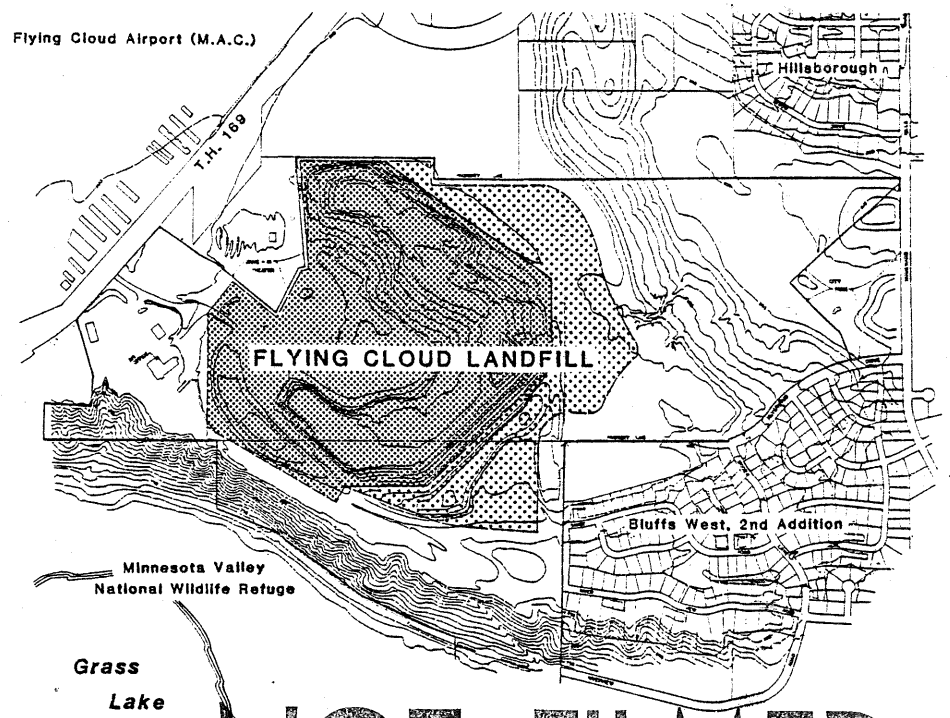
2 Copies

840798

DRAFT

Environmental Impact Statement

Flying Cloud Sanitary Landfill Expansion



NOT FILMED

Prepared by: Metropolitan Council of the Twin Cities Area

Metropolitan Council of the Twin Cities Area

April 1984

Publication No. 12-84-054

FLYING CLOUD SANITARY LANDFILL EXPANSION

EDEN PRAIRIE, MINNESOTA

DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS)

Prepared by: Metropolitan Council of the Twin Cities Area
300 Metro Square Building
7th and Robert Streets
St. Paul, Minnesota 55101

This project is proposed by Woodlake Sanitary Services, Inc., a subsidiary of Browning-Ferris, Industries. Additional information about the project can be obtained by contacting:

Rodney B. Kager, Vice-President
9813 Flying Cloud Drive
Eden Prairie, Minn. 55344
Phone: (612) 941-5174

Additional information about this EIS can be obtained by contacting:

Carl Schenk, Environmental Planner
Metropolitan Council
300 Metro Square Building
St. Paul, Minn. 55101
Phone: (612) 291-6410

ABSTRACT: Woodlake Sanitary Services, Inc. (WSS), 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. This EIS describes and evaluates the potential impacts of the proposed project, mitigation measures to reduce or eliminate the impacts and alternatives to the project.

Written comments on this Draft EIS are due June 7, 1984 and should be sent to:

Carl Schenk
Environmental Planner
Metropolitan Council
300 Metro Square Building,
7th and Robert Streets
St. Paul, Minn. 55101
(612) 291-6410

CONTENTS

	Page
EXECUTIVE SUMMARY	v
BACKGROUND	
EIS Preparation and Permit Approvals	1
Existing Landfill Description	6
Proposed Project	27
POTENTIAL ENVIRONMENTAL IMPACTS	
Site Hydrogeology	39
Surface Water	71
Vegetation and Wildlife	85
Hazardous Waste	94
Air Quality	95
Landfill Gas	103
Noise	127
Vector and Pest Control	139
Fire Hazards	141
SOCIOECONOMIC AND OTHER POTENTIAL IMPACTS	
Litter Control	143
Visual Impacts	148
Highways	163
Regional Plans	176
Local Plans and Zoning	180
Land Use	182
Flying Cloud Airport	199
Property Values	211
Revenue and Employment	221
Service Demands and Other Costs	222
ALTERNATIVES	224
LIST OF PREPARERS	238
NOTES	239
APPENDIX A: Surface Water Quality Data	250
APPENDIX B: Survey of On-Site Plant Species	252
APPENDIX C: Correspondence	256

CONTENTS (Cont.)

Page

LIST OF FIGURES

1. General Process for a Mandatory Environmental Impact Statement 2
2. General Location of Flying Cloud Landfill 7
3. Existing Landfill Area and Proposed Expansion 8
4. Area Topography 10
5. Final Contours Under Present Fill Plan 11
6. Twin Cities Metropolitan Area Sanitary Landfills and Flying Cloud Landfill Service Area 13
7. Existing and Proposed Methane Control and Monitoring System 20
8. Existing Surface Water Drainage 22
9. P.U.D. 70-1 Land Use Plan 25
10. Proposed Excavation Plan for Expansion Area 28
11. Final Contours with Proposed Site Expansion 29
12. Berm Alignment 30
13. Expansion Phasing Plan (Stages 1-4) 31
14. Expansion Phasing Plan (Stages 5-8) 32
15. Proposed End Use Plan 38
16. Bedrock and Subcrop Map 41
17. Geologic Cross-Section 42
18. Original Contours 43
19. Locations of Monitoring Wells, Piezometers, Borings, Springs, and Seeps 45
20. Estimated Groundwater Table Surface Contours 46
21. Chloride Concentration Curves 52
22. 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) 58
23. Estimated Dispersion of Leachate Plume 59
24. Wells within One Mile of Landfill and Extent of Leachate Plume 63
25. Zone of Well Influence for the City of Eden Prairie Well Field 65
26. Surface Water Features 72
27. Surface Water Drainage Under Current Amended Permit 75
28. Stage 8 Cover Plan 80
29. General Classes of Vegetation Near Flying Cloud Landfill 86
30. Location of Sampling Quadrats 87
31. Upgrala Unit of the Minnesota Valley National Wildlife Refuge 88
32. Proposed Upgrala Unit Management Scheme 90
33. Wind Rose 96
34. Percent of Annual Erosive Winds Occurring Each Month 99
35. Typical Gas Composition During Refuse Decomposition 104
36. Multi-Level Methane Probe 109
37. Methane Collection Well 111
38. Active Methane Control System (Conceptual) 112
39. Estimated Rates of Methane Production 114
40. Methane Trench Collection System (Cross-Section) 117
41. Methane Trench Collection System 118
42. Monitoring Locations 129
43. Distances from Landfill Noise Sources 135
44. Cross-Section Locations 149
45. Cross-Section A-A' from the Hillsborough Subdivision to Peak Elevation of Landfill 150

CONTENTS (Cont.)

Page

46. Cross-Section B-B´ from Developed Area of Bluffs West to Peak Elevation of Landfill 153
47. Cross-Section C-C´ from Western Edge of Developed Area of Bluffs West to Peak Elevation of Landfill 154
48. Cross-Section D-D´ from Undeveloped Area of Bluffs West to Peak Elevation of Landfill 156
49. Cross-Section E-E´ from Landfill Across the Minnesota River Floodplain 158
50. Visual Impact of the Flying Cloud Landfill on the Minnesota Valley National Wildlife Refuge 160
51. Refuse Truck Distribution to and from Flying Cloud Landfill 164
52. Existing Conditions and Proposed Developments to Highways Serving Flying Cloud Landfill 165
53. Average Daily Traffic Counts, 1982 167
54. Forecasted Average Daily Traffic Volumes, 1990 168
55. Hourly Distribution of Existing Traffic Volumes 171
56. Accident Rates Along T.H. 169, 1976-1980 174
57. Existing Zoning and Guide Plan Land Use 181
58. Generalized Land Use in the Vicinity of Flying Cloud Landfill 183
59. Eden Prairie Guide Plan, 1982 184
60. Existing Land Use 186
61. Generalized Pipeline Relocation Route 188
62. Flying Cloud Airport and Land Use Zones 200
63. Berm Alignment and Approach Surface to Runway 27L 201
64. Proposed Final Contours and Approach Surface for Runway 27L 202
65. Flying Cloud Airport Noise Zones 209
66. Property Ownership in the Undeveloped Sections of Bluffs West, Second Addition 217
67. Existing Landfill Capacity Overlapping Flying Cloud Landfill´s Service Area 229
68. Twin Cities Metropolitan Area Counties´ Candidate Landfill Sites ... 233
69. Landfill Expansion Boundary with a 1000-Foot Setback 236

LIST OF TABLES

1. Table of Events for Metropolitan Council Review of EIS 3
2. Known Governmental Permits and Approvals Needed for the Flying Cloud Landfill Expansion 5
3. Refuse Deposited in Flying Cloud Landfill (Estimated) 12
4. Composition of Residential and Commercial Solid Waste, 1980 12
5. Vegetation on Existing Landfill 16
6. Stratagraphic Column at Flying Cloud Sanitary Landfill 40
7. Summary of Water Level Measurements for Monitoring Wells and Piezometers 48
8. Compilation of Water Quality Test Results for Monitoring Wells at Flying Cloud Sanitary Landfill 49
9. Summary of Detected Organics at Flying Cloud Landfill Site 53
10. Yearly Volumes of Leachate Generated 55
11. Leachate Travel Time and Arrival Date Estimates 56
12. Leachate Composition 60
13. Mass Balance Results 66

CONTENTS (Cont.)

		Page
14.	Maximum Concentrations of Selected Metals in the Minnesota River Water Year 1981*	71
15.	Existing Surface Water Quality	73
16.	Characteristics of Grass Lake	74
17.	Flow-Weighted Mean Concentrations and Ranges of Concentrations for Watersheds with Construction Activity	78
18.	Representative Rates of Erosion from Various Land Uses	77
19.	Runoff Flows to the Off-Site Stormwater Drainage Basin Before and After the Landfill Expansion	79
20.	Minnesota River Discharge Characteristics	82
21.	Average Monthly Wind Speeds and Directions, Minneapolis-St. Paul	95
22.	Soil Particle Size Distribution	97
23.	Potential Methane Volume for Permitted Landfill	107
24.	Potential Methane Volume for Expanded Landfill	113
25.	Distance to Residential Areas	122
26.	Ambient Noise Standards and Monitoring Results for May 18	128
27.	MPCA Ambient Noise Limits	130
28.	Ambient Octave Band Data, May 18	130
29.	A Comparison of Ambient Noise Levels with and without Landfill Operations	131
30.	Octave Band Data, Landfill Operational, May 18	131
31.	Comparison of Octave Band Criteria to Measured Octave Levels	132
32.	A-Weighted Average Decibel Readings for Refuse Truck Passbys at 50 Feet	132
33.	Octave Band Refuse Truck Passby Data at 50 Feet	133
34.	Stationary Octave Band Measurements at 50 Feet	133
35.	Average A-Weighted Decibel Readings for Landfill Equipment and Refuse Truck Hydraulic Systems	133
36.	Potential Noise Levels Associated with Landfill Activities	134
37.	Projected Noise Impacts at Potential Receivers	136
38.	Reported Violations of Litter Control at Flying Cloud Sanitary Landfill	143
39.	Estimated Total Traffic To/From the Flying Cloud Landfill*	169
40.	Current Employment at Flying Cloud Landfill	221
41.	Local Landfill Capacities and Use Rates	228

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 EIS 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 EIS. 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 degradation exists; however, the site's location adjoining a groundwater discharge zone to the Minnesota River Valley minimizes the potential for health effects attributable to any groundwater contamination. Only 11 homes to the east and three to the southwest are downgradient from the site and served by private wells. In the unlikely event that their water supply becomes contaminated, city water could be made available to them or other appropriate measures taken to mitigate the impact. Dilution and attenuation should greatly decrease the potential for contamination of the Minnesota River or Grass Lake.

Surface water impacts are not expected to be significant, either. Runoff with an increased sediment load will increase by a small amount while a noise berm is built around the landfill site. This change will be of a limited and temporary nature. Woodlake plans to control erosion and runoff primarily by 1) directing some runoff to unfilled portions of the site, and 2) using a detention pond with an outflow pipe that opens into the Minnesota River floodplain, which should protect Grass Lake and the river from erosion-related impacts.

No major impacts on vegetation and wildlife are expected. 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. Leachate dilution and attenuation should also protect the valley from impacts associated with groundwater. There is some potential for long term bioaccumulation of leachate constituents such as metals; a monitoring program would help determine whether such accumulations are occurring, and whether they are affecting the habitat value of the river valley.

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. 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 EIS 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. Futhermore, 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 Highway 169. Trucks using the landfill have rarely

been involved in accidents. The addition of a sheltered left-turn lane and traffic controls 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 expanded monitoring of groundwater quality downgradient of the expansion would further minimize the potential 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 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 EIS.

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 EIS has identified a number of additional mitigating measures to eliminate or minimize potential impacts, such as additional groundwater 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 by delaying residential construction on the closest vacant lots until the landfill or southeast portion is completed, and completing the southeast corner 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 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, 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, does not appear to be a necessary modification due to the location of the site and the expected dilution and attenuation of contaminants in the leachate. 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. 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. New landfills, which will be selected from candidate sites proposed by the seven counties and approved by the MPCA and the Metropolitan Council, would not likely be available for use before 1987. However, this would provide additional capacity several years before the five alternative existing landfills are filled in the early 1990's. The new landfills may be more costly to operate because of more stringent environmental standards. These and other costs could mean higher costs for customers in the Flying Cloud service area.

Land disposal abatement or waste abatement measures reduce the volume of waste going to landfills. Waste abatement will not replace the need for landfilling in the foreseeable future, however. It will take many years to plan and develop the necessary programs and facilities. Many types of wastes will still be landfilled because they cannot be recycled or processed. Waste products from some types of abatement will need to be landfilled, such as incinerator ash.

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 vacant lots which might be developed during the life of the project. This would result in a reduction of 214 acre-feet of capacity.

Reversing Woodlake's proposed staging plan would minimize the impact on Bluff's West. 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 MCARS 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 Browning-Ferris Industries (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 MCARS 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.

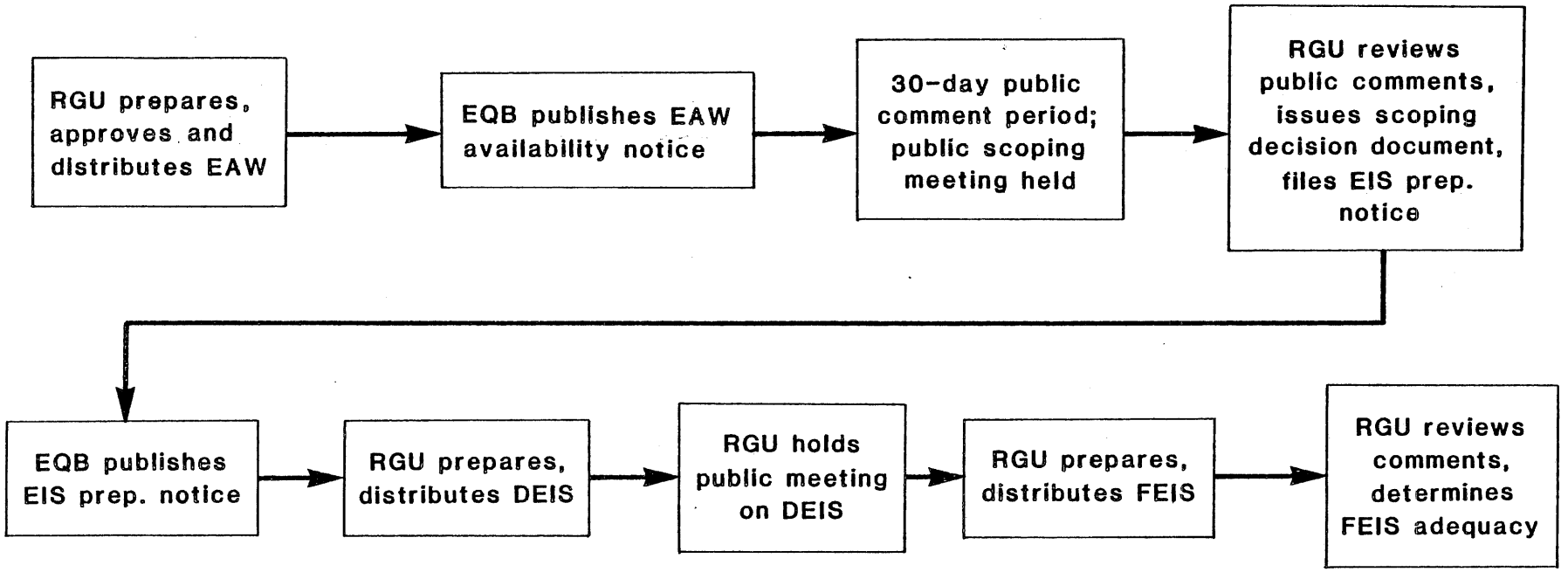
GENERAL EIS PREPARATION PROCEDURES

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 and final EIS. The EAW briefly assesses the environmental effects that may be associated with a proposed project (6 MCARS 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.

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

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 Metropolitan Council as the RGU for the preparation of the 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 Metropolitan Council approved a scoping decision document for the proposed expansion which defines the impacts and alternatives to be evaluted in the EIS. The scoping decision document provides the basis on which the adequacy of the Final EIS is determined by the Metropolitan 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.

An approximate calendar of events that will take place between now and the time that the Final EIS is declared adequate by the Council is presented in Table 1. The review of the Draft EIS and approval of the Final EIS by the Council involves several major steps. The first major step involves Council review of the Draft EIS to release the document for publication and setting a date for a public information meeting. The public meeting provides an opportunity for the public to comment on the scope and adequacy of the Draft EIS. Following the public information meeting and the close of the public comment period a Final EIS will be prepared. The Final EIS will respond to the substantive comments received from the public on the Draft EIS consistent with the amended scoping decision approved by the Metropolitan Council. Following this the Metropolitan Council will review and approve the release of the Final EIS for public review. Finally, the Metropolitan Council will determine the adequacy of the Final EIS and give public notice.

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

	Date
Metropolitan Council Review and Release of Draft EIS for Publication and Public Review	April 12, 1984
Draft EIS Availability Notice Published in EQB Monitor (Initiate public comment period)	April 23, 1984
Public Meeting Held in Local Area	May 23, 1984
Public Comment Period on Draft EIS Closed	June 7, 1984

The public will be notified as to the schedule for the Council's review of the Final EIS.

GOVERNMENTAL PERMITS AND APPROVALS

Once the Council determines that the Final EIS 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 final EIS is declared adequate. The EIS 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 that are known to be needed for the project, and which cannot be issued until the Final EIS 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 Final EIS is determined to be adequate because information for them was gathered currently with EIS preparation (6 MCARS 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 three permits/approvals. 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 and Hennepin County in its decision to approve/deny a license amendment for the expansion (Table 2).

Under the Waste Management Act of 1980 as amended (M.S.473.811) local governments may regulate the construction, operation, inspection, monitoring and maintenance of landfills and other disposal facilities. (These regulations must be approved by the Metropolitan Council.) However, no local government can prevent the establishment or operation of any solid waste facility. As indicated in Table 2, the City of Eden Prairie has several permits which it can issue for various phases of the expansion. However, these are not key decisions for which a record of decision must be kept.

As indicated above, the key decisions concerning approval or denial of the proposed expansion are made by the MPCA, the Metropolitan Council and Hennepin County. The MPCA must approve or deny a state solid waste facility permit. Hennepin County must also approve a license for the expansion before it can be implemented. All of the above bodies must approve the expansion before it can be implemented. If any one of the bodies denies or disapproves of the expansion, the project cannot be undertaken. The MPCA and Hennepin County may condition or limit the expansion in accord with their regulations. The Council may condition or limit the expansion consistent with the Solid Waste Management Policy Plan.

Table 2
KNOWN GOVERNMENTAL PERMITS AND APPROVALS NEEDED FOR
THE FLYING CLOUD LANDFILL EXPANSION

Permits or Approval 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
2. Other Permits or Approvals	**Granting Agency**
Installation and operating air quality permits for landfill gas glare	MPCA
Amendment to current planned unit develop-plan (PUD 70-1)	City of Eden Prairie
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*

*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, Minnesota 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 Minnesota Pollution Control Agency (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 Browning-Ferris Industries, Inc. (BFI), of Houston, Texas. WSS has owned the landfill since 1972. The previous owner was Waste Management, Inc.

ACCESS

The only 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, an unimproved city park, 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.

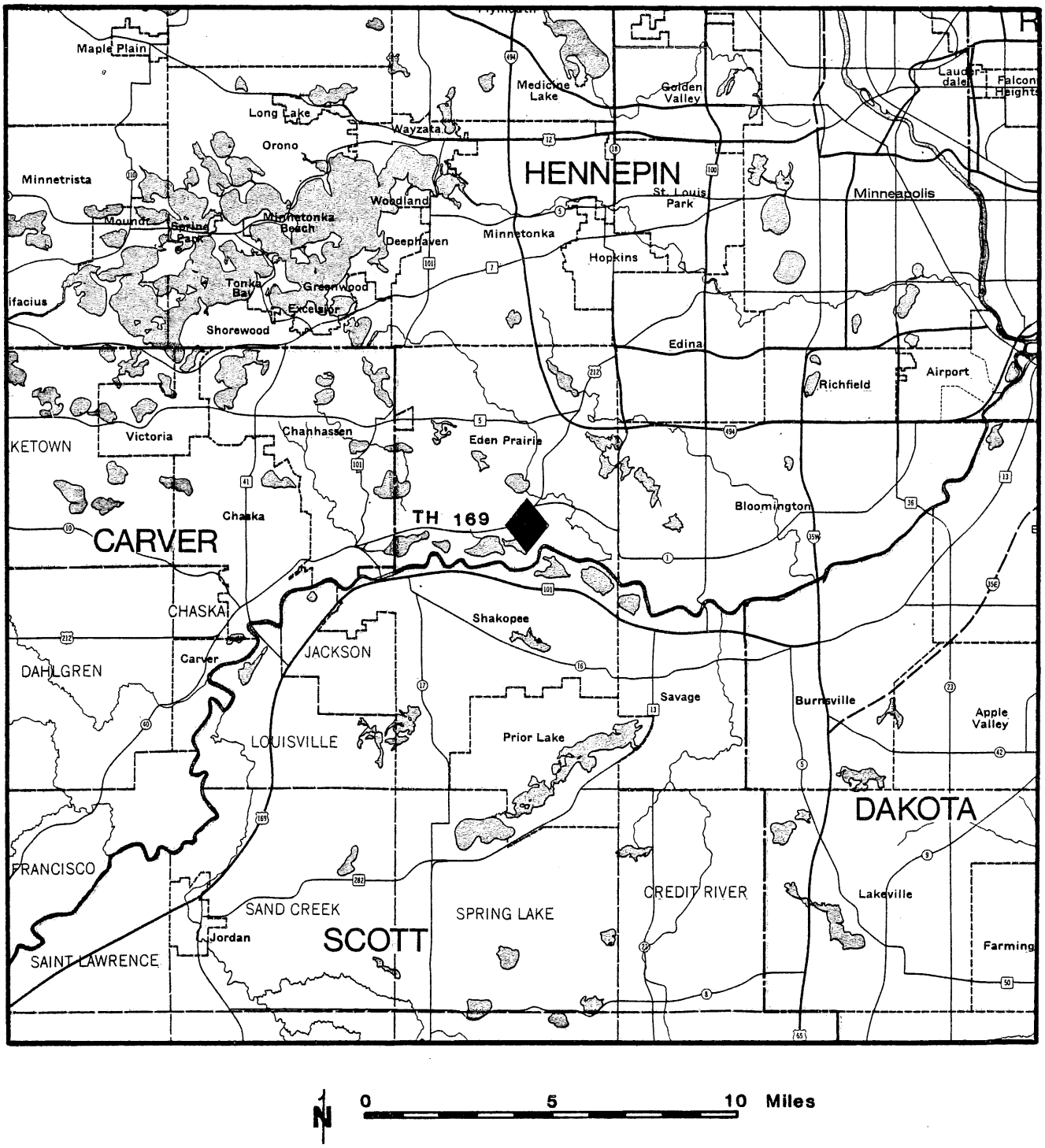
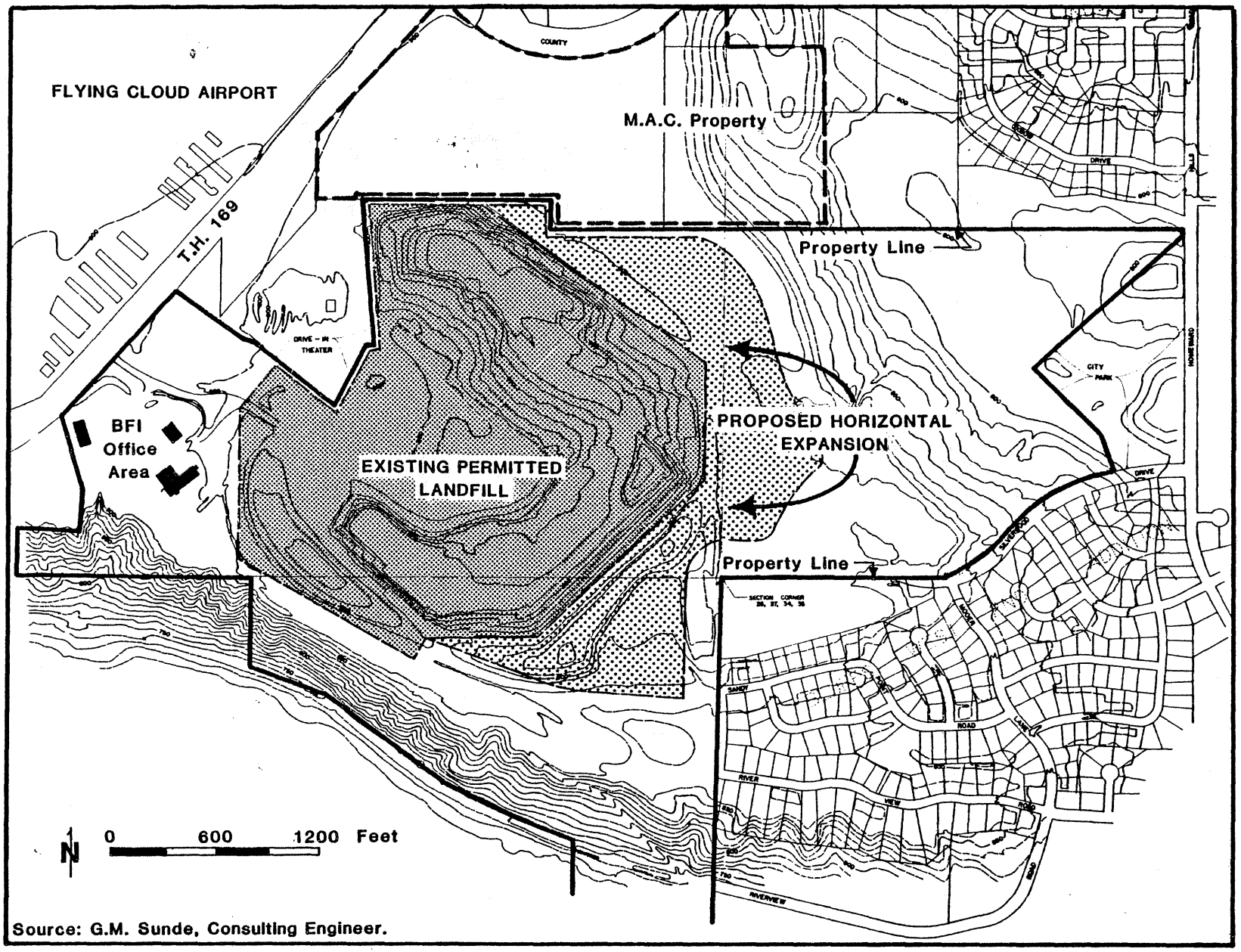


Figure 2.
GENERAL LOCATION OF FLYING CLOUD LANDFILL

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.

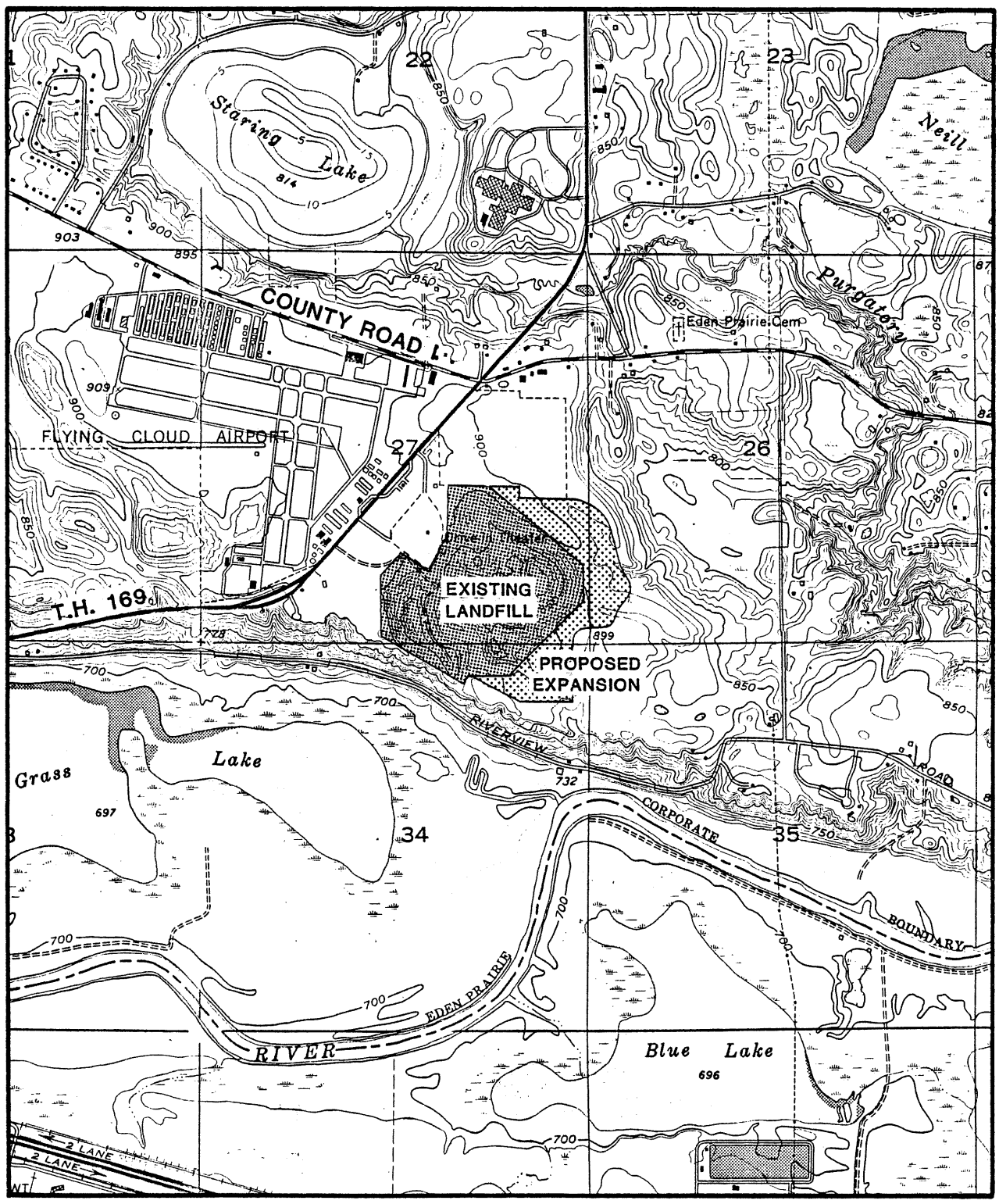
CAPACITY

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

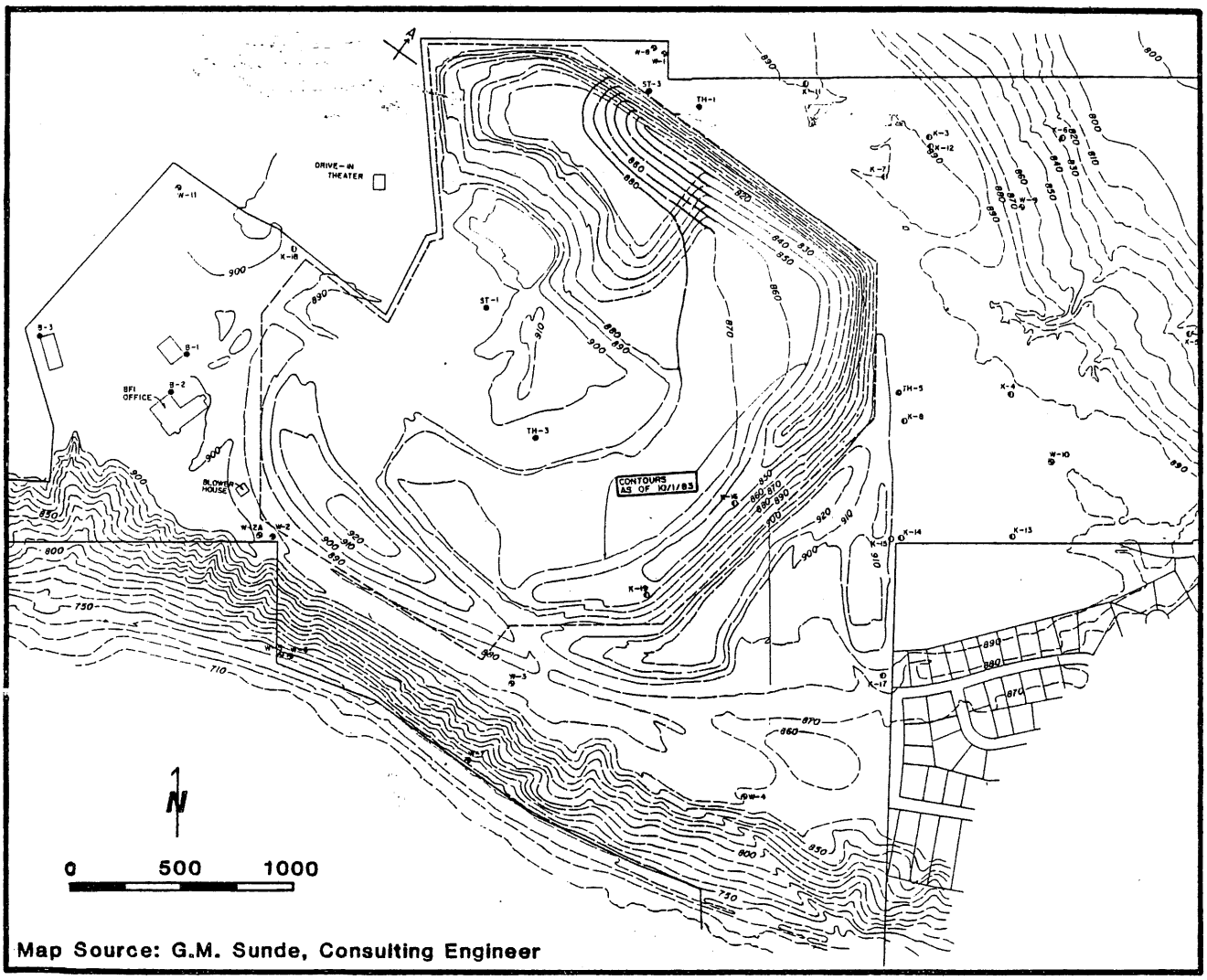


Table 3
REFUSE DEPOSITED IN FLYING CLOUD LANDFILL (ESTIMATED)

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.

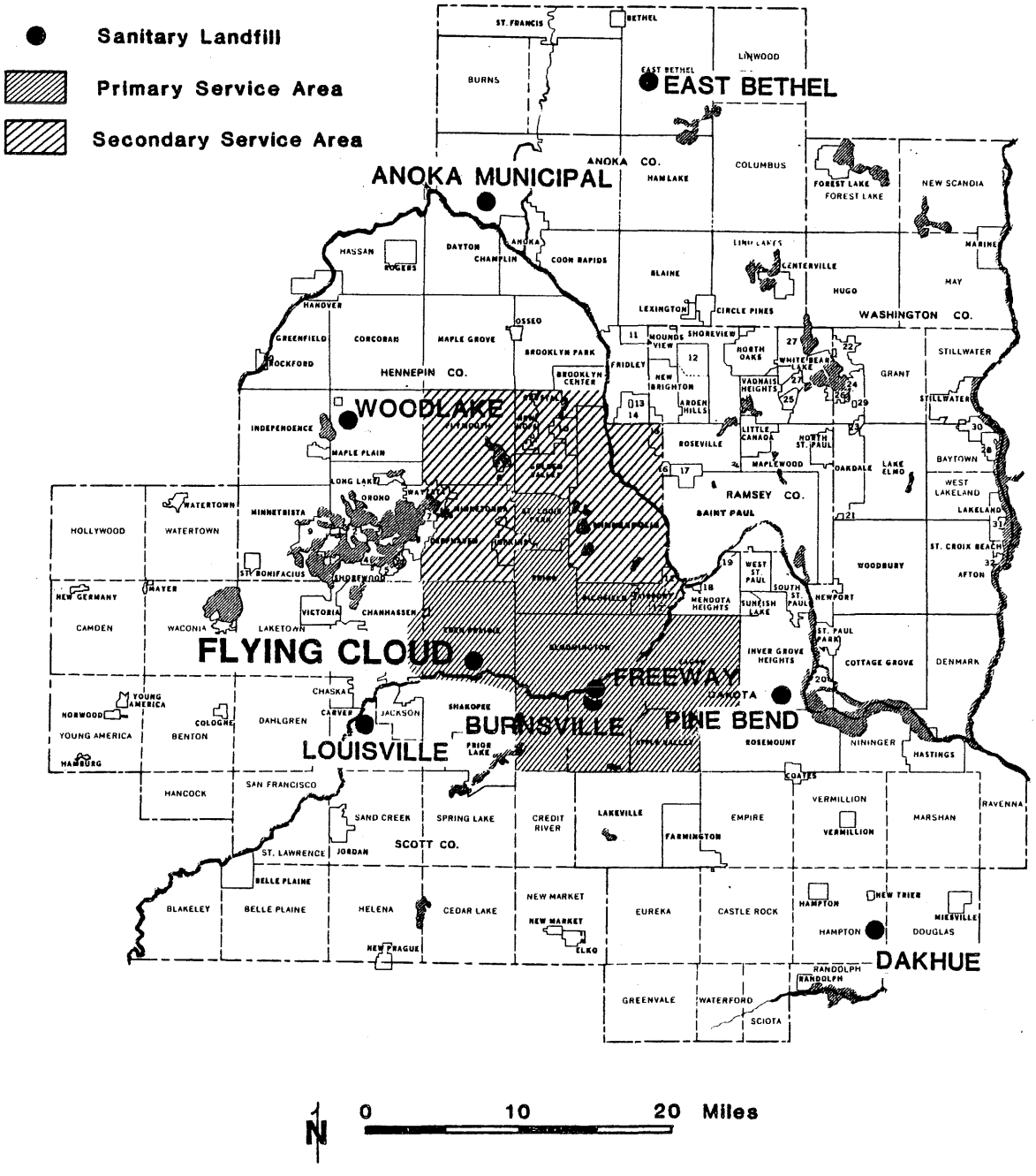
SOLID WASTE SERVICE AREA

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 itself 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 WSS 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
One International tractor with mower

The equipment is stored and maintained at a building adjacent to the office. BFI collection trucks and WSS 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
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 instigated in accordance with the conditions of amended permit SW-14. A summary of current procedures, practices and improvements at the present sites.

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, the surfacing of haul roads, application of mulches, seeding or sodding of 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 figitive 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 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 a perched water table to the east of the site. The remaining seven wells are downgradient of the landfill. Wells W-1, W-2A, and W-3 through W-10 are to be sampled three times a year, in April, July and October 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-1 through W-8, and both W-9 and W-10, are analyzed semi-annually for the following:

Acrolein
Acrylonitrite
Benzene
Toluene
Ethylbenzene
Carbon tetrachloride
Chlorobenzene
1,2 - dichlorethane
1,1,1 - trichlorethane
1,1 - dichloroethane
1,2 - dichloropropane
1,3 - dichloropropene
Methylene chloride
Methyl chloride
Methyl bromide
Bromoform
Dichlorobromomethane
Trichlorofluoromethane
Dichlorodifluoromethane
Chlorodibromomethane
1,1 - dichloroethylene
1,1,2 - trichloroethane
1,1,2,2 - tetrachloroethane
Chlorothane
2 - chloroethyl vinyl ether
Chloroform
Tetrachloroethylene
Trichloroethylene
Vinyl chloride
1,2 - trans-dichloroethylene
Bis (chloromethyl) ether

After the recodified permit has been in effect for one year, Woodlake may propose a reduced list of sample parameters to the MPCA.

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

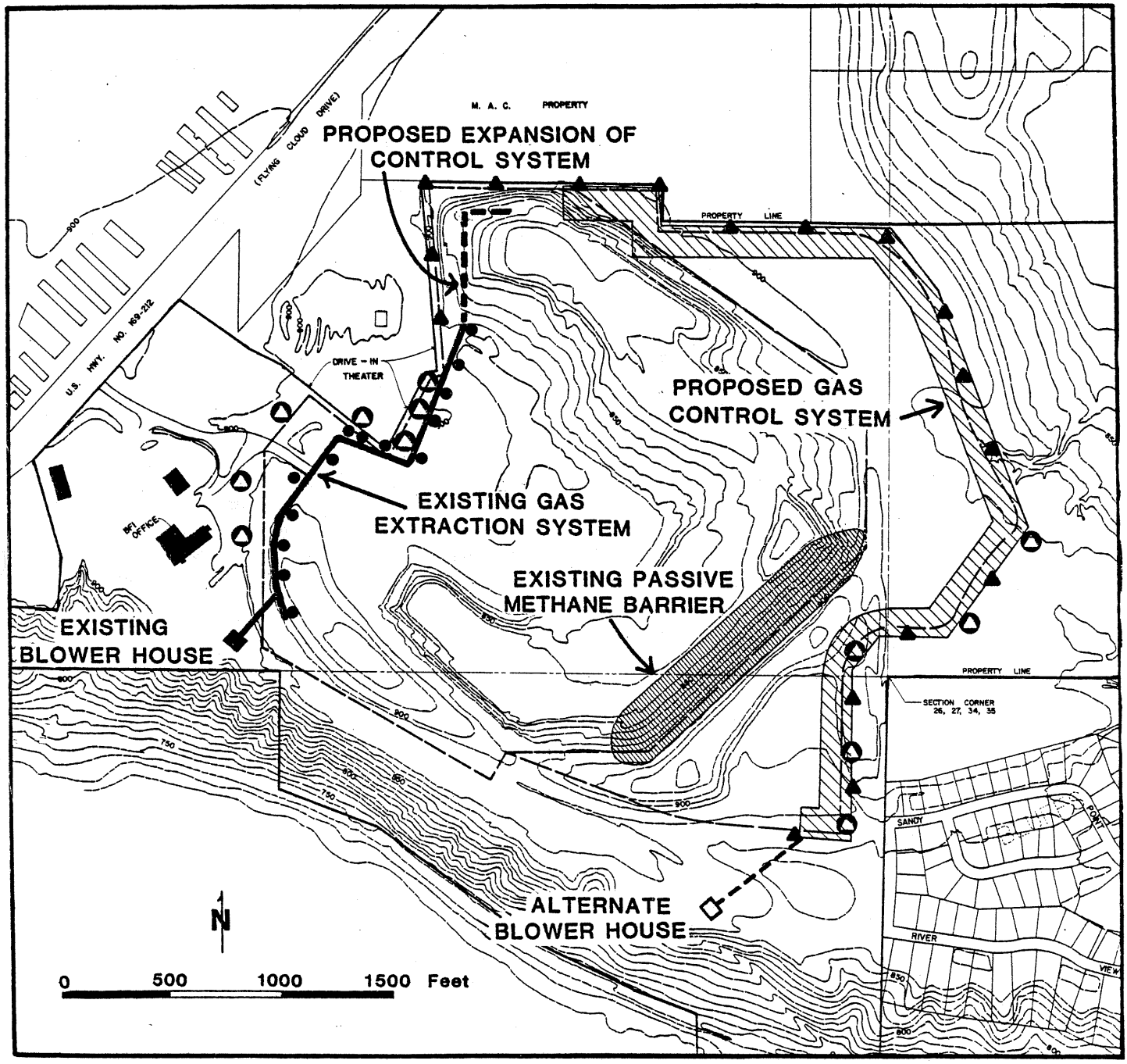
To control the production of landfill gases, including methane, and mitigate the potential impact on off-site land uses, Woodlake has constructed two separate migration control systems at the landfill. A clay barrier has been constructed along the southeastern perimeter of the fill area (Figure 7). The 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.

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 5 years after closure and following the initial 5-year post-closure period.

Figure 7.
EXISTING AND PROPOSED METHANE CONTROL AND MONITORING SYSTEM



● Existing Methane Wells

⊙ Existing Methane Probes

▲ Proposed Methane Probes

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 eventually drains to the Minnesota River and Grass Lake. 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.

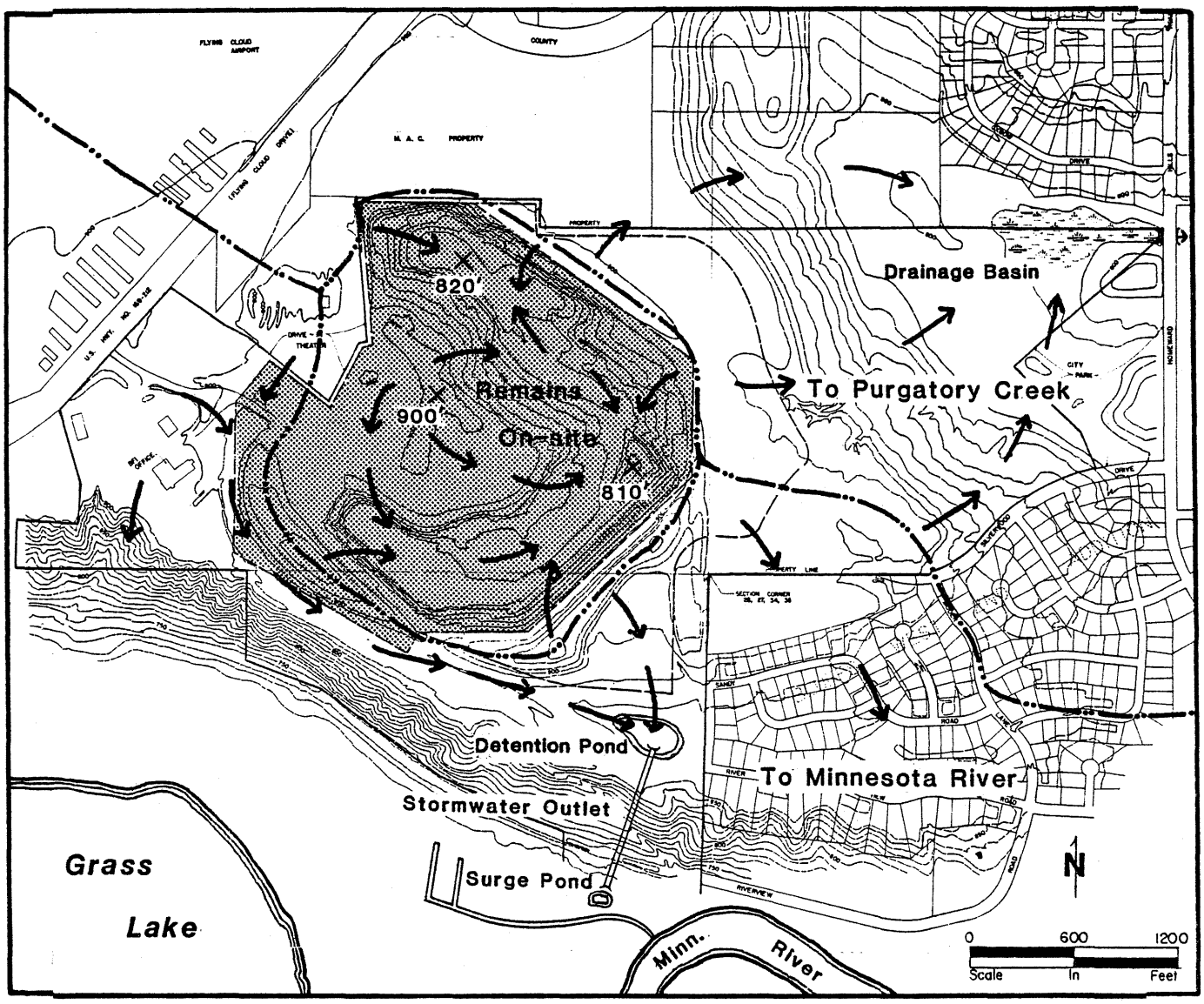
In accordance with the amended permit Woodlake is to submit a combined short-term (active filling) and long-term (closure and post-closure) soil erosion control and surface water drainage plan for MPCA approval. The plan is to control and eliminate gullying and erosion from intermediate and final cover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

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.

Figure 8.
EXISTING SURFACE WATER DRAINAGE



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

Surface Water Drainage Divide

Direction of Flow

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 Register 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

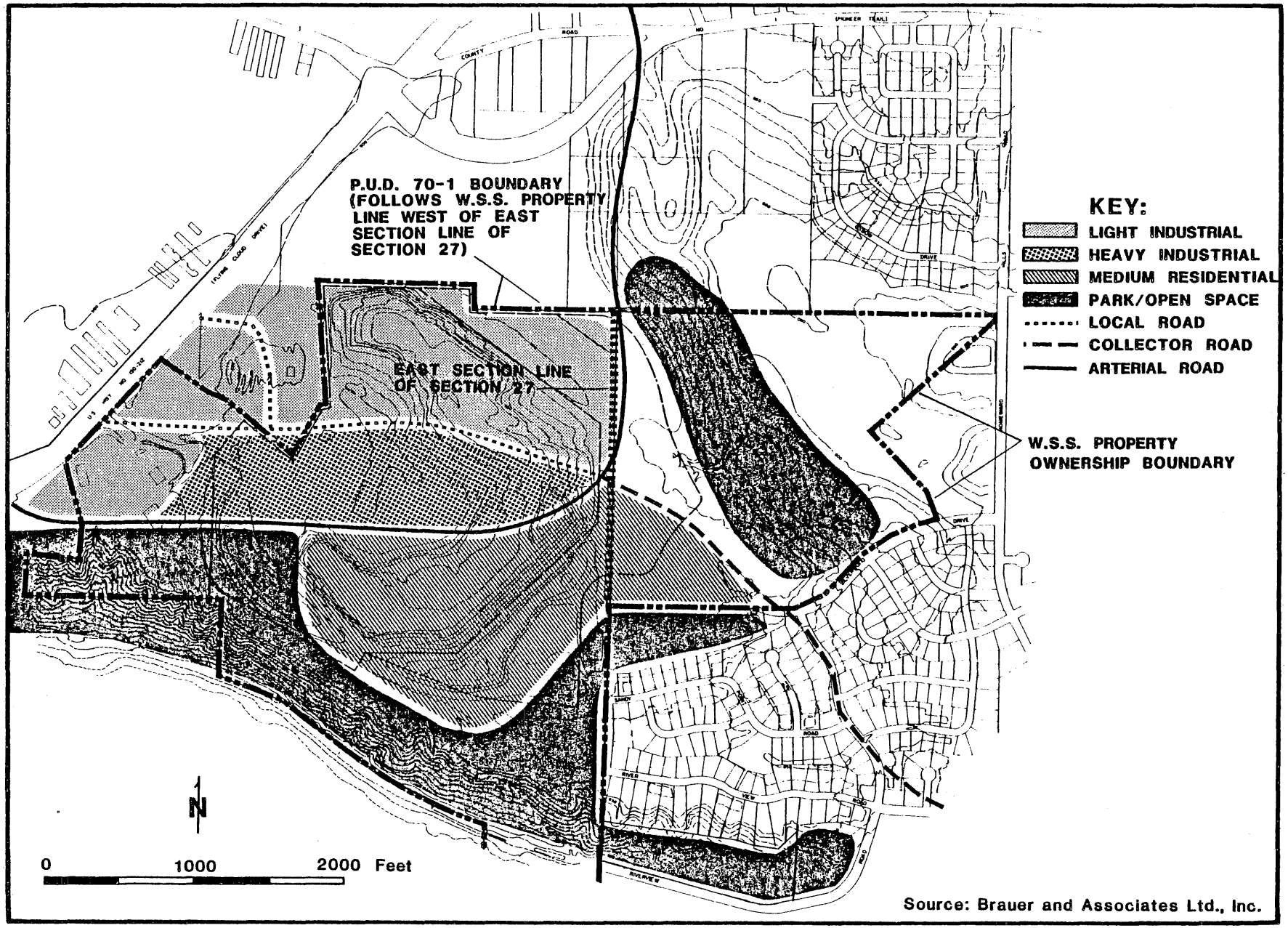
Following the approved closure Woodlake will continue to operate the ground water quality monitoring system for a regulated, but currently, indeterminate period of time and will maintain the integrity of the final cover and vegetation. The methane gas control system will continue to be operated, maintained 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. WSS 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

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



Source: Brauer and Associates Ltd., Inc.

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.

PROPOSED PROJECT

PROJECT CHARACTERISTICS

An application to expand the existing landfill was filed by WSS, a subsidiary of BFI, 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

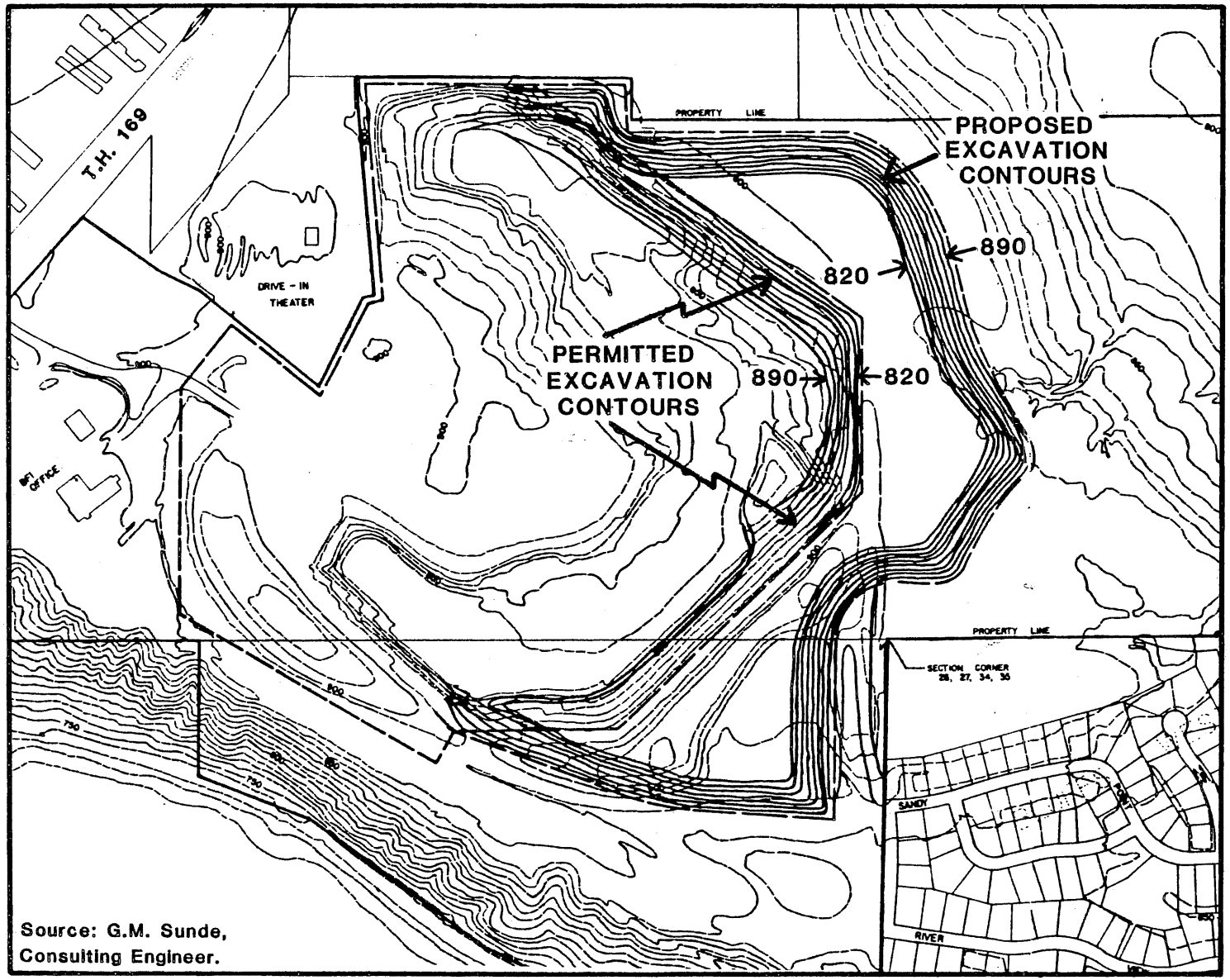
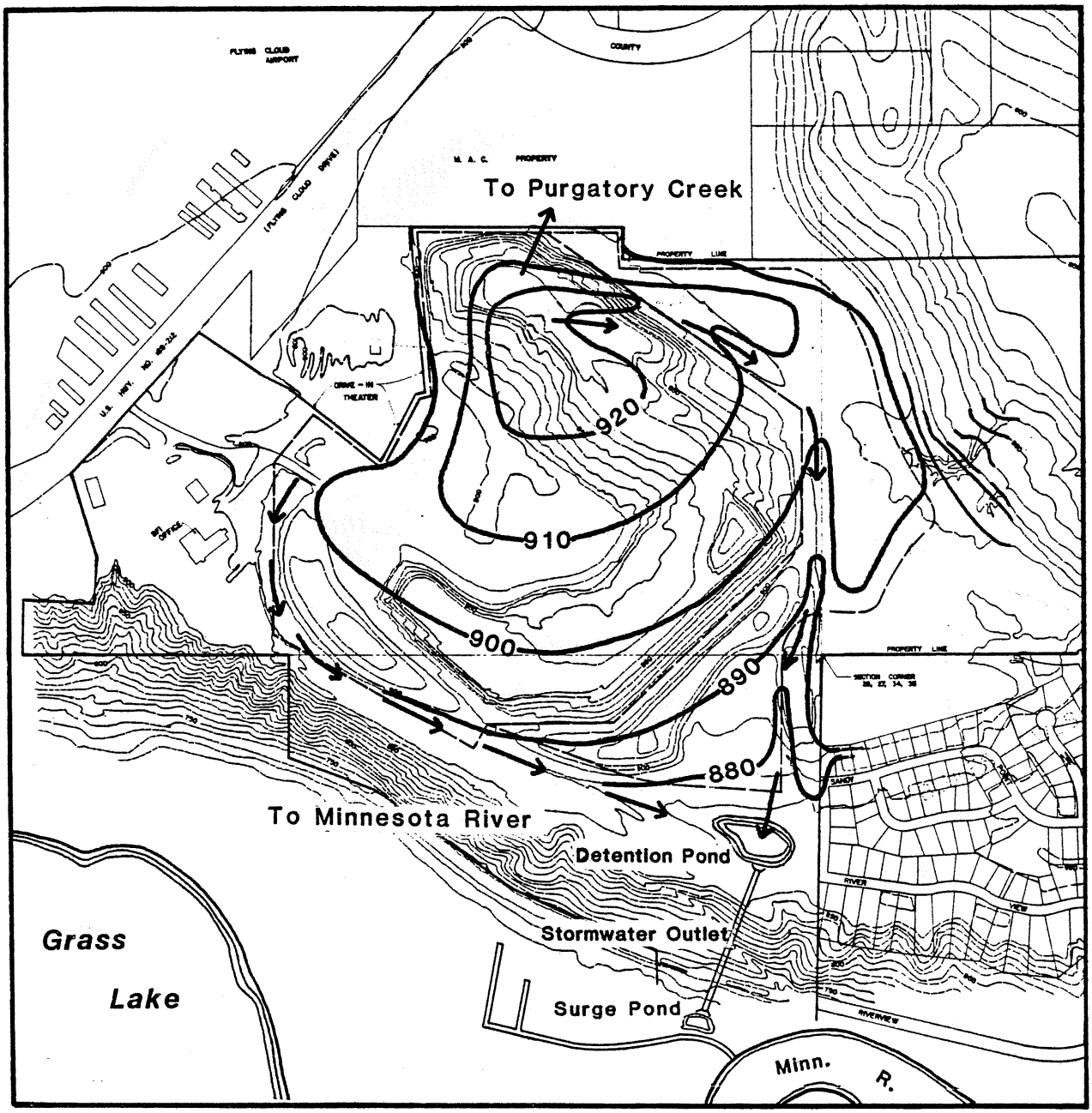


Figure 11.
FINAL CONTOURS WITH PROPOSED SITE EXPANSION

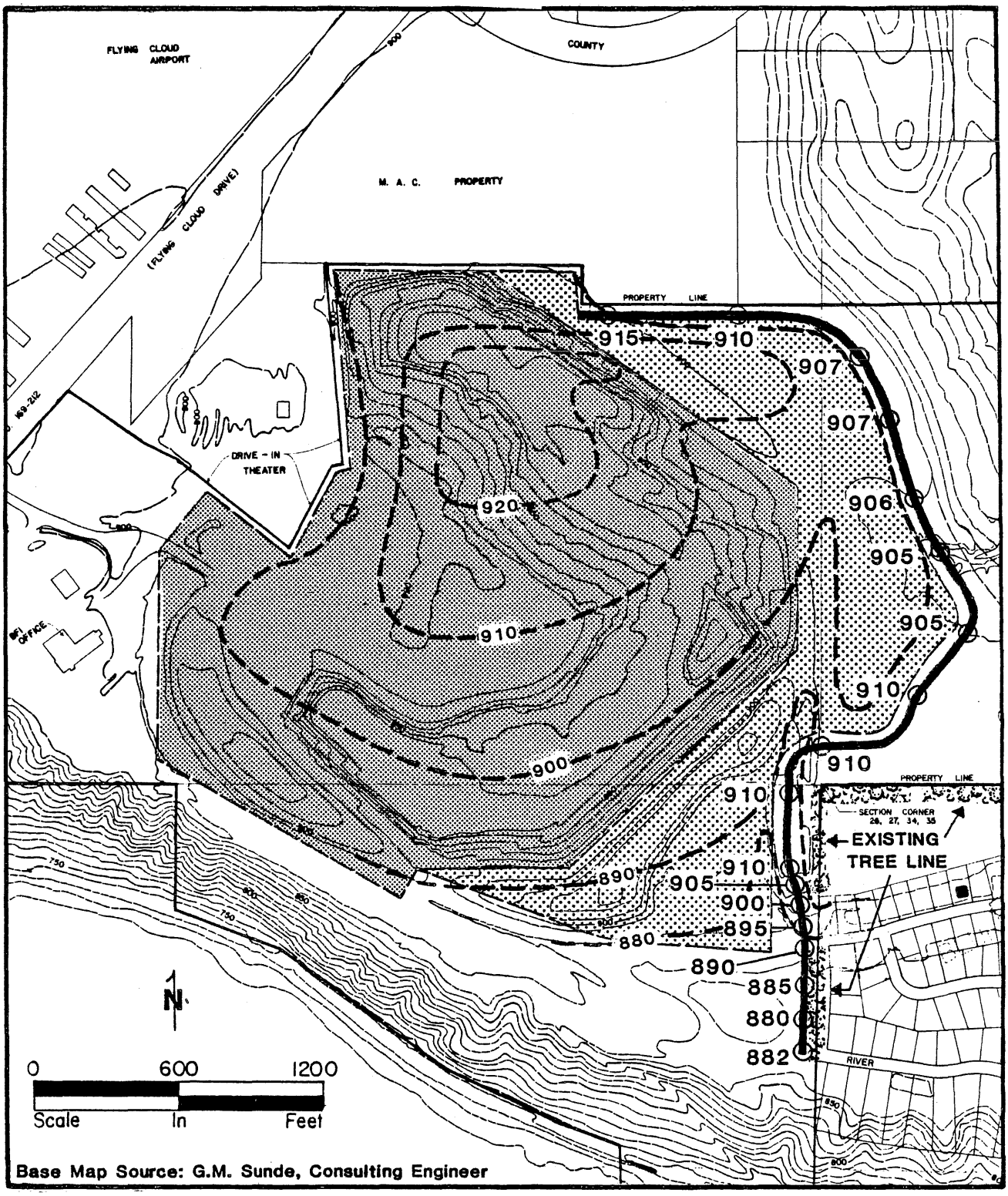


Source: G.M. Sunde, Consulting Engineer

N

→ Direction of surface water flow

0 600 1200
Scale In Feet



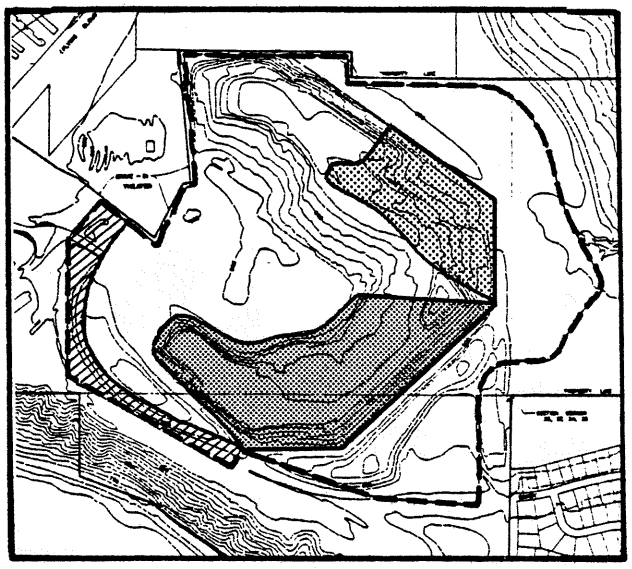
Berm 906 Berm Elevation Proposed Final Fill Contours

Figure 12. BERM ALIGNMENT

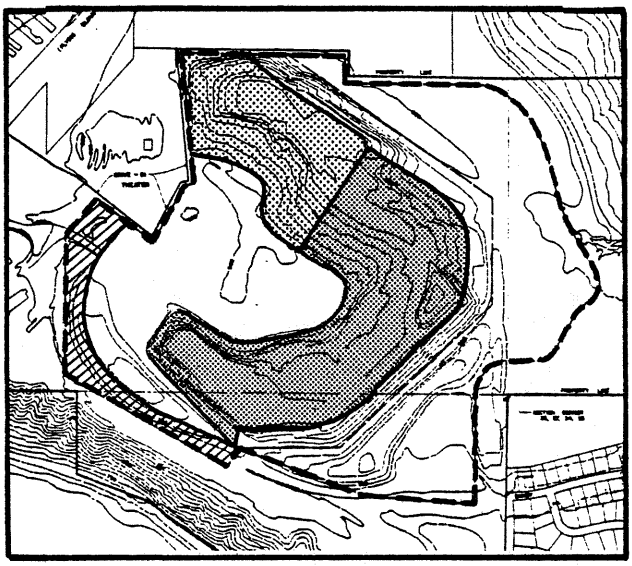
(BERM HEIGHT: 15 FEET)

Figure 13. EXPANSION PHASING PLAN

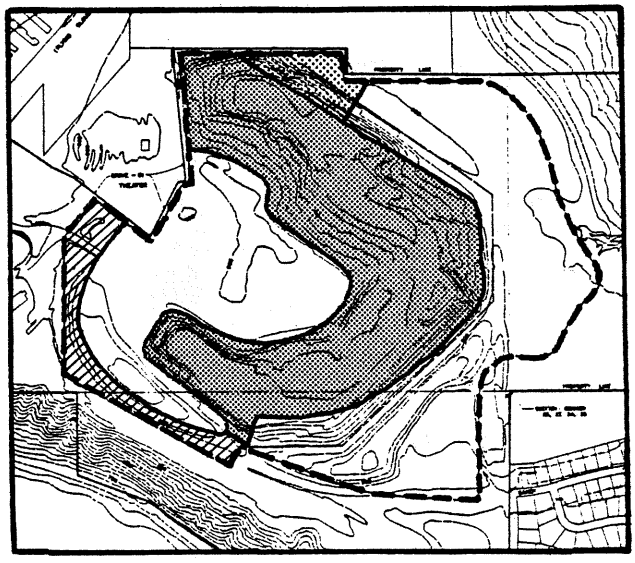
(STAGES 1-4)



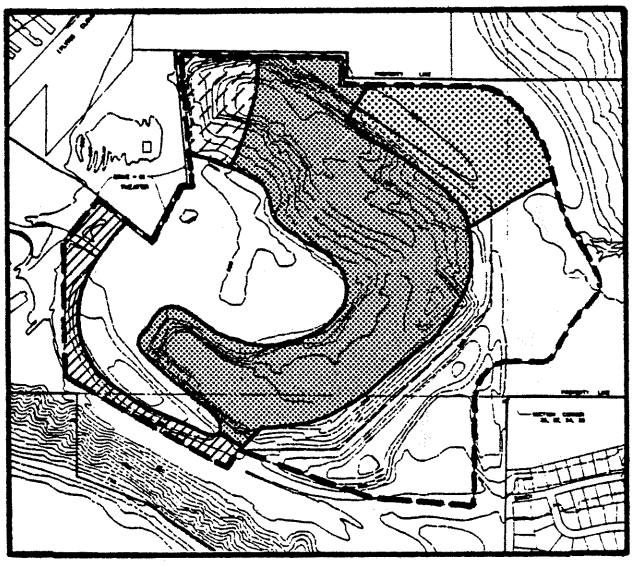
STAGE 1



STAGE 2



STAGE 3



STAGE 4

0 800 1600 Feet

N

SOIL EXCAVATION AREA

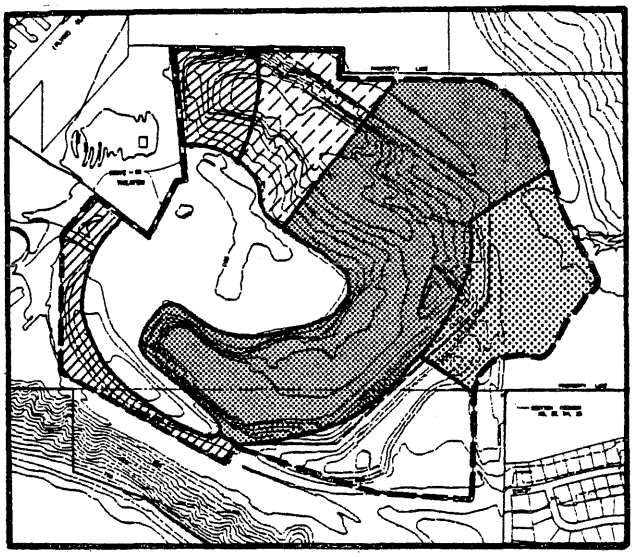
MAJOR FILL AREA

FINAL FILL AND COVER PLACEMENT IN PROGRESS

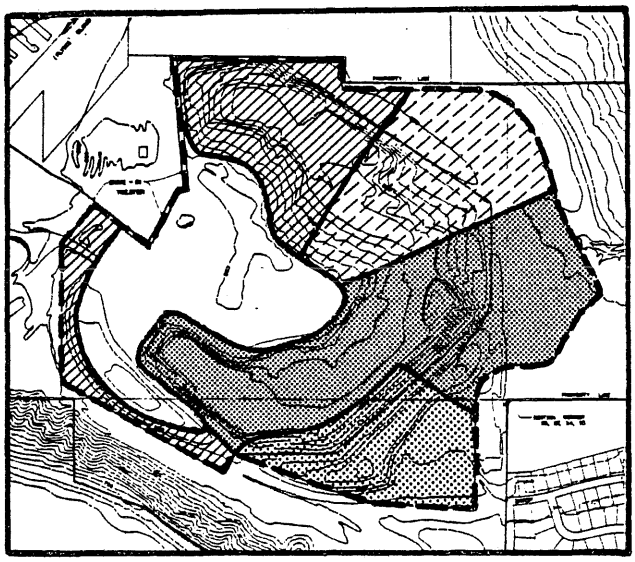
FILL COMPLETED

Source: G.M. Sunde, Consulting Engineer

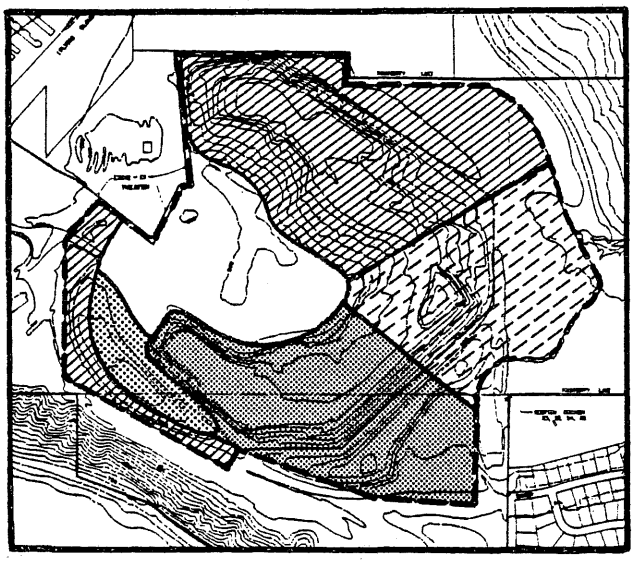
Figure 14. EXPANSION PHASING PLAN
(STAGES 5-8)



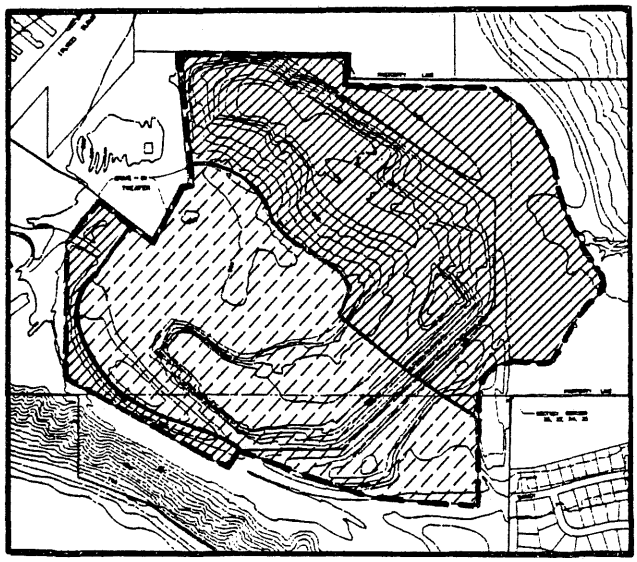
STAGE 5



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 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 overland to the river or Grass Lake. 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.

Consistent with Hennepin County's solid waste ordinance, 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. Coverge 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, the parent company of WSS. 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 WSS 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.

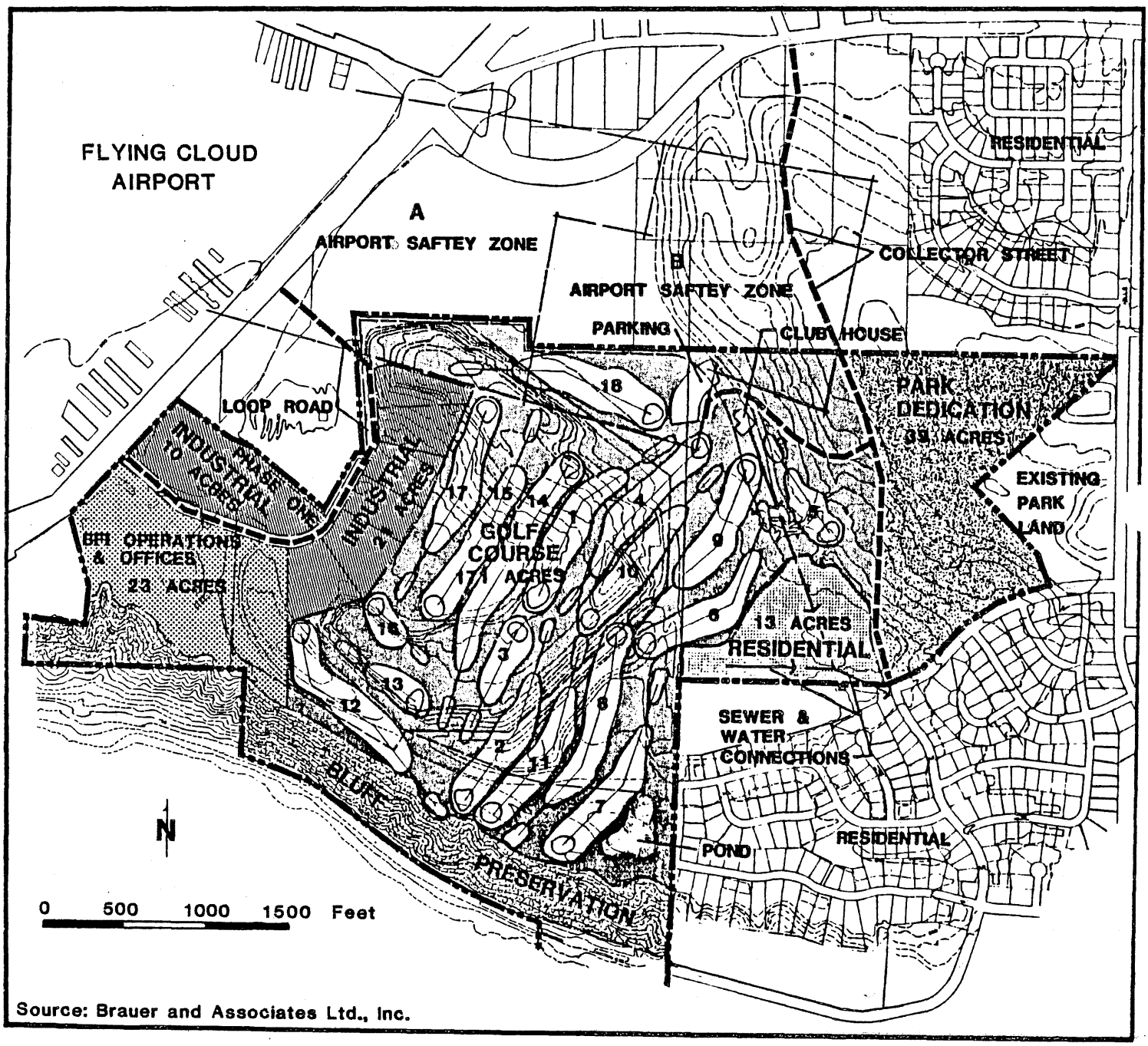
The final cover will be maintained consistent with the end use plan and final landscaping plan. Erosion problems will be corrected. The vegetative cover will be maintained, and vegetation will be replaced when dead or diseased. Records of the inspections and water quality tests will be available to regulatory 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 approval 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 a summary of a technical report prepared on the hydrogeology of the Flying Cloud Sanitary Landfill. That work is reported by Morck in Hydrogeological Analysis of the Proposed Flying Cloud Sanitary Landfill Expansion April 1984. This report is hereby incorporated by reference as part of the EIS (1).

EXISTING ENVIRONMENT

Bedrock Geology

The bedrock structure at 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, the Mt. Simon-Hinckley Sandstones and the St. Peter Sandstone (2,3). With the exception of the St. Peter Sandstone, 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′ 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 supplied 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′ MSL at its deepest point, or about 100 feet below the surrounding terrace (8).

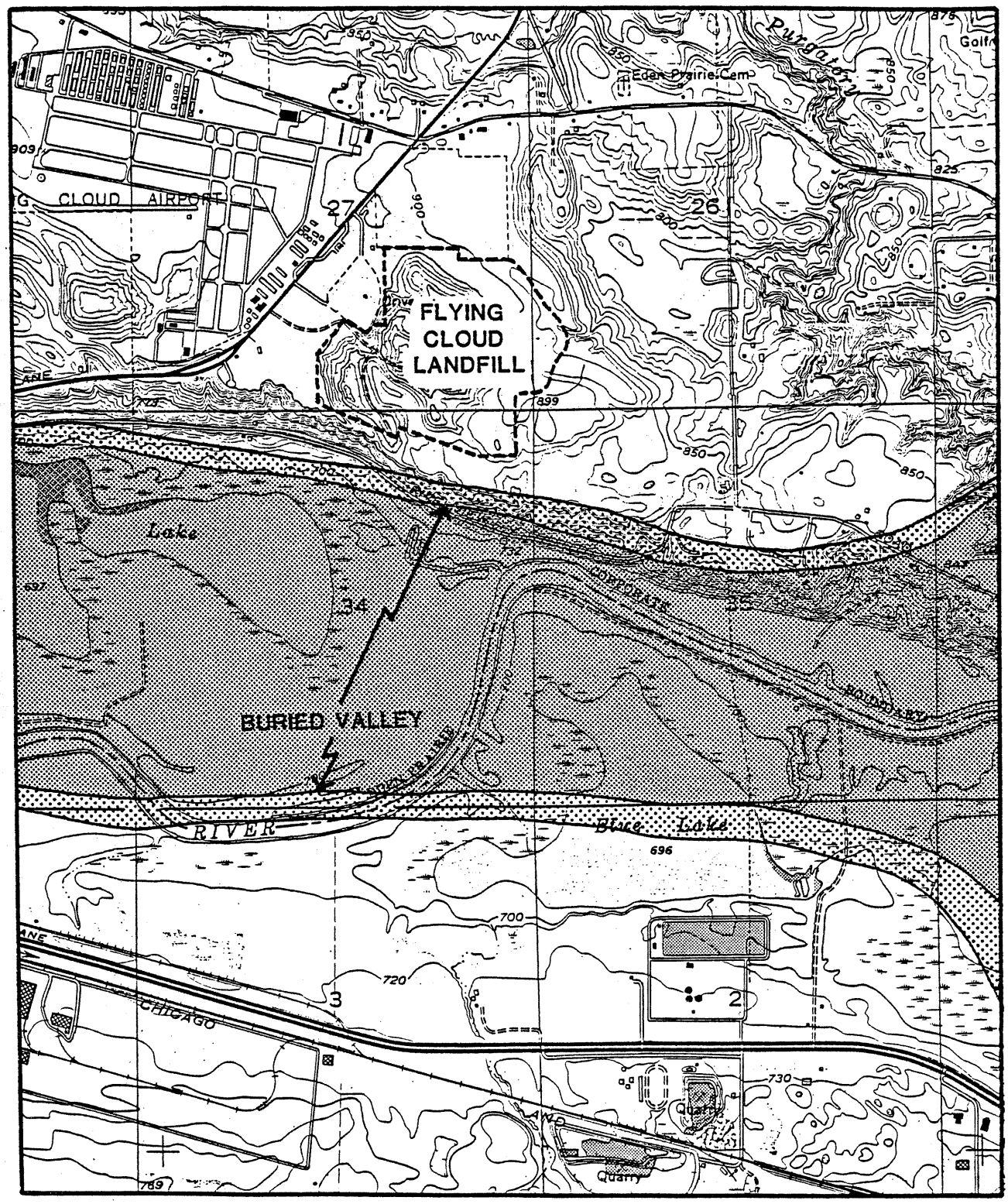
Table 6.

STRATAGRAPHIC COLUMN AT FLYING CLOUD SANITARY LANDFILL

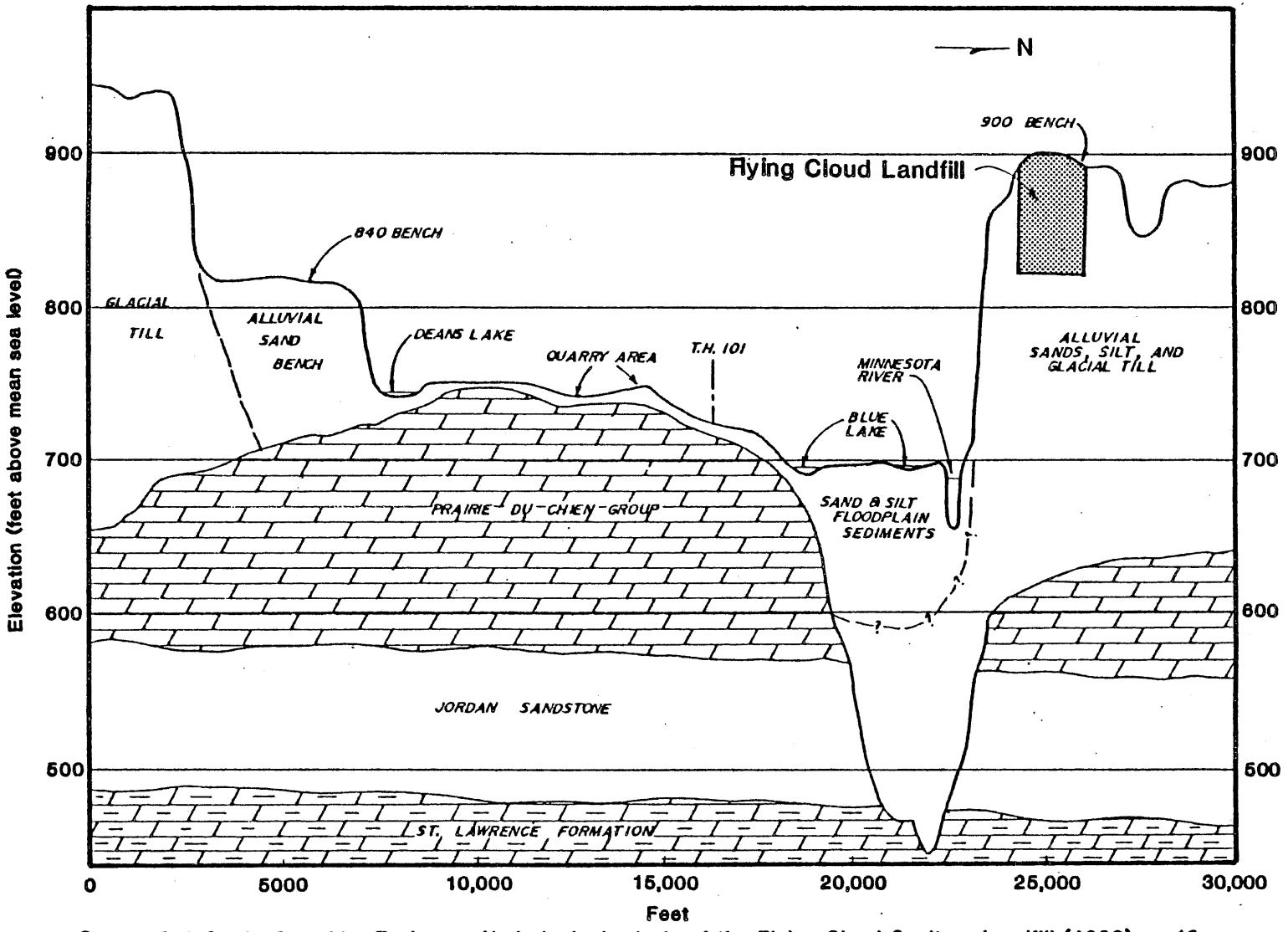
System	Formation	MSL Elevation	General Description	Water-Bearing Characteristics
Quaternary	Alluvium and glacial till, outwash	890	Well graded coarse to medium sand, imbedded silt layer, lenses of silt, clay, glacial till	Some residential wells are finished in the drift aquifer
Ordovician	Prairie du Chien Group	650	Dolostone, buff, thin to thick bedded	Aquifer: high yields from fractures in dolostone and from sandstone, principal aquifer of the Metropolitan Area
	Jordan Sandstone	575	Sandstone, light gray, medium to coarse grained, well sorted, poorly cemented	
	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 aquifer of the Metropolitan Area
Pre-Cambrian	Hinckley Sandstone	0	Sandstone, tan, medium to coarse grained	

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.

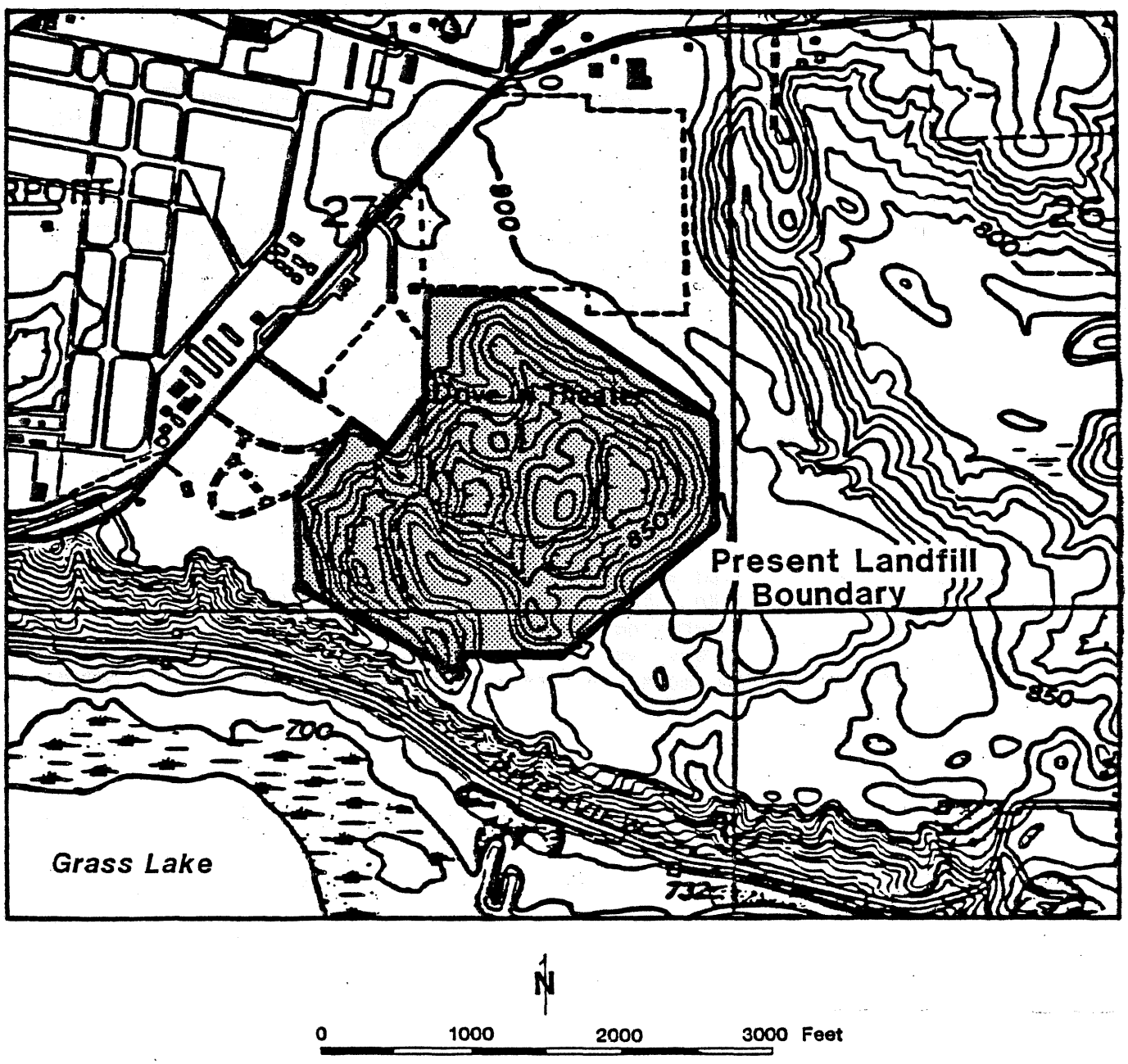


Source: G.M. Sunde, Consulting Engineer , Hydrologic Analysis of the Flying Cloud Sanitary Landfill (1982), p. 10

Figure 17. GEOLOGIC CROSS-SECTION

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

Figure 18. ORIGINAL CONTOURS



Source: Enlargement of U.S.G.S. 7.5 minute Eden Prairie quadrangle

Soils

From the surface of the river terrace at about 900' MSL to approximately 790' 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' MSL to 693' 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' 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 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 spring shown in Figure 19 flows over an exposure of Des Moines lobe till. The silt layer would be located above the till.

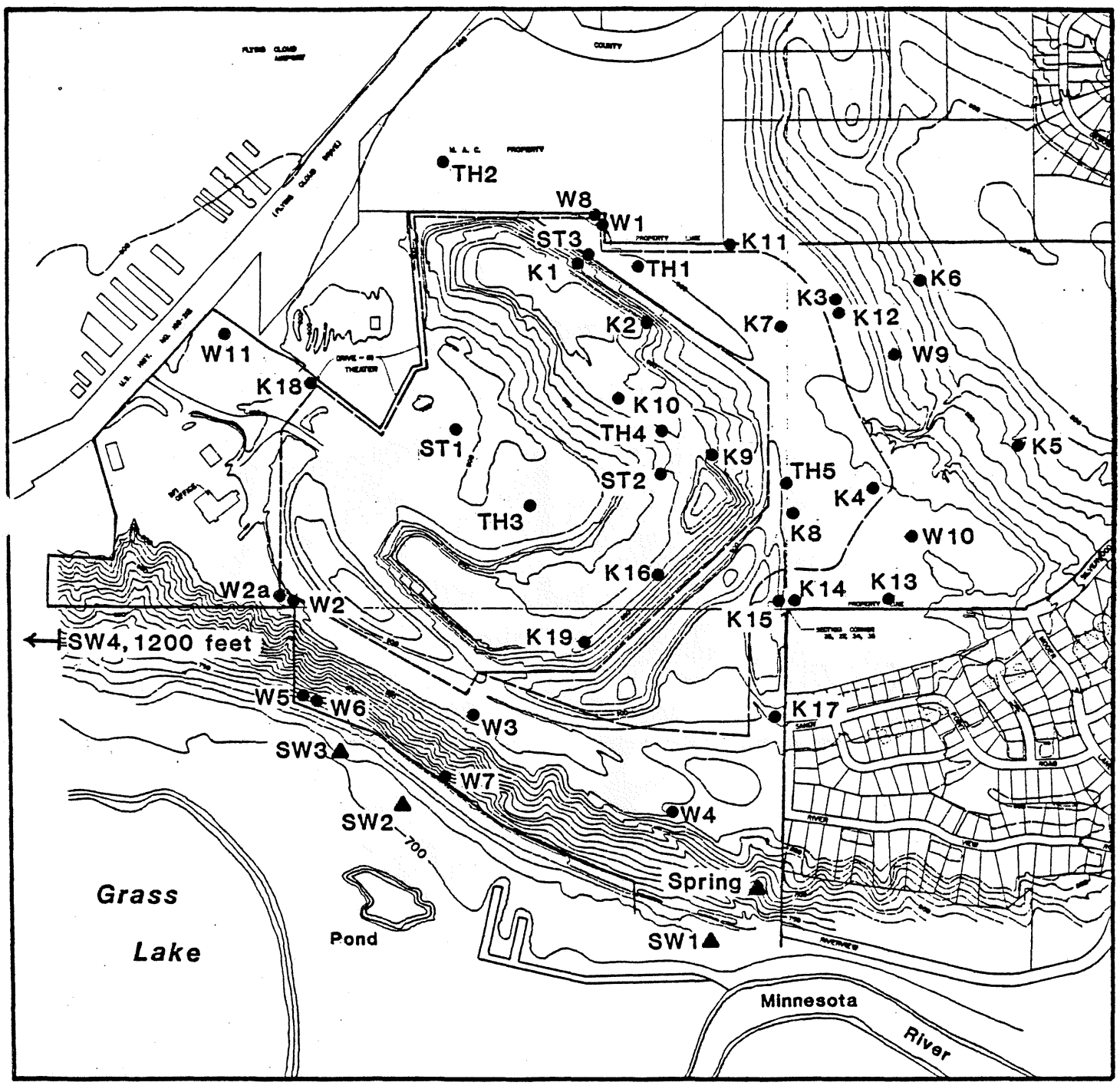
Groundwater

Flow Patterns

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 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 20 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

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 20.
ESTIMATED GROUNDWATER TABLE SURFACE CONTOURS



Map Source: G.M.Sunde, Consulting Engineer

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 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 emerge on the bluff face in the form of springs or seeps. Only one confirmed spring has been located.

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 thus 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 (9,10). 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.

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 (11). No obvious trends are apparent (Figure 21). 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 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). 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).

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	

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

*Denotes "less than."

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 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.

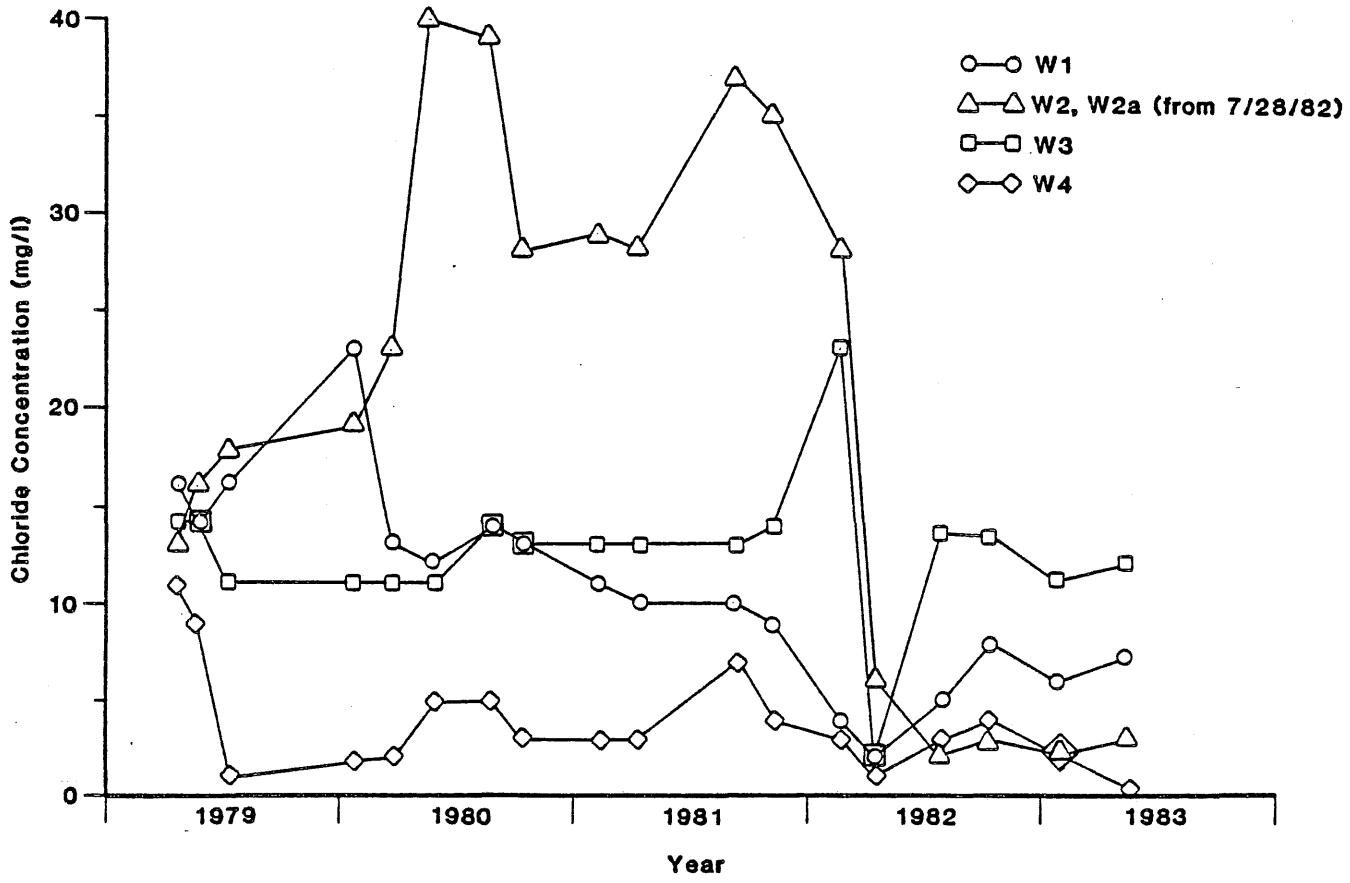


Figure 21. CHLORIDE CONCENTRATION CURVES

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).

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.

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 20). 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 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 (13). 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 EIS are presented in a separate technical report (14). 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 (15).

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 calcuations 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
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 refuseis not at field capacity. The time needed to reach field capacity was estimated to be 12 years from the time of refuse burial (16).

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, soil porosity and hydraulic conductivity.

The rate of vertical movement of leachate through the silt layer to the saturated sandy layer above the Prairie du Chien-Jordan aquifer was estimated at 0.03 ft/day (17).

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 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 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. The leachate will move predominantly in the saturated sand layer although some leachate may reach the Prairie du Chien dolomite. Table 11 summarizes travel times to significant points.

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.

The leachate that percolates down to the groundwater on the east side of the eastern groundwater divide will flow toward the low area west of Homeward Hills Rd. The horizontal flow velocity was estimated at 0.145 ft/day. At this velocity, the leachate will move 290 feet in the time it takes to flow through the silt layer. This indicates that the leachate will not travel very far to the east before it reaches the deep aquifer and begins moving south toward the river valley.

As leachate moves with the groundwater it tends to spread out in a three-dimensional plume (18). Figure 22 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 23 presents the estimated core zone of the expected plume. Lateral plume boundaries of four percent longitudinal distance are included. This value was mulitiplied by a factor of 10 to account for errors, heterogenities and unknown conditions, and represents a conservative estimate of the expected maximum horizontal transverse dispersion of the plume (19).

Vertical dispersion will also be very weak. There will be density differences between the leachate and the background groundwater that will tend to make the leachate sink. 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.

Leachate Composition

In general, three phases of leachate production exist, controlled primarily by products of microbial reactions (20). 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 (21,22). 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.

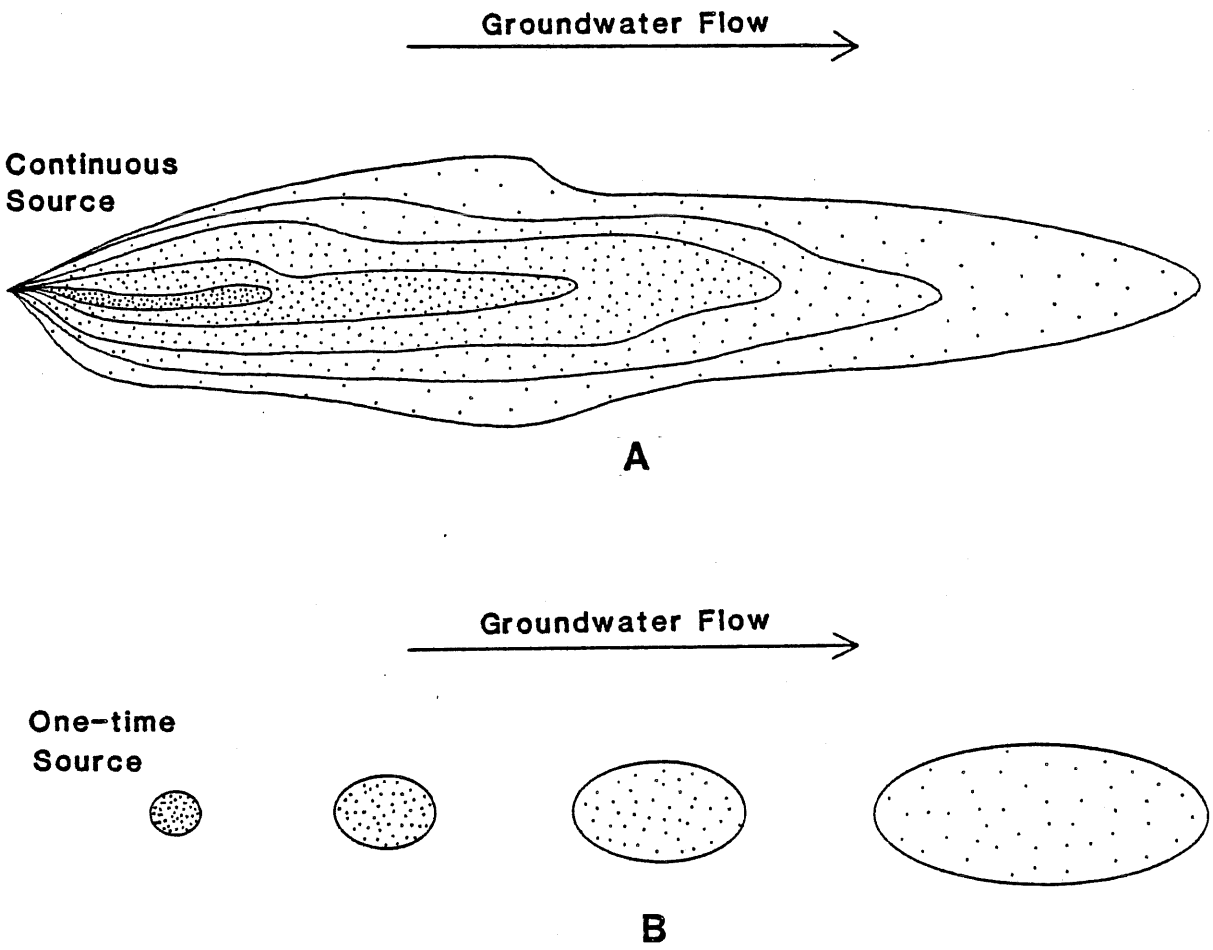


Figure 22.
THE DEVELOPMENT OF A CONTAMINATION PLUME FROM A CONTINUOUS POINT SOURCE (A); THE TRAVEL OF A CONTAMINANT SLUG FROM A ONE-TIME POINT SOURCE (B).

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

Figure 23. ESTIMATED DISPERSION OF LEACHATE PLUME

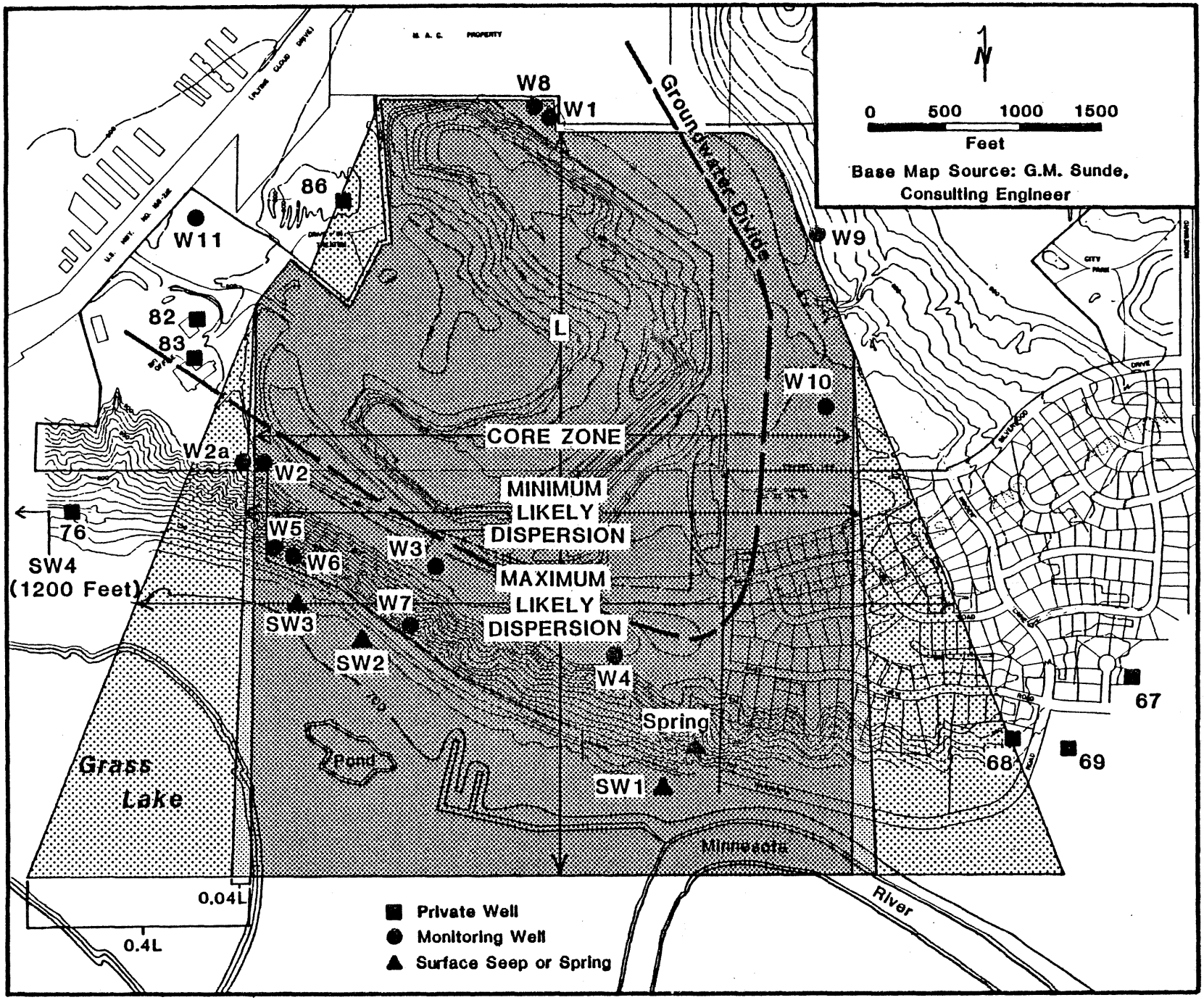


Table 12.
LEACHATE COMPOSITION

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 (23). 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 (24). 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 (25). 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 (26).

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 (27). The octanol-water coefficient is a measure of a compounds 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 (28). An example of this type of organic would be trichloroethylene, a ubiquitous man-made organic solvent (29).

Biodegradation of some trace organics may occur if high enough concentrations occur to support a minimum level of microbial activity (30). 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 (31). 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 vary, with these more mobile metals include chromium, mercury and nickel. Less mobile were lead and copper; mobility of arsenic, beryllium, cadmium, selenium, vanadium and zinc varied with conditions.

Some authors (32) have concluded that geologic materials that form subsurface soils are important in determining the influence of leachate on groundwater. They feel that formations containing active clay minerals are significant in reducing pollutant levels because of increased adsorption and surface chemical reactions.

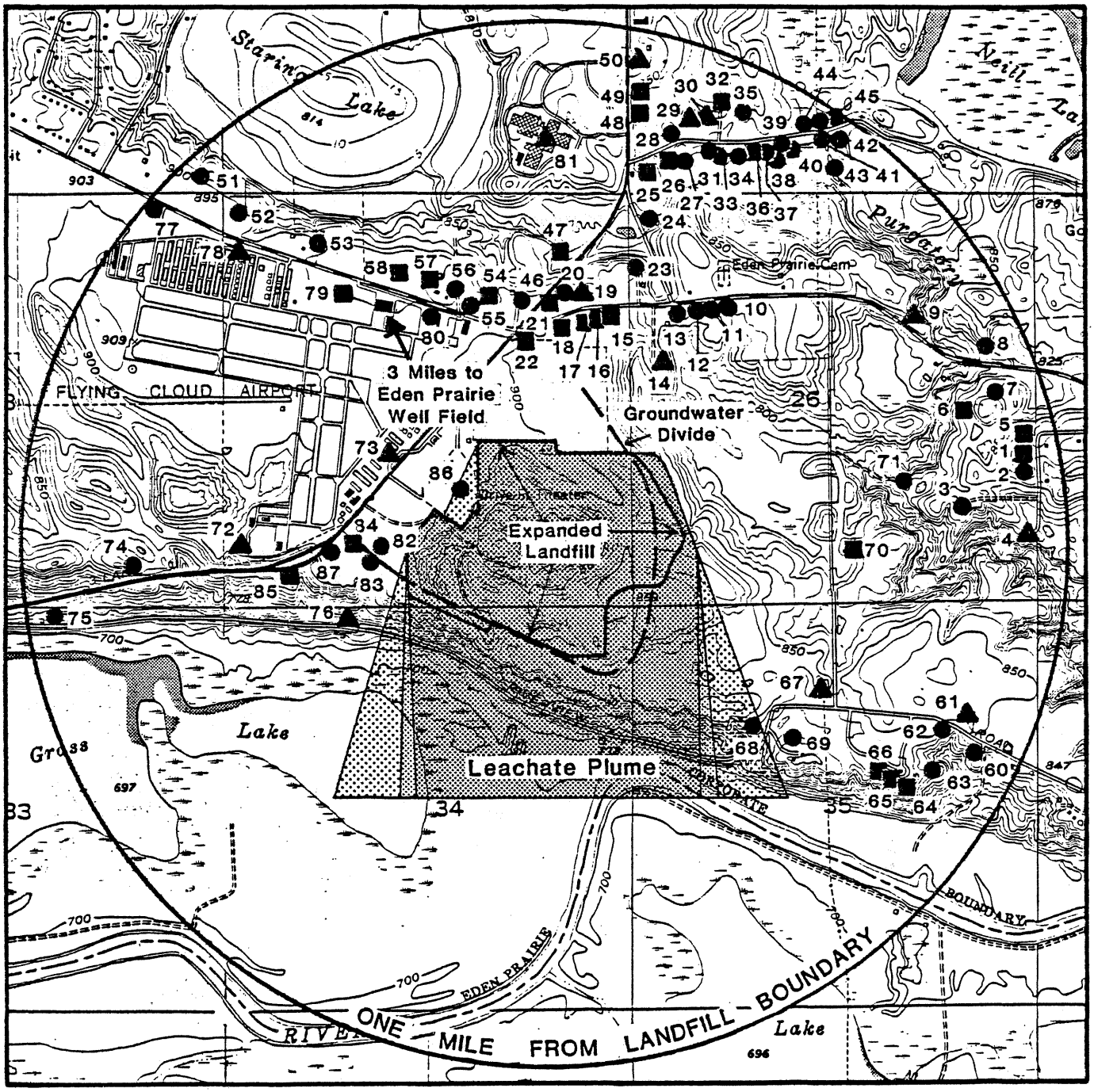
The conditions at the Flying Cloud Landfill site will allow some attenuation to occur. Hydrodynamic dispersion will cause dilution. The silt layer thought to exist beneath the site should provide a good medium for adsorption and ion exchange because it is composed of clays and silts. In addition to its 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, redox, complexation and biological reactions to occur, which further enhances attenuation of the pollutants previously discussed.

Impact on Private and City Wells

Some small private residential and business wells exist within one mile of Flying Cloud Landfill (Figure 24). 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 well (No. 76) are out of the estimated leachate plume (Figure 24). In addition, they are finished in the Prairie du Chien and take their water at a level lower than where leachate would be expected.

Figure 24.
WELLS WITHIN ONE MILE OF LANDFILL AND EXTENT OF LEACHATE PLUME



● Wells having no data available

▲ Wells having driller's logs

■ Wells having data available in city files

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

The quality of a private water supply well along Riverview Rd. (No. 68) could potentially be affected by the landfill expansion. The drive-in well (No. 86) is also within the estimated plume. 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 25). 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 (33).

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. Since dilution would be less; it is assumed that the leachate will discharge below the 710' MSL contour and be diluted into the marshland waters and Grass Lake. The immediate question is: will this input of leachate cause the surface water quality to be degraded to the point of exceeding the MPCA water quality standards for Grass Lake?

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 and outflows the concentration of the chemicals in the reactor can be estimated.

The chemical constituents used as examples were chosen because they are considered highly mobile (chloride, nickel and chromium) and/or can be compared to MPCA standards (copper). Two initial leachate concentrations are used due to the wide variability of literature values (Table 13).

Figure 25.
ZONE OF WELL INFLUENCE FOR THE CITY OF EDEN PRAIRIE WELL FIELD

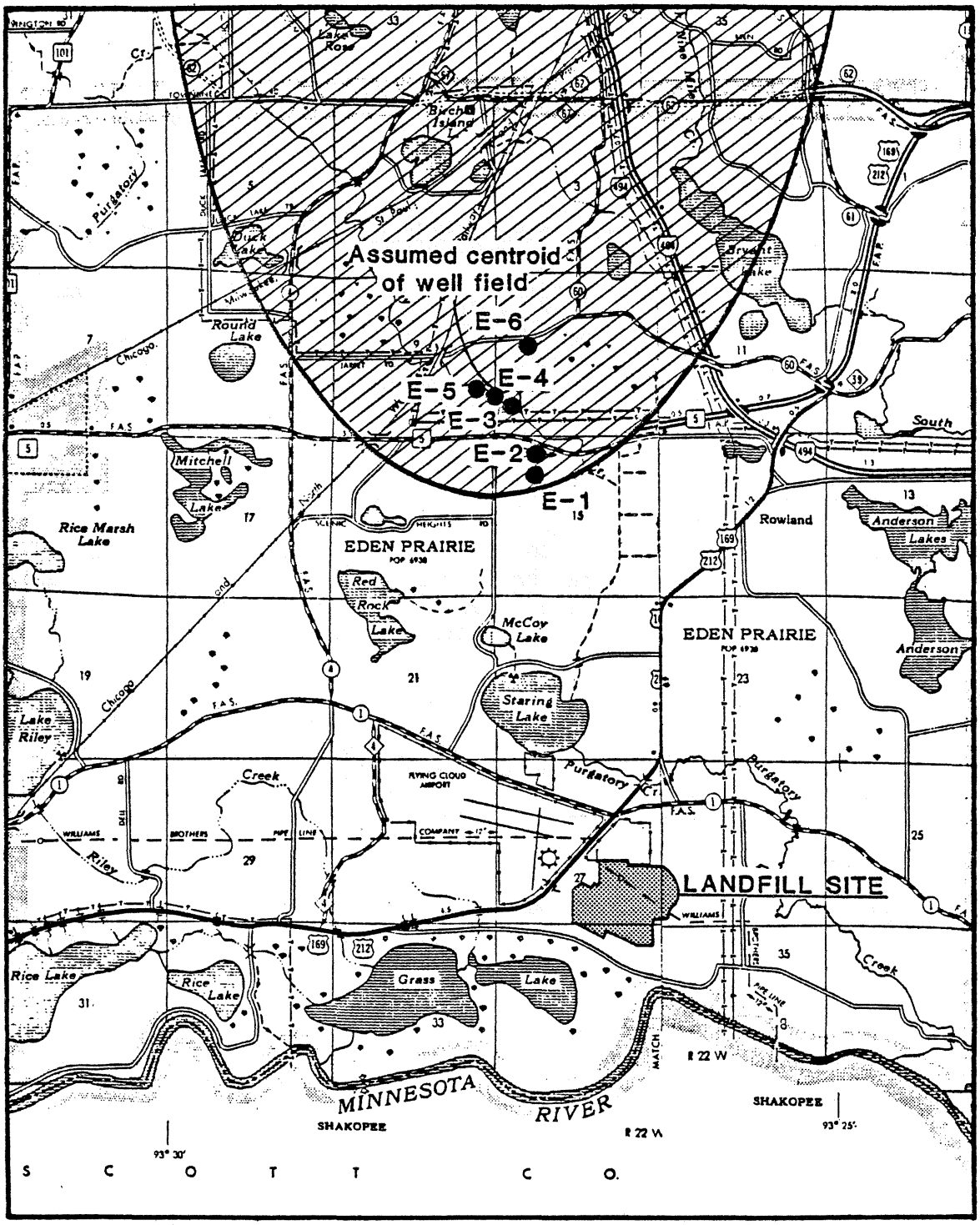


Table 13
MASS BALANCE RESULTS

Chemical Constituent	C_g	C_i	C_L		C_o		MPCA Standard*
Chloride	1.7	18	2300	1500	72	52	250
Chromium	0	0	0.053	0.18	0.001	0.005	0.05
Nickel	0	0	0.069	--	0.002	--	None
Copper	0	0	0.024	0.22	0.001	0.006	0.01

* All concentrations in mg/l.

Sources: C_g from R.E. Norvitch, Water Resources Outlook for the Minneapolis-St. Paul Metropolitan Area (1973).
C_i from G.W. Sunde, Assessment of Soils, Geology and Hydrogeology for Flying Cloud Sanitary Landfill (1983).
C_L and C_o 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.)

The results are not meant to be accurate predictions of the water quality in Grass Lake, rather, they are presented to illustrate that even assuming the worst case conditions, the leachate reaching the river valley is not present in sufficient quantity or concentration to cause the surface water quality standards to be exceeded. Furthermore, these calculations include no attenuation losses and thus overestimate the concentration of leachate constituents to reach the river valley.

However, it is also necessary to point out that the results in Table 14 are based on the assumption that the leachate is completely mixed in Grass Lake and the adjacent marsh. Where the leachate emerges into the valley there could be higher local concentrations and at these points the surface water quality standards may be exceeded.

Impacts at the Minnesota River should be even less noticeable than those at Grass Lake. The historical recorded low flow for the river is 79 cfs (34). If all the leachate were to discharge into the river, it would amount to only 0.5 percent of their low flow and by dilution alone would be brought well below existing MPCA standards.

From this analysis it appears that the leachate impact on Grass Lake, the marshland, and the Minnesota River is minimal. However, there is the possiblity 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 a small possibility that it may affect the biota in the river valley.

It should be noted that the water quality of the Minnesota River often exceeds the levels listed in Table 13. The U.S. Geological Survey (USGS) takes water quality measurements at Jordan, Minnesota. Recorded values for those chemical constituents listed in Table 13 from water year 1982 are as follows:

Choride	7-48 mg/l
Copper	0.002-0.014 mg/l
Nickel	0.002-0.016 mg/l
Chromium	up to 0.03 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.

SUMMARY

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. Certain of the leachate components will be adsorbed by the soil system underneath the site. Other components will migrate into the underlying groundwater system below the site which moves southerly to the Minnesota River Valley. Leachate affected groundwater becomes significantly diluted as it reaches the Minnesota River ground and surface water resource. Because of the physical and chemical activities which modify leachate composition and because of the effect of dilution, it is expected that the effect of landfill leachate on the Minnesota River water resource will be undetectable.

MITIGATION ACTIONS

Mitigation of Impacts on Residential Business Wells

It is likely that groundwaters affected by leachate from the landfill will migrate to and be dilluted by the Minnesota River water resource and will not adversely impact groundwaters used for residential, commerical or industrial purposes. Nevertheless, because of the likelihood of leachate migration, its nature and content and the cost and difficulty of mitigation in the event of adverse impact, the following mitigation measures are identified by area and type of use.

East/Southeast

There is one residential well within the plume approximately 2,000 feet from the southeast corner of the landfill expansion area. Possible measures to avoid and/or mitigate potential impacts from the Landfill on this residential well include:

1. More frequent and/or comprehensive groundwater quality monitoring to ensure thorough, early detection vis-a-vis the composition and concentration of leachate in the groundwater resource and the migration of leachate impacted groundwater. Additional monitoring wells upgradient of Well No. 68 in the path of the expected leachate plume would provide earlier detection of potential contamination problems. The installation of a monitoring well approximately 2,000 feet upgradient from the residential well should allow approximately 11 months following detection within which to take remedial action.

2. Installation of a natural or synthetic liner below the waste deposit on the eastern edge of the expansion area. A liner would divert leachate generated in that portion of the landfill to the west so that it would eventually percolate down the west side of the divide and flow toward the center of the expanded landfill. A liner system roughly 1,800 by 300 feet in size could achieve this protection.

3. Reduction of the eastern extent of the proposed expansion area so that leachate generated percolates to the west side of the divide and flows toward the center of the site. If the eastern boundary were moved 200 feet west of the estimated divide position, the horizontal expansion area would be reduced by approximately 27 acres (63 percent of the proposed expansion area).

4. Connection of the residential well to the municipal water supply system.

5. Acquisition and elimination of the residential use and abandonment of the well.

Northwest

The Flying Cloud Drive-in located adjacent to the northwest edge of the landfill is served by a private well located in approximately the center of the drive-in property. The well is located approximately 250 feet from the edge of the landfill deposit. Because this well is located on the edge of the expected plume, there is a limited possibility that the well could be affected by leachate in the groundwater resource. Possible mitigation measures to minimize potential adverse effects from the landfill on this well include:

1. 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.

2. Installation of a nest of monitoring wells updgradient of the drive-in well.

3. 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.

4. Extension of the city's water supply system to the Flying Cloud Drive-In.

Reduction of Leachate Produced

The key to 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' 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 (35). Grasses like Smooth Brome, tall Fescue and Trefoil have been used successfully (36). Other commmonly used grasses include Canary and Deer tongue varieties. Commonly used shrubs include Bristly locust, Indigo bush, and Autumn-olive (37).

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 (38).

Post-Closure Monitoring

The objective of post-closure monitoring is to detect the movement and concentration of contaminants in groundwater moving away from the landfill site. 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 place upgradient of the landfill site. Concentrations of chemical constituents measured here represent levels found in groundwater uncomtaminated 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 should be placed at several different distances downgradient to be able to monitor the progress of the contaminated groundwater. They should 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 should 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.

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 (39). 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.

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.

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 (40). 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 would preclude the building of permanent structures over the actual fill site (74). 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.

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, Grass Lake, the Minnesota River, Purgatory Creek, Riley Creek and a wet meadow; a portion of the meadow is used as stormwater drainage basin in accordance with the city's drainage plan (Figure 26).

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 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 26).

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

Table 14
MAXIMUM CONCENTRATIONS OF SELECTED METALS IN THE MINNESOTA RIVER
WATER YEAR 1981*

Metal (dissolved)	Concentration (ug/l)
Arsenic	5
Cadmium	2
Chromium	10
Iron	140
Lead	4
Manganese	360
Mercury	0.1

Source: Water Resources Data for Minnesota Water Year 1981. Vol. 2. Mississippi and Missouri River Basins. USGS, St. Paul, Minnesota.

Existing Minnesota River quality is generally low; 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 (41). Riley Creek and Purgatory Creek, in contrast, only occasionally violate water quality standards other than those for fecal coliform (42). 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.

Figure 26. SURFACE WATER FEATURES

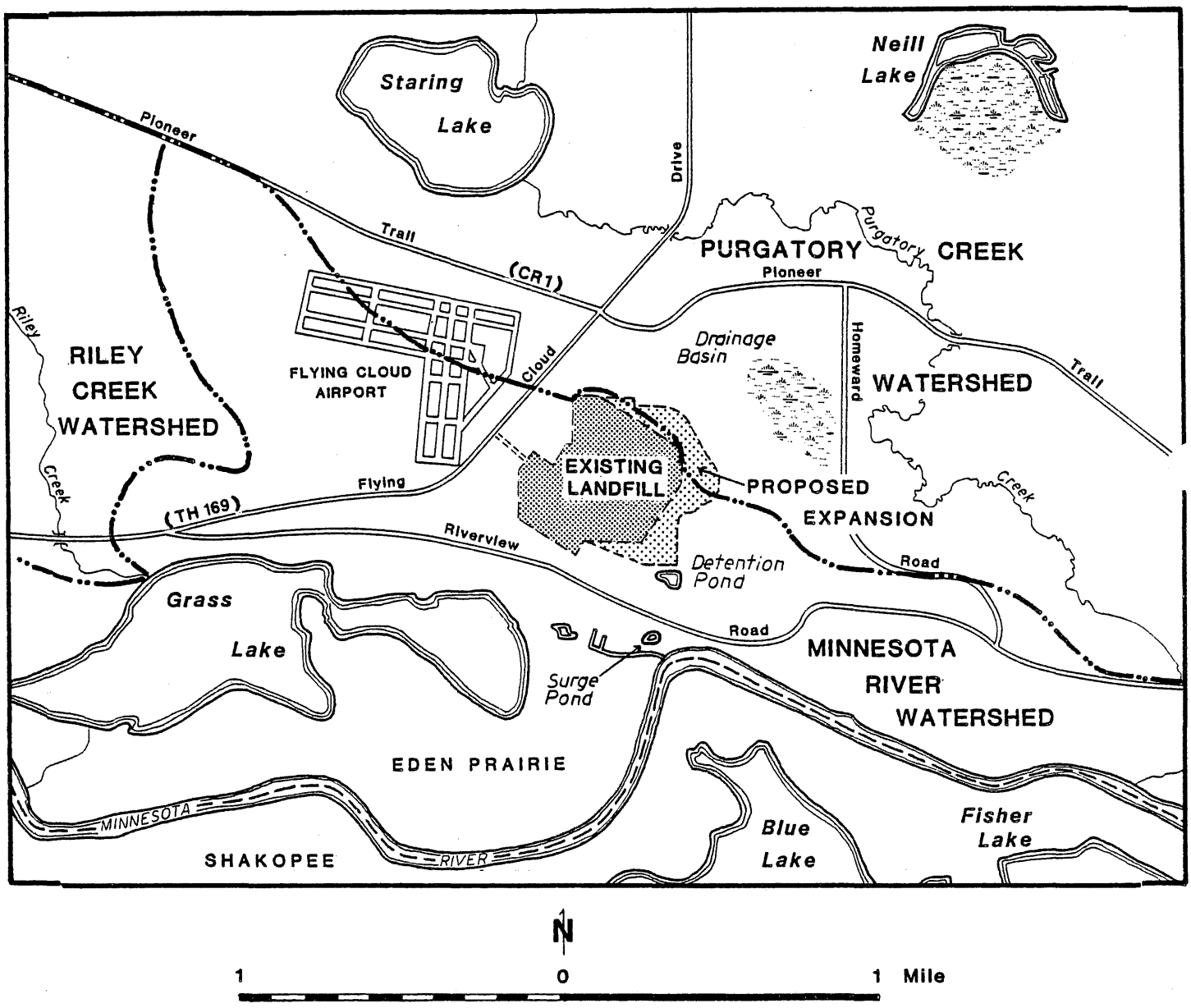


Table 15
EXISTING SURFACE WATER QUALITY[1]

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.

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

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.

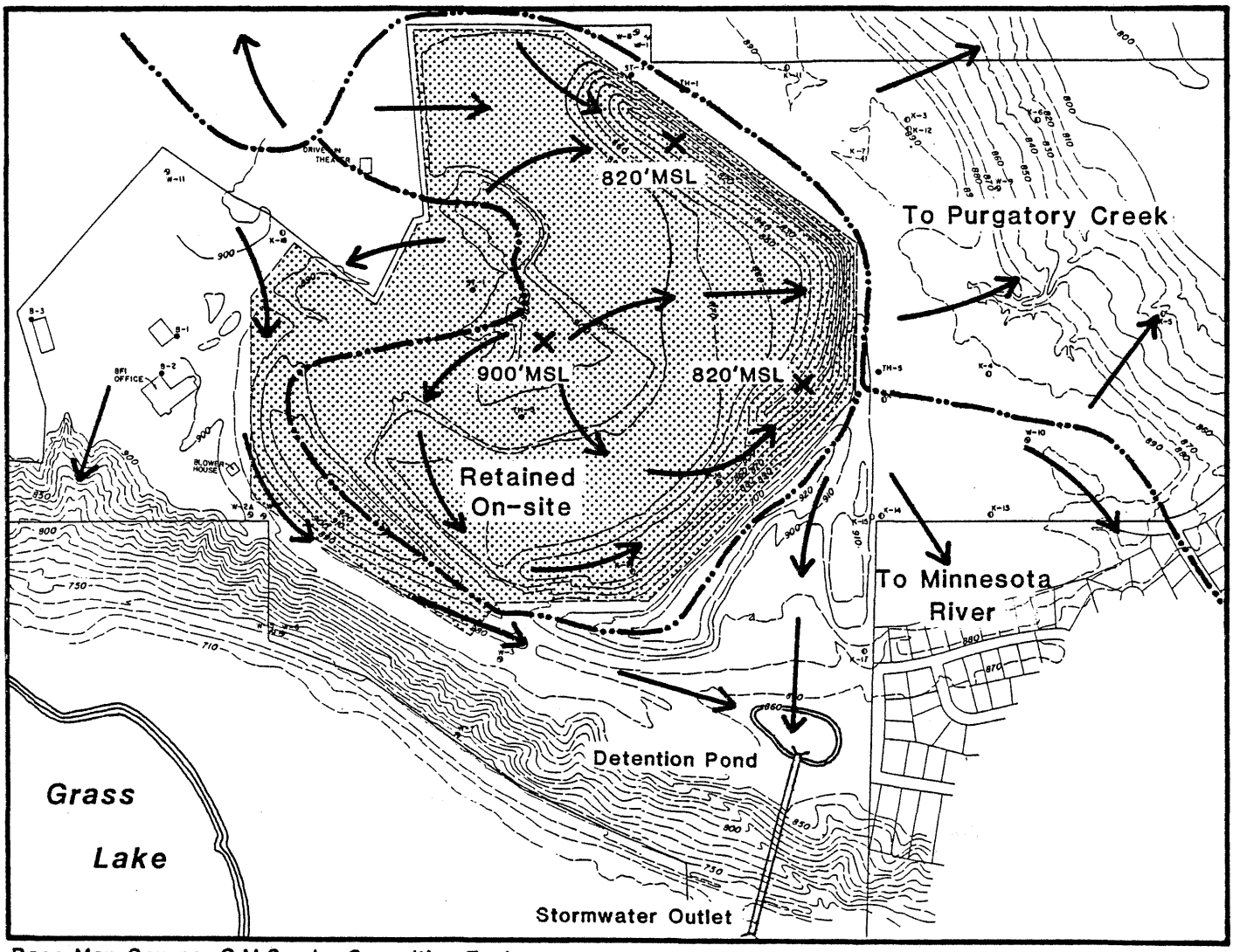
Generally speaking, sediments in the lake are considered to have moderately elevated levels of arsenic, high levels of manganese, and low levels ofother metals tested (43). Only low levels of organics and metals have been found in bullheads, however, the Fish and Wildlife Service feels that bioaccumulation could be a problem in the future (44). Some possible sources of the contaminants are Riley Creek and the Minnesota River.

At the present time, only the on-site detention pond, a surge pond in the Minnesota River Valley, and the Minnesota River receive runoff from the landfill (Figure 8). 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 Road. Water can flow at 30 cfs into a constructed surge pond, and then overland into the Minnesota River and Grass Lake (45). 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'spresent permit (Figure 27).

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.

Figure 27.
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

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 EIS.

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.

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 11).

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 (46). Gullies and rapidly eroding areas will be planted with vegetation (47). 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 (48). Within three months after the landfill is closed, and after final cover is placed, the land surface will be seeded, fertilized and graded (49). (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 (50). 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 (51).

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 (52). 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 several 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 (53). 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 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. 1983.

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 (54). 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.

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 (89). 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.

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 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.

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.

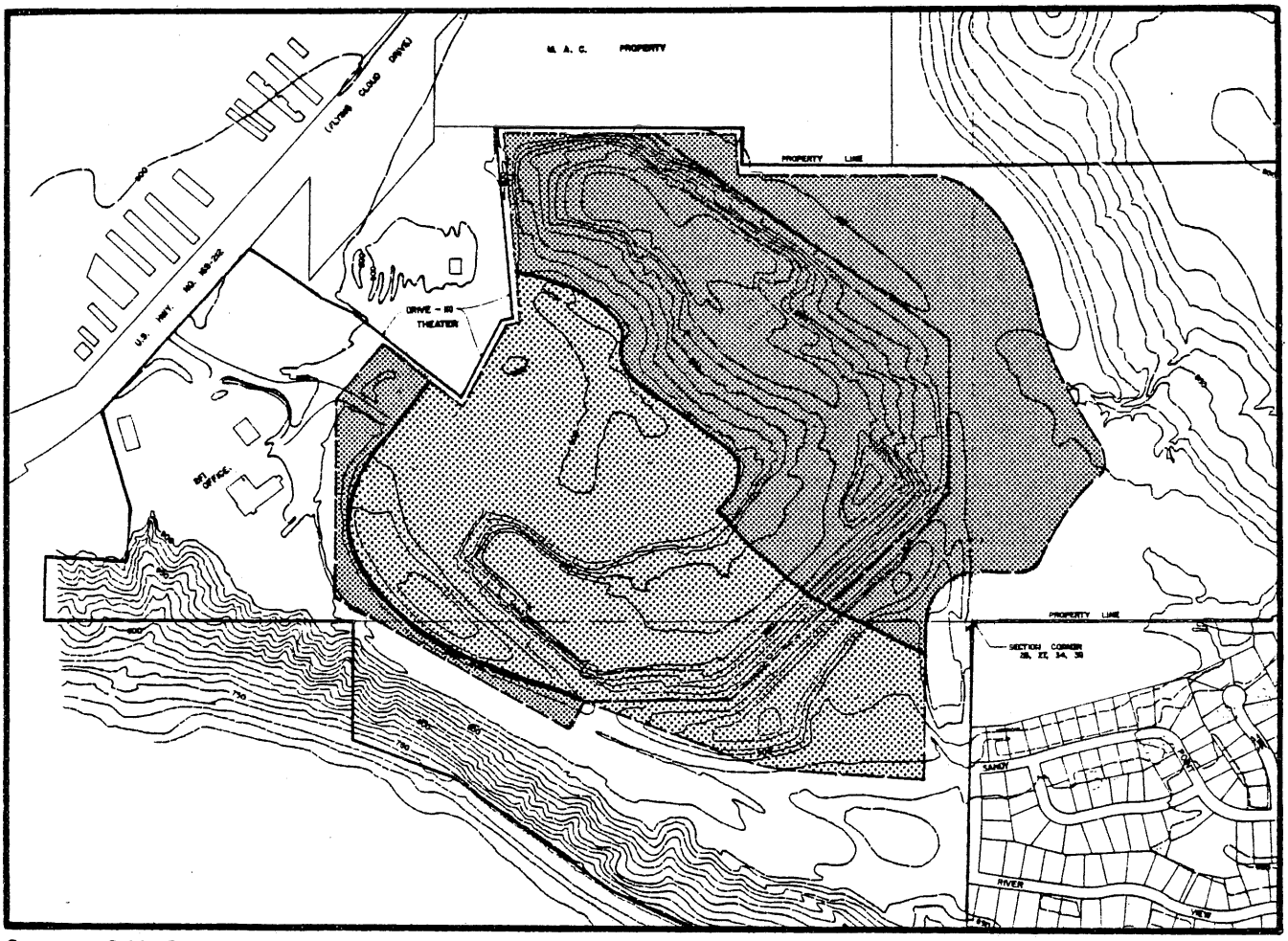
Minnesota River and Grass Lake water quality should not be affected by the construction activities and erosion associated with berm building and initial excavation. The drainage basin to the east of the site, as well as the on-site detention pond, will trap most eroded materials and act as storage ponds 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 Minnesota River and Grass Lake. 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 28). 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.

Figure 28. 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

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 EIS. This section highlights the information on leachate as it relates to surface water quality.

Any leachate that the landfill generates will likely flow in a relatively confined plume along the top of the water table. Its direction of flow 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 also occurs. 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.

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 volume of leachate generated per year at the landfill should range from about 18 acre-feet/year to 73 acre-feet/year. The low estimate was derived from runoff estimates based on the SCS Curve Number Method, while the high estimate was calculated assuming that no runoff occurs. Leachate from the existing landfill is estimated to initially reach the lake sometime in 1985, 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.

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 lake water are all expected to be below MPCA standards, despite the fact that: 1) no attenuation was assumed; 2) no dilution in the groundwater was assumed; and 3) leachate is assumed to be a continuous input into the lake.

Periodic flushing of the lake by floods will tend to reduce pollutant concentrations. Sunde estimates that the Minnesota River will backflow into the lake nearly every year, and that flowthrough conditions will occur in about two of every three years (56).

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. According to the model for instance, chromium could reach its standard of 0.01 mg/l if outflows were .01 -.37 cubic feet per second. (This conservative approach assumes that low flow conditions are attained and maintained for several consecutive months, and that dilution in the lake is the only force acting on the concentration of the contaminant). It should be noted that the Minnesota River, which contains many contaminants, interflows with the lake frequently and therefore could also be a source of substances that may bioaccumulate.

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.. 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.

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 reach the bedrock aquifer and move toward the river before it could surface there. Leachate could reach Grass Lake, however, maximum concentrations of pollutants in the lake water are expected to stay below MPCA 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.

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 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 river and Grass Lake. 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 wier 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 wier 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

The easiest 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. The Site Hydrogeology section should be reviewed to obtain more details on leachate control.

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 (57). 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 29). 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 30). 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 58, Appendix C).

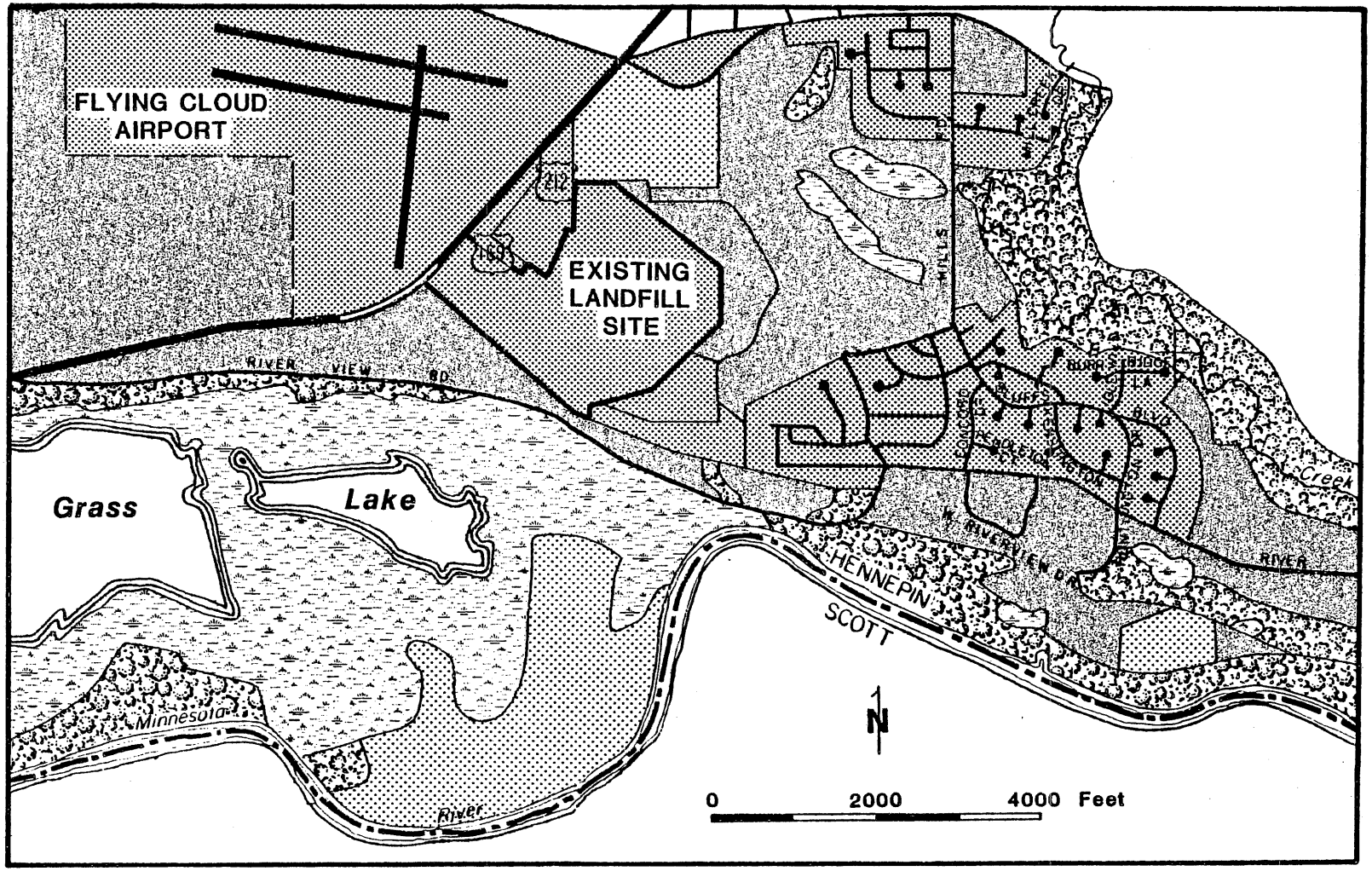
Off-Site

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 (59). 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 (60).

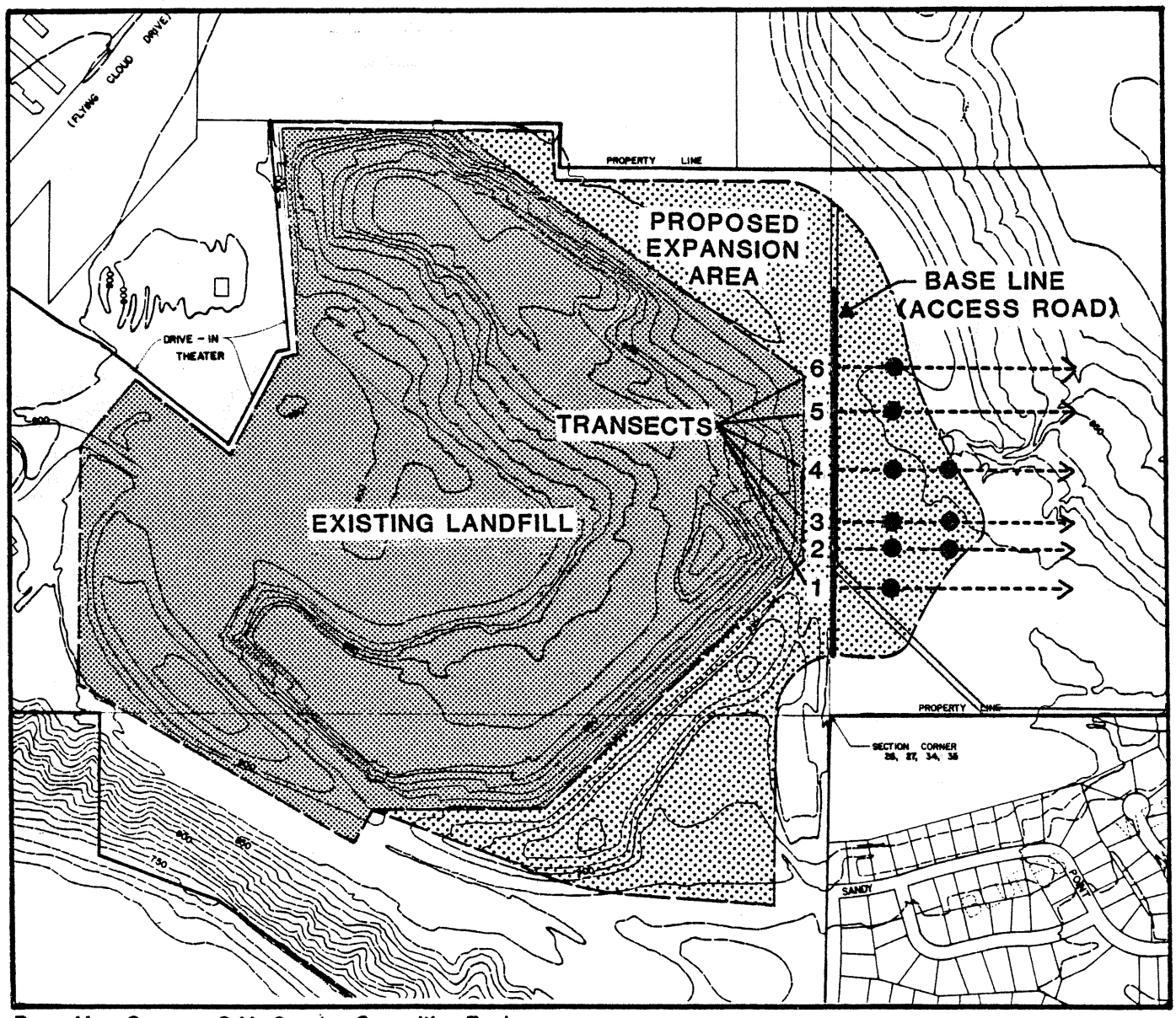
To the south of the proposed expansion site is the Minnesota Valley National Wildlife Refuge and Recreation Area. The Refuge and Recreation Area is quite large, covering over 9,000 acres along the Minnesota River. The bluffs south of the site (owned by Woodlake), as well as the floodplain of the Minnesota River, are included as part of the designated Upgrala (Upper Grass Lake Area) Management Unit in the Refuge and Recreation Area (Figure 31).

Figure 29.
GENERAL CLASSES OF VEGETATION NEAR FLYING CLOUD LANDFILL



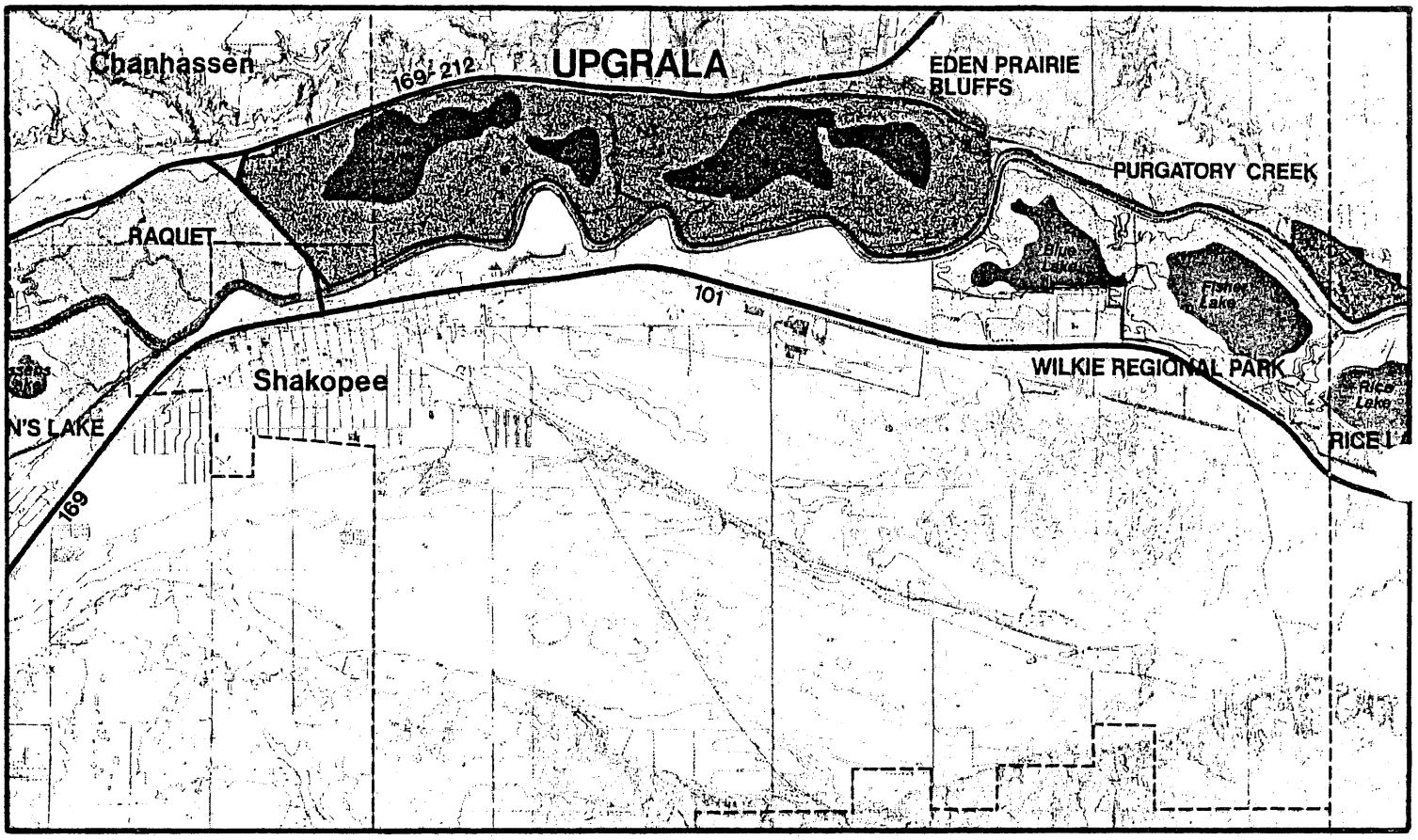
- Grasslands (old fields and undisturbed prairie)
- Urban, developed, or unvegetated areas
- Cropland
- Woodlands
- Wetlands

Figure 30.
LOCATION OF SAMPLING QUADRATS



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

Figure 31.
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..." (61). Its preferred management alternative would develop the Upgrala area south of the proposed landfill site as shown in Figure 32. 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.

Grass Lake, a type IV inland wetland, is a prominent feature in the Upgrala Unit. The lake covers 467 acres. Only about 25% of its area is open water; 75% 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 (62).

Vegetation and animal surveys were conducted in the Refuge and Recreation Area from Nov. 1978 to Dec. 1979 (63). 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.

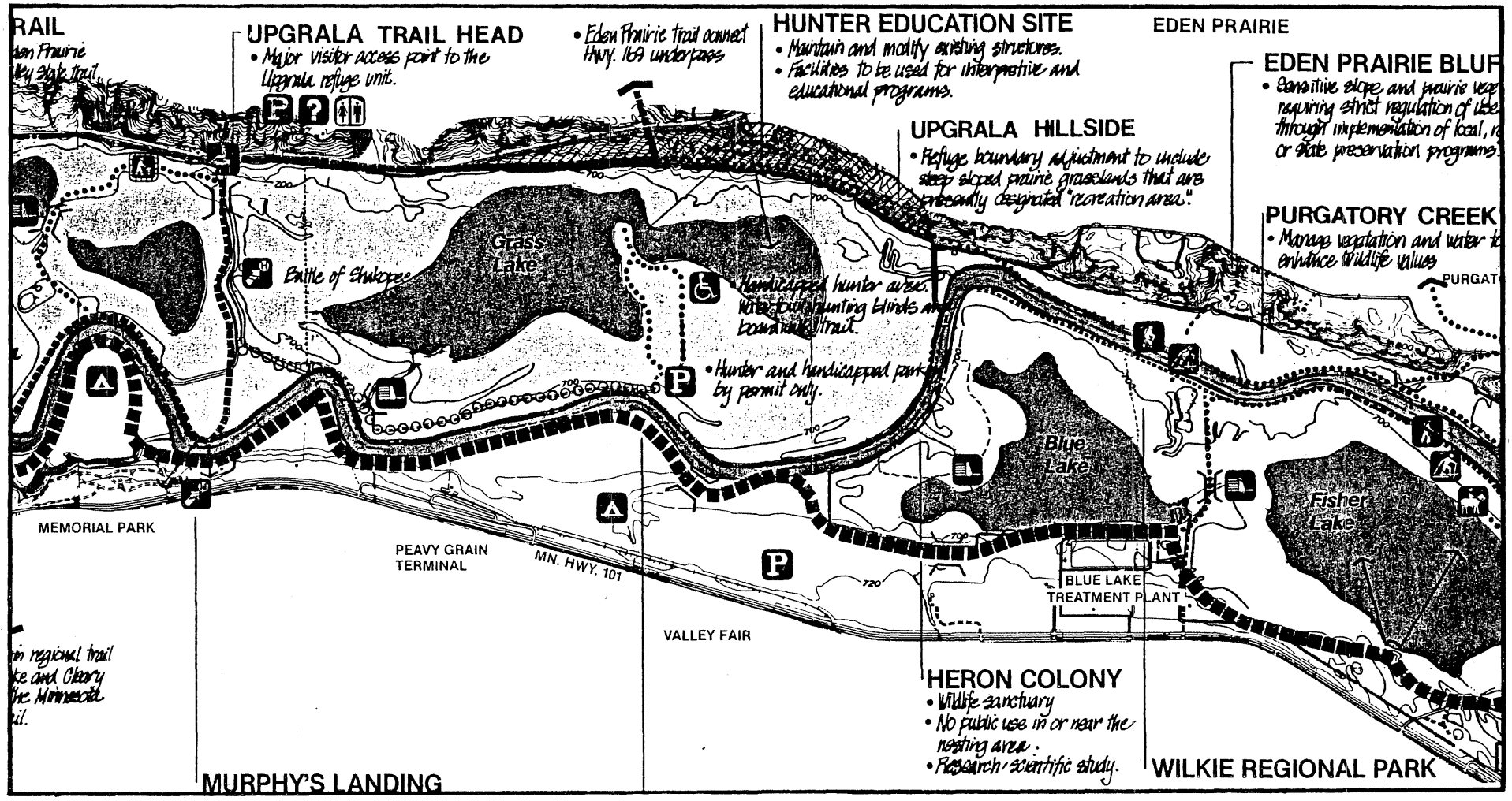
The bird transects south of the landfill covered three habitats: prairie slopes, a wet meadow edge and a floodplain forest; one transect followed Riverview Rd. The dry prairie slope had the lowest breeding bird population (158/100 acres) of the entire valley survey while the wet meadow had the highest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

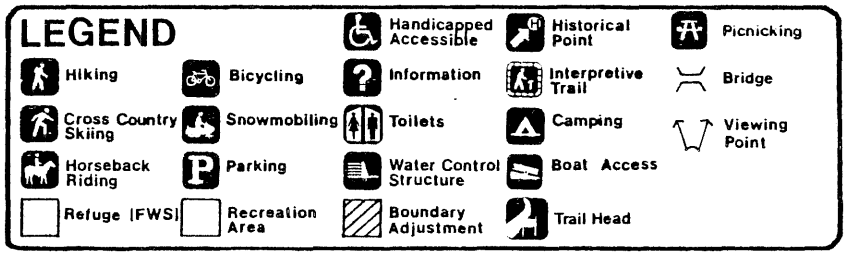
In the small mammal trapping effort, two mammals, the western harvest mouse (Reithrodontomys megalotis) and the deer mouse (Peromyscus leucopus), were found only on the bluffs below the fill. This is significant because the harvest mouse is rarely found in the Metropolitan Area. The Upgrala slope area where it occurred is one "of the most critical areas in the valley" because of its habitat value and threats from all-terrain vehicles (64).

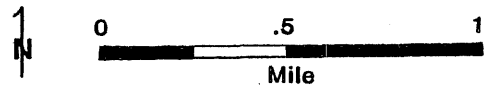
Counts of muskrat houses revealed that Grass Lake provides habitat for a number of these animals. The western arm of the lake had over 450 houses, while the eastern had nearly 300.

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 (65). 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 32. 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 migrating 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

On-site

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 (66). 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).

Off-site

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.

The sections on ground and surface water discussed the potential for contaminated surface and groundwater to reach Grass Lake and the Minnesota River. In general, impacts from runoff will be negligible, and the concentration of pollutants in leachate should be small. Since the exact composition of any contaminated waters, their parameter concentrations and their biological effects are not all known, it is impossible to unequivocably state that the potential for impacts does not exist. Based on existing information, however, it appears that impacts will be negligible or minor; no major changes in the character of the vegetation or wildlife are expected because of the expansion if proper operating and mitigating techniques are employed.

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 most easily be controlled by minimizing infiltration. Fine-grained final cover soils with permeabilities in the range of 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. The groundwater section discusses these options further.

Periodic monitoring could help ensure that any problems will be caught before they become severe and when they can be most easily remedied.

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, 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 active management of lake outflow rates, a more intensive monitoring program, installation of a leachate collection system at the fill, installation of barrier wells in the valley , or alteration of landfill final cover or contours to decrease infiltration, among other things. 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.

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 of the EIS.

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 33 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 (67).

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

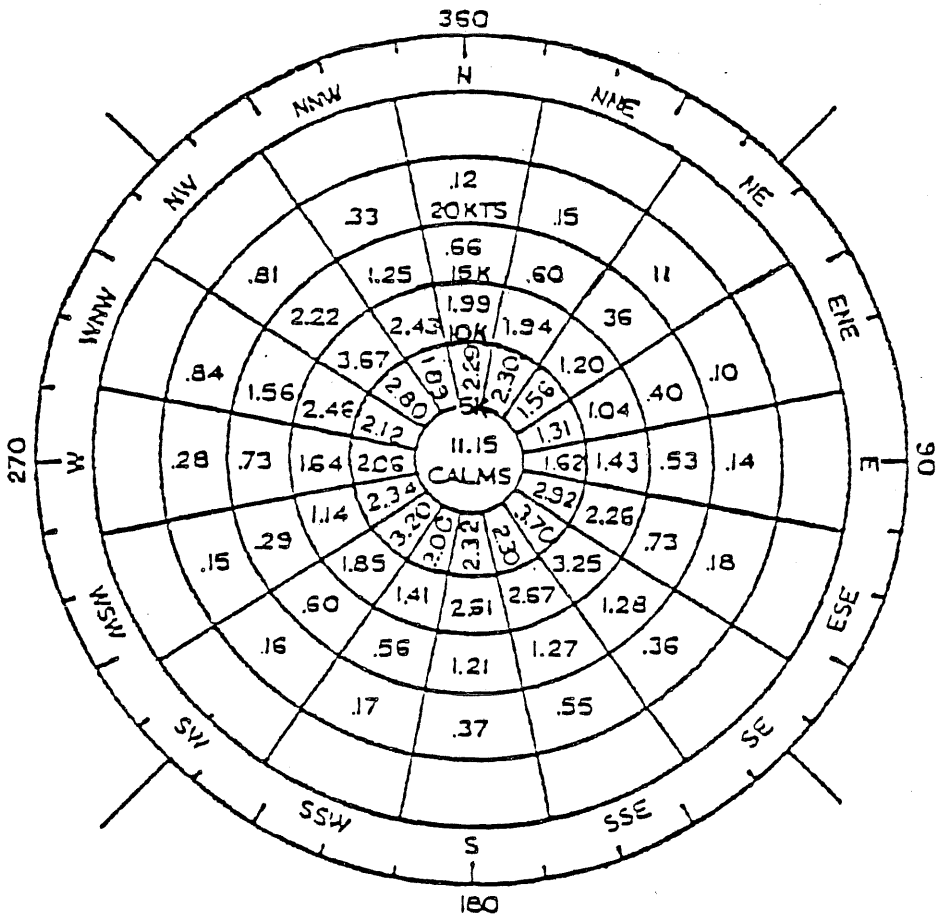
Source: U.S. Dept. of Commerce. National Oceanic and Atmospheric Administration. Local Climatological Data: Summary with Comparative Data. Minneapolis-St. Paul, Minnesota. 1982.

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 33. 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 (68).

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 (69). Presently, about 38 percent of the landfill has been seeded, partially to prevent wind erosion (70). 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 (71). 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 (72). The sandier excavated material will be removed from the site or stockpiled below grade (73). 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 (74). 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) (75). 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.

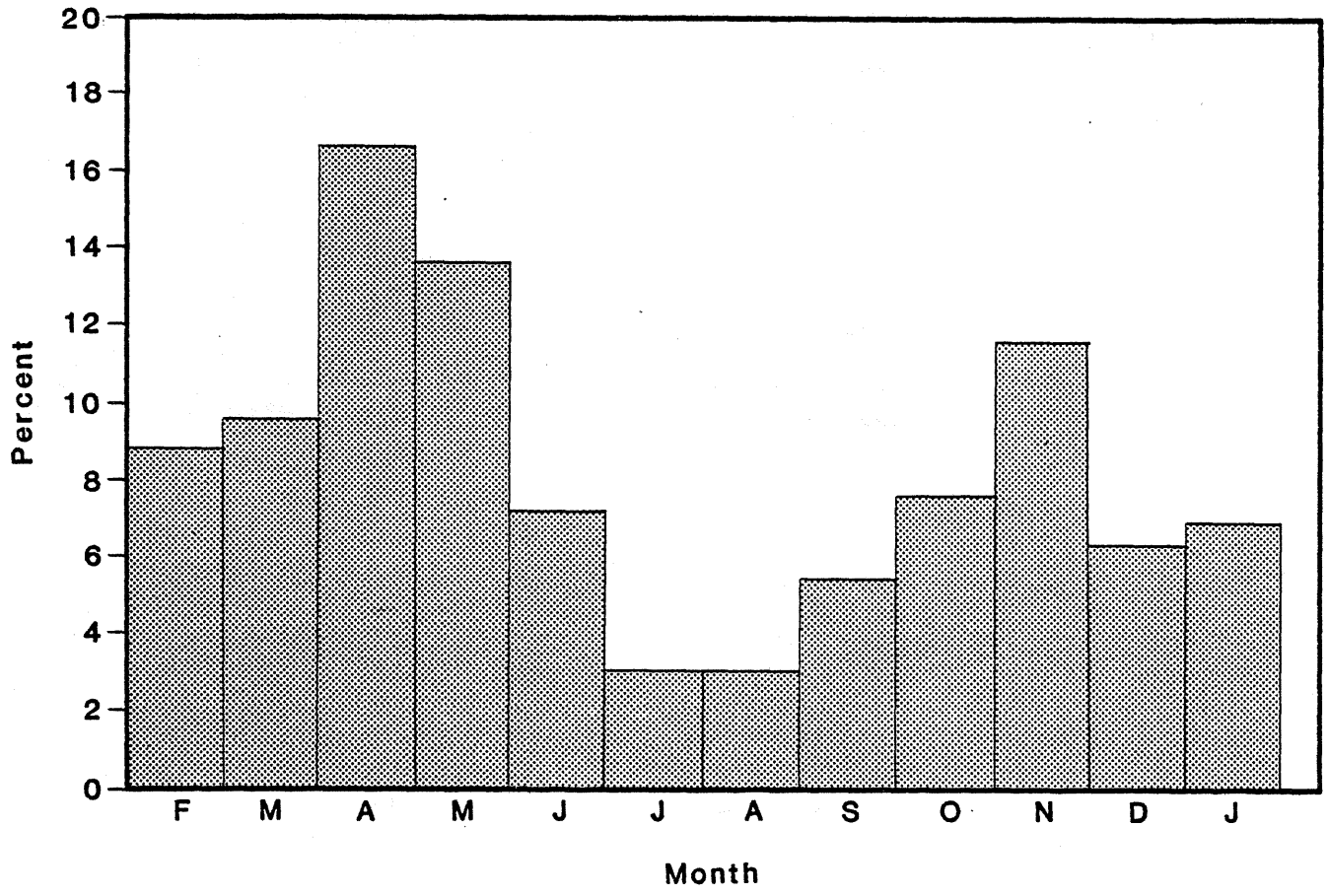
For soil particles to be eroded by the wind, a minimum critical windspeed, called the threshold velocity, must be reached. This velocity will vary, depending on factors such as soil texture, structure, moisture content, and cloddiness. As a general rule, however, the threshold velocity can be defined as winds in excess of 12 miles per hour at one foot above the ground surface (76). 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 (77). 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 34).

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 34.
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 (78).

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 (79). 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 (80). 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 (81).

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 (82). 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.) (83)

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 34). 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 (84). 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 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.

Carbon monoxide (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 (85). 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 Hot-Spot Guidelines shows this as not being a potential location where standards would be violated. The Guideline's verification technique was used to develop an estimate of the maximum 8-hour average CO concentration. If the additional traffic from the expansion

were present today, the maximum 8-hour concentration for a receptore 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 (CH_4) and carbon dioxide (CO_2) 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 ß40 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. (86). 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 35 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

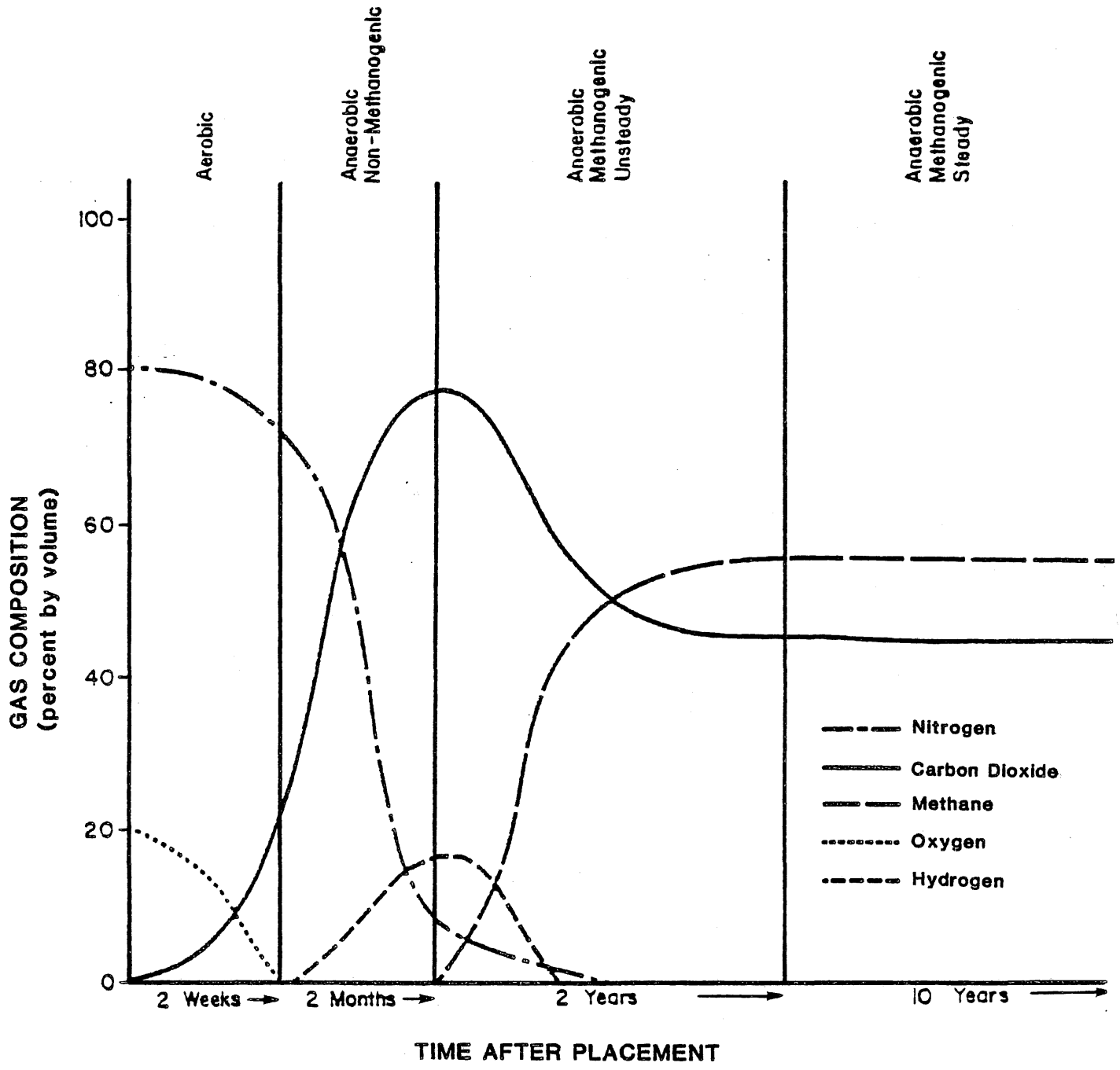


Figure 35.
TYPICAL GAS COMPOSITION DURING REFUSE DECOMPOSITION

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 (87).

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 (88). 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 (89, 90). Reserve Synthetic Fuels, a company that extracts methane for energy, has detected over 60 trace constituents in sanitary landfill gas (91). 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 (92).

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 (93, 94). 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 (95). Gas generation seems to reach a peak within two to ten years after waste has been deposited, although some gas may be produced for more than a century (96).

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 (97). 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 984). 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 (99). 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 (100). 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./cu. yd. 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 (101). 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 (102).

Migration Control

Two basic approaches to gas migration control are in general use at landfills (103). 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.

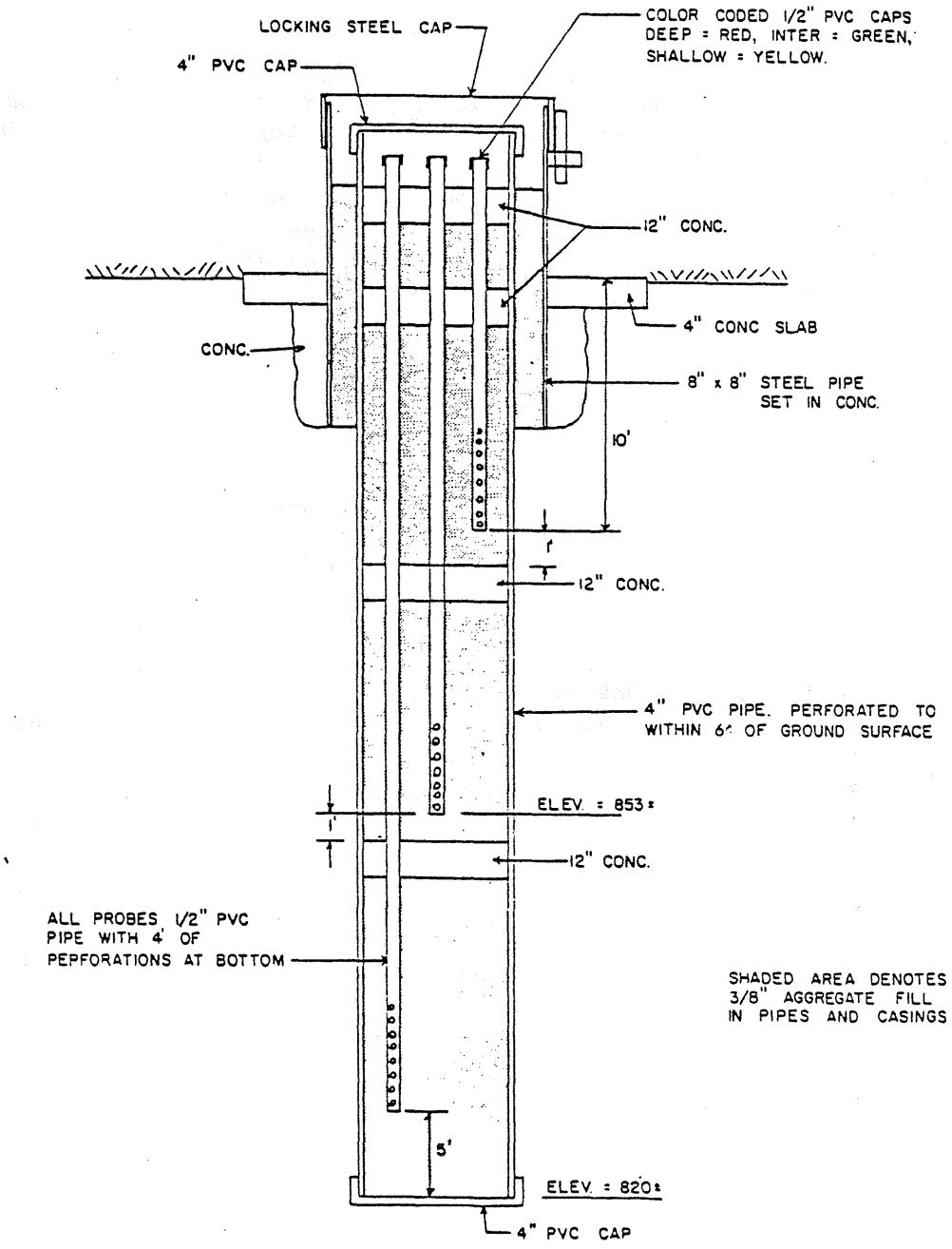
Gravel-filled trenches or wells along the landfill perimeter can function as a passive ventilation system by intercepting laterally migrating gas and providing a low-resistance path to the atmosphere. If there is sufficient soil moisture, the effectiveness of this type of system may be enhanced by the 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 (104).

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 ft. apart and are in native soils 200 ft. 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 ft.) (Figure 36). 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 (105).

Figure 36. 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 ft. deep by 3 ft. thick. The barrier comes in contact with refuse for about 1,200 ft. of its length and 20 ft. 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 (106). 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 ft. apart (Figure 37). 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 (107).

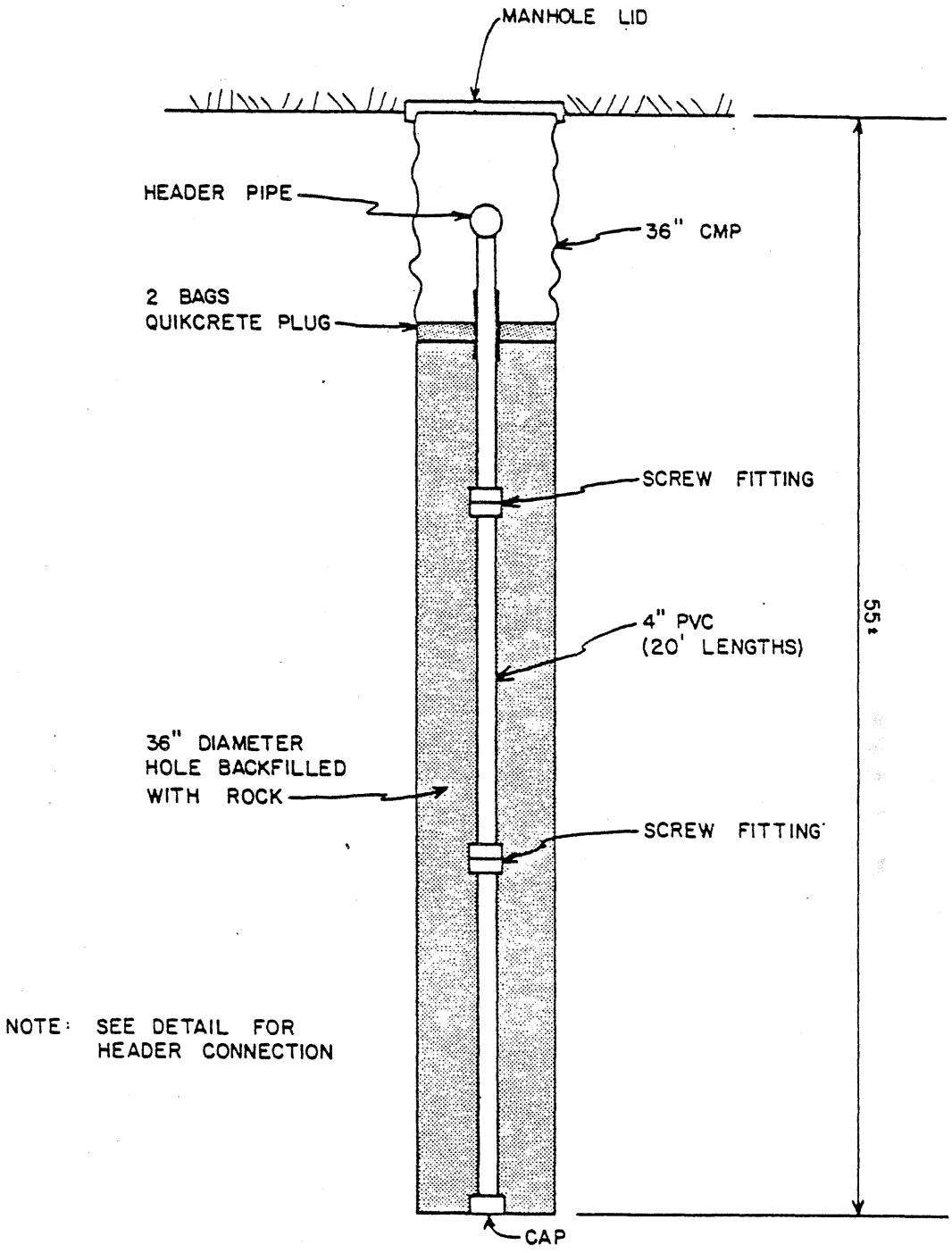
The motor/blower and scrubber are located in a building near the landfill offices. The building is equipped with an exhaust fan which is activated before entrance, and has heat and lighting designed to resist explosion. The switching equipment for the system is mounted nearby outside (108).

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 (109). 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 38 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 (110).

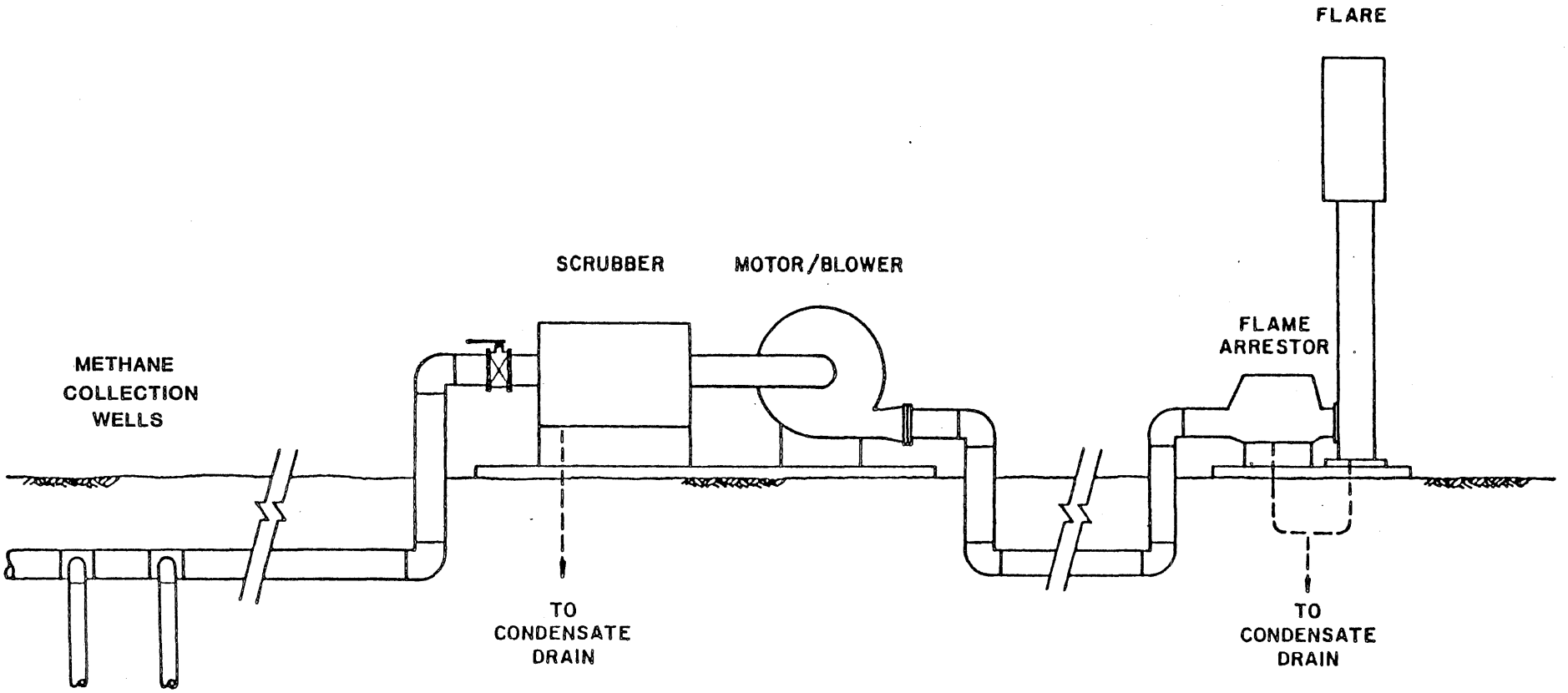
Six temporary probes were installed in and around the drive-in theater concessions building in June 1982. Methane concentrations within the explosive range were detected at these probes. Special monitoring was periodically conducted on drive-in property around the concessions building and the theater's 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. Detailed grid monitoring conducted in September 1983 showed no significant levels of methane around the drive-in.

Figure 37. METHANE COLLECTION WELL



Source: Woodlake Sanitary Service, Inc.

Figure 38.
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.

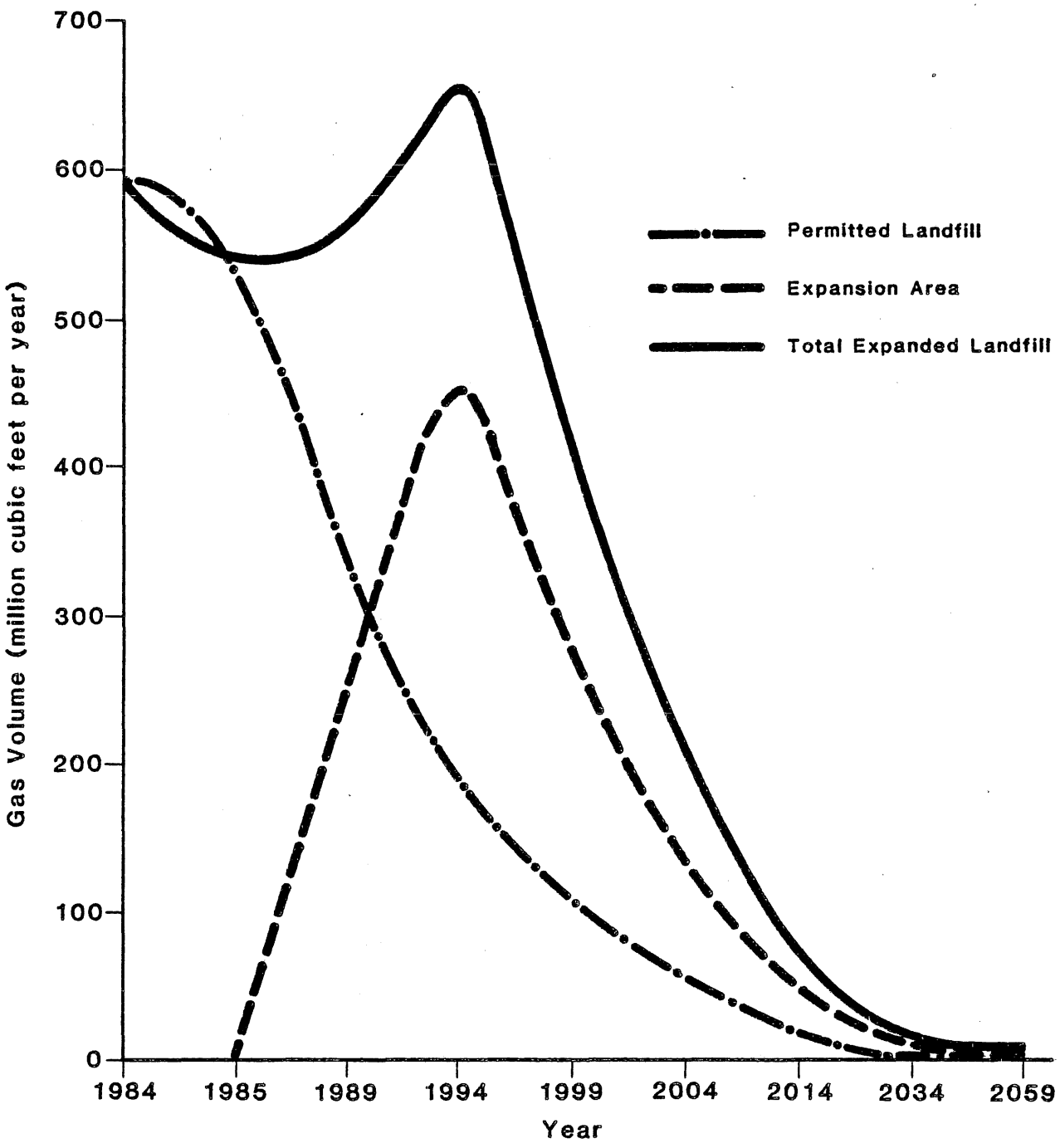
Table 24
POTENTIAL METHANE VOLUME FOR EXPANDED LANDFILL

	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 39. 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.

Figure 39.
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).

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 39 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 39, 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 (147). 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 ft., extending from the surface (900 ft. MSL) to 820 ft. MSL. The soil surrounding and underlying the landfill from the surface to approximately 790 ft. 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

This model indicates that explosive concentrations of methane could occur at distances of up to 800 ft. 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.

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 (112) (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.

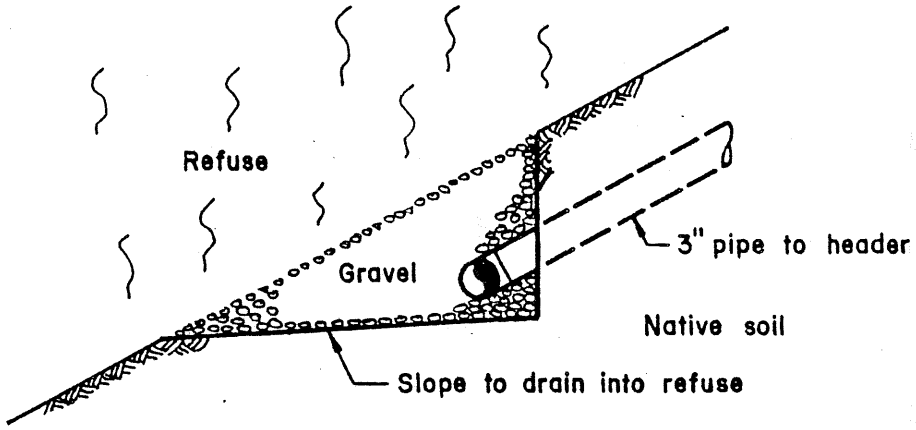
Seventeen new monitoring probes will be installed at approximately 200 foot intervals along the property lines. The probes will be located in native soil near the edge of the refuse and will be of a design similar to those already in place. Each probe will allow sampling at deep, intermediate and shallow 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 37). The existing pump system should have sufficient capacity to operate the additional wells. However, supplemental equipment will be installed if necessary.

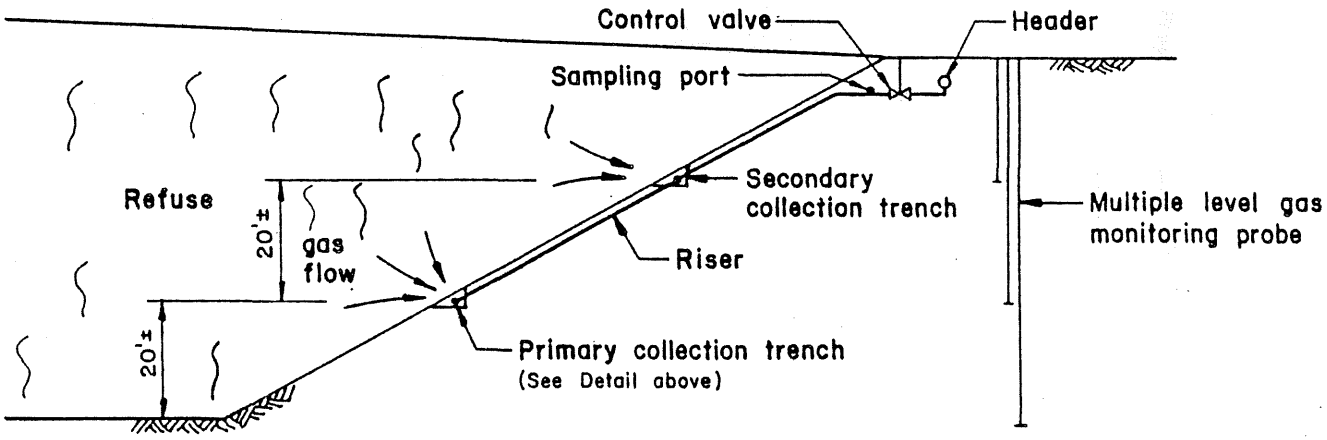
Woodlake has proposed that either a series of trench collectors or a well and header system similar to that on the western boundary be installed along the eastern perimeter. The location of the proposed trench collection system is shown in Figure 7. If collection wells are constructed they will be located 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 40). 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 41. Installation of the trench system would begin along the southeastern boundary of the site, near Bluffs West Second Addition. The secondary trench would be constructed along the rest of the border only if operating experience proved it necessary.

Figure 40.
METHANE TRENCH COLLECTION SYSTEM
(CROSS-SECTION)



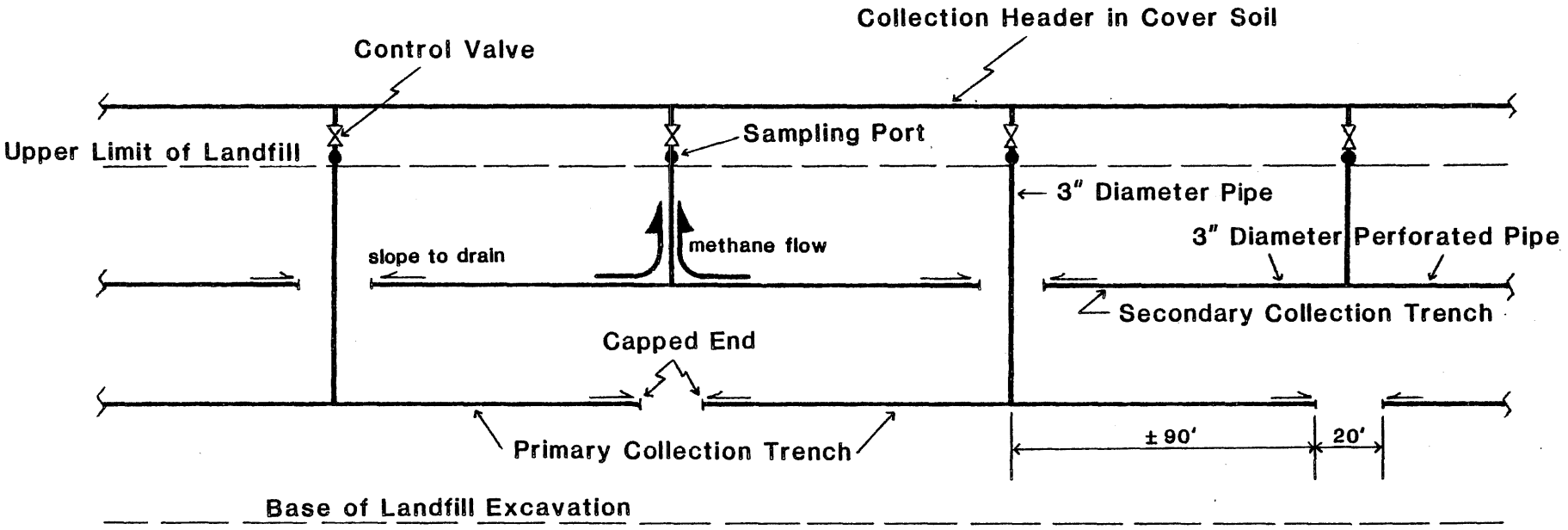
Typical Collection Trench Detail



CROSS SECTION
Typical Collection Trench System

Source: Browning Ferris Industries, Inc.

Figure 41. METHANE TRENCH COLLECTION SYSTEM



Source: Browning Ferris Industries, Inc.

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 (113). Insulated polyeurethane (PVC) tubing would be used to prevent freezing.

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 non-functioning 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 (114).

In general, active trench vent systems and well and header systems are considered to be roughly equivalent in effectiveness (115). 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 (116). 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 (117). 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 (118). 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 (119). 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 (120). 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 (121).

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 Second Addition, 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 Road)	1,200	500
Vacant lots (Sandy Point Road)	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 ft.) 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 1300 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 ft. 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 ft. from a landfill, although severe damage seems to occur more often at distances of 100 ft. or less (122). 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 (123).

The river bluffs are approximately 100 ft. from the existing landfill. The expansion proposal allows for a greater setback, leaving at least 200 ft. 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 (i.e., 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 (124). Several studies have been conducted

which gauge the suitability of various plant species to the landfill environment, including their tolerance to landfill gases (125, 126). 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 (127). 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 feet 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.

The above approach might not mitigate the potential for impacts on nearby occupied residences (which are as close as 900 feet) 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.

NOISE

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, (abbreviated 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 that are recorded for each fraction of the hour (L_x) are reported. For instance, an L_{10} noise level represents the dBA level that was reached or exceeded for 10 percent (six minutes) of the hour. An L_{50} noise level represents the dBA level that was 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 42). 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' 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

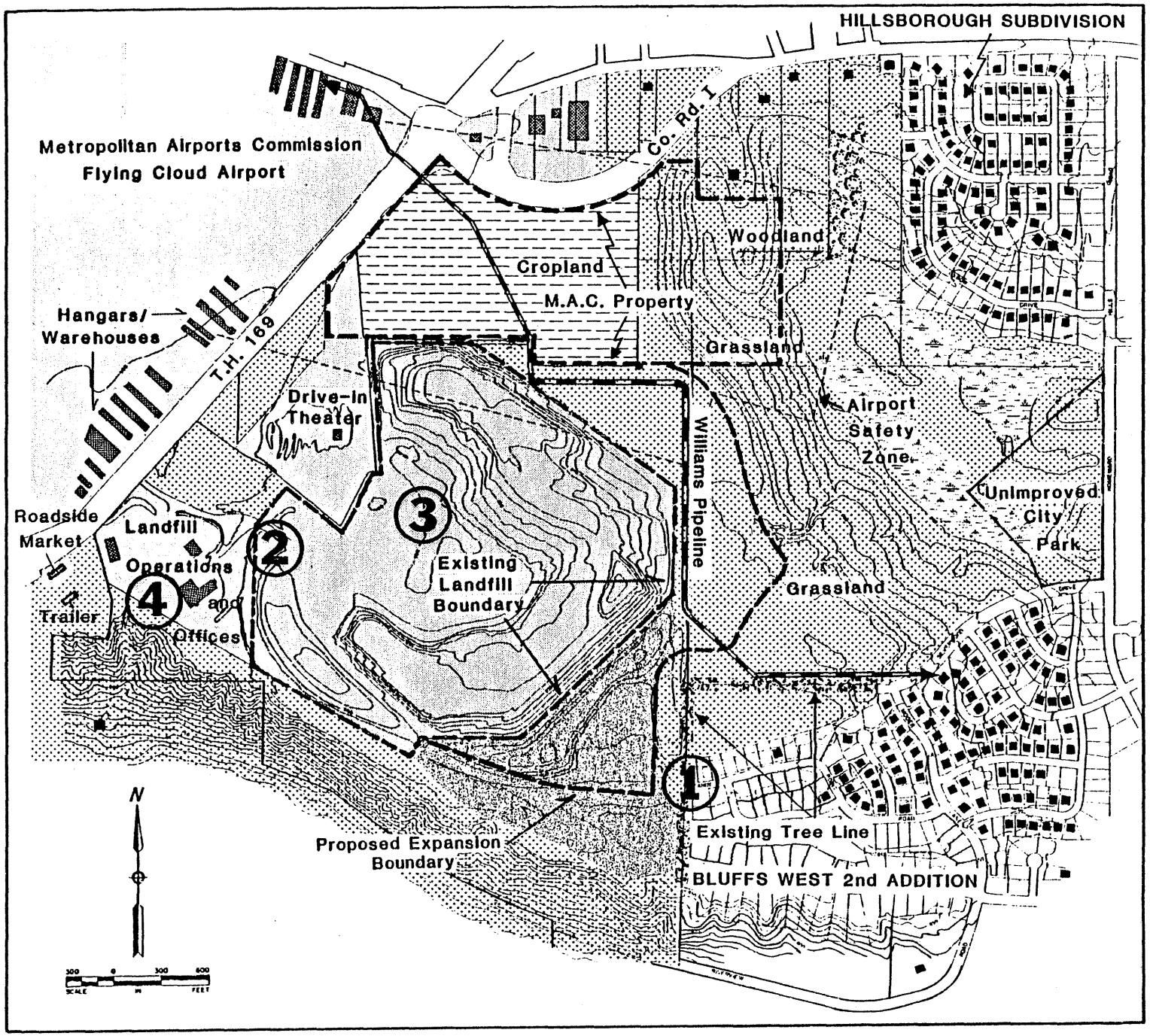


Figure 42.
MONITORING LOCATIONS

- 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 43. 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.

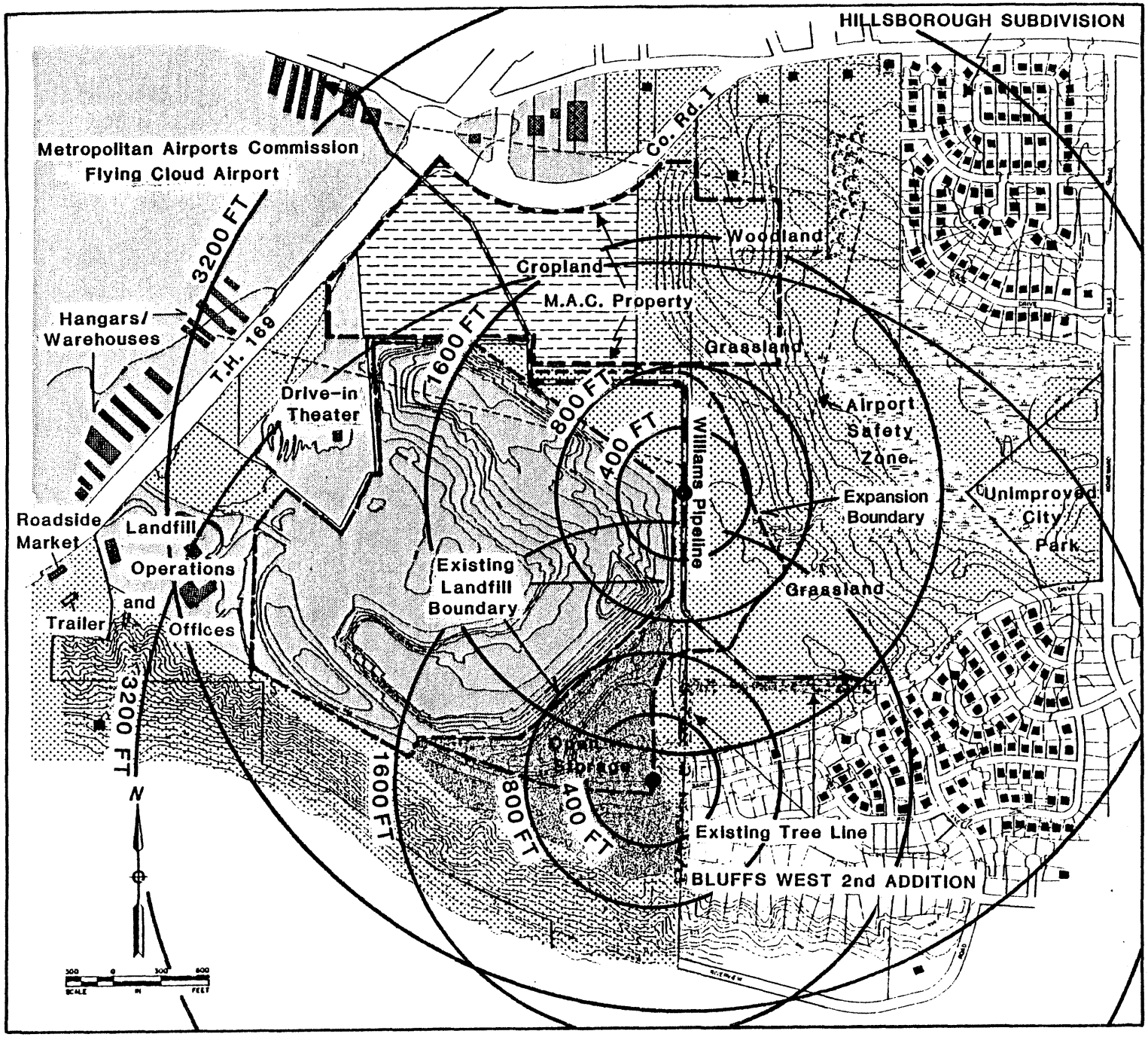


Figure 43.

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 Addition. 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. 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 43). 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.

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 itself 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, say, 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 as stowaways 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) (188). 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 (128).

A study conducted in 1978 concluded that landfills do not seem to be conducive to the growth of rat populations (129). 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, another vector, 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 PCA rules) discourage flys, 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 (130).

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 (131). 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 (132). 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 (133).

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 (135). All landfill vehicles on 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 9 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 provide 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 TH 169 (135).

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 constuction 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 as to 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 (136). 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 indicates 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 TH 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) enduring 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 Service 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 effeciency 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 area.

The snow fence around the landfill area, the chain link fence around the property and the berm will trap some litter. However, the snow fence and chain link fence 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 highways 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 100 ft. 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 wind-blown 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 which 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 44).

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 44):

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

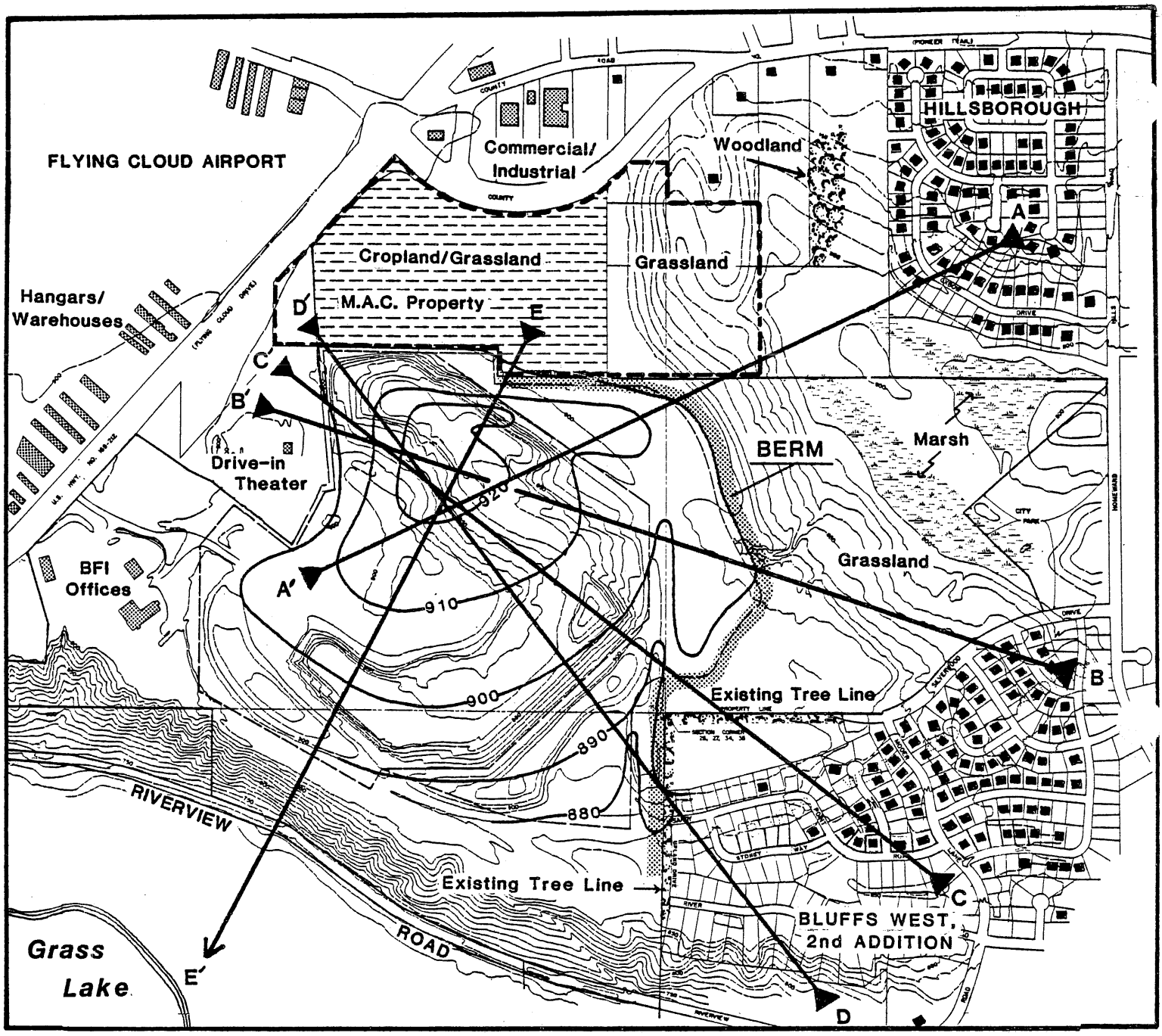
One from across the Minnesota River to the south to examine impacts on the Minnesota Valley National Wildlife Refuge and Recreation Area.

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 44 and 45) 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´ MSL.

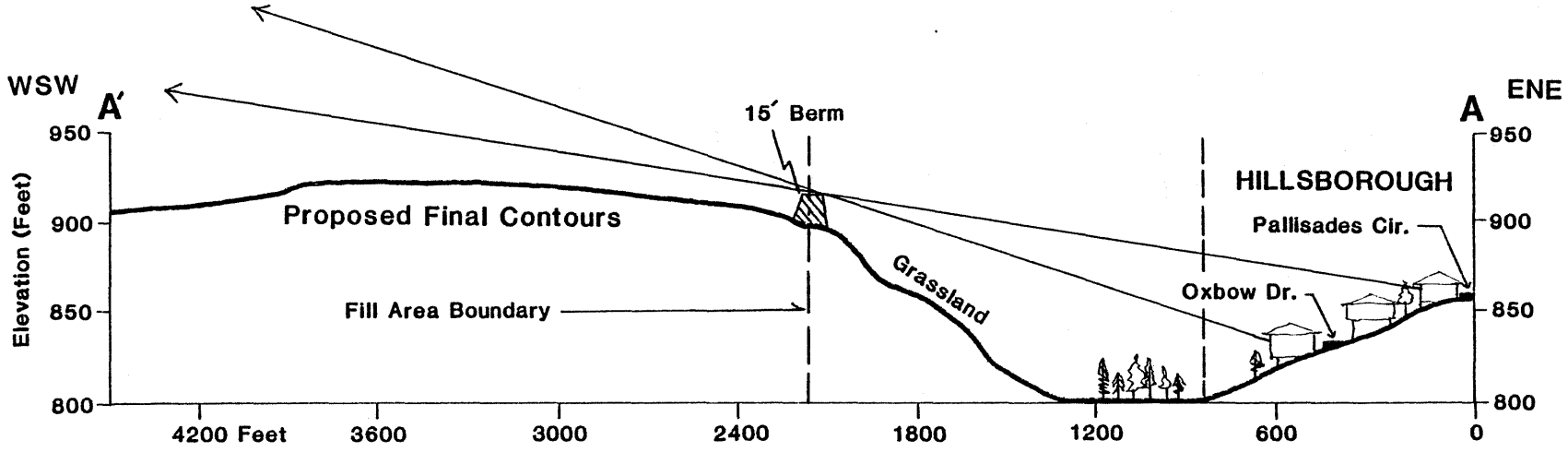


Base Map Source: G.M. Sunde, Consulting Engineer

Figure 44.

CROSS-SECTION LOCATIONS

Figure 45.
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' MSL, and the lower level follows Oxbow Dr. at 800'-830' MSL. The low, marshy area between the landfill and Hillsborough is located at 800' 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' MSL to 900' MSL. The proposed 15-foot berm will extend above the landfill perimeter from elevation 907' to 915' 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 actual 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' MSL) and from all the houses at lower elevations (Figure 45). 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' MSL in Hillsborough indicate a berm elevation of 910' MSL would screen landfill activity up to an elevation of 927' 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 44).

The first of the cross-sections B-B´ (Figures 44 and 46), 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´ 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 to 80 feet below the present elevation of the landfill expansion area.

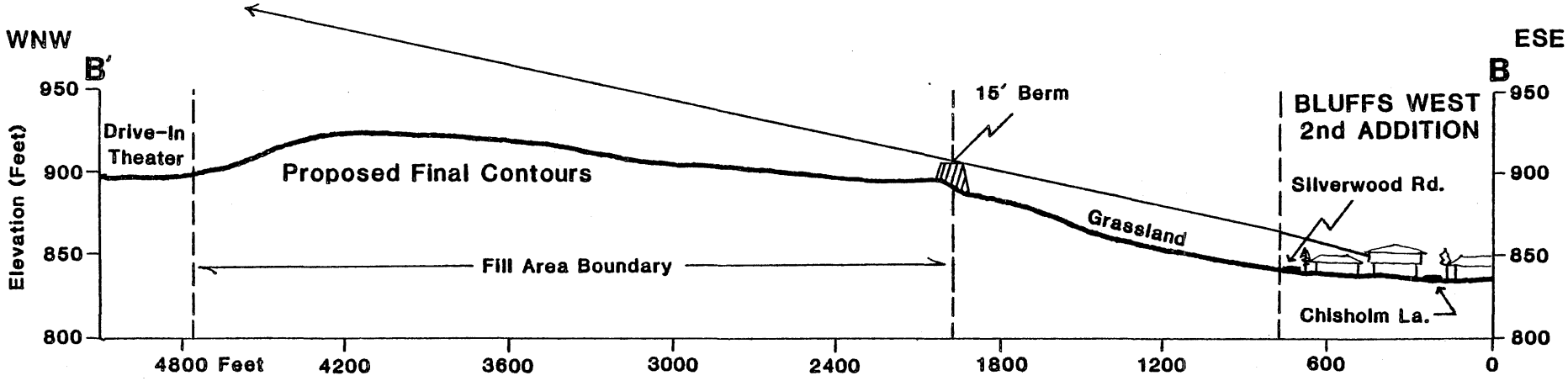
A portion of the landfill expansion extends to near the perimeter of the upland which runs northwest-southeast and has no existing shrubs or trees to block the view to the nearest houses along Silverwood Dr. These houses, combined with the downward slope away from the landfill and existing neighborhood 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 46). However, filling and equipment activity at the eastern perimeter of the expansion would be seen. A 15-foot berm would rise to elevation 905´-910´ 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´ MSL north of the lots along Sandy Pt. Rd. to 850´ 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 47). Approximately 500 feet north and northwest, between the slope and the edge of the landfill expansion, is a line of conifers standing 15 to 20 feet high (Figure 12). There are several gaps in the tree line. The proposed 15-foot berm would rise to 910´ MSL 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 46.
CROSS-SECTION B-B′ FROM DEVELOPED AREA OF BLUFFS WEST TO PEAK ELEVATION OF LANDFILL

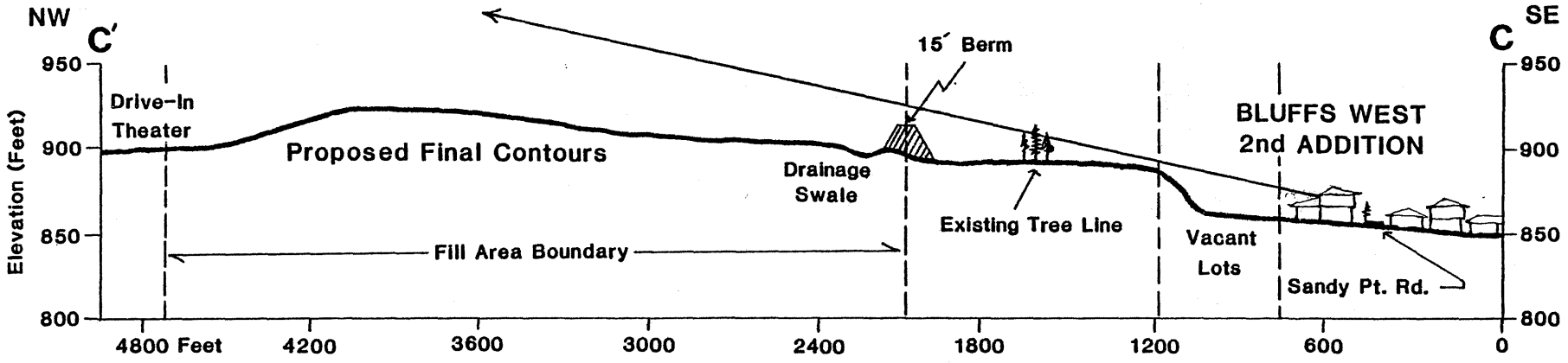


For Illustration Only

Vertical Exaggeration: 6x

Figure 47.

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.

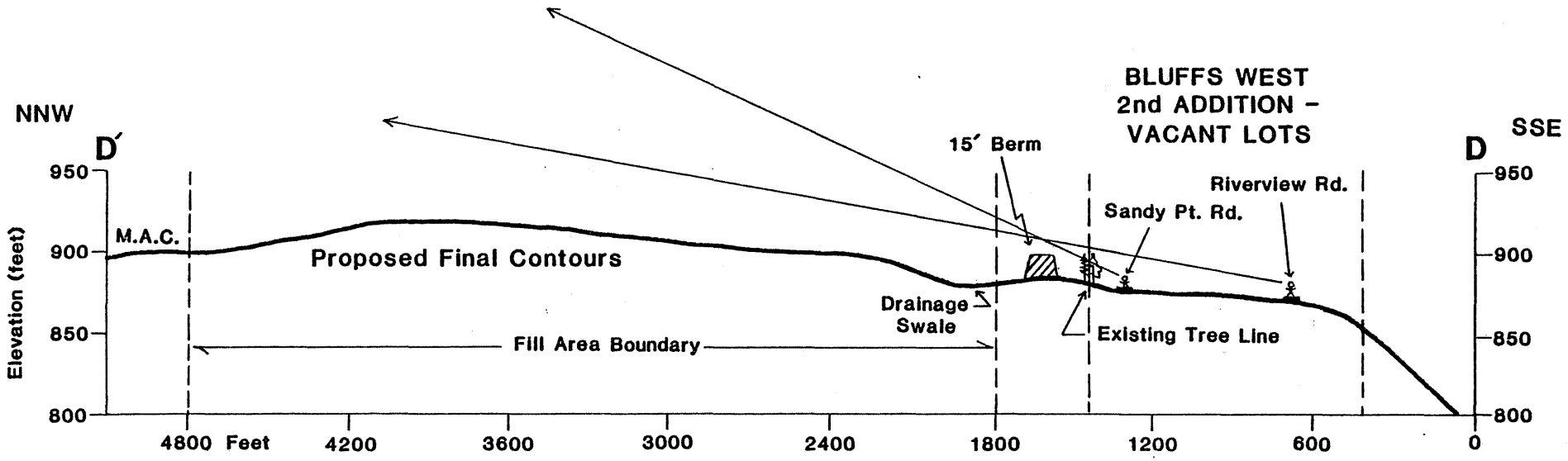
The third cross-section from the Bluffs West Addition, D-D' (Figure 48), represents one view of the proposed expansion from the vacant Sandy Point Rd. area. Houses at the western edge of the subdivision would be located 200 feet from the expansion and next to the berm. Houses along the planned alignment 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' MSL at the northwestern corner to 860' 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' MSL before a berm is constructed. The 15-foot berm would rise to 910' MSL northwest of the development (near section corner 26, 27, 34, 36) and slope down to approximately 880' MSL near the western end of the River View Rd. alignment.

Figure 48 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' 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' MSL, compared to the proposed 923' MSL, to be visible from a second story window at River View Rd. and to approximately 1,040' 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- to 25-foot high ridge located between the pond and the vacant subdivision will be graded down to 880'-890' 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' MSL or 10 to 15 feet below a 15-foot berm which would screen most landfill activity. The existing line of 15- to 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 48.

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' MSL with a second story view at approximately 885'. 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' MSL, however, operations farther west and northwest of the houses at or above 890' 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

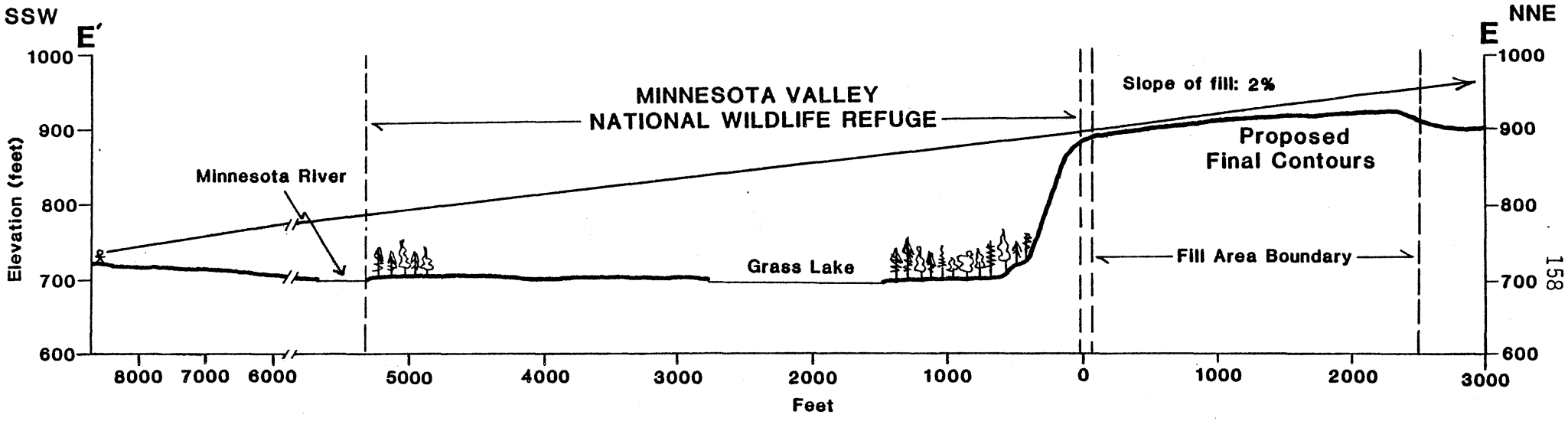
Because of the prominent location of the landfill along the Minnesota River valley bluffs, the proposed project could potentially effect views from within the valley and the National Wildlife Refuge and Recreation Area particularly around Grass Lake. The Refuge boundary extends to the top of the bluff on the landfill property at approximately 870'-880' 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.

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' 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' MSL and the river valley at 700' 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 49) represents one view of the landfill from the river valley and the Refuge. The Minnesota River floodplain lies at approximately 700' 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' 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' 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 TH 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 49.
CROSS-SECTION E-E′ FROM LANDFILL ACROSS THE MINNESOTA RIVER FLOODPLAIN



For Illustration Only

Vertical Exaggeration: approximately 5.5x

Figure 50 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.

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' 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.

Other Visual Impacts

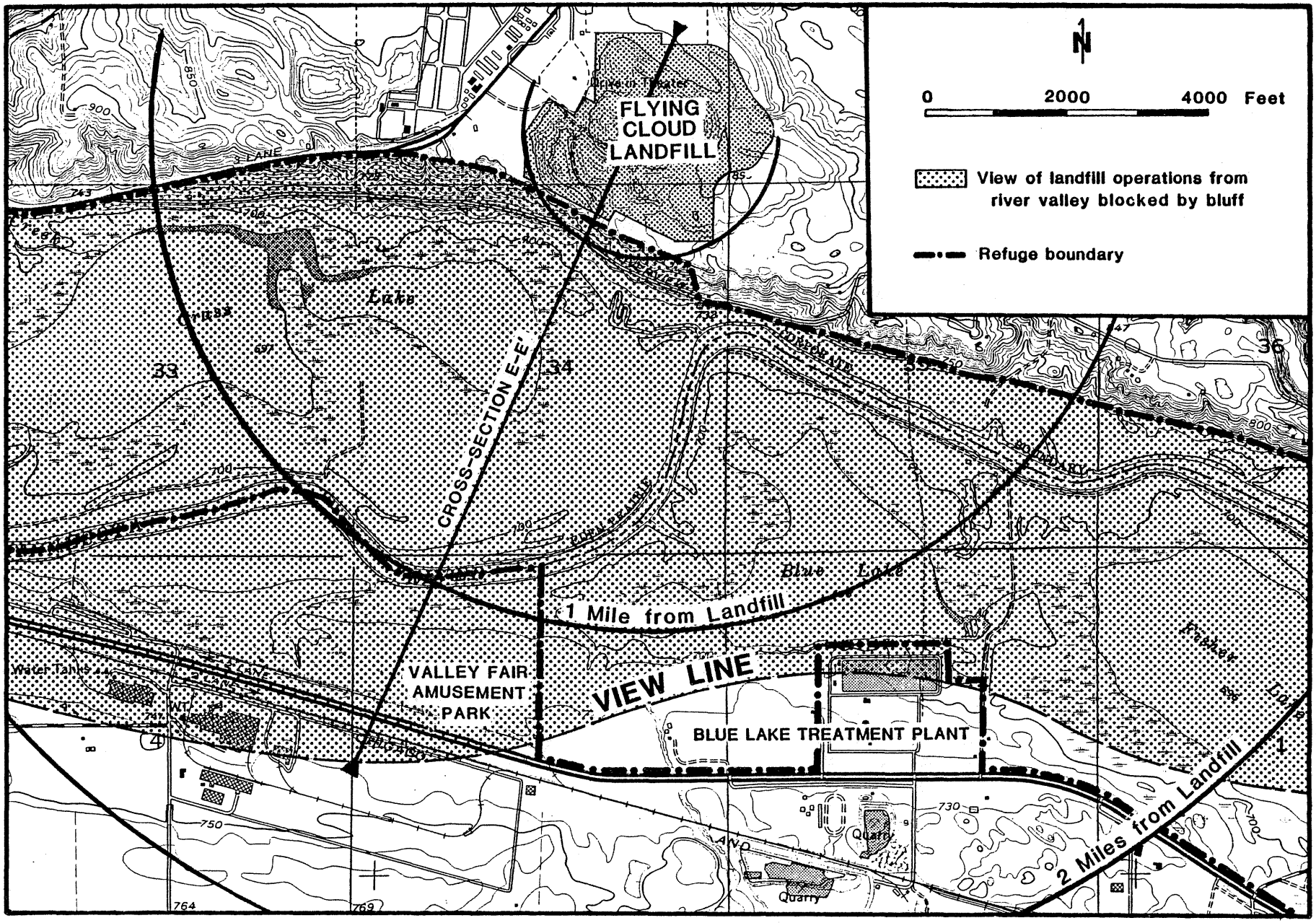
The Flying Cloud Drive-In adjoins the landfill site on the northwest. Although landfill operations above 900' MSL would be visible a short distance away, there would be little impact because of the night pattern of theater operations. This activity would be short-term until final fill and cover placement are completed.

Scattered commercial/industrial land uses are located along 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.

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 44). Elevations of the houses range from 860'-870' 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' MSL houses once the vertical expansion reaches 914'-917' MSL

Figure 50.
VISUAL IMPACT OF THE FLYING CLOUD LANDFILL ON THE MINNESOTA VALLEY NATIONAL WILDLIFE REFUGE



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' 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' 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' 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.

An undeveloped city park is located directly east from the expansion at or below elevation 800' 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' 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' 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 TH 101 in the City of Shakopee. 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 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 51).

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 two percent (Figure 51) (137).

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 (138). 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 51).

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 (139). Under ideal conditions on a multi-lane 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 (141).

Daily Capacities

The daily capacity level for Hwy. 169 is 24,000 vehicles per day (142). 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 52) (143).

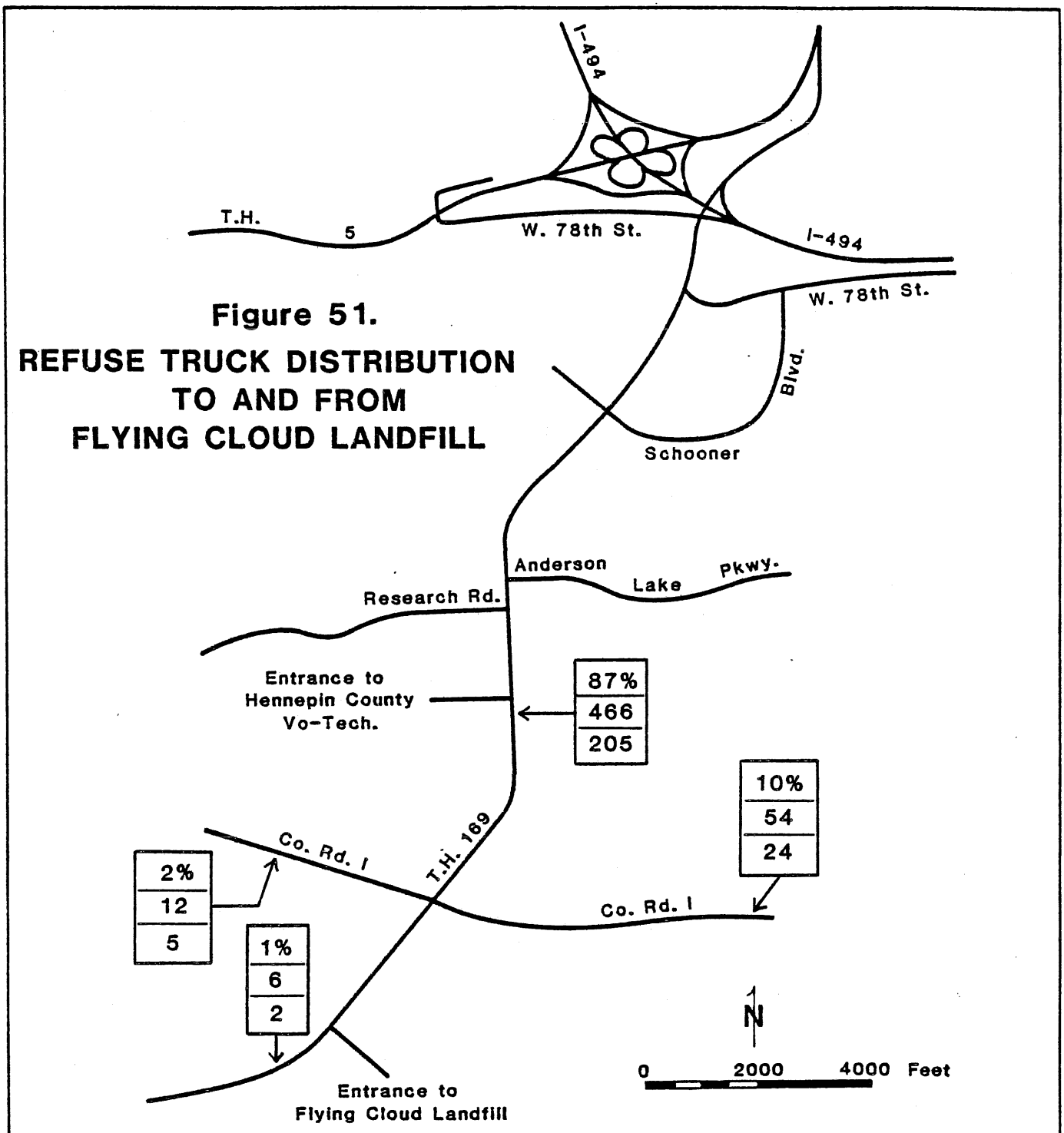


Figure 51.

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.

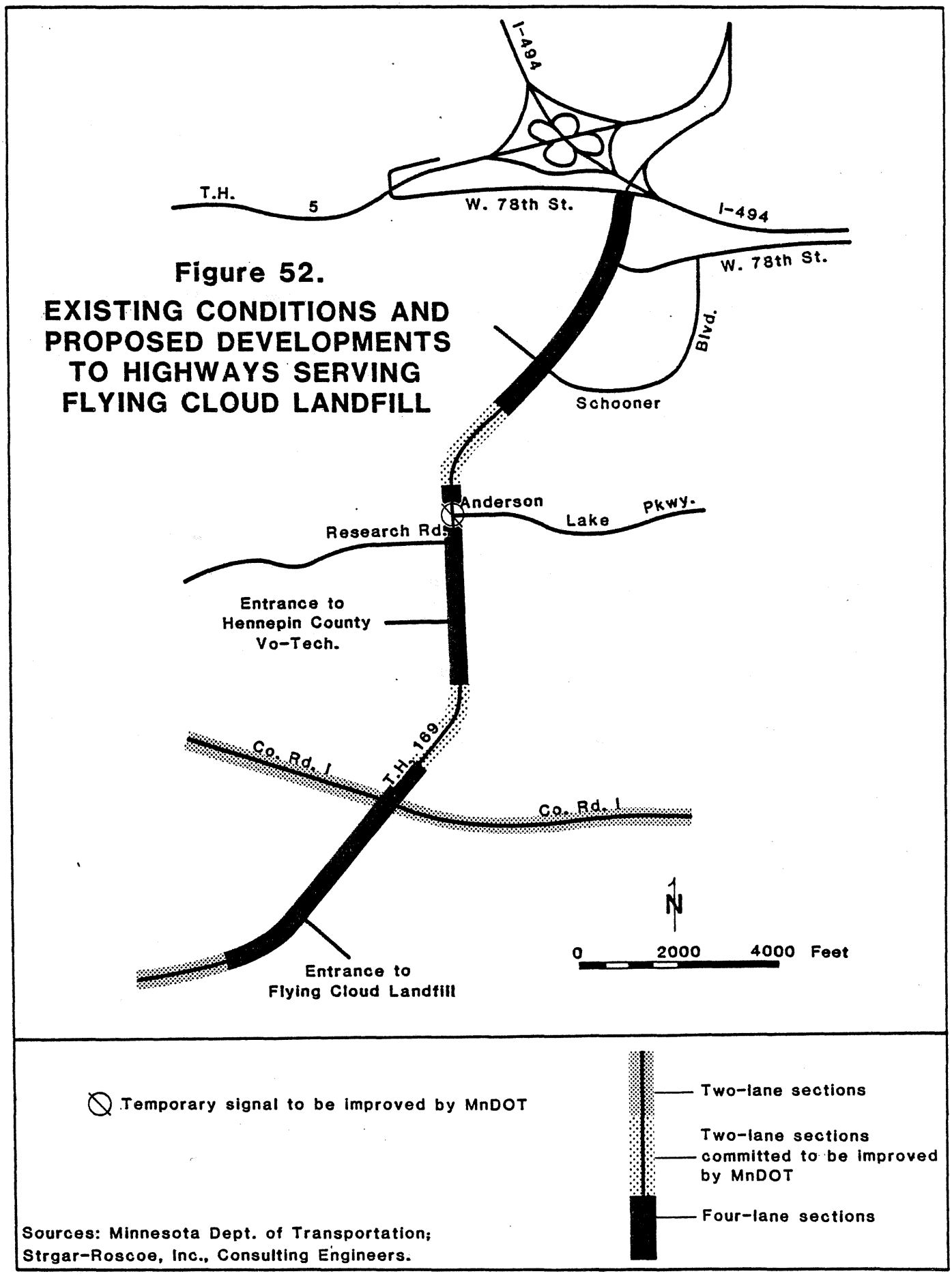


Figure 52.

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 (144).

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 4-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 (145).

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 53) (146).

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.) (147). 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, 2 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 54) (148). 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.

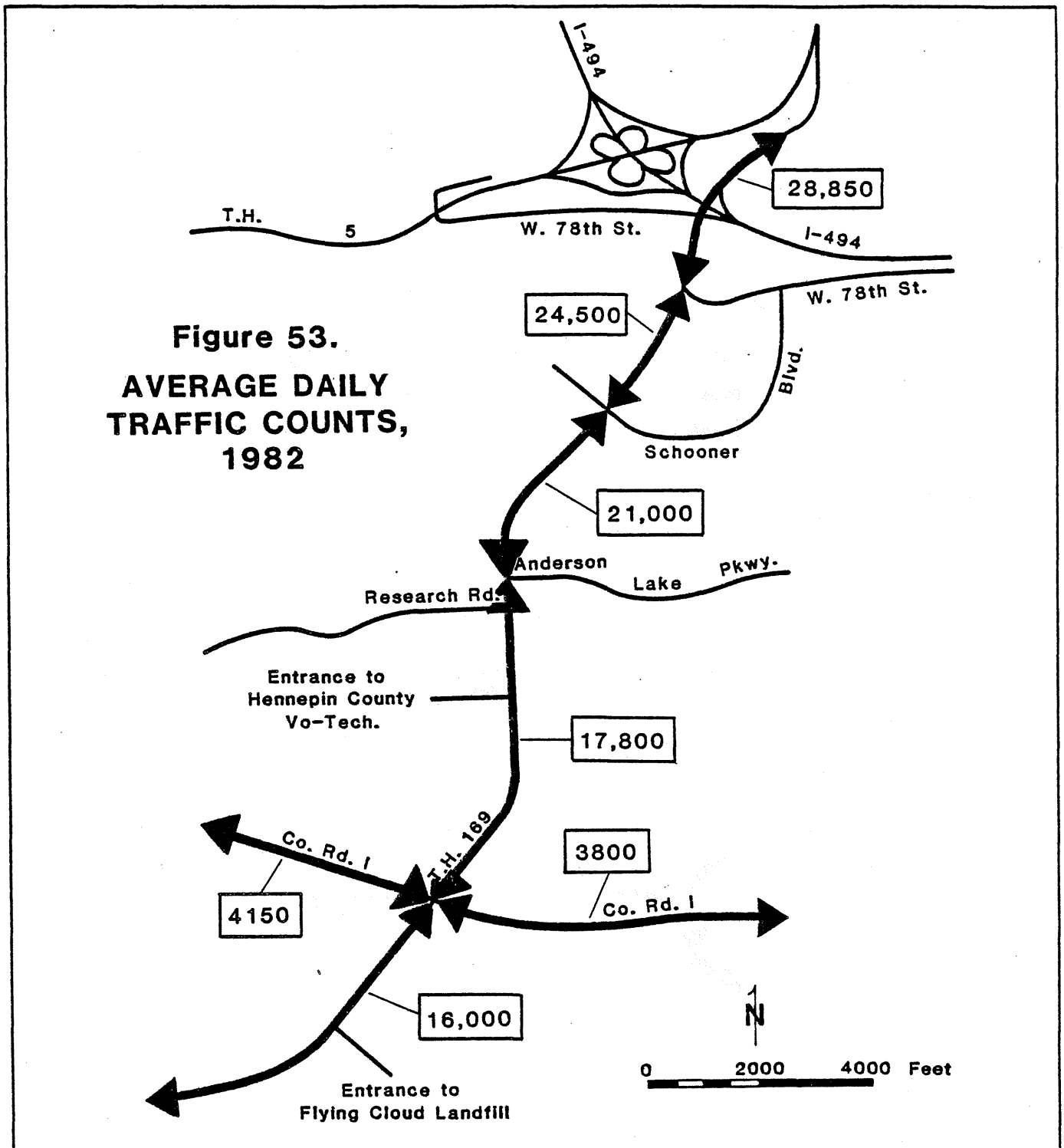


Figure 53.

AVERAGE DAILY TRAFFIC COUNTS, 1982

XXXX

Average daily traffic count, both directions

Sources: Minnesota Dept. of Transportation;
Metropolitan Council

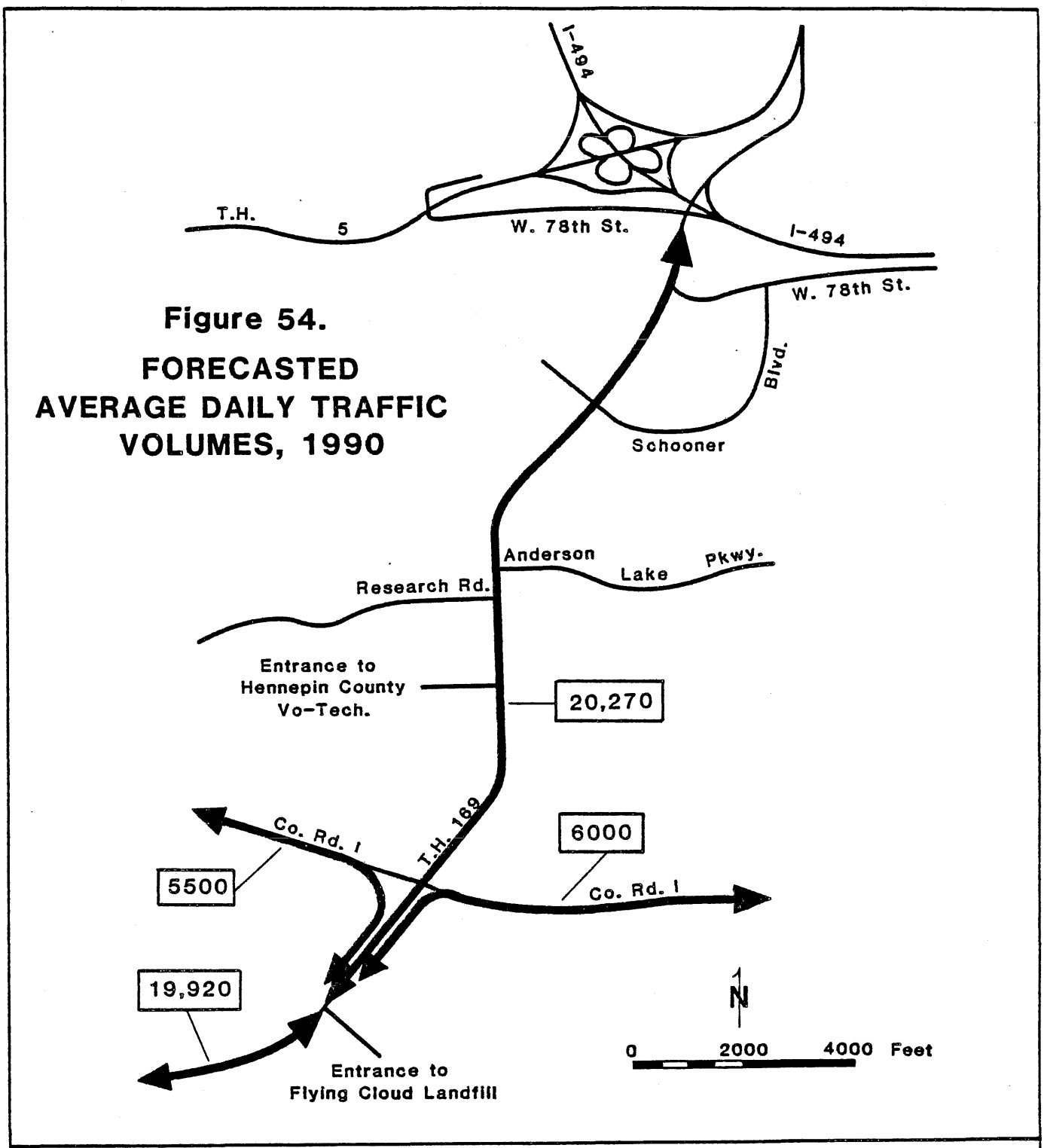


Figure 54.

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 on 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 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 55 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 55 also indicates, the refuse truck traffic is currently a small percentage of the total traffic on TH 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.

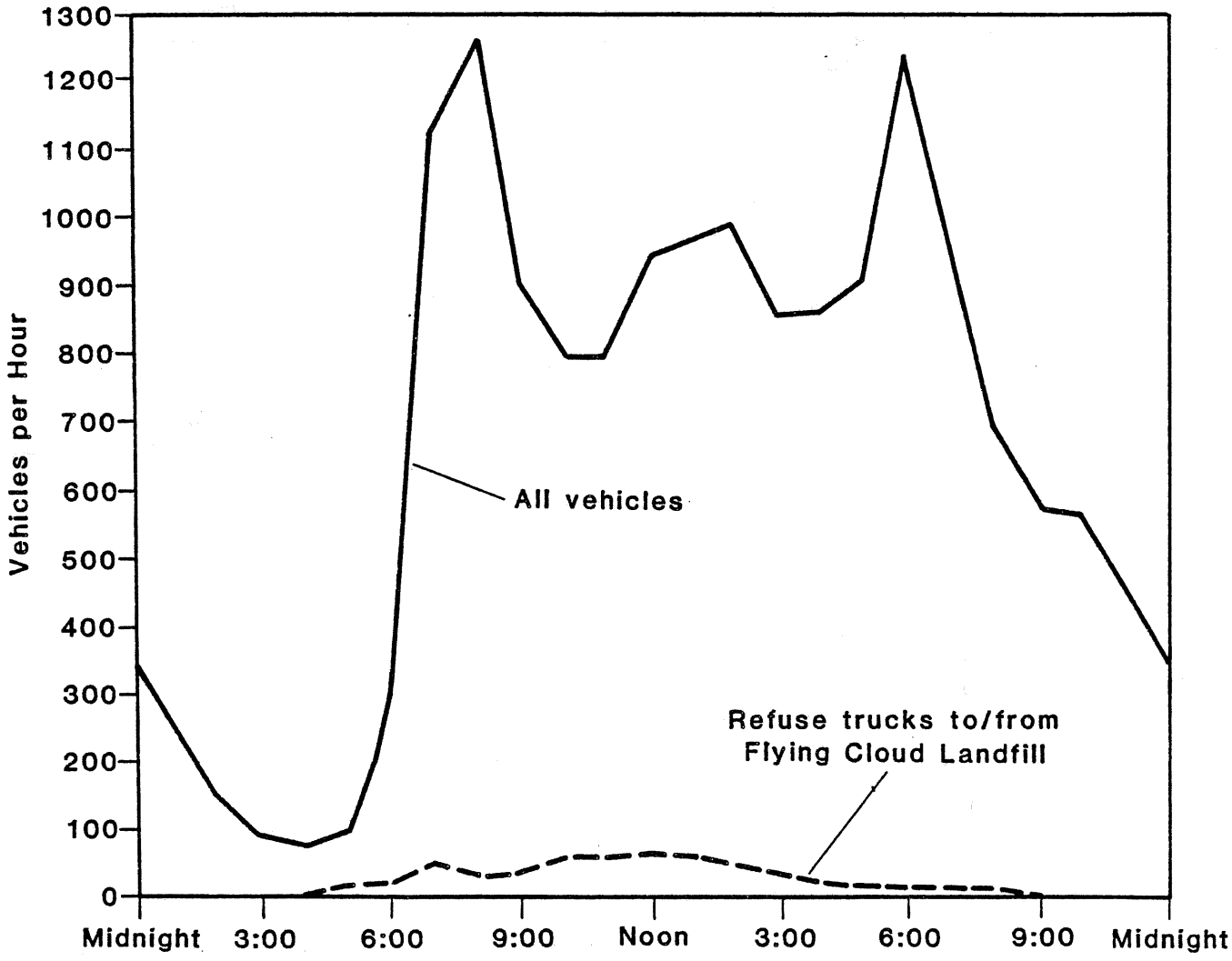
The traffic numbers during any one hour are not significant in terms of the traffic using TH 169 or County Hwy. 1. In 1989, under scenario three (the highest forecast), the a.m. peak is estimated to be 138 vehicles (five percent of the 2,751 vehicles to/from the landfill). These 138 vehicles would represent nine percent of estimated peak-hour traffic in 1990 on TH 169. The impact of this traffic is similar if the estimated hourly capacity of TH 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 affect 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 TH 169 and 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/TH 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 55.

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 (149)

TH 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 (150). 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 (151).

County Hwy. 1 is a nine-ton (per axle) year-round highway with no restrictions attached (152).

At present, the physical condition of both TH 169 and County Hwy. 1 is considered to be fully operable, meaning there are no hazardous operating conditions (i.e., pot holes, cracks, etc.), or destruction of the load carrying capacity by vehicles using the roads (153).

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. (154). This range in weight depends heavily on the distance in feet between axle centers (155). The new larger trucks that service the landfill are three-axle trucks with a loaded carrying capacity that ranges 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 (156). 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 (157). In the report, "analysis was performed to determine the accident experience that relates to refuse trucks." The analysis found that:

> 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 56). 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 TH 169 near the landfill. A Police Department representative suggested that TH 169 should be a divided highway from I-494 to south of the landfill to improve safety and potentially reduce accidents. He stated that TH 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 north-bound 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,

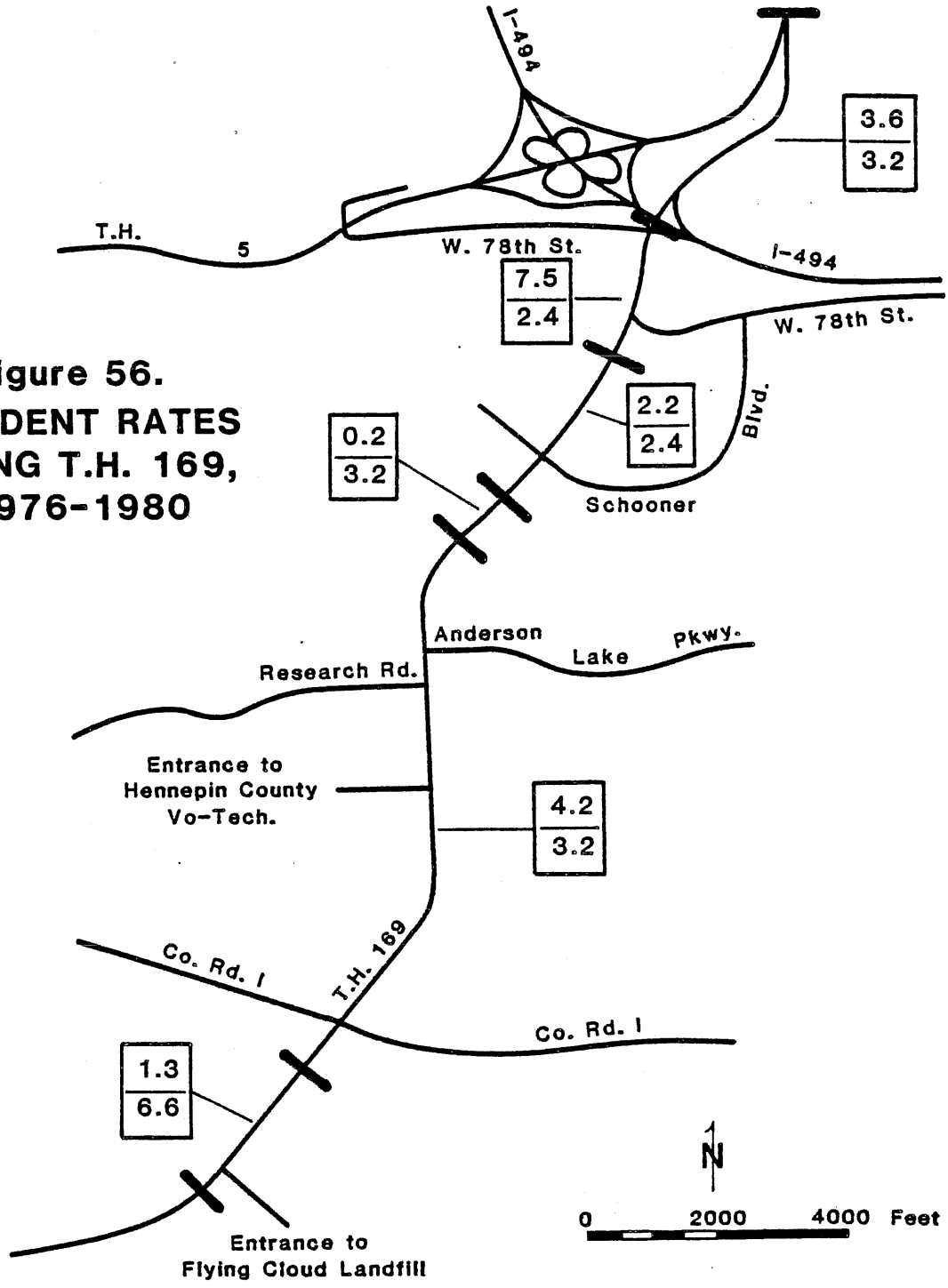


Figure 56.
ACCIDENT RATES ALONG T.H. 169, 1976-1980

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 north-bound through-traffic while impairing the vision of left-turning vehicles from the landfill and south-bound 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 (158).

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 (159). 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 affect 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, waste water treatment, and open space for the Seven County Metropolitan 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, the 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 Metropolitan 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 Metropolitan 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 summer 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 of its relatively low cost 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 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 directly or indirectly 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 of the EIS the Flying Cloud Airport and the landfill have coexisted 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 U.S. Federal Aviation Administration. 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 will continue 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.

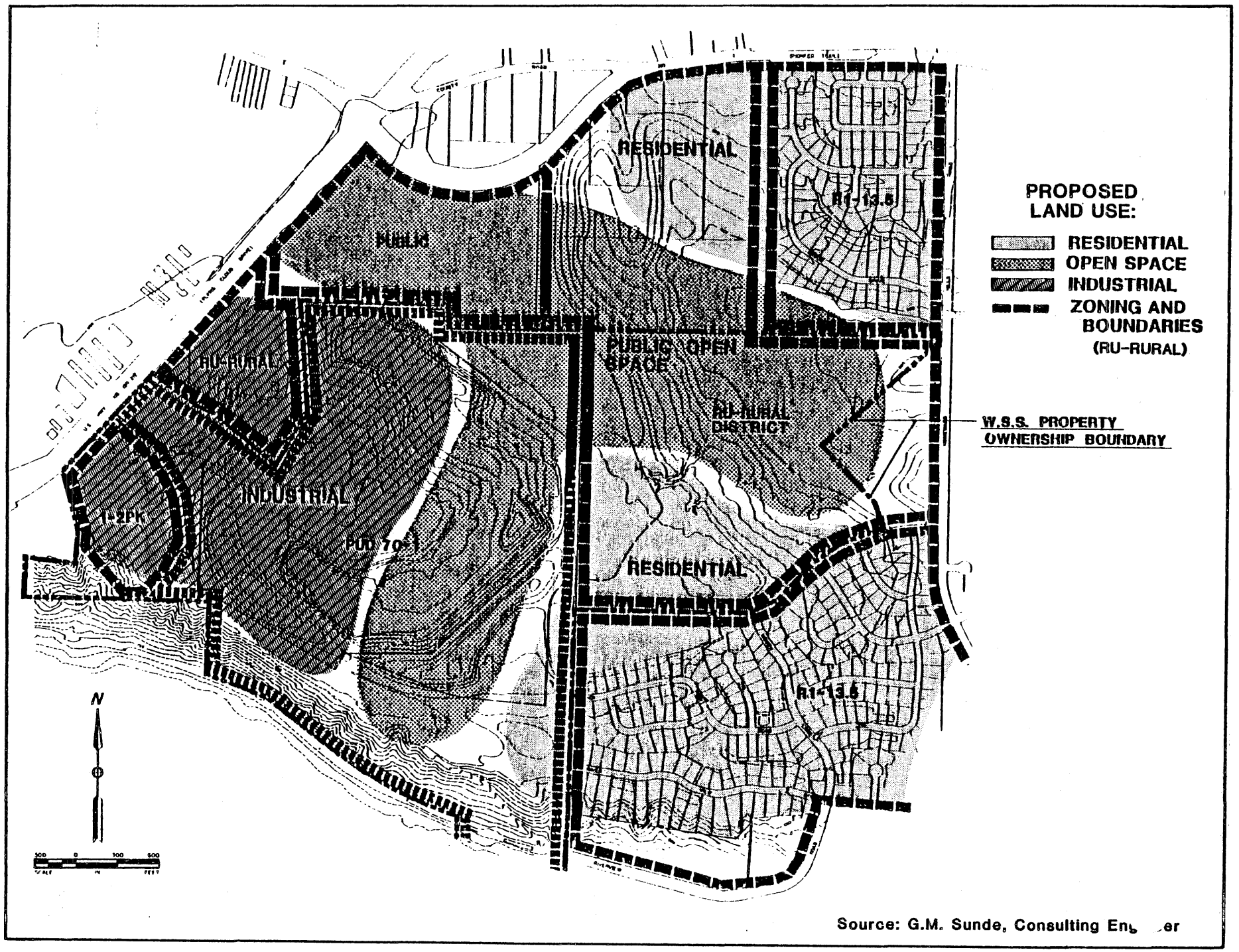
LOCAL PLANS/ZONING

The City of Eden Prairie's adopted comprehensive plan designates the existing landfill for industrial and public open space (Figure 57). 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 57. EXISTING ZONING AND GUIDE PLAN LAND USE



Source: G.M. Sunde, Consulting Engineer

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 58). 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 59).

Figure 58.

GENERALIZED LAND USE IN THE VICINITY OF FLYING CLOUD LANDFILL

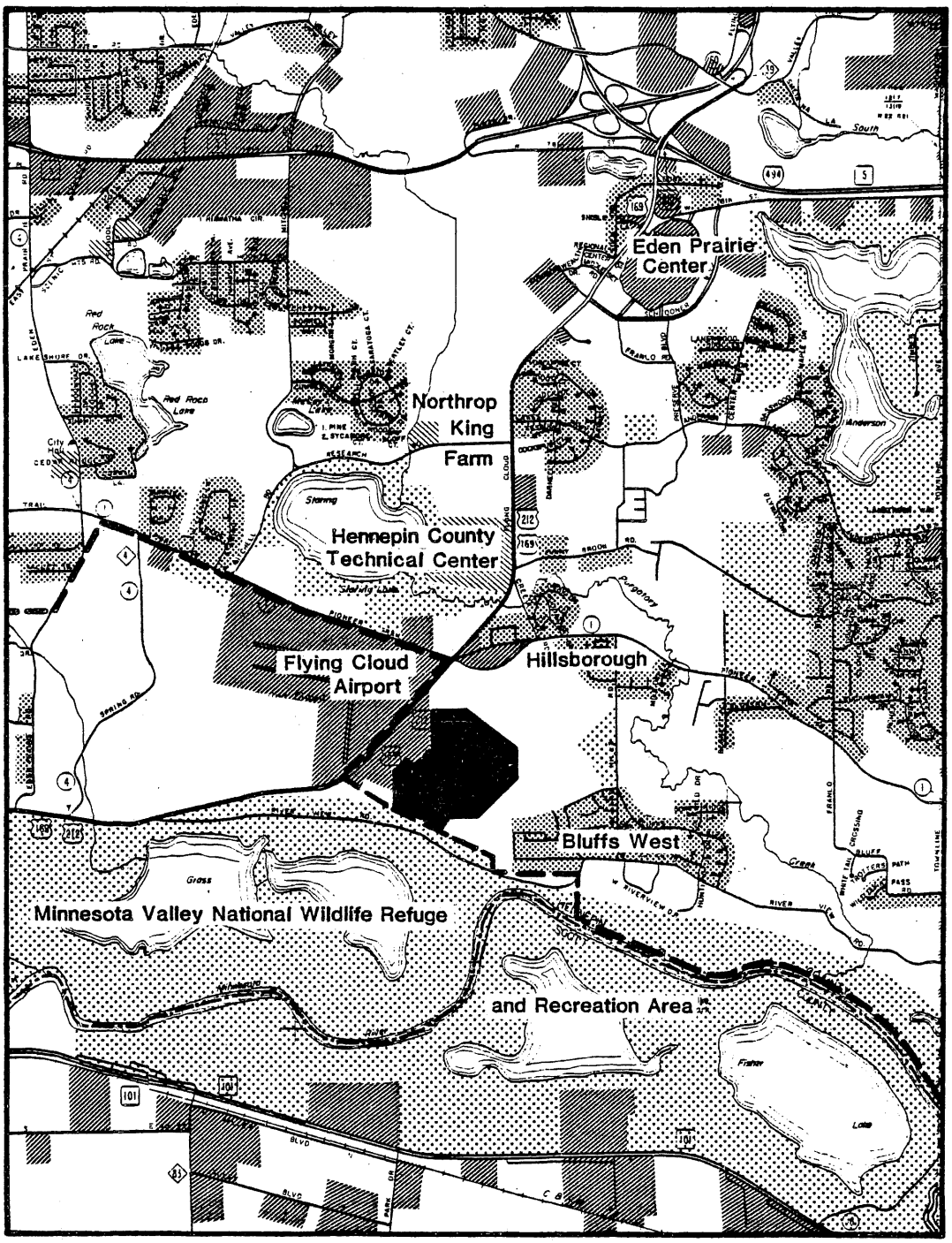


Figure 59.
EDEN PRAIRIE GUIDE PLAN, 1982



EDEN PRAIRIE GUIDE PLAN 1982
MAY 1983

UNDESIGNATED.. low density residential
RM .medium density residential
RM_2 existing pud medium residential to be retained
RH .high density residential

O .office
Id .industrial
NC .neighborhood commercial
CC .community commercial
RC .regional commercial

Land Use Plan

P .public open space,floodplain,park
\+ .church,cemetary
CS .city services
F .fire station
SE/VT.secondary/vocational school
E .elementary school
SC .sports complex
HC .hennepin county
Q .quasi public,open space, H.O.A.

Shoreland management Classification

NE .natural environment water
RD .recreation development water
GD .general development water

1990 Transportation Plan

.principal arterial
.intermediate arterial
.minor arterial
.collector

NORTH

1000 5000 FT
0 1 2 MI 1 MI

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 60). 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 62). 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 MSL to 800 MSL. A grassy and marshy lowland lies at the base of the slope. An unimproved city park, Homeward Hills, is located at the eastern end of the lowland (Figure 60). 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 MSL at the southern edge of the subdivision along the lowland to 880 in the north. (The elevation of the project is approximately 890 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 MSL to 810 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 (165). 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., and 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.)

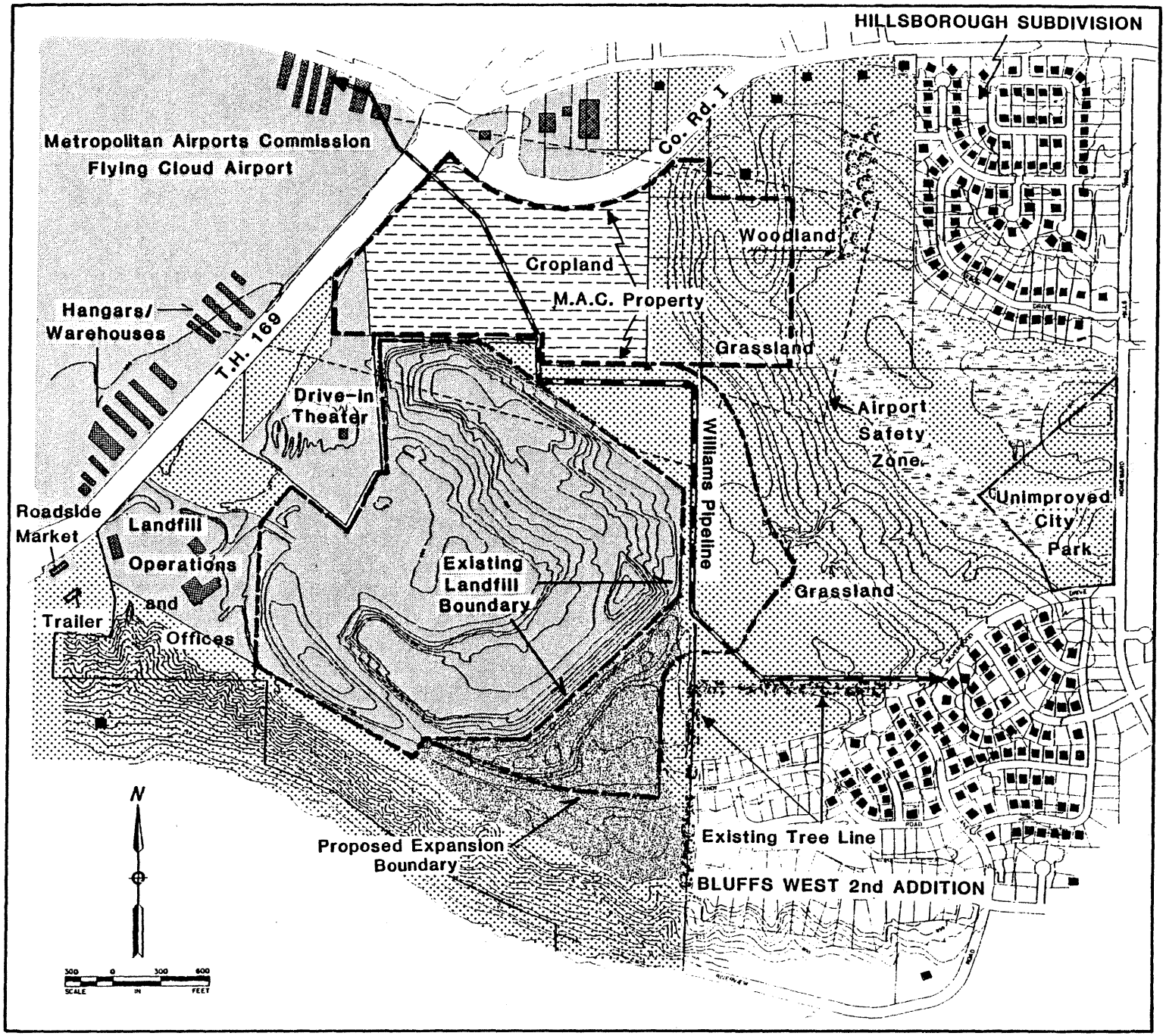


Figure 60.
EXISTING LAND USE

- 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 River View 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 61).

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 31). 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 32). 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 (161). 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.

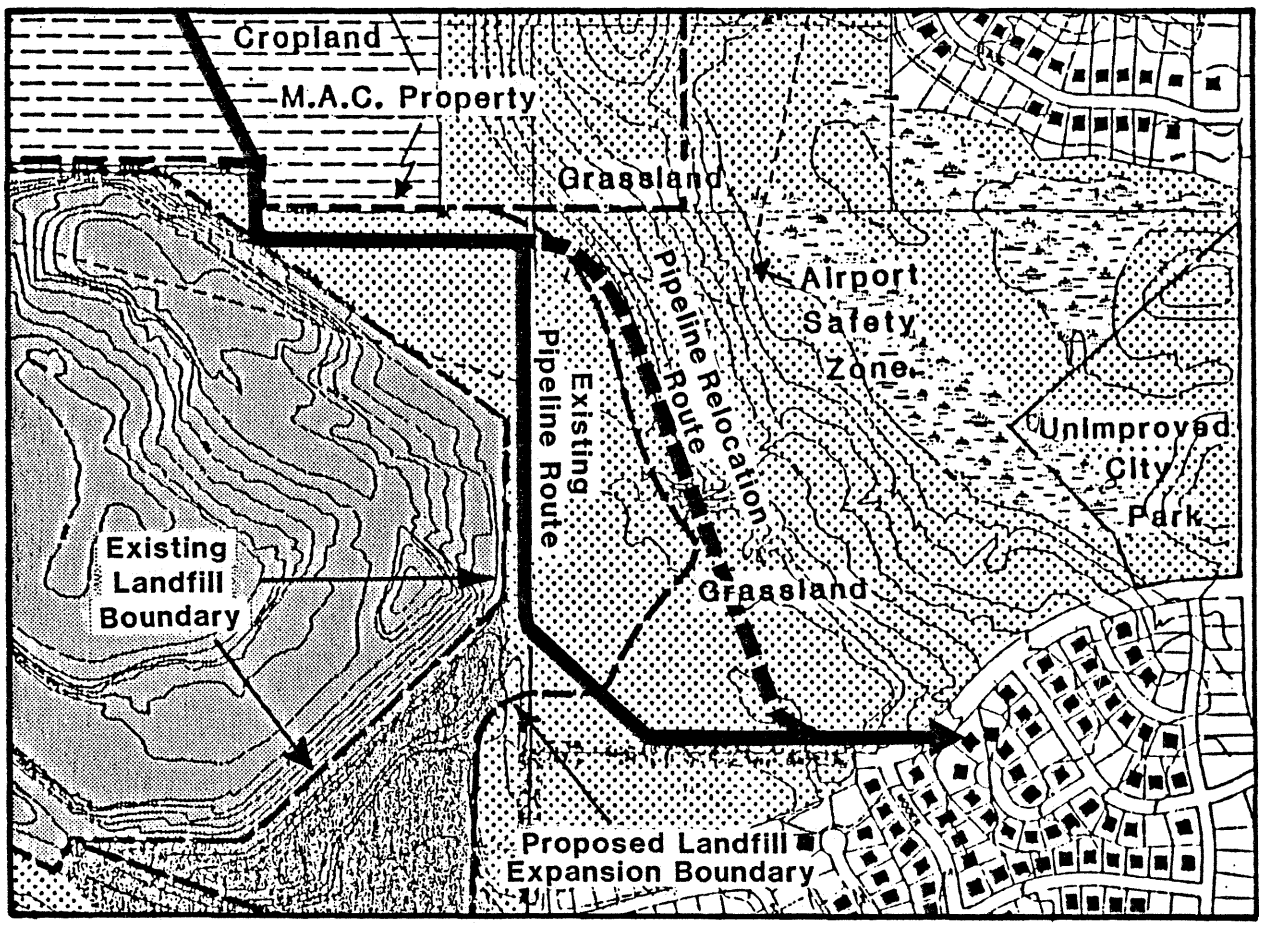
Due to a lack of federal funds the Fish and Wildlife Service has not been able to acquire any lands in the eastern portion of the Upgrala unit around Grass Lake. All the land remains in private ownership. There is no schedule for acquiring land around Grass Lake or the bluff face.

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 60). 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 (162). A single-family home and outbuildings 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 61.
GENERALIZED PIPELINE RELOCATION ROUTE



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 59). 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 occcupied by five residents 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 EIS. 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 are discussed in the Landfill Gas section to mitigate the potential hazards from methane.

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 River View Road 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 who are served by private wells. These wells could potentially be affected by leachate produced from the expansion east of the groundwater divide. However, the chances of these wells being affected is minimal; leachate is not expected to migrate that far east. The leachate plume is expected to move directly south and not disperse as far as the private wells in Bluffs West. The proposed monitoring of groundwater movement towards the river would detect the presence of possible contaminants and provide adequate lead time to undertake the necessary mitigation measures to protect the residents. (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. 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 stage, 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, ie. 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.

Under the state Waste Management Act of 1980, as amended, local government units may impose reasonable conditions regarding the construction, inspection, monitoring and maintenance of landfills. 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 the applicant'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 EIS.)

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 along River View 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 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 River View are within 500 feet of the expansion boundary. The Property Values section of the EIS 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 River View 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 EIS.

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 on the roadside market to the southwest (Figure 60).

The trailer house is located along TH 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 towards the river valley or away from the well serving the trailer home. 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 residence to the southwest is located approximately 1000 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. Because of its location southwest of the landfill it is estimated that leachate from the landfill would not affect the well on this property (see 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.)

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 minimizethe 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, the proposer 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.

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. Groundwater movement and runoff would be away from the market. 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.

City Park Impacts

An undeveloped city park is located to the east of the project along Homeward Hills Rd. (Figure 60). 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.

If the park were developed for use before the expansion is approved, the 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 61). 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) and future land uses in the Minnesota River Valley and National Wildlife Refuge would be minimal. The expansion will not require any physical alteration of areas within the valley or lands in the designated Wildlife Refuge, 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 the proposer and 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.

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 is discussed in the Landfill Gas section.

Although the potential impact appears to be small based on the estimated concentration and delivery rates, 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 Grass Lake and the Minnesota River would be minimal. Directing all the runoff to the river would provide additional protection for Grass Lake.

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.

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 EIS. 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 EIS to control runoff, litter, erosion/dust, odors and methane gas will minimize the potential impacts on the surrounding land uses. 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. 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. Under state law local ordinances can be adopted to control noise, litter and other nuisances associated with landfill operations.

Although the potential is small, metals and organics in the leachate could have a long-term effect on the biota in Grass Lake and marshes. The concentrations of these pollutants entering the lake and wetlands will be small and the effects should be negligible if the proper operating and mitigating techniques are used. An effective monitoring program could help ensure that the integrity of the lake's habitats is maintained (see 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 EIS. 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. Maintaining a buffer zone between the edge of the expansion and vacant lots along River View Dr. and occupied houses would minimize the impact of nuisances including litter, dust and noise. 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 the proposer to the U.S. Fish and Wildlife Service. A cooperative management agreement between the proposer 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 62 and 63). 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 (163). 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 62). 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. Runway 27L, northwest of the landfill, receives 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.

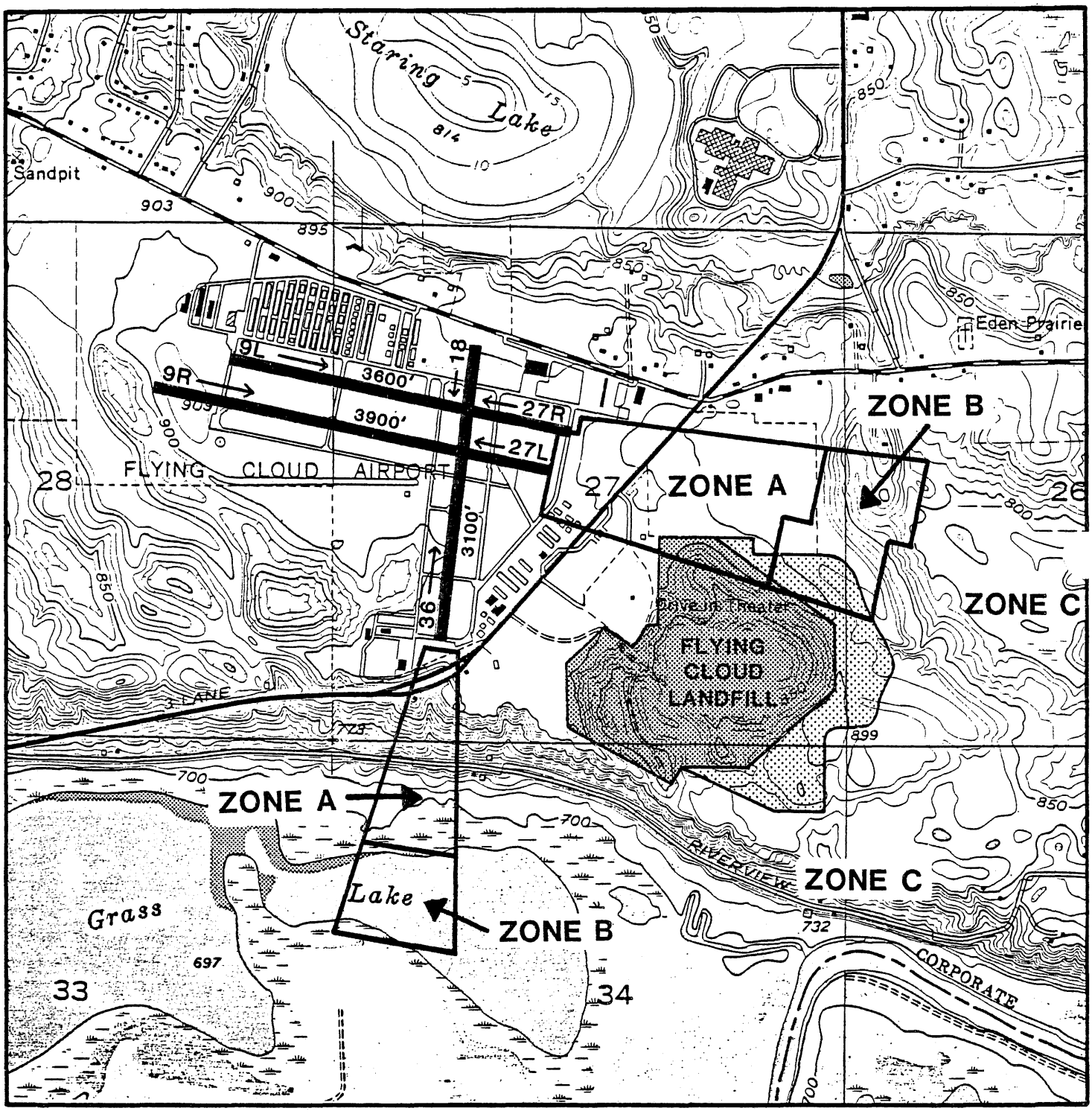
The airport has an FAA Airport Traffic Control Tower in operation 15 hours a day (from 7 a.m. to 10 p.m.) Its airspace control zone covers a five-mile radius and extends from the surface to 14,500 ft. MSL. Only runway 9R is equipped with instrumentation and approach lighting for nighttime and bad weather flights (164).

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 62). 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 63 and 64). Woodlake proposes to construct a 15-foot landscaped berm, which

Figure 62.
FLYING CLOUD AIRPORT AND LAND USE ZONES



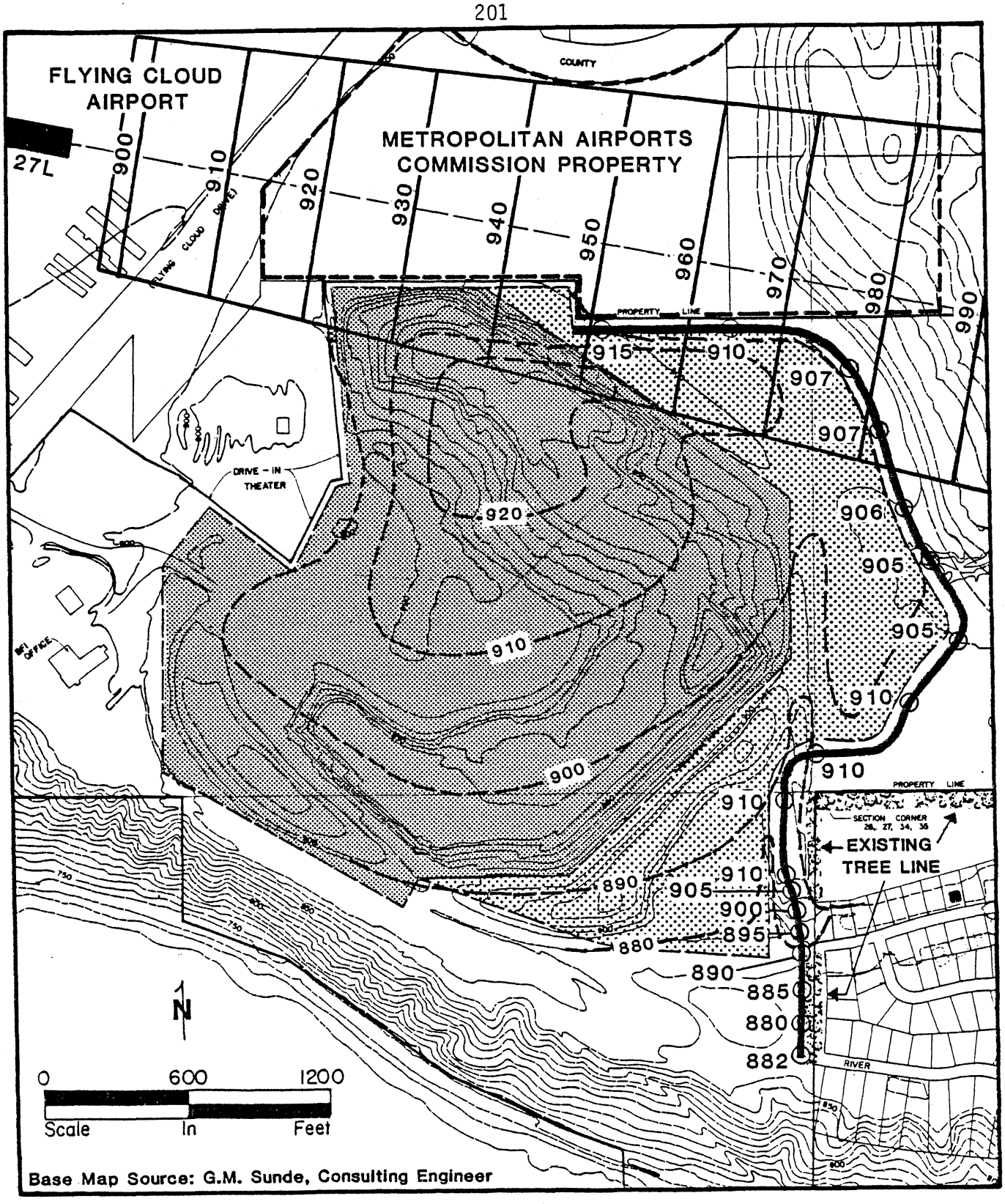
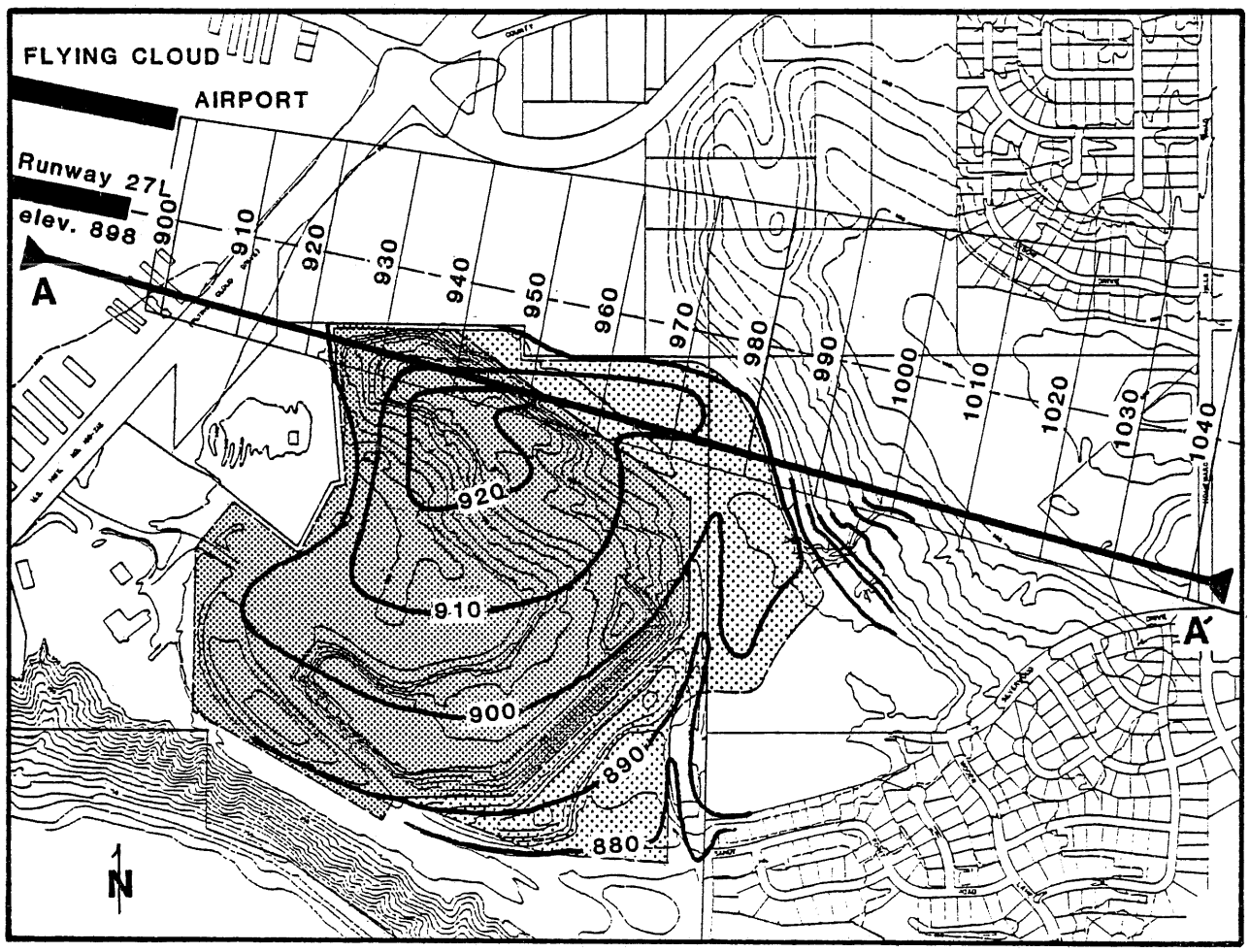


Figure 63.

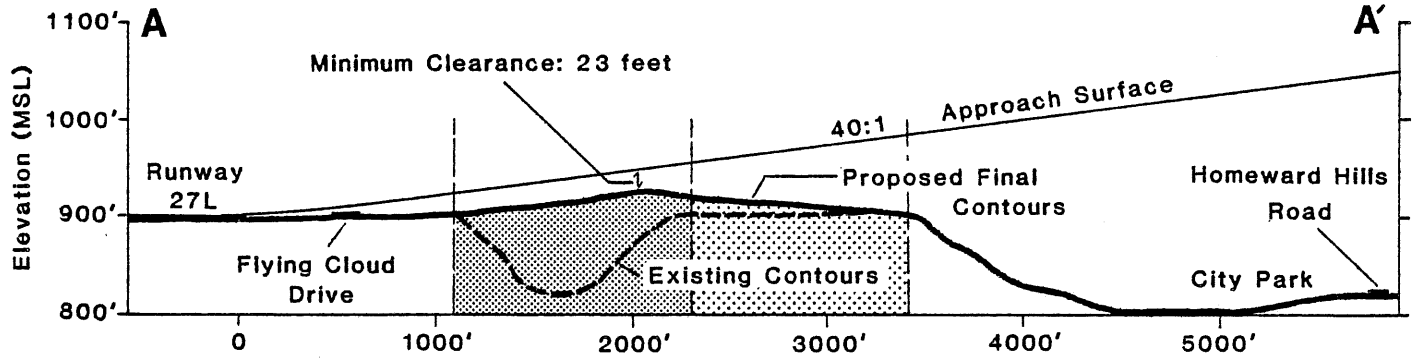
BERM ALIGNMENT AND APPROACH SURFACE TO RUNWAY 27L

(BERM HEIGHT: 15 FEET)

Figure 64.
PROPOSED FINAL CONTOURS AND APPROACH SURFACE FOR RUNWAY 27L



Sources: G.M. Sunde, Consulting Engineer (Base Map);
Federal Aviation Admin., Mpls.



Vertical Exaggeration: 5x

would provide ground noise buffering as well as screening (see Appendix C). The placement of the berm is illustrated in Figure 63. 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 63). 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 3 to 4 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 64). 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 feet 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 62) (165). 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 62). 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 (166). 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 (167).

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 screening 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 approval 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 (168). Despite the application of daily cover, landfills near airports often increase the risk to aircraft by attracting birds that feed at the site (169).

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 (170). 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 (171).

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) (172). 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 (173).

Because it provides habitat for gulls during migratory layovers and breeding habitat for a 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 (174). 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 (175). 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 (176). 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 (177). 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 (178). 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 (179).

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 (180).

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 (181). 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 (182).

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 62). 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.

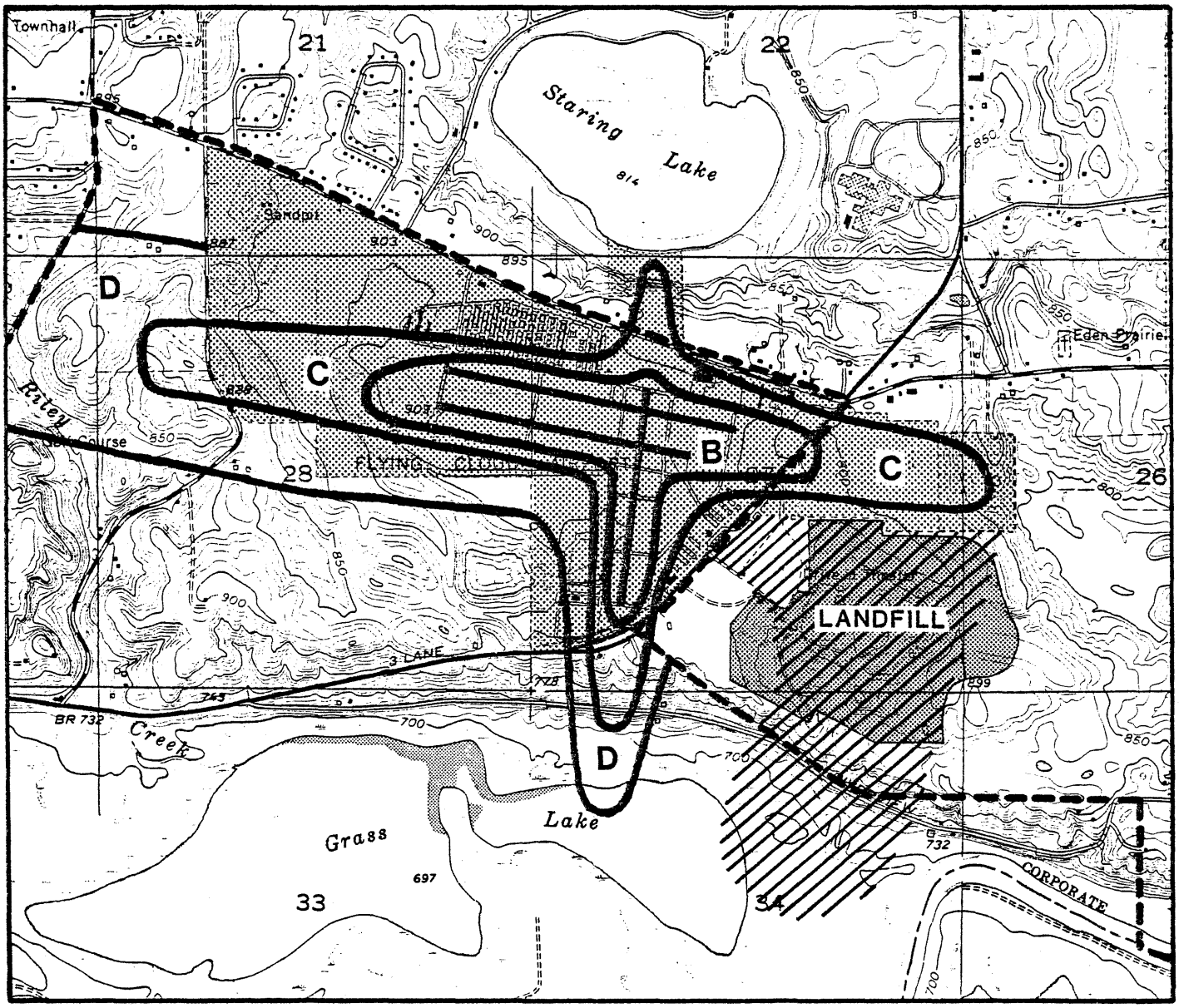
The Metropolitan Council has recently established Land Use Compatibiity Guidelines for areas adjoining airports for the purpose of minimizing conflicts between community land use plans and zoning and aircraft noise (183). The Guidelines affect land use in specific zones as impacted by annualized aircraft 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 65).

The existing landfill and expansion area are located along and beneath aircraft overflight tracks (Figure 65). 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 disuptive to the residents use of outside 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 65).

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 65.
FLYING CLOUD AIRPORT AIRCRAFT NOISE ZONES



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 65).

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 (184). 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 (185). 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 (186). 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 unobstructured 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 (187). 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 (188). 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.

A study of the impact of landfills on local residential property values was prepared by BFI in 1983 (189). 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 appraiser also stated that the past development of the surrounding residential areas had been comparable in general to similar residential areas elsewhere despite the presence of the landfill. He also noted that the improved operation of the landfill in the last five years may have had an impact, also. The appraiser stated that the value of the lots sold more recently for new housing in Bluffs West had been reduced (190). 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 (191). (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 EIS 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, the Woodlake's proposed control measures and the location of the subdivision relative to the landfill would eliminate or minimize visual or nuisance impactson 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 EIS should further minimize this potential problem.

Bluffs West - Second Addition Properties

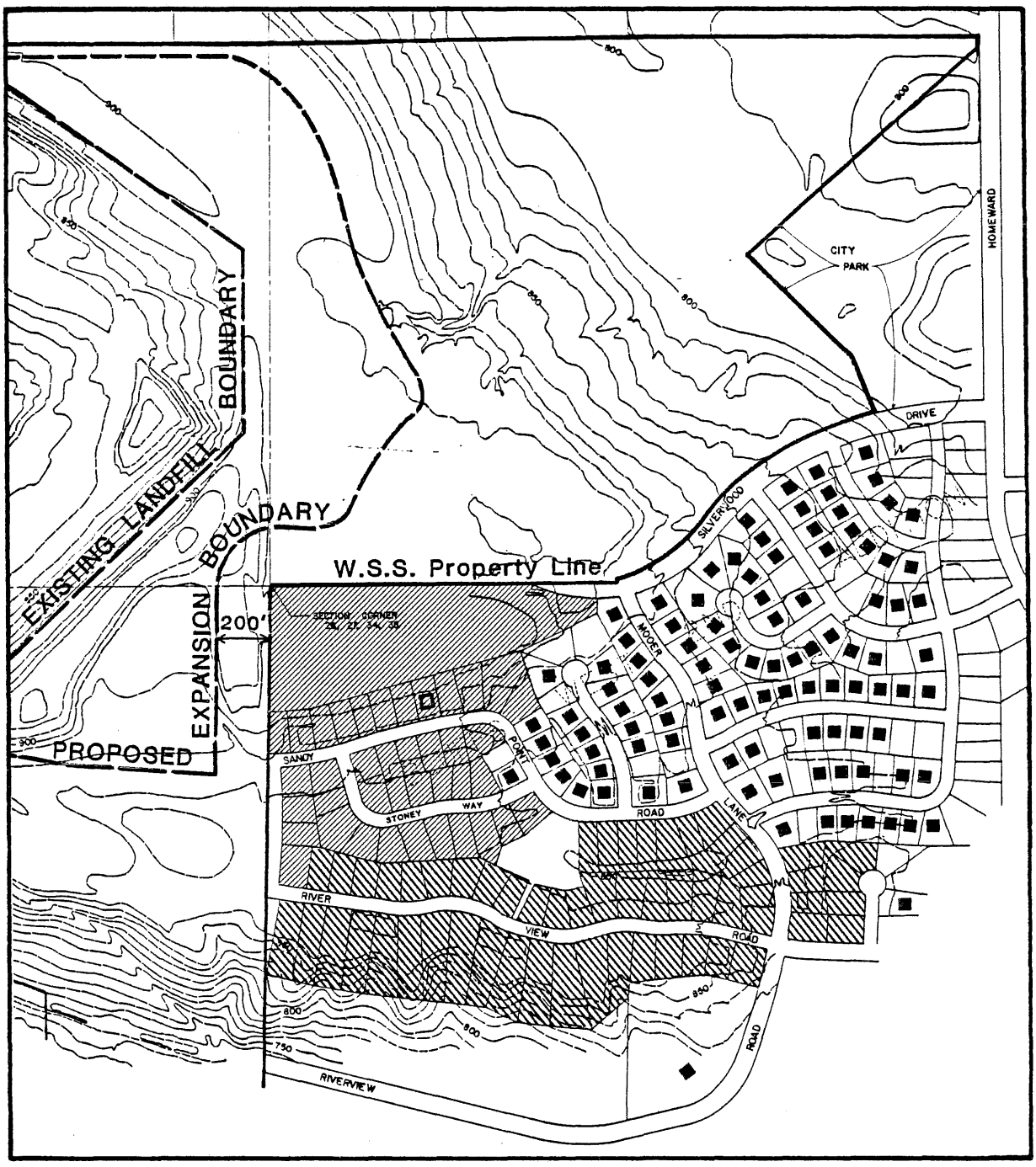
There are three groups of properties in Bluffs West (Figure 66). The owners of individual houses and lots represent the largest group. These are located in the eastern portion of the subdivision. Woodlake owns 39 lots (including a vacant house) and an outlot in the vacant, western portion. These were 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 River View 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 (192). 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 currently). Existing occupied houses would be as close as 900 feet compared to 1,400 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 66.

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 EIS. 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 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 EIS, 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 may be some concern for potential contamination of groundwater beneath Bluffs West, however, most of the houses are served by public water. Monitoring wells located upgradient from the subdivision should detect any contamination, and provide sufficient time to connect the remaining houses to the public system if contamination occurs (see Site Hydrogeology section). This would minimize any impact on 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 because of 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 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 River View 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 River View Rd. would be delayed until the southeast 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 WSS-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.

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 60). 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 60). 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. 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 EIS 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 39). 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 south west of the landfill site along Hwy. 169 would not be affected. The proposer'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

Most of the bluff south of the project is owned by the proposer. Properties along the river valley floor 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. However, the concentrations of pollutants in the leachate are expected to be small, and the impacts would be negligible or minor as indicated in the Site Hydrogeology and Vegetation and Wildlife sections of the EIS if, proper operating and mitigating techniques are employed.

MITIGATION

Maintaining 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. 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 River View 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.

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 (193). 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 (194). 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 (195). 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 (196).

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 similar uses of lands in the same vicinity (197). Lower revenues could result if the site has a low market value because of its previous use as a landfill (198).

EMPLOYMENT

Flying Cloud Landfill provides a limited number of job opportunities in addition to revenues. Woodlake Sanitary Services currently employs 10 to 20 people at the Landfill (Table 40) (199). No additional jobs are expected to be created if the expansion is permitted (200).

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 Metropolitan Urban Service Area. 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 Sanitary Services 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 (201).

Woodlake has several financial mechanisms in place to deal with potential problems (202). 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 development occurs on the site, it may be necessary to extend sewers, water mains, and roads. In this particular situation, the site is already inside the Metropolitan Urban Service Area, 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 (203).

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) 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 S 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.

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 operating hours which might minimize 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.

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;

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

A liner and leachate collection system is one possible alternative that could minimize off-site leachate movement. The liner could consist of natural clays or a synthetic material and would be put into place before refuse is deposited in the landfill. In this instance the liner would be placed only beneath the 42.4 acre horizontal expansion. That portion of the expansion which involves additional vertical filling over the existing landfill would not be lined. The leachate collection system would consist of wells and other equipment designed to gather and remove any leachate that collected above the liner.

A liner and leachate collection system does not appear to be a necessary modification at this site, however. Wells supplying city water would not be affected by leachate, and the potential impact on private wells is minimal. Additional monitoring, as discussed in the Site Hydrolgeology section, would help ensure that any leachate movement is detected before problems develop, and provide sufficient lead time for corrective measures, making it more cost-effective to provide the affected party with an alternative source of water than to install a liner and leachate collection system (see Site Hydrogeology section). Furthermore, dilution and attenuation would weaken any leachate before it reaches the Minnesota River or Grass Lake. Because of the prior weakening and further dilution upon reaching either of these bodies of water, no significant ecological impacts from leachate are expected.

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.

The configuration of the final grades could also affect the end use plan for the site.

Methane Recovery

Woodlake Sanitary Services 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 the concentration of contaminants in leachate in the short run but increases the concentration over a much longer period.

Both shredding and baling would require substantial 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 associated with such facilities could make Flying Cloud less competitive with other landfills. The choice to utilize these methods is a business decision based on the cost and impact on the competitiveness of the project with other landfills. If the cost would result in the project being less competitive the rate of filling could be reduced and the project life would be extended.

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. Any other efforts by the proposer to recycle other materials in the refuse, such as drop-offs for paper or glass, would require a change in behavior of BFI customers or the addition of new customers drawn by the facilities. The recycling of many materials such as glass and paper is currently economical only if they are separated at the source (residence or business) and there is an adequate volume to maintain a market for the materials.

Although shredding, baling and materials recovery would decrease the volume of waste deposited each year at Flying Cloud, they would not totally remove the need for the landfill. Shredding, for instance, could decrease waste volume by a maximum of about 30 percent. Not all materials are technically or economically recoverable at the current time, either.

Noise Berm Changes

Woodlake Sanitary Services 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 need for a 15-foot high berm, see the Visual Impacts and Noise sections.

NO-ACTION ALTERNATIVE

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 below under the existing landfills section. New landfill sites which may be available as a substitute for the expansion could provide all or a portion of the expanded capacity. The seven counties in the Metropolitan Area are currently in 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. These sites could be substituted for the expansion, depending on when they might be opened and in operation. 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 can be categorized as four 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, resource recovery such as burning waste to recover heat, and waste processing including baling and shredding to reduce the volume of waste materials and the amount of space required for landfilling. Abatement alternatives and their environmental impacts are discussed below 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 nine 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.

Table 41
LOCAL LANDFILL CAPACITIES AND USE RATES

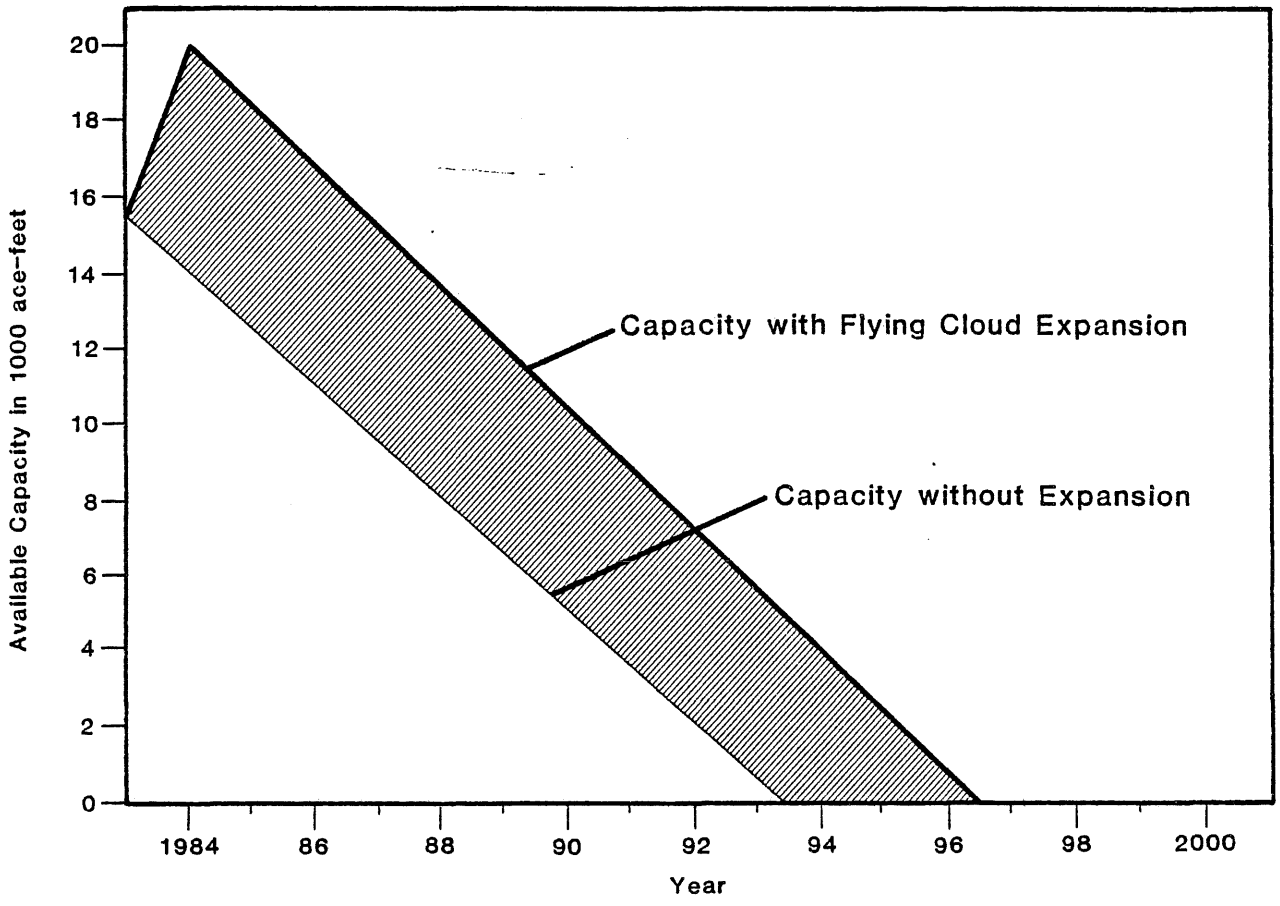
Landfill	January 1983 Remaining Permitted Capacity (acre-feet)	1983 Use Rate (acre-feet)
Burnsville	2,325	59
Freeway	243	57
Flying Cloud	850	439
Louisville	1,689	110
Pine Bend	9,329	615
Woodlake	1,070	93
Total	15,506	1,373

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 67). 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 would be environmental impacts at each of the five existing landfills which would receive the additional waste. There could be increased service costs to the area which would be served by the Flying Cloud expansion. Finally, there could be some increase in the cost of operating the five other existing landfills because of the increased fill activity. These impacts are discussed in detail below.

Figure 67.
EXISTING LANDFILL CAPACITY OVERLAPPING FLYING CLOUD LANDFILL'S SERVICE AREA



Sources: Metropolitan Council and landfill operators

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 landfils could be completed earlier than expected. This would shorten the period during which the environmental and the local communities could be affected by certain kinds of landfill activity and related problems. Impacts associated with active operation of the landfill such as traffic congestion, noise, dust, visual blight, land use conflicts, odors and litter would be concluded sooner than expected. Perhaps the land could be developed earlier for another end use. Other kinds of potential impacts which could develop following closure of the landfill, such as groundwater contamination and methane gas generation, would not be affected by an earlier closure. These are not affected by the rate of filling.

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 more traffic particularly truck traffic and landfill equipment activity at each of the sites. These activities could increase traffic congestion on access routes, and could cause higher noise levels or longer periods of elevated noise and increased 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.

Although the increased rate of fill, traffic levels and equipment activity at the five landfills would have an impact, the location and surrounding land use at each of the sites could 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 Sanitary Services Inc.) is located in a rural area of Medina. The Louisville Landfill is in a low density, commercial-industrial part of 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 approximatatly 1,000 feet from the 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 seved 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 traffic conflicts.

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 stations to be processed or collected in larger trucks to be hauled to landfills in local areas. The use of larger trucks would reduce the number of small trucks arriving/leaving the landfill site and reduce the potential increased 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 Flying Cloud 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 their 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 could also result in higher disposal fees or "tipping fees" for haulers and increased customer charges. Increased receiving rates could increase operating expenses at the landfills. After any existing slack operating capacity is utilized landfill operators would be required to add fill 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 receiving rates. Increased disposal fees would 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 capacity at existing landfills could be affected by the development of new landfills. The Waste Management Act of 1980, as amended, mandated each of the counties in the Metropolitan Area to locate candidate landfill sites. The candidate sites are to be reviewed and approved by the Council and the MPCA. Once the candidate sites have been approved an EIS must be prepared; then the counties will select new landfill sites from among the candidates. State,

regional and local governmental permits/approvals must be granted for each new site. The new sites must be acquired and site preparation and construction completed before the selected sites can be operated. No new site can be issued a permit without a certificate of need, demonstrating that all other feasible and prudent alternatives to land disposal are being implemented.

Metropolitan Council approval of a full complement of candidate sites for each county will be completed by mid-1984. The EIS scoping, preparation and reviews and granting of permits and approvals could be completed by late 1985 or early 1986. Land acquisition and site preparation could require another year or two assuming no substantial delays; therefore it is unlikely that new landfills would be opened and operating before 1987. If this schedule is achieved, the new landfills would provide additional landfill capacity several years before the five alternative landfills discussed above are filled in 1993.

The candidate sites for new landfills which have been approved by the Council are shown in Figure 68. Two other candidate sites in Hennepin County, one in Scott and one in Dakota must be approved.

Although the potential capacity of the new landfills is not known at this time, the new facilities could no doubt provide sufficient capacity to substitute for at least a portion of the Flying Cloud expansion within a few years. (The estimated service life for Flying Cloud project is seven years.) However, the existing landfills in combination with new facilities could provide sufficient capacity to provide a reasonable alternative to the Flying Cloud project in the immediate and more distant future.

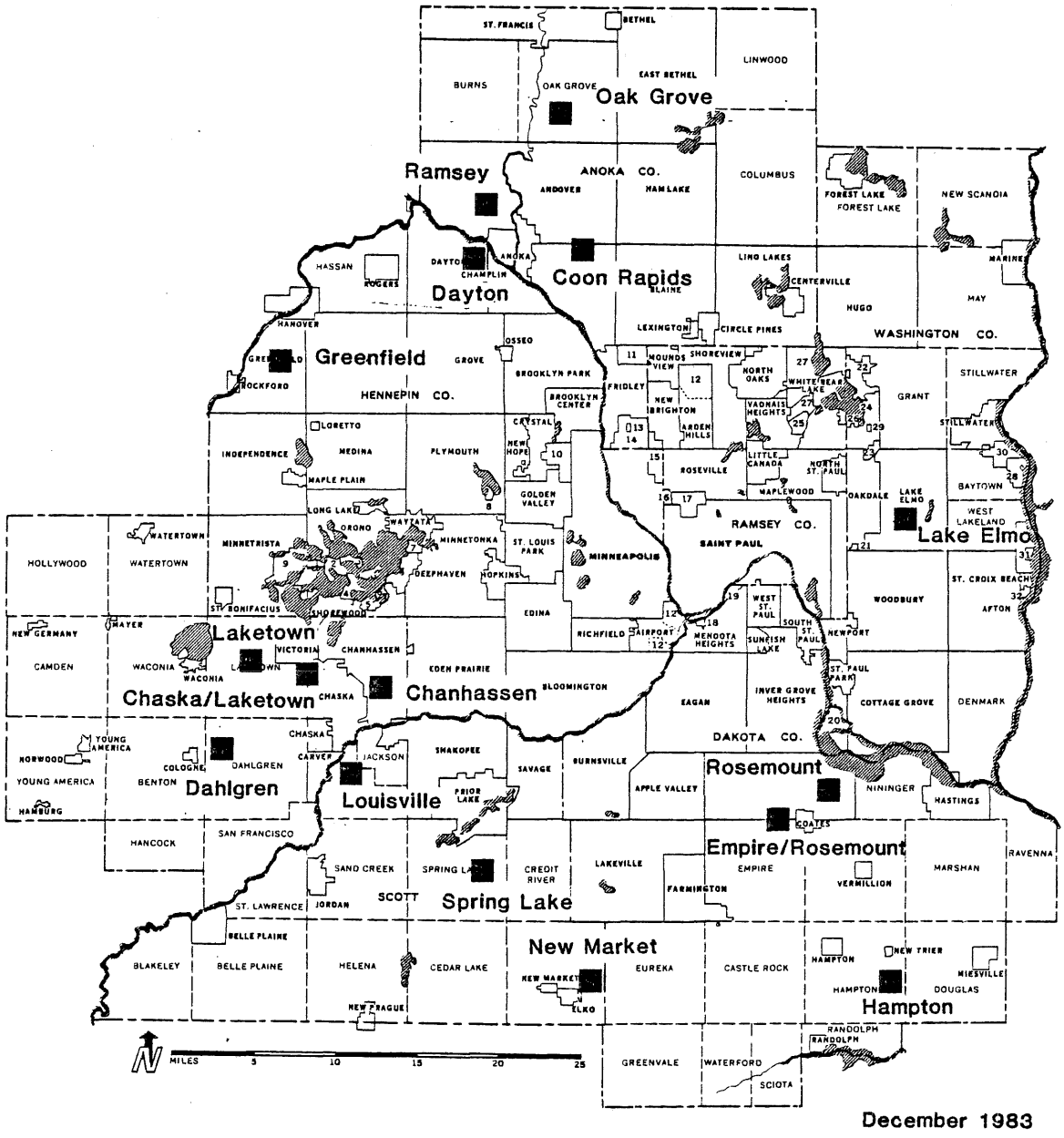
If a portion of the waste to be deposited at the expansion were disposed of in the new landfills, the potential impacts would be similar to those at the other five existing landfills. The rate of filling at the new facilities closest to the Flying Cloud service area would likely increase. The volume of waste deposited at each new facility would not be affected. The allowable volume is regulated by government permits and approvals.

The use of new landfills could have economic impacts. New landfills may be more costly to operate and develop because of higher development costs and more stringent environmental standards. Liners, collection systems, and leachate treatment are examples of added cost. These costs will be passed on to refuse haulers in the form of higher disposal fees and to customers in the form of higher collection fees. If the new sites are more distant from the Flying Cloud service area, longer hauls for refuse collectors could mean higher fees for customers. Higher landfill costs might also make alternative abatement measures more economically competitive and feasible.

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 prevention or reduction, waste separation, resource recovery and waste processing. Waste reduction is targeted at reducing the generation of waste at the source i.e. the office, factory and residence by encouraging the generator to follow practices which conserve, e.g. to reduce the waste of office paper and mulch grass clippings. Waste separation includes a variety of measures to recover and recycle waste materials such as aluminum

Figure 68.
TWIN CITIES METROPOLITAN AREA COUNTIES' CANDIDATE LANDFILL SITES



cans and glass. Resource recovery includes the use of waste material through various "high-technological" processing methods such as incineration or biological treatment, for example, burning refuse to produce energy. Waste processing is a volume reduction technique used before landfilling waste to make more efficient use of landfill capacity. (See earlier discussion of shredding and baling.) It would not reduce the amount of material going into a landfill unless it were combined with waste separation.

The Metropolitan Council estimates that the Metropolitan Area currently abates 14 percent of its waste. Existing abatement programs and projects include curbside collection of recyclables such as glass, aluminum cans and paper, office paper recycling, private incinerators 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 the abatement obectives. A draft of this plan will be released for public comment in mid-1984.

Waste abatement in the foreseeable future will not replace the need for landfill space. 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 resource recovery facilities will be landfilled. Incinerator ash would be landfilled unless it can be used. Waste abatement will reduce the need for landfill capacity, but it will not replace landfills. New capacity will be needed once the existing capacity is filled.

Waste abatement may become more economically attractive in the near future as costs of new landfills rise. However, waste abatement will take several years to implement. New state legislation may be necessary to implement some programs, public education will be necessary to change attitudes towards waste disposal methods and public dollars will have to be provided. It will take time to implement such a comprehensive system and to accomplish the needed changes in waste generators' behavior.

The development of special abatement facilities takes many years to complete. Planning and technical studies are time consuming. Reviews and approvals take additional time. Construction would use more time. For example, the proposed Hennepin County resource recovery plant would incinerate 2000 tons of waste per day. However, it is not expected that this project could be operating until the late 1980s.

Land disposal abatement measures also have environmental and socio-economic impacts. The economic impacts would be mixed. 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. 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. Other forms of abatement measure, however, could be less expensive than land disposal. For example, source separation programs such as curbside 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. However, these methods alone will not radically reduce the waste stream.

The environmental impact of land disposal or waste abatement measures would also be mixed, with many potential positive impacts, but some negatives also. Abatement would reduce the amount and change the composition of the materials which would be landfilled. By reducing the amount of waste and removing materials which contain potential chemicals 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.

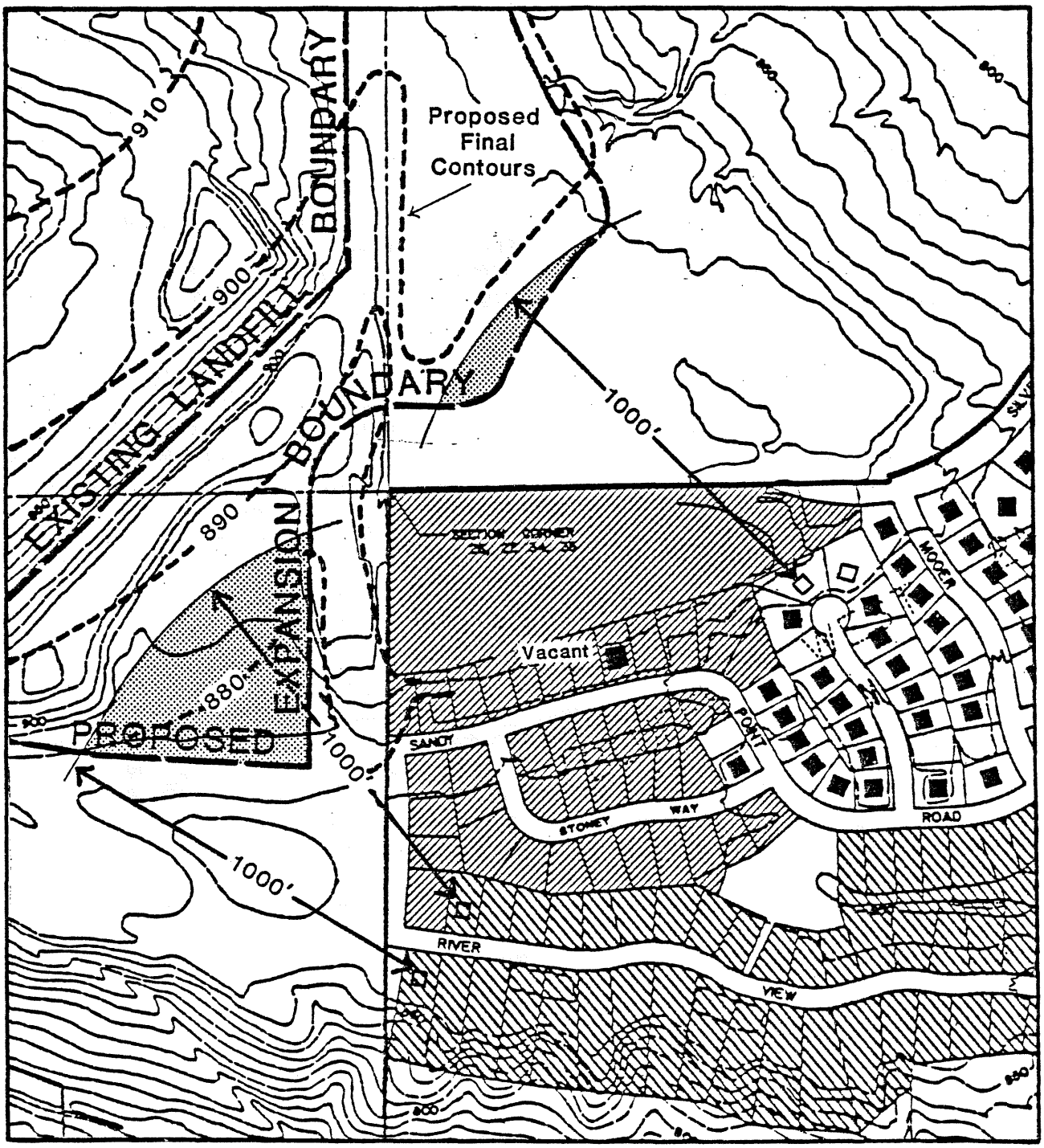
Abatement would eliminate or reduce the level of nuisances which affect areas around landfills, but it could lead to similar impacts elsewhere. However, it is likely that facilities involved in abatement programs will be much smaller than landfills and would be located in industrial areas, minimizing the impact on residential areas and other land uses.

Traffic volumes around the landfills would decrease, but 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 will increase the potential for air pollution.

CHANGE 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, 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 in Bluffs West which might be developed during the life of the project (Figure 69). Lots owned by Woodlake were excluded from consideration since the proposer could delay their development to avoid potential impacts. It is assumed that the 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.

Figure 69.
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.

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 potential conflicts and impacts on land use and their 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 and Bluffs West. The view from houses farther away might be affected by the increased height.

The alternative would not affect the other potential impacts relating to: traffic, groundwater, surface water, the airport, vegetation, wildlife; which have been evaluated in the EIS. In general these are minimal and can be reduced by the proposer's controls plans or the mitigation measures discussed in the EIS.

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

A number of minor changes in the operation of the landfill are discussed through the various mitigation sections of the EIS. These would minimize noise, land use, 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.

... LIST OF PREPARERS ...

LIST OF PREPARERS

Environmental Quality Board Rules require the EIS to include a list of the names and qualifications of the persons primarily responsible for preparing the EIS and significant background reports.

METROPOLITAN COUNCIL

Many members of the Council's staff as well as other individuals and representatives of other agencies have assisted in preparing the EIS. The individuals with primary responsibility for preparation of the document are the project manager for the EIS.

Carl Schenk - Environmental Planner
M.S. University of Illinois
B.S. Valparaiso University

and

Karen Harrington - Associate Environmental Planner
M.A. University of Minnesota
B.A. University of Minnesota

OTHERS

The persons with primary responsibility for each of the special studies undertaken.

Site Hydrogeology

Rick Morck - B.C.E. and B.S. University of Minnesota
Candidate for M.C.E. University of Minnesota

Noise Assessment

John Nelson - Senior Environmental Health Specialist, City of Bloomington
B.S. Eastern Michigan University

Dave Kelso - Research Scientist, Minnesota Pollution Control Agency
M.P.H. University of Minnesota
B.S. University of Minnesota - Duluth

Landfill Gas Assessment

Dr. Walter J. Maier, Ph.D. - Civil Environmental Engineering, Cornell University
M.S. Cornell University
B.S. Rensselaer Polytechnic Institute

Other contributors to the preparation of the EIS were:

Joyce Bowers, Candidate for B.A. Macalester College

Eugene Barringer, B.A. Macalester College

Anthony Carr, B.S. and Candidate for M.S. Morgan State University

Craig Skone, B.A. University of Minnesota

Sunny Emerson, Jane Larson and Jayne Williams, Secretaries

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]J. Pacey and G. Karpinski. "Retrofitting Existing Landfills to Meet RCRA Standards for Leachate Control." Solid Wastes Management. (February 1979).

[10]M. Dilaj and J.F. Leonard. "Stop Leachate Problems." Water and Wastes Engineering. (October 1975).

[11]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).

[12]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.

[13]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.

[14]Morck. Op. cit.

[15]F.A. Rovers and G.J. Farquhar. "Infiltration and Landfill Behavior." J. Environ. Eng. Div. ASCE. (October 1973).

[16]Morck. Op. cit.

[17]Ibid.

[18]R.A. Freeze and J.A. Cherry. Groundwater. Englewood Cliffs, NJ: Prentice-Hall, Inc. 1979.

[19]Morck. Op. cit.

[20]J. Reindl. "Gas and Leachate Movement." Waste Age. (May 1981).

[21]D.R. Brunner and D. Keller. Sanitary Landfill Design and Operation. SW-65. Washington D.C.: U.S. Environmental Protection Agency. 1972. p. 3.

[22]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.

[23]Sabel and Clark. Op. cit.

[24]S.C. James. "Metals in Municipal Landfill Leachate." American Journal of Public Health. 67. No. 5.(1977).

[25]Lu, et. al. Op. cit.

[26]Ibid.

[27]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.

[28]P.L. McCarty, et al. "Trace Organics in Groundwater." Environment, Science & Technology. 15, No. 1 (1981).

[29]P.V. Roberts, et al. "Movement of Organic Contaminants in Groundwater: Implications for Water Supply." American Water Works Association Journal. 74, No. 8 (1982).

[30]McCarty, Op. cit.

[31]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.

[32]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.

[33]Norvitch, et al. Op. cit. p. 20.

[34]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.

[35]Rovers and Farquhar. Op. cit.

[36]Dass, et al. "Leachate Production at Sanitary Landfill Sites." J. Environ. Eng. Div. ASCE. (December 1977).

[37]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.

[38]S.C. Reinfeldt. "Wisconsin Landfill Closure Requirements." Solid Wastes Management. (December 1981). p. 39.

[39]Morck. Op. cit.

[40]Gerald M. Sunde. Assessment of Soils, Geology and Hydrogeology for Flying Cloud Sanitary Landfill. Bloomington, MN.: Sunde Engineering. 1983. p. 22.

[41]Metropolitan Council. Final Environmental Impact Statement. Freeway Sanitary Landfill Expansion, Burnsville, MN. St. Paul: Metropolitan Council. March 27, 1981. p. 70.

[42]Barr Engineering Co. Riley-Purgatory Creek Watershed District. 1981 Engineer's Annual Report. Minneapolis: Barr Engineering Co. 1981. pp. 49, 50, 52.

[43]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.

[44]Ibid. p.6.

[45]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.

[46]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.

[47]Ibid. p. 7.

[48]Ibid. p. 10.

[49]Ibid. p. 11.

[50]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.

[51]Woodlake Sanitary Services, Inc. Op. cit. pp. 11-12.

[52]Interview with Duane Kramer, Rieke, Carroll, Muller and Assoc. Inc. Aug. 10, 1983.

[53]Gary L. Oberts. Water Resources Management: Nonpoint Source Pollution Technical Report. St. Paul, MN: Metropolitan Council. May 1982.

[54]Interview with Rolland Smith, Woodlake Sanitary Services. July, 1983.

[55]Oberts. Op. cit. p. 1.

[56]Gerald Sunde. Amended MPCA Flying Cloud Sanitary Landfill Permit SW-14. Part III.AS.2. Assessment of Soils, Geology, and Hydrogeology. Submitted by Woodlake Sanitary Sanitary Service to the Mn Pollution Control Agency. Bloomington, MN: Sunde Engineering. May 2, 1983.

[57]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.

[58]Minnesota Dept. of Natural Resources. Correspondence of Welby Smith to Karen Harrington, Metropolitan Council. July 18, 1983.

[59]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.

[60]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.

[61]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.

[62]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.

[63]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.

[64]Ibid, p. 171.

[65]U.S. Fish and Wildlife Service. May 1982. Op. cit. pp. 5-8.

[66]Minnesota Dept. of Natural Resources. Op. cit.

[67]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.

[68]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.

[69]Ibid. p. 15.

[70]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.

[71]Interview with Rollin Smith, Woodlake Sanitary Service. Aug. 8, 1983.

[72]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.

[73]Smith, Op. cit.

[74]Woodlake Sanitary Services. March 4, 1982. Op. cit. p. 10.

[75]Glenn O. Schwab, et al., eds. Soil and Water Conservation Engineering. 3rd ed. New York: John Wiley and Sons. 1981. p. 127.

[76]Interview with Dave Breitbach, U.S. Soil Conservation Service. Sept. 15, 1983.

[77]Soil Conservation Service. Minnesota Technical Guide for the Soil Conservation Service. Section IV-1-C. Erosion Prediction. U.S. Dept. of Agriculture. Dec. 1975.

[78]Emil T. Chanlett. Environmental Protection. New York: McGraw-Hill Book Co. 1973. p. 206.

[79]Ibid.

[80]Interview with Rollin Smith, Woodlake Sanitary Services. July 1983.

[81]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.

[82]Interview with Dave Breitbach, U.S. Soil Conservation Service. Sept. 15, 1983. p. 5.

[83]Woodlake Sanitary Services. March 4, 1982. Op. cit. p. 10.

[84]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.

[85]U.S. Environmental Protection Agency. Carbon Monoxide Hot-Spot Guidelines. EPA-450/3-78-033. Washington, D.C.: U.S. Environmental Protection Agency. 1978.

[86]J. Pacey and G. Karpinski. "Assessing a Landfill's Potential as a Methane Gas Producer." Solid Wastes Management. (November 1979). p. 28.

[87]EMCON Associates. State of the Art of Methane Gas Enhancement, prep. for Argonne National Laboratories. San Jose, CA: Emcon Associates. December 1979. p. 10.

[88]Ibid.

[89]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.

[90]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.

[91]Leone, et. al. Op. cit. p. 6.

[92]John Rennie. "Direct Burning of Landfill Gas." Waste Age (June 1983). p. 38.

[93]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.

[94]Gregg Easterbrook. "The Great Escape." Waste Age. (September 1979). p. 32.

[95]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.

[96]Ibid. p. 21.

[97]EMCON Associates. Methane Generation and Recovery from Landfills. Ann Arbor, MI: Ann Arbor Science Publishers, Inc. 1982. p. 59.

[98]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.

[99]Leone, et. al. Op. cit. p. 9.

[100]Ibid. p. 11.

[101]Maier. Op. cit. p. 11.

[102]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.

[103]Ralph Stone. "Reclamation of Landfill Methane and Control of Off-Site Migration Hazards." Solid Waste Management. (July 1978). p. 54.

[104]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.

[105]Ibid. Appendix.

[106]Ibid. p. 7.

[107]Ibid. pp. 4-5.

[108]Ibid. p. 6.

[109]Interview with Rollin Smith, Woodlake Sanitary Services, Inc. August 1983.

[110]Woodlake Sanitary Services, Inc. August 1, 1983. Op. Cit.

[111]John Reindl. "Gas and Leachate Movement." Waste Age. May 1981. p. 63.

[112]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.

[113]Smith. Op. cit.

[114]Thomas L. Connelly. "Exploding Methane Migration Myths." Public Works. (April 1983). p. 31.

[115]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.

[116]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.

[117]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.

[118]Ibid. p. 93.

[119]Maier. Op. cit. p. 37.

[120]Interview with Bob Hutchison, Anoka County. Oct. 4, 1983.

[121]"More on Methane." Waste Age. (January 1980). p. 50.

[122]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.

[123]Ibid. p. 223.

[124]"Sprucin' Up a Landfill." Waste Age. (March 1981). p. 42.

[125]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.

[126]Leone. Op. cit.

[127]J. Pacey. "Controlling Landfill Gas." Waste Age. (November 1979). p. 34.

[128]Minnesota Pollution Control Agency. Final Environmental Impact Statement: Woodlake Sanitary Landfill Proposed Expansion. Roseville, MN: Minnesota Pollution Control Agency. October 1980. p. III.

[129]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.

[130]Interview with Bud Kager, Woodlake Sanitary Services. July 1983.

[131]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.

[132]J. Pacey and G. Karpinski. "Assessing a Landfill's Potential as a Methane Gas Producer." Solid Wastes Management. November 1979. p. 28.

[133]Lutton, et al. Op. cit. pp. 205-206.

[134]"Sanitary Landfill Operation." Waste Age. (September 1981). p. 72.

[135]Interview with the Fire Marshall for Eden Prairie, MN.

[136]Woodlake Sanitary Services, Inc.

[137]Strgar-Roscoe, Inc. "Traffic Analysis for Proposed Expansion to Flying Cloud Landfill." prepared for Woodlake Sanitary Services, Inc. February 1982.

[138]Minnesota Department of Transportation. "Hourly Vehicle Type Data." 1981.

[139]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).

[140]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.

[141]Metropolitan Council. Alternate 3D Historical Report. St. Paul: Metropolitan Council. 1981.

[142]Interview with Minnesota Department of Transportation District 5 Traffic Engineers.

[143]Ibid.

[144]Interview with Danny Larson, Traffic Engineer, Hennepin County Traffic Engineering Department.

[145]Interview with Minnesota Dept. of Transportation District 5 Traffic Engineer.

[146]Minnesota Dept. of Transportation. 1981 Average Daily Traffic Volumes. Map 3D.

[147]Strgar-Roscoe, Inc. Op. cit. pp. 3 and 4.

[148]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.

[149]Minnesota Dept. of Transportation. "Highlights of Minnesota Weight Regulations." Oct. 19, 1982.

[150]Minnesota Dept. of Transporation. Ten Ton Route Guide - State, County & Municipal Ten Ton Routes.

[151]Ibid.

[152]Interview with Hennepin County Traffic Department.

[153]Interview with Minnesota Dept. of Transportation District 5 Traffic Engineers and Hennepin County Traffic Department.

[154]Interview with Rodney B. Kager, Vice President, Woodlake Sanitary Services, Inc.

[155]Interview with Minnesota Dept. of Public Safety, State Patrol Division.

[156]Interview with Minnesota Dept. of Transportation, District Five Engineers.

[157]Strgar-Roscoe, Inc. Op. cit. pp. 9 and 11.

[158]Ibid. p.9.

[159]Institute of Traffic Engineers. Informational Report Trip Generation. Second Ed. 1979.

[160]Interview with Bob Carlson, Orrin Thompson Homes. June 29, 1983.

[161]U.S. Fish and Wildlife Service. Master Plan for the Minnesota Valley National Wildlife Refuge Environmental Impact Statement. May 1982.

[162]Interview with Nigel Finney, Metropolitan Airports Commission.

[163]Interview with Timothy Anderson, Metropolitan Airports Commission. June 1983.

[164]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.

[165]World Magazine. 12, No. 8 (August 1982).

[166]Federal Register. 44, No. 1979 (Sept. 13, 1979.). p. 53459.

[167]Ibid.

[168] Memorandum from Richard Wetzel, U.S. Fish and Wildlife Service. Oct. 14, 1982.

[169]Interview with Nancy Burgstahler, U.S. Fish and Wildlife Service. July 1983.

[170]J.C. Green and R.B. Janssen. Minnesota Birds: Where, When and How Many. Minneapolis: University of Minnesota Press. 1975. pp. 98-100.

[171]Wetzel. Op. cit.

[172]"Shotgun Shells Scare Seagulls at County Landfill." Solid Wastes Management. 23, No. 12 (December 1980). p. 36.

[173]"Land Disposal of Solid Wastes." Waste Age. (April 1981). p. 174.

[174]V.E.F. Solman. "Aircraft and Wildlife." Proc. Wildlife in an Urbanizing Environment. Springfield, Massachusetts. (November 1973). pp. 137-140.

[175]"Landfill Wires Turn Seagulls From Diners Into Spectators." Solid Wastes Management. 22, No. 9 (September 1979). p. 18.

[176]Ibid.

[177]Burgstahler. Op. cit.

[178]Interview with O.R. Burckhardt, Bird Hazard Coordinator. Airports District Office, Federal Aviation Administration. May 1983.

[179]Interview with Robert Palmby, Tower Chief. Flying Cloud Airport. June 1983.

[180]Minnesota Dept. of Transportation. Draft Environmental Impact Statement for St. Paul Downtown Airport (Holman Field). 1982. pp. 5-182.

[181]Metropolitan Council."Guidelines for Land Use Compatability With Aircraft Noise." Aviation Chapter. Metropolitan Development Guide. St. Paul: Metropolitan Council. March 1983.

[182]Burckhardt. Op. cit.

[183]Metropolitan Council. March 1983. Op. cit.

[184]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.

[185]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.

[186]Metropolitan Council. Compensation and Mitigation: Dealing with the Adverse Impacts of Solid Waste Disposal Facilities. St. Paul: Metropolitan Council. 1982. pp. 15-16.

[187]Interview with Pat Poshek, Washington County Assessor's Office. January 1984.

[188]Interview with Dave Beel, Representative of Orrin Thompson Homes. February 17, 1984.

[189]Effects of Sanitary Landfills on the Value of Residential Property (draft) prepared for Browning-Ferris Industries, Research and Planning Consultants, Inc. March 22, 1983.

[190]Interview with Steve Sinell, City Assessor, City of Eden Prairie. February 1984.

[191]Metropolitan Council. Recommendations for Dealing with the Adverse Impacts of Solid Waste Disposal Facilities. St. Paul: Metropolitan Council. 1983. p. 13.

[192]Conversation with Wally Hustad, Hustad Development Corporation, March 8, 1984.

[193]Interview with Bud Kager. Browning-Ferris Industries. Sept. 14, 1983.

[194]Interview with Steven Sinell. Eden Prairie Assessor's Office. Sept. 15, 1983.

[195]Ibid.

[196]Ibid.

[197]Ibid.

[198]Ibid.

[199]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.

[200]Bud Cager. Op. cit.

[201]Woodlake Sanitary Services, Inc. Op. cit. p. 49.

[202]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.

[203]Interview with Kathy Berg and Myrna Colbeck, Mn. Pollution Control Agency. Sept. 26, 1983.

... 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:

$$1) \frac{\sum(A_i CN_i)}{A} \text{ to derive a weighted curve number}$$

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.

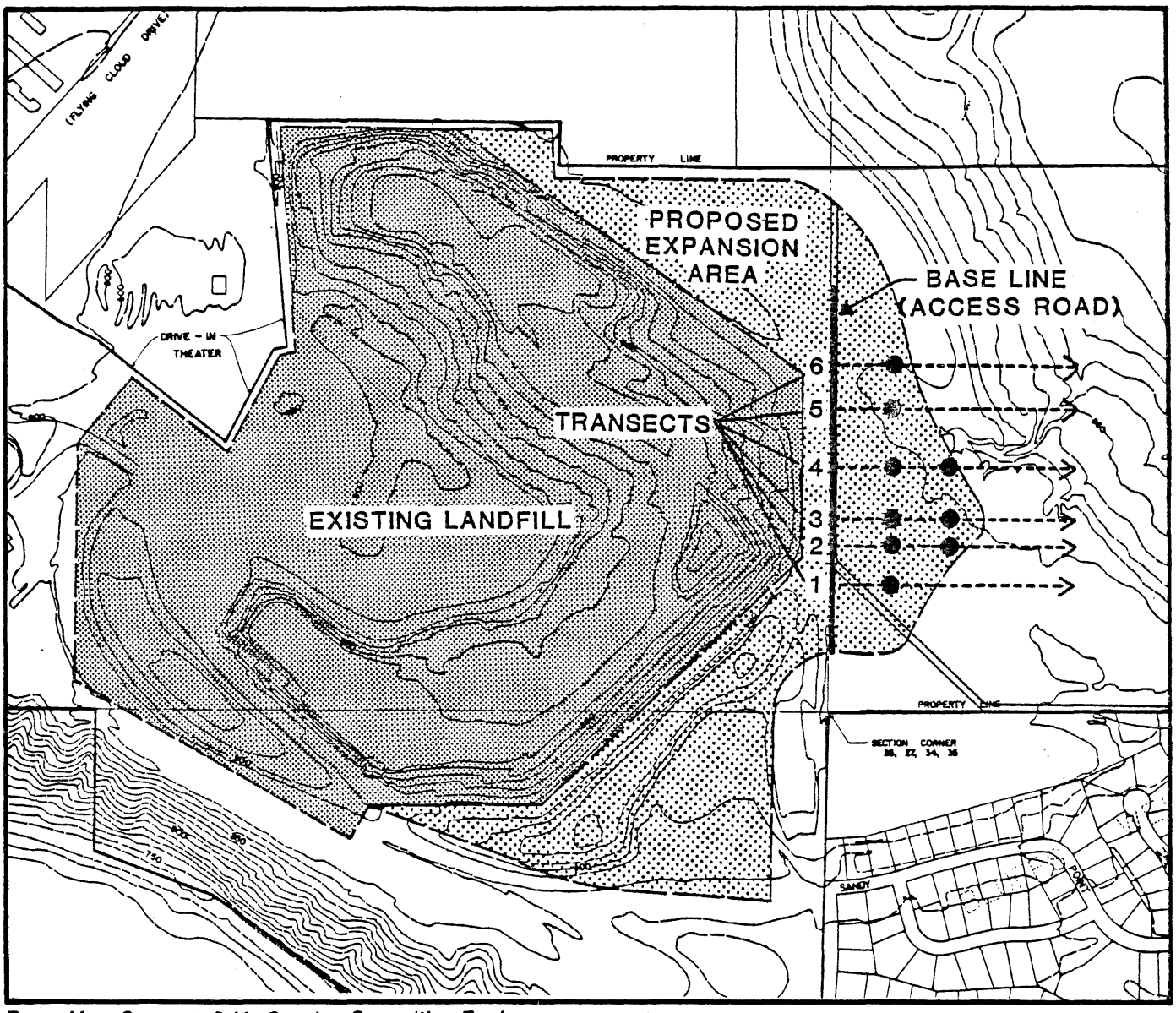
APPENDIX B
SURVEY OF ON-SITE PLANT SPECIES

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).

[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 nyctaginea (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
[redacted]
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.

P.O. BOX 1375 • MINNEAPOLIS, MINNESOTA 55440 • (612) 941-5957
9813 FLYING CLOUD DRIVE • EDEN PRAIRIE, MINNESOTA 55344

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

$$\text{Total Volume} = 3{,}682 + 3{,}665 - 361 = \underline{\underline{6{,}986 \text{ AF}}}$$

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:

$$\text{Expansion Volume} = 6{,}986 - 1{,}342 = \underline{\underline{5{,}644 \text{ acre ft.}}}$$

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.

BFI 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,

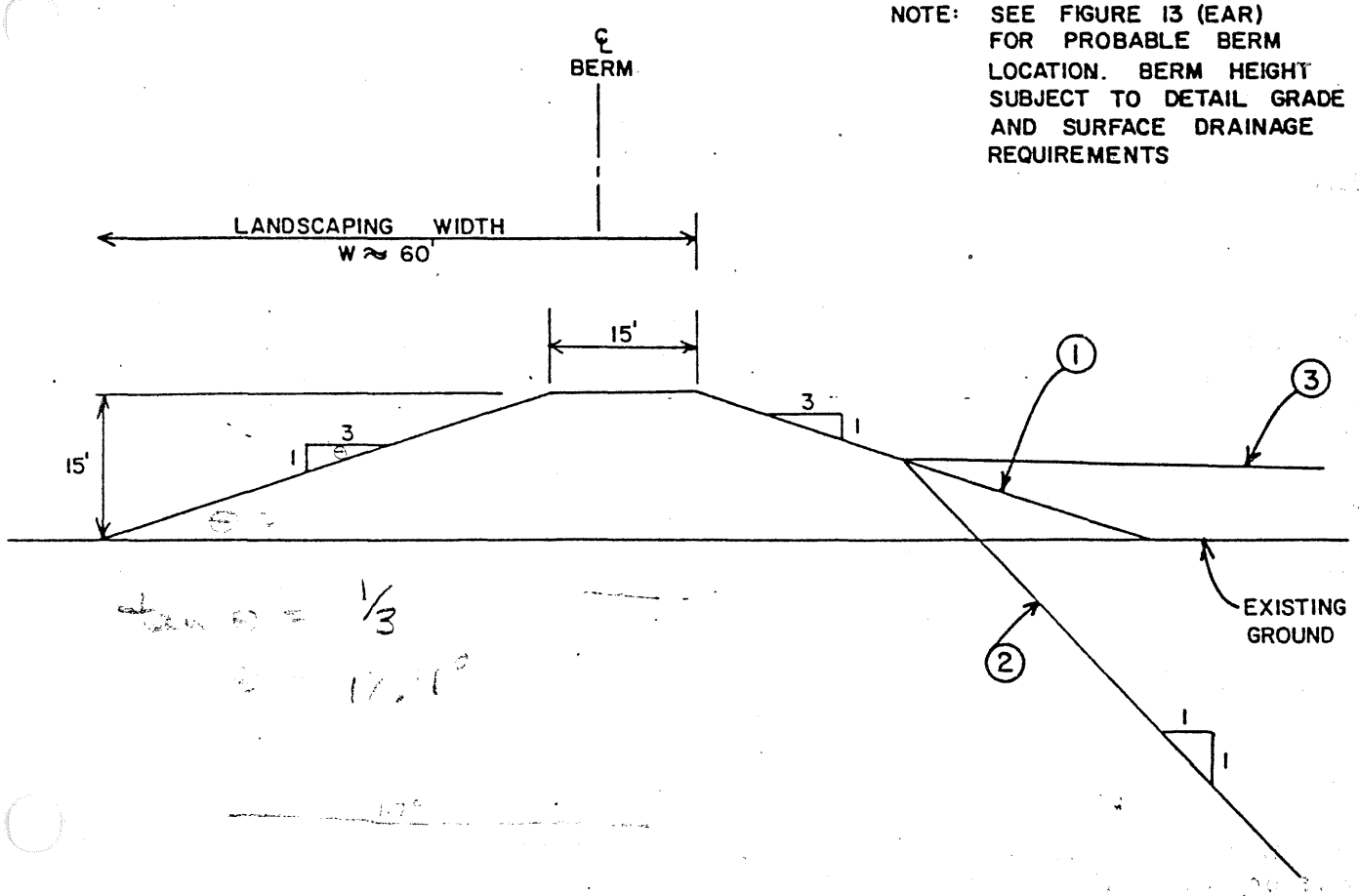
John G. Curry, Jr.
Regional Landfill Manager

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



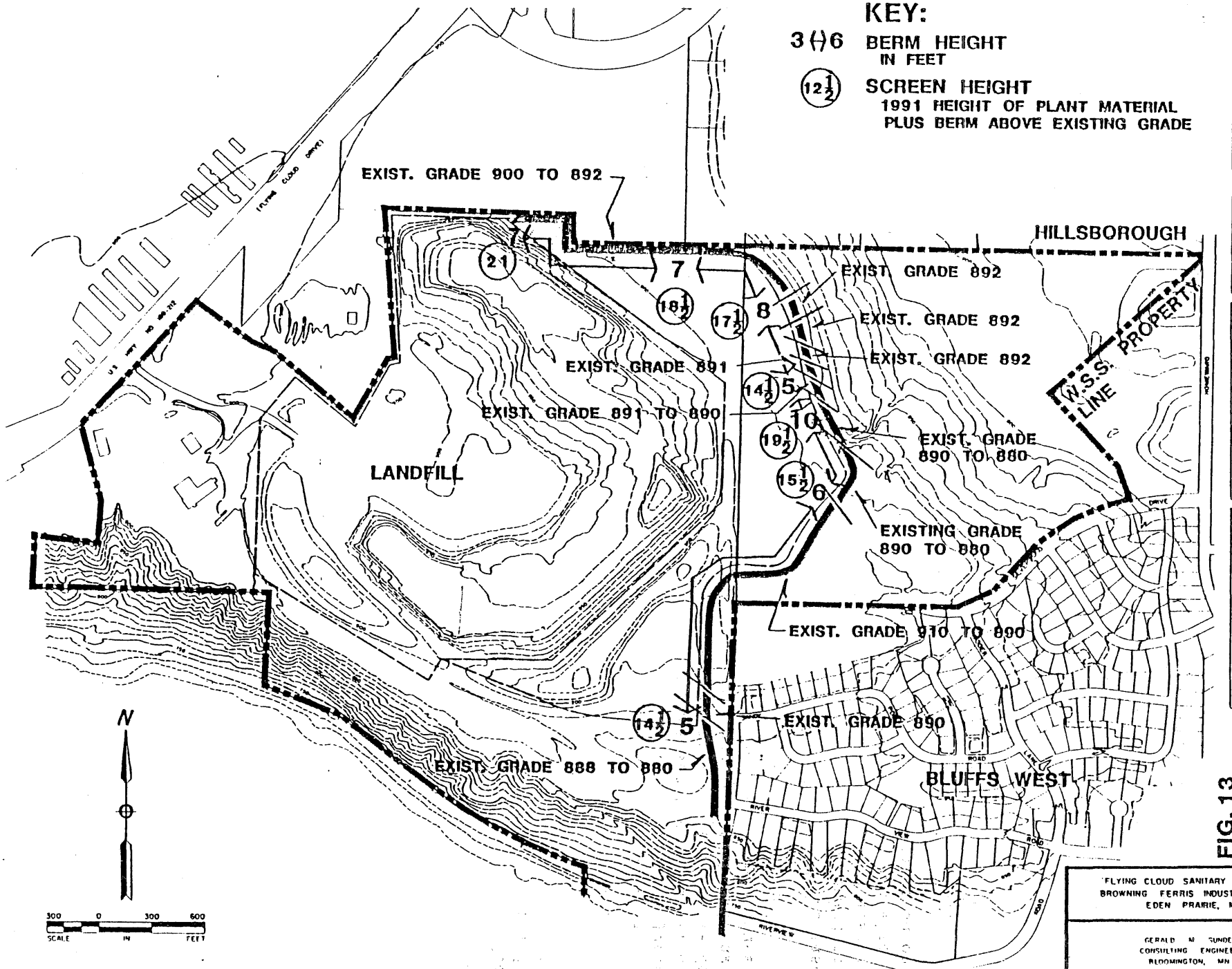
SLOPE 1 — INITIAL BERM SLOPE APPROX. 3:1. BUILD WHEN BERM IS FIRST INSTALLED.

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 ... Date ... Reg. No. ...

Job No. ... Drawn ... Date ... Revisions ... Field Book No. ... Final Check ...

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 Five
3301 Duluth Street
Golden Valley, Minnesota 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
6701 - 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 then 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]

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