased property values.

The value of vacant lots, owned by the original developer, along Riverview Rd. could also be affected. The lots at the western end of the street do not directly adjoin the active fill area; these lots adjoin the detention pond area which is already in place. However, the lots are approximately 500 feet from the southeast corner of the proposed fill, compared to 1,200 feet from the existing boundary. A representative of the Hustad Development Corporation stated that the development of Riverview Rd. would be delayed until the south-

east corner of the expansion is completed, to minimize the impact of potential nuisances, assuming there is no hazard from methane gas migration. If the southeast corner were completed first, this would minimize the delay and the potential impact on property values along River View Rd.

Although the potential impact on existing houses in Bluffs West is less than that for the vacant lots, the value of these houses could be affected. Although existing houses in the eastern portion of Bluffs West would be more distant than the vacant lots, the closest occupied houses would be closer to the expansion than the present landfill--900 versus 1,400 feet. This could affect the perception of property owners and buyers. Houses along the western edge of the developed portion would be close to the estimated area potentially affected by methane gas migration; they are also downwind and could be affected occasionally by noise, litter, dust and odors. Houses at the edge would have a direct view of the berm. This could affect the perception of buyers. The delay of construction on the Woodlake owned lots could add to this impact. These impacts could be mitigated by maintaining a wider buffer zone between the expansion and existing houses. This could be accomplished by reducing the expansion of the fill area to the southeast. Completing the southeast portion of the expansion first and as rapidly as possible would reduce the duration of the potential impact and reduce the time during which the market might be affected.

OTHER RESIDENTIAL PROPERTIES

The potential impact on the value of the Cooley house to the southwest and the residences to the northeast along County Rd. 1 would be minimal assuming that appropriate mitigation measures are followed. The Cooley house is located 1,000 feet away near the base of the bluff on Riverview Rd. and would be screen by the bluff. Potential impacts on the private well and mitigation measures are discussed in the Site Hydrogeology section. The potential impact on the houses along County Rd. 1 would be mitigated by distance also. The closest house would be expansion. The distance and 15-foot berm and Woodlake control palns would minimize the impact of nuisances such as litter, noise and dust and the potential impact of landfill gas.

COMMERCIAL/INDUSTRIAL PROPERTY

Commercial/industrial properties near the landfill which might be affected include the Flying Cloud Drive-In theater, the properties along County Rd. 1 to the north and the roadside market to the southwest (Figure 64). Because of the general commercial/industrial nature of these uses it is unlikely that the project would affect their value. Although the project would extend the life of the landfill activity, the proximity of the landfill to these uses would not be changed greatly by the expansion. The landfill is expanding primarily to the east, away from existing commercial/industrial properties.

The MAC property and the highway north of the project would serve as a buffer zone to minimize the impacts on commercial/industrial along County Rd. 1 (Figure 64). The nearest property would be approximately 1,200 feet from the boundary of the expansion. The proximity to major county and state highways may offset any affect of the project. Potential groundwater and surface water impacts would not affect these properties because they are upgradient from the project. The distance separating the properties from the expansion also minimizes the potential effect of landfill gas migration, noise, visual effect,

dust and litter. Planting shrubs of adequate height along the berm would further reduce the view of the project. There may be an occasional nuisance from litter due to the prevailing south to southeast winds in the summer, but these should have little effect on the commercial use and value of the properties.

The Flying Cloud Drive-In theater adjoins the existing landfill on the northeast border. Because of its nighttime and seasonal pattern of activity there would be minimal impact on property value. There are a number of mitigation measures which can be taken to protect the private well at the drive-in (Site Hydrogeolgy section). Because the landfill does not operate at night, noise would not impact the drive-in. The drive-in property may experience an occasional nuisance from dust, odor or litter. The property would be upwind from the project during the late spring, summer and early fall when the prevailing winds are from the south and southeast. However, these would have little negative impact on the commercial value of the drive-in property. The mitigative measures suggested in the air quality and litter control sections of the FEIS would minimize the potential impacts. Woodlake's control plans should also minimize these nuisances.

There is some potential for methane gas migration to the drive-in property from the landfill because of its close proximity. The expansion will probably increase the total volume and rate of methane gas production at the site and extend the period of generation (Figure 43). However, the existing control system and mitigation measures discussed in the landfill gas section of the EIS should control off-site migration.

The value of the roadside market property southwest of the landfill site along Hwy. 169 would not be affected. Woodlake's office and operations area is located between the market and the project and would screen the project from view. The other potential impacts of the project such as noise, runoff, litter and dust would not affect the property.

MINNESOTA RIVER VALLEY PROPERTY

The land south of the project is located in the Wildlife Refuge, however most of it is currently in private ownership. Most of the bluff south of the project is owned by Woodlake. Properties around Grass Laker are held by private individuals in large holdings. Noise, odor, litter, runoff and other potential impacts of the project would not affect this property because of the intervening distance, change in elevation, prevailing wind directions and control measures proposed by the applicant. Landfill leachate is a concern which might affect property values. The potential the impacts would be negligible or minor as indicated in the Site Hydrogeology and Vegetation and Wildlife sections of the FEIS, if proper operating and mitigating techniques are employed.

MITIGATION

Retaining a buffer zone between the proposed expansion area and the Bluffs West subdivision where property values might be effected would minimize potential impacts on vacant residential/lots and existing occupied houses. Landscaping and maintaining the vegetation in the buffer zone would assist in minimizing the impact. Reducing the proposed horizontal expansion in the southeast corner would provide a buffer. Delaying lot sales and new home construction in the western portion of Bluffs West until active filling is completed, the landfill is closed or final closure has begun in the southeast expansion would minimize the impact on the value of the vacant lots owned by Woodlake and the vacant lots along Riverview Rd. owned by the subdivision developer. However, unless the delay were short this measure might not be acceptable to the developer.

Establishing a fixed completion or closure date for the landfill expansion would enable property owners and would be property buyers to see an end to the project. Limiting the project life to as short a period as possible would reduce the time during which property values might be impacted. Limiting the project life and setting a firm completion date would establish the temporary nature of the project and could reduce the concerns of property owners and buyers, enhancing property values in the long term.

Completing those stages of the expansion which are closest to potentially affected areas in Bluffs West first and as rapidly as possible would minimize the period during which these areas would be exposed to potential impacts.

The impact of landfill activity might be minimized by initiating fill activities in areas close to residential areas during the late fall and winter and working towards the center of the landfill during the spring and summer or away from residences. Filling activities would be carried on in the interior of the site during the warmer months when outdoor activity is highest in residential areas.

Amendments to the Waste Management Act passed in 1984 (H.F. 1577) authorize local county and city governments to impose fees on solid waste operators for the purpose of mitigating/compensating local risks, costs and adverse effects of solid waste facilities. The fee authorities established by the 1984 amendments do not on their face preclude payments to private owners to compensate for the property value impacts of landfills. Whether any particular ordinance establishing such payments is otherwise permissible under the law and practically implementable are questions for the county and city, respectively to resolve.

Finally, compatible end use plans, implemented as soon as possible, could mitigate the impact on property values. For example, open space and recreational end uses, which might have a positive impact on property value, might be developed before the entire project is completed. This would shorten the time during which potential negative impacts affect property values.

REVENUE AND EMPLOYMENT

REVENUE

Landfilling generates revenue for local and state governments and provides job opportunities.

The primary sources of revenue are property taxes and income taxes (207). Property taxes are paid to the county, while corporate taxes are paid to the state and federal governments.

In 1983, property taxes on the active landfill and the BFI office/shop area (which are classified as commercial property for tax purposes) were approximately $110,000 (208). A portion of those taxes were distributed to the city, county and school districts.

Woodlake owns land in addition to the active landfill, including the proposed horizontal expansion area. 1983 property taxes on these additional holdings (approximately 150 acres) amounted to about $21,000 (209). Revenues from the proposed expansion area will increase if the site is permitted, but it is not possible to predict by how much at this time (210).

After the landfill closes, property taxes may change as the land use changes. Taxes on those end uses of the property, however, may not generate the same amount of revenue as other lands in the same vicinity (211). Lower revenues could result if the site has a low market value because of its previous use as a landfill (212). Estimates of future tax revenues once the landfill is closed would be extremly speculative. The value of the land for local tax purposes would depend on the market value of the land which is dependent on a number of factors such as the feasibility of alternative uses, the cost to make the land developable, when it would be feasible to develop another use and the holding costs until the site is developable. If there is no feasible use, the market value and tax revenues could decrease appreciably after closure. At this point suggestions for interim uses and tax revenues estimates are extremely speculative.

EMPLOYMENT

Flying Cloud Landfill provides a limited number of job opportunities in addition to revenues. Woodlake currently employs 10 to 20 people at the landfill (Table 40) (213). No additional jobs are expected to be created if the expansion is permitted (214).

Table 40
CURRENT EMPLOYMENT AT FLYING CLOUD LANDFILL

Job Classification	Number Employed
Full-time operators	5
Scale operator	2
Landfill manager	1
Laborers	2-10

SERVICE DEMANDS AND OTHER COSTS

DURING LANDFILL OPERATION

The existing landfill does not exert a large daily demand for urban services, despite the fact that it is in the MUSA. The expansion should not exert a large service demand, either. Three on-site wells provide water for drinking, equipment washing, and other activities. A 10,000 gallon surge tank is also available, and can supply water rapidly. An on-site sewage and wastewater facility, and a stormwater management system are present as well. A private security force guards the site when company employees are not on-site.

A need for fire protection services from the city does exist. For instance, volunteer city fire crews were needed to help combat a major fire that occurred in 1980 at the landfill. The city billed Woodlake for costs incurred while fighting the fire. Those costs, totalling around $80,000, included water, food for the firefighters and paint for a fire truck.

The probability of a major fire at the landfill is quite small (see Fire Hazards section), nevertheless, should a major fire occur again, the city's crews may be needed. Woodlake could negotiate a contract with the fire department to ensure adequate fire protection.

A fire could exert a demand on water supplies as well as manpower. Expansion of the existing fire department is not necessary to serve the landfill, however, extended water lines would be more convenient in case of a fire. Currently, the closest water main available is at the Bluffs West subdivision. A second water main could be made available at the entrance to the landfill on Hwy. 169 for about $56,000 ($25/linear foot). Currently, this second main only extends as far as County Rd. 1 on Hwy. 169.

The landfill also requires maintenance of good access roads. Hwy. 169 is the primary access road; garbage truck traffic now comprises only three percent of the total daily traffic on this highway near the landfill (215).

Woodlake has several financial mechanisms in place to deal with potential problems (216). While the landfill is operating, the company will carry liability insurance to cover: 1) injuries to persons; and 2) property damage associated with landfill operations. A surety bond for $300,000 will run until landfill closure activities are complete. The bond will provide funds to the county in the event that the company fails to follow permit requirements or abandons the landfill, and the county has to spend money to restore the site to conditions required by the permit. The company will have to show, as a part of the permitting process, that a bond for this amount is adequate. Also, BFI carries environmental impairment liability insurance for all its landfills. This insurance covers property damage and personal injury (see Project Description section).

POST-CLOSURE

After the landfill closes, service demands may change somewhat. If the property remains undeveloped, the requirement for public services would likely be minimal. If development occurs on the site, it may be necessary to extend sewers, water mains, and roads depending on the land use. In this particular situation, the site is already inside the MUSA and adequate sewer capacity is available to service the site.

Post-closure problems associated with the landfill will be remedied either by the owner, the MPCA, or Hennepin County, depending on the nature of the problem and the willingness and/or ability of the owner to cooperate. If the landfill is donated to the city, the city will be liable for post-closure problems unless there are special provisions drawn up to distribute liability in a different fashion (217).

Either the common law of negligence or of nuisance could be used by a property owner ("owner") in a lawsuit against the landfill owner and others to recover damages for water well pollution.

To hold a defendant liable in a negligence suit, the owner of a polluted well would have to: 1) prove that the defendant failed to exercise the care required; 2) prove that the defendant's action or inaction caused the pollution of the well, and 3) set a monetary amount for damages.

In a nuisance suit, by contrast, the landowner would only need to show that the operator's actions constituted a nuisance that interfered with the owner's right to use and enjoyment of his/her property, including the well. Liability would only be imposed, however, when there is proof that a substance that is unnatural to the land and that has a natural tendency to cause harm if it escapes, did in fact escape and harm the owner's land. The measure of damage in a nuisance suit is depreciation in the market value of the owner's property because of the pollution.

If a private defendant is found liable, but is either unavailable or without assets, the owner is essentially left remediless. If the pollution problem is severe or widespread, and is causing a threat to the public health, the taxpayers will likely bear the burden of cleanup costs.

... ALTERNATIVES ...

ALTERNATIVES

BACKGROUND

In accordance with the Environmental Review Program and EQB rules (6MCAR 3.031) the EIS must compare the environmental impacts of the project with other reasonable alternatives. Reasonable alternatives may include changes in site layout or the magnitude of the project, design modifications and alternative means by which the purpose of the project can be achieved. A no-action alternative is also to be discussed. Alternatives that were considered but eliminated are to be discussed briefly, and the reasons for this elimination are to be stated.

ALTERNATIVES CONSIDERED

The scoping document for this EIS, approved by the Metropolitan Council on March 24, 1983, identified the following alternatives to the proposed expansion.

Changes In Design

Alternative designs in the technical or physical aspects of the project that will mitigate the project impacts will be evaluated; for example, changes in the design of the berm to reduce potential noise impacts.

No-Action Alternatives

If the expansion is not permitted, solid waste must be disposed of by other means. The EIS evaluates existing landfills, proposed new landfills and abatement strategies which may reduce or eliminate the need for the landfill expansion.

Changes In Magnitude

Reductions in the size or scale of the project that involve changes in the vertical or horizontal dimensions of the project or combinations thereof will be evaluated; for example, reductions in the horizontal expansion to minimize land-use impacts.

Changes In Operations

Changes in the day-to-day operations and development of the site that would mitigate the impacts will be evaluated; for example, changes in the staging or phasing of filling and closure.

DESIGN ALTERNATIVES

Design alternatives to the project include technical or physical changes which would eliminate or minimize the environmental impacts. For this proposal, they include:

1) Liner and leachate collection system beneath the horizontal expansion/ no vertical expansion.

2) Increased final slopes;

3) Methane recovery system;

4) On-site shredding or baling facilities;

5) Changes in the design of the noise berm.

Several of these are discussed in more detail in the appropriate sections of Impact Analysis and are summarized here.

Liner and Leachate Collection System/No Vertical Expansion

The alternative of placing a liner and collection system under the expansion to contain and allow the removal of the leachate before it moves off site would minimize the possible impacts on groundwater and surface waters. However, it is assumed that a liner and collection system would not be effective under the proposed vertical expansion and over the existing landfill. Because the existing fill will continue to settle, maintaining the integrity of the liner and collection system does not appear to be possible from an engineering standpoint. Therefore the alternative of placing a liner and collection system beneath the expansion would apply only to the horizontal expansion area. The option of foregoing the vertical expansion assuming it cannot be lined is also evaluated to determine the impacts.

Lining the Horizontal Expansion

A liner and collection system would be placed under the 42.4 acre horizontal expansion area after the area is excavated and before filling begins. Because the eastern perimeter of the existing landfill excavation is not being filled pending the approval of the expansion, the liner might be placed over a portion of this area also.

The liner under the horizontal expansion area could consist of natural clays, a synthetic material or a combination of both. The efficiency would depend on the specifications of the design and selection of materials.

The leachate system would consist of collection piping, a storage tank and other equipment designed to gather and remove any leachate that collects above the liner After it is collected, the leachate could be treated on site or hauled to a waste water treatment facility. Under a plan currently being considered by the Metropolitan Waste Control Commission, leachate would be hauled to a central location in St. Paul for disposal and treatment.

Adding a liner and collection system beneath the horizontal expansion would have a number of impacts. The potential volume of leachate which might be discharged annually into the groundwater would be reduced significantly from an estimated range of 18.5-72.8 (worst case) acre-feet to 13.1-51.6, or a reduction of 5.4-20.2 (worst case) acre-feet per year (Table 10). This would also reduce the total potential volume of leachate discharged over the life of the project. The reduced volume represents only those from the horizontal expansion. Since the same amount of precipitation would infiltrate the existing site regardless of whether the vertical expansion is approved or not, the volume of leachate produced annually would not change. (The vertical expansion might slow leachate production at the existing landfill for a time until the new refuse reaches field capacity.)

Collecting the leachate beneath the expansion and removing it would provide improved longer term protection for the Minnesota River, Grass Lake, the wetlands and the associated biota. Collecting the leachate would minimize the potential volume of contaminants which might otherwise discharge annually and over the long term into the river, lake and wetlands. This would minimize the concentration of any leachate emerging in these resources. Contaminants from the existing landfill could continue to move through the groundwater and into the valley and then to the river and lake (Table 10). Since the increased annual and long-term volume of leachate moving into the valley from the project would be reduced, the amount of additional, potential contaminants such as metals and organics discharged to Grass Lake and made available for bioaccumulation by the biota in the lake and wetlands would be reduced. This would reduce short-term and long-term risks to the biota during the active production of leachate at the expansion (see Vegetation and Wildlife section for additional discussion.) Assuming a worst case for the leachate volume and concentrations produced by the horizontal expansion, the liner could avoid or reduce the potential conflicts with MPCA surface water quality standards for Grass Lake. (Table 13 and the Site Hydrogeology section). Lining the horizontal expansion would also provide added protection for groundwater and the private wells downgradient of the project to the southwest. The existing landfill would continue to produce leachate which might affect these wells.

The collected leachate would have to be disposed of in a manner which would minimize its environmental impact. There would be additional costs for the disposal and treatment of the leachate. Under a plan proposed by the Metropolitan Waste Control Commission, leachate would be trucked to a central location in St. Paul for disposal and treatment at the Metro Plant as industrial strength wastewater. Since the leachate would be collected beneath the refuse it is possible that the concentrations for various parameters such as metals and chemical oxygen demand (COD) would qualify the leachate as industrial strength waste. If the concentrations for such parameters as solids, metals and volatiles were high, pretreatment would be required before the leachate would be accepted. Pretreatment would be an additional cost for the landfill operator/owner. Estimated annual costs for the disposal and treatment of industrial strength leachate assuming a COD of 200 milligrams/liter and total suspended solids of 310 milligrams/liter would be $13,000 and $45,000 for 2 and 7 million gallons of leachate respectively based on 1984 strength charges. Trucking costs would be extra and could be substantial because of the distance to/from St. Paul. (The estimates were developed with the assistance of the MWCC staff.) Analytical lab costs to determine the concentrations or strength of leachate periodically would add additional annual costs. The trucking costs would be less if the leachate could be hauled to a closer point for discharge to the metropolitan sewer interceptor system. The MWCC staff is concerned that the strength and volume of leachate would be beyond the treatment capability of smaller plants in the system. The nearest plant to the landfill is Blue Lake located south of the Minnesota River in Shakopee.

The costs of installing a liner and collection system would vary depending on the liner material and the location of the source of the materials. The Council estimates the following costs for a liner and collection system for 40-acre site which is approximately the size of the horizontal expansion.

Liner construction/material:

Clay on-site*	$1,000,000
Clay (10-mile haul)*	1,900,000
Clay (20-mile haul)*	2,700,000
Membrane/clay on-site**	2,500,000
Membrane/clay (10-mile haul)	3,000,000
Membrane/clay (20-mile haul)	3,600,000
Drainage layer ***	500,000
Leachate collection system	200,000

* Assumes a five-foot clay layer and 85 percent efficiency.
** Assumes a three-foot clay base.
*** Assumes a one-foot drainage layer thickness, five mile haul cost.
Source: Report on Landfill Cost Estimating. Prepared for the Metropolitan Council Consulting Engineers Diversified, 1984.

The silt materials on the Flying Cloud site may be suitable as liner materials but more detailed soil testing would be necessary to determine this.

No Vertical Expansion

Woodlake proposes to add additional refuse above the existing fill. An estimated 2,500 acre-feet of refuse and cover material would be placed in the 42.4 acre horizontal expansion. The proposed total expansion capacity is 5,644 acre-feet. This leaves an estimated 3,144 acre-feet of refuse and cover materials to be placed on the existing site.

Foregoing the vertical expansion would provide added protection to groundwater and surface waters. The vertical expansion would increase the volume of refuse and contaminants available for leachate production. Assuming that it would not be possible to line the vertical expansion effectively because of settling in the existing fill, the additional contaminants in the leachate would move into the groundwater and eventually to the river valley, emerging in Grass Lake and the wetlands where they would be available for bioaccumulation in the lake and wetland biota. Expanding vertically without a liner would extend the period or duration of leachate production and the peak period. The new refuse might slow leachate production until the new refuse reaches field capacity. Foregoing the vertical expansion, particularly if that action were paired with the lining of the horizontal expansion, would reduce the long-term potential volume of contaminants impacting the groundwater, Grass Lake and the wetlands. This in turn would reduce the potential volume of contaminant available for bioaccumluation in the Grass Lake and wetland biota.

Foregoing the vertical expansion would have several other beneficial impacts. Reduced landfill capacity would shorten the estimated seven-year life of the project by approximately three years. The landfill would close sooner. This would reduce the period during which noise, litter, dust and odors might impact off-site land uses, property values and residents particularly to the southeast in the closest portion of Bluffs West. A shorter project life would also reduce the period during which potential conflicts with the operation of the Flying Cloud Airport and traffic movement on Hwy. 169 would be a concern. An earlier closure date might also allow for the earlier completion of residential

development in Bluffs West on lots owned by Woodlake and the Hustad Development Corporation.

Reducing the volume of refuse deposited would reduce the long-term and peak volume of landfill gas produced. However, off-site migration of methane gas from the existing landfill and the horizontal expansion would still be a concern and controls would be necessary.

Changes in Final Slopes

Steeper final slopes on the completed project would increase runoff and decrease ponding, thereby decreasing potential leachate generation during fill development and after fill closure and settling. The higher final elevations associated with such increases in slope would provide additional fill capacity as well, and could allow some reduction in the acreage of the proposed horizontal expansion area to the east.

Steeper final slopes would have some disadvantages, however. More care would have to be taken to control erosion of unvegetated slopes. A uniform increase of slopes to 6 percent would also increase final elevations to approximately 1,000 feet, rather than the proposed 923 feet. This would greatly increase the site's visibility from surrounding development.

A final elevation of 1,000 feet MSL would make the highest areas of the fill visible above the proposed berm from the residences at higher elevations in the Hillsborough subdivision and the developed, eastern portion of Bluffs West. The proposed 15-foot berm would continue to screen the closer-in portions of Bluffs West and the lower elevations of Hillsborough. The peak area would also be visible to a larger area of the river valley and Minnesota Valley Wildlife Refuge. However, the latter areas would still be a long distance from the project and this would minimize the visual impact. A final site plan that incorporated a series of short steep slopes and drainage swales, however, could accomplish the desired drainage results while minimizing increases in elevation and erosion. Increasing the height of the berm and shrubs along its top would mitigate visual impacts on residential areas to the east. Final elevations of 1,000 feet could conflict with the approach surface to the Flying Cloud Airport along the northern edge of the landfill. Limiting the increase in height to fill areas outside the approach surface would mitigate the potential impact.

The configuration of the final grades could also affect the end use plan for the site.

Methane Recovery

Woodlake has studied the feasibility of installing a methane gas recovery system at Flying Cloud (see Landfill Gas section). Much of the discussion to date has focused on the use of gas on-site, for example, providing energy for heating buildings. A gas recovery system in and of itself is not an alternative to a gas migration control system: the system that maximizes gas recovery will not necessarily prevent off-site gas migration (see Landfill Gas section). A migration control system will continue to be needed regardless of a decision to install a recovery system. It is possible to design a dual system for both methane recovery and gas migration control.

On-Site Shredding and Baling

Shredding and baling are two alternative waste management techniques that could be incorporated in the expansion. In a shredding operation, raw refuse (excluding very large items) would be shredded, or milled, to a uniform small particle size, (for example, to particles with a diameter of four inches) before it is landfilled. In a baling operation the raw waste would be compressed into large, high density bales. Both techniques reduce the space needed to dispose of a given volume of incoming refuse.

Advantages of shredding include: 1) fewer off-site problems with litter because the shredded waste has less of a tendency to be picked up by the wind than raw waste; 2) fewer vector problems because the wastes do not provide a good source of food; and 3) a decreased fire hazard because combustion appears to be restricted to the upper layers of material. It is generally agreed that shredding increases the rate of decomposition, increases moisture infiltration and as a result increases the initial concentration of contaminants in leachate in the short run but reduces that concentration over the long run. Baling, on the other hand, tends to decrease decomposition rates and infiltration and the concentration of contaminants in leachate in the short run, but baling increases the concentration over a much longer period.

Both shredding and baling would require additional expenditures for equipment by the proposer. A shredding operation could require a shredder such as a vertical hammermill, loading and unloading platforms, conveyors and storage bins. A baling operation could require the balers, conveyors, a control tower, a loading platform, a forklift and an articulated front-end loader. The costs of the equipment could increase the costs of operating the expansion.

If shredding equipment is purchased, on-site materials recovery could further reduce the volume of space needed to dispose of in-coming refuse and help recover the costs of the equipment. Magnetic separation equipment could recover ferrous materials and a trommel could be used to help recover glass. These facilities would not require Woodlake's customers to change their methods of collecting wastes, but it would require the identification of markets to be economically feasible.

Although shredding, baling and materials recovery would decrease the space or capacity required for landfillng each year at Flying Cloud, they would not remove the need for the landfill. Shredding, for instance, could decrease waste the volume of space needed to dispose of unshredded waste by a maximum of about 30 percent. By reducing the volume of space required to dispose of solid waste the landfill could remain open longer than the estimated seven years.

Noise Berm Changes

Woodlake originally proposed a seven-foot high berm and more recently changed this to a 15-foot berm on the eastern edge of the landfill expansion. A seven-foot berm would not be adequate to mitigate potential noise and visual impacts. For instance, a berm of 15 feet is needed to reduce the noise levels associated with at-grade construction and landfill equipment. Furthermore, the 15-foot berm would minimize visual impacts on residences to the east of the site. For details on the effect of a 15-foot high berm, see the Visual Impacts and Noise sections.

NO-ACTION ALTERNATIVES

If the proposed project is not approved, other methods would be necessary to dispose of the 5,644 acre-feet of solid waste which would have been landfilled in the expansion. The no-action option is limited by the availability of alternative methods for refuse disposal. The available capacity at existing landfills could be substituted for all or a portion of the proposed expansion. This alternative and the potential impacts are examined under the Existing Landfills section. New landfill sites would be available as a substitute for the expansion only if a certificate of need were issued. The seven counties in the Metropolitan Area and the Metropolitan Council have recently completed the process of identifying and approving candidate sites for the development of new county-owned landfills. These are the only new landfills currently being planned. The availability of this option is examined under the new landfill section.

If the solid waste cannot be disposed of in existing landfills or new landfills, other means must be used to handle the waste. These other means encompass a variety of technologies and other methods and are generally termed waste abatement. Waste abatement includes three basic approaches--waste reduction or reducing the amount of material thrown away at the source, waste separation to allow the recovery of recyclable materials such as glass and waste processing, including incineration to reduce the volume of waste materials and the amount of space required for landfilling. Abatement alternatives and their environmental impacts are discussed in the waste abatement section.

No-Action Alternative-Existing Landfills

If the Flying Cloud expansion is not granted, the landfill could close as early as February 1985. The waste that would have been disposed in the expansion could be sent to other landfills. The Twin Cities Metropolitan Area currently has eight other landfill sites that could accept the waste (Figure 6). Five of these landfills are located within, or close to, Flying Cloud's service area and would receive the waste which would otherwise be disposed of at Flying Cloud--Burnsville, Freeway, Louisville, Pine Bend and Woodlake (Pine Bend and Woodlake are also owned by BFI subsidiaries). The remaining permitted capacities of Flying Cloud and those five landfills are noted in Table 41. (Expansions are proposed at the Freeway and Louisville Landfills, but no decision has been made yet as to whether these will be approved.)

Table 41
EXISTING LANDFILL CAPACITIES AND USE RATES

Landfill	January 1983 Remaining Permitted Capacity (acre-feet)	1983 Use Rate (acre-feet)
Burnsville	2,325	59
Freeway	243	57
Flying Cloud	850	439
Louisville	1,689	110
Pine Bend	9,329	615
Woodlake	1,070	93
Total	15,506	1,373

Source: Metropolitan Council records, Minnesota Pollution Control Agency records, company records.

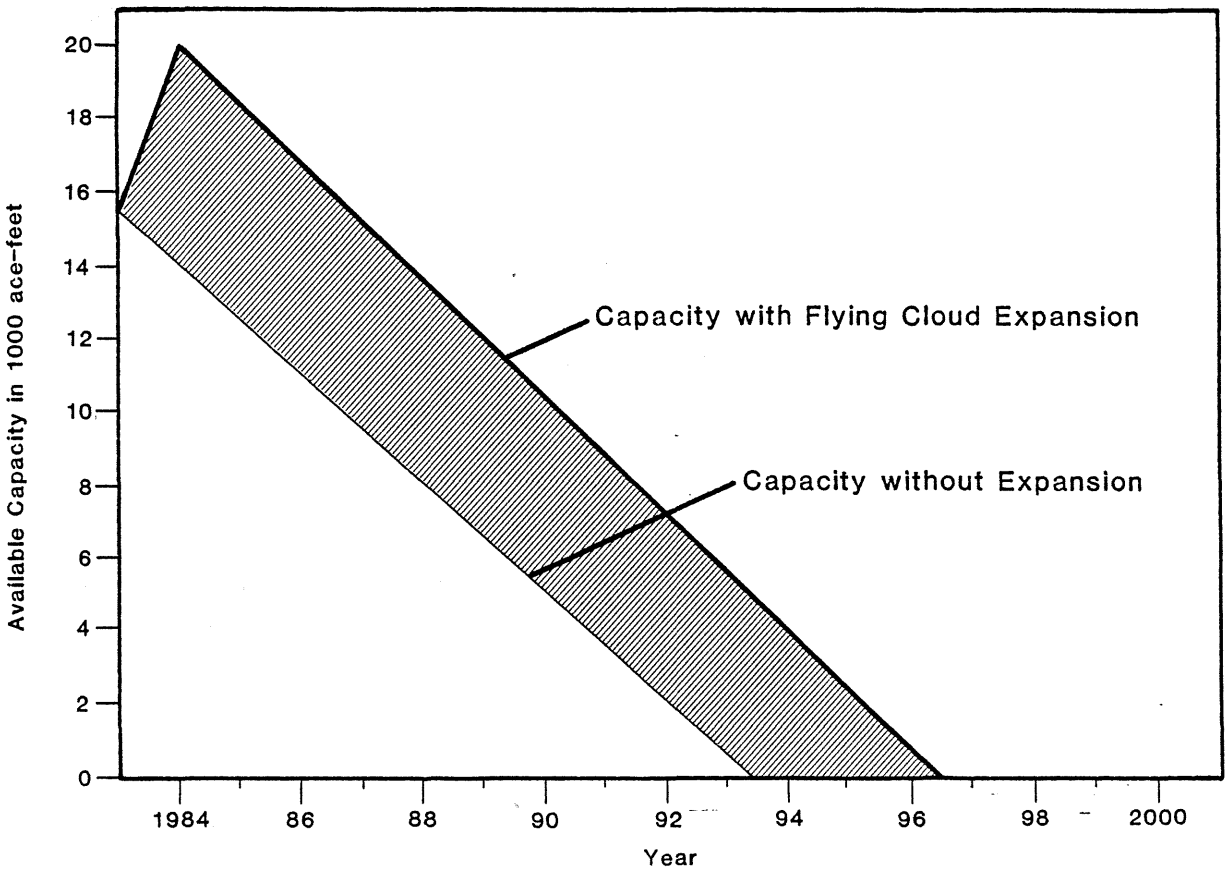
If it is assumed that landfill use rates increase by two percent per year (as they did from 1972 to 1982), that waste abatement remains at its current level, and that none of the other landfills in the Metropolitan Area close in the meantime, the capacity available at these landfills could last through the 1980s (Figure 71). If it were approved, the proposed Flying Cloud expansion would add another two years to this capacity. Based on this analysis, the existing landfill capacity would be a reasonable alternative to the expansion. Existing landfills could provide up to another nine years of capacity for the area served by the expansion.

There could be several different kinds of potential impacts which might occur with the substitution of existing landfills for the expansion. There could be environmental impacts at each of the five existing landfills that would receive the additional waste. There could be increased service costs to the area which would be served by the Flying Cloud expansion depending on the distance to another existing landfill. Finally, there could be some increase in the cost of operating the five other existing landfills because of the increased fill activity depending on their ability to increase operating activity without increased costs. These impacts are discussed in detail below.

Substituting the five existing landfills (Burnsville, Freeway, Louisville, Pine Bend and Woodlake) for the Flying Cloud expansion would increase the daily and annual rate at which these facilities are filled, but would not lead to an increase in total waste deposited. The remaining capacity at each of the landfills has been approved by the necessary state and local governments and is limited to a specified volume by the permit. Filling will proceed at these landfills regardless of the decision on the Flying Cloud expansion.

The increased rate of filling at the five landfills could have positive and negative environmental impacts. If the rate of filling is increased, the five landfills could be completed earlier than expected. This would shorten the period during which the environment and the local communities might be affected by landfill activity and related problems. Impacts associated with active operation of the landfills such as traffic congestion, noise, dust, visual

Figure 71.
EXISTING LANDFILL CAPACITY OVERLAPPING FLYING CLOUD LANDFILL'S SERVICE AREA



Sources: Metropolitan Council and landfill operators

blight, land use conflicts, odors and litter would be concluded sooner than expected. Perhaps the land could be developed earlier for another end use. The production of methane gas would not be affected by an earlier closure. Closing the landfill sooner would allow the placement of the final, less permeable cover. This could reduce the volume of leachate produced.

An increased rate of filling at the five existing landfills could have several kinds of environmental impacts in the local area. Increased fill rates could produce some additional traffic, particularly truck traffic and landfill equipment activity at each of the sites. These activities could increase traffic congestion on access routes depending on the local highway capacity, and could cause higher noise levels or longer periods of elevated noise and somewhat higher levels of air pollutants around the sites. The visual impact could be increased if the area of visible fill activity is increased significantly. Increased traffic and fill activity could result in additional nuisance problems associated with litter, dust and odor. In most instances the impacts would have a minimum impact on land uses around the five sites which are commercial, industrial and rural, low-density residential.

Although the increased rate of filling might increase traffic levels, equipment activity, noise and other nuisances at the five existing landfills, the location and surrounding land use at each of the sites would minimize the environmental effect.

The Burnsville and Freeway Landfills are located along the south bank of the Minnesota River and west of I-35W in extensive commercial/industrial zones away from residential areas in the City of Burnsville. The Woodlake Landfill (also owned by Woodlake) is located in a rural area of the City of Medina. The Louisville Landfill is in a low density, commercial-industrial area in rural Louisville Twp. Less than a dozen scattered residences are within a half-mile radius of either the Woodlake or Louisville sites. The Louisville site adjoins an operating quarry. Pine Bend Landfill is located in a partially developed industrial/commercial area in Inver Grove Heights. The remainder of the land is zoned for agricultural and industrial use. Residences are scattered along the roadways to the west, north and east of the landfill. All are separated from the landfill by open areas the closest residence being approximately 1,000 feet from the present landfill border. Given the land use and development patterns at each landfill and an increased rate of fill activity, the potential impact on air quality, noise, traffic and other nuisances would be minimal for local land uses.

All of the existing landfills, with the exception of Woodlake, are located in proximity to high capacity highways. Burnsville and Freeway are served by I-35W and Hwy. 13 (four lanes). Pine Bend is serviced by Hwy. 52/55 and Louisville is situated near Hwy. 169. These facilities would have adequate capacity to handle increased truck traffic during the peak hours of landfill use. Access to Woodlake Landfill is provided by rural, two-lane roads. Local roadway improvements and traffic control changes might be needed to minimize the additional traffic impacts.

Some traffic impacts could be mitigated by the development of a system of regional transfer stations. Solid waste would be collected and then hauled to central stations to be processed or collected in larger trucks to be hauled to the existing landfills. The use of larger trucks would reduce the number of small trucks arriving/leaving the landfill site and reduce the potential increase in traffic at the five landfills due to the higher rate of fill. Hennepin County has recently proposed a county system of transfer stations.

If the expansion is not granted and the Flying Cloud Landfill closes in 1985, there could be increased costs to some residents and commercial/industrial firms served by Flying Cloud. Haulers using Flying Cloud would have to dump the refuse loads at the other five landfills. This may result in longer trips and increased nonproductive driving time for some haulers particularly as closer, alternative landfills are filled to their permitted capacity. For example, the Burnsville, Freeway, and Pine Bend landfills are in or close to the communities in the primary service area of Flying Cloud (Figure 6). Louisville and Woodlake are more distant from the primary service area and would require longer trips for haulers serving communities in the primary area. As another example, if the Woodlake landfill was used as an alternative and filled within a few years, haulers serving the secondary service area of Flying Cloud would have to drive to the Burnsville or Freeway sites which are several miles more distant. Haulers who serve other communities in northern Hennepin County and rely on Woodlake would have longer haul distances also. Refuse would have to be hauled to landfills in Anoka County or to Burnsville, Freeway or Pine Bend. As the length of the haul route increases, labor and fuel costs increase for haulers. These costs would be passed on to customers as higher collection fees.

A higher rate of filling at the five existing landfills might result in higher disposal fees or "tipping fees" for haulers and increased customer charges. If the existing landfills do not have slack operating capacities to handle the increased rate in of filling, landfill operators would add equipment and operating personnel and possibly expand other facilities such as scales, roadways and parking facilities to handle the increased volumes. If the increased volumes and revenues cannot support the additional capital and operating costs, disposal fees would be raised. Some operators might raise fees at a certain point to discourage further increases in the waste being received. Increased disposal fees could be passed on by haulers to residential and commercial customers.

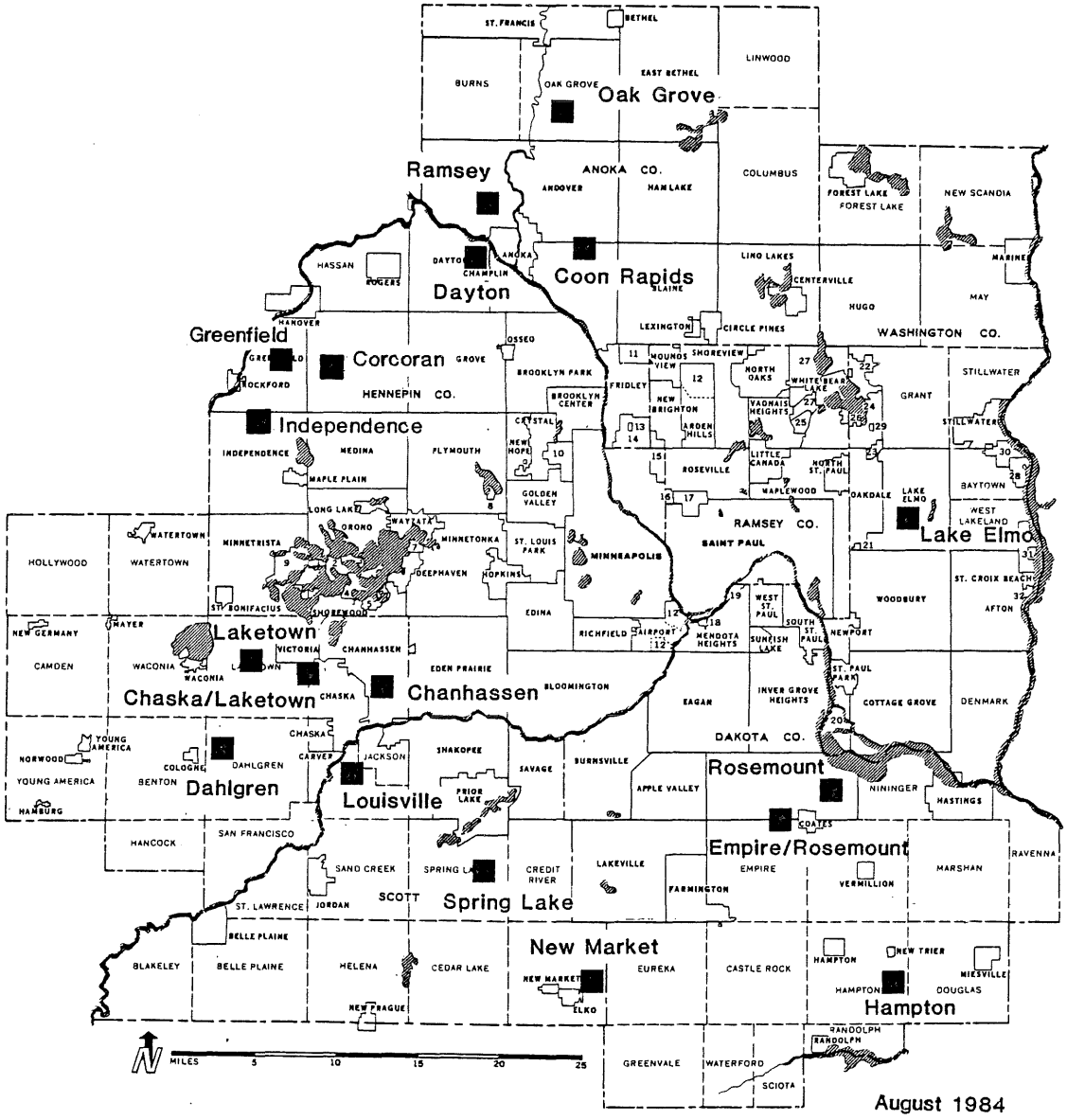
Increased landfill costs might have one additional impact. Increased costs would make alternative methods of waste abatement and disposal such as recycling and incineration more economically competitive with landfill disposal.

No-Action Alternative-New Landfills

The alternative of new landfills is likely to be closely restricted. The Waste Management Act of 1980, as amended, mandated each of the counties in the Metropolitan Area to locate candidate landfill sites. In mid-1984 the counties and Council completed the process of identifying and approving candidate sites for new landfills. However, the approval of permits for new landfill capacity is likely to be restricted. In accordance with amendments to the WMA approved by the Legislature in 1984 no new site can be issued a permit without a certificate of need approved by the Council, demonstrating that all other feasible and prudent alternatives to land disposal are being implemented. To date, the Council has voiced a consensus position that new landfills will be utilized only for the disposal of processed waste; no certificates of need would be issued for the land disposal of unprocessed waste.

The candidate sites for new landfills which have been approved by the Council are shown in Figure 72.

Figure 72.
TWIN CITIES METROPOLITAN AREA COUNTIES' CANDIDATE LANDFILL SITES



No-Action Alternative-Land Disposal Abatement

If the landfill is not approved and the waste is not disposed in other existing or new landfills, another method must be used to dispose of the waste. Reducing the volume of waste which must be landfilled would reduce the need for the expansion or a portion of it. Waste abatement reduces the volume going to landfills. It includes waste reduction, waste separation and waste processing. Waste reduction is targeted at reducing the generation of waste at the source, that is, the office, factory and residence by encouraging the generator to follow practices which conserve, for example, reducing the waste of office paper and mulching grass clippings. Waste separation includes a variety of measures to recover and recycle waste materials such as aluminum cans and glass.

Waste processing means the removal of recyclable materials (glass, metals and newsprint) and removal or oxidation of organic material in solid waste through incineration, composting or other techniques. Processing waste prior to landfilling reduces the overall volume and weight of material that must be hauled and requires landfill space.

Waste processing includes the separating out of reecyclables such as those mentioned above. It could also include the removal and composting of yard waste which is a significant proportion of residential waste in the summer. Removal or oxidation of organic material in the waste could include the incineration of solid waste through resource recovery whereby the energy produced may be used to produce electricity or heat buildings. Processing removes the chemical and biological contaminants from landfilled waste which leach and impact ground and surface waters. Only the remaining residual materials would be landfilled.

The Council estimates that the Metropolitan Area currently abates 10-14 percent of its waste. Existing waste abatement programs and projects include curb-side collection of recyclables such as glass, aluminum cans and paper, office paper recycling, private incineration and yard waste composting. Both government and private organizations have organized and implemented these efforts.

If waste abatement is to be implemented as an alternative to the Flying Cloud expansion and other landfills, a regional approach is necessary to plan and coordinate program and projects development. The flow of waste to Flying Cloud and other landfills crosses community and county boundaries. The Council is currently revising its regional solid waste management plan. The plan will include a regional abatement plan with long-range objectives for the level of waste abatement to be achieved in each county. The plan will then identify the estimated additional landfill capacity needed for the same time period based on abatement objectives.

Thus far the Council has developed a consensus on the basic directions of the revised policy plan. These are as follows. The land disposed of mixed solid waste should be terminated by 1990. This is to be achieved by focusing on waste generators to reduce waste flow through the separation of recoverables (glass, metal, etc.) and hazardous wastes. Waste processing should be an intemediary step prior to resource recovery including combustion. All new landfill capacity (new sites or expansions) is to be approved based on the need for the disposal of residuals from waste abatement programs. No certificate of need will be issued for land disposal of unprocessed waste. New land disposal facilities are to be designed to minimize the impact on groundwater. Liners

and leachate collection systems will be required. Existing landfills may be expanded provided the engineering controls are comparable to new land disposal facilities. Existing landfill capacity is to be utilized prudently. If maximum abatement is to be achieved, multicounty support would be necessary.

The WMA, as amended, exempts the Flying Cloud Landfill expansion from the certificate of need requirement by virtue of the fact that an EIS preparation notice was published prior to March 15, 1984.

A draft of the proposed plan will be released for public comment in the fall of 1984.

Nevertheless, the development of comprehensive waste abatement programs and facilities could take several years to implement. It will take time to plan or design specific projects, provide funding and implement these. Public education will be necessary to change attitudes towards waste disosal methods.

Amendments to the WMA approved in 1984 will accelerate the planning and development of waste abatement programs and facilities. Beginning in 1985 50 percent of the funds from a $.50 per cubic yard surcharge to be collected by landfill operators will be directed to a metropolitan abatement fund. Ten percent of the funds can be used for local solid waste planning activities. Cities can also receive up to $.50 per household for implementation of abatement activities. Other funds will be administered by the Council for a program of grants and loans for resource recovery projects, related public education and market development for reusable and recyclable materials.

Although it will take several years to implement a comprehensive waste abatement program across the Metropolitan Area, there are several projects underway and expanding which involve the recycling of glass, paper and metals. For example, recycling programs in St. Louis Park and Minneapolis are being improved and the Minneapolis program has been expanded from a demonstration area to a city-wide activity. The city of Hopkins has a pilot program under way, and the city of Richfield is implementing a new recycling program for newsprint. All of the cities are served by the Flying Cloud Landfill. Several other cities in Hennepin County are evaluating the feasibility of recycling.

The most significant potential abatement project which would affect the expansion is the proposed Hennepin County waste-to-energy system which would include one or two resource recovery plants. The plants would incinerate approximately 600,000 tons of waste per year which is 60-65 percent of the waste generated in the county according to the Hennepin County staff. The county estimates that the plant(s) could be operating by 1989. This would be several years before the remaining capacity of the five existing alternative landfills is filled in the early 1990s. Expanded abatement activities such as city recycling programs could extend their capacity. Limiting the use of existing landfills to processed waste only would extend this capacity for many more years.

Expanding existing landfill capacity such as Flying Cloud could discourage or delay the development of alternative waste abatement programs and projects. Landfills and landfill costs have not reflected the true costs of proper waste management. Landfills have not provided for adequate protection of the natural environment and mitigation of off-site social and economic impacts. For example, liners and leachate collection systems are now available to protect groundwater and surface water resources from leachate contamination. Because

landfills have not incorporated proper controls, land disposal has been an inexpensive and convenient method of waste disposal in the region. Expanding the region's landfill capacity without proper environmental controls will continue the availability of a relatively inexpensive form of waste disposal. Abatement alternatives, which reflect the true costs of environmentally sound solid waste management, e.g., removing potential groundwater contaminants from the waste, would be at an economic and competitive disadvantage. The continued availability of less costly landfill capacity would in effect reduce the pressure and incentives for the development of alternative waste abatement programs in the region.

In accordance with the WMA, counties may control the flow of waste which allows a county to designate the waste facility where solid waste is to be deposited. Flow control could affect the volume and composition of waste landfilled in the proposed expansion. All or a portion of the waste from the Flying Cloud service area that would normally be deposited in the expansion could be directed to another waste facility. The other facility might process the waste to remove recyclables and organic material. The residuals would then be landfilled. This would reduce the volume and change the composition of the waste deposited at Flying Cloud. This would diminish the potential negative effect of the project on regional land disposal abatement.

Waste abatement programs and projects will reduce the need for landfills but will not replace them. There are waste materials which must be landfilled because they cannot be recycled or processed. Also, the waste products or residuals from abatement programs such as recycling and resource recovery facilities will be landfilled. For example, incinerator ash would be landfilled unless it can be put to a beneficial use. Waste abatement will reduce the need for landfill capacity, but it will not replace landfills. Additional capacity will be needed once the existing capacity is filled.

Land disposal abatement measures would have many beneficial environmental and socio-economic impacts. Some of the abatement measures, particularly the high technology resource recovery methods such as incinerations, may be more costly, initially, than land disposal due to the capital costs resulting in higher waste disposal costs. However these costs would more accurately reflect the true costs of sound waste management. Because some of the abatement projects such as resource recovery plants will be large, centralized facilities, hauling distances may increase from residential and commercial waste generators in the Flying Cloud service area. Waste processing could reduce the weight and volume of materials transported and this would save transportation costs. Other forms of abatement, however, could be less expensive than land disposal. For example, source separation programs such as curb-side recycling and recycling centers which facilitate the recycling of glass, metals, waste paper and other materials are based on studies that indicate the revenues from the sale of recyclables will reduce the net cost of waste disposal. These methods will also reduce the waste stream and extend the service life of existing landfills.

Abatement may provide new employment and economic development opportunities through recycling and waste processing programs. The environmental impact of waste abatement measures would have many potential positive impacts. Abatement particularly waste processing, would reduce the amount and change the composition of the materials which would be landfilled. By reducing the amount of landfilled waste and removing materials which contain potential chemical or biological contaminants hazardous to the environment, waste abatement measures such as recycling and resource recovery will reduce the potential impact on

groundwater and surface water. The recovery of materials which can be recycled or processed for reuse (glass, paper and aluminum) would also conserve natural resources. Abatement programs involving energy recovery would benefit the Flying Cloud service area directly and indirectly by conserving the traditional energy resources and reducing the Metropolitan Area's dependence on out-of-state energy sources.

Abatement would eliminate or minimize the nuisances which affect areas around landfills. Limiting landfill use to the disposal of only processed waste would reduce traffic and landfill activity. This would reduce odor, noise and litter impacts on the surrunding land uses, residents and property values. Limiting land disposal to processed waste would virtually eliminate the production of landfill gases specifically methane gas which is a potential hazard to off-site development.

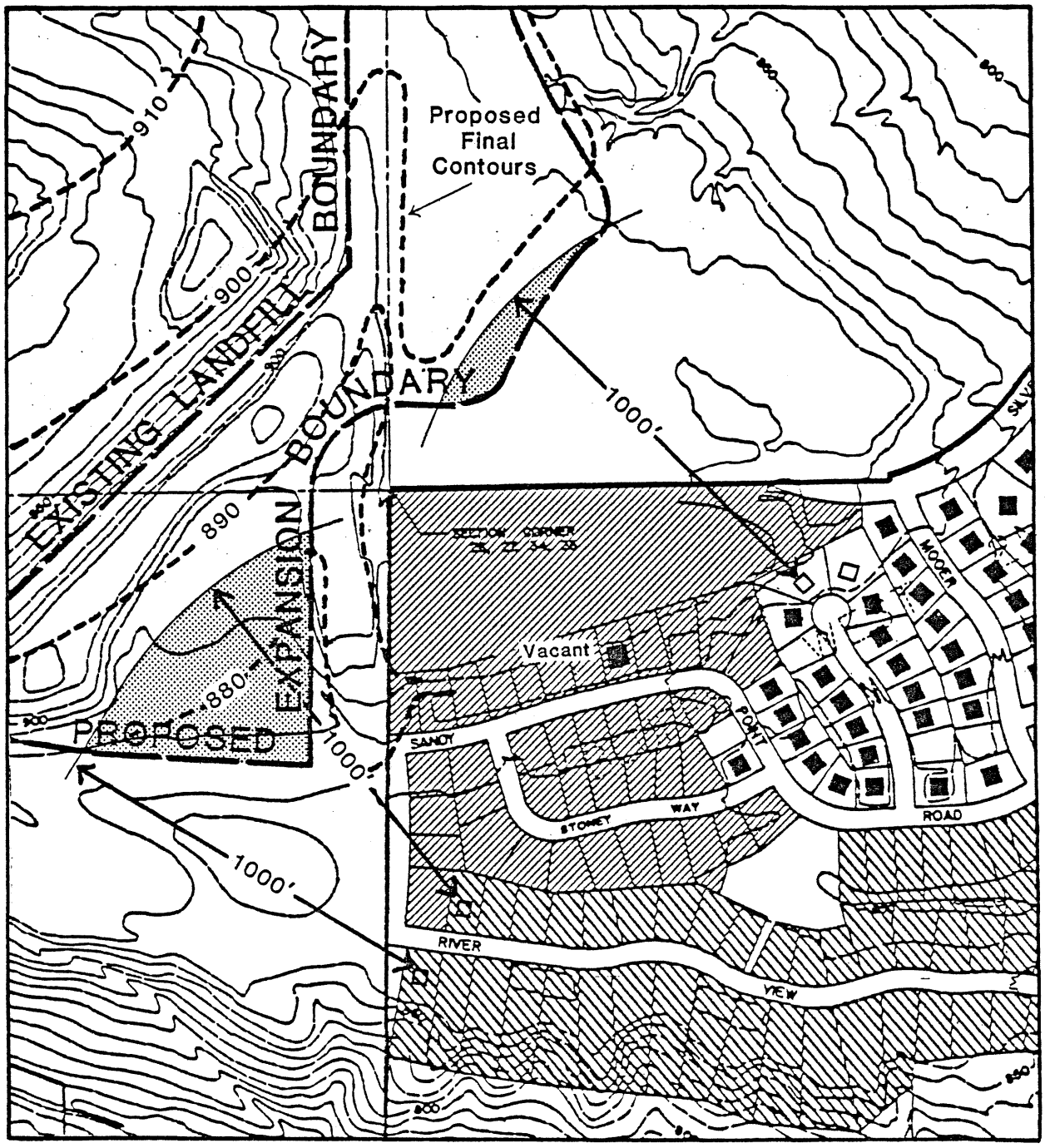
Traffic around the landfills would decrease, but it could increase at abatement project sites. Locating abatement facilities where the highway and street capacities are adequate would minimize the impact. Certain types of abatement projects such as resource recovery plants could increase the potential for air pollution. Locating abatement facilities in industrial areas would minimze the land use conflicts.

REDUCTION IN MAGNITUDE ALTERNATIVE

A change in the general magnitude of the project would further reduce or minimize potential impacts. Because of its proximity, the potential impacts of the expansion could affect the Bluffs West Second Addition. The proposed expansion would reduce the current buffer area between the existing landfill boundary, and the vacant lots and existing occupied residences in the western portion of Bluffs West. A reduction of the southeast area of the horizontal expansion would maintain a larger buffer to mitigate potential impacts during the life of the expansion. A 1,000-foot setback could be maintained between the closest existing houses or vacant lots owned by the Hustad Corporation in Bluffs West which might be developed during the life of the project. Lots owned by Woodlake are not taken into consideration. It is assumed that these lots would not be developed (Figure 73). Lots owned by Woodlake were excluded from consideration since the proposer could delay their development to avoid potential impacts. It is assumed that Hustad Corporation and other property owners intend to proceed with developing the remaining vacant lots during the operation of the expansion. The 1,000-foot setback is based on MPCA regulations which restrict landfill areas within 1,000 feet of an occupied dwelling subject to the discretion of the director. The reduction in horizontal expansion would reduce the capacity of the expansion by 214 acre-feet. The loss could be offset by increasing the vertical expansion in the north-central portion of the site.

The change in magnitude would have several beneficial impacts, primarily in the Bluffs West subdivision. The 1,000-foot setback would increase the distance to existing houses and potential house sites. This would mitigate the potential impacts of noise, litter, dust and other nuisances. Maintaining a wider buffer could also mitigate the potential impacts on land use and the effect on property values in Bluffs West. The buffer would also provide a wider area for the natural venting of methane gas which might migrate past the proposed control system. If the vertical expansion were increased in the north central area, more of the landfill would be in view from the surrounding area. However, the landscaped berm would screen the closer residences in Hillsborough

Figure 73.
LANDFILL EXPANSION BOUNDARY WITH A 1000-FOOT SETBACK



Lots owned by Woodlake Sanitary Service

Lots owned by single developer

Houses owned by individuals

Future housing nearest the landfill expansion

N 0 400 800 Feet

Sources: Base Map: G.M. Sunde, Consulting Engineer; Data: Hustad Development Corp., Woodlake Sanitary Service, Orrin Thompson Homes.

and Bluffs West. The view from houses farther away might be affected by the increased height depending on the increase.

Reducing the magnitude of the horizontal expansion would not affect the other potential impacts relating to: traffic, groundwater, surface water, the airport, vegetation, wildlife; which have been evaluated in the FEIS.

Other changes in magnitude were examined. These included the possibility of expanding the landfill into other adjoining properties. The Flying Cloud Drive-In and MAC property are large, open or relatively undeveloped areas and could provide a significant amount of capacity which might be substituted for some of the horizontal expansion to the east. However, these properties would have to be acquired by Woodlake, and it would be a business decision by the proposer if these were to be implemented. The MAC property is the airport approach zone and would not be available for use in any case. These properties do not represent reasonable alternatives at this time.

CHANGES IN OPERATION

Limiting the Expansion to Processed Waste

Limiting the expansion, or a portion such as the vertical expansion over the existing fill, to the disposal of processed waste would also minimize the potential environmental impact of leachate from the expansion on groundwater and surface waters. Processing includes the removal of recyclable materials and the removal or oxidation of organic material present in mixed refuse, leaving the residuals to be landfilled. For example, the waste ash and slag from incinerators will require landfilling if these materials cannot be put to another use.

Processing the waste before it is landfilled would have several environmental benefits. Processing reduces the volume of waste which must be landfilled. This, however, could extend the life of the proposed expansion depending on how much of the processed waste is landfilled at Flying Cloud. There would be minimum leachate impacts on groundwater, the river and Grass Lake because there would be no biological activity occurring in the expansion. No methane gas would be produced which would mitigate the potential hazard to off-site land uses.

There would be other benefits to the surrounding land uses and residents. There would be significant reductions in odors, litter and noise impacts. These benefits would reduce the potential impact on property values which concerns residents and potential home buyers. Limiting the expansion to processed waste would also reduce the attraction of the landfill as a food source for birds. This would minimize the concerns for potential conflicts with the operation of the Flying Cloud Airport.

Other Operational Changes

A number of minor changes in the operation of the landfill are discussed through the various mitigation sections of the EIS. These would minimize land use, noise, air quality and other potential impacts. One such change could potentially minimize the impacts on Bluffs West. Woodlake's proposed staging plan for the expansion indicates that excavation, filling and cover placement would proceed clockwise from north to south. Because of the proximity to Bluffs West and the potential impacts of noise and nuisances on existing houses

and vacant property, reversing this staging might minimize the impacts. Completing the southeast corner of the expansion first and moving northward would move the activities which are the source of potential impacts away from the closest area to the western portion of Bluffs West. The change might reduce the concern of property owners and potential buyers over the proximity and extended life of the landfill. Completing the southeast corner first could be perceived as a method of minimizing those aspects of the expansion, which could affect the Bluffs West subdivision.

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LIST OF PREPARERS

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NOTES

[1]Richard H. Morck. Hydrogeological Analysis of the Proposed Flying Cloud Landfill Expansion. St. Paul: Metropolitan Council. March 1984.

[2]G.S. Austin. Paleozoic Lithostratigraphy of Southeastern Minnesota. Minnesota Geological Survey. Information Circular No. 36. Minneapolis: University of Minnesota. 1969.

[3]J.H. Mossler. "Paleozoic Structure and Stratigraphy of the Twin City Region." Geology of Minnesota: A Centennial Volume. Minneapolis: Minnesota Geological Survey, University of Minnesota. 1972. pp. 494-495.

[4]H.W. Anderson, et al. "Water Resources of the Lower Minnesota River Watershed, South-Central Minnesota," Hydrologic Investigations Atlas HA-526. Washington, D.C.: U.S. Geological Survey, U.S. Dept. of Interior. 1974.

[5]Gerald M. Sunde. Hydrogeologic Analysis of the Flying Cloud Sanitary Landfill. Bloomington, Minnesota: Sunde Engineering. 1982.

[6]Morck. Op. cit.

[7]Mossler. Op. cit.

[8]G.M. Sunde. Op. cit. p. 14.

[9]M.E. Schoenberg. Water Levels and Water-Level Changes in the Prairie DuChien-Jordan and Mount Simon-Hinckley Aquifer, Twin Cities Metropolitan Area Minnesota 1971-80. St. Paul Minnesota: U.S. Geological Survey, U.S. Department of the Interior. 1984.

[10]Gerald M. Sunde. Assessment of Soils, Geology and Hydrogeology. Amended MPCA Flying Cloud Sanitary Landfill Permit SW-14. Bloomington, Minnesota: Sunde Engineering. 1983.

[11]E. A. Hickok and Associates. Unpublished maps of the hydrogeology in the Flying Cloud Airport and Flying Cloud Sanitary Landfill area, Eden Prairie, 1983.

[12]R. E. Norvitch, et. al. Water Resources Outlook for the Minneapolis-St. Paul Metropolitan Area, Minnesota. Washington, D.C.: U.S. Dept. of the Interior, U.S. Geological Survey; and St. Paul: Metropolitan Council. 1973. and Schoenberg, Op. cit.

[13]Schoenberg, Op. cit.

[14]J. Pacey and G. Karpinski. "Retrofitting Existing Landfills to Meet RCRA Standards for Leachate Control." Solid Wastes Management. (February 1979).

[15]M. Dilaj and J.F. Leonard. "Stop Leachate Problems." Water and Wastes Engineering. (October 1975).

[16]D.S. MacFarlane, et al. "Migration of Contaminants in Groundwater at a Landfill: A Case Study. 1. Groundwater Flow and Plume Delineation." J. Hydrology. 63 (May 1983).

[17]G.V. Sabel and T.P. Clark. Volatile Organic Compounds as Indicators of Municipal Solid Waste Leachate Contamination. Roseville, MN: Minnesota Pollution Control Agency. To be published.

[18]R.E. Norvitch, et al. Water Resources Outlook for the Minneapolis-St. Paul Metropolitan Area, Minnesota. Washington D.C.: U.S. Dept. of the Interior, U.S. Geological Survey; and St. Paul: Metropolitan Council. 1973. p. 109.

[19]Morck. Op. cit.

[20]F.A. Rovers and G.J. Farquhar. "Infiltration and Landfill Behavior." J. Environ. Eng. Div. ASCE. (October 1973).

[21]Morck. Op. cit.

[22]Ibid.

[23]Ibid.

[24]Ibid.

[25]R. E. Norvitch, et. al. Op. cit.

[26]Morck. Op. cit., p. 22.

[27]R.A. Freeze and J.A. Cherry. Groundwater. Englewood Cliffs, NJ: Prentice-Hall, Inc. 1979.

[28]Morck. Op. cit.

[29]J. Reindl. "Gas and Leachate Movement." Waste Age. (May 1981).

[30]D.R. Brunner and D. Keller. Sanitary Landfill Design and Operation. SW-65. Washington D.C.: U.S. Environmental Protection Agency. 1972. p. 3.

[31]J.C.S. Lu, et al. "Leachate Production and Management from Municipal Landfills: Summary and Assessment." Land Disposal: Municipal Solid Waste. EPA 600/9-81-002a. Washington, D.C.: U.S. Environmental Protection Agency. 1981.

[32]Sabel and Clark. Op. cit.

[33]S.C. James. "Metals in Municipal Landfill Leachate." American Journal of Public Health. 67. No. 5.(1977).

[34]Lu, et. al. Op. cit.

[35]Ibid.

[36]P.V. Roberts and A.J. Valocchi. "Principles of Organic Contaminant Behavior During Artificial Recharge." The Science of the Total Environment. 21 (1981).p. 163.

[37]P.L. McCarty, et al. "Trace Organics in Groundwater." Environment, Science & Technology. 15, No. 1 (1981).

[38]P.V. Roberts, et al. "Movement of Organic Contaminants in Groundwater: Implications for Water Supply." American Water Works Association Journal. 74, No. 8 (1982).

[39]McCarty, Op. cit.

[40]W.H. Fuller. Investigation of Landfill Leachate Pollutant Attenuation of Soils. EPA 600/2-78-158. Washington, D.C.: U.S. Environmental Protection Agency. August 1978.

[41]A.A. Fungaroli and R.L. Steiner. Investigation of Sanitary Landfill Behavior. Vol. I. Final Report. EPA 600/2-79-053a. Washington D.C.: U.S. Environmental Protection Agency. July 1979. p. 278.

[42]Norvitch, et al. Op. cit. p. 20.

[43]U.S. Geological Survey. Water Resources Data for Minnesota. Vol. 2 Upper Mississippi and Missouri River Basins. Washington, D.C.: U.S. Dept. of the Interior. 1981.

[44]Rovers and Farquhar. Op. cit.

[45]Dass, et al. "Leachate Production at Sanitary Landfill Sites." J. Environ. Eng. Div. ASCE. (December 1977).

[46]U.S. Environmental Protection Agency. Handbook for Remedial Action at Waste Disposal Sites. EPA 625-6-82-006. Washington, D.C.: U.S. Environmental Protection Agency. June 1982. pp. 53-55.

[47]S.C. Reinfeldt. "Wisconsin Landfill Closure Requirements." Solid Wastes Management. (December 1981). p. 39.

[48]Morck. Op. cit.

[49]Gerald M. Sunde. Op. cit.

[50]Gerald M. Sunde. Op. cit. p. 51

[51]Ibid.

[52]Ibid.

[53]Metropolitan Council. Final Environmental Impact Statement. Freeway Sanitary Landfill Expansion, Burnsville, MN. St. Paul: Metropolitan Council. March 27, 1981. p. 70.

[54]Barr Engineering Co. Riley-Purgatory Creek Watershed District. 1981 Engineer's Annual Report. Minneapolis: Barr Engineering Co. 1981. pp. 49, 50, 52.

[55]U.S. Fish and Wildlife Service. "A Survey of Potential Contaminants in Fish and Sediments from Lakes on the Minnesota Valley National Wildlife Refuge." St. Paul, Mn.: U.S. Dept. of the Interior. Aug. 1981. p.17.

[56]Ibid. p.6.

[57]Woodlake Sanitary Services, Inc. Environmental Assesment Report. Expansion of Flying Cloud Sanitary Landfill. Eden Prairie, MN: Woodlake Sanitary Services. March 4, 1982. p. 22. Appendix D; and Woodlake Sanitary Services, Inc. Woodlake Sanitary Servies, Inc. Application to Amend Hennepin County Solid Waste License and Minnesota Pollution Control Agency Permit SW-14 for Flying Cloud Sanitary Landfill. Eden Prairie, MN. p. 4.

[58]Woodlake Sanitary Services, Inc. Woodlake Sanitary Services, Inc. Application to Amend Hennepin County Solid Waste License and Minnesota Pollution Control Agency Permit SW-14 for Flying Cloud Landfill. Eden Prairie, MN.: Woodlake Sanitary Services, Inc. p. 6.

[59]Ibid. p. 7.

[60]Ibid. p. 10.

[61]Ibid. p. 11.

[62]Mn. Office of Revisor of Statutes. Minnesota Code of Agency Rules. Rules of the Minnesota Pollution Control Agency. 1982 reprint. St. Paul: State Register and Public Documents Div., Dept. of Admin. p. 200.

[63]Woodlake Sanitary Services, Inc. Op. cit. pp. 11-12.

[64]Interview with Duane Kramer, Rieke, Carroll, Muller and Assoc. Inc. Aug. 10, 1983.

[65]Gary L. Oberts. Water Resources Management: Nonpoint Source Pollution Technical Report. St. Paul, MN: Metropolitan Council. May 1982.

[66]Interview with Rolland Smith, Woodlake Sanitary Services. July, 1983.

[67]Oberts. Op. cit. p. 1.

[68]U.S. Army Corps of Engineers. Hydrologic Engineering Center. HEC-2 Water Surface Profiles. Davis, California. November 1976, Updated May 1984.

[69]U. S. Department of Agriculture Soil Conservation Service. Urban Runoff, Erosion and Sediment Control Handbook. St. Paul, Minn.

[70]Woodlake Sanitary Service. Amended MPCA Flying Cloud Sanitary Landfill Permit. Article V.B.2. Dust Emission Plan. Submitted to Minnesota Pollution Control Agency. Aug. 1, 1983. p. 5.

[71]Minnesota Dept. of Natural Resources. Correspondence of Welby Smith to Karen Harrington, Metropolitan Council. July 18, 1983.

[72]Interview with Robert C. Obermeyer, Barr Engineering. July 1983; Minnesota Dept. of Natural Resources. Correspondence of Ron Lawrenz to Karen Harrington, Metropolitan Council. Sept. 20, 1983.

[73]Werth, L. et al. A Wetlands Survey of the Twin Cities 7-County Metropolitan Area West Half. Report to the Minnesota Dept. of Natural Resources, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, U.S. Dept. of Agriculture Soil Conservation Service, and the Twin Cities Metropolitan Council. St. Paul: Institute of Agriculture, Forestry, and Home Economics, University of Minnesota. Nov. 1, 1979. p. 6.

[74]U.S. Fish and Wildlife Service. Minnesota Valley National Wildlife Refuge Environmental Impact Statement. St. Paul: U.S. Dept. of the Interior. May 1982.p. 3-3.

[75]U.S. Fish and Wildlife Service. "A Survey of Potential Contaminants in Fish and Sediments from Lakes on the Minnesota Valley National Wildlife Refuge." St. Paul: U.S. Dept. of the Interior. August 1981. p. 5.

[76]Dwain W. Warner. Wildlife Inventory of the Lower Minnesota River Valley. Minnesota Valley Wildlife Refuge/Recreation Area. Prepared for the U.S. Fish and Wildlife Service, Dept. of the Interior. St. Paul, Minnesota. December 1979. p. 1.

[77]Ibid, p. 171.

[78]U.S. Fish and Wildlife Service. May 1982. Op. cit. pp. 5-8.

[79]Minnesota Dept. of Natural Resources. Op. cit.

[80]U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration. Local Climatological Data. Annual Summary with Comparative Data. Minneapolis-St. Paul, Minnesota. Asheville, NC: National Climatic Data Center. 1982. p. 3.

[81]Woodlake Sanitary Services. Environmental Assessment Report. Expansion of Flying Cloud Sanitary Landfill. Eden Prairie, MN: Woodlake Sanitary Services. March 4, 1982. p. 6, Appendix A.

[82]Ibid. p. 15.

[83]Woodlake Sanitary Services. Amended MPCA Flying Cloud Sanitary Landfill Permit SW-14. Article V.B.2. Dust Emission Plan. Submitted to the Minnesota Pollution Control Agency. Eden Prairie, MN: Woodlake Sanitary Services. Aug. 1, 1983. p. 5.

[84]Interview with Rollin Smith, Woodlake Sanitary Service. Aug. 8, 1983.

[85]Woodlake Sanitary Services. Application to Amend Hennepin County Solid Waste License and Minnesota Pollution Control Agency Permit SW-14 for Flying Cloud Sanitary Landfill. Eden Prairie, Minnesota. Eden Prairie, MN: Woodlake Sanitary Services. p. 6.

[86]Smith, Op. cit.

[87]Woodlake Sanitary Services. March 4, 1982. Op. cit. p. 10.

[88]Glenn O. Schwab, et al., eds. Soil and Water Conservation Engineering. 3rd ed. New York: John Wiley and Sons. 1981. p. 127.

[89]Interview with Dave Breitbach, U.S. Soil Conservation Service. Sept. 15, 1983.

[90]Soil Conservation Service. Minnesota Technical Guide for the Soil Conservation Service. Section IV-1-C. Erosion Prediction. U.S. Dept. of Agriculture. Dec. 1975.

[91]Emil T. Chanlett. Environmental Protection. New York: McGraw-Hill Book Co. 1973. p. 206.

[92]Ibid.

[93]Interview with Rollin Smith, Woodlake Sanitary Services. July 1983.

[94]Woodlake Sanitary Services. Woodlake Sanitary Services, Inc. Application to Amend Hennepin County Solid Waste License and Minnesota Pollution Control Agency Permit SW-14 for Flying Cloud Sanitary Landfill. Eden Prairie, MN: Woodlake Sanitary Serivces. pp. 7, 10.

[95]Interview with Dave Breitbach, U.S. Soil Conservation Service. Sept. 15, 1983. p. 5.

[96]Woodlake Sanitary Services. March 4, 1982. Op. cit. p. 10.

[97]S.J. Wilson and R.U. Cooke. "Wind Erosion." Soil Erosion. eds. M.J. Kirby and R.P.C. Morgan. New York: John Wiley and Sons. 1980. p. 232.

[98]U.S. Environmental Protection Agency. Carbon Monoxide Hot-Spot Guidelines. EPA-450/3-78-033. Washington, D.C.: U.S. Environmental Protection Agency. 1978.

[99]J. Pacey and G. Karpinski. "Assessing a Landfill's Potential as a Methane Gas Producer." Solid Wastes Management. (November 1979). p. 28.

[100]EMCON Associates. State of the Art of Methane Gas Enhancement, prep. for Argonne National Laboratories. San Jose, CA: Emcon Associates. December 1979. p. 10.

[101]Ibid.

[102]Ida A. Leone, Franklin B. Flower, Edward F. Gilman, John J. Arthur. Adapting Woody Species and Planting Techniques to Landfill Conditions. EPA-600/2-79-128. U.S. Environmental Protection Agency. August 1979. pp. 5-6.

[103]Minnesota Pollution Control Agency. "Assessing the Potential for Generating Gas and Odor from Residual Waste Landfill Sites." Disposal of Residuals by Landfilling. p. IV-1.

[104]Leone, et. al. Op. cit. p. 6.

[105]John Rennie. "Direct Burning of Landfill Gas." Waste Age (June 1983). p. 38.

[106]N.W. Flynn and M. Guttman. Trace-Chemical Characterization of Pollutants Occurring in the Production of Landfill Gas. DOE/CS/20291-2* NTIS. U.S. Dept. of Energy. October 1982. pp. 5/2, 5/18.

[107]Gregg Easterbrook. "The Great Escape." Waste Age. (September 1979). p. 32.

[108]Walter J. Maier. Assessment of Landfill Gas Generation, Control Methods and Hazards; Flying Cloud Landfill. Technical Report prepared in conjunction with Flying Cloud EIS. October 1983. p. 5.

[109]Ibid. p. 21.

[110]EMCON Associates. Methane Generation and Recovery from Landfills. Ann Arbor, MI: Ann Arbor Science Publishers, Inc. 1982. p. 59.

[111]R.J. Lutton, G.L. Regan, and L.W. Jones. Design and Construction of Covers for Solid Waste Landfills. EPA-600/2-79-165. U.S. Environmental Protection Agency. August 1979. p. 124.

[112]Leone, et. al. Op. cit. p. 9.

[113]Ibid. p. 11.

[114]Maier. Op. cit. p. 11.

[115]Woodlake Sanitary Services, Inc. Environmental Assessment Report: Expansion of Flying Cloud Sanitary Landfill. Eden Prairie, MN: Woodlake Sanitary Services, Inc. March 4, 1982. pp. 15, 43-44.

[116]Ralph Stone. "Reclamation of Landfill Methane and Control of Off-Site Migration Hazards." Solid Waste Management. (July 1978). p. 54.

[117]Woodlake Sanitary Services. Inc. Amended MPCA Flying Cloud Sanitary Landfill Permit SW-14. Part V.A. Methane Report. subm. to the Minnesota Pollution Control Agency. Eden Prairie, MN: Woodlake Sanitary Services, Inc. Aug. 1, 1983. pp. 4, 7.

[118]Ibid. Appendix.

[119]Ibid. p. 7.

[120]Ibid. pp. 4-5.

[121]Ibid. p. 6.

[122]Interview with Rollin Smith, Woodlake Sanitary Services, Inc. August 1983.

[123]Woodlake Sanitary Services, Inc. August 1, 1983. Op. Cit.

[124]John Reindl. "Gas and Leachate Movement." Waste Age. May 1981. p. 63.

[125]EMCON Associates. Landfill Gas Migration Control System: Flying Cloud Landfill, Eden Prairie, MN. prep. for Woodlake Sanitary Services, Inc. San Jose, CA.: EMCOM Associates. March 1982. pp. 1-10.

[126]Smith. Op. cit.

[127]Thomas L. Connelly. "Exploding Methane Migration Myths." Public Works. (April 1983). p. 31.

[128]C.A. Moore, Igbal S. Rai, and John Lynch. "Computer Design of Landfill Methane Migration Control." Journal of the Environmental Engineering Division, ASCE. 108, No. EE1 (February 1982). pp. 104-105.

[129]EMCON Associates. Landfill Gas Recovery Assessment: Flying Cloud Landfill, Eden Prairie, MN. prep. for Browning-Ferris Industries. San Jose, CA: EMCON Associates. March 1982. pp. 9-21.

[130]Charles A. Moore and Iqbal S. Rai. "Design Criteria for Gas Migration Control Devices." Management of Gas and Leachate in Landfills. Op.cit. p. 96.

[131]Ibid. p. 93.

[132]Maier. Op. cit. p. 37.

[133]Interview with Bob Hutchison, Anoka County. Oct. 4, 1983.

[134]"More on Methane." Waste Age. (January 1980). p. 50.

[135]Franklin B. Flower, Ida A. Leone, Edward F. Gilman, and John J. Arthur. "Vegetation Kills in Landfill Environs." Management of Gas and Leachate in Landfills. EPA-600/9-77-026. U.S. Environmental Protection Agency. 1977. p. 221.

[136]Ibid. p. 223.

[137]"Sprucin' Up a Landfill." Waste Age. (March 1981). p. 42.

[138]Franklin B. Flower, Ida. A. Leone, Edward F. Gilman and John J. Arthur. A Study of Vegetation Problems Associated with Refuse Landfills. EPA 2.3/2=600/2-78-094. U.S. Environmental Protection Agency. May 1978.

[139]Leone. Op. cit.

[140]J. Pacey. "Controlling Landfill Gas." Waste Age. (November 1979). p. 34.

[141]G. R. Ford. Evaluation of Potential Impacts of Construction and Traffic Vibrations Along Alternate Alignments 1, 3A and 4 in the Town of Wabasha, Minnesota S.P. 7910-07 and 7911-05, T.H. 60. Minnesota Department of Transportation, 1980.

[142]Minnesota Pollution Control Agency. Final Environmental Impact Statement: Woodlake Sanitary Landfill Proposed Expansion. Roseville, MN: Minnesota Pollution Control Agency. October 1980. p. 111.

[143]G.D. Schroder and M. Hulse. "Survey of Rodent Populations Associated with an Urban Landfill." American Journal of Public Health. 69, No. 7 (July 1979). pp. 713-715.

[144]Interview with Bud Kager, Woodlake Sanitary Services. July 1983.

[145]R.J. Lutton, G.L. Regan and L.W. Jones. Design and Construction of Covers for Solid Waste Landfills. EPA 625/6-82-006. U.S. Environmental Protection Agency. August 1979. p. 204.

[146]J. Pacey and G. Karpinski. "Assessing a Landfill's Potential as a Methane Gas Producer." Solid Wastes Management. November 1979. p. 28.

[147]Lutton, et al. Op. cit. pp. 205-206.

[148]"Sanitary Landfill Operation." Waste Age. (September 1981). p. 72.

[149]Interview with the Fire Marshall for Eden Prairie, MN.

[150]Woodlake Sanitary Services, Inc.

[151]Strgar-Roscoe, Inc. "Traffic Analysis for Proposed Expansion to Flying Cloud Landfill." prepared for Woodlake Sanitary Services, Inc. February 1982.

[152]Minnesota Department of Transportation. "Hourly Vehicle Type Data." 1981.

[153]Institute of Transportation Engineers 1982. Transportation And Traffic Engineering Handbook. 2nd ed. -"Level of Service "C" is still a zone of stable flow but at this volume and density most drivers are becoming restricted in their freedom to select speed, change lanes, or pass. Operating speeds are still in the range of two-thirds to three-forths of maximum; land density reaches 30 to 35 vehicles/miles on freeways (19 to 22 vehicles/km).

[154]Level of service "D" approaches unstable flow. Tolerable operating speeds are maintained but are subject to considerable and sudden variation. Freedom to maneuver and driving comfort are low because lane density may reach as high as 45 to 50 vehicles/miles (28 to 31 vehicles/km). Most drivers would consider this service level undesirable.

[155]Metropolitan Council. Alternate 3D Historical Report. St. Paul: Metropolitan Council. 1981.

[156]Interview with Minnesota Department of Transportation District 5 Traffic Engineers.

[157]Ibid.

[158]Interview with Danny Larson, Traffic Engineer, Hennepin County Traffic Engineering Department.

[159]Interview with Minnesota Dept. of Transportation District 5 Traffic Engineer.

[160]Minnesota Dept. of Transportation. 1981 Average Daily Traffic Volumes. Map 3D.

[161]Strgar-Roscoe, Inc. Op. cit. pp. 3 and 4.

[162]Metropolitan Council. Assignment 1A 1990 ADT on 1975 No Build Network (MVT). St. Paul: Metropolitan Council. Assignment 1A was used because of its No Build Network, which assumes that the new Highway 212 is not yet built. More recent forecasts which assume the construction of 212 assign much of the traffic which would normally be on TH 169 to the new 212, giving a lower ADT for TH 169. Assignment 1A assigns the traffic to TH 169.

[163]Minnesota Dept. of Transportation. "Highlights of Minnesota Weight Regulations." Oct. 19, 1982.

[164]Minnesota Dept. of Transporation. Ten Ton Route Guide - State, County & Municipal Ten Ton Routes.

[165]Ibid.

[166]Interview with Hennepin County Traffic Department.

[167]Interview with Minnesota Dept. of Transportation District 5 Traffic Engineers and Hennepin County Traffic Department.

[168]Interview with Rodney B. Kager, Vice President, Woodlake Sanitary Services, Inc.

[169]Interview with Minnesota Dept. of Public Safety, State Patrol Division.

[170]Interview with Minnesota Dept. of Transportation, District Five Engineers.

[171]Strgar-Roscoe, Inc. Op. cit. pp. 9 and 11.

[172]Ibid. p.9.

[173]Institute of Traffic Engineers. Informational Report Trip Generation. Second Ed. 1979.

[174]Interview with Bob Carlson, Orrin Thompson Homes. June 29, 1983.

[175]U.S. Fish and Wildlife Service. Master Plan for the Minnesota Valley National Wildlife Refuge Environmental Impact Statement. May 1982.

[176]Interview with Nigel Finney, Metropolitan Airports Commission.

[177]Interview with Timothy Anderson, Metropolitan Airports Commission. June 1983.

[178]Metropolitan Airports Commission. Environmental Impact Assessment Report: Proposed Extension to Runway 9R-27L; Associated Taxiways and Lighting System for Flying Cloud Airport. June 1979. pp. 1/6-2/5.

[179]World Magazine. 12, No. 8 (August 1982).

[180]Federal Register. 44, No. 1979 (Sept. 13, 1979.). p. 53459.

[181]Ibid.

[182] Memorandum from Richard Wetzel, U.S. Fish and Wildlife Service. Oct. 14, 1982.

[183]Interview with Nancy Burgstahler, U.S. Fish and Wildlife Service. July 1983.

[184]J.C. Green and R.B. Janssen. Minnesota Birds: Where, When and How Many. Minneapolis: University of Minnesota Press. 1975. pp. 98-100.

[185]Wetzel. Op. cit.

[186]"Shotgun Shells Scare Seagulls at County Landfill." Solid Wastes Management. 23, No. 12 (December 1980). p. 36.

[187]"Land Disposal of Solid Wastes." Waste Age. (April 1981). p. 174.

[188]V.E.F. Solman. "Aircraft and Wildlife." Proc. Wildlife in an Urbanizing Environment. Springfield, Massachusetts. (November 1973). pp. 137-140.

[189]"Landfill Wires Turn Seagulls From Diners Into Spectators." Solid Wastes Management. 22, No. 9 (September 1979). p. 18.

[190]Ibid.

[191]Burgstahler. Op. cit.

[192]Interview with O.R. Burckhardt, Bird Hazard Coordinator. Airports District Office, Federal Aviation Administration. May 1983.

[193]Interview with Robert Palmby, Tower Chief. Flying Cloud Airport. June 1983.

[194]Minnesota Dept. of Transportation. Draft Environmental Impact Statement for St. Paul Downtown Airport (Holman Field). 1982. pp. 5-182.

[195]Metropolitan Council."Guidelines for Land Use Compatability With Aircraft Noise." Aviation Chapter. Metropolitan Development Guide. St. Paul: Metropolitan Council. March 1983.

[196]Burckhardt. Op. cit.

[197]Metropolitan Council. March 1983. Op. cit.

[198]Richard Schmalensee, et. al. Measuring External Effects of Solid Waste Management. EPA-600/5-75-010. Washington D.C.: U.S. Environmental Protection Agency. March 1975. pp. 383-395.

[199]Hays B. Gamble, et. al. Effects of Solid Waste Disposal Sites on Community Development and Residential Property Values. Institute for Research on Land and Water Resources. Pennsylvania State University. University Park, Pennsylvania. November 1982.

[200]Metropolitan Council. Compensation and Mitigation: Dealing with the Adverse Impacts of Solid Waste Disposal Facilities. St. Paul: Metropolitan Council. 1982. pp. 15-16.

[201]Interview with Pat Poshek, Washington County Assessor's Office. January 1984.

[202]Interview with Dave Beel, Representative of Orrin Thompson Homes. February 17, 1984.

[203]Effects of Sanitary Landfills on the Value of Residential Property (draft) prepared for Browning-Ferris Industries, Research and Planning Consultants, Inc. March 22, 1983.

[204]Interview with Steve Sinell, City Assessor, City of Eden Prairie. February 1984.

[205]Metropolitan Council. Recommendations for Dealing with the Adverse Impacts of Solid Waste Disposal Facilities. St. Paul: Metropolitan Council. 1983. p. 13.

[206]Conversation with Wally Hustad, Hustad Development Corporation, March 8, 1984.

[207]Interview with Bud Kager. Browning-Ferris Industries. Sept. 14, 1983.

[208]Interview with Steven Sinell. Eden Prairie Assessor's Office. Sept. 15, 1983.

[209]Ibid.

[210]Ibid.

[211]Ibid.

[212]Ibid.

[213]Woodlake Sanitary Services, Inc. Environmental Assessment Report. Expansion of Flying Cloud Sanitary Landfill. Eden Prairie, Mn: Woodlake Sanitary Service, Inc. March 4, 1983. p.9.

[214]Bud Cager. Op. cit.

[215]Woodlake Sanitary Services, Inc. Op. cit. p. 49.

[216]Woodlake Sanitary Services, Inc. Application to Amend Hennepin County Solid Waste License and Minnesota Pollution Control Agency Permit SW-14 for Flying Cloud Sanitary Landfill. Eden Prairie, Minnesota. Eden Prairie: Woodlake Sanitary Services, Inc. pp. 8,9.

[217]Interview with Kathy Berg and Myrna Colbeck, Mn. Pollution Control Agency. Sept. 26, 1983.

JH0025, PHENV1

... APPENDICES

APPENDIX A
SURFACE WATER QUALITY DATA

The SCS Curve Number Method was used to derive runoff estimates for the proposed project. This method considers land use or cover, precipitation and soil type in arriving at estimates of runoff. The basic equation used is:

$$\frac{1}{A}\sum(A_i CN_i) \text{ to derive a weighted curve number}$$

where A_i = acres of land in $usage_i$; CN_i = curve number for $usage_i$ and its hydrologic soil group.

The weighted curve number and precipitation are then used to enter tables that have pre-calculated runoff estimates.

In these calculations, the precipitation from the 100-year six-hour storm (4.4") was used. Acreages were estimated using a planimeter.

Table A1
RUNOFF CALCULATIONS FOR THE CITY'S DRAINAGE BASIN

Time Period	Land Use	Acreage	Soils Group	Weighted CN	Runoff (Acre-ft.)
Before expansion	meadow	19.9	B		
	dirt road	.9	B		
	Total	20.8		59	1.58
After completion	good open space	10.8	C;D	74	1.71; 2.14[a]

Table A2
RUNOFF CALCULATIONS TO THE ON-SITE DETENTION POND AND MINNESOTA RIVER

Time Period	Land Use	Acreage	Soils Group	Weighted CN	Runoff (Acre-ft.)
Stage 8	fallow (fill)	65.0	C		
	good open space (swale)	20.3	C		
	dirt road (drive-in)	7.4	A & B		
	industrial (shop area)	18.6	A		
	good open space (fill)	73.5	C,D		
	Total	184.8		81;83	37.9; 40.7[a]
After completion	good open space (fill)	138.5	C,D		
	good open space (swale)	20.3	C		
	dirt road (drive in)	7.4	A & B		
	industrial (shop area)	18.6	A		
	Total	184.8		75;79	30.3; 35.3[a]

[a]The first estimate is for group C final soils; the second, for group D.

APPENDIX B
SURVEY OF ON-SITE PLANT SPECIES

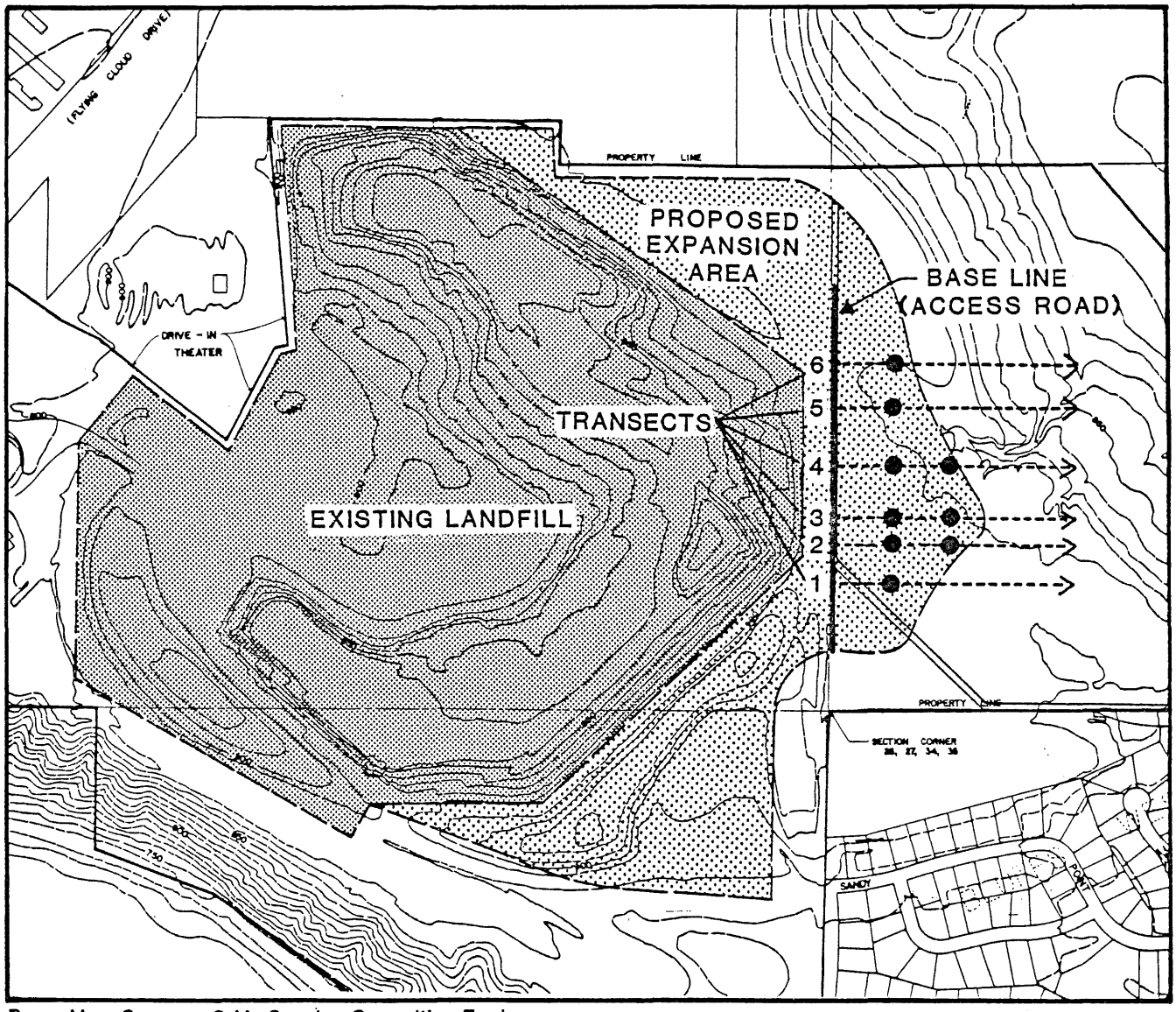
Metropolitan Council staff surveyed the proposed horizontal expansion area on July 12 and 13, 1983 to identify plant species. Staff, along with a representative of the Dept. of Natural Resources Heritage Program, also surveyed the site on July 15.[1]

Six transect base points were randomly selected, rounded to the nearest 50-foot increment, and placed along a dirt road just east of the existing landfill. The transect themselves were placed perpendicular to the dirt road, and extended eastward. A circular quadrat 10 feet in diameter was placed at 200 foot intervals along each transect (Figure B1). On June 12 and 13, staff identified the plant species present in each quadrat, and estimated percent coverage for each species. The raw data for each quadrat is contained in Table 1B. On June 15, staff surveyed the site to locate and identify species outside of the quadrats (Table 2B).

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[1] Welby Smith of the DNR Natural Heritage Program assisted Council staff on June 15.

Figure B1.
LOCATION OF SAMPLING QUADRATS



Base Map Source: G.M. Sunde, Consulting Engineer

N

0 500 1000 Feet

● QUADRATS

Table 1B.
COVER ABUNDANCE AND SPECIES PRESENCE DATA[1,2]

Species	Transect/Quadrat 1/1	2/1	2/2	3/1	3/2	4/1	4/2	5/1	6/1
Agropyron repens (quack grass)	X1		X1	X1	X1	X2			X2
Bromus inermis (smooth brome grass)	X3	X3	X1	X1	X5	X2	X4	X2	X2
Phleum pratense (timothy)							X1		
Poa pratensis (Ky. blue grass)		X2	X2	X3	X2	X2	X4	X4	X4
Melilotis alba (white sweet clover)	X3		X4	X2	X1	(combined =	(combined =	X1	
Melilotis officinales (yellow sweet clover)	X2	X2	X3	X2	X2	X2)	X1)	X1	X1
Trifolium pratense (red clover)	X1	X1		X1				X1	X1
Trifolium repens (white clover)			X1	X1				X1	
Acer negundo (boxelder)				X1					
Ambrosia artemisiifolia (common ragweed)		X1	X1	X1	X1	X4	X2	X1	X1
Amphicarpa bracteata (hog-peanut)				X1					
Anemone cylindrica (long-fruited thimbleweed)			X1	X1					
Aster ericoides (heath aster)	X1	X1		X1				X1	
Berteroa incana (hoary alyssum)	X1	X2	X1			X1		X1	X2
Carya sp. (hickory)				X1					
Circium spp. (thistle)			X1	X1					X1
Convolvulus arvensis (field bindweed)				X2	X2	X1		X1	X1
Crepis tectorum (hawk's beard)	X1	X1	X1	X1	X1		X1		X1
Erigeron annuus (daisy fleabane)	X1	X1	X1	X1			X1		
Euphorbia esula (leafy spurge)		X2					X3	X4	X2
Hedeoma hispida (mint)				X1					
Lactuca serriola (prickly lettuce)			X1						
Lychnis alba (white campion)		X1							
Mentha arvensis (wild mint)						X1			
Plantago sp. (plantain)				X1					
Polygonum convolvulvus (black bindweed)	X1	X1	X1			X1	X1		
Rosa arkansana (prairie rose)				X1			X1		
Rubus ideaus (red raspberry)				X1					
Sisymbrium altissimum (tumble mustard)	X1			X1	X1	X1			X1
Solidago spp. (goldenrod)	X1	X2	X1	X2	X1	X1		X1	
Sonchus oleraceus (common sowthistle)		X1							
Tragopogon dubius (yellow goat's-beard)		X1	X1	X1		X1			
Urtica dioica (stinging nettle)				X1					

[1]An "X" indicates that the species was present in the quadrat. Other letters and numbers indicate cover abundance:

r = single occurrence
1 = cover < 5 percent
2 = cover 5-25 percent
3 = cover 25-50 percent
4 = cover 50-75 percent
5 = cover 75-100 percent

Table 2B
ADDITIONAL SPECIES OBSERVED OUTSIDE OF QUADRATS

Acer negundo (boxelder)
Ambrosia trifida (giant ragweed)
Agrostis alba (redtop grass)
Apocynum sibiricum (dogbane)
Artemesia serrata (sawtooth prairie sage)
Asclepias verticillata (whorled milkweed)
Carex brevior

Carex gravida
Carex sp.
Chenopodium album (lamb's quarters)
Cynoglossum officinale (hound's tongue)

Dactylio gromerata (orchard grass)
Hordeum jubatum (foxtail grass)
Elymus canadensis (canadian wild rye)
Fraxinus pennsylvania (green ash)
Leonurus cardiaca (motherwort)
Lobelia spicata (pale spiked lobelia)
Lonicera japonica (Japanese honeysuckle)
Juniperus virginiana (red cedar)
Medicago sativa (alfalfa)
Mentha arvensis (wild mint)
Mirabilis hyctaginea (wild four-o-clock)
Phlox divaricata (wild blue phlox)
Physalis heterophylla (clammy ground cherry)
Polygonum convolvulvous (_____ _____)
Polygonum persicaria (lady's thumb)
Populus deltoides (cottonwood)
Potentilla simplex (common cinquefoil)
Prunus virginiana (chokecherry)
Rubus strigosus (raspberry)
Rumex crispus (curled dock)
Rumex mexicana (____ dock)
Salix interior (sandbar willow)
Salix amygdaloides (peachleaf willow)
Silene anturhina (sleepy catchfly)
Solanum sp. (nightshade)
Sporabolis cryptandius (____ dropseed)
Symphoricarpos occidentalis (wolf berry)
Taraxacum officinale (common dandelion)
Ulmus americana (American elm)
Verbena hastata (blue vervain)

APPENDIX C
CORRESPONDENCE

WOODLAKE SANITARY SERVICE, INC.

A Subsidiary of Waste Systems™ BROWNING-FERRIS INDUSTRIES

April 19, 1983

Steve Hendren
Eden Prairie Citizens Coalition
10283 Winter Place
Eden Prairie, MN 55344

Dear Mr. Hendren;

First, I'd like to apologize for any misunderstanding which may exist as a result of our conversation of March 7, 1983. Our concern has always been that of good neighbors. Secondly, I'd like to thank you for bringing to my attention obvious operational problems that have been corrected.

So that we may better coordinate our efforts, we have installed a phone for the use of area residents to call attention to potential problem areas. This number will be answered between the hours of 8:00 A.M. and 4:30 P.M. - Monday thru Friday as well as 8:00 A.M. and 2:00 P.M. on Saturday's. All conversations will be logged in with appropriate response times. That number is 941-8835.

Additionally, for off sight litter control, we have hired a person whose responsibility is to assure the adequacy of our litter control program. Possibly you will be seeing her in your area.

I can assure you that it is our intention to meet all responsibilities as outlined in our permit. To that end, should you have any concerns which I can alleviate, please feel free to contact me.

Sincerely,

Rodney B. Kager
District Manager

cc: Dan Comeau
John Moeger
Karl Schenk
Wolfgang Penzl
Randy Johnson
Carl Julie
Ed Monteleone

(612)296-1652

February 28, 1983

Carl Schenk
Metropolitan Council
300 Metro Quare Building
St. Paul, Minnesota 55101

Re: Expansion of Flying Cloud Sanitary Landfill
Environmental Assessment Worksheet
District 5

Dear Mr. Schenk:

The Minnesota Department of Transportation (Mn/DOT) has completed a review of the above referenced EAW. We do not anticipate that the proposed development will adversely impact Mn/DOT transportation systems.

If you require additional information from Mn/DOT, please contact Robert Morast, Transportation Analysis Engineer at our District Office in Golden Valley, phone number (612)545-3761.

Sincerely,

Cheryl Heide

Cheryl Heide, Planner
Office of Environmental Services

BFI Waste Systems™
BROWNING-FERRIS INDUSTRIES
ARROWHEAD REGION

January 24, 1983

Mr. Karl Schenk
Metropolitan Council
300 Metro Square Building
7th & Robert
St. Paul, MN 55101

Re: Landfill Volume and Remaining Life
Flying Cloud Sanitary Landfill

Dear Mr. Schenk:

Enclosed are calculations for remaining life and volumes at the Flying Cloud Sanitary Landfill. Two cases are considered: filling as will be permitted under the amended permit now being prepared by the MPCA and filling to the expansion limits as proposed by Woodlake Sanitary Services, Inc., in their environmental assessment report dated March 4, 1982.

Please contact me if you have any questions or require further information.

Yours very truly,

John G. Curry, Jr.

John G. Curry, Jr.
Regional Landfill Manager

JGC/gdp

Enc.

LANDFILL VOLUME AND REMAINING LIFE
FLYING CLOUD SANITARY LANDFILL

The following calculation is intended to estimate the remaining landfill air space volume at the Flying Cloud Sanitary Landfill for two cases. The first is the amount allowed by the draft permit being prepared in 1982-83 (the latest available draft is dated January 6, 1983). The second case is for the proposed expansion of the landfill as described in the environmental assessment report prepared by Woodlake Sanitary Services, Inc., and dated March 4, 1982.

The effective date used in the above calculations is June 1, 1982, that date used in preparation of the draft amended permit.

Total Remaining Air Space

As part of the preparation work for the environmental assessment report dated March 4, 1982, air space volumes were calculated for the site. Two values were calculated and were either cited in that report or in subsequent correspondence (Gerald M. Sunde's letter to BFI dated April 15, 1982). These are as follows:

1. Volume to fill the existing landfill

The volume to fill the existing landfill was based on completion of the site to the final contours as developed by BFI in 1977. These final contours are shown in Figure 5 of the environmental assessment report. Excavation contours for the existing site are shown in Figure 9 of the same report. The extent of filling of the site was based on contours as of July of 1981.

The calculations indicated that as of July 1981, 3,682 acre feet of air space volume remained to fill the site to the final contours as developed by BFI in 1977.

2. Volume of the proposed expansion

The environmental assessment report dated March 4, 1982, shows final excavation contours (Figure 9) and final fill contours (Figure 7) for the proposed landfill expansion. Calculations indicate that the air space volume for the expansion would be 3,665 acre feet (see page 2 of the environmental assessment report).

3. Total remaining air space

The MPCA in their amended permit process has elected to allow a landfill quantity somewhat less than that which will fill the existing site to the final contours. However, the Woodlake Sanitary Services, Inc., proposal for the expansion of the site remains the same. Therefore, the total remaining site volume (permitted plus expansion) will equal the sum of the volumes calculated above less the amount filled during the period from July 1981 to June 1, 1982.

The following table shows tons of refuse received by the landfill during the period from July 1981 to June 1, 1982.

Month & Year	Tonnage
August 1981	32,717
September 1981	33,746
October 1981	32,221
November 1981	27,903
December 1981	25,481
January 1982	25,954
February 1982	21,279
March 1982	25,954
April 1982	33,980
May 1982	36,098
Total	291,614 T

The above tonnage can be converted to air space volume using a yield of 1,000 gate pounds per inplace air space cubic yard. This is the same yield used in the previously cited environmental assessment report of March 4, 1982.

$$\text{Air space vol.} = 291{,}614 \frac{2{,}000(27)}{1{,}000(43{,}560)} = 361 \text{ AF}$$

Therefore the remaining total air space volume at the Flying Cloud Sanitary Landfill (permitted plus expansion) will be

$$\text{Total Volume} = 3{,}682 + 3{,}665 - 361 = \underline{6{,}986 \text{ AF}}$$

Permitted Air Space Volume

The MPCA draft permit dated January 6, 1983, indicates that 1,342 acre feet of air space volume will be permitted under that interim permit based on a date of June 1, 1982.

Air Space Volume of Proposed Expansion

The air space volume of the proposed expansion will be the total remaining volume less the permitted volume as indicated in the MPCA draft permit or:

$$\text{Expansion Volume} = 6{,}986 - 1{,}342 = \underline{5{,}644 \text{ acre ft}}.$$

Remaining Life

Estimated life of the landfill is calculated based on present generation rates, a landfill density of 1,000 pounds per air space cubic yard, and an annual growth rate in tonnage received of 10 percent. As a base, the year 1982 is used. In that year, the Flying Cloud Sanitary Landfill received 355,345 tons (440 cubic yards of air space volume).

The following table shows the calculation of incoming refuse tonnage expressed as air space volume.

Time interval	Volume, AF	Cumulative Volume AF
6/1/82 - 12/31/82	268	268
1/1/83 - 12/31/83	484	752
1/1/84 - 12/31/84	532	1,284
1/1/85 - 12/31/85	586	1,870
1/1/86 - 12/31/86	644	2,514
1/1/87 - 12/31/87	709	3,223
1/1/88 - 12/31/88	779	4,002
1/1/89 - 12/31/89	857	4,859
1/1/90 - 12/31/90	943	5,802
1/1/91 - 12/31/91	1,037	6,839
1/1/92 - 12/31/92	1,141	7,980

Therefore, the 1,342 acre feet of air space volume to be permitted by the present draft permit (latest revision of January 6, 1983) would be filled by about February of 1985.

The total of 6,986 acre feet of remaining life (permitted volume plus the proposed expansion) would be filled by about February of 1992.

Waste Systems™
BROWNING-FERRIS INDUSTRIES
ARROWHEAD REGION

June 30, 1983

Mr. Carl Schenk
Metropolitan Council
300 Metro Square Building
St. Paul, MN 55101

Re: Flying Cloud Landfill Expansion - Exterior Berm Detail on East Side

Dear Mr. Schenk:

Per your request (letter of June 8, 1983) regarding the berm details at Flying Cloud, we are submitting a cross-section detail of the berm that is proposed for the east side of the expansion area.

The linear extent and location of the berm that is proposed can be seen on Figure 13 of the E.A.R.

The landscaping and plantings on the berm will consist of understory and overstory which will be composed of native deciduous and coniferous mix.

If more information than this is required, please let me know.

Yours truly,

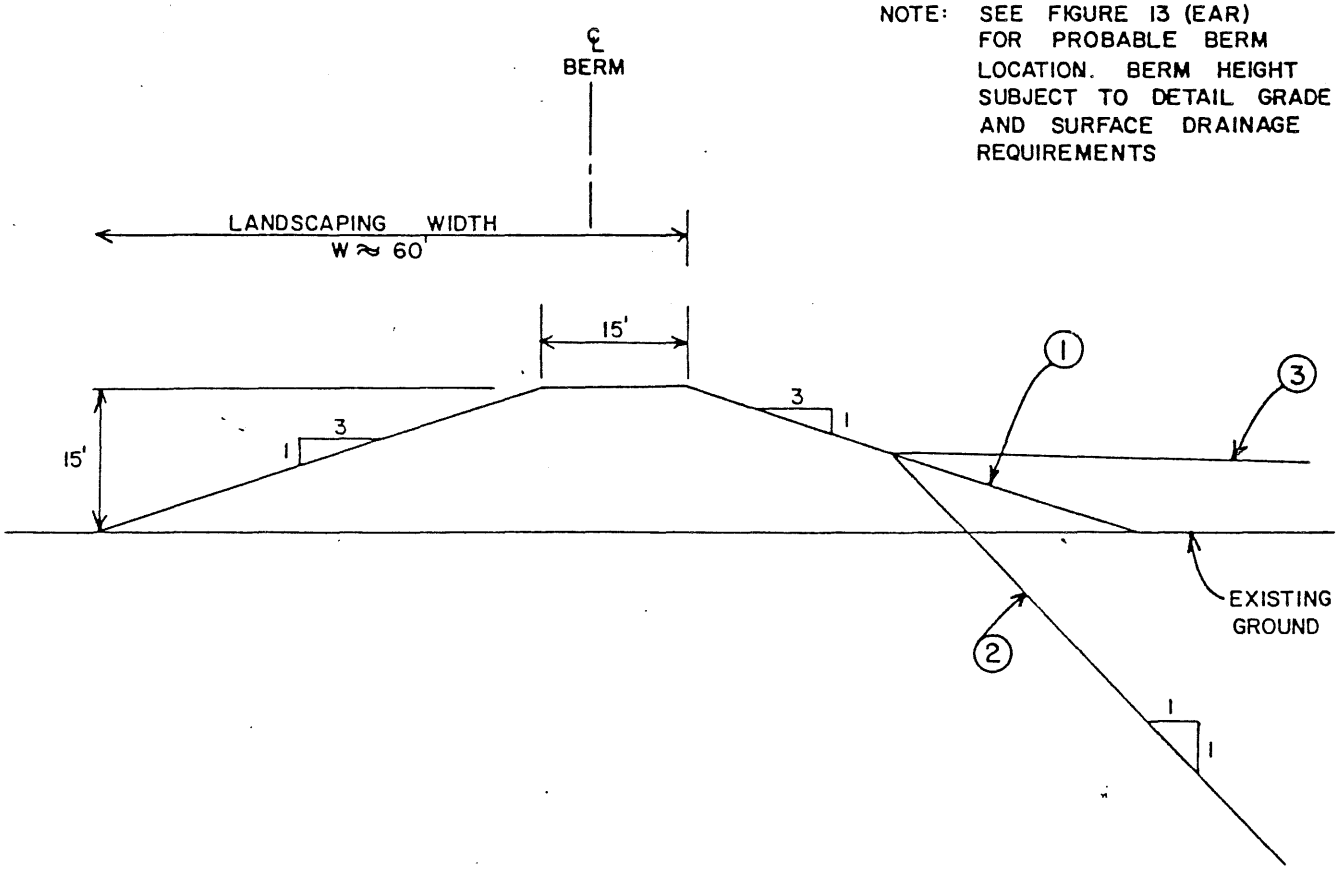
John G. Curry, Jr.
Regional Landfill Manager

JGC/pjb

Enc.

cc: G. M. Sunde
D. Nowlin
D. Coy
B. Kager

NOTE: SEE FIGURE 13 (EAR) FOR PROBABLE BERM LOCATION. BERM HEIGHT SUBJECT TO DETAIL GRADE AND SURFACE DRAINAGE REQUIREMENTS



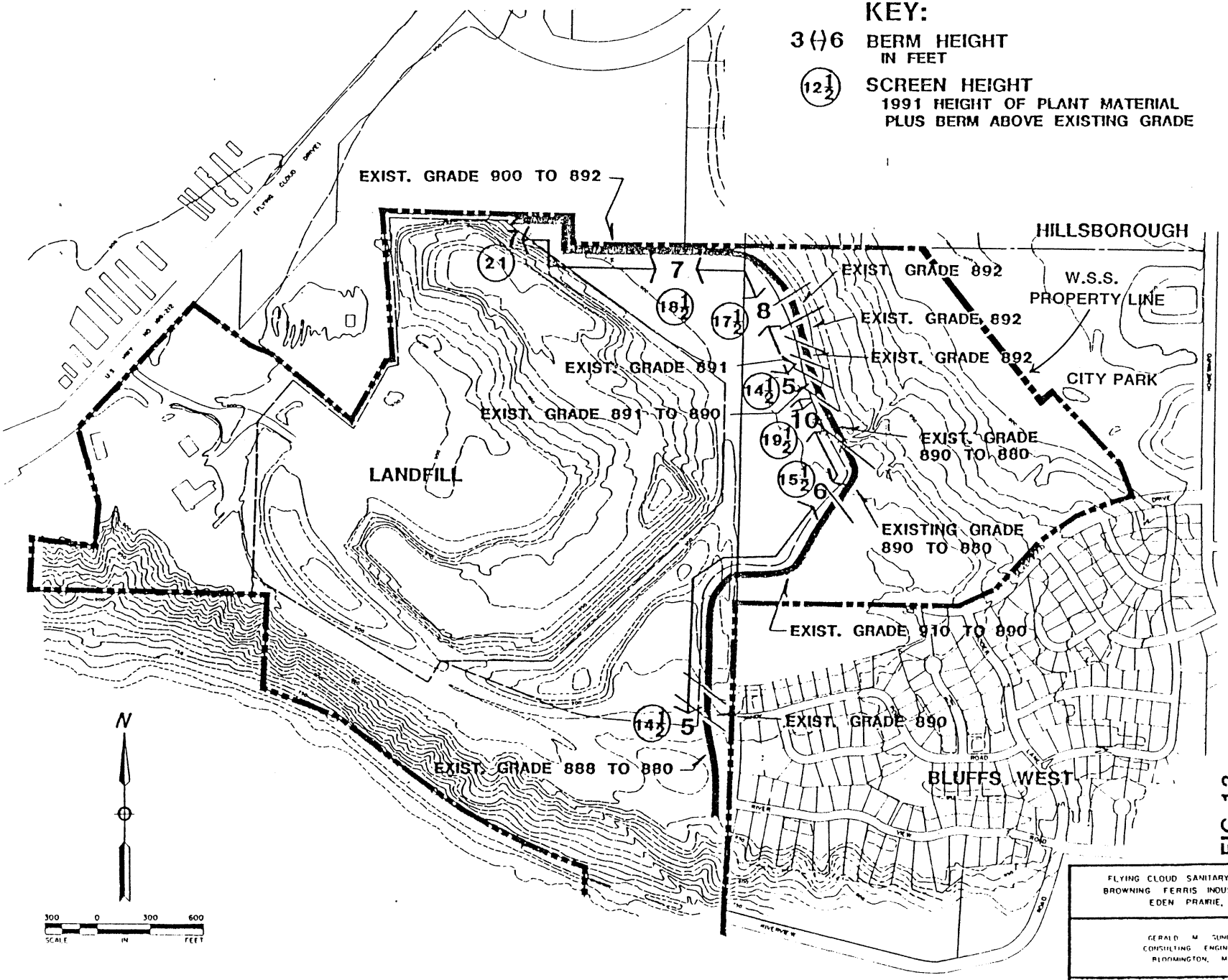
SLOPE 1 — INITIAL BERM SLOPE APPROX. 3:1. BUILD WHEN BERM IS FIRST INSTALLED.

SLOPE 2 — STEEP SLOPE: CASE WHEN EXCAVATION IS DONE NEXT TO BERM FOR LANDFILL AIR SPACE.

SLOPE 3 — FINAL TOP OF LANDFILL GRADE. SEE GRADING PLAN FOR SLOPE (MIN. = 2%). GRADE SHOWN IS TOP OF FINAL COVER.

SECTION: PERIMETER BERM

SCALE: 1" = 20'



Brauer & Associates Ltd. Inc.
7901 Flying Cloud Drive, Eden Prairie, Minnesota 55344

I certify that this plan, specification or report was prepared by me or under my direct supervision and I am a duly registered ... Under the laws of the state of ... Reg. No. ... Date ...

Job No. ... Drawn ... Date ...
Revisions ... Final Check ...
Field Book No. ...

FIG. 13
LANDFILL SCREENING PLAN

FLYING CLOUD SANITARY LANDFILL
BROWNING FERRIS INDUSTRIES, INC
EDEN PRAIRIE, MN

GERALD M. SUNDE
CONSULTING ENGINEER
BLOOMINGTON, MN

WOODLAKE SANITARY SERVICES, INC.
-EDEN PRAIRIE LANDFILL-

SHEET ... OF ...

Minnesota
Department of Transportation
District Nine
3801 Duluth Street
Golden Valley, MN 55422

December 8, 1983

Mr. Carl Schenk
Metropolitan Council
300 Metro Square Building
7th & Robert Street
St. Paul, MN 55101

Re: Expansion of the Flying Cloud Sanitary Landfill and Potential Highway Impacts

Dear Carl:

We have reviewed the traffic forecast in the Environmental Impact Statement Scoping Decision Document. It would appear that the forecast of increased truck traffic in the next ten years to the landfill area will require some type of protected southbound left turn.

We have conducted an accident study in the Flying Cloud area from CSAH 1 to the hill near the Metro Airport Commission access. From January 1, 1981 to the present, there have been a total of 23 accidents (16 property damage, 6 personal injuries and 1 fatal). This is within a one mile stretch including the sanitary landfill access. Only one accident (property damage) can be attributed to this access, but we do feel that accidents would increase with more than double the number of trucks using this access by 1992. Further, it is possible that a number of accidents were caused indirectly by southbound trucks making left turns to the landfill.

The Scoping Document alluded to possible improvements to alleviate the increased truck traffic impacts and also the proposed project from Schooner Boulevard to CSAH 1. In addition to the improvements proposed, the following should also be considered: Include a traffic control system at the landfill access and also interconnect the frontage roads on either side of T.H.169 serving the airport on one side and the business property on the other.

Sincerely,

C. J. Hoffstedt
Transportation Planning Engineer

CJH:pn
(GTA)

WILLIAMS PIPE LINE COMPANY
ONE OF THE WILLIAMS COMPANIES

APACHE OFFICE PARK - SUITE 246
2500 39th AVENUE NORTHEAST
MINNEAPOLIS, MN 55421

August 24, 1983

Rodney B. Kager
Woodlake Sanitary Service, Inc.
9813 Flying Cloud Drive
Eden Prairie, Minnesota 55344

Re: Tracts 7321, 7322, 7323

Dear Mr. Kager:

Pursuant to our meeting on August 18, 1983, this letter will confirm the procedure necessary to accomplish relocation of Williams pipe line across property owned by your company.

First you must make a formal request that Williams consider rerouting the line. The request should state why the reroute is being requested and show the proposed location for the reroute. The proposed reroute will be reviewed by our Engineering Department and, if they find that the proposed reroute is acceptable and feasable, will so indicate to our Lands Records and Claims Section. Land Records and Claims and this office will be involved in negotiating the terms of an agreement for relocation of our line and reumbursement of same. When this has been done, a formal agreement will be drawn in triplicate and executed by all parties thereto. Any required deposits of cash will have to be made upon execution of the agreement and prior to purchase of materials and commencement of construction.

The actual reroute will be accomplished by construction of a new line at the new location. That line will be laid at about four feet below the proposed final grade of the land at the new location. After the line has been constructed, all welds x-rayed and the line pressure tested, the existing line will be shut down and the product in the line will be drained out into transport trucks. When the line is empty, it will be cut at both ends of the reroute section and the new section of pipe tied into the main line. This tie-in will be accomplished in one long days time. After the reroute is tied in and in operation, the abandoned line will be removed from the site.

A final accounting of cost will then be made and you will be billed for any additional monies owed or returned any monies due you.

The review and agreement process will take from four to eight weeks. Acquisition of materials and the bid process will take about 6 to 8 weeks. Actual construction will take 8 to 12 working days.

If you have any further questions, please contact me.

Very truly yours,

D. L. Berry
Supervisor
Lines and Right of Way

cc: H. E. Janzen
J. R. Grisham

Carl Schenk
Metropolitan Council
300 Metro Square Bldg.
Seventh and Robert
St. Paul, Minnesota 55101

DLB:js

Minnesota Department of Transportation

District 5
2055 No. Lilac Drive
Golden Valley, Minnesota 55422 (612)545-3761

January 5, 1982

Chris Enger
Director of Planning
City of Eden Prairie
8950 Eden Prairie Road
Eden Prairie, MN 55344

RE: C.S. 2744, T.H. 169
Flying Cloud Landfill

Dear Chris:

Your letter of December 31st was received by this office and I consulted with our maintenance section and have the following information to report to you in the same order as the questions are asked in your letter.

1) Our maintenance foreman and supervisor do not believe that T.H. 169 has had any more debris on it than any of our other major roads. In fact, they remarked that the landfill operation has fairly stringent control measures to prevent loss of loads.

2) The question of whether land or road improvements are needed in order to facilitate safer truck movements is somewhat difficult to answer. Practically any intersection on T.H. 169 could be made safer with additional work. At the present time there are 3 lanes at the entrances so that trucks can stop before making a left hand turn.

3) It is difficult, even impossible, to distinguish an overload by a refuse truck or any other overloaded vehicle. Overloads of any kind present a problem to us and with the proximity of the old Flying Cloud Scalehouse, the Department of Public Safety may have better control on T.H. 169 than in other areas.

4) There have been a few times when high winds have deposited paper and debris on our highway. In these instances, we have found Browning Ferris Industries to be very cooperative in cleaning up with their own forces or, if traffic conditions required our cleanup, they promptly reimbursed the State for those hours lost. We have other landfills on other highways that probably have more problems in this regard than the Flying Cloud Landfill.

5) We know there was a substantial fire at the landfill, but our foreman and supervisor could not remember any significant problems to the highway resulting from that fire.

I trust that this provides the information you wished.

Sincerely,

W. M. Crawford, P.E.
District Engineer

Airports District Office
6301 - 34th Avenue, South
Minneapolis, Minnesota 55450

MAR 19 1982

10377-1

Mr. Rodney E. Massey, P. E.
Chief, Program Development and
Facility Review Section
Minnesota Pollution Control Agency
1935 West County Road B2
Roseville, Minnesota 55113

Dear Mr. Massey:

We have received a copy of the Metropolitan Council's notice of review of the Woodlake Sanitary Services, Inc. MPCA Solid Waste Disposal Facility Permit Application for expansion of the Flying Cloud Sanitary Landfill at Eden Prairie, Minnesota.

We have reviewed the proposal and have the following comments:

The site of the proposed expansion would fall within 5000 feet of a runway used by piston type aircraft. FAA Order 5200.5 considers sanitary landfills incompatible land use when within this distance. This proposal would move the landfill operations closer to the flight path of aircraft departing and landing at the Flying Cloud Airport. (See F.R. 1 Vol. 44, No. 1791 Thursday, September 13, 1979, Pages 53438 through 53464).

The proposed site presently serves as a sanitary landfill that has been in operation for a number of years. There has been a history of problems with birds attracted to the vicinity of the airport due to the availability of putrescible wastes at the sanitary landfill. However, as a result of good housekeeping practices on the part of Browning-Ferris Industries (B.F.I.) and their cooperation, potential bird hazards have occurred only on rare occasions and these were promptly corrected.

3.22

Based on our past experience with B.F.I. operations at the Flying Cloud Sanitary Landfill we remove our objections to the proposed expansion plans.

Sincerely,

Contingent on FAA approval of [illegible] amendment [illegible] the Instrument [illegible].

Original Signed by:
OREN R. BURCKHARDT

Oren R. Burckhardt
Bird Hazard Coordinator

cc: Myking, MDA
Finney, MAC
Palmby, ATCT
Quick, AGL-662.1
Wetzel, FWS
Rutford, MC

APPENDIX D
U.S. ENVIRONMENTAL PROTECTION AGENCY
WATER QUALITY CRITERIA

human epidemiology studies using the following basic exposure assumptions: a 70-kilogram male person (*Report of the Task Group on Reference Man,* International Commission for Radiation Protection, November 23, 1957) as the exposed individual; the average daily consumption of freshwater and estuarine fish and shellfish products equal to 6.5 grams/day; and the average ingestion of two liters/day of water (*Drinking Water and Health,* National Academy of Sciences, National Research Council, 1977). Criteria based on these assumptions are estimated to be protective of an adult male who experiences average exposure conditions.

Two basic methods were used to formulate health criteria, depending on whether the prominent adverse effect was cancer or other toxic manifestations. The following sections detail these methods.

Carcinogens

Extrapolation of cancer responses from high to low doses and subsequent risk estimation from animal data is performed using a linearized multi-stage model. This procedure is flexible enough to fit all monotonically-increasing dose response data, since it incorporates several adjustable parameters. The multi-stage model is a linear non-threshold model as was the "one-hit" model originally used in the proposed criteria documents. The linearized multi-stage model and its characteristics are described fully in Appendix C. The linear non-threshold concept has been endorsed by the four agencies in the Interagency Regulatory Liaison Group and is less likely to underestimate risk at the low doses typical of environmental exposure than other models that could be used. Because of the uncertainties associated with dose response, animal-to-human extrapolation and other unknown factors, because of the use of average exposure assumptions, and because of the serious public health consequences that could result if risk were underestimated, EPA believes that it is prudent to use conservative methods to estimate risk in the water quality criteria program. The linearized multistage model is more systematic and invokes fewer arbitrary assumptions than the "one-hit" procedure previously used.

It should be noted that extrapolation models provide estimates of risk since a varitey of assumptions are built into any model. Models using widely different assumptions may produce estimates ranging over several orders of magnitude. Since there is at present no way to demonstrate the scientific validity of any model, the use of risk extrapolation models is a subject of debate in the scientific community. However, risk extrapolation is generally recognized as the only tool available at this time for estimating the magnitude of health hazards associated with non-threshold toxicants and has been endorsed by numerous Federal agencies and scientific organizations, including EPA's Carcinogen Assessment Group, the National Academy of Sciences, and the Interagency Regulatory Liaison Group as a useful means of assessing the risks of exposure to various carcinogenic pollutants.

Non-Carcinogens

Health criteria based on toxic effects of pollutants other than carcinogenicity are estimates of concentrations which are not expected to produce adverse effects in humans. They are based upon Acceptable Daily Intake (ADI) levels and are generally derived using no-observed-adverse-effect-level (NOAEL) data from animal studies although human data are used wherever available. The ADI is calculated using safety factors to account for uncertainties inherent in extrapolation from animal to man. In accordance with the National Research Council recommendations *(Drinking Water and Health,* National Academy of Sciences, National Research Council, 1977), safety factors of 10, 100, or 1,000 are used depending on the quality and quantity of data. In some instances extrapolations are made from inhalation studies or limits to approximate a human response from ingestion using the Stokinger-Woodward model (Journal of American Water Works Association, 1958). Calculations of criteria from ADIs are made using the standard exposure assumptions (2 liters of water, 6.5 grams of edible aquatic products, and an average body weight of 70 kg).

Dated: October 24, 1980.

Douglas M. Costle,

Administrator.

Appendix A—Summary of Water Quality Criteria

Acenaphthene

Freshwater Aquatic Life

The available data for acenaphthene indicate that acute toxicity to freshwater aquatic life occurs at concentrations as low as 1,700 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of acenaphthene to sensitive freshwater aquatic animals but toxicity to freshwater algae occur at concentrations as low as 520 μg/l.

Saltwater Aquatic Life

The available data for acenaphthene indicate that acute and chronic toxicity to saltwater aquatic life occur at concentrations as low as 970 and 710 μg/l, respectively, and would occur at lower concentrations among species that are more sensitive than those tested. Toxicity to algae occurs at concentrations as low as 500 μg/l.

Human Health

Sufficient data is not available for acenaphthene to derive a level which would protect against the potential toxicity of this compound. Using available organoleptic data, for controlling undesirable taste and odor quality of ambient water, the estimated level is 20 μg/l. It should be recognized that organoleptic data as a basis for establishing a water quality criteria have limitations and have no demonstrated relationship to potential adverse human health effects.

Acrolein

Freshwater Aquatic Life

The available data for acrolein indicate that acute and chronic toxicity to freshwater aquatic life occurs at concentrations as low as 68 and 21 μg/l, respectively, and would occur at lower concentrations among species that are more sensitive than those tested.

Saltwater Aquatic Life

The available data for acrolein indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 55 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of acrolein to sensitive saltwater aquatic life.

Human Health

For the protection of human health from the toxic properties of acrolein ingested through water and contaminated aquatic organisms, the ambient water criterion is determined to be 320 μg/l.

For the protection of human health from the toxic properties of acrolein ingested through contaminated aquatic organisms alone, the ambient water criterion is determined to be 780 μg/l.

Acrylonitrile

Freshwater Aquatic Life

The available data for acrylonitrile indicate that acute toxicity to freshwater aquatic life occurs at concentrations as

low as 7,550 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No definitive data are available concerning the chronic toxicity of acrylonitrile to sensitive freshwater aquatic life but mortality occurs at concentrations as low as 2,600 μg/l with a fish species exposed for 30 days.

Saltwater Aquatic Life

Only one saltwater species has been tested with acrylonitrile and no statement can be made concerning acute or chronic toxicity.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of acrylonitrile through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are .58 μg/l, .058 μg/l and .006 μg/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 6.5 μg/l, .65 μg/l, and .065 μg/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

Aldrin-Dieldrin

Dieldrin

Freshwater Aquatic Life

For dieldrin the criterion to protect fresh water aquatic life as derived using the Guidelines is 0.0019 μg/l as a 24-hour average and the concentration should not exceed 2.5 μg/l at any time.

Saltwater Aquatic Life

For dieldrin the criterion to protect saltwater aquatic life as derived using the Guidelines is 0.0019 μg/l as a 24-hour average and the concentration should not exceed 0.71 μg/l at any time.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of dieldrin through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are .71 ng/l, .071 ng/l, and .0071 ng/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are .76 ng/l, .076 ng/l, and .0076 ng/l respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

Aldrin

Freshwater Aquatic Life

For freshwater aquatic life the concentration of aldrin should not exceed 3.0 μg/l at any time. No data are available concerning the chronic toxicity of aldrin to sensitive freshwater aquatic life.

Saltwater Aquatic Life

For saltwater aquatic life the concentration of aldrin should not exceed 1.3 μg/l at any time. No data are available concerning the chronic toxicity of aldrin to sensitive saltwater aquatic life.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of aldrin through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are .74 ng/l, .074 ng/l, and .0074 ng/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are .79 ng/l, .079 ng/l, and .0079 ng/l, respectively. Other concentrations respresenting different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

Antimony

Freshwater Aquatic Life

The available data for antimony indicate that acute and chronic toxicity to freshwater aquatic life occur at concentrations as low as 9,000 and 1,6[illegible] μg/l, respectively, and would occur at lower concentrations among species that are more sensitive than those tested. Toxicity to algae occurs at concentrations as low as 610 μg/l.

Saltwater Aquatic Life

No saltwater organisms have been adequately tested with antimony, and no statement can be made concerning acute or chronic toxicity.

Human Health

For the protection of human health from the toxic properties of antimony ingested through water and contaminated aquatic organisms, the ambient water criterion is determined to be 146 μg/l.

For the protection of human health from the toxic properties of antimony ingested through contaminated aquatic organisms alone, the ambient water criterion is determined to be 45,000 μg/l.

Arsenic

Freshwater Aquatic Life

For freshwater aquatic life the concentration of total recoverable trivalent inorganic arsenic should n[illegible] exceed 440 μg/l at any time. Short-effects on embryos and larvae of aquatic vertebrate species have been shown to occur at concentrations as low as 40 μg/l.

Saltwater Aquatic Life

The available data for total recoverable trivalent inorganic arsenic indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 508 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of trivalent inorganic arsenic to sensitive saltwater aquatic life.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of arsenic through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are

estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 22 ng/l, 2.2 ng/l, and .22 ng/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 175 ng/l, 17.5 ng/l, and 1.75 ng/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

Asbestos

Freshwater Aquatic Life

No freshwater organisms have been tested with any asbestiform mineral and no statement can be made concerning acute or chronic toxicity.

Saltwater Aquatic Life

No saltwater organisms have been tested with any asbestiform mineral and no statement can be made concerning acute or chronic toxicity.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of asbestos through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 300,000 fibers/1, 30,000 fibers/1, and 3,000 fibers/1, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

Benzene

Freshwater Aquatic Life

The available data for benzene indicate that acute toxicity to freshwater aquatic life occurs at concentrations as low as 5,300 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of benzene to sensitive freshwater aquatic life.

Saltwater Aquatic Life

The available data for benzene indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 5,100 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No definitive data are available concerning the chronic toxicity of benzene to sensitive saltwater aquatic life, but adverse effects occur at concentrations as low as 700 μg/l with a fish species exposed for 168 days.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of benzene through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 6.6 μg/l, .66 μg/l, and .066 μg/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 400 μg/l, 40.0 μg/l, and 4.0 μg/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

Benzidine

Freshwater Aquatic Life

The available data for benzidine indicate that acute toxicity to freshwater aquatic life occurs at concentrations as low as 2,500 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of benzidine to sensitive freshwater aquatic life.

Saltwater Aquatic Life

No saltwater organisms have been tested with benzidine and no statement can be made concerning acute and chronic toxicity.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of benzidine through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 1.2 ng/1, .12 ng/1, and .01 ng/1, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 5.3 ng/1, .53 ng/1, and .05 ng/1, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

Beryllium

Freshwater Aquatic Life

The available data for beryllium indicate that acute and chronic toxicity to freshwater aquatic life occurs at concentrations as low as 130 and 5.3 μg/l, respectively, and would occur at lower concentrations among species that are more sensitive than those tested. Hardness has a substantial effect on acute toxicity.

Salt water Aquatic Life

The limited saltwater data base available for beryllium does not permit any statement concerning acute or chronic toxicity.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of beryllium through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 37 ng/l, 3.7 ng/l, and .37 ng/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 841 ng/l, 84.1 ng/l, and 8.41 ng/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

Cadmium

Freshwater Aquatic Life

For total recoverable cadmium the criterion (in μg/l) to protect freshwater aquatic life as derived using the Guidelines is the numerical value given

by $e^{(1.05\,(\ln(\text{hardness}))-3.49}$ as a 24-hour average and the concentration (in μg/l) should not exceed the numerical value given by $e^{(1.05\,(\ln(\text{hardness}))-2.73}$ at any time. For example, a hardnesses of 50, 100, and 200 mg/l as $CaCO_3$ the criteria are 0.012, 0.025, and 0.051 μg/l, respectively, and the concentration of total recoverable cadmium should not exceed 1.5, 3.0 and 6.3 μg/l, respectively, at any time.

Saltwater Aquatic Life

For total recoverable cadmium the criterion to protect saltwater aquatic life as derived using the Guidelines is 4.5 μg/l as a 24-hour average and the concentration should not exceed 59 μg/l at any time.

Human Health

The ambient water quality criterion for cadmium is recommended to be identical to the existing drinking water standard which is 10 μg/l. Analysis of the toxic effects data resulted in a calculated level which is protective of human health against the ingestion of contaminated water and contaminated aquatic organisms. The calculated value is comparable to the present standard. For this reason a selective criterion based on exposure solely from consumption of 6.5 grams of aquatic organisms was not derived.

Carbon Tetrachloride

Freshwater Aquatic Life

The available date for carbon tetrachloride indicate that acute toxicity to freshwater aquatic life occurs at concentrations as low as 35,200 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of carbon tetrachloride to sensitive freshwater aquatic life.

Saltwater Aquatic Life

The available data for carbon tetrachloride indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 50,000 μg/l and would occur at lower concentrations among species that are more sensitive that those tested. No data are available concerning the chronic toxicity of carbon tetrachloride to sensitive saltwater aquatic life.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of carbon tetrachloride through ingestion of contaminated water and contaminated aquatic organisms the ambient water concentration should be zero based on the non-thresho' l assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 4.0μg/l, .40 μg/l, and .04 μg/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 69.4 μg/l, 6.94 μg/l, and .69 μg/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

Chlordane

Freshwater Aquatic Life

For chlordane the criterion to protect freshwater aquatic life as derived using the Guidelines is 0.0043 μg/l as a 24-hour average and the concentration should not exceed 2.4 μg/l at any time.

Saltwater Aquatic Life

For chlordane the criterion to protect saltwater aquatic life as derived using the Guidelines is 0.0040 μg/l as a 24-hour average and the concentration should not exceed 0.09 μg/l at any time.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of chlordane through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 4.8 ng/l, .46 ng/l, and .046 ng/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 4.8 ng/l, .48 ng/l, and .048 ng/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

Chlorinated Benzenes

Freshwater Aquatic Life

The available data for chlorinated benzenes indicate that acute toxicity to freshwater aquatic life occurs at concentrations as low as 250 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are availab' concerning the chronic toxicity of the more toxic of the chlorinated benzenes to sensitive freshwater aquatic life but toxicity occurs at concentrations as low as 50 μg/l for a fish species exposed for 7.5 days.

Saltwater Aquatic Life

The available data for chlorinated benzenes indicate that acute and chronic toxicity to saltwater aquatic life occur at concentrations as low as 160 and 129 μg/l, respectively, and would occur at lower concentrations among species that are more sensitive than those tested.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of hexachlorobenzene through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding recommended criteria are 7.2 ng/l, .7 ng/l, and .072 ng/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 7.4 ng/l, .74 ng/l, and .074 ng/l, respectively.

For the protection of human health from the toxic properties of 1,2,4,5-tetrachlorobenzene ingested through water and contaminated aquatic organisms, the ambient water criterion is determined to be 38 μg/l.

For the protection of human health from the toxic properties of 1,2,4,5-tetrachlorobenzene ingested through contaminated aquatic organisms alone, the ambient water criterion is determined to be 48 μg/l.

For the protection of human health from the toxic properties of pentachlorobenzene ingested through water and contaminated aquatic organisms, the ambient water criterion is determined to be 74 μg/l.

For the protection of human health from the toxic properties of pentachlorobenzene ingested through contaminated aquatic organisms alone, the ambient water criterion is determined to be 85 μg/l.

Using the present guidelines, a satisfactory criterion cannot be deri

at this time due to the insufficiency in the available data for trichlorobenzene.

For comparison purposes, two approaches were used to derive criterion levels for monochlorobenzene. Based on available toxicity data, for the protection of public health, the derived level is 488 μg/l. Using available organoleptic data, for controlling undesirable taste and odor quality of ambient water, the estimated level is 20 μg/l. It should be recognized that organoleptic data as a basis for establishing a water quality criteria have limitations and have no demonstrated relationship to potential adverse human health effects.

Chlorinated Ethanes

Freshwater Aquatic Life

The available freshwater data for chlorinated ethanes indicate that toxicity increases greatly with increasing chlorination, and that acute toxicity occurs at concentrations as low as 118,000 μg/l for 1,2-dichloroethane, 18,000 μg/l for two trichloroethanes, 9,320 μg/l for two tetrachloroethanes, 7,240 μg/l for pentachloroethane, and 980 μg/l for hexachloroethane. Chronic toxicity occurs at concentrations as low as 20,000 μg/l for 1,2-dichloroethane, 9,400 μg/l for 1,1,2-trichloroethane, 2,400 μg/l for 1,1,2,2-tetrachloroethane, 1,100 μg/l for pentachloroethane, and 540 μg/l for hexachloroethane. Acute and chronic toxicity would occur at lower concentrations among species that are more sensitive than those tested.

Saltwater Aquatic Life

The available saltwater data for chlorinated ethanes indicate that toxicity increases greatly with increasing chlorination and that acute toxicity to fish and invertebrate species occurs at concentrations as low as 113,000 μg/l for 1,2-dichloroethane, 31,200 μg/l for 1,1,1-trichloroethane, 9,020 μg/l for 1,1,2,2-tetrachloroethane, 390 μg/l for pentachloroethane, and 940 μg/l for hexachloroethane. Chronic toxicity occurs at concentrations as low as 281 μg/l for pentachloroethane. Acute and chronic toxicity would occur at lower concentrations among species that are more sensitive than those tested.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of 1,2-dichloroethane through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 9.4 μg/l, .94 μg/l, and .094 μg/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 2,430 μg/l, 243 μg/l, and 24.3 μg/l respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

For the protection of human health from the toxic properties of 1,1,1-trichloroethane ingested through water and contaminated aquatic organism, the ambient water criterion is determined to be 18.4 mg/l.

For the protection of human health from the toxic properties of 1,1,1,-trichloroethane ingested through contaminated aquatic organisms alone, the ambient water criterion is determined to be 1.03 g/l.

For the maximum protection of human health from the potential carcinogenic effects due to exposure of 1,1,2-trichloroethane through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 6.0 μg/l, .6 μg/l, and .06 μg/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 418 μg/l, 41.8 μg/l, and 4.18 μg/l respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

For the maximum protection of human health from the potential carcinogenic effects due to exposure of 1,1,2,2-tetrachloroethane through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 1.7 μg/l, .17 μg/l, and .017 μg/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 107 μg/l, 10.7 μg/l, and 1.07 μg/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

For the maximum protection of human health from the potential carcinogenic effects due to exposure of hexachloroethane through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 19 μg/l, 1.9 μg/l, and .19 μg/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 87.4 μg/l, 8.74 μg/l, and .87 μg/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

Using the present guidelines, a satisfactory criterion cannot be derived at this time due to the insufficiency in the available data for monochloroethane.

Using the present guidelines, a satisfactory criterion cannot be derived at this time due to the insufficiency in the available data for 1,1,-dichloroethane.

Using the present guidelines, a satisfactory criterion cannot be derived at this time due to the insufficiency in the available data for 1,1,1,2-tetrachloroethane.

Using the present guidelines, a satisfactory criterion cannot be derived at this time due to the insufficiency in the available data for pentachloroethane.

Chlorinated Naphthalenes

Freshwater Aquatic Life

The available data for chlorinated naphthalenes indicate that acute toxicity to freshwater aquatic life occurs at concentrations as low as 1,600 μg/l and would occur at lower concentrations among species that are

more sensitive than those tested. No data are available concerning the chronic toxicity of chlorinated naphthalenes to sensitive freshwater aquatic life.

Saltwater Aquatic Life

The available data for chlorinated napthalenes indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 7.5 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of chlorinated naphthalenes to sensitive saltwater aquatic life.

Human Health

Using the present guidelines, a satisfactory criterion cannot be derived at this time due to the insufficiency in the available data for chlorinated napthalenes.

Chlorinated Phenols

Freshwater Aquatic Life

The available freshwater data for chlorinated phenols indicate that toxicity generally increases with increasing chlorination, and that acute toxicity occurs at concentrations as low as 30 μg/l for 4-chloro-3-methylphenol to greater than 500,000 μg/l for other compounds. Chronic toxicity occurs at concentrations as low as 970 μg/l for 2,4,6-trichlorophenol. Acute and chronic toxicity would occur at lower concentrations among species that are more sensitive than those tested.

Saltwater Aquatic Life

The available saltwater data for chlorinated phenols indicate that toxicity generally increases with increasing chlorination and that acute toxicity occurs at concentrations as low as 440 μg/l for 2,3,5,6-tetrachlorophenol and 29,700 μg/l for 4-chlorophenol. Acute toxicity would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of chlorinated phenols to sensitive saltwater aquatic life.

Human Health

Sufficient data is not available for 3-monochlorophenol to derive a level which would protect against the potential toxicity of this compound. Using available organoleptic data, for controlling undesirable taste and odor quality of ambient water, the estimated level is 0.1 μg/l. It should be recognized that organoleptic data as a basis for establishing a water quality criteria have limitations and have no demonstrated relationship to potential adverse human health effects.

Sufficient data is not available for 4-monochlorophenol to derive a level which would protect against the potential toxicity of this compound. Using available organoleptic data, for controlling undesirable taste and odor quality of ambient water, the estimated level is 0.1 μg/l. It should be recognized that organoleptic data as a basis for establishing a water quality criteria have limitations and have no demonstrated relationship to potential adverse human health effects.

Sufficient data is not available for 2,3-dichlorophenol to derive a level which would protect against the potential toxicity of this compound. Using available organoleptic data, for controlling undesirable taste and odor quality of ambient water, the estimated level is .04 μg/l. It should be recognized that organoleptic data as a basis for establishing a water quality criteria have limitations and have no demonstrated relationship to potential adverse human health effects.

Sufficient data is not available for 2,5-dichlorophenol to derive a level which would protect against the potential toxicity of this compound. Using available organoleptic data, for controlling undesirable taste and odor quality of ambient water, the estimated level is .5 μg/l. It should be recognized that organoleptic data as a basis for establishing a water quality criteria have limitations and have no demonstrated relationship to potential adverse human health effects.

Sufficient data is not available for 2,6-dichlorophenol to derive a level which would protect against the potential toxicity of this compound. Using available organoleptic data, for controlling undesirable taste and odor quality of ambient water, the estimated level is .2 μg/l. It should be recognized that organoleptic data as a basis for establishing a water quality criteria have limitations and have no demonstrated relationship to potential adverse human health effects.

Sufficient data is not available for 3,4-dichlorophenol to derive a level which would protect against the potential toxicity of this compound. Using available organoleptic data, for controlling undesirable taste and odor quality of ambient water, the estimated level is .3 μg/l. It should be recognized that organoleptic data as a basis for establishing a water quality criteria have limitations and have no demonstrated relationship to potential adverse human health effects.

Sufficient data is not available for 2,3,4,6-tetrachlorophenol to derive a level which would protect against the potential toxicity of this compound. Using available organoleptic data, for controlling undesirable taste and odor quality of ambient water, the estimated level is 1 μg/l. It should be recognized that organoleptic data as a basis for establishing a water quality criteria have limitations and have no demonstrated relationship to potential adverse human health effects.

For comparison purposes, two approaches were used to derive criterion levels for 2,4,5-trichlorophenol. Based on available toxicity data, for the protection of public health, the derived level is 2.6 mg/l. Using available organoleptic data, for controlling undesirable taste and odor quality of ambient water, the estimated level is 1.0 μg/l. It should be recognized that organoleptic data as a basis for establishing a water quality criteria have limitations and have no demonstrated relationship to potential adverse human health effects.

For the maximum protection of human health from the potential carcinogenic effects due to exposure of 2,4,6-trichlorophenol through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may nc be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 12 μg/l, 1.2 μg/l, and .12 μg/l respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 36 μg/l, 3.6 μg/l, and .36 μg/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

Using available organoleptic data, for controlling undesirable taste and odor quality of ambient water, the estimated level is 2 μg/l. It should be recognized that organoleptic data as a basis for establishing a water quality criterion have limitations and have no demonstrated relationship to potential adverse human health effects.

Sufficient data is not available for 2-methyl-4-chlorophenol to derive a level which would protect against any potential toxicity of this compound. Using available organoleptic data, for controlling undesirable taste and odc quality of ambient water, the estimate level is 1800 μg/l. It should be

recognized that organoleptic data as a basis for establishing a water quality criterion have limitations and have no demonstrated relationship to potential adverse human health effects.

Sufficient data is not available for 3-methyl-4-chlorophenol to derive a level which would protect against the potential toxicity of this compound. Using available organoleptic data, for controlling undesirable taste and odor quality of ambient water, the estimated level is 3000 μg/l. It should be recognized that organoleptic data as a basis for establishing a water quality criterion have limitations and have no demonstrated relationship to potential adverse human health effects.

Sufficient data is not available for 3-methyl-6-chlorophenol to derive a level which would protect against the potential toxicity of this compound. Using available organoleptic data, for controlling undesirable taste and odor quality of ambient water, the estimated level is 20 μg/l. It should be recognized that organoleptic data as a basis for establishing a water quality criterion have limitations and have no demonstrated relationship to potential adverse human health effects.

Chloroalkyl Ethers

Freshwater Aquatic Life

The available data for chloroalkyl ethers indicate that acute toxicity to freshwater aquatic life occurs at concentrations as low as 238,000 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No definitive data are available concerning the chronic toxicity of chloroalkyl ethers to sensitive freshwater aquatic life.

Saltwater Aquatic Life

No saltwater organisms have been tested with any chloroalkyl ether and no statement can be made concerning acute and chronic toxicity.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of bis-(chloromethyl)-ether through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are .038 ng/l, .0038 ng/l, and .00038 ng/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 18.4 ng/l, 1.84 ng/l, and .184 ng/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

For the maximum protection of human health from the potential carcinogenic effects due to exposure of bis (2-chloroethyl) ether through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are .3 μg/l, .03 μg/l, and .003 μg/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 13.6 μg/l, 1.36 μg/l, and .136 μg/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

For the protection of human health from the toxic properties of bis (2-chloroisopropyl) ether ingested through water and contaminated aquatic organisms, the ambient water criterion is determined to be 34.7 μg/l.

For the protection of human health from the toxic properties of bis (2-chloroisopropyl) ether ingested through contaminated aquatic organisms alone, the ambient water criterion is determined to be 4.36 mg/l.

Chloroform

Freshwater Aquatic Life

The available data for choloroform indicate that acute toxicity to freshwater aquatic life occurs at concentrations as low as 28,900 μg/l, and would occur at lower concentrations among species that are more sensitive than the three tested species. Twenty-seven-day LC50 values indicate that chronic toxicity occurs at concentrations as low as 1,240 μg/l, and could occur at lower concentrations among species or other life stages that are more sensitive than the earliest life cycle stage of the rainbow trout.

Saltwater Aquatic Life

The data base for saltwater species is limited to one test and no statement can be made concerning acute or chronic toxicity.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of chloroform through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 1.90 μg/l, .19 μg/l, and .019 μg/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 157 μg/l, 15.7 μg/l, and 1.57 μg/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

2-Chlorophenol

Freshwater Aquatic Life

The availabe data for 2-chlorophenol indicate that acute toxicity to freshwater aquatic life occurs at concentrations as low as 4,380 μg/l and would occur at lower concentrations among species that are more sensitive that those tested. No definitive data are available concerning the chronic toxicity of 2-chlorophenol to sensitive freshwater aquatic life but flavor impairment occurs in one species of fish at concentrations as low as 2,000 μg/l.

Saltwater Aquatic Life

No saltwater organisms have been tested with 2-chlorophenol and no statement can be made concerning acute and chronic toxicity.

Human Health

Sufficient data is not available for 2-chlorophenol to derive a level which would protect against the potential toxicity of this compound. Using available organoleptic data, for controlling undesirable taste and odor quality of ambient water, the estimated level is 0.1 μg/l. It should be recognized that organoleptic data as a basis for establishing a water quality criteria have limitations and have no

demonstrated relationship to potential adverse human health effects.

Chromium

Freshwater Aquatic Life

For total recoverable hexavalent chromium the criterion to protect freshwater aquatic life as derived using the Guidelines is 0.29 μg/l as a 24-hour average and the concentration should not exceed 21 μg/l at any time.

For freshwater aquatic life the concentration (in μg/l) of total recoverable trivalent chromium should not exceed the numerical value given by "e(1.08[ln(hardness)]+3.48)" at any time. For example, at hardnesses of 50, 100 and 200 mg/l as $CaCO_3$ the concentration of total recoverable trivalent chromium should not exceed 2,200, 4,700, and 9,900 μg/l, respectively, at any time. The available data indicate that chronic toxicity to freshwater aquatic life occurs at concentrations as low a 44 μg/l and would occur at lower concentrations among species that are more sensitive than those tested.

Saltwater Aquatic Life

For total recoverable hexavalent chromium the criterion to protect saltwater aquatic life as derived using the Guidelines is 18 μg/l as a 24-hour average and the concentration should not exceed 1,260 μg/l at any time.

For total recoverable trivalent chromium, the availabe data indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 10,300 μg/l, and would occur at lower concentrations amoung species that are more sensitive than those tested. No data are available concerning the chronic toxicity of trivalent chromium to sensitive saltwater aquatic life.

Human Health

For the protection of human health from the toxic properties of Chromium III ingested through water and contaminated aquatic organisms, the ambient water criterion is determined to be 170 mg/l.

For the protection of human health from the toxic properties of Chromium III ingested through contaminated aquatic organisms alone, the ambient water criterion is determined to be 3433 mg/l.

The ambient water quality criterion for total Chromium VI is recommended to be identical to the existing drinking water standard which is 50 μg/l. Analysis of the toxic effects data resulted in a calculated level which is protective of human health against the ingestion of contaminated water and contaminated aquatic organisms. The calculated value is comparable to the present standard. For this reason a selective criterion based on exposure solely from consumption of 8.5 grams of aquatic organisms was not derived.

Copper

Freshwater Aquatic Life

For total recoverable copper the criterion to protect freshwater aquatic life as derived using the Guidelines is 5.8 μg/l as a 24-hour average and the concentration (in μg/l) should not exceed the numerical value given by e(0.94[ln(hardness)]-1.23) at any time. For example, at hardnesses of 50, 100, and 200 mg/l $CaCO_3$ the concentration of total recoverable copper should not exceed 12, 22, and 43 μg/l at any time.

Saltwater Aquatic Life

For total recoverable copper the criterion to protect saltwater aquatic life as derived using the Guidelines is 4.0 μg/l as a 24-hour average and the concentration should not exceed 23 μg/l at any time.

Human Health

Sufficient data is not available for copper to derive a level which would protect against the potential toxicity of this compound. Using available organoleptic data, for controlling undesirable taste and odor quality of ambient water, the estimated level is 1 mg/l. It should be recognized that organoleptic data as a basis for establishing a water quality criteria have limitations and have no demonstrated relationship to potential adverse human health effects.

Cyanide

Freshwater Aquatic Life

For free cyanide (sum of cyanide present as HCN and CN^-, expressed as CN) the criterion to protect freshwater aquatic life as derived using the Guidelines is 3.5 μg/l as a 24-hour average and the concentration should not exceed 52 μg/l at any time.

Saltwater Aquatic Life

The available data for free cyanide (sum of cyanide present as HCN and CN^-, expressed as CN) indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 30 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. If the acute-chronic ratio for saltwater organisms is similar to that for freshwater organisms, chronic toxicity would occur at concentrations as low as 2.0 μg/l for the tested species and at lower concentrations among species that are more sensitive than those tested.

Human Health

The ambient water quality criterion for cyanide is recommended to be identical to the existing drinking water standard which is 200 μg/l. Analysis of the toxic effects data resulted in a calculated level which is protective of human health against the ingestion of contaminated water and contaminated aquatic organisms. The calculated value is comparable to the present standard. For this reason a selective criterion based on exposure solely from consumption of 8.5 grams of aquatic organisms was not derived.

DDT and Metabolites

Freshwater Aquatic Life

DDT

For DDT and its metabolites the criterion to protect freshwater aquatic life as derived using the Guidelines is 0.0010 μg/l as a 24-hour average and the concentration should not exceed 1.1 μg/l at any time.

TDE

The available data for TDE indicate that acute toxicity to freshwater aquatic life occurs at concentrations as low as 0.8 μg/l and would occur at lower concentrations among species that a more sensitive than those tested. No data are available concerning the chronic toxicity of TDE to sensitive freshwater aquatic life.

DDE

The available data for DDE indicate that acute toxicity to freshwater aquatic life occurs at concentrations as low as 1,050 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of DDE to sensitive freshwater aquatic life.

Saltwater Aquatic Life

DDT

For DDT and its metabolites the criterion to protect saltwater aquatic life as derived using the Guidelines is 0.0010 μg/l as a 24-hour average and the concentration should not exceed 0.13 μg/l at any time.

TDE

The available data for TDE indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 3.6 μg/l and would occur at lower concentrations among species that a more sensitive than those tested. No data are available concerning the

chronic toxicity of TDE to sensitive saltwater aquatic life.

E

The available data for DDE indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 14 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of DDE to sensitive saltwater aquatic life.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of DDT through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are .24 ng/l, .024 ng/l, and .0024 ng/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are .24 ng/l, .024 ng/l, and .0024 ng/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment of an "acceptable" risk level.

Dichlorobenzenes

Freshwater Aquatic Life

The available data for dichlorobenzenes indicate that acute and chronic toxicity to freshwater aquatic life occurs at concentrations as low as 1,120 and 763 μg/l, respectively, and would occur at lower concentrations among species that are more sensitive than those tested.

Saltwater Aquatic Life

The available data for dichlorobenzenes indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 1,970 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of dichlorobenzenes to sensitive saltwater aquatic life.

Human Health

For the protection of human health from the toxic properties of dichlorobenzenes (all isomers) ingested through water and contaminated aquatic organisms, the ambient water criterion is determined to be 400 μg/l.

For the protection of human health from the toxic properties of dichlorobenzenes (all isomers) ingested through contaminated aquatic organisms alone, the ambient water criterion is determined to be 2.8 mg/l.

Dichlorobenzidines

Freshwater Aquatic Life

The data base available for dichlorobenzidines and freshwater organisms is limited to one test on bioconcentration of 3,3'-dichlorobenzidine and no statement can be made concerning acute or chronic toxicity.

Saltwater Aquatic Life

No saltwater organisms have been tested with any dichlorobenzidine and no statement can be made concerning acute or chronic toxicity.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of dichlorobenzidine through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero base on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are .103 μg/l, .0103 μg/l, and .00103 μg/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are .204 μg/l, .0204 μg/l, and .00204 μg/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

Dichloroethylenes

Freshwater Aquatic Life

The available data for dichloroethylenes indicate that acute toxicity to freshwater aquatic life occurs at concentrations as low as 11,600 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No definitive data are available concerning the chronic toxicity of dichlorethylenes to sensitive freshwater aquatic life.

Saltwater Aquatic Life

The available data for dichlorethylenes indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 224,000 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity dichloroethylenes to sensitive saltwater aquatic life.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of 1,1-dichloroethylene through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are .33 μg/l, .033 μg/l, and .0033 μg/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 18.5 μg/l, 1.85 μg/l, and .185 μg/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

Using the present guidelines, a satisfactory criterion cannot be derived at this time due to the insufficency in the available data for 1,2-dichloroethylene.

2,4-Dichlorophenol

Freshwater Aquatic Life

The available data for 2,4-dichlorophenol indicate that acute and chronic toxicity to freshwater aquatic life occurs at concentrations as low as 2,020 and 365 μg/l, respectively, and would occur at lower concentrations among species that are more sensitive that those tested. Mortality to early life stages of one species of fish occurs at concentrations as low as 70 μg/l.

Saltwater Aquatic Life

Only one test has been conducted with saltwater organisms on 2,4-dichlorophenol and no statement can be made concerning acute or chronic toxicity.

Human Health

For comparison purposes, two approaches were used to derive criterion levels for 2,4-dichlorophenol.

Based on available toxicity data, for the protection of public health, the derived level is 3.09 mg/l. Using available organoleptic data, for controlling undesirable taste and odor quality of ambient water, the estimated level is 0.3 µg/l. It should be recognized that organoleptic data as a basis for establishing a water quality criteria have limitations and have no demonstrated relationship to potential adverse human health effects.

Dichloropropanes/Dichloropropenes

Freshwater Aquatic Life

The available data for dichloropropanes indicate that acute and chronic toxicity to freshwater aquatic life occurs at concentrations as low as 23,000 and 5,700 µg/l, respectively, and would occur at lower concentrations among species that are more sensitive than those tested.

The available data for dichloropropenes indicate that acute and chronic toxicity to freshwater aquatic life occurs at concentrations as low as 6,060 and 244 µg/l, respectively, and would occur at lower concentrations among species that are more sensitive than those tested.

Saltwater Aquatic Life

The available data for dichloropropanes indicate that acute and chronic toxicity to saltwater aquatic life occurs at concentrations as low as 10,300 and 3,040 µg/l, respectively, and would occur at lower concentrations among species that are more sensitive than those tested.

The available data for dichloropropenes indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low a as 790 µg/l, and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of dichloropropenes to sensitive saltwater aquatic life.

Human Health

Using the present guidelines, a satisfactory criterion cannot be derived at this time due to the insufficiency in the available data for dichloropropanes.

For the protection of human health from the toxic properties of dichloropropenes ingested through water and contaminated aquatic organisms, the ambient water criterion is determined to be 87 µg/l.

For the protection of human health from the toxic properties of dichloropropenes ingested through contaminated aquatic organisms alone, the ambient water criterion is determined to be 14.1 mg/l.

2,4-Dimethylphenol

Freshwater Aquatic Life

The available data for 2,4-dimethylphenol indicate that acute toxicity to freshwater aquatic life occurs at concentrations as low as 2,120 µg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of dimethylphenol to sensitive freshwater aquatic life.

Saltwater Aquatic Life

No saltwater organisms have been tested with 2,4-dimethylphenol and no statement can be made concerning acute and chronic toxicity.

Human Health

Sufficient data are not available for 2,4-dimethylphenol to derive a level which would protect against the potential toxicity of this compound. Using available organoleptic data, for controlling undersirable taste and odor quality of ambient water, the estimated level is 400 µg/l. It should be recognized that organoleptic data as a basis for establishing a water quality criteria have limitations and have no demonstrated relationship to potential adverse human health effects.

2,4-Dinitrotoluene

Freshwater Aquatic Life

The available data for 2,4-dinitrotoluene indicate that acute and chronic toxicity to freshwater aquatic life occurs at concentrations as low as 330 and 230 µg/l, respectively, and would occur at lower concentrations among species that are more sensitive than those tested.

Saltwater Aquatic Life

The available data for 2,4-dinitrotoluenes indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 590 µg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of 2,4-dinitrotoluenes to sensitive saltwater aquatic life but a decrease in algal cell numbers occurs at concentrations as low as 370 µg/l.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of 2,4-dinitrotoluene through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may n be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 1.1 µg/l, 0.11 µg/l, and 0.011 µg/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 91 µg/l, 9.1 µg/l, and 0.91 µg/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

1,2-Diphenylhydrazine

Freshwater Aquatic Life

The available data for 1,2-diphenylhydrazine indicate that acute toxicity to freshwater aquatic life occurs at concentrations as low as 270 µg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of 1,2-diphenylhydrazine to sensitive freshwater aquatic life.

Saltwater Aquatic Life

No saltwater organisms have been tested with 1,2-diphenylhydrazine and no statement can be made concerning acute and chronic toxicity.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of 1,2-diphenylhydrazine through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 422 ng/l, 42 ng/l, and 4 ng/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 5.8 µg/l, 0.58 µg/l, and 0.058 µg/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not

represent an Agency judgment on an "acceptable" risk level.

Endosulfan

Freshwater Aquatic Life

For endosulfan the criterion to protect freshwater aquatic life as derived using the Guidelines is 0.056 μg/l as a 24-hour average and the concentration should not exceed 0.22 μg/l at any time.

Saltwater Aquatic Life

For endosulfan the criterion to protect saltwater aquatic life as derived using the Guidelines is 0.0087 μg/l as a 24-hour average and the concentration should not exceed 0.034 μg/l at any time.

Human Health

For the protection of human health from the toxic properties of endosulfan ingested through water and contaminated aquatic organisms, the ambient water criterion is determined to be 74 μg/l.

For the protection of human health from the toxic properties of endosulfan ingested through contaminated aquatic organisms alone, the ambient water criterion is determined to be 159 μg/l.

Endrin

Freshwater Aquatic Life

For endrin the criterion to protect freshwater aquatic life as derived using the Guidelines is 0.0023 μg/l as a 24-hour average and the concentration should not exceed 0.18 μg/l at any time.

Saltwater Aquatic Life

For endrin the criterion to protect saltwater aquatic life as derived using the Guidelines is 0.0023 μg/l as a 24-hour average and the concentration should not exceed 0.037 μg/l at any time.

Human Health

The ambient water quality criterion for endrin is recommended to be identical to the existing drinking water standard which is 1 μg/l. Analysis of the toxic effects data resulted in a calculated level which is protective of human health against the ingestion of contaminated water and contaminated aquatic organisms. The calculated value is comparable to the present standard. For this reason a selective criterion based on exposure solely from consumption of 6.5 grams of aquatic organisms was not derived.

Ethylbenzene

Freshwater Aquatic Life

The available data for ethylbenzene indicate that acute toxicity to freshwater aquatic life occurs at concentrations as low as 32,000 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No definitive data are available concerning the chronic toxicity of ethylbenzene to sensitive freshwater aquatic life.

Saltwater Aquatic Life

The available data for ethylbenzene indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 430 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of ethylbenzene to sensitive saltwater aquatic life.

Human Health

For the protection of human health from the toxic properties of ethylbenzene ingested through water and contaminated aquatic organisms, the ambient water criterion is determined to be 1.4 mg/l.

For the protection of human health from the toxic properties of ethylbenzene ingested through contaminated aquatic organisms alone, the ambient water criterion is determined to be 3.28 mg/l.

Fluoranthene

Freshwater Aquatic Life

The available data for fluoranthene indicate that acute toxicity to freshwater aquatic life occurs at concentrations as low as 3980 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of fluoranthene to sensitive freshwater aquatic life.

Saltwater Aquatic Life

The available data for fluoranthene indicate that acute and chronic toxicity to saltwater aquatic life occur at concentrations as low as 40 and 16 μg/l, respectively, and would occur at lower concentrations among species that are more sensitive than those tested.

Human Health

For the protection of human health from the toxic properties of fluoranthene ingested through water and contaminated aquatic organisms, the ambient water criterion is determined to be 42 μg/l.

For the protection of human health from the toxic properties of fluoranthene ingested through contaminated aquatic organisms alone, the ambient water criterion is determined to be 54 μg/l.

Haloethers

Freshwater Aquatic Life

The available data for haloethers indicate that acute and chronic toxicity to freshwater aquatic life occur at concentrations as low as 360 and 122 μg/l, respectively, and would occur at lower concentrations among species that are more sensitive than those tested.

Saltwater Aquatic Life

No saltwater organisms have been tested with any haloether and no statement can be made concerning acute or chronic toxicity.

Human Health

Using the present guidelines, a satisfactory criterion cannot be derived at this time due to the insufficiency in the available data for haloethers.

Halomethanes

Freshwater Aquatic Life

The available data for halomethanes indicate that acute toxicity to freshwater aquatic life occurs at concentrations as low as 11,000 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of halomethanes to sensitive freshwater aquatic life.

Saltwater Aquatic Life

The available data for halomethanes indicate that acute and chronic toxicity to saltwater aquatic life occur at concentrations as low as 12,000 and 6,400 μg/l, respectively, and would occur at lower concentrations among species that are more sensitive than those tested. A decrease in algal cell numbers occurs at concentrations as low as 11,500 μg/l.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of chloromethane, bromomethane, dichloromethane, bromodichloromethane, tribromomethane, dichlorodifluoromethane, trichlorofluoromethane, or combinations of these chemicals through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk, over the lifetimes are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are

1.9 µg/l, 0.19 µg/l, and 0.019 µg/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 157 µg/l, 15.7 µg/l, and 1.57 µg/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

Heptachlor

Freshwater Aquatic Life

For heptachlor the criterion to protect freshwater aquatic life as derived using the Guidelines is 0.0038 µg/l as a 24-hour average and the concentration should not exceed 0.52 µg/l at any time.

Saltwater Aquatic Life

For heptachlor the criterion to protect saltwater aquatic life as derived using the Guidelines is 0.0036 µg/l as a 24-hour average and the concentration should not exceed 0.053 µg/l at any time.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of heptachlor through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk, over the lifetimes are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 2.78 ng/l, .28 ng/l, and .028 ng/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 2.85 ng/l, .29 ng/l, and .029 ng/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

Hexachlorobutadiene

Freshwater Aquatic Life

The available data for hexachlorobutadiene indicate that acute and chronic toxicity to freshwater aquatic life occur at concentrations as low as 90 and 9.3 µg/l, respectively, and would occur at lower concentrations among species that are more sensitive than those tested.

Saltwater Aquatic Life

The available data for hexachlorobutadiene indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 32 µg/l and would occur at lower concentrations among species that are more sensitive that those tested. No data are available concerning the chronic toxicity of hexachlorobutadiene to sensitive saltwater aquatic life.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of hexachlorobutadiene through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk, over the lifetimes are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 4.47 µg/l, 0.45 µg/l, and 0.045 µg/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 500 µg/l, 50 µg/l, and 5 µg/l respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

Hexachlorocyclohexane

Lindane

Freshwater Aquatic Life

For Lindane the criterion to protect freshwater aquatic life as derived using the Guidelines is 0.080 µg/l as a 24-hour average and the concentration should not exceed 2.0 µg/l at any time.

Saltwater Aquatic Life

For saltwater aquatic life the concentration of lindane should not exceed 0.16 µg/l at any time. No data are available concerning the chronic toxicity of lindane to sensitive saltwater aquatic life.

BHC

Freshwater Aquatic Life

The available date for a mixture of isomers of BHC indicate that acute toxicity to freshwater aquatic life occurs at concentrations as low as 100 µg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of a mixture of isomers of BHC to sensitive freshwater aquatic life.

Saltwater Aquatic Life

The available date for a mixture of isomers of BHC indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 0.34 µg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of a mixture of isomers of BHC to sensitive saltwater aquatic life.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of alpha-HCH through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk, over the lifetimes are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 92 ng/l, 9.2 ng/l, and .92 ng/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 310 ng/l, 31.0 ng/l, and 3.1 ng/l respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

For the maximum protection of human health from the potential carcinogenic effects due to exposure of beta-HCH through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk, over the lifetimes are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 163 ng/l, 16.3 ng/l, and 1.63 ng/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 547 ng/l, 54.7 ng/l, and 5.47 ng/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not

represent an Agency judgment on an "acceptable" risk level.

For the maximum protection of human health from the potential carcinogenic effects due to exposure of tech-HCH through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk, over the lifetimes are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 123 ng/l, 12.3 ng/l, and 1.23 ng/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 414 ng/l, 41.4 ng/l, and 4.14 ng/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

For the maximum protection of human health from the potential carcinogenic effects due to exposure of gamma-HCH through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentrations should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 186 ng/l, 18.6 ng/l, and 1.86 ng/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 625 ng/l, 62.5 ng/l, 6.25 ng/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

Using the present guidelines, a satisfactory criterion cannot be derived at this time due to the insufficiency in the available data for delta-HCH.

Using the present guidelines, a satisfactory criterion cannot be derived at this time due to the insufficiency in the available data for epsilon-HCH.

Hexachlorocyclopentadiene

Freshwater Aquatic Life

The available data for hexachlorocyclopentadiene indicate that acute and chronic toxicity to freshwater aquatic life occurs at concentrations as low as 7.0 and 5.2 μg/l, respectively, and would occur at lower concentrations among species that are more sensitive than those tested.

Saltwater Aquatic Life

The available data to hexachlorocyclopentadiene indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 7.0 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of hexachlorocyclopentadiene to sensitive saltwater aquatic life.

Human Health

For comparison purposes, two approaches were used to derive criterion levels for hexachlorocyclopentadiene. Based on available toxicity data, for the protection of public health, the derived level is 206 μg/l. Using available organoleptic data, for controlling undesirable taste and odor quality of ambient water, the estimated level is 1.0 μg/l. It should be recognized that organoleptic data as a basis for establishing a water quality criterion have limitations and have no demonstrated relationship to potential adverse human health effects.

Isophorone

Freshwater Aquatic Life

The available data for isophorone indicate that acute toxicity to freshwater aquatic life ocurs at concentrations as low as 117,000 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of isophorone to sensitive freshwater aquatic life.

Saltwater Aquatic Life

The available data for isophorone indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 12,900 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of isophorone to sensitive saltwater aquatic life.

Human Health

For the protection of human health from the toxic properties of isophorone ingested through water and contaminated aquatic organisms, the ambient water criterion is determined to be 5.2 mg/l.

For the protection of human health from the toxic properties of isophorone ingested through contaminated aquatic organisms alone, the ambient water criterion is determined to be 520 mg/l.

Lead

Freshwater Aquatic Life

For total recoverable lead the criterion (in μg/l) to protect freshwater aquatic life as derived using the Guidelines is the numerical value given by e(2.35[ln(hardness)]−9.48) as a 24-hour average and the concentration (in μg/l) should not exceed the numerical value given by e(1.22[ln(hardness)]−0.47) at any time. For example, at hardnesses of 50, 100, and 200 mg/l as $CaCO_3$ the criteria are 0.75, 3.8, and 20 μg/l, respectively, as 24-hour averages, and the concentrations should not exceed 74, 170, and 400 μg/l, respectively, at any time.

Saltwater Aquatic Life

The available data for total recoverable lead indicate that acute and chronic toxicity to saltwater aquatic life occur at concentrations as low as 668 and 25 μg/l, respectively, and would occur at lower concentrations among species that are more sensitive than those tested.

Human Health

The ambient water quality criterion for lead is recommended to be identical to the existing drinking water standard which is 50 μg/l. Analysis of the toxic effects data resulted in a calculated level which is protective to human health against the ingestion of contaminated water and contaminated aquatic organisms. The calculated value is comparable to the present standard. For this reason a selective criterion based on exposure solely from consumption of 6.5 grams of aquatic organisms was not derived.

Mercury

Freshwater Aquatic Life

For total recoverable mercury the criterion to protect freshwater aquatic life as derived using the Guidelines is 0.00057 μg/l as a 24-hour average and the concentration should not exceed 0.0017 μg/l at any time.

Saltwater Aquatic Life

For total recoverable mercury the criterion to protect saltwater aquatic life as derived using the Guidelines is 0.025 μg/l as a 24-hour average and the concentration should not exceed 3.7 μg/l at any time.

Human Health

For the protection of human health from the toxic properties of mercury

ingested through water and contaminated aquatic organisms, the ambient water criterion is determined to be 144 ng/l.

For the protection of human health from the toxic properties of mercury ingested through contaminated aquatic organisms alone, the ambient water criterion is determined to be 146 ng/l.

Note.—These values include the consumption of freshwater, estuarine, and marine species.

Naphthalene

Freshwater Aquatic Life

The available data to naphthalene indicate that acute and chronic toxicity to freshwater aquatic life occur at concentrations as low as 2,300 and 620 μg/l, respectively, and would occur at lower concentrations among species that are more sensitive than those tested.

Saltwater Aquatic Life

The available data for naphthalene indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 2,350 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of naphthalene to sensitive saltwater aquatic life.

Human Health

Using the present guidelines, a satisfactory criterion cannot be derived at this time due to the insufficiency in the available data for naphthalene.

Nickel

Freshwater Aquatic Life

For total recoverable nickel the criterion (in μg/l) to protect freshwater aquatic life as derived using the Guidelines is the numerical value given by e(0.76 [ln (hardness)] +1.06) as a 24-hour average and the concentration (in μg/l) should not exceed the numerical value given by e(0.76[ln (hardness)] + 4.02) at any time. For example, at hardnesses of 50, 100, and 200 mg/l as $CaCO_3$ the criteria are 56, 96, and 160 μg/l, respectively, as 24-hour averages, and the concentrations should not exceed 1,100, 1,300, and 3,100 μg/l, respectively, at any time.

Saltwater Aquatic Life

For total recoverable nickel the criterion to protect saltwater aquatic life as derived using the Guidelines is 7.1 μg/l as a 24-hour average and the concentration should not exceed 140 μg/l at any time.

Human Health

For the protection of human health from the toxic properties of nickel ingested through water and contaminated aquatic organisms, the ambient water criterion is determined to be 13.4 μg/l.

For the protection of human health from the toxic properties of nickel ingested through contaminated aquatic organisms alone, the ambient water criterion is determined to be 100 μg/l.

Nitrobenzene

Freshwater Aquatic Life

The available data for nitrobenzene indicate that acute toxicity to freshwater aquatic life occurs at concentrations as low as 27,000 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No definitive data are available concerning the chronic toxicity of nitrobenzene to sensitive freshwater aquatic life.

Saltwater Aquatic Life

The available data for nitrobenzene indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 6,680 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of nitrobenzene to sensitive saltwater aquatic life.

Human Health

For comparison purposes, two approaches were used to derive criterion levels for nitrobenzene. Based on available toxicity data, for the protection of public health, the derived level is 19.8 mg/l. Using available organoleptic data, for controlling undesirable taste and odor quality of ambient water, the estimated level is 30 μg/l. It should be recognized that organoleptic data as a basis for establishing a water quality criteria have limitations and have no demonstrated relationship to potential adverse human health effects.

Nitrophenols

Freshwater Aquatic Life

The available data for nitrophenols indicate that acute toxicity to freshwater aquatic life occurs at concentrations as low as 230 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of nitrophenols to sensitive freshwater aquatic life but toxicity to one species of algae occurs at concentrations as low as 150 μg/l.

Saltwater Aquatic Life

The available data for nitrophenols indicate that acute toxicity to saltwa aquatic life occurs at concentrations low as 4,850 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of nitrophenols to sensitive saltwater aquatic life.

Human Health

For the protection of human health from the toxic properties of 2,4-dinitro-o-cresol ingested through water and contaminated aquatic organisms, the ambient water criterion is determined to be 13.4 μg/l.

For the protection of human health from the toxic properties of 2,4-dinitro-o-cresol ingested through contaminated aquatic organisms alone, the ambient water criterion is determined to be 765 μg/l.

For the protection of human health from the toxic properties of dinitrophenol ingested through water and contaminated aquatic organisms, the ambient water criterion is determined to be 70 μg/l.

For the protection of human health from the toxic properties of dinitrophenol ingested through contaminated aquatic organisms alor the ambient water criterion is determined to be 14.3 mg/l.

Using the present guidelines, a satisfactory criterion cannot be derived at this time due to the insufficiency in the available data for mononitrophenol.

Using the present guidelines, a satisfactory criterion cannot be derived at this time due to the insufficiency in the available data for tri-nitrophenol.

Nitrosamines

Freshwater Aquatic Life

The available data for nitrosamines indicate that acute toxicity to freshwater aquatic life occurs at concentrations as low as 5,850 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of nitrosamines to sensitive freshwater aquatic life.

Saltwater Aquatic Life

The available data for nitrosamines indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 3,300,000 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concer the chronic toxicity of nitrosamines sensitive saltwater aquatic life.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of n-nitrosodimethylamine through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk, over the lifetimes are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 14 ng/l, 1.4 ng/l, and .14 ng/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 160,000 ng/l, 16,000 ng/l, and 1,600 ng/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

For the maximum protection of human health from the potential carcinogenic effects due to exposure of n-nitrosodiethylamine through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk, over the lifetimes are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 8 ng/l, 0.8 ng/l, and 0.08 ng/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 12,400 ng/l, 1,240 ng/l, and 124 ng/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

For the maximum protection of human health from the potential carcinogenic effects due to exposure in n-nitrosodi-n-butylamine through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk, over the lifetimes are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 64 ng/l 6.4 ng/l and .064 ng/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 5,868 ng/l, 587 ng/l, and 58.7 ng/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

For the maximum protection of human health from the potential carcinogenic effects due to exposure in n-nitrosodiphenylamine through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk, over the lifetimes are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 49,000 ng/l 4,900 ng/l and 490 ng/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 161,000 ng/l, 16,100 ng/l, and 1,610 ng/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

For the maximum protection of human health from the potential carcinogenic effects due to exposure in n-nitrosopyrrolidine through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk, over the lifetimes are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 160 ng/l 16.0 ng/l and 1.60 ng/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 919,000 ng/l, 91,900 ng/l, and 9,190 ng/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

Pentachlorophenol

Freshwater Aquatic Life

The available data for pentachlorophenol indicate that acute and chronic toxicity to freshwater aquatic life occur at concentrations as low as 55 and 3.2 μg/l, respectively, and would occur at lower concentrations among species that are more sensitive than those tested.

Saltwater Aquatic Life

The available data for pentachlorophenol indicate that acute and chronic toxicity to saltwater aquatic life occur at concentrations as low as 53 and 34 μg/l, respectively, and would occur at lower concentrations among species that are more sensitive than those tested.

Human Health

For comparison purposes, two approaches were used to derive criterion levels for pentachlorophenol. Based on available toxicity data, for the protection of public health, the derived level is 1.01 mg/l. Using available organoleptic data, for controlling undesirable taste and odor quality of ambient water, the estimated level is 30 μg/l. It should be recognized that organoleptic data as a basis for establishing a water quality criterion have limitations and have no demonstrated relationship to potential adverse human health effects.

Phenol

Freshwater Aquatic Life

The available data for phenol indicate that acute and chronic toxicity to freshwater aquatic life occur at concentrations as low as 10,200 and 2,560 μg/l, respectively, and would occur at lower concentrations among species that are more sensitive than those tested.

Saltwater Aquatic Life

The available data for phenol indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 5,800 ug/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of phenol to sensitive saltwater aquatic life.

Human Health

For comparison purposes, two approaches were used to derive criterion levels for phenol. Based on available toxicity data, for the protection of public health, the derived level is 3.5 mg/l. Using available organoleptic data, for controlling

undesirable taste and odor quality of ambient water, the estimated level is 0.3 mg/l. It should be recognized that organoleptic data as a basis for establishing a water quality criterion have limitations and have no demonstrated relationship to potential adverse human health effects.

Phthalate Esters

Freshwater Aquatic Life

The available data for phthalate esters indicate that acute and chronic toxicity to freshwater aquatic life occur at concentrations as low as 940 and 3 μg/l, respectively, and would occur at lower concentrations among species that are more sensitive than those tested.

Saltwater Aquatic Life

The available data for phthalate esters indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 2944 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of phthalate esters to sensitive saltwater aquatic life but toxicity to one species of algae occurs at concentrations as low as 3.4 μg/l.

Human Health

For the protection of human health from the toxic properties of dimethyl-phthalate ingested through water and contaminated aquatic organisms, the ambient water criterion is determined to be 313 mg/l.

For the protection of human health from the toxic properties of dimethyl-phthalate ingested through contaminated aquatic organisms alone, the ambient water criterion is determined to be 2.9 g/l.

For the protection of human health from the toxic properties of diethyl-phthalate ingested through water and contaminated aquatic organisms, the ambient water criterion is determined to be 350 mg/l.

For the protection of human health from the toxic properties of diethyl-phthalate ingested through contaminated aquatic organisms alone, the ambient water criterion is determined to be 1.8 g/l.

For the protection of human health from the toxic properties of dibutyl-phthalate ingested through water and contaminated aquatic organisms, the ambient water criterion is determined to be 34 mg/l.

For the protection of human health from the toxic properties of dibutyl-phthalate ingested through contaminated aquatic organisms alone, the ambient water criterion is determined to be 154 mg/l.

For the protection of human health from the toxic properties of di-2-ethylhexyl-phthalate ingested through water and contaminated aquatic organisms, the ambient water criterion is determined to be 15 mg/l.

For the protection of human health from the toxic properties of di-2-ethylhexyl-phthalate ingested through contaminated aquatic organisms alone, the ambient water criterion is determined to be 50 mg/l.

Polychlorinated Biphenyls

Freshwater Aquatic Life

For polychlorinated biphenyls the criterion to protect freshwater aquatic life as derived using the Guidelines is 0.014 μg/l as a 24-hour average. The available data indicate that acute toxicity to freshwater aquatic life probably will only occur at concentrations above 2.0 μg/l and that the 24-hour average should provide adequate protection against acute toxicity.

Saltwater Aquatic Live

For polychlorinated biphenyls the criterion to protect saltwater aquatic life as derived using the Guidelines is 0.030 μg/l as a 24-hour average. The available data indicate that acute toxicity to saltwater aquatic life probably will only occur at concentrations above 10 μg/l and that the 24-hour average should provide adequate protection against acute toxicity.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of PCBs through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are .79 ng/l, 0.79 ng/l, and .0079 ng/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are .79 ng/l, .079 ng/l, and .0079 ng/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

Polynuclear Aromatic Hydrocarbons (PAHs)

Freshwater Aquatic Life

The limited freshwater data base available for polynuclear aromatic hydrocarbons, mostly from short-term bioconcentration studies with two compounds, does not permit a statement concerning acute or chronic toxicity.

Saltwater Aquatic Life

The available data for polynuclear aromatic hydrocarbons indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 300 ug/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of polynuclear aromatic hydrocarbons to sensitive saltwater aquatic life.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of PAHs through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. Howev zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 28 ng/l, 2.8 ng/l, and .28 ng/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 311 ng/l, 31.1 ng/l, and 3.11 ng/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

Selenium

Freshwater Aquatic Life

For total recoverable inorganic selenite the criterion to protect freshwater aquatic life as derived using the Guidelines is 35 μg/l as a 24-hour average and the concentration should not exceed 260 μg/l at any time.

The available data for inorganic selenate indicate that acute toxicity to freshwater aquatic life occurs at concentrations as low as 760 μg/l an would occur at lower concentrations among species that are more sensitive

than those tested. No data are available concerning the chronic toxicity of inorganic selenate to sensitive freshwater aquatic life.

Saltwater Aquatic Life

For total recoverable inorganic selenite the criterion to protect saltwater aquatic life as derived using the Guidelines is 54 μg/l as a 24-hour average and the concentration should not exceed 410 μg/l at any time.

No data are available concerning the toxicity of inorganic selenate to saltwater aquatic life.

Human Health

The ambient water quality criterion for selenium is recommended to be identical to the existing drinking water standard which is 10 μg/l. Analysis of the toxic effects data resulted in a calculated level which is protective of human health against the ingestion of contaminated water and contaminated aquatic organisms. The calculated value is comparable to the present standard. For this reason a selective criterion based on exposure solely from consumption of 6.5 grams of aquatic organisms was not derived.

Silver

Freshwater Aquatic Life

For freshwater aquatic life the concentration (in μg/l) of total recoverable silver should not exceed the numerical value given by "e[1.72(ln (hardness)-6.52)]" at any time. For example, at hardnesses of 50, 100, 200 mg/l as $CaCO_3$ the concentration of total recoverable silver should not exceed 1.2, 4.1, and 13 μg/l, respectively, at any time. The available data indicate that chronic toxicity to freshwater aquatic life may occur at concentrations as low as 0.12 μg/l.

Saltwater Aquatic Life

For saltwater aquatic life the concentration of total recoverable silver should not exceed 2.3 μg/l at any time. No data are available concerning the chronic toxicity of silver to sensitive saltwater aquatic life.

Human Health

The ambient water quality criterion for silver is recommended to be identical to the existing drinking water standard which is 50 μg/l. Analysis of the toxic effects data resulted in a calculated level which is protective of human health against the ingestion of contaminated water and contaminated aquatic organisms. The calculated value is comparable to the present standard. For this reason a selective criterion based on exposure solely from consumption of 6.5 grams of aquatic organisms was not derived.

Tetrachloroethylene

Freshwater Aquatic Life

The available data for tetrachloroethylene indicate that acute and chronic toxicity to freshwater aquatic life occur at concentrations as low as 5,280 and 840 μg/l, respectively, and would occur at lower concentrations among species that are more sensitive than those tested.

Saltwater Aquatic Life

The available data for tetrachloroethylene indicate that acute and chronic toxicity to saltwater aquatic life occur at concentrations low as 10,200 and 450 μg/l, respectively, and would occur at lower concentrations among species that are more sensitive than those tested.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of tetrachloroethylene through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 8 μg/l, .8 μg/l, and .08 μg/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 88.5 μg/l, 8.85 μg/l, and .88 μg/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

Thallium

Freshwater Aquatic Life

The available data for thallium indicate that acute and chronic toxicity to freshwater aquatic life occur at concentrations as low as 1,400 and 40 μg/l, respectively, and would occur at lower concentrations among species that are more sensitive than those tested. Toxicity to one species of fish occurs at concentrations as low as 20 μg/l after 2,600 hours of exposure.

Saltwater Aquatic Life

The available data for thallium indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 2,130 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of thallium to sensitive saltwater aquatic life.

Human Health

For the protection of human health from the toxic properties of thallium ingested through water and contaminated aquatic organisms, the ambient water criterion is determined to be 13 μg/l.

For the protection of human health from the toxic properties of thallium ingested through contaminated aquatic organisms alone, the ambient water criterion is determined to be 48 μg/l.

Toluene

Freshwater Aquatic Life

The available data for toluene indicate that acute toxicity to freshwater aquatic life occurs at concentrations as low as 17,500 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of toluene to sensitive freshwater aquatic life.

Saltwater Aquatic Life

The available data for toluene indicate that acute and chronic toxicity to saltwater aquatic life occur at concentrations as low as 6,300 and 5,000 μg/l, respectively, and would occur at lower concentrations among species that are more sensitive than those tested.

Human Health

For the protection of human health from the toxic properties of toluene ingested through water and contaminated aquatic organisms, the ambient water criterion is determined to be 14.3 mg/l.

For the protection of human health from the toxic properties of toluene ingested through contaminated aquatic organisms alone, the ambient water criterion is determined to be 424 mg/l.

Toxaphene

Freshwater Aquatic Life

For toxaphene the criterion to protect freshwater aquatic life as derived using the Guidelines is 0.013 μg/l as a 24-hour average and the concentration should not exceed 1.6 μg/l at any time.

Saltwater Aquatic Life

For saltwater aquatic life the concentration of toxaphene should not exceed 0.070 μg/l at any time. No data

are available concerning the chronic toxicity of toxaphene to sensitive saltwater aquatic life.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of toxaphene through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 7.1 ng/l, .71 ng/l, and .07 ng/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 7.3 ng/l, .73 ng/l, and .07 ng/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

Trichloroethylene

Freshwater Aquatic Life

The available data for trichloroethylene indicate that acute toxicity to freshwater aquatic life occurs at concentrations as low as 45,000 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of trichloroethylene to sensitive freshwater aquatic life but adverse behavioral effects occurs to one species at concentrations as low as 21,900 μg/l.

Saltwater Aquatic Life

The available data for trichloroethylene indicate that acute toxicity to saltwater aquatic life occurs at concentrations as low as 2,000 μg/l and would occur at lower concentrations among species that are more sensitive than those tested. No data are available concerning the chronic toxicity of trichloroethylene to sensitive saltwater aquatic life.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of trichloroethylene through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 27 μg/l, 2.7 μg/l, and .27 μg/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 807 μg/l, 80.7 μg/l, and 8.07 μg/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

Vinyl Chloride

Freshwater Aquatic Life

No freshwater organisms have been tested with vinyl chloride and no statement can be made concerning acute or chronic toxicity.

Saltwater Aquatic Life

No saltwater organisms have been tested with vinyl chloride and no statement can be made concerning acute or chronic toxicity.

Human Health

For the maximum protection of human health from the potential carcinogenic effects due to exposure of vinyl chloride through ingestion of contaminated water and contaminated aquatic organisms, the ambient water concentration should be zero based on the non-threshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 10^{-5}, 10^{-6}, and 10^{-7}. The corresponding criteria are 20 μg/l, 2.0 μg/l, and .2 μg/l, respectively. If the above estimates are made for consumption of aquatic organisms only, excluding consumption of water, the levels are 5,248 μg/l, 525 μg/l, and 52.5 μg/l, respectively. Other concentrations representing different risk levels may be calculated by use of the Guidelines. The risk estimate range is presented for information purposes and does not represent an Agency judgment on an "acceptable" risk level.

Zinc

Freshwater Aquatic Life

For total recoverable zinc the criterion to protect freshwater aquatic life as derived using the Guidelines is 47 μg/l as a 24-hour average and the concentration (in μg/l) should not exceed the numerical value given by $e^{(0.83\,[\ln(\text{hardness})]\,+\,1.95)}$ at any time. For example, at hardnesses of 50, 100, and 200 mg/l as $CaCO_3$ the concentration total recoverable zinc should not exc 180, 320, and 570 μg/l at any time.

Saltwater Aquatic Life

For total recoverable zinc the criterion to protect saltwater aquatic life as derived using the Guidelines is 58 μg/l as a 24-hour average and the concentration should not exceed 170 μg/l at any time.

Human Health

Sufficient data is not available for zinc to derive a level which would protect against the potential toxicity of this compound. Using available organoleptic data, for controlling undesirable taste and odor quality of ambient water, the estimated level is 5 mg/l. It should be recognized that organoleptic data as a basis for establishing a water quality criteria have limitations and have not demonstrated relationship to potential adverse human health effects.

Appendix B—Guidelines for Deriving Water Quality Criteria for the Protection of Aquatic Life and Its Uses

Introduction

This version of the Guidelines provides clarifications, additional details, and technical and editorial changes in the last version published in the Federal Register [44 FR 15970 (March 15, 1979)]. This version incorporates changes resulting from comments on previous versions and from experience gained during U.S. EPA's use of the previous versions. Future versions of the Guidelines will incorporate new ideas and data as their usefulness is demonstrated.

Criteria may be expressed in several forms. The numerical form is commonly used, but descriptive and procedural forms can be used if numerical criteria are not possible or desirable. The purpose of these Guidelines is to describe an objective, internally consistent and appropriate way of deriving numerical water quality criteria for the protection of the uses of, as well as the presence of, aquatic organisms.

A numerical criterion might be thought of as an estimate of the highest concentration of a substance in water which does not present a significant risk to the aquatic organisms in the water and their uses. Thus the Guidelines are intended to derive criteria which will protect aquatic communities by protecting most of the species and the uses most of the time, but not

APPENDIX E

RESPONSES TO DEIS RECEIVED FROM GOVERNMENTAL UNITS/ORGANIZATIONS/INDIVIDUALS

I. Federal Agencies

A. U.S. Department of the Army, Corps of Engineers, St. Paul District (April 30, 1984), page 322

B. U.S. Department of the Interior, Fish and Wildlife (June 7, 1984), page 323

II. Minnesota State Agencies

A. Minnesota Department of Health (June 6, 1984), page 327

B. Minnesota Department of Natural Resources (June 7, 1984), page 328

C. Minnesota Department of Transportation (June 6, 1984), page 330

D. Minnesota Environmental Quality Board (April 13, 1984), page 332

E. Minnesota Historical Society (May 18, 1984), page 333

F. Minnesota Historical Society (July 12, 1984), page 335

G. Minnesota Pollution Control Agency (June 7, 1984), page 336

III. Regional and Local Governments

A. City of Eden Prairie (June 1, 1984), page 337

B. Hennepin County, Department of Environmental and Energy (June 7, 1984), page 342

C. Lower Minnesota River Water Watershed District (May 23, 1984), page 378

D. Metropolitan Airports Commission (June 1, 1984), page 379

IV. Organizations and Groups

A. Sierra Club, page 380

V. Individuals/Businesses

A. Art Granzberg, resident Bluffs West subdivision (April 26, 1984), page 383

B. Bradley J. Gunn, attorney for Flying Cloud Drive-in Theater (June 7, 1984), page 384

C. Carol and Kevin McCradden, resident Bluffs West Subdivision (June 3, 1984), page 388

D. Charles M. Moos on behalf of Upgrala Management Company, representing 12 landowners in the Grass Lake area (June 4, 1984), page 390

E. Kathy J. Palmer, resident Bluffs West subdivision (May 21, 1984), page 408

F. Sever Petersen family, landowner Grass Lake area (June 5, 1984), page 410

VI. Public Meeting of May 23, 1984--Summary of Comments and Responses, page 411

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
1135 U. S. POST OFFICE & CUSTOM HOUSE
ST PAUL, MINNESOTA 55101

REPLY TO
ATTENTION OF:

April 30, 1984

Construction-Operations
Regulatory Functions (84-J0375-12)

Rodney Kager
9813 Flying Cloud Drive
Eden Prairie, MN 55344

Re: Expansion of the Flying Cloud
Sanitary Landfill
Secs 26, 27, 34, T 116 N., R 22 W.
Hennepin County, Minnesota

We have reviewed the information provided us concerning the referenced project. The work you propose at the location stated is not within the jurisdiction of the Corps of Engineers.

A Department of the Army permit is not required to do this work. The reason for this determination is given at the bottom of this letter.

This letter is valid only for the project referenced above. Therefore, if any change in design, location, or purpose is contemplated, contact this office at (612) 725-7558 to avoid accomplishment of work which may be in violation of Federal law.

If you have any questions, please call Mr. Tim Fell.

Sincerely,

Timothy J. Fell
for Dennis E. Cin
Chief, Regulatory Functions Branch
Construction-Operations Division

Reason for determination:
The expansion of this facility will not require the grading or placement of dredged or fill material into any water of the United States, including wetlands.

CF Carl Schenk
Met. Council

Rec'd 6-11-84

United States Department of the Interior

FISH AND WILDLIFE SERVICE

IN REPLY REFER TO:

Bishop Henry Whipple Federal Building
Fort Snelling
Twin Cities, Minnesota 55111

June 7, 1984

Mr. Carl Schenk
Environmental Planner
Metropolitan Council
300 Metro Square Building
7th and Robert Streets
St. Paul, Minnesota 55101

Dear Mr. Schenk:

This provides U.S. Fish and Wildlife Service comments on the April 1984 Draft Environmental Impact Statement for the proposed Flying Cloud Sanitary Landfill expansion. The comments which follow stem from the Service's general mandate to conserve and protect our nation's fish and wildlife resources for future generations as well as from more specific obligations and concerns related to the future acquisition of Grass Lake and adjacent lands and waters as part of the Upgrala Unit of the Minnesota Valley National Wildlife Refuge.

General Comments

We found several statements related to State Water Quality Standards and leachate detection limits to be misleading. We also question the relevance of various other remarks describing existing hydrologic and water quality conditions in Grass Lake, the Minnesota River and the landfill leachate. Each such concern will be addressed individually under Specific Comments.

We are encouraged by the apparent willingness by Woodlake Sanitary Services, Inc. to work with the Fish and Wildlife Service, the Minnesota Pollution Control Agency and others to develop and implement an effective monitoring program for Grass Lake and other surface waters (Page 93, paragraph 2). We believe such a plan is necessary and must be implemented whether or not the proposed landfill expansion is approved. We are less encouraged by the manner in which possible remedial actions are addressed. Should a trend toward leachate contamination develop in Grass Lake or other lands or waters under Service ownership, this agency will assess its significance in accordance with sound biological principles and consistency provisions of the National Wildlife Refuge Act and, to the extent our authority permits, could require that necessary

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FISH AND WILDLIFE SERVICE LETTER (FWS)

A. The establishment of a monitoring program for Grass Lake is presented in the FEIS as part of the mitigation discussion. WSS has not indicated any position regarding such a program. The establishment of a specific monitoring program would be discussed at the time of permitting.

corrective action be taken. We would much prefer, however, that the Minnesota Pollution Control Agency develop site-specific Water Quality Standards for Riley Creek and Grass Lake which would protect the most sensitive indigenous aquatic species in those water bodies. Such a State requirement would assume even greater importance should the above area remain in private ownership. B

Specific Comments

Following is an item-by-item discussion of various issues of interest or concern to the Service in the order in which they first appear in the draft Environmental Impact Statement.

Page 37, paragraph 3:

We recommend that the final vegetative cover for the landfill be selected with a view toward maximizing wildlife benefits consistent with desirable erosion control and evapotranspiration considerations. The Refuge Manager, Minnesota Valley National Wildlife Refuge, would be pleased to assist in the selection of a mixture of native plant species or a native/introduced species mix which would fulfill all three of the above considerations. C

Page 64, paragraphs 5, 6, 7; Page 66, Table 13 and subsequent discussion thereof:

The discussion and Table related to the "mass balance" analysis is confusing and in need of further elaboration. In any event, the results of the analysis do not present a convincing argument against the potential development of a contaminants problem in Grass Lake or nearby wetlands. D

One of our larger overall concerns with respect to the document's approach lies in its interpretation of a significant water quality effect. Here and elsewhere, a significant water quality effect has been implicitly defined as violation of an MPCA Water Quality Standard for the Minnesota River. State standards have been established on the basis of Use Classes for specific water bodies, and thus may not in all cases provide site-specific protection to the most sensitive aquatic life. The Fish and Wildlife Service will make its interpretation of effects on Refuge waters (as well as the possible need for remedial measures) on the basis of the best applicable aquatic toxicity information available. This may or may not conform with an existing State Water Quality Standard for the Minnesota River. E

Page 67, paragraph 1:

In view of the relatively wide annual fluctuations in Minnesota River trace metal concentrations, information on typical concentrations F

B. The FWS is concerned that current MPCA surface water standards do not adequately protect Grass Lake. State standards for most organic compounds and so me heavy metals do not exist. There is also the concern that even low concentrations of the contaminants in leachate could accumulate in the lake bottom and biota and affect the ecosystem (FEIS p. 111).

C. Final vegetative cover and end use considerations are discussed in the FEIS on pages 83 and 85 in the Site Hydrogeology section. The technical advice of the Refuge manager would be valuable at the time of permitting when the conditions for final cover and vegetation would be discussed.

D. Further analysis of the potential impacts on Grass Lake are discussed in the FEIS in the Site Hydrogeology, Surface Water and Vegetation and Wildlife sections. The mass balance is discussed completely in the consultant's technical report, which is referenced in the opening paragraph of the Site Hydrogeology section.

E. The Minnesota River is classified as 2C, 3B by the MPCA. Grass Lake is classified as 2B, 2C or one class above (more restrictive) than that of the river. Further analysis of the potential impacts on Grass Lake are discussed in the Site Hydrogeology, Surface Water and Vegegation and Wildlife sections.

F. The concentration of metal in the Minnesota River would be lower during periods of highwater, (when the river overflows Grass Lake). If the metals attach themselves to organic matter and other particulates during high water, they would settle out with the particulates. The velocity of the river during high water decreases, where the floodplain widens, allowing particulates to settle out in the area around Grass Lake. This would likely reduce the amount of metals available for direct uptake by the aquatic life in Grass Lake. The impact of the river overflow is evaluated in the FEIS Surface Water section.

during the period of spring high water would be particularly relevant. It would also seem appropriate to consider the extent to which metals transported in the Minnesota River water column during flood stage would be available for direct uptake by aquatic life in Grass Lake. Metals would likely be bound to organic matter or other particulates and we suspect they would remain suspended in the Grass Lake water column for relatively short periods of time. F

Page 70, paragraph 1:

We concur in the need for a surface water monitoring program which would include Grass Lake and nearby wetlands.

Page 76, paragraph 2:

The limits of detection reported for the referenced 1982 water samples were so low (imprecise) as to be incapable of pointing out violations of State standards for various trace metals (e.g., cadmium, copper, lead). When monitoring contaminant levels in water for potential biological effects, more sophisticated analytical methods are required. G

Page 81, paragraph 9:

See our discussion in response to Page 67, paragraph 1. Will Minnesota River flowthrough velocities across Grass Lake be sufficient to scour away the lake's bottom substrate wherein most trace metals and organic compounds would be expected to accumulate? H

Page 93, paragraphs 1-3:

We agree that information on the water quality and aquatic ecology of Grass Lake and adjacent wetlands is presently lacking. While 1980 sampling by Service biologists established a "baseline" condition for contaminants in sediments and fish in Grass Lake, similar information should be obtained in the near future for its waters, vegetation and major fauna. Once obtained, that information would be used to detect trends, if any, in contaminant levels in Grass Lake and its biota.

Our views with respect to development of a comprehensive contaminants monitoring plan are outlined in the preceding General Comments section. We would be pleased to meet with the project proposers and other interested parties to discuss the scope, level of detail and financial and operational aspects of such a plan.

G. Two of the detection level limits for copper and lead, were above MPCA surface water standards for Grass Lake. Seven other detection levels were at or below the standards. In both instances the detected values were below the detection limits. If a monitoring program for Grass Lake were established, detection limits for the laboratory analysis of samples could be set approximately.

H. Because of the width of the floodplain, the velocity of the river at high water levels when it overflows Grass Lake would diminish. The velocity in general would be less than that at which scouring of the floodplain and lake bed would occur. This is discussed in the FEIS on page 98.

Page 124, paragraph 2:

Due to the vulnerability of the bluff face to soil erosion, we recommend that any vegetation problems in that area related to landfill gas be taken care of immediately.] I

Page 196, paragraph 3:

The proposal to work with the Fish and Wildlife Service to ensure the long-term protection of the bluff is an excellent idea, and in line with the Service's own land protection plan. The Service can develop such a cooperative agreement and/or some other type of land management responsibility transfer as soon as the proposer desires. To initiate the process, the proposers should contact the Refuge Manager, Minnesota Valley National Wildlife Refuge.] J

We appreciate the opportunity to express our views with regard to the proposed project and its relationship to the Minnesota Valley National Wildlife Refuge. We look forward to working with all responsible parties toward satisfactory resolution of all issues of concern.

Sincerely yours,

James P. Pitman

[illegible] Pitman
[illegible]ting Regional Director

I. Additional discussion addressing the potential impacts of landfill gas on the bluff and mitigation measures are contained in the FEIS on pages 143 and 146.

J. Implementation of mitigation measures to protect the bluff can be discussed at the time of permitting.

minnesota department of health
717 s.e. delaware st. p.o. box 9441 minneapolis 55440
(612) 623-5000

June 6, 1984

Mr. Carl Schenk
Metropolitan Council
300 Metro Square Building
St. Paul, Minnesota 55101

Dear Mr. Schenk:

Thank you for the opportunity to review the Draft Environmental Impact Statement for the proposed expansion of the Flying Cloud Landfill, Eden Prairie, Minnesota. My review focused mainly on the hydrogeological analysis found in that document and I have the following comments regarding that section of the EIS:

1. The features identified as "ground water divides" will have a minimal effect in mitigating ground water contamination because of the overall configuration of the flow system. The "divides" should not be relied on for that purpose. A

2. Careful attention should be given to statements by the author that certain calculations and predictions are estimates only. The estimates are based on numerous assumptions and limited field data and should not be relied upon for monitoring or design criteria. B

3. The EIS should include some information regarding the impact of the proposed extension on human health. C

Yours,

Patricia Leonard-Mayer
Senior Hydrologist
Section of Water Supply
and General Engineering

PLM:mrs

equal opportunity employer

DEPARTMENT OF HEALTH LETTER

A. The FEIS indicates that the groundwater divides, east and south of the project site, are relatively minor in comparison to the vertical and horizontal movement towards the river. The FEIS (pages 48 and 54) indicates that the divides are important locally in influencing the direction of water percolating through the soils. However, the movement is minor compared to the general vertical and horizontal movement.

The additional discussion in the FEIS concerning hydrogeological impacts and mitigation measures also indicate the relatively minor importance of the divides in affecting the direction of groundwater and leachate movement. The effectiveness of the mitigation measures is not dependent on the divides.

B. Estimates are appropriate and suitable in the FEIS for the purposes of evaluating the potential impacts of the proposed project. A number of worst-case analysis of leachate movement and surface water impacts have been included in the FEIS in those instances where additional data is unavailable (Site Hydrogeology). Data limitations are noted.

C. A discussion of the potential health impacts has been added to the FEIS on page 78.

Recd 6-5-84

STATE OF
MINNESOTA
DEPARTMENT OF NATURAL RESOURCES

BOX . CENTENNIAL OFFICE BUILDING • ST. PAUL, MINNESOTA • 55155

DNR INFORMATION
(612) 296-6157

FILE NO._____

June 7, 1984

Mr. Carl Schenk
Metropolitan Council
300 Metro Square Building
St. Paul, Minnesota 55101

RE: Flying Cloud Sanitary Landfill Expansion
Draft Environmental Assessment Worksheet (EAW)

Dear Mr. Schenk:

The Department of Natural Resources (DNR) has reviewed the above-referenced document and we offer the following comments for your consideration.

Generally, we feel that you have provided an objective, thorough evaluation of the potential impacts of the landfill expansion project. Our comments are primarily concerned with the effects of the project on the Minnesota Valley Refuge and Recreation Area.

The discussion of leachate migration impacts on page 81 indicates that any leachate effects on Grass Lake will not exceed MPCA water quality standards. We feel that these standards may not be the best benchmark to use for determining the significance of the potential impacts. We suggest that you contact the U.S. Fish and Wildlife Service and determine what pollutant concentrations would be appropriate considering their management objectives for Grass Lake. A

The visual impact of the existing and proposed landfill on recreational users in the valley is of concern to our Department. The DEIS, on page 157, discusses visual effects on people in the Grass Lake area. We feel that the major recreational use in the vicinity of the landfill will be on the Minnesota Valley Trail. From the trail the existing landfill is an obvious feature on the bluff. We assume that vegetative screening on the berm will conceal the expansion area from the Valley Trail vantage point. However, as part of the construction of the expansion, we suggest that planting of screening vegetation be made on the existing berm facing the river to hide the existing landfill from view. B

We support the recommendation for bluff protection in the third paragraph on page 196. In addition to transfer of ownership or development rights to the U.S. Fish and Wildlife Service, another alternative is to pursue easement C

AN EQUAL OPPORTUNITY EMPLOYER

DNR LETTER

A. In a telephone conversation on July 3, 1984, the manager of the Wildlife Refuge indicated that the U.S. Fish and Wildlife Service (USFS) does not currently administer any water quality standards or criteria which would apply to the water bodies in the Refuge. The Service depends on MPCA standards for managing and protecting Grass Lake. However, the manager indicated that the USFS is concerned that these standards might not provide sufficient protection for the various lakes within the Refuge. Additional discussion concerning other water quality criteria for Grass Lake are included in the FEIS on page 108.

B. The planned Minnesota Valley Trail is located along the river valley south of the Minnesota River. (See revised Figure 54.) The analysis of visual impacts on the Minnesota Valley National Wildlife Refuge would also apply to the Trail. A discussion of the impact on the Minnesota Valley Trail is included in the FEIS on page 180.

C. The FEIS lists several measures for protecting the bluff such as a cooperative management agreement between Woodlake Sanitary Services (WSS) and the USFS or transfer of title. (See page 218.) The city of Eden Prairie also has regulations governing bluff development which could be utilized to protect the resource. In addition to those discussed in the FEIS, there may be other methods such as the dedication of an easement that could achieve the same purpose.

dedication through provisions established by the City of Eden Prairie. Whichever method is selected it should be examined for consistency with the objectives of the comprehensive plan prepared for the refuge and recreation area. C

Thank you for the opportunity to comment on this document.

Sincerely,

Thomas W. Balcom

Thomas W. Balcom
Environmental Review Coordinator

pje
2242G

c: Karen Loechler - Region V/Metro
Ron Harnack
Tim Kelly
Chris Enger - City of Eden Prairie
Tom Rulland - EQB
Rodney B. Kager - Woodlake Sanitary Services, Inc.

Minnesota
Department of Transportation
Transportation Building
St. Paul, Minnesota 55155

(612) 296-1652
Phone

June 6, 1984

Carl Schenk
Metropolitan Council
300 Metro Square
St. Paul, Minnesota 55101

Re: Flying Cloud Sanitary Landfill
Draft Environmental Impact Statement
District 5 (Eden Prairie)

Dear Mr. Schenk:

The Minnesota Department of Transportation (Mn/DOT) has completed a review of the above referenced Draft Environmental Impact Statement (DEIS). We offer the following comments for your consideration in preparing the final EIS.

As we emphasized in our comments on the Scoping Decision Document for this project, the additional traffic to and from the Flying Cloud Landfill will necessitate a protected left turn for south-bound traffic on Trunk Highway TH (169). It may also be necessary, within a few years, to place a signal system at this intersection.

There are four driving lanes on (TH) 169 within the project area, however, approximately 400 feet south of the landfill intersection the highway narrows to two lanes. North of the landfill intersection and just south of the County Road 1 intersection, southbound traffic on TH 169 is already queing to the inside lane. This, of course, magnifies the problem at the landfill intersection where there is no protected left turn. Traffic must proceed with somewhat unsafe maneuvers to the other lane which then ends in approximately 400 feet. A

Mn/DOT believes that the peak hour landfill haul traffic as presented on page 170 of the DEIS has greater significance than portrayed in the document. The highest hour of traffic on TH 169 occurs between 7 and 8 A.M. with 1800 vehicles which is 7.6% of TH 169 Average B

An Equal Opportunity Employer

MINNESOTA DEPARTMENT OF TRANSPORTATION LETTER

A. The potential traffic hazards on Hwy. 169 at the entrance to the landfill are discussed in the FEIS on page 195. A sheltered left-turn bay and a traffic-control system on Hwy. 169 are suggested as mitigation measures. The MnDOT comments provide additional information related to the discussion of mitigation measures.

B. In a telephone conversation in July 1984, a representative of the Region Five office, MnDOT, stated that these comments are intended to provide additional support for the agency's conclusion that the additional traffic from the expansion would require a protected left turn on TH 169. The protected left-turn bay would provide safer movement of through traffic on TH 169 during the a.m. peak hour, the peak hour of fill activity (11 a.m. to 12 noon) and the other hours of landfill activity.

Daily Traffic (ADT). Between 11 A.M. and 12 Noon during the greatest haul period, there are 1395 vehicles or 5.9% of TH 169 ADT. During 9 A.M. and 3 P.M., identified as the busiest daily period of landfill activity, 34% of TH 169 average daily traffic occurs. From Mn/DOT's perspective, during all haul hours a significant impact is present.

B

Thank you for the opportunity to comment on the DEIS for the Flying Cloud Landfill. If you have any questions regarding Mn/DOT's comments or require any additional information, please contact Carl Hoffstedt, Transportation Planning Engineer at our District Office in Golden Valley, phone number (612) 545-3761.

Sincerely,

Cheryl Heide

Cheryl Heide, Planner
Office of Environmental Services

Minnesota
Environmental Quality Board
100 Capitol Square Building
550 Cedar Street
St. Paul, Minnesota 55101
Phone _____

April 13, 1984

Mr. Carl Schenk
300 Metro Square Building
St. Paul, Minnesota 55101

RE: Draft Environmental Impact Statement (DEIS) for Flying Cloud Landfill Expansion

Dear Mr. Schenk:

This letter acknowledges receipt of the DEIS for this project and notice of the public meeting on the DEIS. Notice of the DEIS availability, the meeting, and the comment period will be published in the EQB Monitor on April 23, 1984. A press release must be supplied to at least one newspaper of general circulation in the area.

In preparing the Final EIS, please note the following requirements of the Environmental Review Program rules:

1. 6 MCAR 3.031 E.8. requires that a tape-recorded or typewritten transcript be made of the public meeting(s).

2. 6 MCAR 3.031 F.2. requires that the draft text be rewritten if other than minor changes are necessitated by comments received.

3. 6 MCAR 3.031 F.1. requires that all timely substantive comments on issues consistent with the scoping decision must be responded to in the Final EIS.

4. 6 MCAR 3.031 F.4. through 6. specify the distribution and notice requirements for the Final EIS.

Sincerely,

Gregg M. Downing

Gregg M. Downing
Environmental Review Coordinator
(612) 296-8253
Toll-free: 1-800-652-9747, ask for EQB, Environmental Review Program.

GMD:lw

cc: Rodney B. Kager

AN EQUAL OPPORTUNITY EMPLOYER

MINNESOTA HISTORICAL SOCIETY

FOUNDED IN 1849

690 Cedar Street, St. Paul, Minnesota 55101 • (612) 296-6126

18 May 1984

Mr. Gerald J. Isaacs
Metropolitan Council
300 Metro Square Building
7th and Robert Streets
St. Paul, Minnesota 55101

Dear Mr. Isaacs:

RE: Proposed Expansion of the Flying Cloud Sanitary Landfill

MHS Referral File Number: R-19
(PLEASE REFER TO THIS NUMBER IN ALL FUTURE CORRESPONDENCE)

Thank you for the opportunity to review and comment on the above project. It has been reviewed pursuant to responsibilities given the State Historic Preservation Officer by the National Historic Preservation Act of 1966 and the Procedures of the National Advisory Council on Historic Preservation (36CFR800).

There are no recorded archaeological sites or historic structures in the proposed expansion area. However, its location on a prominent bluff overlooking the Minnesota River Valley suggests that unrecorded prehistoric archaeological sites may be present. Specifically, we could expect burials and/or burial mounds (well documented im similar sittings both to the east and west of this location) and camp sites associated with overlooks.

Consequently, we recommend that an archaeological survey of the project area be conducted. Such a survey would determine the existence of any sites, their eligibility to the National Register, and the specific effects on them from the proposed activity. I have enclosed for your reference a list of archaeological consultants who have indicated an interest in performing such surveys. The archaeologist hired will need a map of the project area and an explanation of the kind of development proposed. Upon the completion of the survey and before work on the project begins, a copy of the survey results should be submitted to this office for final review.

MINNESOTA HISTORICAL SOCIETY

This letter has been superseded by a more recent letter from the Historical Society which follows. The latest letter indicates there is no impact on historical or archaeological resources. (See letter dated July 12, 1984.)

I should add, however, that if you are aware of any extensive alterations to the project area and feel that the need for a survey should be reevaluated, you should not hesitate to contact Ted Lofstrom, Environmental Assessment Officer, State Historic Preservation Office, Fort Snelling History Center, Fort Snelling, St. Paul, Minnesota 55111; phone 612-726-1171 with that information.

Thank you for your participation in this important effort to preserve Minnesota's cultural resources.

Sincerely,

Russell W. Fridley
State Historic Preservation Officer

Encl.

MINNESOTA HISTORICAL SOCIETY
FOUNDED IN 1849
690 Cedar Street, St. Paul, Minnesota 55101 • (612) 296-6126

July 12, 1984

Mr. Carl Shenk
Metropolitan Council
300 Metro Square Building
7th and Robert Streets
St. Paul, Minnesota 55101

Dear Mr. Shenk:

RE: Proposed expansion of the Flying Cloud Sanitary Landfill

MHS Referral File Number: R-19
(PLEASE REFER TO THIS NUMBER IN ALL FUTURE CORRESPONDENCE)

We recently sent you a letter expressing concern over the potential expansion of this landfill. In reviewing earlier correspondence, we note that it has already been determined that the expansion area has been severely disturbed. Consequently we conclude that the expansion will have no effect on any historical or archaeological properties.

If you have any questions on our review, please contact Ted Lofstrom, Environmental Assessment Officer, Minnesota Historical Society, Fort Snelling History Center, St. Paul, Minnesota 55111.

Thank you for your continued close attention to historic values in your planning process.

Sincerely,

for Russell W. Fridley

Minnesota Pollution Control Agency

June 7,1984

Ms. Sandra S. Gardebring
Chairperson
Metropolitan Council
300 Metro Square Building
7th & Robert Streets
St. Paul, Minnesota 55101

Dear Ms. Gardebring:

The Minnesota Pollution Control Agency (MPCA) staff has reviewed the draft environmental impact statement (EIS) for the proposed expansion of the Flying Cloud sanitary landfill (SW-14) in Eden Prairie and, in general, finds that the document and accompanying appendices present a thorough discussion of the issues delineated in the scoping decision document dated March 24, 1983. Your staff is to be commended for their efforts.

Our respective staffs have cooperated extensively on the project, and minor concerns have already been communicated. These concerns include an apparent inconsistency in statements concerning water quality impacts of periodic inundation of Grass Lake by the Minnesota River, and a general concern that the hydrogeology section include a discussion of the assumptions upon which it is based. Neither of these concerns is considered a significant detraction from the adequacy of the document. A B

Thank you for the opportunity to comment on the draft EIS. Should you have any questions, please contact Deborah Pile, Director, Office of Planning and Review at 296-7799.

Sincerely,

Thomas Kalitowski
Executive Director

TK:es
cc: Dick Nowlin, Larkin, Hoffman, Doty & Lindgren
Gregg Downing, EQB

Phone: 296-7301
1935 West County Road B2, Roseville, Minnesota 55113-2785
Regional Offices • Duluth/Brainerd/Detroit Lakes/Marshall/Rochester
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MPCA LETTER

A. The discussion regarding the potential impact of the Minnesota River on Grass Lake has been clarified in the FEIS on page 98. Although the Minnesota River overflows Grass Lake about one year out of two, during high water periods, the river velocity would diminish as it flows through the wide floodplain around the lake. During the 100-year flood, the average overbank velocity in the Grass Lake would be 0.84 ft./second. A telephone conversation with a representative of the U.S. Army Corps of Engineers, St. Paul District, on Aug. 15, 1984, indicated that this velocity would not result in scouring of the lake bottom.

B. Additional analysis of the potential impacts on groundwater and surface waters is included in the FEIS. The assumptions for the analyses have been stated in the FEIS. The FEIS includes a worst-case analysis of the potential impacts, assuming the silt layer is not present beneath the existing site.

CITY OFFICES / 8950 EDEN PRAIRIE ROAD / EDEN PRAIRIE, MN 55344-2499 / TELEPHONE (612) 937-2262

METROPOLITAN COUNCIL
CHAIRMAN'S OFFICE

JUN 7 1984

Route to:

June 6, 1984

Sandra Gardebring, Chair
Metropolitan Council
300 Metro Square Building
7th and Robert Streets
St. Paul, MN 55101

Dear Ms. Gardebring:

Through its Mayor and City Manager, the City of Eden Prairie made its position known at a public hearing held May 23, 1984, regarding the Draft Environmental Impact Statement for the proposed expansion of the Flying Cloud sanitary landfill. In accordance with the rules for the public hearing process, the City is also submitting written comments by June 7, 1984. These comments will condense and amplify the concerns raised at the formal public hearing.

Long-Term Responsibility: The City is very concerned about assurances that neither it nor any private property owner will bear any liability to remedy or mitigate possible environmental pollution. The draft EIS assumes Woodlake Sanitary Service, Inc./Browning-Ferris Industries, Inc. will remain viable corporate entities well beyond the post-closure date of the landfill. However, the continued existence of such private enterprises must not be taken for granted. The final EIS should specify that some form of economic assurance - e.g., a bond, long-term post-closure liability insurance, escrow fund - be required of WSS/BFI. Also, some form of back-up assurance from Hennepin County will be appropriate. **A**

The draft EIS contains numerous references that some party or agency should take certain actions or have certain responsibilities. The final EIS needs to identify responsibilities more definitively. **B**

Inspection and Testing: The frequency and quality of tests and inspections are additional issues. The City is concerned that the Minnesota Pollution Control Agency has proper staffing to inspect landfill operations for compliance with the permit and State regulations for landfill use. It is equally anxious about the equipment and funds the MPCA will be able to commit for environmental testing during and after the operational phase of a landfill expansion. **C**

Based on the results of tests conducted prior to issuance, the Draft EIS suggests that general conditions regarding litter, noise, dust, groundwater quality, leachate migration, impacts on surface water resources and wildlife habitat are all acceptable for current and expanded landfill operations. Eden Prairie questions the determination of the criteria for these factors. It requests that further testing be conducted and that results be interpreted by a disinterested third party before the final EIS is published. **D**

EDEN PRAIRIE LETTER

A. The purpose of the FEIS is to provide information regarding the potential impacts and mitigation measures. It is not the purpose of the FEIS to establish the responsibility for long-term liability. The permitting process would determine the need for and types of long-term financial assurances asked for here. Amendments to the Waste Management Act passed in 1984 require the MPCA to adopt rules for closure/post closure and for proof of financial responsibility on the part of operators of new and expanded landfills. Proof of financial responsibility will be required of an existing operator or owner of a facility with a remaining capacity of more than five years or 500,000 cubic yards (Laws of Minnesota 1984, Ch. 644, Section 49, subd. 4h). These rules may apply to the proposed expansion, depending on the remaining capacity at the time the rules are adopted.

B. The purpose of the FEIS is to evaluate the potential impacts, mitigation measures and alternatives. The responsibilities of the proposer and governmental agencies will be identified during the permitting process.

C. The MPCA has the authority and responsibility to monitor and inspect the operations of the landfill to insure compliance with all permit conditions and state regulations. Hennepin County has similar authority to enforce all the conditions attached to the county license for the project. Concerns about those agencies' abilities to fulfill their responsibility should be directed to them.

D. Additional analyses of groundwater, surface water and wildlife habitat impacts are included in the FEIS. Mitigation measures to reduce the impacts mentioned, are discussed. A determination as to whether any of the impacts and mitigation measures are acceptable will be determined at the time of permitting.

The Minnesota Environmental Quality Board (EQB) has assigned the task of preparing the draft and final EIS and determining the adequacy of the FEIS to the Council as the responsible governmental unit (RGU).

Long-Term vs. Temporary Problems: Sanitary landfills represent both temporary and long-term uses. Issues associated with temporary uses are noise, odor, dust, litter, traffic, aircraft operations, and scavenging birds and rodents. Problems arising from these factors could be considered an acceptable burden in that they would last only through the seven-year expansion of the life of the landfill (estimated to close in 1992). Long-term problems need further amplification. Groundwater leachate problems are estimated to last 100 years. Methane gas would be vented from 50 to 150 years. Soils in very deep landfills, and the Draft EIS places the Flying Cloud landfill in this category, may take as long as 100 years before they have settled sufficiently to support structures. This land essentially is removed from development. An expansion would widen the area of adjoining lands which would be subject to the long-term effects of the landfill. These long-term issues present a much greater concern than that associated with the relatively temporary phase of operation. **E**

Capacity: With respect to capacity needs, the Draft EIS presents information showing the metropolitan landfill capacity without the Flying Cloud expansion to be adequate until 1992. Expansion of Flying Cloud would extend the regional capacity until 1994, or only two years.

The extended lifespan of the Flying Cloud landfill appears to be understated. It is quite likely that solid waste reduction efforts like recycling and incineration will intensify and thus further lengthen the life of landfills. If this scenario actually occurs, when would the Flying Cloud landfill ever close? **F**

The Draft EIS shows five existing landfills within a reasonable distance of Eden Prairie which could meet the solid waste disposal needs of Eden Prairie and surrounding communities. Arguments about meeting regional landfill capacity needs by expanding the area of Flying Cloud are questionable. It appears that expansion is based upon convenience and perhaps not on well-tested necessity.

Methane: The Draft EIS notes potential hazards with odor and explosion. To mitigate these hazards, "elimination of, or reduction in, the southeast corner of the expansion could be a more effective approach in these instances," (pg. 125). It also notes that Woodlake has not identified a backup method for gas detection. **G**

Groundwater: Groundwater pollution can occur from landfill leachate. Traces of volatile organics like benzene and toluene have already been detected in groundwater samples around the existing landfill. While soils will absorb some of the harmful substances in the leachate, it is possible that traces of heavy metals can migrate to the Grass Lake/Minnesota River water system. The Draft EIS also states that landfill operations will likely increase horizontal infiltration of leachate rather than the vertical infiltration. This movement will accelerate this aspect of landfill impacts to adjoining lands. **H**

Effect on Biota and Habitat: The Draft EIS makes little conclusive analysis of the impact on biota (flora and fauna) and water/vegetative resources. Too little study has been done on the water and lake-bottom quality to determine what influence the leachate would have in addition to compounds which may already exist. While it is suggested that the Minnesota River's frequent flooding pattern should mitigate pollution through dilution, the Draft EIS does not adequately state the impact of simultaneously increased levels of these compounds downstream. **I**

E. The FEIS identifies the potential longer term concerns such as landfill gas and groundwater and discusses mitigation corrective measures. The effect of additional mitigation measures such as a liner and collection system which might provide longer term protection is examined on page 81. The permit would indicate the specific long-term conditions which will be implemented to minimize future impacts.

Settling and protection of the final cover could be a long-term concern in terms of the end use. There might be public and private uses which would neither disturb the final cover nor be constrained by settling. The FEIS addresses this issue on pages 85 and 219.

F. The FEIS indicates the expansion could extend the life of the landfill up to another seven years.. This estimate does not reflect the impact of future programs to expand recycling and process waste through resource recovery plants and composting. If these programs and facilities are implemented during the life of the project, the amount of waste being disposed of at the project annually could be reduced. This could extend the life of the project, depending on how much of the residuals from processing would require land disposal.

Extending the life of the project would have a mixed effect on the potential environmental impact. The total size of the facility design might not change so the possible visual impacts would not be altered. However, waste processing which removes the organics would preclude the production of methane gas and minimize leachate impacts. Assuming waste processing would reduce the volume of fill material, the traffic on TH 169 and County Rd. 1 and the potential for conflicts with through traffic would be reduced because of less landfill truck traffic. Extending the landfill operations could delay the placement of the final cover which minimizes infiltration. However, limiting the active fill area to a small size could accelerate the placement of final fill and cover. Waste processing would minimize leachate impacts. Waste processing would minimize the impacts of nuisances from dust, odors and litter which affect nearby residents, property values and residential land use. Noise impacts would be less because of reduced fill activity.

G. This is addressed in the FEIS in the Alternatives and Landfill Gas sections.

H. Additional analyses of the potential impacts on groundwater and Grass Lake are contained in the FEIS in the Site Hydrogeology and Surface Water sections.

I. Additional evaluation of the potential impact on Grass Lake and the associated biota is presented in the Site Hydrogeology and Surface Water sections. The potential impact on the river is discussed on page 99.

Soils and Siting Criteria: The siting criteria used by the Metropolitan Council for new landfills would eliminate the Flying Cloud site. This site has porous sandy soils, not the clayey soils needed for new landfills. The Draft EIS points out that the soils at Flying Cloud have the potential to allow easy and relatively rapid movement and venting of methane. The soils also allow the vertical movement of leachate at a rate of ten feet per year. The ground upon and in which the landfill expansion would occur are inherently unsuitable for the siting of new landfills. Expansion of the landfill will surely add to any hazards already existing. J

Proximity to an airfield (Flying Cloud) would also preclude siting approval.

Aircraft Compatibility: The Federal Aviation Administration (FAA) prohibits landfill uses within 10,000 feet of an airfield. This regulation results primarily from the need for aircraft to avoid striking birds which often congregate to scavenge sustenance from the landfills. We do note that the FAA has withdrawn its objection to the expansion because the managers of the airport and the landfill cooperate closely to scare birds away from the area. The draft EIS states that a landfill is a compatible adjacent use to an airfield; however, based on the FAA regulations, this assertion may not be correct. K

A berm proposed to be placed along the north, east and southeast fringe of the landfill would also have trees planted. The Draft EIS identifies a potential problem that the trees may grow to a mature height which would interfere with take-off and landing clearances.

Zoning: Current siting regulations require that the landfill have a 1000-foot setback from residential properties. A map on page 236 shows the reduced expansion acreage resulting from compliance with this ordinance provision. It appears that there will not be a significant reduction in acreage if the provision is enforced. There needs to be further clarification if the setback requirement relates to distance from developed properties or platted parcels. L

Traffic Impacts: The Draft EIS identifies few problems existing with traffic patterns to the landfill. It notes that refuse truck traffic is a small percentage (1.7 per cent) of total traffic. A need for improved signage, striping, and a sheltered left-turn lane is identified. The City presumes these improvements would be made at the expense of the operator. These traffic safety needs should become greater as more traffic uses U.S. 169 to travel to Shakopee. M

Firefighting Safety and Requirements: The Eden Prairie Fire Marshal gives a strong recommendation to extend the water supply to the landfill site. City water is available one-half mile away on Pioneer Trail. Water is necessary to protect the buildings on site as well as to contain fires occurring in the fill area. Fire-fighting capacity is now limited to a 3000-gallon tanker that is on the Woodlake property. City firefighters need a 1200 - 1300 gallon-per-minute water supply. N

A major fire occurred in January 1980 which lasted ten days. Water was used at a rate of 180,000 gallons per day. Needless to say, the on-site water supply has limited value.

End Uses: Many of the proposed end land uses are not practical in view of the impact they would suffer due to ground settlement and leachate acceleration. City staff has requested information about experiences of other units of government or landfill operators have had with end uses of landfills as deep as Flying Cloud. O

J. The siting criteria referenced have been utilized by the Council and the MPCA in reviewing and determining the environmental suitability of candidate sites for new landfills submitted by the seven counties in the Metropolitan Area. The proposed project is an expansion of an existing landfill and has not been proposed by Hennepin County as a new site. However, the potential environmental impacts of the project will be subjected to a similar careful evaluation including the FEIS and during the permitting process. Supplementary analysis of the soils and potential impacts on groundwater and surface water is contained in the FEIS as noted previously.

K. The potential impacts on the airport are addressed in the FEIS on page 221. The FAA has withdrawn its objections to the project. See Appendix C. The FEIS addresses the problem of vegetation on pages 226-227.

L. The FEIS clarifies the question about the 1,000-foot setback in the Alternatives section.

M. The financial responsibility for these improvements will be addressed as part of the permitting process. It is not the purpose of the FEIS to determine this.

N. The potential for fire hazards is evaluated in the FEIS on pages 162. The probability is quite small. The cost of extending a line is discussed on page 244.

O. Additional evaluation of potential end uses is included in the FEIS, pages 85 and 219. Protection of the bluffs and the specific means for accomplishing this, could be discussed during the permitting process.

The City still awaits this information. Given the probability of extensive ground settlement, productive uses as recreation or building development may be impractical.

Woodlake Sanitary Service proposes a golf course, open space, residential, and commercial/industrial uses on the site following closure. The Draft EIS notes that a golf course is not desirable because water used to irrigate tees, greens, and fairways would accelerate leachate infiltration. It states that the soils will not stabilize to the point that they can support structures for as long as a century. The bluffs north of Riverview Drive are suggested to be given to the U.S. Fish and Wildlife Service. The City may wish to acquire the bluffs or, like Bloomington, gain control and maintain the bluffs. There is no indication that Woodlake has any position on this last issue.

O

Fiscal Impact: The section of the Draft EIS relating to fiscal impact on municipal infrastructure and on property value needs further refinement. Conclusions from studies done by Browning-Ferris, Inc. on comparative property values showing little change in valuation need to be reexamined due to the questionable methodology used. Possible costs from the effects of agents migrating from the landfill need to be identified. For example, 11 private wells may become contaminated. Who will pay for new water supplies? The tax revenue impact of removing land from commercial/industrial use to inert use needs to be explored. These long-term costs do not appear to be adequately quantified to make a well-informed decision on the costs and benefits to permit expansion.

P

Most of the residents living to the east of the landfill moved in before any suggestion of expanding the landfill and relied on a promised closure date of 1982. Long-term effects on the residents and their properties are not known. The landfill is a region-wide facility with region-wide benefit. Eden Prairie strongly believes it is inappropriate and unfair to subject these residents to the possibility of serious future problems without having some plan of action directed toward reimbursing them for any losses they may sustain. The City recognizes that this plan may not be easily developed and accomplished, but some substantial research in this area has already been completed in conjunction with recently-proposed legislation.

Q

Specific solutions or detailed mitigation plans are noticeably lacking on such critical issues as leachate control systems (should they become necessary,) and the extension of the City's watermain system. The final EIS must be more specific in identifying feasible mitigation solutions and how they will be financed.

R

Effects on Residential Areas to the East: We are most concerned with the health, safety, and welfare of those residents living close to the landfill and proposed expansion area. Expansion of the landfill would be in the direction of greatest potential detrimental impact. Prevailing winds from the northwest would blow litter, dust, and odors over the Bluffs West and Hillsborough subdivisions. According to the EIS, methane gas can be in explosive concentrations at a distance of 800 feet from the site; the closest occupied parcels are currently 1000 feet from the limit of the expansion. Methane can also travel through public utility lines and vacated pipelines. A groundwater divide runs through the middle of the expansion area. Full expansion could result in groundwater running eastward toward some eleven residences which have private wells. The residential area would be subject to solid, liquid, and gaseous nuisances and below ground level.

S

State-of-the-Art Technology: If expansion is approved, Woodlake should be required to install state-of-the-art technologies for leachate and methane collection. The thrust of recent, existing legislation has been to prevent

T

P. The BFI comparative study of property value impacts at Flying Cloud and other BFI landfills in the U.S. was not undertaken as part of the FEIS. The FEIS indicates there are several limitations in the technical aspects of the report. The FEIS addresses the potential impacts on property values on pages 233.

Additional analysis regarding the possible impact of the project on private wells to the southeast and those to the southwest and mitigation measures are discussed in the FEIS on page 79. The mitigation measures should minimize the potential impacts and any future costs. If contaminants affect the use of private wells in the area, and the landfill is determined to be the source, it is assumed that Woodlake would be financially responsible for corrective measures.

The FEIS discusses the problem of end uses on page 85 and 219 and the impact on tax revenues on page 243. As long as the property is in private ownership, it would produce some tax revenues, but these might be lower than the current figure. The FEIS indicates the property taxes which are currently paid by Woodlake. Once the landfill is closed, there would be minimal requirements for city services, unless the property is developed for other uses.

Q. Mitigation measures to minimize the potential impact on property values are discussed in the FEIS on pages 233. An additional mitigation measure is included in the FEIS on page 242 reflecting amendments to the WMA passed in 1984.

R. The purpose of the FEIS is to evaluate potential impacts and possible mitigation measures. Specific plans incorporating the mitigation suggestions will be addressed in the permitting process as conditions for permit approval.

Implementing responsibility would be indicated for these plans as part of the permit.

S. These impacts and mitigation measures are discussed in the appropriate sections in the FEIS.

T. Mitigation measures for the control of leachate and methane are discussed in the FEIS as previously noted and will be addressed in the permitting process.

environmental pollution to the greatest extent possible. Use of state-of-the-art technologies would keep problems arising from landfill operations to date from being exacerbated. T

The City of Eden Prairie earnestly requests that the Metropolitan Council seriously considers these issues during preparation of the final EIS. We are willing to provide the Council whatever information we have or may be able to gather during this process.

Sincerely,

CITY OF EDEN PRAIRIE

Carl J. Jullie

Carl J. Jullie
City Manager

CJJ:jp

HAND DELIVERED 6/7/84

DEPARTMENT OF ENVIRONMENT AND ENERGY
320 Washington Av. South
Hopkins, Minnesota 55343

935-3381
TTY-935-6433

June 7, 1984

Mr. Carl Schenk, Environmental Planner
Metropolitan Council
300 Metro Square Building
St. Paul, Mn 55101

Dear Mr. Schenk:

Hennepin County had its consultants, GME Consultants, Inc, consulting engineers, prepare a technical review of the hydrogeologic and gas control aspects of the Draft Environmental Impact Statement (DEIS) for the Flying Cloud Sanitary Landfill Expansion. Their report "Review of DEIS, Flying Cloud Landfill, dated June 5, 1984", is being sent under separate cover.

The County was able to express and input its concerns on the scope and the contents of the DEIS at the many meetings held on the matter. This practice is recommended to be continued and staff is available to meet with the council and discuss the subject matter of the above report.

The County finds that the scope and contents of the EIS will be beneficial to the County when making its review of the license application for the expansion of the Flying Cloud Sanitary Landfill.

Sincerely,

Edward Monteleone
Edward Monteleone
Principal Environmentalist

EM:dr

cc: A. J. Lee

GME CONSULTANTS, INC.
CONSULTING ENGINEERS
2083 East Center Circle / Minneapolis, MN 55441 / 612/559-1859

June 5, 1984

Mr. Luther Nelson, P.E.
Hennepin County
Department of Environment and Energy
320 Washington Avenue South
Hopkins, MN 55343

GME Job #134

RE: Review of Draft Environmental Impact Statement and supporting reports for the Flying Cloud Landfill Expansion in Eden Prairie, Minnesota

Dear Mr. Nelson:

Enclosed with this letter is our review of the above referenced report. This review was limited to the hydrogeologic and gas control aspects of the report.

The summary conclusions and detailed discussion of our findings are included in the executive summary and report. Our two main conclusions are:

1. The hydrogeologic investigation and analysis is incomplete.

2. The gas control report and control plans are, with minor exceptions, acceptable.

If you have any questions concerning the enclosed executive summary, report, or supporting materials, please do not hesitate to contact us immediately.

Very truly yours,

R. Eric Zimmerman, P.E., Ph.D.
Senior Consultant

William Kwasny, P.E.
President

mk

Executive Summary

The purpose of this executive summary is to present the major findings of GME conultants' review of three documents. The documents are:

1. Draft Environmental Impact Statement, Flying Cloud Landfill Expansion, Minnesota Council of the Twin Cities Areas, April, 1984, Publication # 12-84-054

2. Hydrogeological Analysis of the Proposed Flying Cloud Sanitary Landfill Expansion, Metropolitan Council of the Twin Cities Area, April, 1984, Publication # 12-84-57

3. Assessment of Landfill Gas Generalization, Control Methods and Hazards, Proposed Flying Cloud Sanitary Landfill Expansion, Metropolitan Council of the Twin Cities Areas, April, 1984, Publication # 12-84-055

With the objective of providing a concise executive summary, the findings and conclusions of this review are listed in the order in which they were encountered in the Environmental Impact Statement (EIS) and the report of June 5, 1984. The specific page reference for the material in both reports is indicated after the summary findings. A great deal of the material contained in the two supporting documents is also contained in the EIS, the specific comments on these two documents is limited.

On May 25, 1984 Dr. R. E. Zimmerman and Mr. William Kwasny of GME Consultants visited Mr. Roland C. Smith of Woodlake Sanitary Services at the Flying Cloud Landfill. The purpose of this site visit was to visually inspect the site and the surrounding areas. One of the observations made at this landfill concerns the site operation and cleanliness which is not part of the charge presented to GME Consultants concerning the technical review of the hydrogeologic investigation and analysis, and gas control systems at the site. However, Zimmerman and Kwasny were sufficiently impressed with the site conditions during this unannounced visit that they felt comment was in order.

First, the unannounced site visit was made on a Friday afternoon after a week in which high winds had occurred. The authors noted no paper or blowing litter along the site boundary which they completely traversed. In addition, the cover conditions and filling operations were in excellent order and exposed refuse existed only on the working face of the fill. The site vegetation appeared to be in excellent condition, as were buildings and grounds. Dr. Zimmerman has visited landfills in 15 states and the conditions at this site were among the best, if not the best.

The conclusions presented in the summary report and report are based upon the information presented in the EIS and two supporting documents. It is not a reflection of the daily operation of the landfill or the site conditions there.

Summary Findings and Conclusions

I. Existing Gas Control Systems,
Page 19-EIS; Page 4, GME.

The existing passive gas barrier on the southeast side of the site should have a venting system for the gas that is to be deflected upwards. Otherwise the gas may migrate off site. In additon, the vegetation on the southwest side parallel to the Minnesota River should be monitored to assure that damage is not occurring from the landfill gas.

II. Proposed Methane and Landfill Control,
Page 34, EIS; Page 6, GME.

Two suggestions are made to the proposed design. First, along the southeast side of the landfill, the potential housing area east of the alternative blower house will be unprotected. Gas monitoring wells should be installed to determine if gas is migrating around the south end of the control system. Second, the natural slope on the southwest side of the landfill is very steep and the vegetation existing there must be protected from damage that might occur from gas ventin through the side of the slope. This may include additional monitoring wells or could possibly require the installation of an active system along this boundary.

III. Bedrock and Glacial Geology,
Page 39, EIS; Page 7, GME.

Conclusions developed in the EIS concerning the subsurface conditions at the site are based upon insufficient field data. Projections of a silty clay layer beneath the site are made in the EIS and Hydrogeologic Report, yet the EIS says that this layer was not found at the site.

Additional data and analysis is required.

IV. Groundwater Flow Patterns,
Page 44, EIS; Page 14, GME.

The groundwater flow pattern discussion lacks sufficient data to make the conclusions or speculations that are presented in the report.

Additional data and analysis is required.

V. Groundwater Quality and Leachate Monitoring,
Page 47, EIS; Page 47, GME.

Based on the data presented in the report the existing groundwater beneath the site is contaminated by both inorganic and organic compounds. Insufficient data is presented to evaluate if the source of these compounds are the landfill or other potential sources.

However, based upon the information contained in the report, the most likely source of these is the landfill.

Additional data and analysis is required.

VI. Leachate Movement,
Page 55-57, EIS; Page 24, GME.

Due to the lack of sufficient hydrogeologic and groundwater flow data as discussed above, and the lack of a complete analysis, the conclusions reported in the EIS on leachate movement have no scientific or engineering basis.

Additional data and a thorough analysis of the leachate and its interaction with the groundwater is required.

VII. Leachate Attenuation,
Page 61-62, EIS; Page 28, GME.

The EIS assumes that the attenuation and dilution of the contaminates contained in the leachate will occur in the soils beneath the site to a level sufficient to greatly decrease the potential for contamination. These conclusions are based upon incomplete data and analysis. In fact, based upon the soils speculated to exist beneath the site, the potential for attenuation is very low.

Additional data and analysis is required.

VIII. Impact on City Wells, Minnesota River Valley and Summary of Potential Impacts,
Page 82, EIS; Page 29, GME.

Based upon the data presented in the EIS and the Hydrogeologic Analysis of the proposed landfill expansion, there is insufficient data to make conclusions or analyses concerning the site conditions, groundwater flow, or leachate movement.

Additional data and analysis is required.

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HENNEPIN COUNTY, MINNESOTA

FLYING CLOUD SANITARY LANDFILL EXPANSION

1. Introduction

This document is a technical review of three documents which describe the proposed expansion and environmental impacts of the Flying Cloud Landfill in Eden Prairie, Minnesota. These three documents have been published by the Metropolitan Council of the Twin Cities Area. This technical review deals with the hydrogeologic and gas control aspects of the project. The three documents are:

a. Draft Environmental Impact Statement (EIS), Flying Cloud Sanitary Landfill Expansion, Metropolitan Council of the Twin Cities Area, Publication No. 12-84-054, April, 1984;

b. Hydrogeologic Analysis of the Proposed Flying Cloud Landfill Expansion (Hydrogeologic Report), Metropolitan Council of the Twin Cities Area, Publication No. 12-84-057, April, 1984;

c. Assessment of Landfill Gas Generation, Control Methods and Hazards (Gas Report), Proposed Flying Cloud Sanitary Landfill Expansion, Metropolitan Council of the Twin Cities Area, Publication No. 12-84-055, April, 1984.

Earlier drafts of the first two documents were reviewed by GME consultants in November, 1983, and comments were forwarded to Mr. Edward Monteleone of the Hennepin County Department of Environment and Energy, Hopkins, Minnesota on November 22, 1983.. Five summary conclusions were presented in our letter of November 22, with regard to the technical quality and organizational features of the two reports. Please contact Mr. Monteleone for details regarding these conclusions.

This report contains three sections, which are described below. The first section is the Introduction. Section 2 reviews the Draft Environmental Impact Statement (EIS), and comments on both the Hydrogeologic Report and the Gas Report. Section 3 contains recommendations. Since the EIS contains large sections of both the Hydrogeologic Report and Gas Report, many of the comments made are applicable to more than one report. This report is intended to be a stand-alone document; portions of the text and figures from the three documents reviewed will be included in the text.

On May 25, 1984 Dr. R. E. Zimmerman and Mr. William Kwasny of GME Consultants visited Mr. Roland C. Smith of Woodlake Sanitary Services at the Flying Cloud Landfill. The purpose of this site visit was to visually inspect the site and the surrounding areas. One of the observations made at this landfill concerns the site operation and cleanliness which is not part of the charge presented to GME Consultants concerning the technical review of the hydrogeologic investigation and analysis, and gas control systems at the site. However, Zimmerman and Kwasny were sufficiently impressed with the site conditions during this unannounced visit that they felt comment was in order.

First, the unannounced site visit was made on a Friday afternoon after a week in which high winds had occurred. The authors noted no paper or blowing litter along the site boundary which they completely traversed. In addition, the cover conditions and filling operations were in excellent order and exposed refuse existed only on the working face of the fill. The site vegetation appeared to be in excellent condition, as were buildings and grounds. Dr. Zimmerman has visited landfills in 15 states and the conditions at this site were among the best, if not the best.

The conclusion presented in the report are based upon the information presented in the EIS and two supporting documents. It is not a reflection of the daily operation of the landfill or the site conditions there.

2.0 Review Comments-Draft Environmental Impact Statement Flying Cloud Sanitary Landfill Expansion, 1984.

This section contains review comments on the EIS. These comments are listed by subject areas with specific references to the section of the EIS to which they apply.

2.1 Background Existing Landfill Gas Control

(EIS, Page 19)

The existing landfill gas control procedures are described and include two systems, a passive clay barrier and an active extraction system. The clay barrier is described in the EIS report as follows:

> A clay barrier has been constructed along the southeastern perimeter of the fill area (Figure 7)(GME Fig. 1.). The barrier is 1,500 feet long, 100 feet deep and at least 36 inches thick, and is placed at a slope of 2.5 to 1. The barrier is compacted at 95 percent Proctor density to achieve a maximum coefficient of permeability of 1×10^{-7} cm/sec throughout its depth. Its design induces gas to move upward into the air at the surface rather than migrating laterally into off-site areas.

Figure 1 (EIS Fig. 7) shows the location of the barrier, and the existing and proposed extraction system. The clay barrier will induce the gas to move upward. However, if a venting system is not installed at the top of the clay barrier, lateral gas movement to the southwest and northeast will occur when the final cover layer is completely saturated and/or frozen. With a final

A

HENNEPIN COUNTY/GME LETTER

A. These comments relate to the existing landfill and not the proposed expansion. The issue of whether the existing clay barrier would control gas migration, once the final cover is in place, should be addressed by permitting agencies. If the expansion is permitted, the clay barrier would be removed and replaced by a control and monitoring system along the eastern perimeter of the expanded site, which is indicated in the FEIS, page 34.

Figure 7.
EXISTING AND PROPOSED METHANE CONTROL AND MONITORING SYSTEM

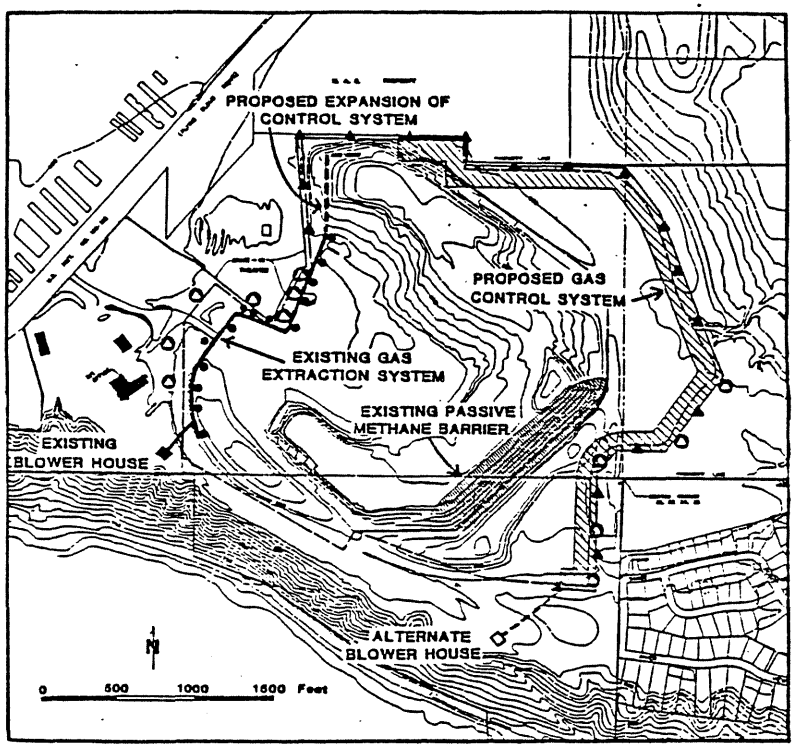


FIGURE 1.

clay cover several feet thick beneath a park or golf course, saturation will occur during most of the year. With other, more permeable covers, saturation can be expected from fall to late spring. Laterally escaping gas will migrate until vents are found. These vents may be pipelines, sewers, and/or buildings.

A

2.2 Proposed Project-Methane and Landfill Gas Control

(EIS, Page 34)

This section of the EIS describes the proposed Landfill Gas Control System which is proposed to be operative for the expanded landfill. The proposed system, shown on Figure 1 (EIS Fig. 7) includes expansion of the existing active extraction system around the landfill on the north and east. When the expansion is combined with the present extraction system the entire site, except for the southwest side parallel to the Minnesota River, will have active gas control. The EIS says :

> The existing passive clay control barrier along the southeast corner of the landfill will be removed during excavation of the expansion.
>
> No control system is proposed along the south perimeter of the landfill which borders the bluffline (Figure 7)(GME Fig. 1).

There are two areas of concern regarding the proposed plan. First, along the southeast side, the potential housing area east of the Alternative Blower House will be unprotected. Gas monitoring wells should be installed to

B

B. It appears unlikely that gas would migrate around the end of the proposed control system at the southeast corner of the expanded site. The gas would also have to pass around the detention pond at this location. Additional discussion addressing this concern is included in the FEIS on page 145.

Additional discussion of mitigation measures with regard to the protection of bluff vegetation is contained in the FEIS, page 146

determine if gas is migrating around the south end of the control system. Second, vegetation on the natural slope on the southwest side of the site must be protected from damage that might occur from venting gas.

B

2.3 Potential Environmental Impact

Bedrock Geology and Glacial Geology

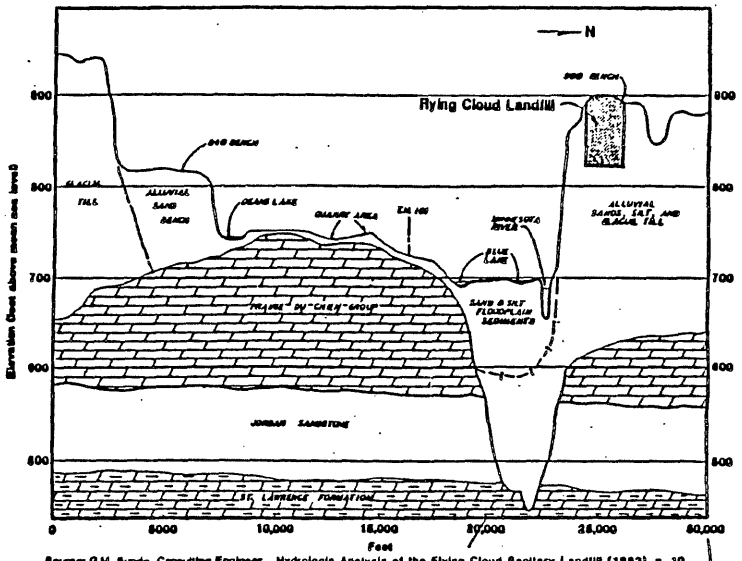
(EIS, Page 39)

The EIS describes the existing site bedrock and glacial geology in this section. This information is illustrated on Figure 2 (EIS, Fig. 17), a geologic cross-section of the site and is accurate in its generalizations. However, Figure 2 (EIS, Fig. 17) has a horizontal to vertical exaggeration of 40 to 1. The result of this exaggeration is that the location of the landfill appears to be of little consequence in the underlying dolomite. The figure does clearly illustrate that a very large subsurface aquifer may exist beneath the Minnesota River Valley and could provide a hydrogeologic connection from the landfill to both the Jordan Sandstone and the St. Lawrence Formation.

Figure 2A. shows the same information drawn with a 2.2 to 1 horizontal to vertical ratio. As can be seen by comparing the two drawings, the large horizontal to vertical ratio distorts the fact that the Prairie-Du-Chien dolomite extends for a considerable distance to the south beyond the edge of the landfill.

C

C. The original version of Figure 17 does exaggerate the relationship of the underlying geology. A revised Figure 17 is contained in the FEIS. The revised figure indicates that the Prairie du Chien dolomite extends south towards the river valley beneath the project site.



Source: G.M. Sunde, Consulting Engineer , Hydrologic Analysis of the Flying Cloud Sanitary Landfill (1982), p. 10

Figure 17. GEOLOGIC CROSS-SECTION

(N-S, ON SECTION LINE AT WEST END OF BLUE LAKE)

FIGURE 2

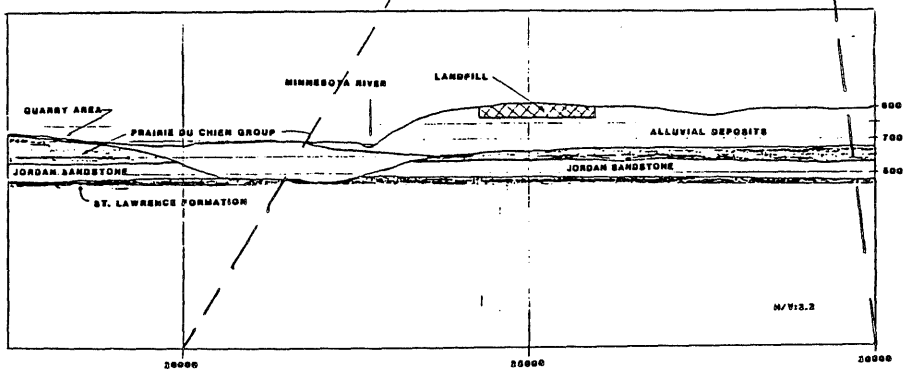


FIGURE 17 A

FIGURE 2-A

Soils

(EIS, Page 41)

The EIS describes the unconsolidated materials overlying the bedrock at the site as follows:

> From the surface of the river terrace at about 900' MSL to approximately 790' MSL are poorly graded sands with little or no fine particles. Lenses of silty sands, silt, and clay also exist in this initial layer. From about 790' MSL to 693' MSL is an uneven layer of inorganic silts very fine sands, silty and clayey fine sands, silt with lenses of inorganic clays, and sandy and silty clays. In addition, lenses of silty sands and clayey sands exist. These soils, hereafter referred to as the silt layer, have hydraulic conductivities in the range of 5.5×10^{-6} cm/sec, about three orders of magnitude less than the sandy layers. The silt layer thins out towards the west and south of the site; it is only 14 feet thick at wells W2 and W2a, compared to 96 feet at well W3, 74 feet at W4, and 90 feet at W8.
>
> The presence of the silt layer beneath the depression has not been documented by soil borings. The deepest boring in the depression (TH3) goes to 760' MSL without detecting the silt layer. The approximate elevation of the silt layer in the area surrounding the depression is 790' MSL.

There are two possible explanations for this observation. The simplest explanation is that the silt layer does not exist beneath the depression. This is difficult to justify however, given the large hydraulic gradients that exist in the vertical direction. This is indicative of some underlying geologic formation that is highly resistant to flow.

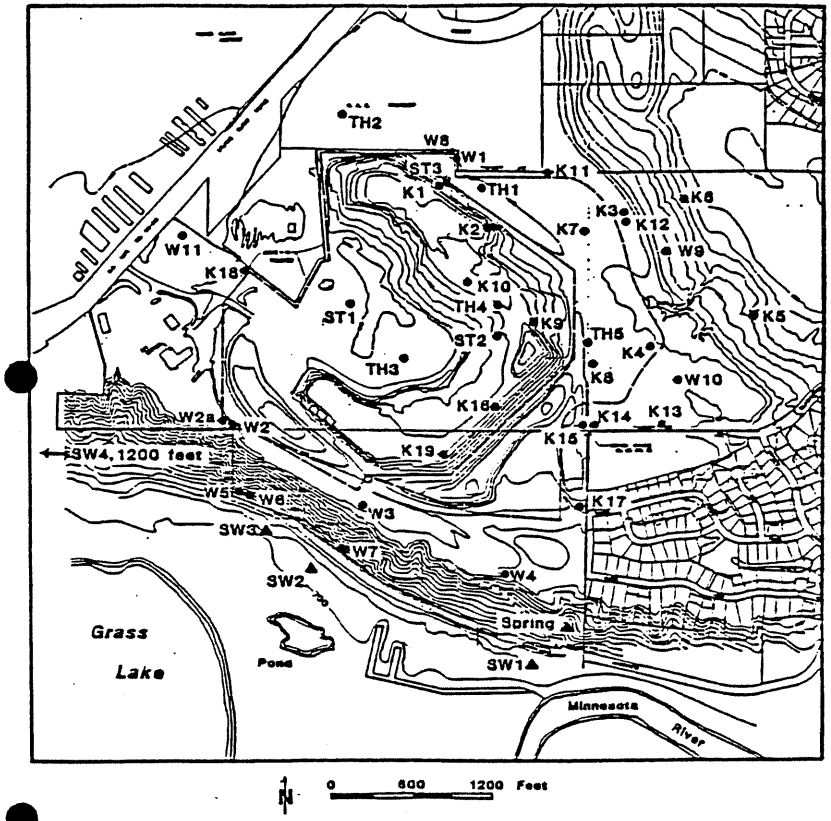
The other explanation assumes that the fine-grained soils that compose silt layer were deposited on top of the ice block. The sandy soils of the outwash plain were deposited on top of the silt layer. As the ice block melted these soils settled and formed the present day kettle. This settling would have caused the silt layer to form a bowl-shaped depression centered beneath the kettle depression that forms the landfill site.

An exposure of the silt layer exists in the bluff above Riverview Rd. Along most of the bluff, however, the silt layer is not exposed. This is most likely a result of slumping of the overlying sandy materials along the slope. The spring shown in Figure 1 (GME Fig. 3) occurs over an exposure of Des Moines lobe till . The silt layer would be located above the till.

The second paragraph of the above excerpt states that "The presence of the silt layer beneath the depression has not been documented". This is then followed by two possible explanations. The first is that the material does not exist beneath the landfill site, and the second postulates that a silt layer forms a bowl-shaped depression beneath the kettle hole. The geologic

D

Figure 19.
LOCATIONS OF MONITORING WELLS, PIEZOMETERS, BORINGS, SPRINGS, AND SEEPS



Base Map Source: G.M. Sunde, Consulting Engineer.

● K18 – Monitoring well, piezometer, or boring
▲ SW1 – Open surface water seep used for sampling
▲ Spring – Free-running spring

FIGURE 3

mechanism used with the second theory, the large ice block, is a more plausible explanation why the silt layer is missing, and can just as easily be used to argue that there is no silt layer.

In the Hydrogeologic Report, Figure 4 (Hydrologic Report Fig. 5) was used to show the "bowl-shaped silt deposit." This figure, not in the EIS, has a vertical to horizontal exaggeration of approximately 8.2 to 1. Figure 4-A shows the same soils data on a 2.1 to 1 scale. When making projections such as those shown in the two Figures, the silt layer could just as easily be shown to terminate at the edge of the kettle. As indicated in Figure 4-A, until the existance of the silt layer is established from actual field data, it should be assumed not to exist at the site.

In the first paragraph of the excerpt on soils the authors refer to the silty layer having a conductivity of 5.5×10^{-6} cm/sec. Since the layer was not encountered beneath the site, these values could not have been obtained from samples from beneath the site and there is no indication as to how this value was developed. The EIS also says in the third paragraph, third sentence, quoted above, that large vertical hydraulic gradients exist beneath the site. Since there is no soils data, it must be assumed that no ground water data is available. How then, without data can the EIS say the large vertical gradients exist?

The lack of a significant barrier to vertical ground water flow beneath the site is strongly suggested by the data presented in the Hydrogeologic Report and summarized in the EIS. The section is included in its entirety in the below:

D.

D. It is possible that the silt layer is present beneath the original depression or kettle which forms the existing landfill. However, there is no existing data to verify this. As the FEIS indicates soil borings beneath the kettle are not deep enough to detect the silt layer. A discussion of the need for more data beneath the existing landfill, with the staff of the MPCA and DOH, indicates the agencies would not favor additional borings through the existing refuse to obtain the necessary soils data since this would open a conduit for leachate. In accordance with state regulations when the RGU determines that there is scientific uncertainty or gaps in relevant information the RGU shall make clear that the information is lacking. If the information, relevant to the impacts, is essential to a reasoned choice among alternatives and is not known; and the cost of obtaining the data is excessive, or the information cannot be obtained within the time limits of FEIS preparation, the RGU shall weigh the need for the project against the risk and severity of possible adverse impacts, were the project to proceed in the face of uncertainty. The FEIS shall, in these circumstances, include a worst case analysis and an indication of the probability of its occurrence. 6MCAR3.031(D).

Because additional soils data, which would verify the presence of the silt layer and hydraulic gradients beneath the existing landfill site cannot be obtained, a worst case analysis is included in the FEIS. The worst case assumes the silt layer is not present beneath the existing landfill site and there would be no attenuation of leachate. The FEIS analyzes the possible impact on groundwater aquifers, the Minnesota River and Grass Lake in terms of the concentration and quantity of pollutants wich might reach these resources and the rate of leachate movement. These are presented in the Site Hydrogeology section.

Figure 5. GROUNDWATER FLOW PATTERN
(ALONG GEOLOGIC CROSS-SECTION D-D')

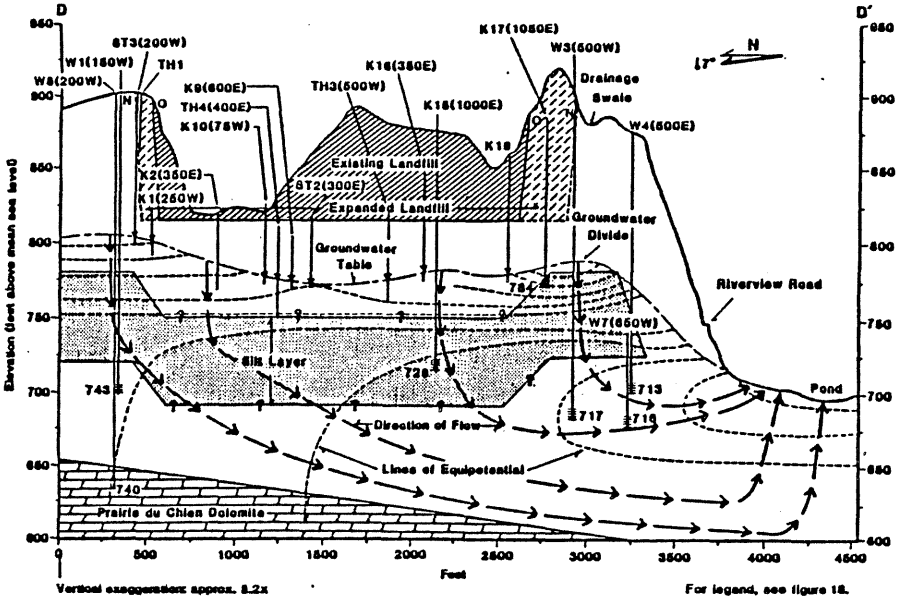


FIGURE 4

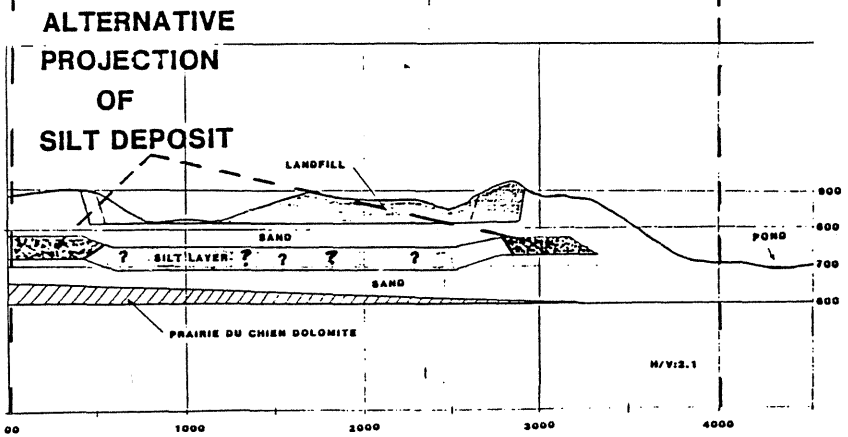


FIGURE 5 A

FIGURE 4-A

360

Groundwater

Flow Patterns

(EIS, Page 44)

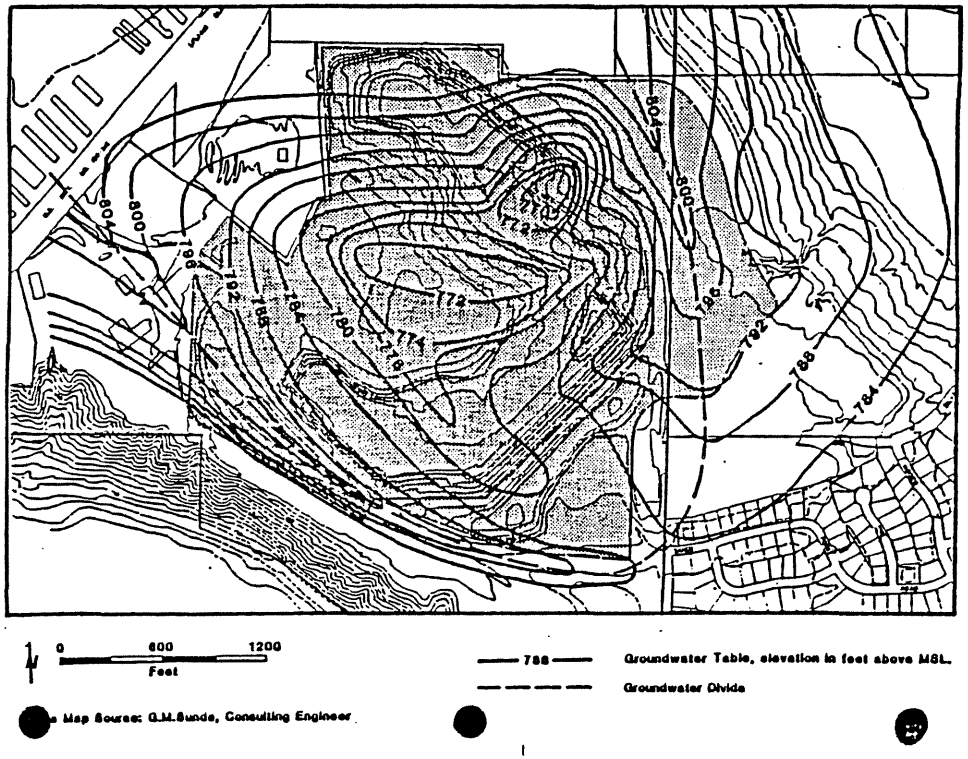
The existing landfill and its proposed expansion are close to a discharge area for the Prairie du Chien-Jordan aquifer system. Percolating water will move predominatntly downward through the silt layer and then horizontally to the river valley. Upon reaching the river valley, the flow direction will become upward as groundwater discharges into the valley marshes, Grass Lake and the Minnesota River.

Figure 20 (GME Fig. 5) presents a plan view of the estimated groundwater surface contours. In addition to the downward flow that is occurring, there is also a horizontal gradient moving groundwater toward the center of the site. This movement is minor compared to the vertical flow , but it assumes importance along the groundwater divide east of the landfill. Groundwater on the eastern side of the divide will have an initial component of flow direction east-southeast. This water will also eventually reach the Prairie du Chien-Jordan aquifer in the same manner as groundwater flowing toward the center of the site. How far this water will move to the east depends on how fast it is able to move downward through the silt layer and reach the Prairie du Chien-Jordan aquifer.

Likewise, water percolating into the south side of the southern groundwater divide will flow south toward the Minnesota

FIGURE 5

Figure 20.
ESTIMATED GROUNDWATER TABLE SURFACE CONTOURS



River. The flow pattern for water on the south side of this groudwater divide is down toward the Prairie du Chien-Jordan aquifer beneath the face of the bluff. This flow may emerge on the bluff face in the form of springs or seeps. Only one confirmed spring has been located.

The first paragraph quoted above states that at the site percolating water will move downward, then horizontally, then vertically to the river valley. This assumed flow pattern is shown in figure 4 (Hydrogeologic Report, Fig. 5) and is not substantiated by sufficient soils or groundwater data to justify those projections. E

In other sections of the report, the EIS claims that the reported silty clay layer will retard vertical flow. Figure 5 (EIS Fig. 20) shows the estimated groundwater surface contours for the site. Based on this map, there is a groundwater sink beneath the center of the site, i.e., the groundwater flows downward and the confining features of the silty layer are not apparent. If the same data were projected deeper, it would indicate that the water from beneath the site flows into the underlying Prairie du Chien dolomite, not across the top of the dolomite as indicated on figure 4 (Hydrogeologic Report, Fig. 5). F

Based upon the data presented in the EIS and the Hydrogeologic Report no conclusions with regard to the groundwater flow and soil conditions beneath the site can be made, except that there is an indication that groundwater sinks exist beneath the site. Whether or not this flow pattern is reflected in the lower levels of the soils strata is totally unknown. Before any G

E. Based on its continuing monitoring of groundwater levels and flows in the metropolitan area, the U.S. Geological Survey (USGS) has concluded that a strong hydraulic connection exists between the groundwater aquifers and the major streams, including the Minnesota River. The investigations of the USGS indicate that groundwater north and south of the Minnesota River near the project site moves towards the river valley. This information is included in the FEIS.

F. A worst case analysis is included in the FEIS which examines the potential impacts if leachate from the project flows downward into the underlying Prairie du Chien dolomite.

G. See response to (E).

groundwater flow projections can be made from the site, a great deal more data is required to establish what the groundwater flow conditions at the site.

G

In addition, the EIS does not discuss the possibility of the leachate from the site flowing into the underlying dolomite. No discussion of the regional groundwater use or characteristics of the Prairie du Chien Dolomite or Jordan Sandstone is presented. Also, a large subsurface aquifer likely exists beneath the flood plane of the Minnesota River, (Figure 2 (EIS Fig. 17)) and the landfill leachate could enter this aquifer. There is no data indicating the groundwater flow conditions or use in the river valley.

H

Groundwater Quality and Leachate Monitoring

(EIS, Page 47)

The existence of unaccounted for compound in the groundwater at the site is indicated by the water quality data. The last two paragraphs on page 47 and the first on page 54 of the EIS illustrate this point:

> Present groundwater quality as determined from the monitoring well program is summarized in Table 8 (GME Table 1). Chloride was chosen as an indicator of leachate because it is chemically unreactive in the groundwater environment (11). No obvious trends are apparent (Figure 21) (GME Fig. 6). However, it does appear from marked increases in chloride for W2 and W3 in late 1981 and early in 1982 that some weak leachate could have moved through.

H. See response to (F). Also, there is no other use of the groundwater in the river valley, public or private, which would be impacted by the proposed project. Groundwater south of the river moves north and discharges into the valley. Any wells south of the river would not be affected. The staff of the Minnesota Geological Survey in a telephone conversation on Aug. 16, 1984 indicated there are no wells downstream and north of the river which would be affected. Other wells are too distant and are pumped at too low a rate to alter groundwater flow patterns. There is no direct use of the Minnesota River for public consumption downstream of the project.

TABLE 1

Table 8.
COMPILATION OF WATER QUALITY TEST RESULTS FOR
MONITORING WELLS AT FLYING CLOUD SANITARY LANDFILL

Date	Chemical Oxygen Demand mg/L	Chloride mg/L	Ammonia Nitrogen mg/L as N	Nitrate Nitrogen mg/L as N	Specific Conductance umhos/cm at 25° C.	pH
Well M-1						
04/26/79	211	16	0.56	--	462	7.8
05/24/79	93	14	0.16	--	594	7.7
07/11/79	31	16	0.26	--	660	7.7
01/17/80	10	23	--	3.5	345	7.4
03/25/80	38	13	--	2.31	341	7.2
05/20/80	53	12	0.26	2.10	320	7.4
08/18/80	49	14	--	2.05	442	7.5
10/13/80	45	12	--	0.77	410	7.4
02/06/81	31	11	--	1.42	314	7.4
04/13/81	98	10	0.01	--	360	7.2
09/04/81	42	10	--	0.46	420	7.3
11/06/81	58	9	0.16	--	315	6.9
02/17/82	53	4	--	0.44	461	7.8
04/13/82	28	2	--	0.46	430	7.5
07/20/82	40	5	*0.10	--	500	7.6
10/05/82	*10	8	*0.10	--	490	7.3
01/21/83	10	6	*0.10	--	500	7.5
05/04/83		7				
Well M-2						
04/26/79	65	13	0.17	--	1,180	6.5
05/24/79	8	16	0.10	--	1,260	7.6
07/11/79	35	18	0.14	--	1,452	6.7
01/17/80	24	19	--	3.50	850	6.6
03/25/80	116	23	--	2.37	1,000	6.3
05/20/80	114	40	0.55	2.44	1,200	6.3
08/18/80	233	39	--	1.49	1,500	6.4
10/13/80	157	28	--	1.39	1,400	6.3
02/06/81	300	29	--	2.17	1,070	6.5
04/13/81	550	28	1.27	--	1,200	6.4
09/04/81	66	37	--	0.71	1,200	6.2
11/06/81	79	35	0.18	--	790	5.9
02/17/82	29	28	--	0.92	1,330	6.5
04/13/82	160	6	--	1.74	1,200	6.6

*Denotes "less than."

TABLE 1

Table 8 (cont.)

COMPILATION OF WATER QUALITY TEST RESULTS FOR MONITORING WELLS AT FLYING CLOUD SANITARY LANDFILL

Date	Chemical Oxygen Demand mg/L	Chloride mg/L	Ammonia Nitrogen mg/L as N	Nitrate Nitrogen mg/L as N	Specific Conductance umhos/cm at 25° C.	pH
Well W-2A						
07/28/82	4	2	*0.10	--	590	7.3
10/04/82	*10	3	*0.10	--	550	7.1
01/20/83	20	2	*0.10	--	560	7.3
05/04/83		*1				
Well W-3						
04/26/79	68	14	0.35	--	528	7.2
05/24/79	80	14	0.18	--	536	7.3
07/11/79	23	12	0.20	--	607	7.4
01/17/80	16	12	--	2.90	338	7.2
03/25/80	55	12	--	1.57	330	7.0
05/20/80	40	12	0.16	1.00	340	7.3
08/18/80	49	14	--	2.03	580	7.3
10/13/80	61	13	--	1.50	430	7.1
02/06/81	106	13	--	2.69	339	7.4
04/13/81	84	13	0.14	--	390	6.9
09/04/81	66	13	--	1.82	470	7.1
11/06/81	72	14	0.04	--	360	6.7
02/17/82	53	23	--	1.51	540	7.3
04/13/82	31	4	--	1.60	410	7.7
07/21/82	15	13	*0.20	--	710	7.2
10/01/82	32	13	*0.10	--	730	7.1
01/18/83	*10	11	*0.10	--	860	7.2
05/04/83		12				
Well W-4						
04/26/79	168	11	1.30	--	343	7.4
05/24/79	42	9	0.62	--	561	7.5
07/11/79	31	1	0.30	--	554	7.6
01/17/80	16	2	--	2.90	290	7.4
03/25/80	28	2	--	1.57	295	7.2
05/20/80	71	5	0.20	1.00	310	7.5
08/18/80	45	5	--	2.03	430	7.5
10/13/80	66	3	--	1.50	392	7.5
02/06/81	52	3	--	2.69	309	7.6
04/13/81	77	3	0.03	--	340	7.1
09/04/81	66	7	--	1.82	410	7.3
11/06/81	55	4	0.08	--	310	7.0
02/17/82	49	3	--	0.06	459	7.5
04/13/82	41	1	--	0.23	410	7.7
07/21/82	*10	3	*0.20	--	490	7.7
10/01/82	*10	4	*0.10	--	460	7.3
01/18/83	10	2	*0.10	--	540	7.6
05/04/83		3				

*Denotes "less than."

TABLE 1

Table 8 (cont.)

COMPILATION OF WATER QUALITY TEST RESULTS FOR MONITORING WELLS AT FLYING CLOUD SANITARY LANDFILL

Date	Chemical Oxygen Demand mg/L	Chloride mg/L	Ammonia Nitrogen mg/L as N	Nitrate Nitrogen mg/L as N	Specific Conductance umhos/cm at 25° C.	pH
Well W-5						
01/??/82	90	1	0.10	0.50	580	7.4
04/13/82	82	*1	--	0.59	455	7.7
07/21/82	*10	2	*0.20	--	500	7.4
10/05/81	*10	6	*0.10	--	580	7.2
01/21/83	20	2	*0.10	--	580	7.4
05/04/83		1				
Well W-6						
07/28/82	6	1	*0.10	--	530	7.3
10/05/82	*10	4	*0.10	--	530	6.9
01/21/83	*10	1	*0.10	--	540	7.2
05/04/83		*1				
Well W-7						
07/28/82	2	17	*0.10	--	960	7.1
10/05/82	12	19	*0.10	--	930	6.8
01/21/83	*10	19	*0.10	--	1,100	6.9
05/04/83		17				
Well W-8						
07/28/82	22	2	*0.10	--	600	7.6
10/05/82	12	3	*0.10	--	610	7.0
01/21/83	10	1	*0.10	--	610	7.3
05/04/83		1				
Well W-9						
05/04/83		28				
Well W-10						
05/04/83		2				
Well W-11						
05/04/83		1				

*Denotes "less than."

Source: G.M. Sunde, Assessment of Soils, Geology and Hydrogeology for Flying Cloud Sanitary Landfill (Bloomington, MN, 1982). p. 66.

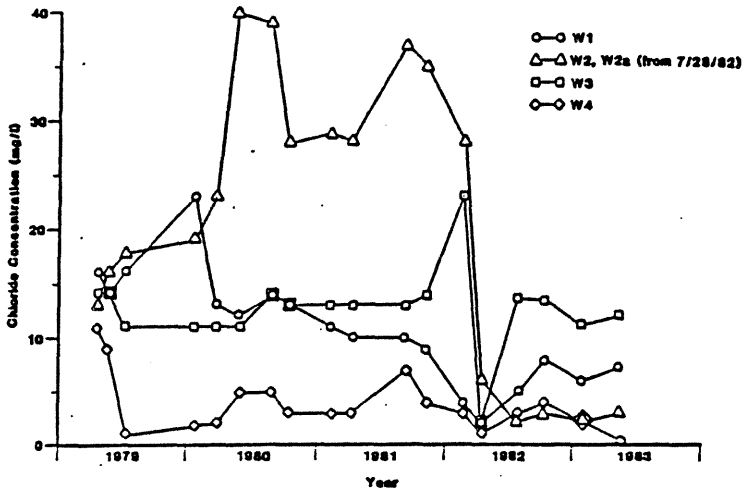


Figure 21. CHLORIDE CONCENTRATION CURVES

FIGURE 6

The dip in middle 1982 appears to be relatively chloride-free groundwater moving through or a mistake common to all the analyses for that quarter. In late 1982 a series of organic compounds were detected in trace amounts in some of the monitoring and private wells around the site (Table 9) (Table 2, GME). Subsequent testing detected only trace quantities of one organic (trichlorofluromethane) in four open seeps. A later analysis of several monitoring wells showed none of the earlier compounds, but detected small amounts of two other organics (benzene and toluene).

The evidence is inconclusive as to whether or not the source of these organics is the landfill. If landfill leachate is the source, a number of other compounds, ions and trace elements would be expected to be found in higher concentrations. However, the MPCA has found volatile organics like toluene, methylene chloride, trichloroethylene, dichloroethylene, dichloroethane and benzene to be ubiquitous in municipal landfill leachate (12). Continued monitoring would help to determine whether the landfill is the source of the organics.

The data contained in Table 1 (EIS Table 8) and Table 2 (EIS Table 9) show that manmade contaminants have entered the groundwater in the proximity of the site. The EIS says that if the landfill were the source of these contaminates, other organic compounds would be expected to be observed. This is not true. Normally, when landfill leachate enters the groundwater, chlorides and certain organic compounds move through the soil at nearly the same velocity as the groundwater. Other compounds are delayed due to

I. The FEIS does not conclude that the existing landfill is not the source of the organics. The FEIS states that the data is not conclusive as to whether the landfill is the source or not. This is based on the inconsistent pattern of the monitoring data to date. The proposer continues to sample monitoring wells and submit these to the MPCA as required.

Table 9.

SUMMARY OF DETECTED ORGANICS AT FLYING CLOUD LANDFILL SITE
(Parts per Billion)

Well	W1	W2	W2a	W3	W5	W6	W7	W8	W9	SW1	SW2	SW3	SW4
Methylene chloride	D*	238	--	D	D	--	50	--	--	--	--	--	--
Trichloroethylene	--	93	7	D	--	6	11	5	--	--	--	--	--
Tetrachloroethylene	--	72	--	--	--	--	3	--	--	--	--	--	--
Dichloroethane	--	18	--	D	--	--	3	--	--	--	--	--	--
Trichlorofluromethane	--	18	3	D	15	3	6	2	--	12	14	11	11
Trichloroethane	--	13	--	D	D	--	2	--	--	--	--	--	--
Dichloroethylene	--	10	--	--	--	--	1	--	--	--	--	--	--
Benzene	--	--	--	--	--	--	--	--	0.6	--	--	--	--
Toluene	--	--	--	--	--	--	--	--	0.8	--	--	--	--

*D = detected

Source: Figures taken from R.O. Ball, Project No. 20247K (Parkridge, IL: ERM North Central Inc., letter dated Oct. 15,1982) and from W.A. O'Conner, Reports of Laboratory Analysis (Minneapolis, MN: Pace Laboratories, INC., letters dated June 24, 1982 and June 16, 1983).

TABLE 2

physical and chemical interactions with the soil. The presence of the compound shown on Table 1 (EIS Table 8) and Table 2 (EIS Table 9) clearly indicate contamination of the groundwater. Until proven otherwise, the landfill cannot be dismissed as a source of this mixture of compounds.

I

Leachate Movement

(EIS, Page 55-57)

This section of the EIS discusses leachate movement and presents a number of conclusions which are based upon insufficient data or are contradictory. The first paragraph of the leachate movement section states that the leachate will move down towards the limestone bedrock, then horizontally toward the Minnesota River Valley as illustrated in Figure 4 (Hydrogeologic Report Fig. 5). As discussed earlier, there is insufficient data to base this statement on. The second paragraph through the end of the leachate movement section states:

J

> Leachate Movement
>
> Flow velocity in the bedrock aquifer is difficult to estimate since it depends on which matrix of the bedrock aquifer the water is moving through: the saturated sand and sandy soils above the Prairie du Chien dolomite, the Prairie du Chien dolomite itself, or the Jordan sandstone. All three of these aquifer units are hydraulically connected, which means that water can move from one to the other. However, because of different hydraulic conductivities and porosities, the pore velocity of water in each matrix is different. Therefore, the rate of leachate movement toward the Minnesota River Valley depends on which matrix it is moving through.

J. Additional worst case analyses has been included in the FEIS which evaluates the potential impacts in those instances where the data is unavailable, particularly the potential rate of movement and impact of leachate on the Prairie du Chien aquifer. See discussion in the Site Hydrogeological section.

Horizontal flow velocity estimates in the saturated sandy layer above the Prairie du Chien dolomite ranged from 0.08 ft/day to 6.13 ft/day. Horizontal flow velocity in the bedrock units was estimated at 1.70 ft/day to 13.28 ft/day.

The flow rate calculations are estimates only. The values used to derive them are based on approximations and six soil sample analyses applied to the entire site. Homogeneity is assumed for the aquifers. This means that the soil or rock physical properties are assumed to be uniform throughout the area. Isotrophy, the condiition where hydraulic properties of the matrix are equal in all directions, was also assumed.

The choice of hydraulic conductivities and aquifer unit the leachate moves through has an overriding impact on the time it will take for the leachate to reach the Minnesota River Valley. The leachate will move predominantly in the saturated sand layer although some leachate may reach the Prairie du Chien dolomite. Table 11 (GME Table 3) summarizes travel times to significant points.

In the first paragraph above, the EIS says that the various geologic strata shown on figure 2 (EIS Fig. 17) are hydrogeologically connected. The next paragraph speculates that in a horizontal direction the dolomite is much more permeable than the overlying sandy layers. While the paragraph beginning with "The flow rate calculations are estimates only" states that there is very little data (six soil samples, possibly no permeability test), and that

J

broadbased assumptions of homogeneity and isotrophy were employed. The leachate travel times developed on Table 3 (EIS Table 11) indicate that the the contaminates, once they enter the ground water will move through the limestone much faster than the overlying soils. A number of very important conclusions and recommendations are made in the EIS concerning leachate movement based upon little or no data.

In addition, in the final paragraph, final sentence in the leachate movement section (EIS, Page 57), the EIS says "At the Flying Cloud Landfill site the leachate should stay near the top of the saturated sand layer since there is little recharge down gradient, but rather, there are upward-directed hydraulic gradients as groundwater discharges to the Minnesota River Valley." There is no basis for the statement. In fact, looking at the data projected in the hydrogeologic analysis Figure 4 (Hydrogeologic Report Fig. 5) and Figure 5 (EIS Fig. 20) indicate that beneath the landfill there is not an upward directed gradient, but rather a downward gradient. The denser (than groundwater) leachate may flow downward to the dolomite, rather than to the Minnesota River.

J

TABLE 3

Table 11
LEACHATE TRAVEL TIME AND ARRIVAL DATE ESTIMATES*

Point	Distance from Center of Site	Travel Time: Saturated Sandy Soils	Travel Time: Prairie du Chien	Approximate Date**: Saturated Sandy Soils	Approximate Date**: Prairie du Chien
Well W3	1,400 ft.	3-56 yr.	5 yr.	1985-2038	1987
710 MSL Contour	2,400 ft.	7-86 yr.	6 yr.	1985-2038	1988
Grass Lake	2,700 ft.	7-97 yr.	7 yr.	1989-2079	1989
Minnesota Lake	3,000 ft.	8-107 yr.	7 yr.	1990-2089	1989

*These are gross estimates only and do not necessarily encompass the entire range of values. They are provided to illustrate possible time frames.

**Based on initial refuse emplacement in 1970 and 12 yr. to reach field capacity.

2.4 Leachate Attenuation

(EIS, Pages 61-62)

The discussion of leachate attenuation in the EIS presents a number of facts concerning attenuation which have been observed by other writers, and the final paragraph in the section presents some conclusions relating to the attenuation beneath the site. This paragraph states:

> The conditions at the Flying Cloud Landfill site will allow some attenuation to occur. Hydrodynamic dispersion will cause dilution. The silt layer thought to exist beneath the site should provide a good medium for adsorption and ion exchange because it is composed of clays and silts. In addition to its chemical properties the layer also slows the groundwater velocity and thus increases detention time of the leachate in the soil. Increased detention time allows greater opportunity for precipitation, redox, complexation and biological reactions to occur, which further enhances attenuation of the pollutants previously discussed.

The EIS assumes that some attenuation will occur, and this is likely true; however, the total amount due to the nature of the soils, will be very small and should not be considered a major consequence with regard to purifying the leachate. The exposure of the leachate to any clays that may exist in the silty clay layers will be minimized because the leachate will tend to flow through the more permeable silts and sands and not less permeable materials. Without any data, or analysis, the EIS implies that the strength of the

K

K. The worst case analysis of potential leachate impacts contained in the FEIS assumes no attenuation and examines the potential impacts and consistency with water quality standards.

leachate will be significantly reduced due to site soils. Based upon the information presented in the report, it is unlikely that over a long time period significant reductions in the leachate strength will occur. K

2.5 Impact on Private and City Wells and Impact on the Minnesota River Valley--Grass Lake

Based upon the sections referred to above, the EIS makes a number of conclusions. There is no basis for the conclusions and a complete hydrogeologic investigation is required to assess where the leachate will flow and, if in fact, it will discharge into the Minnesota River. L

2.6 Summary of Potential Impacts

The EIS states that any leachate that reaches Grass Lake or the Minnesota River will be below state discharge standards or negligible because of dilution. However, as stated earlier, there is insufficient hydrogeologic data to support these conclusions. M

2.8 Conclusions

Based upon the data presented in the EIS and Hydrogeologic Report, there is insufficient data to make conclusions with regard to the groundwater conditions at the site. The Gas Control Program with some minor variations and a detailed monitoring program should be satisfactory. N

L. This issue has been addressed earlier. A worst case analysis is included in the FEIS where the data is unavailable.

M. This issue has been addressed earlier. A worst case analysis is contained in the FEIS (Site Hydrogeology section) indicating the potential impacts.

N. These issues have been addressed earlier.

3.0 Recommendations

There are a number of recommendations that should be carried out before the proper assessment of the site conditions can be completed.

1. A thorough, comprehensive hydrogeologic investigation must be conducted. This investigation should either include samplings beneath the landfill site (which must then be properly sealed to prevent leakage) or an analysis based on the assumption that the entire site is underlaid by sands and gravels. **O**

2. A complete analysis of the groundwater potentials and a hydrogeologic investigation that analyzes flow conditions based upon current data should be developed. **P**

3. Design recommendations for the landfill should be presented to minimize the impact of the additional refuse on the generation and flow of leachate from the site. **Q**

4. Based upon the results of the hydrogeologic analysis, possible techniques for controlling or collecting the leachate from the existing site should be evaluated. **R**

5. The landfill gas monitoring and control system should be established through trial and error and its success determined by a detailed monitoring program. **S**

O. This issue has been addressed earlier. Additional worst case analyses, which assumes there is no silt layer beneath the existing landfill, is contained in the FEIS. It indicates the potential impact on the rate of leachate movement and the impact on the river, Grass Lake and wetlands.

P. This issue is addressed earlier.

Q. Various mitigation measures are discussed in the FEIS on page 79. Specific design recommendations will be proposed at the time of permitting.

R. The effect of a liner and leachate collection system is discussed in the mitigation section of the FEIS on page 81.

S. Monitoring and control systems are discussed in the FEIS on page 144. Additional adjustments can be made to systems as the required monitoring data is reported to permitting agencies.

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Lower Minnesota River Watershed District

WARRIOR OFFICE BUILDING
BURNSVILLE, MINNESOTA 55378

May 23, 1984

Merrill Madsen, Jr.
Russell A. Sorenson — *President*
~~Jerry Sandstrom~~ — *Vice President*
Russell Heitne — *Treasurer*
Cyril B. Ess — *Secretary*
William J. Jaeger, Jr.
Lawrence E. Samstad — *Engineer*
Raymond A. Haik — *Attorney*

PUBLIC STATEMENT TO THE METROPOLITAN COUNCIL REGARDING

FLYING CLOUD SANITARY LANDFILL EXPANSION

Gentlemen:

The Staff of the Lower Minnesota River Watershed District has reviewed the D.E.I.S. of the Flying Cloud Landfill Expansion. The District Managers would like to note their concerns in the following areas.

First, that no toxic wastes be disposed of in the Flying Cloud Landfill.] A

Second, that leachates be controlled to the point that nearby wells are not contaminated.] B

Third, that leachates reaching the Minnesota River and its natural valley do not exceed M.P.C.A. guidelines for ground and surface water quality in this area.] C

Fourth, that since the Flying Cloud Landfill and Expansion lie partially within the District, The Managers wish to be considered in the reviewing process of the Final E.I.S. and the final plans of the Flying Cloud Landfill Expansion.] D

The Managers in the past have reviewed similar applications and have commented responsibly on the nature of landfills on the bluffs and their relationship with the Minnesota River, its valley and the Lower Minnesota River Watershed District.

Thank you for allowing us to make the above comments.

Managers of the
Lower Minnesota River Watershed District.

MANAGERS OF THE LOWER MINNESOTA RIVER WATERSHED DISTRICT

A. The disposal of hazardous wastes in Flying Cloud Landfill, except the small amounts normally found in mixed municipal waste, is prohibited by MPCA regulations. WSS has adopted extensive procedures for preventing the disposal of hazardous waste at the landfill. These are discussed in the FEIS on page 114.

B. The FEIS contains an analysis of the potential impact of leachate on nearby wells in the "Site Hydrogeology" section, specifically, page 79. Mitigation measures to prevent the potential impacts are discussed.

C. Additional analysis regarding the potential impacts on the river and the river valley, including Grass Lake, are included in the FEIS.

D. A southern portion of the existing landfill site and horizontal expansion are located within the district. The district has been added to the list of reviews and approvals on page 5 (Table 2). However, the president of the district indicated in a telephone conversation on July 5, 1984 that the district does not grant a permit. The district will review and comment on the project to other permitting authorities.

Minneapolis • Saint Paul
METROPOLITAN AIRPORTS COMMISSION
P. O. BOX 1700 • TWIN CITY AIRPORT • MINNESOTA 55111
OFFICE OF EXECUTIVE DIRECTOR • PHONE (612) 726-1892

June 1, 1984

Mr. Carl Schenk
Environmental Planner
Metropolitan Council
300 Metro Square Building
St. Paul, MN 55101

RE: Flying Cloud Sanitary Landfill Expansion
Draft Environmental Impact Statement

Dear Mr. Schenk:

MAC Staff have reviewed the Draft Environmental Impact Statement for the Flying Cloud Sanitary Landfill Expansion. The data related to Flying Cloud Airport and its relationship to the landfill appears to accurately represent impacts of the landfill on the airport, and of the airport on the landfill. We would request that serious consideration be given to the plantings proposed for the berm on the north side of the landfill to ensure that penetrations of approach surfaces to the east/west runways do not occur, and also that bird hazards are not created by additional vegetation. A

We also suggest that the wording regarding runway utilization on page 199 of the Draft Environmental Impact Statement be modified to indicate that at Flying Cloud Airport westerly winds dominate and therefore Runways 27R, 27L, and 18 are more frequently used. B

Thank you for the opportunity to review this document.

Sincerely yours,

Nigel D. Finney
Director of Planning & Engineering

/jr

cc: Mark Ryan - Metro Council
Jeff Hamiel - MAC

MINNEAPOLIS/ST. PAUL METROPOLITAN AIRPORTS (MAC) COMMISSION

A. The potential conflict between vegetation planted on the proposed berm and the approved zone is discussed on page 225 of the FEIS, paragraphs four and five. The mitigation section on page 226 discusses a number of measures involving the length and height of the berm and substituting low shrubs or grass for the northern section of the berm to mitigate potential conflict. As the FEIS indicates, limiting the height (at maturity) and the type of vegetation planted on the berm would minimize conflicts. These concerns can be addressed specifically during the permitting process.

B. The pattern of airport use is discussed on page 221 paragraph three, in the FEIS. The modification as proposed by MAC is accurate as it applies to the general operation of the airport. The third sentence in paragraph three, beginning with the words "Runway 27L", has been revised to include the MAC's suggestions. This revision does not affect the remainder of the paragraph which applies to particular aspects of the operations at the airport.

Carl Schenk, Environmental Planner
Metropolitan Council
300 Metro Square Building
St. Paul, MN 55101

Re: Flying Cloud Landfill Expansion
Draft Environmental Impact Statement

The following comments are submitted on behalf of the North Star (Minnesota) Chapter of the Sierra Club, representing 6,500 members in Minnesota.

Groundwater Flow and Discharge

It is a known fact that landfills result in leachate and groundwater contamination. The groundwater flow at the Flying Cloud landfill expansion is vertically downward into the Prairie du Chien - Jordan aquifer system and horizontal to the Minnesota River Valley, where it will be discharged to the Minnesota River, Grass Lake and nearby marshes.

The Draft Environmental Impact Statement (DEIS) raises groundwater related issues which are not adequately addressed.

*No information about the existing water quality of Grass Lake is presented, although given the above groundwater flow pattern it is likely to be affected by groundwater contamination. **A**

*Although the leachate plume is likely to contaminate Grass Lake, the maximun concentration of pollutants is not known. In estimating the contamination an assumption is made that it will be within (undefined) Minnesota Pollution Control Agency (MPCA) surface water quality standards. Which specific standards are being referred to? **B**

*The maximum pollution estimation is also based upon the assumption that the leachate will be thoroughly mixed in Grass Lake and the surrounding marshes. Mention is made, however, that the leachate could emerge in higher local concentrations, thereby exceeding MPCA standards. An estimate of these local concentrations is missing, as is an estimate of their effect. Given the presence of springs at the base of the bluff, the discharge of contaminated groundwater in "higher local concentrations" is likely enough to merit further consideration. **C**

*Dilution of the contaminated groundwater by the Minnesota River is relied upon in determining subsequent pollution levels for Grass Lake and surrounding marshes. The fact that the water quality of the Minnesota River is quite low due to agricultural runoff is not an acceptable argument for allowing further pollution. **D**

*Existing well #7 indicates pollution by organics (although at low levels), but evidence that this is the result of the landfill is inconclusive as presented in the DEIS. More information on the well water contamination prior to the existence of the landfill would be useful in determining the source of current pollution levels. **E**

NORTH STAR/SIERRA CLUB LETTER

A. Little information regarding the existing quality of Grass Lake is available. Sediment data for the west arm of the lake and fish tissue data obtained by FWS are presented in the FEIS, page 75 (Site Hydrogeology section). No information for the east arm is available. However, a worst-case analysis for the lake is analyzed in the FEIS.

B. Grass Lake is classified as 2B, 2C and 3B, under MPCA surface water regulations--one class above (more restrictive) the Minnesota River, which is classified 2C, 3B. (6MCAR 4.8014 and 4.8015) These standards are discussed in the FEIS.

C. Discussion of the potential impacts of higher local concentrations has been added to the FEIS on pages 75, 90 and 111. A worst-case analysis of the potential impact on Grass Lake is also included on page 70.

D. The FEIS does not take the position that potential impacts on the Minnesota River are acceptable or good public policy. This issue will be decided at the time of permitting. The present quality of the Minnesota River is discussed in the FEIS as it relates to the potential impact of leachate on the river and the impact of the river on Grass Lake. The purpose of the FEIS is to provide information for the permitting and approval process. Additional discussion of the potential impact on the river have been included.

E. Most of the wells on the site were drilled after the landfill was in operation for several years. (TH 1 through TH 5 were drilled in 1969 and January 1970, but only for the purposes of obtaining soil data.) A telephone conversation with the DOH in July 1984, indicated that no water quality data is available for the area prior to the landfill opening in 1970.

*The DEIS states that there is the possibility of bioaccumulation of contaminants in the food chain, affecting aquatic vegetation and fish. Mention as to possible effects on waterfowl is absent. The effects of bioaccumulation of toxics on the river valley biota are not closely enough examined, especially since the most significant habitat lies in the area of the leachate plume. F

Little information is given as to what measures will be taken in the event of groundwater pollution. Such contamination would be very difficult and expensive to correct as it percolates through the high river bluff. Since the position of this DEIS should be to anticipate the worst case situation when facts are unknown or inadequate, the DEIS should address the prevention of contamination which it has not done adequately, and in its examination should provide possible methods for cleanup of the contaminated lands and waters. G

The mitigation measures proposed by the DEIS for groundwater contamination are not adequate. Although increased monitoring is desirable, it is not a mitigation measure. A natural or synthetic liner is another possibility presented, but only as a system which would divert leachate to the center of the landfill. A liner with a collection system is not considered, although it would provide better groundwater protection. H

Methane Gas Control

Monitoring to the south in the Grass Lake area for presence of methane gas has not been done, nor is it proposed. If vegetation in this area is adversely affected by methane build-up, the resulting erosion of the bluff could be quite serious. It seems that close monitoring of this area is essential. What remedial measures could be taken once the bluff is contaminated? What would they cost? I

Alternatives Considered

Liner and Leachate Collection System Alternative

If the need for the landfill expansion is clearly established, use of a liner and leachate collection system could be the most feasible alternative, but the DEIS indicates that it is not necessary. The DEIS alternative is to 1) provide additional monitoring to detect leachate movement, 2) to hope for attenuation of leachate and 3) rely upon leachate dilution. Dilution is not an acceptable remedy for groundwater pollution. J

No Action Alternative - Use of Existing Landfills

This section of the DEIS briefly mentions potential increased landfilling costs resulting in more competitive recycling and other abatement programs. This would be a much desired effect - to commence the realization of the true cost of landfilling. We hope that the Council will look closely at this cost element in their permitting process.

F. Additional analysis of the potential impacts on the biota in the Grass Lake area is discussed in the FEIS on pages 108 and 111.

G. Additional discussion regarding corrective measures for groundwater contamination and Grass Lake is contained in the FEIS on page 84. Additional mitigative or preventative methods are discussed on page 79.

H. An evaluation of the impact of a liner is discussed on page 81 in the FEIS.

I. A discussion regarding potential landfill gas impacts on bluff vegetation and possible corrective measures is contained in the FEIS on pages 141, 143 and 146 in the mitigation section.

J. Additional discussion regarding the use of a liner and collection system is discussed in the Site Hydrogeology section of the FEIS on page 81.

With regard to the issue of attenuation or dilution groundwater quality is currently protected in Minnesota by state drinking water standards which prescribe the maximum permissible contaminant level in water provided for public use. The application of these standards allows for the attenuation of contaminants in groundwater in determining whether state standards are met. For example, the concentration of a contaminant in a private well must exceed a specific concentration before it is considered a hazard to public health. Between the point at which the contaminant is produced and the point at which it affects a public water supply, attenuation may reduce the concentration to an acceptable level under state drinking water standards.

No Action - Use of New Landfills

Use of new landfills (to the extent they are needed following aggressive abatement procedures) is mentioned in the DEIS as an economic negative for precisely the reason it would be preferable to expansion of existing landfills - more stringent environmental standards. A new landfill would require not only a certificate of need, but also a liner, collection system and leachate treatment. K

Again, the possibility of increased cost makes waste abatement more attractive. An estimate of the costs associated with the various alternatives to the expansion is not provided by the DEIS and should be presented in the final EIS. L

The Metropolitan Council is revising its regional Solid Waste Management Plan as noted in the DEIS. Although the DEIS does not evaluate the proposed project in light of this plan, we sincerely hope that the Council scrutinizes them in tandem during their permitting process. The proposed Flying Cloud landfill expansion may then be found to be less suitable than it appears when evaluated on its own.

Again, the DEIS, when facts are unknown or inadequate, should present and evaluate the worst possible environmental effects. This DEIS does not, which poses serious questions as to its completeness. The final EIS should address the items presented in these comments to insure protection of the Minnesota River Valley environment. M

Sincerely

Kristin E. Sigford

Kristin E. Sigford
North Star Chapter
Sierra Club

K. The Alternatives section in the FEIS, indicates that the alternative of new landfills is likely to be closely restricted. In accordance with the Waste Management Act of 1980, as amended, no new site can be issued a permit without a certificate of need, approved by the Council demonstrating that all other feasible and prudent alternatives to land disposal are being implemented. Also the consensus of the Council is that new landfills will be used only for processed waste from which recyclables and organic materials have been removed or oxidized.

L. The potential impact and cost of a liner and collection system are included in the FEIS.

M. Worst-case analyses are presented, assessing the potential impact on the Minnesota River and Grass Lake in the Site Hydrogeology section.

Art Granzberg
12438 Sandy Point Rd.
Eden Prairie, Mn. 55344

April 26, 1984

Mr. Carl Schenk
Environmental Planner
Metropolitan Council
300 Metro Square Building
7th and Robert Streets
St. Paul, Minnesota 55101

Dear Mr. Schenk:

The expansion of Flying Cloud Sanitary Landfill will increase the intolerable noise, litter, and odors emanating from the current site. The terms mitigating, minor impact, and minimize potential problems are pure rhetoric. Elegant, idealistic words without realistic values.

The noise level at the current site can be heard at all hours of the day and night. Special mufflers and additional elevation of the berm will not decrease the noise. Logic dictates, the proximity of equipment to homes, regardless of a 15 ft. berm, will increase noise. It is unacceptable at this distance and would be intolerable with the expansion. A

Litter is an everyday occurrence. The ability to contain refuse on the landfill site is impossible. With or without wind our neighborhood streets and yards are inundated with litter. Restricting work sites during windy days with the expansion will not improve the litter problem. If it can not be controlled now--the expansion will only intensify the littering of our property and streets. Making our neighborhood an extension of the landfill. B

Odor and dust permeate our homes continuously. Ground cover and watering at the current site does not stop the odor and dust problems. The expansion will only intensify it, diminishing our quality of life. C

Snow fences, ground cover, wind screens, watering, policing litter, mitigating noise, are at best, nothing more than platitudes. The inability of Woodlake Sanitary Services to control the landfill site now--demonstrates the disastrous results if granted a permit to expand.

The diminished quality of life we now experience due to the current site of the landfill, will be magnified if it expands.

Sincerely,

Art Granzberg

ART GRANZBERG'S LETTER

A. Existing noise levels and the potential for increased noise impacts and potential mitigation measures to reduce these are discussed in detail on page 147 in the FEIS. The proposed expansion may result in increased noise impacts in some nearby residential areas in Bluffs West. Some of the noise levels may temporarily exceed state standards during construction of the berm and landfill operations. A properly designed 15-foot berm will reduce noise levels by 12 db at any given point.

The landfill is currently open between 4 a.m. and 6 p.m. However, the landfill equipment is not started until 5:30 a.m. BFI and WSS trucks leave the garage area which is a separate operation between 12 midnite and 6 a.m. to drive to commercial routes to pick up refuse. The garage is located west of the landfill close to TH 169. (See FEIS, page 15.)

B. The potential nuisances associated with litter control problems and possible measures to control these impacts are discussed in the FEIS, page 164. There have been occasional problems associated with current landfill operations, and there may be occasional problems in adjoining areas during the operation of the expansion, particularly in areas downwind of the project.

C. Potential dust impacts associated with wind erosion are discussed in the FEIS under air quality page 115. Mitigation measures for reducing the impact are also discussed. Potential odor problems and mitigation methods are discussed in the Landfill Gas Section, page 123.

OLSON, GUNN AND SERAN, Ltd.

LAW OFFICES

315 Peavey Building
730 Second Avenue South
Minneapolis, Minnesota 55402-2473
612 339-8846

June 7, 1984

Mr. Carl Schenk
Environmental Planner
Metropolitan Council
300 Metro Square Building
7th and Robert Streets
St. Paul, Minnesota 55101

Re: Proposed expansion of
Flying Cloud Landfill

Dear Mr. Schenk:

We are submitting this letter on behalf of the owner of the Flying Cloud Drive-In Theatre, in opposition to the proposed expansion of the Flying Cloud Landfill. We respectfully request that these comments be included in the record of the E.I.S. proceedings.

There is clearly a need for solid waste disposal facilities in the metropolitan area. We seriously question, however, whether this need is best, and most fairly, served by the expansion of a landfill that has already caused significant harm, and potential hazards, to neighboring properties.

The Flying Cloud Drive-In Theatre was established approximately 25 years ago on a 17-acre tract that adjoins the Landfill's westerly and northerly boundaries. The Landfill and the Drive-In share a common border totalling approximately 2400 lineal feet. The Drive-In property is currently guided for "industrial" development by the City of Eden Prairie. For all of the following reasons, we are strongly opposed to any expansion of the Flying Cloud Landfill:

1. Methane Migration: The Drive-In property is already subject to sigificant concentrations of explosive methane gas, which presumably migrates from decomposing materials within the Landfill. In fact, the Drive-In's manager experienced a small gas explosion underneath the concessions building when he ignited a blow-torch to make some repairs. The methane migration creates a danger to present Drive-In patrons and employees, and it may restrict the future development of the property. A

Wayne H. Olson
Richard J. Gunn
Alonzo B. Seran
David R. Knodell
Harold H. Sheff
Michelle J. Ulrich
Bradley J. Gunn

GUNN LETTER

A. Past problems and the potential impact of methane gas production and measures to control off-site migration are discussed in the FEIS page 123. Past problems and proposed controls related to the drive-in theater are discussed on page 130. Mitigative measures are discussed on page 145.

The small gas explosion, referred to, occurred in about April 1981. (See letter from Bradley Gunn, dated July 19, 1984, following these comments.) WSS installed a methane control system in December 1981 which was put into operation in March 1982. No significant levels of methane have been detected around the drive-in through June 1984 or inside the concession building through April 1984. (WSS no longer has access to the inside of the building.) This information is based on monitoring reports filed with the MPCA by WSS. The FEIS, page 130reflects the more recent information.

2. Groundwater Contamination: According to the Draft E.I.S., the Drive-In is located within the Landfill's leachate plume. This is particularly unsettling since city water is not available, and the Drive-In is forced to rely on well water. Monitoring of this well has already revealed abnormally high levels of nitrates. B

3. Market Value: We believe the market value of the Drive-In property has been seriously diminished as a result of its proximity to the Landfill. The site is simply much less attractive to potential developers than it would otherwise be. This is an unfair result, and it should not exacerbated by expanding the source of the problem. C

4. Hazardous Wastes: While B.F.I. continues to maintain there has been no dumping of hazardous wastes at the Landfill (except for "household residue" materials), this is hardly comforting in view of the recent revelations as to the groundwater contamination near B.F.I.'s Pine Bend Landfill. Rather than expanding the Flying Cloud Landfill, which is constructed on sandy soils and up-gradient from a major river, we submit it would be far preferable to construct a new, state-of-the-art facility that could minimize externalities to a much greater degree than the present Landfill. D

5. Other Effects: The Landfill already burdens neighboring property owners with obnoxious odors, litter, noise, smoke, pests and vectors, and additional highway congestion. Any expansion of the Landfill would have the effect of continuing these nuisances for many more years. E

In summary, we believe that the Landfill was "orginally" intended to serve a common, "public good." Unfortunately, the neighboring residents of Eden Prairie have already paid a disproportionately high price for this "good." It would be both unfair and unsafe to now permit the Landfill to expand any further. We therefore request that the proposed expansion of the Landfill be denied.

Respectfully submitted,

OLSON, GUNN AND SERAN, LTD.

Brad Gunn

By
Bradley J. Gunn
Attorneys for Flying Cloud
Drive-In Theatre

BJG:sjm

B. The potential impact on the well at the drive-in theater and mitigating measures are discussed in the FEIS on page 80 These measures include the construction of a new, deeper well, construction of a well at a greater distance from the expansion or the extension of city water. A city water main is located at County Rd. 1 and Hwy 169.

According to the results obtained from Mr. Gunn the test indicated a nitrate level of 2.4 parts per million in the theater well. (See letter and attachment from Bradley Gun, dated July 19, 1984, following these comments.) The standard of the Minnesota Department of Health (DOH) for drinking water is 10 parts per million. The median value for nitrate levels in the glacial drift and Prairie du Chien aquifers in the Metropolitan Area is less than 4.4 and 4.4 parts per million, respectively. (Novitch, Ross and Brietkrietz, Water Resources Outlook for the Minneapolis-St. Paul Metropolitan Area, Metropolitan Council 1973.)

C. The potential impact on commercial/industrial property values is discussed in the FEIS on page 240.

D. The potential impact of hazardous waste is evaluated in the FEIS on page 114. Alternatives to the project such as new landfills are discussed on page 246.

E. The impacts mentioned are discussed in the FEIS. Open burning is prohibited at sanitary landfills by state regulation which would minimize any potential impact from smoke.

OLSON, GUNN AND SERAN, Ltd.

LAW OFFICES

315 Peavey Building
730 Second Avenue South
Minneapolis, Minnesota 55402-2473
612 339-8846

July 19, 1984

Mr. Carl Schenk
Environmental Planner
Metropolitan Council
300 Metro Square Building
7th and Robert Streets
St. Paul, Minnesota 55101

Re: Proposed expansion of Flying Cloud Landfill

Dear Mr. Schenk:

Pursuant to our telephone conversation this morning, I am forwarding a copy of a well water analysis conducted on a sample from the Flying Cloud Drive-In Theatre's well. Please note the indicated nitrate level of 2.4 p.p.m. According to Mr. O'Neil, the test was conducted by or for an agency of Hennepin County.

In regard to the second matter we discussed, the small gas explosion in the concessions building occurred in or about April 1981. The manager, who ignited the gas, is Mr. Thomas Maraushe.

Please let me know if I can be of any further assistance.

Very truly yours,

OLSON, GUNN AND SERAN, LTD.

By Brad Gunn
Bradley J. Gunn

BJG:rmn

cc: Mr. R. J. O'Neil

Enclosure

Wayne H. Olson
Richard J. Gunn
Alonzo B. Seran
David R. Knodell
Harold H. Sheff
Michelle J. Ulrich
Bradley J. Gunn

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TRI-CITY PUBLIC HEALTH LABORATORY

WATER AND SEWAGE ANALYSIS

Earl Meichsner, Director
5146 Eden
Edina, Minnesota 554[illegible]
Phone: 927-8861, Ext. 4

Health Department of: JOHN GILCHRIST
HENNEPIN COUNTY
Bloomington: ____
Edina: ____
St. Louis Park: ____
810 FIRST STREET SOUTH
HOPKINS, MN 55343

Sample Address: FLYING CLOUD DRIVE IN. EDEN PRAIRIE MN

Date Sampled: 4/11/84

Time Sampled: 3:55 P.M

Sampled By: JOHN A. GILCHRIST

Lab Number: 272

Inc. Temperature: 35°

Media Conditions: NORMAL

Controls: OK

Date Analyzed: 4/12/84

Sample No.	Sample Description & Location	Coli	SPC	Nitrate-Nitrogen	F	Surf	pH	Cl	
HC01	WELL WATER	<1/100*		2.4 ppm					

Field Remarks: * Some Atypical colonies on coliform plate (2%/100ml) Earl

Last time 1982

next time 1986

Lab Remarks: Index - negative or will charge $10

Rec'd 6-5-84

12010 Jasper Lane
Eden Prairie, MN 55344
June 3, 1984

Metropolitan Council
300 Metro Square Building,
Seventh and Robert Streets
St. Paul, MN 55101

Mr. Carl Schenk:

We live in Bluffs West and we are writing in response to the Flying Cloud Sanitary Landfill Expansion-- EIS. We will address points we feel qualified to address.

It is inconceivable to us that anyone could consider an expansion that would be as close as 900 feet to existing, occupied residences.

We would like to address the statements on page IV of the EIS. "The potential impact on these uses would be minimal in most instances. ....Bluffs West...could be impacted occasionally by litter, dust, odors, and noise." We do not consider occasionally having litter, dust, odors, and noise in our neighborhood a minimal impact. We think anyone with common sense and wanting an average mode of living would agree. The EIS also admits that litter control has been a problem at the existing landfill. That seems enough reason to believe that the litter would not be occasionally in our neighborhood, but it consistently would be. A

We are concerned about the proximity of the Flying Cloud Airport to the landfill. The FAA does not object to the proposed expansion because of the lack of problems with the existing landfill. This logic and reasoning does not make any sense to us. Under any other circumstances the FAA would not approve a landfill near an airport. Now you are considering an even larger landfill. What makes you think there will be no problems in the future? We feel that chance should not be taken-- let's not find out if there will or will not be any problems. B

We also would like to address the impact the expansion will have on property values and our quality of living. C

MCCRADDEN LETTER

A. The statements on page vii of the FEIS represent a summary statement of the detailed discussions contained in the sections on litter control, air quality, landfill gas (odors) and noise impacts. The discussion of these impacts indicates there would be short-term, temporary and occasional impacts. For example, there could be occasions when litter will be blown from the expansion onto adjoining properties. In the sense that the impacts would be limited in frequency and duration the impact will be minimal. Mitigation measures to minimize the problems are included in the FEIS.

B. In view of the on-going relationship and efforts of the landfill and airport operators to prevent and correct conflicts in the past, the FAA has withdrawn its objections to the project. See FEIS, Appendix C, letter dated March 19, 1982 The potential safety conflicts between the approach zone and the elevation of the berm and fill area are analyzed on page 221. The conclusion is that there is adequate clearance between approaching aircraft and the expansion.

C. The potential impact on property values is discussed on page 233. The conclusions are that the potential impact on non-residential property values and the residential properties in Hillsborough would be minimal. Because of their close proximity, vacant lots and houses in Bluffs West could be affected (page 237). A number of mitigative measures are discussed on page 241. An additional potential mitigative measure has been included reflecting legislation passed in 1984. This is discussed on page 242.

We know that selling our home will be difficult, if not impossible, if the landfill is expanded. If it is sold it will be at a loss. We are sure we are correct in these assumptions. We realize the landfill was in existence before the residential area was and that is the point. Why was Bluffs West developed? Someone must have been assured that the existing landfill would not be expanded and that it was at the end of it's use. When we purchased our home we were placing our trust in our government, that Bluffs West would be a safe and healthy place to live, and therefore be a home in which we could raise our future children. It is your responsibility to assure us that our neighborhood is safe and healthy and to not approve or let this landfill expansion happen. We do not think we are asking too much-- we just want to live in an average, safe, healthy, and clean neighborhood. We are a young couple, ages 30 and 29. We still believe in the American Dream and in our government. Meaning in this case, that we expect that this landfill expansion will not be approved and happen because you can not guarantee us that our neighborhood would be safe, healthy, and clean. We feel every citizen deserves that right and quality of living.

C

In closing we want to emphasize safety. The landfill gas that is produced will be doubled with the expansion. It does not seem it would be safe to live only 900 feet away from where this is being produced.

D

If we were the only people who opposed this expansion it would still be and is your responsibilty to consider this issue with what you think is RIGHT and not by what will be the easiest decision. We realize if you do not approve this expansion you are probably back to square one because you must find a place for garbage disposal. We think other alternatives should be considered. We are referring to what a gentleman spoke about at the public meeting on May 23, 1984. He informed us that there are other modern and updated methods for disposing of garbage rather than a landfill.

E

We sincerely hope, and we are putting our total trust and faith in you, that you will make the RIGHT decision and will not let this landfill expansion happen in our neighborhood. Thank you for your consideration.

Sincerely,

Carol McCradden

Kevin W. McCradden

Carol and Kevin McCradden

D. The potential problems from methane gas are discussed on page 123 in the FEIS. Woodlake has proposed a control and monitoring system be constructed along the eastern edge of the expansion to protect nearby residential areas. Additional measures to provide increased monitoring and control are discussed on page 144.

E. Alternatives to the proposed expansion are discussed on page 246 of the FEIS. These include changes in the design, magnitude, and operations of the project and alternatives to the project (no-action alternatives). The latter includes a discussion of other existing landfill capacity, new landfills and abatement strategies including recycling and burning refuse to produce energy.

(Corrected ver)

CHARLES M. MOOS
ATTORNEY AT LAW
2360 DAIN TOWER
MINNEAPOLIS, MINNESOTA 55402

TELEPHONE
612-333-1871

June 4, 1984

Mr. Carl Schenk
Environmental Planner
Metropolitan Council
300 Metro Square Building
7th and Robert Streets
St. Paul, Minnesota 55101

Re: Flying Cloud Sanitary Landfill Expansion Draft EIS:
Comments of Upgrala Management Company (UMC)
Our File Number 2171.01

Dear Mr. Schenk:

Upgrala Management Company (UMC) is the management arm for the twelve tenants who own part of the land referred to in your draft EIS as the "Upgrala Management Unit." The Upgrala tenants control over 1,000 acres in the Minnesota River bottom land known as "Upgrala," which includes two shallow lakes, Upper and Lower Grass Lakes.

The land consists of over 100 acres of wooded and flood plain land, 180 acres of cultivated farmland, 60 acres of potential residential land and about 700 acres of marshland and shallow lakes.

This area is the "crown jewel" of the proposed wildlife refuge, containing prime habitat for a variety of wildlife species. As your draft EIS notes at page 89, on some survey days over 1,500 waterfowl were seen. These are among the highest quality marshes in the proposed refuge, consistently supporting extensive populations of waterfowl, shorebirds and other wildlife.

In addition to the following comments, we are submitting herewith the comment of Dr. Edward B. Swain, a research associate at the Gray Freshwater Biological Institute. Significantly, Dr. Swain sampled and analyzed water from the pipe discharging into the surge pond and the pond itself. He found levels of cadmium, an extremely toxic chemical, of 140 parts per billion in the pipe and 60 parts per billion in the pond. This is a chemical which causes a substance to be defined as hazardous waste if its leachate contains the chemical at a level of one part per million. 6 MCAR §4.9002.

Drinking water standards prohibit levels in excess of .01 milligrams per liter (10 parts per billion). 6 MCAR §4.8014. Also submitted is the comment of Dr. Joseph Rossillon, President of the Freshwater Foundation, particularly raising concerns about bioaccumulation.

Because of the area's importance as a highly productive wetland, we have four principal areas of concern about the draft EIS which should be remedied in the final document.

1. Disregard of the nondegradation standard.

2. Pervasive conjecture regarding the crucial questions of impacts on Grass Lake.

3. Reliance upon post-disposal monitoring and cleanup to solve pollution problems, given the uncertainties of the impacts upon Grass Lake, are unacceptable.

4. Alternatives which would prevent leachate from reaching the groundwater, such as a clay liner and collection system should be fully discussed, rather than dismissed summarily.

Disregard of the nondegradation standard. Minnesota Pollution Control Agency (MPCA) Regulation WPC-22 provides for a no discharge standard with respect to the underground waters of the state, unless the Agency determines that some change is justifiable by reason of necessary economic or social development and will not preclude appropriate beneficial present and future uses of the waters. The draft EIS assumes that there will be a significant discharge of leachate to the underground waters which will at some point discharge into Grass Lake. The draft EIS does not discuss the necessary justification for such a discharge of waste to the groundwater. In addition to WPC-22(c) referred to above, the MPCA regulation WPC-22(d)(2) provides:

A

> "No sewage, industrial or other wastes or other pollutants shall be allowed to be discharged to the unsaturated zone or deposited in such place, manner or quantity that the effluent or residue therefrom, upon reaching the water table, may actually or potentially preclude or limit the use of underground waters as a potable water supply, nor shall any such discharge or deposit be allowed which may

MOOS LETTER

A. The staff of the MPCA stated at a meeting on July 27, 1984 that the proposed project will be reviewed for consistency with WPC-22 and other state regulations at the time of permitting. (WPC-22 does not require that a specific permit be granted.) According to the MPCA staff, nondegradation is a policy, not a standard and is to be balanced against social and economic development as provided for in the regulation. The need or basis for a variance from the standards as contained in WPC-22 will be determined at the time of permitting.

pollute the underground waters. All such possible sources of pollutants shall be monitored at the discharge's expense, as directed by the Agency."

A

In the past few years the MPCA has been engaged in a process of determining the intrinsic suitability of landfill sites in the seven county metropolitan area, pursuant to the Waste Management Act of 1980. The Agency's practice has been, where an underlying aquifer is not protected by an impermeable layer, to require other preventative measures, such as a liner and leachate collection system, as a condition of determining the intrinsic suitability of the site. There is no basis for a different approach here. Although the proposal is styled as an "expansion" of existing landfill, it is in fact and effect a new landfill, and should be subject to the same standards. For example, at Oak Grove, an existing landfill is immediately adjacent to one of the new sites in the Anoka County landfill inventory, recently approved by the Metropolitan Council. This draft EIS assumes, as it must, that a large volume of leachate will be produced in this landfill, and the leachate will migrate downward through the groundwater. The proposer thus plans to use the groundwater as a discharge area, "a free dump" without legal justification, insofar as we are able to determine. Dilution and attenuation are not concepts that are found in groundwater pollution regulations. Even with respect to surface water discharge, dilution is an outmoded concept. Given the presence of the landfill on the top of the bluffs, the nature of the intervening subsoils, and the certainty that leachate will be generated and will migrate downward and discharge into Grass Lake, there is little difference between this operation and an industry which is discharging waste to the lake and to the river. The only distinction is that here there is some hope (and it is only that) that the effluent might be attenuated by the time it is discharged. At a minimum, a variance from PCA standards must be sought and obtained.

B

C

Pervasive Conjecture regarding the crucial questions of impacts on Grass Lake.

Monitoring should be provided at Grass Lake itself, both to provide a baseline and to measure pollution effects.

D

B. The comment refers to the MPCA's review of new candidate landfill sites in the Metropolitan Area submitted by each of the seven counties under the Waste Management Act of 1980. In some instances the MPCA required that a liner and leachate collection system be installed as a condition for approval of the site. The FEIS analyzes the potential benefits of a liner, p. 81.

C. State water quality standards imply that dilution and attenuation are acceptable mechanisms. State drinking water standards (MCAR 4720.0400-1983) and surface water quality standards for lakes and rivers (6MCAR 4.8014 and 4.8015) are stated in terms of the allowable concentrations of a given contaminant. Most standards provide for some allowable maximum level of a potential contaminant. This implies that some attenuation or dilution could occur before another existing or potential use is affected, reducing the concentration to a safe level. The natural mechanisms, acting in surface water and groundwater, can reduce potential contaminant concentrations to levels which are consistent with the above standards.

D. The establishment of a monitoring program for Grass Lake is discussed in the FEIS.

Page 21. The draft EIS leaves unanswered most of the questions concerning the effects of leachate and surface water runoff on Grass Lake. Because of the importance of the area as a major wetland area within the metropolitan area, the best information possible should be provided. If additional studies are necessary, they should be identified. If scientific knowledge is insufficient to answer the questions, that gap should be described. What is the ownership of the land upon which the surge pond is located? Is there a survey of the land in this area which would show the boundaries? E

Page 22. Does the surge pond drain to the Minnesota River or to Grass Lake or to both? What is the quality of the water being discharged to the surge pond? What samples have been taken, and what are the results of any tests? How will the quality of that water change with the addition of the expansion? F

Page 35. Is runoff from the detention pond discharged from the surge pond continuously or only during a 100-year event? G

Page 44. Another example of uncertainty is the question of the existence of the silt layer. The lack of certainty on this point, underscores the need for preventative measures such as a liner. H

Page 54. Another uncertainty is whether the organics in the monitoring wells originated in the landfill. We would point out, that while the levels of trichloroethane and dichloralethylene in well 7 are very low, those chemicals do not appear in the other monotoring wells located at the base of the bluff, nor in the seeps. Could this be an indication that the leading edge of the plume is beginning to reach well 7? (See map page 45.) I

Page 54. Para. 4. Comparing the surface area of the landfill with the surface area of the huge recharge zone for the aquifer is another example of the misguided approach of dilution as an answer to contamination. J

Since Grass Lake is spring fed, and United States Fish and Wildlife Service tests show it's quality to be consistently better than the river, measures should be taken to ensure that the surge pond discharges only to the river. K

E. The FEIS indicates that data to verify the presence of the silt layer beneath the existing landfill is unavailable (page 44). In accordance with EQB regulations, a worst case analysis is presented in the FEIS which assumes the the silt layer is not present and evaluates the potential impact on leachate movement, groundwater and Grass Lake. (Site Hydrogeology and Surface Water sections.)

The surge pond is located on Woodlake property, according to the proposer.

F. The surge pond drains to the adjoining marshy areas and abandoned drainage ditches to the south. It does not drain to the Minnesota River.

A 15-element analysis of samples from the surge pond and a nearby pipe obtained on May 30, 1984, was performed for a group of landowners around Grass Lake (represented by the Upgrala Management Company). (See the attached letter to Charles M. Moos from Edward Swain, dated June 24, 1984.) The sample values for copper, boron and chromium are below state standards for the Minnesota River and Grass Lake (6MCAR 4.8014, 4.8015). The detection level for lead is above the state standard so no conclusion can be made for this metal. The concentrations for cadmium were higher than the state standard. (See table below.)

Table .
TESTS FOR CADMIUM LEVELS
(milligrams/liter)

Location	Standard[1]	Upgrala Company Test Results[2] (5-30-84)	Woodlake Test Results[3] (6-14-84)	Metro Council Test Results[4] (8-14-84)	Woodlake Test Results[4] (8-14-84)
Detention Pond - Water	0.010	-	0.0025	0.000077	<0.00010
Sediments[5]		-	-	1.2	1.5
Drainage Pipe West	0.010	0.140	-	0.000027	<0.00010
Free-flowing Well East	0.010	-	-	0.000010	<0.00010
Inlet to Surge Pond	0.010	-	0.0003	-	-
Surge Pond - Water	0.010	0.060	-	0.000011	<0.00010
Sediments[5]		-	-	1.3	1.5
Outlet from Surge Pond	0.010	-	0.0002	-	-

1) The State standard for drinking and surface waters is the same.
2) Minimum detection level: 0.00001 mg/l; analyzed by the University of Minnesota.
3) Minimum detection level: 0.00020 mg/l; analyzed by PACE Laboratories, Inc.
4) These are split samples obtained at the same time. The Metropolitan Council sample was analyzed by the Minnesota Dept. of Health and the Woodlake sample was analyzed by PACE Laboratories, Inc. The detection limit for the former is 0.00001 mg/l, and for the latter is 0.00010 mg/l.
5) Sediments measured in micrograms per gram; State standard does not apply to sediments.

Page 55. If leachate moves vertically into the deep aquifer and then horizontally toward the Minnesota River valley, where will the leachate be discharged? There are a series of springs along the base of the bluff in the Grass Lake area. These springs are not discussed. Will the leachate be discharged at these points? There are also springs in the bottom of Grass Lake itself that keep the waters open in places during much of the winter. Will they become discharge points? You state at page 47 only one confirmed spring has been located. Owners of Upgrala have observed a number of other springs and seepages at the base of the bluff. L

Page 56. Leachate arrival times for Grass Lake vary by 90 years, depending upon hydraulic conductivity. Why can this not be estimated with greater accuracy? Why cannot hydraulic conductivity be measured? Is such a study too expensive? M

Page 57. The extent of diversion of the leachate plume is conjectural and is regarded as "difficult to measure." Also the composition of the leachate is uncertain. Since "some hazardous organics could be leached from the existing and expanded site," (DEIS at 57) the landfill must be designed upon the assumption that this will occur. N

Page 59. The estimated diversion of the leachate plume does not show the plume reaching well number 76, the "Cooley well." This is a residence on land owned by Upgrala and leased to the Cooleys. Well 2 which is on the top of the bluff is slightly east of the Cooley well (page 59), is the well which is already showing the results of leachate pollution rather clearly (see Table 9, at 53). What is the true likelihood that the Cooley well could be polluted by leachate migration? Of course, the Cooley well is probably in jeopardy whether or not the expansion occurs because of the existing fill. What measures will be taken to monitor the migration of the plume in the direction of that well and the drinking water at that residence? If such leachate migration occurs in that direction, what possible mitigation measures could be taken to prevent that well from being polluted? Wouldn't it just be too expensive to do anything at that point? Such a scenario demonstrates the futility of reliance upon post-deposition monitoring as a means of preventing pollution in the river valley below the bluff. O

For the purposes of the FEIS, another round of samples were analyzed to evaluate the apparent high level of cadmium. Samples were obtained from the surge pond, a drainage pipe to the northwest of the surge pond which carries seepage from the bluff under Riverview Rd., an abandoned, free flowing well in the river valley, east of the surge pond, and the stormwater detention pond on the top of the bluff at the southeast corner of the landfill sites which drains into the surge pond.

Water samples were obtained from each of the sources, four in all, on Aug. 14, 1984 by the Council. Samples of the bottom sediments in the detention pond and surge pond were also obtained--two in total. The samples were collected and split on the site with a representative of a private lab, performing a similar analysis for Woodlake.

The samples were analyzed for the Council by the DOH. The concentrations of cadmium in the samples were quite low and well below the state drinking water standard for cadmium--.010 mg/liter which is more restrictive than state surface water standards for Grass Lake and the Minnesota River. (See table below.) The samples analyzed for Woodlake also indicated very low cadmium concentrations below state drinking water standards. (See table below.) The results of an earlier, separate analysis of samples from the detention pond and surge pond, performed on June 14, 1984, for Woodlake also indicated very low concentrations for cadmium. The test results indicate that the present cadmium concentrations in the landfill drainage system should not be a concern. There could be a number of reasons for the apparent difference in test results. For example, the original test, for the Upgrala landowners, used a different analytical technique and the results could have been affected by this. As the FEIS indicates, any future potential impacts on Grass Lake from the drainage system, associated with the expansion, could be mitigated by directing the surge pond overflow to the Minnesota River where it would be diluted, even at low flow conditions.

G. The runoff from the detention pond is not continuous. During storms with one inch of rainfall or more, the pond will discharge water to the valley surge pond as indicated in the FEIS. This would occur on the average about once a year.

H. A worst case analysis, assuming the silt layer is not present, is evaluated in the FEIS in the Site Hydrogeology section. The impact of a liner is discussed in the mitigation sub-section on page 81 and the Alternative section.

I. The landfill could be the source of these potential contaminants, but the pattern of monitoring well test results has been inconsistent. (See Table 9, FEIS.) As a result, it is not clear whether the landfill is or is not the source.

J. The statement does not refer to potential groundwater quality impacts. The point of the paragraph is that the project will not effect the capacity of local water wells. The wells are located in a large groundwater aquifer, 1,350 square miles in area. The landfill occupies only .02 percent of the area.

K. There is no complete set of water quality data for Grass Lake. It is presumed to be of better quality than the river because it is spring fed. The mitigation section suggests that the surge pond drainage be directed to the river.

Page 62. The concluding paragraph of the section on leachate attenuation again demonstrates the uncertainties of the effects on the project. "Some attenuation" will occur. The silt layer "thought to exist beneath the site should provide a good medium for absorption." Again, preventative measures should be provided at the outset. P

Page 61. The study cited in paragraphs 1 and 2 would indicate that there is very little doubt that volatile organics and trace metals will be present in the leachate from the site. Thus, the doubt expressed on page 57, bottom paragraph is unjustified, and again, the landfill should be designed to prevent problems from such contaminants, rather than speculating that they might not occur. Q

Page 62. The draft EIS states that the Cooley well is finished in the Prairie du Chien and takes water at a level lower than where leachate is expected. Please explain this statement, particularly in view of the statements at the bottom of page 44 and the top of 47 that the groundwater will eventually reach the Prairie du Chien -- Jordon aquifer. R

Page 66. Leachate pollution of Grass Lake. The draft EIS states that it is assuming "worse case conditions" as to the quality of the leachate which may reach Grass Lake. However, it assumes best case conditions when determining maximum concentrations of selected pollutants, since it assumes complete mixing of leachate in Grass Lake and the adjacent marsh. Clearly, such dispersion unlikely to occur. While mixing might occur in a river, mixing will not occur to the same degree in a lake, and if the pollutants are discharged above the lake level, at some point along the bluff they will be even more concentrated. S

Page 66. Application of water quality standards. What water quality standards are being applied? Please refer specifically to the regulations relied upon. T

Page 67. Minnesota River water quality. Reliance upon the water quality contamination in the Minnesota River in excess of water quality standards as a justification for polluting Grass Lake is inappropriate. First, the water quality in Grass Lake is consistently better than the Minnesota River, because it is spring fed. This landfill threatens that U

L. As the FEIS indicates the leachate could move along two paths. The leachate could move vertically to the Prairie du Chien formation and then horizontally to the river valley where it would discharge to the river, Grass Lake or wetlands. The springs in the bottom of the lake could become discharge points. Leachate discharged into the lake would be mixed and diluted. The FEIS discusses these potential impacts (page 70). The leachate could also move vertically and then horizontally through the saturated sands and discharge to the valley via seeps along the bluff (710 feet MSL). The leachate will drain into the valley and eventually into the wetlands and Grass Lake, diluting the leachate. The potential effect on Grass Lake and the local impacts are discussed in the FEIS.

M. Additional information, verifying the presence and conductivity of the silt layer beneath the existing landfill is not available. Additional soil borings through the refuse would be necessary to obtain the soils data, and the staffs of the MPCA and DOH have discouraged proposals to undertake this work because of the possibility of opening a conduit from the refuse to the groundwater. In accordance with state environmental review regulations (6MCAR 3.031 D), when the scientific data is available a worst case analysis is to be included. This is included in the FEIS.

The revised estimates (Table 11) reflect a worst case in which it is assumed that the silt layer is not present and the various routes the leachate could follow as it moves.

N. There are many variables which could effect the extent of the plume and the composition of leachage as the FEIS discussion indicates. The various methods used to analyze what might happen and the possible effects on groundwater, Grass Lake, etc., are estimates of the interaction of a complex system. Additional worst case analysis is evaluated in the FEIS, in those instances where scientific data is unavailable, to estimate what the potential environmental impacts and risks might be. A revised leachate plum and the basis for this is presented in the Site Hydrogeology section.

O. The potential impact on the Cooley well and mitigation measures are discussed in the FEIS on page 79.

P. The worst case analysis in the FEIS evaluates the potential impacts if the silt layer were not present beneath the site. Additional mitigation measures to prevent groundwater impacts are discussed.

Q. Care must be taken in utilizing data from other landfill sites on which to base specific conclusions about the potential impacts at Flying Cloud. Variables such as the composition of the waste, local soil characteristics, amount of precipitation and design of the landfill affect the composition and quantity of leachate produced, and the potential impact on groundwater. The conditions at the other landfills may not be comparable to those at Flying Cloud.

The paragraphs on page 68 provide a general perspective on the types and quantities of contaminants produced at sanitary landfills. The paragraph on the bottom of page 64 relates to the general composition of the refuse deposited at landfills in the region. No specific data regarding the composition and quantities of the refuse deposited at Flying Cloud is available. The landfill receives industrial, commercial and residential waste.

R. Additional analysis of the potential impact on the Cooley Well assuming the leachate reaches the Prairie du Chien is discussed in the FEIS on page 79.

water source. Second, continuing efforts are underway to improve that water quality. For example, legislation pending in Congress would help to cut down on the agricultural runoff pollution which causes much of the problem for the Minnesota River. The leachate from this landfill may continue, according to the draft EIS, for 100 years or more. It is a reasonable hope that the Minnesota River water quality will improve greatly within the next few decades. Therefore, it is no answer to the pollution concerns to argue that similar pollution levels exist in the river, as would exist in Grass Lake, if Grass Lake water were totally and completely mixed with the leachate reaching it. Moreover, the same assumptions (that violations are now occurring in the river) would not apply to the volatile organics. U

Page 66. Bioaccumulation. Here again, general statements and conjecture cloud any accurate assessment of the potential impact of the landfill. What substances are likely to bioaccumulate and in what organisms? What will be the effect upon waterfowl species if invertebrates are affected by leachate pollution? What is the basis for the conclusion that flooding grass lake with Minnesota River water once every two years has the same potential for impacts on the biota as leachate pollution? As noted above, this is not true. Moreover, if the lake is identical to the river in quality, addition of leachate will be cumulative, and will exacerbate the existing problems of the river water. V

Page 67. "Summary:" The conclusion that "the effect" of landfill leachate on the "Minnesota River water resource" will be "undetectable" is little more than a hope and does not address Grass Lake. If Grass Lake is intended to be included in that conclusion, it should be specifically stated. W

Page 68. Mitigation by a natural or synthetic liner: The only liner considered here is one which would divert leachate to the west. From our perspective, such a measure would simply increase the volume of leachate reaching Grass Lake, and would be unwise. A liner system which would divert leachate through a central collection point should be examined and discussed. Again, the draft EIS simply assumes that a continuing discharge from the new expansion area portion of the landfill to the groundwater is perfectly acceptible, in disregard of WPC-22. X

S. Additional worst case analysis regarding the potential impacts on Grass Lake is included in the FEIS. As to the estimated concentrations of leachate which could enter Grass Lake, it is appropriate to assume that the contaminants could be mixed completely. The lake will turn over frequently, perhaps continually, because of its shallow depth (one to three feet) and the action of the wind. Pollutants discharged along the bluffs would drain to Grass Lake where they would be dispersed or mixed. Other local concentrations in small ponds, seeps or in the marsh could exceed state standards and result in localized impacts on the biota of the type discussed in the FEIS (Vegetation and Wildlife section).

T. The source of the water quality standards are specified in the FEIS.

U. It is not the intent of the FEIS to justify any potential impact on Grass Lake based on the possible impact of contaminants in the Minnesota River. The purpose is to provide background information concerning affected surface water. There is no complete set of data available regarding the water quality of Grass Lake. This precludes the possibility of an adequate comparison. It is assumed the lake water quality is better than the river, since the lake is spring fed. There is no basis for estimating what the water quality of the Minnesota River would be, if or when control programs were implemented to reduce pollutants in the river. The point of the discussion is that certain pollutants in the river could have similar types of impacts on Grass Lake biota. The Surface Water section includes additional analysis of the impact of river overflow.

V. Additional analyses of the potential impacts on Grass Lake biota is included in the FEIS on page 108.

W. Based on the analysis of the potential concentration of leachate discharged to the river, the impact on the river would be minimal. The natural mixing of potential contaminants in the river would dilute them to concentrations below MPCA water quality standards even during low flow periods. However, potential leachate contaminants could add to the accumulation of these chemicals from other sources over the long term. The summary conclusion relating to the river does not apply to Grass Lake.

X. The potential effect of a liner is discussed in the Mitigation section of the FEIS (page 81).

Page 69-70. Monitoring wells. Of course, monitoring should be provided. However, monitoring is an inadequate method of protection of the Grass Lake area from pollution. If contaminants reached the monitoring wells, what then can be done to contain the pollution, and what would be the cost? It is our fear that any post-deposition mitigation measures such as barrier wells would either be impossible on the steep bluff or too expensive, and a decision would be made that nothing can be done except to allow the pollution to reach Grass Lake, and to hope that the effects will not be severe. AA

Page 69-70. What monitoring is currently being done to determine the concentrations of chemical constitutents from the present fill? If a collection system or other protective device were used for the new landfill, what mitigating measures could be taken if monitoring demonstrates pollution of Grass Lake or the likelihood thereof from the existing landfill? BB

Page 74. Surface water impacts. Again, it is unclear whether the surge pond receives discharge continuously or only during a 100-year rainfall. The cadmium levels in the tests done by Swain, letter attached, raise the concern that Grass Lake could be seriously polluted by toxic substances from the landfill. CC

Page 76. Please explain the statement that "in 1982, trichloroflurmethane, arsenic, chromium, mercury, phenol, zinc and antimony were found at barely detectible levels in four surface water seeps at the base of the bluff." The same result is referred to at the bottom of page 47 of the draft EIS, in general terms, and the references is to Table 9. But table 9, at page 53, shows only one organic compound being detected in the seeps, trichloroflurmethane present in four seeps, but no other chemicals present. Where are the results of the earlier testing? Typically, uncertainty is expressed as to whether these compounds originate in the landfill. However, given this undeveloped and unspoiled environment at the base of the bluff; it is difficult to see how these seeps could receive such chemicals from any other source. Moreover, given the presence of some chemicals at one point and not at another, is it possible that the difference is accounted for by pollution slugs which moved to the seeps and was not a continuous flow? Why would such chemicals appear at all of the seeps? If the results are thought to be due to some laboratory error, why were the tests not repeated? DD

AA. Additional mitigation and corrective measures are discussed in the FEIS, pages 79-85. Monitoring would trigger other preventative actions if problems are identified.

BB. The existing monitoring system is discussed in the FEIS on page 17. Additional mitigation and correction measures are discussed in the FEIS, pages 79-85. The correction measures could be applied to the existing landfill.

CC. This was discussed previously in (F) and (G) above.

DD. Revised Table 9 indicates only the test results for organic compounds as does the discussion on page 54 of the FEIS. The discussion in the Surface Water section, page 90 refers to the test results for metals and other contaminants obtained at the same time. No pesticides or PCBs were detected. Trace amounts of metals below state standards were present. These data are discussed in the FEIS.

Due to the lack of a consistent pattern as shown by test results from samples obtained from upgradient and downgradient monitoring wells, it is not clear whether the landfill is the source. (Table 9, FEIS.) Woodlake continues to sample monitoring wells around the landfill and analyze them for possible contaminants under the current permit. These results are submitted to the MPCA and Hennepin County. These procedures are described in the FEIS on page 17.

Page 76. The draft EIS states that during storms with over one inch of rainfall, the ponds outlet pipe will carry water to the surge pond. At other places, the surge pond is to be utilized during the 100-year event. What is the explanation for the difference? If the explantion is that the overflow to the surge pond will occur frequently, what is the quality of the water expected to reach the surge pond? **EE**

Page 81. The range in the volume of leachate from 18-acre feet to 73-acre feet is a tremendous difference. Is it possible to define it more closely? **FF**

Page 81. The expectation that concentration of pollutants in the lake water of Grass Lake will be below MPCA standards is not justified in view of the uncertainties of the information presented. What specific water quality standards are being applied to Grass Lake? The cadmium tests referred to in Dr. Swain's letter must now be considered and additional tests done. **GG**

Page 82. It is certainly correct to state that it "is not possible to predict that no changes to Grass Lake will occur."

Page 82. Perhaps this deserves to be treated as an effluent discharge into a lake, since in fact, that is what will occur. At a minimum, a variance from WPC-22 would be required. **HH**

Page 83. The statement that concentrations are expected to stay below MPCA standards, for the reasons noted above, cannot be supported. **II**

Page 85. Upgrala and its lands are controlled by the Upgrala owners, not the Fish and Wildlife Service. This should be clarified throughout the report. **JJ**

Page 89. Although the existing conditions are described, there is little effort to determine what the impacts on wildlife will be, particularly bioaccumulation. What species will be affected? What will be the impact on waterfowl and bald eagles from bioaccumulation of toxics? **KK**

Pages 91-92. The impacts will not be "negligible" or "minor", given the extremely high level of cadmium in the surge pond discharge. **LL**

EE. Although the detention pond is designed to handle the runoff from a 100-year event, water will begin to flow via the outlet pipe during storms of one inch which is less than a 100-year storm. A storm of one inch or more would occur about once a year. The impact of the water leaving the surge pond is discussed on page 91 of the FEIS. The FEIS indicates that constructing an overflow channel to the Minnesota River would be one means of minimizing the potential impact on Grass Lake. The runoff would be diluted in the river even at low flow.

FF. Because of the many variables which affect the production of leachate, it is appropriate for the purposes of the FEIS to present a range of estimates of what might occur. The high value represents a worst case--assuming no runoff or the infiltration of all precipitation (5.9 inches annually) into the landfill.

GG. Additional analysis of the potential impacts on Grass Lake, including a worst case estimate is presented in the FEIS on page 70. The specific MPCA standards are indicated in the FEIS. The additional tests for cadmium were discussed previously in (F) above.

HH. A discussion of additional mitigation measures including the construction of a liner and collection system is included in the FEIS. These measures would, in effect, provide additional protection for the lake. The matter of WPC-22 was discussed previously in (A) above.

II. Additional analysis of the potential impact on Grass Lake is presented in the FEIS on page 70.

JJ. The FEIS indicates in several sections that the land around Grass Lake is owned by private individuals.

KK. Additional analysis of the potential impacts and risks to wildlife is discussed in the FEIS on page 102.

LL. Additional tests regarding the levels of cadmium were discussed previously in (F) above.

Page 92. The only suggestion is that "indirect impacts on vegetation and animals have the potential to occur." While it is true that it is impossible to unequivocally state that the potential for impact does not exist, it is equally impossible to state that the impacts will be negligible or minor, based on the data presented. MM

Page 92. Mitigating measures. There is no discussion here of a liner as a means of minimizing the effect on the environment. There is a suggestion that monitoring will help early detection and problems can be easily remedied, but there is no explanation of how a problem of leachate contamination of the groundwater once started in the area adjacent to the bluff can be remedied. NN

Page 92. Suggestions for additional studies: The draft EIS suggests that it would be useful to do sampling in Grass Lake and associated wetlands. Such sampling should definitely be done and should be made apart of the final EIS. It is crucial to have a present baseline study of Grass Lake. OO

Page 93. Last paragraph. This discussion as to mitigating measures is of no help in determining whether in fact, once leachate pollution has begun, it could be stopped before seriously affecting Grass Lake. PP

Page 123. Gas migration to the bluffs. The draft EIS states that vegetation along the river bluffs "may be" adversely affected by migrating gas and that the gas may be associated with higher soil temperatures. This is particularly serious, since if the vegetation is removed, it is almost certain that severe erosion will occur, as was the case several years ago when a major washout of the bluffs occurred during a heavy rainfall in 1978, depositing soil from the bluff downwards into Grass Lake. What is the likelihood that this could occur as a result of vegetation death due to gas migration? QQ

Page 125-126. Ventilation trench. Is such a trench feasible as means of preventing migration of methane to the bluff face? What is the cost? Would it make sense, in terms of preventing loss of vegetation on the bluff face? RR

MM. Additional analysis regarding wildlife and vegetation impacts is included in the FEIS on page 102.

NN. Discussion of the value of a liner and collection system as a mitigation measure and correction measures are discussed in the FEIS on page 81.

OO. It would take at least a year of monitoring to develop an adequate baseline data for the present water quality of Grass Lake including the associated biota. Sampling would have to be done over several seasons to indicate changes in the qualitative indicators. A "one-shot" program of sampling would not be adequate for the purposes of establishing a baseline for the lake and biota.

PP. Additional discussion of corrective measures and their impacts relative to Grass Lake is included in the FEIS on page 84.

QQ. Additional measures to be taken regarding bluff vegetation are discussed in the FEIS on page 146. The setbacks from the bluffline and well-aerated, sandy soils on the bluff should provide for the natural diffusion of landfill gas.

RR. A ventilation trench and other measures are discussed in the FEIS as a secondary or backup system to Woodlake's proposed control system along the northern and eastern perimeter to protect residential areas, but not along the bluff side. See (QQ) above.

Page 197. Again, it is not possible to conclude that impacts on the wildlife area of Grass Lake will be minimal or minor. SS

Page 198. Last paragraph. The question of long-term protection for the river bluff by transfer of title to the Fish and Wildlife Service is a good one. The Fish and Wildlife Service should protect the bluffs first, since the river bottom is already being protected.

Reliance upon post-disposal monitoring and cleanup to solve pollution problems, given the uncertainties of the impacts upon Grass Lake, are unacceptable. TT

Cleanup of leachate pollution on this scale would be likely to be impossible or too expensive.

Page 197. Mitigation. What is the basis for the statement that "additional monitoring of groundwater downgradient from the expansion areas would allow sufficient lead time to develop an action program to prevent any impact on the surrounding uses?" Monitoring is not mitigation. First, would the problems of leachate pollution of the groundwater be remedial at all? If so, what measures would be appropriate and what would they cost? If leachate from the existing landfill is not expected to reach the lake until 1985 (page 81), that means that 10 years or more of leachate is already in the groundwater. Is it not more likely that the resource will be sacrificed rather than a great expenditure of funds necessary for cleanup, should serious leachate pollution threaten the Grass Lake and the river? UU

Alternatives which would prevent leachate from reaching the groundwater, such as a clay liner and collection system should be fully discussed, rather than dismissed summarily.

Page 225. Liner and leachate collection system. What is the basis for the statement that "the liner and leachate collection system does not appear to be a necessary modification at this site." As noted above, there is no assurance that even if detected early, leachate movement could be prevented from reaching Grass Lake. Moreover, it is not sufficient to suggest an alternative source of water, when dealing with the lake. In fact, the draft EIS does not discuss VV

SS. Additional discussion regarding the potential impacts on biota are discussed in the Vegetation and Wildlife section in the FEIS.

TT. The bluffs along the landfill are included in the Refuge but owned by Woodlake. Lands along the river and lake are owned by private individuals. In general, the U.S. Fish and Wildlife Service must rely upon state and local government plans and regulations to protect these lands until the federal government can acquire the land.

UU. Assuming a worst case estimate for the movement of leachate, if contaminants were detected in the groundwater at hazardous levels by monitoring wells, close to the landfill, there would be limited time to take corrective action to protect Grass Lake (Table 11). Corrective actions and additional mitigation measures including a liner are discussed in the FEIS. Corrective actions could have a significant impact on the lake and biota. The issue of the potential effect on the resource versus the cost will be addressed at the time of permitting.

VV. Additional analysis of the potential impact on Grass Lake and the associated biota, the effect of a liner and collection system, are included in the FEIS (Site Hydrogeology section).

The consistency of the project with MPCA Regulation SW6 (1) (t) will be evaluated at the time of permitting.

the leachate collection system and liner, but rather discusses the reasons why such a system is not needed. Given the uncertainties discussed above, the EIS should at a minimum discuss the design and operation of a liner and collection system, and its costs. Even if the cost is high, the risk may be great enough to justify the cost. However, the draft EIS fails to give us sufficient information to balance (1) risk of significant pollution of Grass Lake (2) ability to prevent leachate from reaching the lake once it has been detected in monitoring wells, and (3) the cost of prevention. Only if these factors are known with great certainty can it be said that a liner and collection system is not appropriate. VV

It is however, inappropriate to continue to assume that groundwater may be used as a free dumping ground for leachate from landfills. The MPCA would certainly not permit this as a new landfill without a leachate collection system. A design which would not simply direct the leachate to the western side of the landfill should be discussed and evaluated in the final EIS. Under P.C.A. Regulations, SW 6(1)(t) requires a leachate collection system to protect groundwater.

Liability.

Page 223. Clearly, strict liability would apply to provide a remedy to the Upgrala owners, and such a legal remedy will be sought if appropriate. WW

Conclusion. The Final EIS should be amended in accordance with the foregoing comments and to answer the questions raised. At a minimum, a liner and collection system should be studied, a baseline study of Grass Lake is needed, and additional monitoring of the movement of leachate and of the Cooley well is needed. If the questions are impossible to answer, that should be noted, and measures evaluated which would prevent the worst case scenario from occurring. Without the requested information, agencies cannot make a determination of the proposed permit. XX

Yours very truly,

UPGRALA MANAGEMENT COMPANY

By _____
Charles Moos
Vice President

CM/rj

WW. This is an issue which the affected property owners would decide.

XX. These questions have been discussed in (A) through (TT) above. A year of sampling of the lake and biota would be necessary to establish a baseline for lake water quality and the ecosystem.

UNIVERSITY OF MINNESOTA
TWIN CITIES

Gray Freshwater Biological Institute
College of Biological Sciences
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June 5, 1984

Charles M. Moos
3710 Northome Road
Wayzata, Minnesota 55391

Dear Mr. Moos:

I have read the draft Environmental Impact Statement (April 1984) for the Flying Cloud Sanitary landfill expansion, and provide the following critical comments for your information. I have focussed exclusively on hydrological issues because that is my area of expertise.

There seems to be little concern in the EIS about the predicted low quality of ground and surface water, apparently because of circumstances unique to this site. These circumstances are: (1) few private wells are presently in the ground water plume from the landfill, (2) the ground water plume probably discharges into the Minnesota River valley, and (3) the overland runoff does discharge into the Minnesota River valley.

Thus the message of the EIS is that it is okay to have contaminated water because it is probably carried away from areas of human use, into the river valley where it will be diluted. I find this approach to be as short-sighted as our society's ignorant behavior of the past; with the difference that in this case it appears to be a conscious choice.

My major concerns are as follows:

(1) Groundwater contamination has already occurred and the pollutants are moving relatively quickly through the aquifers, as indicated by the detection of a sequence of organic compounds in the monitoring wells (p. 47). YY

(2) The EIS appears to excuse the contamination of the Minnesota River valley on the ground that the Minnesota River already contains many contaminants (p. 82). This does not seem to me to be a defensible position, because rivers respond very quickly to clean-up efforts, but landfills continue to pollute for centuries. ZZ

(3) The pollutants contained in the ground water will eventually be discharged into the land that is a refuge for wildlife at the base of the bluffs in the valley. This area includes Grass Lake, of which very little is known, but almost certainly has better water quality than the Minnesota River. The EIS suggests that should Grass Lake be contaminated by land-fill leachate the MPCA would ask the landfill operator to recommend remedial measures (p. 93). That is a noble statement, but I know of no measure that can clean up the diffuse discharge of contaminated groundwater. AAA

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YY. And the FEIS indicates trace amounts of contaminants have been detected in the monitoring wells on several separate occasions. However, because of the lack of consistency in the pattern and test values, it is not clear whether the landfill is or is not the source.

ZZ. The FEIS provides background information regarding the quality of the Minnesota River since it could be affected by leachate discharged into the river valley, and the river overflows Grass lake. The conclusion of the FEIS is that leachate would be diluted if it reaches the river, and the effect should be minimal. However, the project could add to the long-term accumulation of contaminants in the river from other sources. Additional analysis of potential impacts is included in the FEIS.

AAA. The FEIS discusses the need for additional and frequent monitoring. Monitoring wells placed downgradient from the project would detect contaminants before they reach Grass Lake. Assuming a worse case estimate in which the silt layer is not present, there would be limited time in which to take actions to protect the lake. Corrective actions and their effects are discussed in the FEIS.

(4) The EIS assumes that toxic organic compounds discharged into the Minnesota River Valley will be diluted and naturally decomposed so as to present no hazard. The EIS barely mentions the issue of organics that are resistant to decay and that are concentrated by organisms, especially fish and wildlife at the top of food chains. **BBB**

(5) The EIS does mention the problem of heavy metals, which are toxins that never decompose and also can be concentrated by organisms ("bioaccumlation"). In response to this problem the EIS retreats to a position taken many times in the document: a monitoring program. Monitoring is good but does nothing to solve a problem once it is discovered. Ground water contamination and its effects in a discharge area are among the most difficult types of pollution to clean up. Why allow ground water contamination to occur and pretend that monitoring solves any problems? The only "solution" to such a problem might be to post signs warning people to not consume any fish or game caught in that area. **CCC**

(6) The provisions for control of surface runoff seem markedly less than adequate. Runoff is "treated" by channeling it to a detention pond, where it is discharged through a pipe to a "surge" pond, where excess water flows overland towards Grass Lake. Therefore, the only treatment, aside from the settling of particulates in the detention pond, occurs in the river valley, which is not owned by the landfill operators.

The sections of the EIS dealing with surface water (pp. 71-80) are particularly weak. There is very little, if any, data presented that is pertinent to this site.

I obtained a grab sample of effluent from the pipe discharging into the surge pond and from the surge pond itself on 30 May 1984. I had the water analyzed for a suite of heavy metals. The effluent had high concentrations of cadmium (140 ug/liter), as did the surge pond (60 ug/liter). In comparison, the EIS lists the maximum 1981 concentration of the Minnesota River as 2 ug/liter (p. 71). The presence of high concentrations of cadmium is prone to further concentration in food chains, and cadmium is very toxic. **DDD**

It is clear that the surface water is contaminated with at least cadmium and should be studied in some detail. It also seems inappropriate to me that the major clean-up of the surface water presently occurs in the river valley rather than on the landfill site.

BBB. Additional evaluation of the potential impacts of toxic organic compounds is discussed in the FEIS in the Vegetation and Wildlife section.

CCC. Additional analysis of the possible impacts of heavy metals and mitigation measures is discussed in the FEIS in the Surface Water and Vegetation and Wildlife sections.

DDD. The potential impact of the surface runoff is indicated as minimal in the FEIS. Mitigation measures to reduce the impacts are also discussed. Further evaluation of the apparently high level of cadmium in the surge pond was discussed in (F) above.

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In sum, the EIS allows contaminated water to enter the Minnesota River Valley, apparently confident that dilution and attenuation will make any toxins unimportant. The idea is that monitoring will reveal any hazards that do occur. However, bioaccumulation would of course occur in organisms, and nowhere in the EIS do I see a plan to monitor the concentrations of toxins in fish and wildlife. In addition, monitoring does nothing to solve the problems of contamination. Surface water runoff appears to be inadequately dealt with, expecially during the period of active use before the relatively less permeable cap is installed over the site.

Sincerely,

Edward B. Swain

Edward B. Swain, Ph.D.
Research Associate

ES/lk

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FRESHWATER FOUNDATION

June 4, 1984

TO: MR. CHARLES MOOS, VICE PRESIDENT
UPGRALA MANAGEMENT COMPANY

FROM: DR. JOSEPH P. ROSSILLON, PRESIDENT
FRESHWATER FOUNDATION

SUBJECT: E.I.S. FLYING CLOUD SANITARY LAND FILL EXPANSION

The discussion of environmental impacts of the Flying Cloud Sanitary Landfill Expansion makes two statements relative to water that should be reviewed.

1. "The potential for groundwater quality degradation exists; . . ." Page V. In the unlikely event that their water supply becomes contaminated, city water could be made available.

Discussion: "The content of solid waste (in the United States) ranges from vegetable cuttings and paper towels to more than one pound (per year) per household of hazardous materials including lead, cadmium, mercury and an assortment of poisons and pesticides." (P. 68 Groundwater: A Non-Technical Guide, by James Wilson)

a) Currently the MPCA estimates that there are 1,500 potential groundwater contamination sites in Minnesota. We need to decrease that number, not add to it.

b) If groundwater becomes contaminated, we have no current acceptable mechanism for reclaiming it - consequently, we lose that water supply.

c) It has been proposed by the Minnesota Department of Health that groundwater is the No. 1 problem issue in Minnesota. A supply that might be contaminated must not be "written off" so easily.

2. "Dilution and attenuation should greatly decrease the potential for contamination of the Minnesota River or Grass Lake".

Discussion: One of the reasons for the establishment of the 208 Water Quality Act was the acceptance that "dilution is not a solution for pollution".

a) An increase of biodegradable materials into adjoining surface water will enhance the eutrophication process of the shallow marshes of Upgralla and speed up their demise into bogs.

EEE

FFF

EEE. The issue of hazardous waste is discussed in the FEIS on page 114.

FFF. Additional analysis of the potential impact on Grass Lake, the risks and mitigation and corrective measures are discussed in the FEIS.

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b) Bioaccumulants neither degrade nor dilute, they usually build up in low areas and sediment. Toxic bioaccumulants like heavy metals, synthetic poisons not only build up but can have a major impact on the balance of the ecosystem.

c) "The U.S. E.P.A. has estimated that at least 57 million metric tons of the nation's total wasteland can be classified as hazardous. In hundreds of cases, environmental damage has been recorded from the indiscriminate dumping of hazardous waste into the terrestrial and aquatic environment.

"The vast majority of the cases involve the pollution of water from improperly sited or operated landfills and surface impoundments". (P. 47, To Quench Our Thirst, David A. Francko and Robert G. Wetzel.

FFF

Opinion: The final statement under environmental impacts in the Executive Summary states: "Small quantities of hazardous wastes are found in household wastes; these may legally be deposited at the site."

One pound per year per household of a toxic material leaching into the water supply or surface water will not be insignificant if it accumulates.

I am concerned about any synthetic material leaching into water supplies.

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471-7106

24 June 1984

Carl Schenk
Metro Council
300 Metro Square Building
St. Paul, MN 55101

Dear Mr. Schenk,

This is in response to your request for additional information about the analysis of the water samples I obtained on 30 May 1984 in the vicinity of the Flying Cloud landfill. The pipe itself was located about 10 meters south of Riverview Road, and just north of what I believe to be the surge pond described in the EIS prepared by the Metro Council. At the time of my sampling (about 9 a.m.) there was only a pencil-sized stream coming out of the pipe. I also obtained a sample from the surge pond.

The samples were obtained in acid-washed polyethylene bottles. There were particulates in both samples, and these particulates were not filtered out. I acidified sub-samples to 2 N HCl and submitted these samples plus a blank and two samples of my own from Halsteds Bay of Lake Minnetonka for analysis at the Research Analytical Laboratory on the St. Paul campus of the University of Minnesota.

The analysis that I requested was a 15-element suite that is analyzed through inductively coupled plasma emission spectroscopy. The results are as shown on the following page (all expressed as mg per liter):

element	blank	pond	pipe	Halsteds surface	Halsteds 9 m depth
P	<.26	.38	<.26	<.26	.56
K	<.36	6.33	<.36	4.89	5.08
Ca	.11	101.37	78.44	45.96	47.40
Mg	.04	37.03	22.31	18.34	18.75
Al	<.05	.13	.15	.10	.06
Fe	<.01	.33	.34	<.01	.02
Na	<.11	7.39	2.32	8.85	9.18
Mn	<.01	.44	.14	.12	1.39
Zn	.04	.06	.06	.04	.05
Cu	<.01	<.01	<.01	<.01	<.01
B	.02	.08	.05	.04	.03
Pb	<.10	<.10	<.10	<.10	<.10
Ni	<.03	<.03	<.03	<.03	<.03
Cr	<.01	<.01	<.01	<.01	<.01
Cd	<.01	.06	.14	.03	.03

As you can see, the only heavy metal that seems high is cadmium (Cd) in the pipe effluent (140 ug/liter) and in the surge pond (60 ug/liter). I am not familiar enough with environmental concentrations of cadmium to know whether the 30 ug/liter cadmium concentrations found in Halsteds Bay are unusual or worrisome. However, the measurements seem to be real, in that the cadmium concentration in the blank was low.

I hope that you find this information useful.

Sincerely,

Edward B. Swain

Edward B. Swain
Postdoctoral Associate

21 May 1984

Mr. Carl Schenk
Environmental Planner
Metro Council
300 Metro Square
St. Paul, MN 55101

Mr. Schenk:

The Environmental Impact Study was the most ridiculous waste of time and money that I have seen in quite a while - but then I guess I should have expected its redundancy.

Several times throughout the report, mention was made of a proposed "new" 15 foot berm to reduce noise, litter, etc. How does BFI assume that a new berm will do anything more than the existing berm? The present berm does not contain refuse, does not "hide" refuse from sight, and does nothing to inhibit noise and vibration. The present litter problem will be greatly increased with the proposed expansion, since BFI cannot stop the wind. A

And the wind also carries the odors. The odors presently wafting over our neighborhood will also intensify with an expansion. B

Our next problem is the noise level we now experience at all hours of the day and night. Again mention of the "new" berm around the proposed expansion says that the noise level should be no greater than it is now - well, I feel the noise level is totally unacceptable now. I propose that BFI should be limited in the conducting of business to the restricted hours of MONDAY to FRIDAY from 8:30 AM to 5:00 PM!!! C

Another significant problem - and one that to my knowledge has not been addressed - is the vibration due to earthmoving equipment. A typical vibration is equivalent to the "old-fashioned" motel massage beds (the kind where 25¢ bought a 15 minute massage). Only this is almost an every night occurance and for much more than 15 minutes. The vibratinn problem will also intensify with an expansion - to what impact on all of our home foundations? D

A very brief message of pest control was made in the statement, but no mention of a remedy for an already exorbitant number of insects due to our close proximity to the existing dump. Will BFI guarantee to take all necessary precautions for pest/insect control? I highly doubt it. E

The most important problem however, is the one of hazardous/contaminating waste. How does BFI propose to control this problem? With a monitoring crew of trained technical scientists to sift through each and every piece of refuse? How can BFI guarantee that their customers will never include any hazardous/contaminating waste in their garbage? They CAN'T!! F

PALMER LETTER

A. There is no berm around the present site. A ridge adjoins the current site along the southeast corner, and this would be replaced by the berm if the expansion is approved. A 15-foot high berm will be constructed along the eastern edge of the expansion designed specifically in terms of its slope, height and width to reduce visual and noise impacts. Woodlake proposes to landscape the berm with a deciduous and coniferous mix of vegetation. See FEIS, Appendix C, letter to Carl Schenk, June 30, 1983.

The potential litter impacts and control measures are discussed in the FEIS page 164.

B. Potential odor impacts are discussed in the FEIS, page 123.

C. Present and potential noise impacts and mitigation measures are discussed in the FEIS, page 147. The discussion indicates that there could be increased noise impacts in residential areas and that these impacts could temporarily exceed state standards during various phases of the project. A properly designed 15-foot high berm could reduce noise levels by 12 db at any given point. The discussion of mitigation measures includes limiting hours of operation, particularly during the night time hours.

D. Additional discussion regarding the potential impact of vibrations is included in the noise section of the FEIS on page 157.

E. The purpose of the FEIS is to identify potential problems associated with the proposed expansion. Existing problems, whether they be associated with insects, noise or dust can be corrected through the enforcement authorities of Hennepin County and the MPCA.

Potential vector and pest problems and control measures are discussed in the FEIS, page 160. The potential impact appears to be minimal, and there are measures to mitigate problems.

F. Potential hazardous waste impacts are discussed in the FEIS, page 114. State regulations prohibit the disposal of hazardous waste in a sanitary landfill except in the small amounts normally found in mixed municipal waste. Woodlake has adopted extensive procedures for preventing the disposal of hazardous waste at the landfill because of the high costs associated with liability.

A point was made of the $100,000.00 property tax paid by BFI yearly. Our house tax is $2482.14 per year - if you take that figure as an approximate average and multiply by the number of homes in Hillsborough and Bluffs West that are and will be directly affected by the existing dump and the exposed expansion, I'm sure that we pay more than the $100,000.00 BFI now pays. And the owners of BFI don't live in the dump as do the homeowners of Hillsborough and Bluffs West. G

To be perfectly honest - I certainly do not enjoy paying first-class taxes and living as a second-class citizen!!

Sincerely,

Kathy J. Palmer

Kathy J. Palmer
10294 Winter Place
Eden Prairie, MN 55344
(612) 944-7305

P.S. Your conspicuous absence or attendence at the community meeting on Wednesday, 23 May 1984, will be duly noted by the members of the Eden Prairie coalition.

C.C. - Mr. Don Storm
C.C. - Mr. Wolfgang Penzel
C.C. - Mr. Carl Julie

G. In accordance with state regulations the FEIS must evaluate the socio-economic impacts (benefits) of the project. One of the potential economic impacts (benefits) of the proposed expansion is the amount of additional local property tax revenue which might be generated. This is discussed on page 243 of the FEIS. The purpose of this section is not to compare the value of the landfill with surrounding land uses. The potential impact of the project on surrounding property values is discussed on page 233 of the FEIS.

Dear Mr. Schenk

6-5-84

I am writing to you about the proposed landfill expansion at Flying Cloud. I would like to have my concerns, objections if necessary, be on record. Our property is on Upper Grass Lake and I am concerned about leachate from the landfill damaging our property and/or water.

Referring to the Draft E.I.S., I am concerned about the effectiveness and safety of the post-disposal methods of eliminating problems. We have some concerns about conjecture in the E.I.S. relating to Grass Lake as well as what may be a disregard,by the landfill, of non-degradation standards. Finally, we would like to see alternatives such as "collection systems" and "clay liners" explored more thoroughly.

A

B

C

Respectfully,

Sever Peterson Family

SEVER PETERSON FAMILY LETTER

A. Additional discussion regarding correction measures has been included in the FEIS on page 85.

B. Additional discussion regarding the potential impact on Grass Lake and groundwater is included in the FEIS on page 70.

C. Additional discussion regarding mitigation measures such as a liner and collection system is discussed in the FEIS on page 81.

SUMMARY OF PUBLIC MEETING
ON THE
DRAFT EIS (DEIS) FOR PROPOSED EXPANSION OF
FLYING CLOUD SANITARY LANDFILL

May 23, 1984

Council Members Present: Alton Gasper, M. Hauser, M. McLauglin, J. Nunn, D. Rietow, P. Scully, G. Ulrich.

Council Staff Present: Carl Schenk and Shirlee Smith. Rick Morck, consulting hydrogeologist.

Gertrude Ulrich, Council District 12, chaired the meeting. She explained the purpose of the public meeting and the process the Council will follow in preparing and determining the adequacy of the final EIS.

Carl Schenk, Metropolitan Council Staff, and Rick Morck, consulting hydrogeologist, summarized the proposed expansion project and DEIS.

Following the staff presentation, local officials and citizens presented their views of the proposed expansion and the adequacy of the DEIS. Nine individuals among the forty-four individuals signed on the attendance register made statements. The number of persons in the audience was approximately 60 persons. Five residents from the Hillsborough residential area and twenty-three from the Bluffs West residential area, located northeast and southeast of the site respectively, signed the attendance register.

A summary of each public statement is provided below. A complete record of each statement is on file at the Metropolitan Council offices, 300 Metro Square Building, Saint Paul.

Wolfgang Penzel, Mayor of the City of Eden Prairie, indicated that the Flying Cloud Landfill was to have been filled by 1980, according to the original schedule as promised to the City of Eden Prairie. He indicated the DEIS is a good attempt at a comprehensive look at the potential short and long term concerns, but the City is concerned that the impacts will be worse than anticipated in the DEIS and expressed a need to plan for that eventuality. A, B

The mayor expressed the view that the more recent state-of-the-art criteria for siting new landfills should be applied to the expansion. The mayor also expressed concern over the lack of specific plans for implementing and paying for leachate and methane gas collection systems; the impact of using the Minnesota River to dilute contaminants from the expansion and the additional impact of landfill traffic on the hazardous taffic conditions along TH 169. He stated that the MnDOT plans mentioned in the DEIS to improve TH 169 are not assured of funding and there is no plan to upgrade TH 169 as it approaches from the south. He expressed the need to address the compensation of local property owners who would be negatively impacted by a regional project. He questioned whether the landfill would be filled by 1992 and whether it would not continue to operate into the 21st century. The mayor supported higher monitoring requirements for leachate and methane gas, tighter limitations for leachate and a C, D, E, F, G, H, I

PUBLIC MEETING RESPONSES

A. The original permit issued by the MPCA in 1970 indicated that the existing landfill would close in 1982. However, there is nothing to prevent Woodlake from seeking permission to expand.

B. Additional mitigation and correction measures are included in the FEIS. Specific plans will be addressed during the permitting process.

C. The MPCA and the Council applied a "more stringent set of criteria" in reviewing and approving proposed candidate sites for new landfills submitted by the seven counties in the Metropolitan Area. The criteria and process for reviewing the sites were consistent with the WMA of 1980. The proposed expansion project is not a new site under the WMA and was not submitted by Hennepin County for review under the more stringent criteria. However, the expansion is also reviewed for potential environmental impacts in the FEIS and the permitting process, and the potential impacts will be addressed.

D. Specific plans for leachate and methane control and the responsibility for implementing these will be addressed during the permitting process. The process and the plans will be subject to public review and evaluation at the metropolitan, state and county levels.

E. The possible impact on the Minnesota River is discussed in the FEIS (pages 75 and 99).

F. The potential impacts on highway safety are addressed in the FEIS on page 195. Contracts are to be let in August 1986 for the improvements to the two, two-lane sections of Hwy. 169, north of the project, and the construction will be completed in 1987, according to a telephone conversation with a representative of MnDOT, Region Five office on Aug. 21, 1985.

There are no plans to upgrade Hwy. 169 south of the project. However, 99 percent of the landfill truck traffic approaches from the north which is to be improved. Mitigation measures to minimize possible conflicts, with north- and south bound-traffic at the entrance to the landfill, are discussed in the FEIS on page 195.

G. An additional mitigation measure, reflecting amendments to the WMA passed in 1984 is discussed in the FEIS on page 242. The amendment allows cities and counties to impose a fee on landfill operators. The revenues may be used for mitigating/compensating for local risks, costs and adverse effects.

H. If recycling and other abatement programs and facilities reduce the amount of refuse being landfilled, the life of the project could be extended beyond the estimated seven-year life. This issue is discussed in more detail in the response to the city of Eden Prairie letter, paragraph F.

I. The FEIS discusses monitoring requirements for leachate and methane gas in the mitigation sections of the respective sections. The effect of a liner and leachate collection system on surface and groundwater impacts is discussed on page 81. Corrective actions, should Grass Lake and groundwater be impacted, are evaluated on page 84.

firmer corrective program in the final EIS. He questioned whether Woodlake is adequately bonded to pay for a corrective program, given the size of the landfill and the costs. He questioned whether the current operations have been adequately monitored and raised a similar concern for the expansion. J K

Carl Jullie, City Manager, Eden Prairie, expressed concern that recycling and decreasing use of the landfill would extend the operating life of the expansion beyond 1992. He questioned the need for the expansion, given the available capacity in the five existing landfills which could serve Eden Prairie. He supported the need for a back-up gas control system and reduced expansion to the southeast to minimize off-site hazards from methane gas migration. He expressed concern for the increased horizontal infiltration of leachate and the impact on Grass Lake and the Minnesota River. He suggested more detailed study of the impacts, including sampling. He also supported the idea that the more recent, stringent criteria for new landfills be applied to this site. He stated that these criteria rule out sites with sandy soils, such as those present at the project site. L M N O P

Mr. Jullie expressed concern for the potential conflict with the Flying Cloud airport operation and suggested the final EIS address the conflicts between the height of trees along the berm and the airport appproach zones. He suggested that improved controls are needed at TH 169 and the landfill entrance to minimize traffic hazards. He pointed out that the city fire marshall recommends strongly, that public water be extended to the site to provide the necessary capacity to fight future fires in the landfill. He questioned the suitability of proposed end uses, given the problem of settling. Q R S T

Mr. Jullie expressed concern over the fiscal impact on the city for such things as the extension of city water, should private wells be affected. He asked what the tax revenue impacts of putting land to interim use would be. U V

Mr. Jullie referenced a letter from Donahue & Associates, consulting engineers to the city. In their letter, the firm expressed the opinion that more field data is needed to support the conclusions in the DEIS as to the potential hydrogeological impacts, particularly ground water flow and leachate migration rates. (Copy attached.) W

Douglas Lynch, resident and spokesperson for the Eden Prairie Citizens Coalition (an organization of residents formed to oppose the project) stated their concerns about noise, odor and litter impacts; the visual impact on the Hillsborough residential area; the safety of children who might not be discouraged by the fences around the site and the proximity of the site to Bluff West. He questioned whether it would be fair for private well owners and the city to provide public water if their wells were contaminated. He suggested that Woodlake figures on methane gas production and litter pick-up be checked. He expressed concern for the property value impacts since the existing landfill has affected the resale value of one house and value of vacant lots. He asked whether the landfill is presently covered or served by city fire services and expressed concern over the hazards to adjoining houses in case of a fire at the site. He opposed the expansion and supported the alternatives of recycling the material being dumped. Finally, he questioned the rationale of zoning the area for residential development in view of the continued operation of the landfill and the potential to expand in a direction closer to the residential areas. X Y Z AA BB

J. Financial responsibilities will be addressed during the permitting process. Additional discussion regarding financial responsibility, is provided in the response to the city of Eden Prairie's letter, paragraph A (Appendix D).

K. Monitoring of the existing and proposed expansion, are the responsibility of the MPCA and Hennepin County. Concerns about the adequacy of this effort should be directed to those organizations.

L. This issue is discussed in paragraph H above and in the response to the city of Eden Prairie's letter, paragraph F.

M. This issue is addressed in the Alternatives section of the FEIS.

N. This issue is addressed in the FEIS in the Landfill Gas section.

O. Additional analyses of the potential impacts on groundwater, Grass Lake and the Minnesota River are included in the FEIS in the Site Hydrogeology, Surface Water and Vegetation and Wildlife sections.

P. This issue is addressed above in paragraph C above.

Q. This issue is addressed in the Final EIS on page 227 and in the reponse to the Metropolitan Airports Commission letter, paragraph A.

R. This issue is addressed in the FEIS, Highways section, page 195.

S. The potential for fire hazards and the cost of extending the water line are analyzed in the FEIS on pages 162 and 244. The FEIS indicates the probability of a major fire is quite small.

T. Supplementary discussion regarding possible end uses are included in the Land Use section (page 219) and the Site Hydrogeology section (page 85).

U. If private wells are affected, and it is determined that the landfill is the source of the contaminants in the well, it is presumed that Woodlake would be responsible for the costs. Also amendments to the WMA (H.F. 1577) allow cities and counties to impose fees on landfill operators for mitigating/compensating for local risks, costs and adverse effects. The amendments on their face do not preclude payments for such costs as the extension of a water line.

V. The FEIS addresses the issue of interim use, page 243, and the impact on local tax revenues.

W. Additional analysis is contained in the FEIS in the Site Hydrogeology section including a worst-case analysis in those instances where the data is unavailable.

X. The impacts identified here are evaluated in the FEIS. Company personnel and security guards (during non-operating periods), are on the site to minimize security problems. The visual impact on the Hillsborough residential area would be minimal. The nearest house is 1,300 ft. away, and the landscaped berm would screen the landfill from view (FEIS, page 169).

Jackie Stubba, resident of Hillsborough area, opposed the project and stated her concern that the natural area and resident wild life in the basin between Hillsborough and the landfill would be reduced and impacted. The proximity to this area was reflected in the purchase price of their house. She also expects that the area will be effected by litter, based on past problems. She presented two photographs showing litter along the natural area. She expressed concern over the potential property value impacts of the project and the needfor and impact on local taxes of the proposed golf course. CC DD EE

Stan Johannes, resident, stated his concern about increased odor, dust and noise problems because of the proximity to residences. He recognized the need and public good in having landfills but questioned whether it was fair to balance this need at the expense of local residents. He indicated that he had determined, before he bought his house, that the landfill would close and the city plan recommended low density residential development for the proposed expansion site. He supported the view that the expansion would affect the property values and residents' ability to sell their house. He asked for protection for residents from the nuisance impacts and that the site be judged against the criteria used for new landfill sites. Finally, he expressed concern as to whether the public would pay for any clean-up. FF GG HH II JJ

Lawrence Samstad, consulting engineer to the Lower Minnesota River Watershed District, stated that portions of the project are located in the district and the expansion would be reviewed by the district. He also read a statement from the district managers which stated that hazardous waste be precluded from the project, leachate be controlled to protect nearby wells, leachates reaching the Minnesota River not exceed MPCA guidelines for ground and surface waters - present and future - and that the district will review the final EIS and final plans for the project. KK

Steve Lindenberg, resident of Hillsborough, indicated his previous understanding that the landfill would be closing. He expressed similar concerns about odor, noise and property value impacts. He indicated his concern that leachate might move to the east through sandy sub-soils, toward the proposed city park, Hillsborough and Bluffs West if the landfill is expanded east of the groundwater divide. He requested that any expansion east of the divide be prohibited and any changes which would modify the horizontal direction of leachate movement not be allowed. He expressed concern that the pressure to dispose of hazardous waste would eventually affect the amount of such waste disposed of at Flying Cloud Landfill. LL MM NN OO

Randy Johnson, Commissioner of Hennepin County, indicated he shared the concerns of the previous speakers. He outlined the county's proposed plan for a resource recovery plant in downtown Minneapolis based on the Board's conclusion that burning garbage is much safer than burying it. He estimated that by the end of 1988 or early 1989, Hennepin County would be relying on incineration to dispose of 2,000 of the 2,500 tons of garbage generated daily, to minimize the need for landfills. PP

John Klein, representing Robert O'Neill, owner of the Flying Cloud Drive-in theater, expressed a concern about the hazards of methane gas, the hazards to proposed end uses of the completed site and the need to compensate affected property owners. QQ

Y. The issue is discussed in paragraph U above.

Z. Information on litter problems at the existing site were provided by Hennepin County and MPCA personnel. These agencies inspect the site under the current state permit and county license. Woodlake's litter control plan is a condition of the existing permit and can be enforced by MPCA and Hennepin County.

AA. The FEIS indicates that the sale prices of some of the remaining lots in Bluffs West have been reduced. However, there could be several reasons for this, including the existing landfill and the general condition of the housing market.

The house referenced in the statement is located on Winter Place in the western portion of Bluffs West. In a telephone conversation on Aug. 24, 1984, a representative of the city of Eden Prairie assessor's office, stated that the resale price of the house in February 1984, was $94,000 compared to the sale price of $109,538 in December 1981. The existing landfill or concern over the proposed expansion could be a reason for the decrease. However, there could be other reasons for the decline, including the general housing market conditions and the specific reasons of the owner for selling. As the FEIS indicates, there could be property value impacts in the Bluffs West area due to the close proximity and extended life of the landfill.

BB. The FEIS indicates that the project is served by the city's volunteer fire department. (Service Demands and Other Costs section, page 244.) The potential for fire hazards is analyzed in the FEIS. (Fire Hazards section, page 163.)

CC. The natural area in the basin east of the project will not be altered by the project and the impact of runoff from the project would be minimal. These concerns are addressed in the Surface Water and Vegetation and Wildlife sections of the FEIS.

DD. The potential impact of litter on the Hillsborough area is addressed in the FEIS. Prevailing wind patterns from the northwest and the south and the intervening open-space buffer, would minimize the impact on Hillsborough. Litter would more likely settle in the natural open space buffer if it is blown off the landfill.

EE. Potential property value impacts are evaluated in the FEIS. Because of the 1,300-foot wide natural open space buffer, 15-foot berm and other measures, there should be no adverse impacts on property values in Hillsborough. The golf course is a tentative proposal by Woodlake. Unless the golf course was owned by the city or other local governmental unit, there would be no direct impact on local taxes. The city would have to accept or acquire ownership of the golf course for this to happen.

FF. Odor, dust and noise impacts are addressed in the appropriate sections of the FEIS.

GG. The original permit for the existing landfill estimated that the landfill would be filled by 1982. However, there is nothing to prevent Woodlake from changing its mind and seeking to expand.

HH. Potential property value impacts are addressed in the FEIS. The question of whether the criteria for new landfills should be applied is evaluated in paragraph C above.

Donohue

MAY 15 1984

May 15, 1984

Mr. Carl Jullie
City Manager
City of Eden Prairie
8950 Eden Prairie Rd.
Eden Prairie, MN 55344

Re: Flying Cloud Landfill Evaluations
Review Comments of the Draft Environmental Impact Statement
Donohue Project No. 12351.000

Dear Mr. Jullie:

At your request, we have reviewed the Draft Environmental Impact Statement for the Flying Cloud Sanitary Landfill Expansion. Our review comments are presented in the following discussions. A considerable amount of technical data has been generated for the site since our initial involvement on the project. Our earliest comments relative to the completed engineering plans and reports emphasized the need for more detail on existing site and local base mapping and on the hydrogeologic assessment of the site and local area.

In regard to the adequacy of the site base mapping, it is our opinion that the areal extent of the base mapping and the existing physical features presented thereon, appears to better depict actual field conditions. In contrast to the earliest base mapping presented for the site, these base maps now contain all local surrounding subdivisions, location of private water supply wells, on-site monitoring wells and soil borings and other local physical features which are of primary importance when assessing the environmental impacts associated with the site operations.

The majority of our previous review comments eluded to the technical adequacy of the hydrogeologic evaluations of the site and local area. Since our previous data evaluations, several additional groundwater observation wells and soil borings have been installed at the site. This is a significant improvement over that data available during our earliest evaluations. However, we must emphasize that additional data could be gathered to further verify and define the subsurface soil and groundwater conditions. Additional soil borings, soil laboratory testing and groundwater well installations placed in several more ideal locations would provide more geotechnical data to support the conclusions presented in the Draft EIS. Perhaps some additional support geotechnical data will be presented in the BFI final engineering reports.

RR

The primary emphasis of these investigations should be focused towards assessing the impacts site operations will pose on the groundwater system. All the

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II. Mitigation measures to reduce noise, dust and other nuisances are addressed in the FEIS. The question of whether the criteria for new landfills should be applied is evaluated in paragraph C above.

JJ. The public costs of any future clean-up is addressed in the response to the city of Eden Prairie letter, paragraph A.

KK. The evaluation of these statements is stated in the response to the Lower Minnesota River Watershed District letter which was received at the public meeting.

LL. This issue is addressed in paragraphs A and GG above.

MM. These impacts are discussed in the FEIS.

NN. The potential groundwater impacts are evaluated in the Site Hydrogeology section. The groundwater divides would not be significant in terms of altering the general movement of leachate southwest towards the river valley. See page 63 for a discussion of the potential movement of leachate to the east.

OO. The potential impact of hazardous waste is discussed in the FEIS on page 114.

PP. The development of a resource recovery plant and the impact on the project is discussed in the Alternatives section of the FEIS.

QQ. The potential impacts of methane gas and mitigation measures are addressed in the Landfill Gas section of the FEIS, page 123. Property value impacts and mitigation measures are discussed in the Property Value section, page 233.

RR. Additional analysis regarding the potential impact on groundwater is included in the Site Hydrogeology section, FEIS. Data regarding the presence of the silt layer beneath the existing site is unavailable. Discussions with the staffs of MPCA and DOH indicated they are not in favor of new soil borings through the existing refuse. Under state environmental review regulations, if scientific data is unavailable, the preparer of the EIS must include a worst case. The worst case is contained in the FEIS. The worst case assumes that the silt layer is not present and analyzes the impact on the rate of leachate movement, groundwater and Grass Lake.

soil borings, laboratory testing and groundwater observation wells were installed to qualify and quantify these impacts. We do not question the technical methodologies used to assess these impacts, however, we question whether sufficient geotechnical data has been gathered to fully support the conclusions.

A key statement relative to leachate production, migration and attenuation can be quoted from the summary on page 65 of the Draft EIS, "In summary, leachate produced at the Flying Cloud Landfill contains a variety of metals and inorganic and organic compounds possibly including trace amounts of volatile organic chemicals. The leachate generated at the landfill will be attenuated by physical chemical and biological processes as it migrates, but the specific nature and degree of attenuation is difficult to predict with certainty."

We agree, it is indeed true that some leachate will be attenuated and that the degree of attenuation is very difficult to predict without adequate field and laboratory support data. The majority of the leachate attenuation discussion evolves around the presence of a clay layer underlying the site. As presented on page 43, paragraph 1, "These soils, hereafter referred to as the silt layer, have hydraulic conductivities in the range of 5.5×10^{-6} cps, about three orders of magnitude less than the sandy layers." We question whether this hydraulic conductivity is an estimate or actually established in the laboratory. This is also questioned in the Draft EIS on page 43, paragraph 7, "How far this water will move to the east depends on how fast it is able to move downward through the silt layer and reach the Prairie du Chien-Jordan aquifer." The soil laboratory testing should be completed to more accurately establish these rates.

RR

The entire discussion on page 54 relative to leachate movement is based apparently on estimated data. Additionally, on page 61, paragraph 3 of the Draft EIS, "The silt layer thought to exist beneath the site should provide a good medium for absorption and ion exchange because it is composed of clays and silts." Again, we ask that if the silt layer exists, where is it and if it is a good medium for absorption perhaps this should be qualified and quantified.

In conclusion, again it is our technical opinion that the methodologies used to assess the leachate impacts on the groundwater system appear acceptable. However, it is our opinion that more field data is required to support the conclusions presented in the Draft EIS. Soil laboratory testing should include more particle size gradations and permeability testing upon which more accurate groundwater flow and leachate migration rates can be established. In addition, leachate soil column and cation exchange capacity testing should be completed to support the conclusions presented in the Draft EIS.

Donohue

We thank you for the opportunity to provide our input into this project. At your request we will continue to submit additional recommendations and comments as appropriate. During the interim, should additional comments or questions arise, please feel free to contact our office.

Very truly yours,

DONOHUE & ASSOCIATES, INC.

R. E. Fedler, P.E.
Executive Vice President

Lawrence N. Hicks
Project Manager

