ESTABLISHMENT OF NATIVE VEGETATION AT ST. JOHNS LANDFILL:

PROJECT OVERVIEW

AND

PHASE 1 WORK GUIDELINES AND COST ESTIMATES

FINAL DRAFT

Prepared for:

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A. Project Overview

Summary of Past Work (1992-1996)

Overview
Since the initiation of SJL final closure work in 1992, four series of vegetative testplots were established in 1992, 1994, 1995 and 1996. Specific information about each test plot is summarized in **Table 1: Native Grass Testplots 1992-1996** (revised from: M.G. Wilson, *SJL Vegetation Maintenance Program: Task Two- Native Grassland Management Plan*, 1997).

Of the twelve total plots seeded, six have been abandoned. In five of the six abandoned plots, the seedings of native grasses failed, primarily due to competition from un-seeded non-native grasses in the seedbank or from a seeded covercrop. The sixth plot has been abandoned due to it's depredation by waterfowl grazing. It should be noted that of the six abandoned grassland plots, four were on plots that had no site (or soil) preparation manipulation other than cover soil placement.

Several other factors have contributed to the failure of test plots:

- When the final closure soils and composts were placed, heavy road building equipment was used resulting in soil compaction.
- The use of recycled soil (from the temporary soil cover) and imported soil containing weeds has resulted in contaminated soil seedbanks.
- All testplots were sown with out of area seed.

To date, none of the established testplots were replicated. Each test plot was established using different combinations of site preparation manipulations and seeding methods. While some testplots were successful, the results obtained from each plot were incomplete and therefore unable to be fully analyzed.

TABLE 1: SJL Native Grass Testplots 1992-1996

Location/Size	Site Prep.	Date/Method	Species	App. Rate	Status
Mesic Plots: **SA-1** **4 Acres total**	None	9/92 - Track & Broadcast Hydroseed	covercrop + 4 grasses 7 forbs	variable (mix)	abandoned: failure
Xeric Plots: **SA-1** **4.5 Acres total**	None	9/92 - Track & Broadcast Hydroseed	covercrop + 4 grasses 3 forbs	variable (mix)	abandoned: failure
Plot 1A: SA-1 **.5 Acre**	Herbicide- Tillage	9/94 No-till drill	BRca & FEid	8.5 #/Acre equal mix	abandoned: failure
Plot 1B: SA-1 **.6 Acre**	Herbicide- No Tillage	9/94 No-till drill	BRca & FEid	8.5 #/Acre equal mix	seed production
Plot 2A: SA-1 **.10 Acre**	Solarization	9/94 No-till drill	BRca & FEid	8.5 #/Acre equal mix	seed production
Plot 2B: SA-1 **.25 Acre**	Tillage only	9/94 No-till drill	BRca & FEid	8.5 #/Acre equal mix	uncertain
Plot 3A: SA-1 **.6 Acre**	Tillage only	9/94 No-till drill	BRca & FEid	16.3 #/Acre equal mix	seed production
Plot 3B: SA-1 **.55 Acre**	Acid pH	9/94 No-till drill	BRca & FEid	16.3 #/Acre equal mix	abandoned: failure
Plot 4: SA-2 **1.5 Acres**	None	9/94 No-till drill	BRca & Feid	16.3 #/Acre equal mix	abandoned: failure
Plot A: SA-4 **1 Acre**	None	9/95 - Track & Broadcast	ELgl	30 #/Acre	abandoned: depredation
Plot B: SA-5 **1 Acre**	Sterile Soil	9/96 - Track & Broadcast	BRca & ELgl	30 #/Acre equal mix	uncertain
Plot C: SA-5a **6 Acres**	Sterile Soil	9/96 - Track & Broadcast	BRca & ELgl	30 #/Acre equal mix	uncertain

Species: BRca=Bromus carinatus/FEid=Festuca idahoensis/ELgl=Elymus glaucus

Summary of Proposed Experimental Plot Procedures

Contract Overview

This summary provides an explanation of the Wilson-Brophy-Wilson Design Group (WBW) approach to the establishment of three 1 acre experimental plots at the St. John's Landfill. This summary is provided as an overview of the 1997 [Phase I] Final Draft document entitled, "Project Overview and Phase I Work Guidelines and Cost Estimates". Future changes to the 1997 [Phase I] Final Draft document are anticipated as more complete site information (such as the results of planned vegetation surveys during the 1998 growing season) becomes available. Additional information about the project is available in the initial proposal submitted to Metro on May 21, 1997. The initial proposal is entitled "Proposal for Professional Services: Establishment of Native Vegetation at St. Johns' Landfill"; it was the basis for the award of contract #905795.

Purpose of the 1997-1998 Experimental Plots

The experimental plots to be seeded during the fall of 1998 are designed to determine the identity of sustainable native grass species and/or native-dominant herbaceous assemblages that can be planted as cover on the landfill, along with management practices for establishment and maintenance of these assemblages. These assemblages and management practices should not jeopardize the integrity and function of the existing cover system at St. John's Landfill, but should prevent or control erosion and the spread of invasive noxious weeds, and enhance the wildlife habitat and scenic values of the landfill.

Question to be Answered by the 1997-1998 Experiments

The proposed experimental plots are designed to answer the question, "Which of the proposed experimental treatments provides the best growth of native or native-dominant vegetation during the 5-year contract period?" Treatments to be tested are described under "Experimental plot treatments..." below. Statistical analysis of experimental results will be used to compare these treatments.

Site Preparation Methods (1997-1998)

The goal of site preparation is to provide a "clean slate" for the experimental plots - specifically, an area free of severe competition from undesired vegetation - so that the different experimental treatments can be evaluated without the serious handicap of different initial weed populations at the beginning of the experiment. A single, uniform site preparation method must be applied across all experimental plot areas in order to allow comparison of the experimental treatments. [Treatments are described below under Experimental plot treatments...] Given the short (5-year) duration of this contract, both the "clean slate" approach and use of a single, uniform site preparation method are vital to improve the chances of significant experimental results. Uneven initial weed control and/or lengthy experimentation on site preparation methods would almost certainly lead to inconclusive results in the experimental plots.

Site preparation for the 1997-1998 testplots will consist of a combination of herbicide (glyphosate), irrigation, and/or tillage. Application of the herbicide glyphosate was recommended for fall 1997 in order to reduce the vigor of existing non-native vegetation while maintaining erosion control over the winter 1997-98 period. [See the 1997 [Phase I] Working Draft Document submitted August 1997].

Specifications and rationale for any changes to proposed site preparation work in late winter and spring 1998 will be provided as revisions to the 1997 [Phase I] Final Draft Report in the spring and summer of 1998. Additional applications of glyphosate may be recommended. For example, a second application should be applied in late winter before winter annuals go to seed. Further applications may be needed to provide additional control of the site's dense stand of perennial non-native grasses. Decisions regarding these applications will be based on the extent of regrowth after earlier herbicide applications, as well as the effects of tillage and irrigation if these methods are used. [See following 2 paragraphs].

Site preparation specified in future revisions of the 1997 [Phase I] Final Draft Report may also include irrigation to sprout any remaining seed bank during the dry part of the summer. If irrigation is used to sprout weed seeds, a final herbicide application would be needed to control the weeds that sprout. Irrigation may also be recommended in conjunction with planting, to speed the establishment of the desired species before the onset of 1998-99 winter rains. Total herbicide applications recommended will not exceed manufacturer's recommendations as provided in the herbicide label.

A single tillage operation may also be added to the site prep schedule, depending on results of soil physical testing in winter 1997-98. Tillage is not recommended as the primary method for control of existing non-native vegetation, because repeated tillage would be necessary to achieve the desired level of weed control. Repeated tillage would increase the risk of erosion, because it would weaken the already-poor soil structure at the site.

Experimental Plot Design

Experimental plot layout is a split-plot design with subplots consisting of mycorrhizal treatments applied as strips arranged perpendicular to the slope within each site. [See attached plot layout diagrams]. Two main plots (two mycorrhizal treatments) constitute a block. This design allows efficient application of mycorrhizal inoculum (or other planter-applied treatments) with the tractor-pulled, 3-point hitch mounted no-till seed drill that is the recommended planting equipment for this study. Blocks are designed to separate out variability at the sites due to slope position and soil texture. This type of blocking greatly reduces experimental error due to environmental variability.

<u>The 1997-98 Testplot locations are shown on Map A</u>. Site <u>SA2</u> (Figure 1) has twelve 35' X 125' plots; Site <u>SA3-N</u> (Figure 2) has twelve 30' X 175' plots, and Site <u>SA3-S</u> (Figure 3) has twelve 40' X 100' plots. Plot sizes were designed to be as large as possible given the blocking and replication requirements. A minimum of 3 replications for mycorrhizal inoculum level and six replications for seed mixture are included in the design for each

site. Experimental plot layout is subject to change based on the availability of treatment supplies and planting equipment.

Experimental Plot Treatments

The proposed experiment involves two factors: seed mixture and mycorrhizal treatment. The two proposed seeding mixtures are: 1) *Bromus carinatus* (CA brome-grass) + *Elymus glaucus* (blue wild-rye), and 2) *Bromus carinatus* + *Elymus glaucus* + *Lotus purshianus* (spanish clover). The two proposed mycorrhizal treatments are: 1) added mycorrhizal inoculum, and 2) control (native mycorrhizae only). Treatments to be applied are subject to change based on soil sampling and research during winter 1997-98 and spring 1998.

Seed Mixture Treatments.

The two grasses proposed for the seed mixtures were chosen based on results of previous research at the landfill; these were the most successful of the native grasses planted to date. Addition of a native legume is proposed based on two factors. First, the soils that have been placed on the surface of the landfill are low in nitrogen compared to native prairie soils. Therefore, legumes may be an important addition to the native plant community due to their ability to fix nitrogen. Second, by using legumes rather than nitrogen fertilizer to increase availability of nitrogen in the plant community, the chances of formation of a strong mycorrhizal association may be improved. Many studies have shown that addition of fertilizer reduces development of mycorrhizal associations.

Mycorrhizal Treatments.

Mycorrhizae are fungi that are considered the most important component of the soil microflora. These fungi form a symbiotic association with plant roots and can greatly increase plant uptake of water as well as phosphorus and other nutrients. Mycorrhizae also protect plants against root pathogens. Besides their direct benefits to plants, mycorrhizae also appear to benefit the entire soil ecosystem by supplying nutrients to other soil microflora and helping to develop a healthy, aggregated soil structure. They may even help control weeds by giving mycorrhizal native plant species a competitive advantage over non-mycorrhizal weedy species. Addition of mycorrhizal inoculum is proposed as an experimental treatment because mycorrhizae are vital to early growth and long-term survival of plant communities, especially in stressful environments such as droughty or low-fertility soils or soils that impede root development. The landfill soils are subject to drought in the summer due to their very limited water storage capacity. Specifically, the topsoil layer is thin; the sand layer below the topsoil holds very little water; and deep root penetration is not possible due to the geomembrane. Although sewage sludge has brought nutrient levels up in some areas, the cover soil is often low in fertility, and the structure of the soil profile definitely impedes root development, as described above. Addition of mycorrhizal inoculum may be needed because native mycorrhizal populations may be low on the landfill. Much of the cover's surface layer is actually composed of subsoils rather than topsoil, and subsoils do not generally have high populations of mycorrhizal fungi. Even if mycorrhizae are already present in cover soils, plant growth is often aided by placement of additional inoculum. Soil microflora testing in the winter of 1998 will provide general information on mycorrhizal development in roots of native and nonnative grasses at several locations on the landfill; final quantitative analysis of soil microflora in the final year of the study will determine levels of mycorrhizal development in the two treatments. It is important to note that development of mycorrhizal associations in the plots that did not receive mycorrhizal inoculum would not invalidate the experiment, since addition of mycorrhizal inoculum beyond the levels that were initially present in the soil can be highly beneficial to plant growth.

Experimental Plot Planting
No-till planting is recommended, to minimize erosion risk and reduce seed bank competition with plantings. No-till planting implements such as the cross-slot planter are designed to provide good seedling establishment conditions even in compacted soils. Recommended equipment is a tractor-pulled, 3-point hitch mounted no-till seed drill; the specific model of drill and its supplier/operator will be determined during winter/spring 1998. The no-till drill previously supplied by Oregon State University is no longer available. To date only one potential subcontractor with a no-till drill available has been found in the Willamette Valley. Every effort is being made to locate other equipment and subcontractors necessary to carry out testplot seeding operations scheduled for Fall 1998. The purchase of a suitable drill will also be investigated.

Small amounts of two native grass species (*Bromus carinatus* and *Elymus glaucus*) that are proposed for seeding in the 1998 testplots was harvested from SJL in the summer of 1997. This seed will be cleaned and tested for viability this winter. The SJL seed will be supplemented with additional Willamette Valley grown grass seed. However, only one supplier of suitable seed is available as of this date. Several other growers are expected to have seed available for harvest in the summer of 1998. They will be contacted in the spring after the growers are able to determine winter crop survival. The legume seed will be available for collection from the SJL site.

A supplier for mychorrizal innoculum for the testplots will be specified after the results of Winter 1998 soil testing have been analyzed determined. See the attached Project Work Schedule for the Consultants.

More detailed information will be presented in the planned Final Draft Report revisions scheduled for Spring and Summer of 1998. All recommended expenditures for supplies and subcontractors will adhere to the current budget estimate. See the attached Metro Project Staffing and Budget.

Experimental Testplot Monitoring
Monitoring of the testplots after planting will be quantitative, and will be designed to allow statistical analysis of results. Quantitative data will be collected for individual species of interest and for the plant community as a whole, in the form of percent cover,

frequency, density, and/or other statistically valid measures. These data will be used to answer the question, "Which of the experimental treatments provides the best growth of native (or native-dominant) vegetation during the 5-year contract period?". Prior to finalization of the statistical protocol, we will conduct preliminary sampling at the site to determine the best type of sampling units, unit size, number of units, and parameters to be measured. Most likely, randomly-placed quadrats will be used to sample for cover and frequency. We will interpret experimental data via means comparisons using accepted test statistics; analysis of variance and covariance; regression; and/or other appropriate linear methods. The WBW Project team proposes that the test plots will be considered successful if the subplots sown with native vegetation have a percent cover >/= 50% by the summer of year 2002.

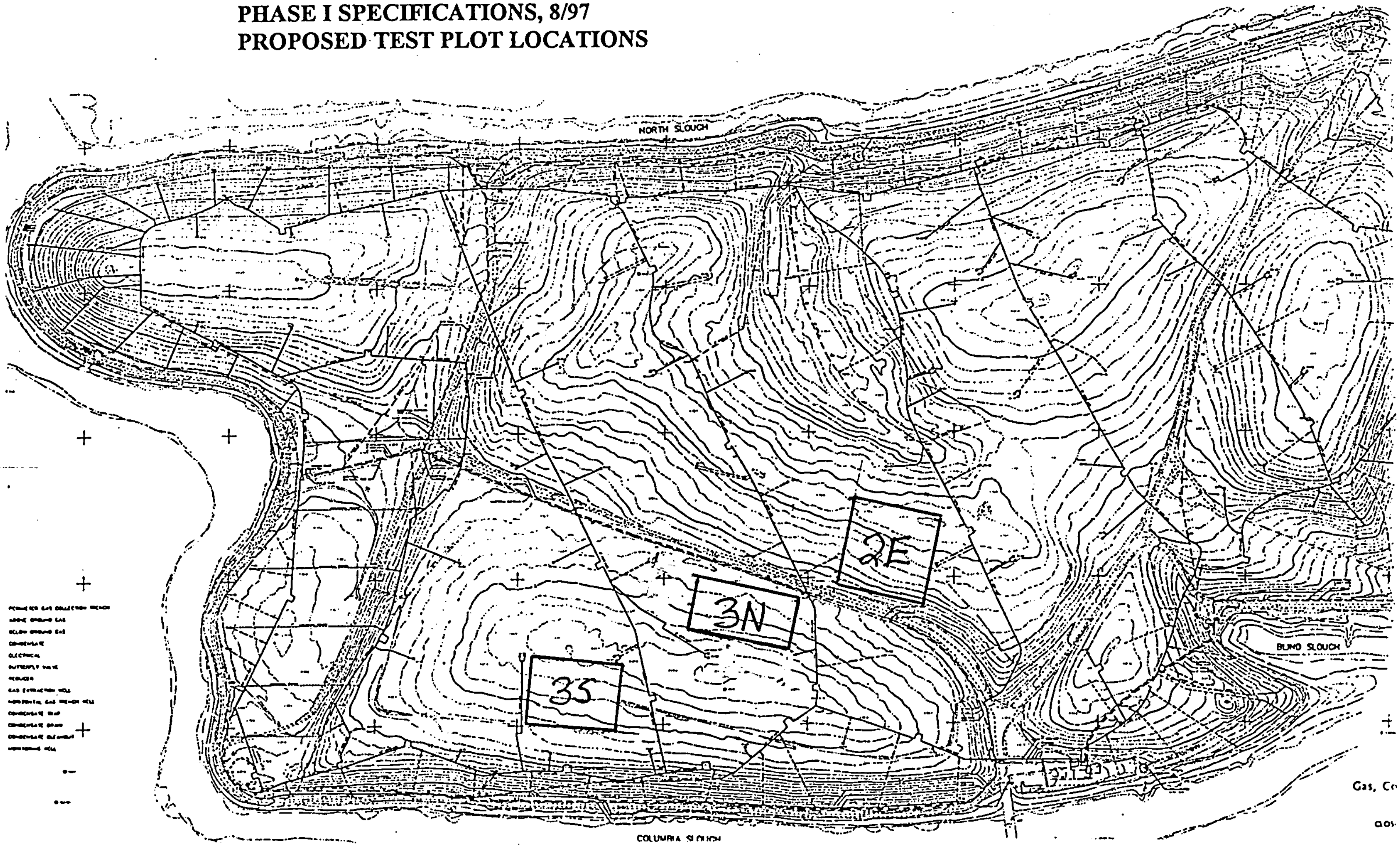
Testplot Statistical Monitoring Protocol

The proposed statistical monitoring protocol is as follows: during summer, place two transects lengthwise through each experimental subplot (for 97/98, there are 12 such subplots per site, and three sites on the landfill). Exclude buffer strips of 5' on each side of the subplot. Using a random number table, locate 2 sample points along each transect within the subplot. At each sample point, place a one-square-meter quadrat frame on the ground, oriented with its sides parallel to the transect and alternating left and right of the transect. For analysis of vegetation cover by species, within each quadrat, record percent cover for seeded species and other dominant species, and other important species (such as invasive weeds) . [See Appendix C, Sample Data Sheet]. Compute average percent cover per subplot for species of interest. Construct an Analysis of Variance (ANOVA) table for the experiment with average percent cover as dependent variable, showing variance components attributable to the following effects: replication, main plot treatment (added mycorrhizal inoculum versus native mycorrhizal population), subplot treatment (presence or absence of legume in seeding mix), intereaction between main and subplot treatments, and experimental error. Compute the F value and determine the significance (p-value) of differences between treatments (effects). Use the results to answer the question, "Which of the experimental treatments provides the best growth of native (or native-dominant) vegetation during the 5-year contract period"?

Continuing Testplot Site Preparation and Maintenance

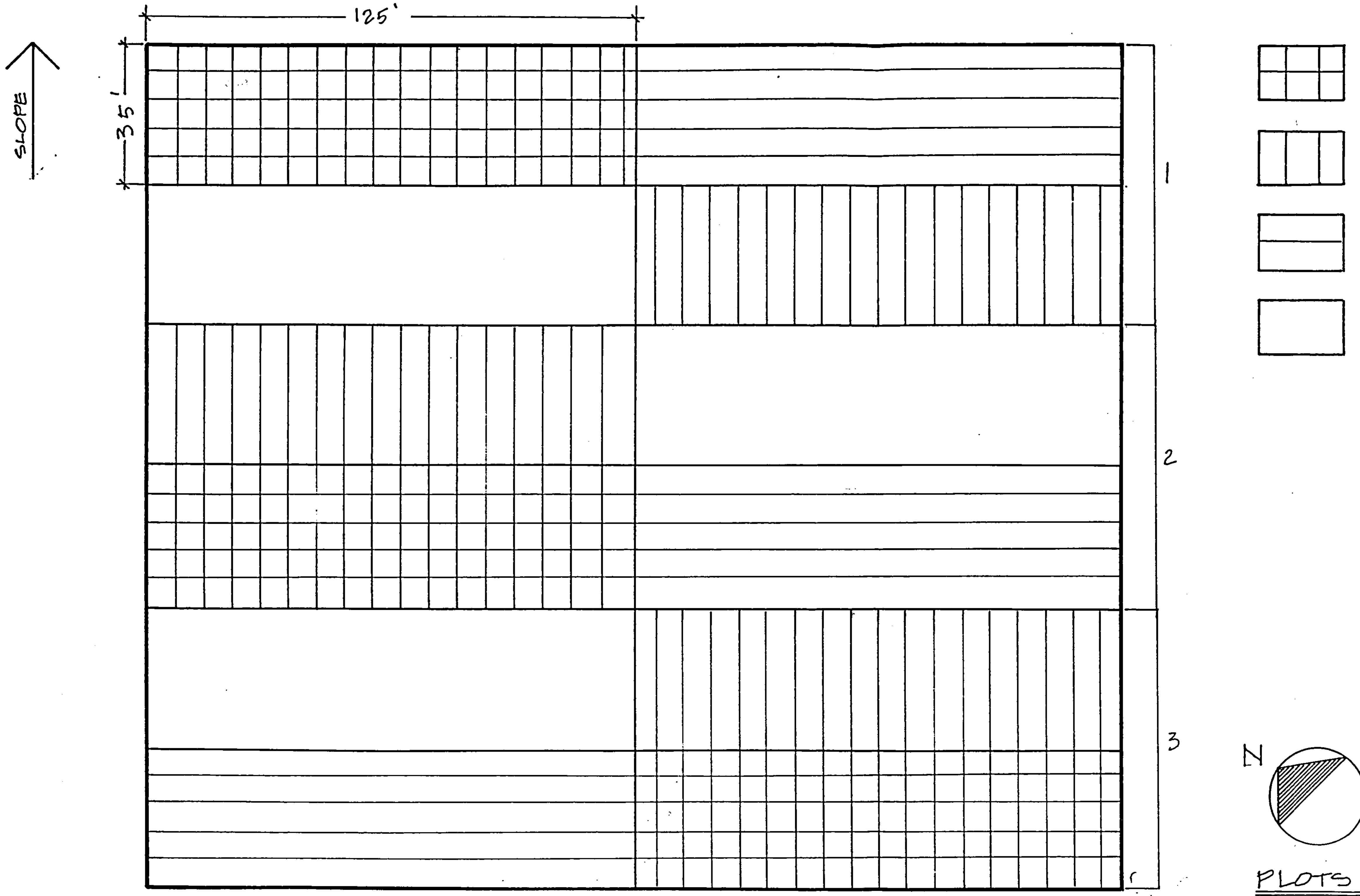
During the 1998 growing season, the testplots will be monitored to determine the timing (and needs for) additional herbicide applications (and optional irrigation and tillage) to control the growth of existing invasive, exotic vegetation prior to seeding in the fall of 1998. The surveying and monitoring of old testplots and SJL areas not planted to native dominant vegetation will also begin in 1998 and revisions to the existing Integrated Vegetation Maintenace (IVM) Plan are planned as a component of the 1998 Working Draft Report. [See the Project Work Schedule for the Consultants on the following page <u>and</u> Task One: Integrated Vegetation Management Plan for Species of Concern- Final Report, (M. G. Wilson, April 1997)]. The need for testplot maintenance to control particular plant species will be identified through monitoring. The consultants, utilizing the revised IVM Plan as required, will supervise activities such as high mowing, and hand weeding. [See maintenance timing in Metro Project Staffing & Budget section following].

WILSON/BROPHY/WILSON DESIGN GROUP
PHASE I SPECIFICATIONS, 8/97
PROPOSED TEST PLOT LOCATIONS



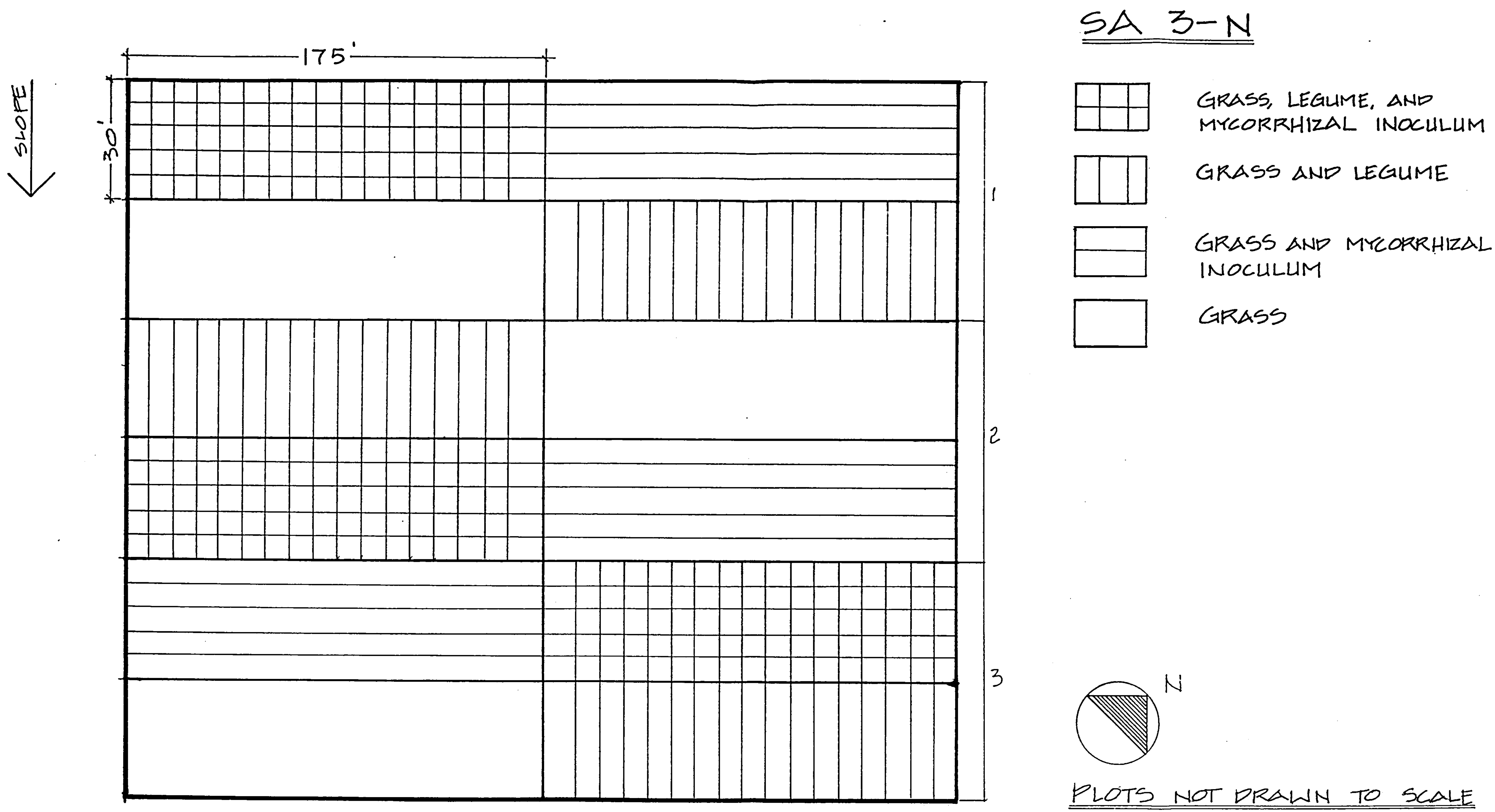
MAP A

SA 2

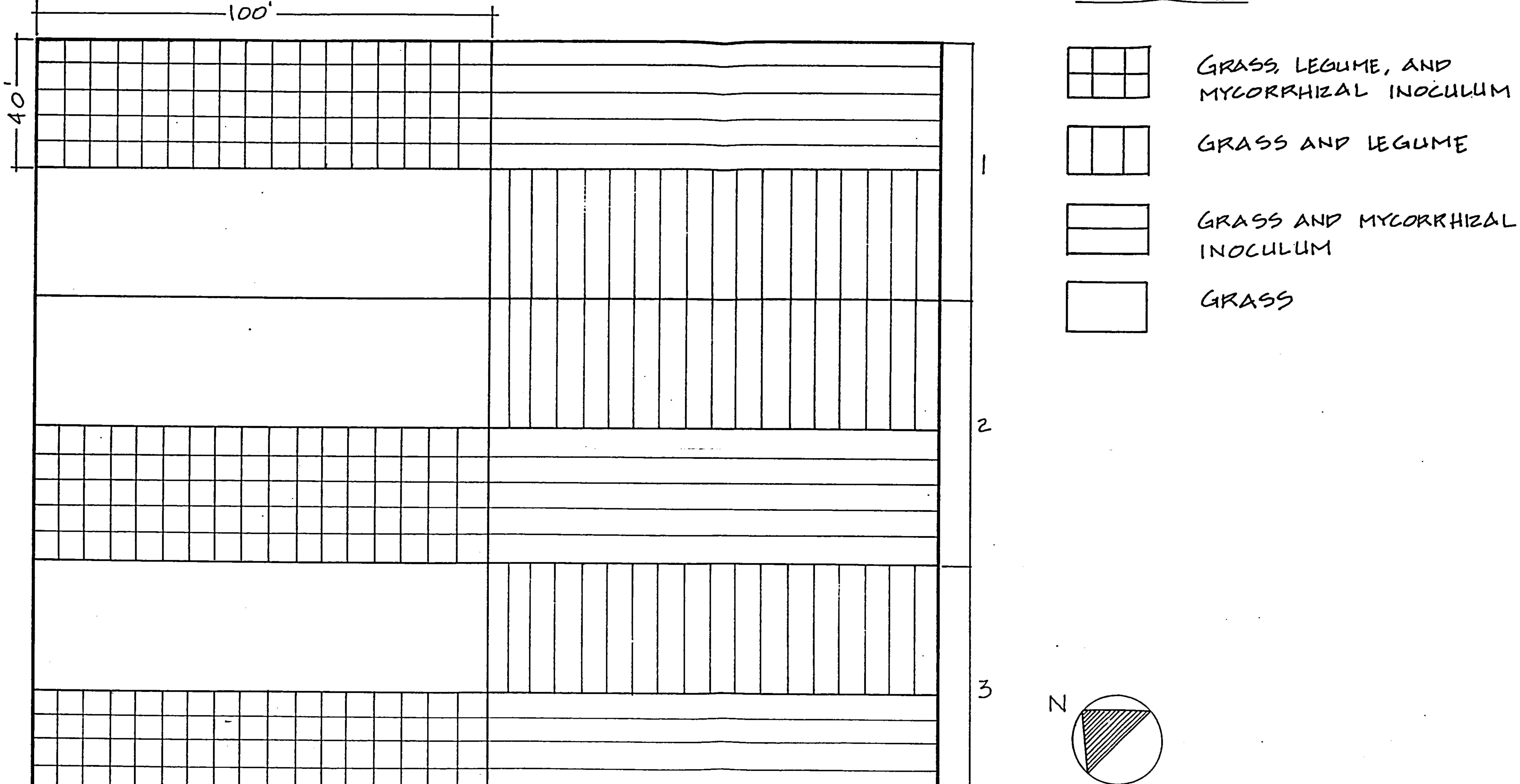


Crosshatched grid	GRASS, LEGUME, AND MYCORRHIZAL INOCULUM
Vertical lines	GRASS AND LEGUME
Horizontal lines	GRASS AND MYCORRHIZAL INOCULUM
Blank	GRASS

PLOTS NOT DRAWN TO SCALE


SA 3-N
175'
30'
SLOPE
1
2
3
GRASS, LEGUME, AND MYCORRHIZAL INOCULUM
GRASS AND LEGUME
GRASS AND MYCORRHIZAL INOCULUM
GRASS
N
PLOTS NOT DRAWN TO SCALE

SA 3-S.



PLOTS NOT DRAWN TO SCALE

Project Work Schedule for the Consultants

August 1997 through June 1998 (FY 98)

Summer 1997

- Conduct vegetative survey and preliminary soil analysis to determine 1997-1998 testplot locations.
- Prepare 1997 [Phase 1] Working Draft Report.
- Determine location of garden plot. Oversee grow-out of vegetative plugs.

Fall 1997

- Present 1997 Working Draft Report to: Smith & Bybee Lakes Technical Advisory Committee and Smith & Bybee Lakes Management Committee for approval.
- Prepare 1997 Final Draft Report. Present to Smith & Bybee Lakes Technical Advisory Committee and Smith & Bybee Lakes Management Committee for approval.
- Oversee herbicide application to three 1 acre testplots and planting of plugs in garden plot.

Winter 1997-1998

- Conduct additional soil testing on 97/98 testplots to determine soil depth and severity of compaction.
- Conduct preliminary sampling of soil microflora on 97/98 testplots, old testplots and reference sites.
- Survey the vegetation on the 97/98 testplots. Oversee an additional application of herbicide to 97/98 testplots.
- Oversee additional garden plot plantings.
- Prepare Scope and Budget for submittal of 1998 [Phase 2] Working Draft Report.
- Conduct background research for preparation of 1997 Final Draft Report revisions and 1998 Working Draft Report.
- Submit 1997 Final Draft Report with revisions.

Spring 1998

- Survey/Monitor: old testplots and SJL areas not planted to native dominant vegetation.
- Survey the vegetation on the 97/98 testplots. Oversee an additional application of herbicide to 97/98 testplots.
- Prepare and Submit revisions to: 1997 Final Draft Report as required.
- Select garden plot expansion area. Initiate site prep work.
- Oversee continuing site prep work on 97/98 testplots.
- Locate suppliers and subcontract labor for testplot seeding in Fall 1998.
- Conduct background research for preparation of 1998 Working Draft Report.

July 1998 through June 1999 (FY 99)

Summer 1998

- Prepare and Submit revisions to 1997 Final Draft Report as required.
- Prepare 1998 Working Draft Report. Present to Smith & Bybee Lakes Technical Advisory Committee and Smith & Bybee Lakes Management Committee for approval.
- Prepare 1998 Final Draft Report. Combine with 1997 Final Draft Report.
- Survey/Monitor: old testplots and SJL areas not planted to native dominant vegetation.
- Survey the vegetation on the 97/98 testplots. Oversee an additional application of herbicide to 97/98 testplots (optional).
- Oversee production of mycorrhizal innoculum for 97/98 testplots.

Fall 1998

- Survey the vegetation on the 97/98 testplots. Oversee an additional application of herbicide to 97/98 testplots (optional).
- Oversee seed drilling and (possible) irrigation of 97/98 testplots and plug planting in garden plot expansion.
- Initiate monitoring of 97/98 testplots.

Winter 1998/1999

- Monitor garden plots and 97/98 testplots.
- Prepare 1st annual monitoring report.

Spring 1999

- Survey/Monitor: garden plots; 97/98 testplots; old testplots; and SJL areas not planted to native dominant vegetation.

July 1999 through June 2000 (FY 2000)

Summer 1999

- Survey/Monitor: garden plots; 97/98 testplots; old testplots; and SJL areas not planted to native dominant vegetation.
- Oversee seed harvest in garden plots.

Fall 1999

- Initiate monitoring of 97/98 testplots. Continue monitoring of 97/98 testplots.

Winter 1999/2000

- Monitor garden plots and 97/98 testplots.
- Prepare 2nd annual monitoring report.

Spring 2000

- Survey/Monitor: garden plots; 97/98 testplots; old testplots; and SJL areas not planted to native dominant vegetation.

July 2000 through June 2001 (FY 2001)

Summer 2000

- Survey/Monitor: garden plots; 97/98 testplots; old testplots; and SJL areas not planted to native dominant vegetation.
- Oversee seed harvest in garden plots.

Fall 2000

- Monitor garden plots and 97/98 testplots.

Winter 2000/2001

- Prepare 3rd annual monitoring report.

Spring 2001

- Survey/Monitor: garden plots; 97/98 testplots; old testplots; and SJL areas not planted to native dominant vegetation.
- Conduct quantitative monitoring of 97/98 testplots (physical soil)
- Conduct quantitative monitoring of 97/98 testplots (soil microflora)

July 2001 through June 2002 (FY 2002)

Summer 2001

- Survey/Monitor: garden plots; 97/98 testplots; old testplots; and SJL areas not planted to native dominant vegetation.
- Oversee seed harvest in garden plots.

Fall 2001

- Monitor garden plots and 97/98 testplots.

Winter 2001/2102

- Prepare 4th annual monitoring report.

Spring 2002

- Monitor garden plots and 97/98 testplots.
- Prepare final report.

September 21, 2002

- Submit Final Report

Metro Project Staffing and Budget

Introduction

The following chart should be considered a preliminary document and is presented for planning purposes only. Information presented in the work task and staffing columns are complete and reasonably accurate and is complemented by the Project Work Schedule for the Consultants. The total estimated cost of the project includes all options for the establishment of the 1997-1998 testplots (e.g. herbicide applications, discing, irrigation, etc.).

August 1997 through June 1998 (FY 98)-

WORK TASK	STAFFING*	COST EST.
Summer 1997		
97/98 Testplots:		
• Test soil (chemistry, texture & seedbank)	SC	$700.00
Garden Plot:		
• Grow-out grass plugs.	SC	$200.00
• Prepare garden plot for planting.	M	$1,600.00
Fall 1997		
97/98 Testplots:		
• Apply herbicide to three 1 acre testplots.	SC	$450.00
Garden Plot:		
• Plant plugs in garden plot. Mulch.	M	$100.00
• Mulch unplanted areas w/black plastic.	M	$50.00
Winter 1997-1998		
97/98 Testplots:		
• Test soil (compaction & soil depth).	SC	$700.00
• Test soil microflora.	SC	$1,500.00
• Additional application of herbicide.	SC	$450.00
Old Testplots/reference sites		
• Test soil microflora	SC	$0 (see above)
Garden Plot:		
• Plant additional plugs. Mulch.	M	$100.00
Other:		
• Clean/Test *Bromus* & *Elymus* grass seed (harvested @ SJL summer 1997)	SC	$500.00
Spring 1998		
97/98 Testplots:		
• Additional application of herbicide.	SC	$450.00
• Order seed.	SC	$500.00
• Order treatment supplies.	SC	$750.00
Garden Plot:		
• Select expansion area. Initiate site prep..	M	$1,000.00
• Initiate routine maintenance.	M/SC	$700.00

*** SC=Subconsultant or Vendor/M=Metro REM Operations Staff**

July 1998 through June 1999 (FY 99)-

	WORK TASK	STAFFING*	COST EST.
Summer 1998			
	97/98 Testplots:		
	• Continue site prep work:	M/SC	
	irrigate (rent or purchase)		$3,000.00
	disc [optional]		$100.00
	apply herbicide [optional]		$450.00
	Garden Plot:		
	• Continue routine maintenance.	M/SC	$700.00
	• Harvest seed.	SC	$200.00
	• Grow out grass plugs	SC	$200.00
Fall 1998			
	97/98 Testplots:		
	• Apply herbicide [optional]	SC	$450.00
	• Drill seed/Apply treatments	SC	$5,000.00
	Garden Plots:		
	• Continue routine maintenance.	M/SC	$700.00
	• Plant additional plugs. Mulch.	M	$100.00
Spring 1999			
	97/98 Testplots:		
	• Maintain as needed.	M/SC	$500.00
	Garden Plots:		
	• Continue routine maintenance.	M/SC	$700.00

July 1999 through June 2000 (FY 2000)-

	WORK TASK	STAFFING*	COST EST.
Summer 1999			
	Garden Plots:		
	• Continue routine maintenance.	M/SC	$700.00
	• Harvest seed.	SC	$200.00

*** SC=Subconsultant or Vendor/M=Metro REM Operations Staff**

July 2000 through June 2001 (FY 2001)-

WORK TASK	STAFFING*	COST EST.
Summer 2000		
Garden Plots:		
• Harvest seed	SC	$300.00
97/98 Testplots		
• Harvest seed	SC	$300.00
Spring 2001		
97/98 Testplots, Old Testplots, Reference sites:		
• Quantitative analysis of physical soil	M/SC	$700.00
• Quantitative analysis of soil microflora	M/SC	$5,000.00

July 2001 through June 2002 (FY 2002)-

WORK TASK	STAFFING*	COST EST.
Summer 2001		
Garden Plots:		
• Harvest seed	M/SC	$300.00
97/98 Testplots		
• Harvest seed	SC	$300.00
TOTAL ESTIMATED COST [see introduction]		**$29,650.00**

*** SC=Subconsultant or Vendor/M=Metro REM Operations Staff**

B. Phase I Statement of Purpose

Two work tasks are proposed for implementation during the Phase I time period [July 15, 1997 through November 3, 1997]:

1. Select the locations of three 1 acre test plots, and initiate a one year site/soil preparation period prior to seeding them with native dominant vegetation in the fall of 1998.
2. Select garden plot location(s). Prepare the garden site and seed with one native legume species and plant plugs of two native grass species in the fall of 1997 and winter of 1997-1998.

Rationale- Test Plot Site Preparation
The design team recommends a single site preparation method be implemented on all test plots for ecological, scientific, and economic reasons.

First, we anticipate that natural decline of the existing ryegrass cover over the next few years will create openings for invasion of a much more aggressive weed community. Rapid establishment of native vegetation cover is therefore important to forestall this weed invasion. Consistent application of the best possible site preparation method will focus the experiment on providing high-quality data on successful seeding methods for native vegetation establishment. Also, testing site preparation methods on a changing weed community might not provide useful information, since control requirements could change as the community changes.

Second, in order to scientifically compare the results of one testplot seeding method with another, either all plots should undergo the same site preparation (in order to reduce testplot variability), or all seeding methods must be replicated on all site preparation method areas. If the latter alternative were chosen, the total cost of the experiment would be multiplied by a factor equal to or greater than the number of site preparation methods. The total area required for the experiment would similarly be multiplied by the number of site preparation methods. In practical terms, this would mean much smaller test plots for evaluation of seeding methods, since suitable space on the landfill is limited. Smaller test plots would provide less-useful data, because of border effects and smaller sampling areas.

Finally, implementing a single site preparation treatment on all test plots will be more economical than applying several site preparation treatments on the same acreage, due to economies of scale. [See **Appendix 1: Rationale for the Use of Glyphosate Herbicide at SJL** for more detailed information regarding recommended site preparation work.]

Rationale- Garden Plot Establishment

Since final cover work began in 1993, all native grass and forb seed used for revegetation seeding has been provided from out of area commercial sources due to the unavailability of local sources. The exclusive use of out of area seed is strongly suspected of being one the contributing factors in the failure of many testplot seedings to germinate and thrive. Although the shortage of locally produced native seed situation has improved in the past several years, many native grasses and forbs that could be evaluated in the test plots remain unavailable commercially. In order to help meet the future need at SJL for seed of native species, a series of garden plots are proposed for establishment. The goal of these garden plots is to increase the amount of seed available for use in direct seeding operations at SJL. The project design team will donate three native species hand collected in the northern Willamette Valley for seeding and planting in the garden plots during the fall of 1997 and the early spring of 1998. These species are: the native perennial grasses *Agropyron caninum* (dog wheatgrass) and *Festuca idahoensis* var. *romeri* (Roemer's fescue), and the native annual legume *Trifolium suksdorfii* (clover). The native grass seed will be grown out by a Metro subcontractor as plugs; the legume is proposed to be seeded in the garden plot by hand.

C. Test Plots: Selection and Phase 1 Site Preparation

Test Plot Selection Criteria
Proposed test plot locations are shown on **Map A**. Locations on the map are approximate; final locations have been identified in the field.

Testplot locations were selected based on the following criteria:

1. Several areas representing several of the major soil/slope/aspect groups on the landfill
2. Relatively homogeneous slope and aspect within each test plot area
3. Relatively homogeneous soils within each area, or soil variability following a topographic gradient (based on appearance of vegetation in summer 1997 and in past aerial photographs)
4. Contiguous area of about 200' X 300' available without approaching within 20' of gas wells or other structures requiring regular maintenance (and thus potential soil disturbance)

Three separate test plot areas are proposed, totaling about 3A. Each area (between 0.8 and 1.2A) represents a different combination of soil, slope and aspect; each area will be useful in determining the best approach for native vegetation establishment on portions of the landfill that are most similar to the test area. The areas have the following general characteristics:

- **Area 2E**. South aspect, higher than average moisture content in soils on lower slope due to seepage and/or slumping. Thin, dry, sandy soil on top of ridge. Soil characteristics relate to topographic gradient.
- **Area 3N**. North aspect, deep loam soils with higher-than-average moisture levels. Shallow slope.
- **Area 3S**. South aspect, low moisture level in soils on upper and lower slope.

Soil test results for proposed test plot areas
Soil test results for sample areas within the proposed test plot areas are summarized in **Appendix 2**. Soil tests verified that soils are appropriate for experimental plot use (soil textures, macro- and micronutrient levels, salinity and pH are within normal range for agricultural soils). A sample from a native upland prairie site near Corvallis ("GS" in **Appendix 2**) provides reference data.

Although soil penetrability has not yet been measured, soils in sampled areas are clearly compacted and have poor structure. These soils are loams to silt loams, not high clay soils, and should be less subject to compaction than clays. Still, they were more difficult to sample with a tile spade than many clay loam soils on heavily-grazed sites, where trampling often causes surface compaction. These observations indicate that the growth of seedlings on the test plots may be slowed by poor root penetration unless the soil is loosened with tillage or a planting opener design that adequately fractures the soil below the seed placement zone.

Soil fertility on the tested areas of the landfill appears to be adequate in general. As expected, soil fertility is lower in the sandier areas on ridge tops (e.g., SA2-ED, and to a lesser extent SA3-SD). However, soil penetrability may be better on these sandier soils than in the heavier soils. The soil that most closely matches the characteristics of the native prairie site is area SA3-N.

Site Preparation Guidelines
Fall 1997 site preparation work will consist of plot layout and application of glyphosate herbicide after greenup of the existing vegetation (particularly perennial ryegrass, *Lolium perenne*). After glyphosate application, killed sod will be left in place to protect against erosion during winter 1997-98.

Plot layout was done by the Wilson-Brophy-Wilson Design Group in early October.

Guidelines for Application of Glyphosate

Application goal: 80% kill of existing vegetation alive at time of application.

Materials: *Roundup Pro*® herbicide, 2 lb. a.i./A in 15-30 gal/A water

Equipment: Standard field spraying equipment (tractor-mounted or trailer-mounted low-pressure boom sprayer).

Execution: Apply *Roundup Pro*® at a time that meets **all three** specifications below:

- After fall greenup and during active fall growth of target vegetation
- Before soil is saturated from heavy fall rains
- Before killing frost

Calibration and setup: Check nozzle spacings and spray pattern to ensure even application without gaps. Use adequate dilution to ensure complete coverage of green foliage without runoff (15-30 gal/A). Spray at a ground speed of 2-3 mph.

Cost Estimate for Site Preparation
Glyphosate application will be subcontracted at an estimated cost of at $150/A including labor and materials; total cost is estimated at $450 total for the 3 test plot areas.

D. Garden Plot: Selection, Site Preparation and Planting

Garden Plot Location/Size
The location of the approximately 4,800 square foot Garden Plot is shown on **Map B**.

Garden Plot Establishment: Work Sequencing

July 1997

- Deliver two species of native grass seed to subcontractor for growing into plugs.

Late August

- Using string line trimmer, remove flower stalks from vegetation in plot.

Mid September

- Flail mow plot. Remove large rocks and inorganic materials from plot.
- Purchase/Place enough well rotted, weed free, compost/soil/sand mix on plot to bring soil level slightly higher than the surrounding road elevation.
- Disc and cross disc compost/soil substrate.

Early October

- Erect temporary protective fencing (with gate) around perimeter of plot. (4' sheep wire fencing or comparable).
- Using hand tools or Roundup ® herbicide Remove or apply herbicide to sprouting unwanted vegetation from plot as required.

Mid October

- Layout plot. Using a dibble, plant plugs of *Agropyron caninum* (dog wheatgrass) on 18" centers. Fertilize all plugs with low nitrogen slow release fertilizer. Apply mulch and water as needed.
- Cover unplanted portion of prepared garden plot with secured black plastic.

Late Winter 1997-98

- As weather permits, plant plugs of *Festuca idahoensis* v. romeri (Roemer's fescue) on 18" centers. Fertilize all plugs with low nitrogen slow release fertilizer. Apply mulch.
- Seed legume in prepared plot.

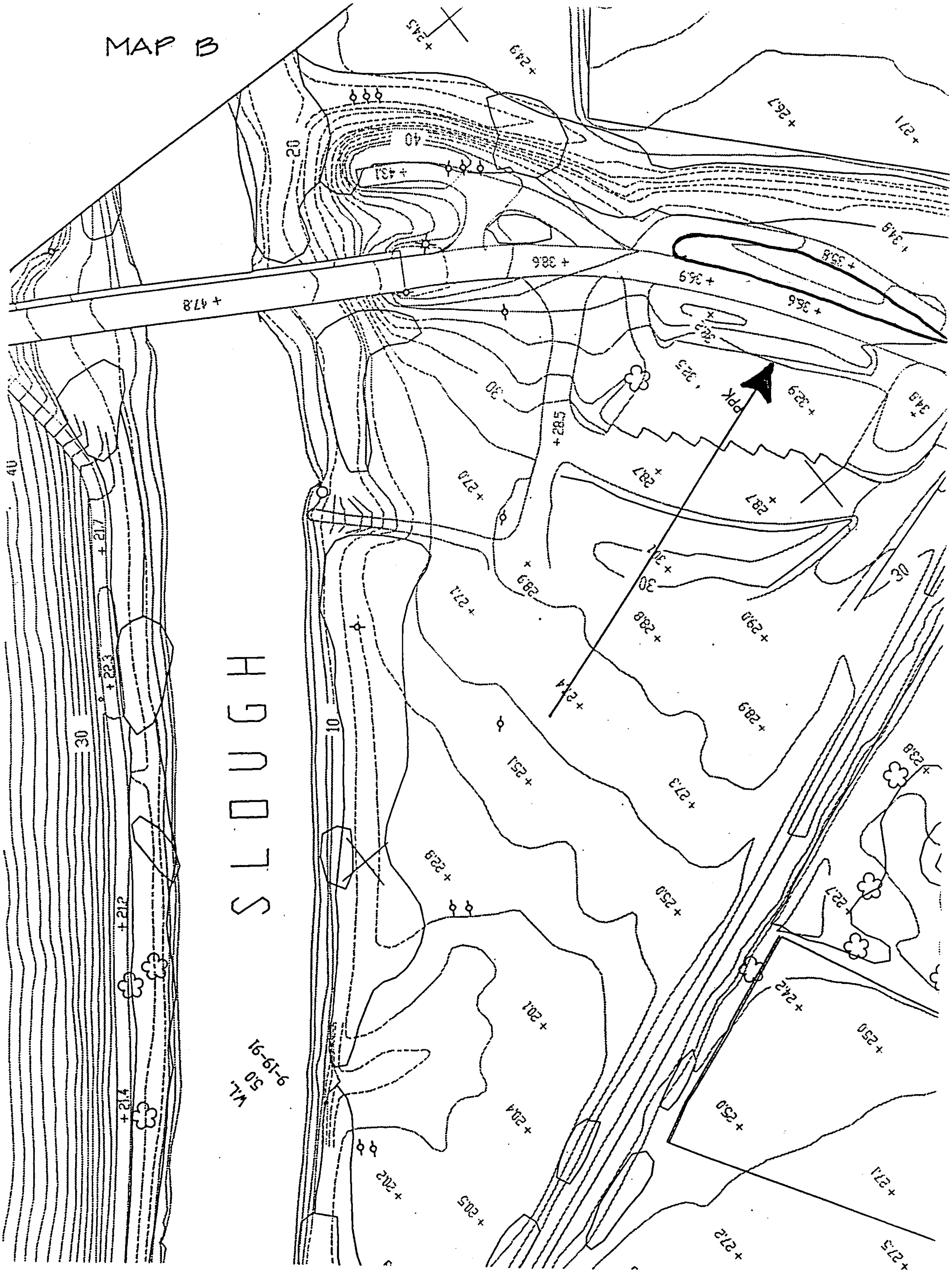
Spring 1997

- Erect permanent fencing around garden plot (6' Cyclone w/ gate or comparable).
- Plumb an all weather hose bib within 50' feet of Garden Plot.

Garden Plot Establishment Costs

Labor	**Estimated Cost**
Flail mowing (Metro staff)	$30.00 (labor/equipment)
Sod stripping, rock removal & discing(Metro staff)	$300.00 (labor/equipment)
Planting/Fertilizing/Install Fencing (Metro staff)	$100.00 (labor only)
Materials	
450 native grass seed plugs	$170.00
1/8 lb. legume seed	$ 0
3.5 units compost/soil/sand mix	$800.00
2 cubic yards mulch	$30.00
50 lb. slow release fertilizer	$50.00
12 steel fence posts/wire fence	$260.00
Total Estimated Cost	$1,740.00

MAP B



E. Appendices

Appendix 1:

Rationale for the Use of Glyphosate Herbicide at SJL

Table 2

Appendix 2:

Vegetation Monitoring Results (Summer 1997)

Soil Test Results (Summer 1997)

Appendix 3:

Monitoring Data Sheet

Appendix 1:
Rationale for the Use of Glyphosate Herbicide for Site Preparation on Experimental Plots at St. Johns Landfill

Summary

Use of the low-toxicity herbicide glyphosate (commercial formulations: "Roundup", "Roundup Pro", "Rodeo") is recommended for control of existing undesired vegetation on experimental test plots at the St. Johns Landfill. Glyphosate is the recommended option because it offers the highest chance of success with the lowest environmental and health risk. One other option (repeated tillage) was considered feasible and economically acceptable, but repeated tillage is not recommended due to potential damage to soil structure and removal of surface plant residue, resulting in increased erosion potential. This document presents a rationale for the use of glyphosate at the test plots on the landfill, following the guidelines of Metro's Executive Order Number 60 (Metro, 1995).

Life Cycle and Characteristics of Pest

Perennial ryegrass (*Lolium perenne*, or LOPR) is the dominant species in the existing undesired vegetation community on the proposed experimental plot area. LOPR is a short-lived perennial grass introduced from Europe, cultivated worldwide and escaped from cultivation in many areas. Seed for LOPR is grown almost exclusively in the Willamette Valley. LOPR is a cool-season grass with a bunch-type growth habit, expanding from individual crowns with basal innovations similar to the tillers of wheat plants. LOPR readily crosses with *Lolium multiflorum* (annual or Italian ryegrass) and with the genus *Festuca* (fescue), forming natural hybrids (Heath et al, 1985).

LOPR grows vigorously in fertile soils, particularly soils with high available nitrogen. The optimum soil pH is 6 to 7. If the available nitrogen in the substrate is not continually replenished (either by fertilization, or through slow decomposition of nitrogen-rich composts or sludge), the cover of LOPR generally declines after a few years as the nitrogen level drops (Dr. Ray William, pers. comm., 8/15/97). LOPR is considered a less persistent forage than certain other perennial cool-season forage species such as tall fescue (*Festuca arundinacea*), timothy (*Phleum pratense*), and orchardgrass (*Dactylis glomerata*).

Although LOPR grows best on well-drained, fertile soils, it can persist in areas where soils are too wet for many other cool-season perennial grasses. Where adapted, it is extremely competitive with other grass and forb species, and its vigorous growth may prevent the establishment of desired legumes. The crowns of LOPR easily survive fire, and fire is often used as a management tool to control fungal diseases and weeds and to remove residue after seed harvest in commercial ryegrass fields.

Other Potential Pests

LOPR is expected to decline as available nitrogen declines on the landfill due to compost decomposition and starter fertilizer depletion. This is likely to occur during the next 2-3 years. As LOPR declines, the weed community is expected to change for the worse, moving from dominance by perennial ryegrass to dominance by perennial, noxious, and highly invasive weeds such as knapweed, starthistle, ripgut brome, cheatgrass, medusa-head, thistles, prickly lettuce, Himalayan blackberry, and Scot's broom. All of these species will be far more difficult to control than perennial ryegrass. The risk of noxious weed invasion is much higher if persistent native or native-dominant vegetation has not yet become established during the decline of LOPR. Therefore, to reduce the risk of noxious weed invasion, **rapid establishment of native vegetation is a high priority.** Undesired vegetation must be controlled thoroughly and rapidly, and the control method must maximize the early development of native species plantings while simultaneously minimizing soil erosion. Glyphosate meets these requirements.

Damage Caused by *Lolium perenne*

The competitiveness of LOPR at this time makes establishment of native grass species very difficult. LOPR covers 60 to 65% of the ground surface on much of the proposed experimental plot area. If native grasses or forbs were overseeded directly into the LOPR stand, they would have low germination rates (due to shading), and those that germinated would grow very slowly (due to competition for nutrients, water, and light).

Intended Use of the Landscape

The landscape on which herbicide use is recommended consists of the areas shown in the map entitled "Proposed Test Plot Locations" in the Phase I document (Wilson, Brophy and Wilson, 1997b). These test plots will provide information needed for long-term establishment of native vegetation at the landfill.

An experimental plot is designed to test a the effect of a small number of controllable factors on a variable of interest (in this case, growth of native species). For the 1998 experimental plot plantings, the controllable factors will include such factors as seeding method, fertility, soil amendments, and species mixtures. As on any experimental farm or on-farm trial, existing undesirable vegetation must be controlled **before** beginning the experiment, to eliminate the effect of variation in weed cover on experimental results. In other words, effective initial control of undesirable vegetation is a prerequisite to successful testing of native vegetation establishment methods.

Monitoring Program

The approach that will be used for vegetation monitoring in the test plots is described in the document, "Establishment of Native Vegetation at St. Johns Landfill" (Work Plan, Task 5) (Wilson, Brophy and Wilson, 1997a). Monitoring will be quantitative and statistically valid, and will be designed to maximize accuracy, precision and repeatability of measurements. Frequency of monitoring will be at least once per growing season; more frequent monitoring may be conducted if required due to plant community changes during the native species establishment period. Preliminary quantitative data on vegetation cover were collected in July 1997 (Wilson, Brophy and Wilson, 1997b) and will be used for comparison to post-treatment data.

Options for Control
The options for control of LOPR and other existing vegetation are shown in Table 1, with comments on their feasibility at the landfill site.

Table 2. Options for control of existing vegetation

Option	Feasibility
Biological controls	Not feasible due to commercial culture of LOPR. Any effective biological control would have unacceptable economic impact.
Fertility management	Not feasible. LOPR will decline naturally over time as available N declines, but action is very slow, preventing early establishment of native species and allowing invasion of noxious weeds as LOPR declines.
Water management	Not feasible. LOPR and other undesirable species are well-adapted to natural water regime.
Burning	Not feasible; LOPR survives burning
Mulching	Not feasible. Used to prevent weed growth; cannot be used to eliminate well-established stands
Solarization	Feasible, but expensive
Mowing	Not feasible; evidently unsuccessful at SJL in past years.
Tillage	Feasible and could be effective. However, repeated tillage would be needed, and this would damage soil structure in existing poorly-aggregated soils
Soil-applied herbicide	Not feasible; residual activity would damage native plantings and active herbicide could be carried offsite if erosion occurred
Foliar-applied herbicide - selective	Not feasible. No herbicide is available that could selectively remove LOPR from native grasses, even if native grasses could first be established in the LOPR stand.
Foliar-applied herbicide - nonselective, translocated	**Feasible and **RECOMMENDED**. No soil residual activity; creates "safe sites" for seedling establishment; leaves plant material on soil surface for erosion control. Low-toxicity materials are readily available. See text for specifics.

Feasible options therefore include solarization, tillage, and foliar-applied, nonselective, translocated herbicide. The recommended option is the herbicide, for the reasons outlined below:

Solarization
Solarization has been successful on Subarea 1 (Demonstration Plot 2) in the past. However, its cost (about $2600/A) makes it unacceptable for use on the entire experimental plot area. In addition, even if this method might be appropriate for the experimental plots, it could not feasibly be applied to the entire landfill.

Tillage

Tillage has been fairly successful on Subarea 1 (Demonstration Plot 3A). However, tillage has two undesirable effects that could cause problems at the landfill: damage to soil structure, and removal of surface residue.

Disadvantage: Damage to soil structure.

Repeated tillage (probably 4 to 6 tillage operations during the growing season) would be required to sufficiently reduce competition from undesirable vegetation. This amount of tillage would be very likely to cause damage to the soil structure on the proposed experimental plot area. The silt loams and loams found on the proposed test plot area are already compacted and poorly-aggregated, and are vulnerable to further compaction and loss of soil structure with repeated tillage. Compacted, poorly-aggregated soils are particularly vulnerable to erosion, which is a major concern at the landfill.

Disadvantage: Surface residue ("mulch") removal.

Surface residue (dead plant material, or "mulch") is the most important factor in erosion control. Tillage removes mulch by turning the material under the soil surface. Repeated tillage leaves very little mulch on the surface, leaving the soil vulnerable to erosion -- a definite risk on the sloping proposed test plot areas (and similarly on the majority of the landfill). Mulch (if not excessive) also aids in seedling establishment and growth, by providing protected "safe sites" where seedlings are protected from desiccation and wind.

Herbicide

Use of a foliar-applied, non-selective, translocated herbicide (specifically, glyphosate) is recommended for control of undesired vegetation on the test plots for the following reasons:
low toxicity; minimal chronic health effects; environmental safety; no soil residual action; effectiveness on weed species of concern; and maintenance of mulch.

Advantage: Low toxicity

Glyphosate is assigned by the EPA to the category IV (least toxic). Its oral LD50 (a measure of acute toxicity if a material is ingested orally) is about 5000 mg/kg. For comparison, the chlorinated hydrocarbons and organophosphate insecticides that first created public awareness of pesticide toxicity in the 1970's are 100 to 1000 times more toxic than glyphosate. Since spray personnel are unlikely to ingest glyphosate, dermal (skin) absorption is a more appropriate measure of toxicity. Glyphosate apparently causes little or no skin irritation and is absorbed through human skin at a very low rate (<2%) (Wester et al, 1991). In a 21-day study of 346 human volunteers, the level of irritation caused by undiluted Roundup (a glyphosate formulation) on the skin was less than that caused by baby shampoo or liquid dishwashing detergent (Maibach, 1986).

Advantage: Minimal chronic health effects

Acute toxicity is not the only concern for human health; carcinogenicity (potential to cause cancer) and teratogenicity (potential to cause birth defects) and must be evaluated. EPA has classified glyphosate as Group E (evidence of non-carcinogenicity for humans), indicating that studies have not shown evidence that glyphosate causes cancer. Franz et al (1997) summarized studies on rats and rabbits, which showed that the lowest level of glyphosate in the diet that caused observable birth defects ranged from 176 mg/kg/day (about a half-ounce per day for a 150-lb human) to 3500 mg/kg/day (about a half-pound per day for a 150-lb human). Many studies have shown that glyphosate is rapidly excreted from mammals, and does not leave detectable residues in their tissues (Franz et al, 1997).

Advantage: Environmental safety
An intensive study in the Pacific Northwest Coast Range showed no bioaccumulation of glyphosate, and all animals tested excreted glyphosate faster than they absorbed it from their food (Newton et al, 1984). Other studies have shown no toxicity and no repellent effect on beetles or earthworms in the field (Eysackers, 1985; Brust, 1990; Clements et al, 1990). In field tests, soil fungal and bacterial populations were lower 2 months after application of Roundup herbicide, but returned to normal after 6 months (Chakravarty et al, 1990a). Other studies showed increases in bacterial and fungal propagules in glyphosate-treated areas (Grossbard, 1985; Carlisle, 1988). A review of several studies (Olson et al, 1991) concluded that Roundup herbicide does not reduce nitrification in sandy or silt loam agricultural soils, even at 10 times normal field rates. In a review, Grossbard (1985) concluded that Roundup herbicide generally either had no effect on straw decomposition, or enhanced straw decomposition, and other studies showed that Roundup did not inhibit mycorrhizal colonization or development on trees (Chakravarty et al, 1990b; Palmer et al, 1980; Schoenholtz, 1987).

Advantage: No soil residual activity
Glyphosate is rapidly adsorbed and tightly bound to the cation exchange complex in soils, and therefore has no significant activity after it reaches the soil surface. A review of several studies on agricultural and forest soils showed that glyphosate did not leach out of soils to which it was applied to any appreciable extent, even on steep (8%) slopes with sandy soils (Franz et al, 1997).

Advantage: Effectiveness on target species
The undesired vegetation cover at St. Johns Landfill consists mainly of LOPR; some areas have fairly high cover of colonial bentgrass (*Agrostis tenuis*). According to the Pacific Northwest Weed Control Handbook (1997), LOPR is susceptible to glyphosate, as are annual and perennial grasses in general. Annual weeds are also a concern in the test plots; glyphosate is considered effective on the predominant annual weeds observed on the 1994 test plots (*Cardamine* spp., *Poa annua*, and *Veronica persica*).

Advantage: Maintenance of mulch
Since erosion is a major concern at the landfill, a mulch layer should be maintained on the soil surface as long as possible during establishment of the native cover. Use of herbicide allows the killed weed cover to be left in place as mulch, reducing erosion and providing good conditions for seed germination and seedling development.

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Appendix 2:
Vegetation Monitoring Results (Summer 1997)

In July 1997 Laura Brophy and Loverna Wilson visited the landfill to obtain soil samples and describe the existing plant communities at three locations we selected as possible locations for our test plots. We examined one location on Subarea 2 (covering proposed test plot 2E), and two locations on Subarea 3 (proposed test plots 3N and 3S). All three areas have a dense cover of mixed grasses, especially ryegrass, plus a variety of scattered forbs. The following is a description of the communities on these sites.

Subarea 2, mid-slope
This site is currently dominated by three grass species:

Perennial ryegrass (*Lolium perenne*)	60 percent cover
Colonial bentgrass (*Agrostis tenuis*)	30 percent cover
Velvetgrass (*Holcus lanatus*)	10 percent cover

There are small amounts of other species scattered across the site, such as bull thistle (*Cirsium vulgare*), prickly lettuce (*Lactuca serriola*), prickly sow-thistle (*Sonchus asper*), rough hawksbeard (*Crepis setosa*), white clover (*Trifolium repens*), red clover (*Trifolium pratense*), common vetch (*Vicia sativa*), curly dock (*Rumex crispus*), clustered dock (*Rumex conglomeratus*), soft cheat (*Bromus mollis*), and timothy (*Phleum pratense*).

Subarea 3, north side
This site is dominated by three grasses and one forb:

Perennial and Italian (*L. multiflorum*) ryegrass	65 percent cover
White clover	20 percent cover
Spike bentgrass (*Agrostis exarata*)	15 percent cover

Other scattered species include rough hawksbeard, Mayweed (*Anthemis cotula*), red clover, least hop clover (*Trifolium dubium*), hairy vetch (*Vicia hirsuta*), soft rush (*Juncus effusus*), tall fescue (*Festuca arundinacea*), and winter bentgrass (*Agrostis scabra*).

Subarea 3, south side
This location is dominated by three grass species:

Colonial bentgrass	60 percent cover
Perennial ryegrass and Italian ryegrass	40 percent cover

This site has the lowest number of associated species. They include Mayweed, red clover, curly dock, timothy, and spike bentgrass.

Appendix 2:
Soil Test Results (Summer 1997)

St. John's Landfill Soil Test Results, 8/12/97

Sample Site	pH	Sol.salt mmhos	OM %	P ppm	K ppm	Ca meq	Mg meq	NO3 #/A	NH4 #/A	S ppm	B ppm	Zn ppm	Mn ppm	Cu ppm	Fe ppm	Total bases	SMP buf.pH	sand	% silt	clay	Textural class
SA2-ED	6.3	0.08	3.8	41	113	5.0	1.7	3	5	3.0	0.3	12.4	11	6.8	186	7.0	7.0	59.0	30.4	10.6	sandy loam
SA2-EM	6.7	0.16	6.0	26	224	10.7	4.1	6	14	3.6	0.3	9.6	35	4.5	193	15.4	6.6	38.4	51.8	9.8	silt loam
SA3-N	6.5	0.22	12.0	33	370	15.8	4.0	8	18	5.0	1.0	22.6	55	4.7	295	20.7	6.4	27.0	62.2	10.8	silt loam
SA3-SD	6.3	0.14	3.9	16	129	8.1	3.6	6	8	2.0	0.4	4.7	34	4.9	215	12.0	6.6	32.0	47.2	20.8	loam
SA3-SM	6.4	0.12	6.0	20	189	10.4	4.4	6	9	4.5	0.5	5.0	28	4.7	219	15.3	6.7	27.8	53.6	18.6	silt loam
Native prairie	6.3	0.20	10.2	11	276	21.3	10.4	3	24	4.0	0.6	2.4	27	9.4	221	32.4	6.3	11.4	51.6	37.0	silty clay loam

Results of seed bank testing (seeds/lb):

	Lolium sp.	Festuca myuros	Others
SA2-ED	-0-	27	none
SA2-EM	153	27	9 Poa sp., 18 Trifolium dubium
SA3-N	18	-0-	none
SA3-SD	126	9	9 Glyceria sp., 9 Polygonum aviculare
SA3-SM	27	18	81 Agrostis sp.

Chemical analysis done by Agri-Check, Umatilla, OR

Extraction methods used:

P: Weak Bray extraction

K: Acetate extraction

Micronutrients: DTPA extraction

Organic matter: Walkley-Black method

Appendix 3:
Monitoring Data Sheet

Establishment of Native Vegetation at St. Johns Landfill
1997-1998 Testplots: Data Sheet for Vegetative Monitoring

Obs.#	Rep.	Mainplot	Subplot	Quadrat Location	% cover BRca	% cover ELgl	% cover Lopu	% cover other species