Schiller
Barlow
O'Neill
ems

11-5-02

Discussed dome ideas (intro native grasses & forbs)
Perimeter - woody plants @ >800/acre (BES regards this as healthy)
- will do soil sampling to see if salt concentration an issue

Lynn @ BES Pond
10:00 Fri.

—— CITY OF PORTLAND ——
ENVIRONMENTAL SERVICES

1120 SW Fifth Avenue., Room 1000, Portland, Oregon 97204-1912 Dean Marriott, Director Dan Saltzman, Commissioner

November 1, 2002

Dennis O'Neil, Program Supervisor
Metro – REM
600 NE Grand Avenue
Portland, OR 97232-2736

Dear Dennis,

With this letter I would like to summarize the BES Watershed Revegetation Program's (BES) partnership with the Metro-REM/St. John Landfill (SJL) to date and propose further restoration efforts for consideration. After seven years of planting and weed/herbivore management and monitoring, the perimeter of SJL has developed good initial establishment of trees and some shrubs. Realizing the functional role that vegetation fills in landfill bank stabilization and the ecological position of the SJL in the whole of the Smith and Bybee Lakes Wildlife Area, I hope to continue a relationship with SJL to protect Metro's initial investment and pursue further restoration at the landfill. BES has funded with EPA grant dollars one more herbicide treatment, which is scheduled for March 2003. Beyond this treatment, my records show no further funding for any BES revegetation efforts at SJL besides the LUR obligation on the Engineered Slopes.

With Metro's support, since March 1996 BES has implemented several planting and weed/herbivore management techniques at the SJL, including bare root plantings, live pole cuttings, seeding of native grasses, beaver protection cages, cutting, and herbicide application. More than 20,000 woody plants have been installed, bareroot and live pole. Native grasses have been seeded on some areas of the landfill. A total of 630 wire cages have been installed around black cottonwood and some willow trees to ward off beaver. These efforts have largely been trial-and-error, in light of constraints such as fill soils, rodents, droughty conditions, and potentially landfill by-products at the site. But I am happy to report that as of early November 2002 we have achieved average woody plant stocking rate around the perimeter of >800 woody plants per acre. Only one fresh sign of beaver damage was observed during this monitoring, two low branches of a caged cottonwood were chewed off.

In an effort to sustain this initial investment, BES would like to propose the following continued management treatments **over the next three years**:

- **One early spring herbicide application/year targeting broadleaved weeds.** Poison hemlock and mustard are still prevalent on the site, and both are some of the earliest weeds to flower. By targeting broad-leaved weeds, we can favor the expansion of grasses on the site.

- Another **mid-summer herbicide application/year** to target later flowering broad-leaved weeds such as thistles.

- A **mid-summer cut/year** to reduce moisture competition for the grasses and generally clear vegetation from around establishing plantings.

Further restoration recommendations:

- A **seeding** of approximately five acres to fill in areas which are particularly bare or weedy, eg. the northeast corner of the landfill near the water control structure.

- A **light interplanting in winter 2004** targeting the toes of slopes, steep bank and cut areas and "holes" in the planting around the perimeter. BES would install species we have observed to be more herbivore resistant and which perform well in dry conditions.

- Considering the seven year investment thus far, SJL might consider **installation of more beaver resistant cages.** An assessment would need to be conducted of how many cottonwoods, willows, and other susceptible species are currently established and would benefit from this additional protection. BES is researching less expensive techniques of beaver protection, as well.

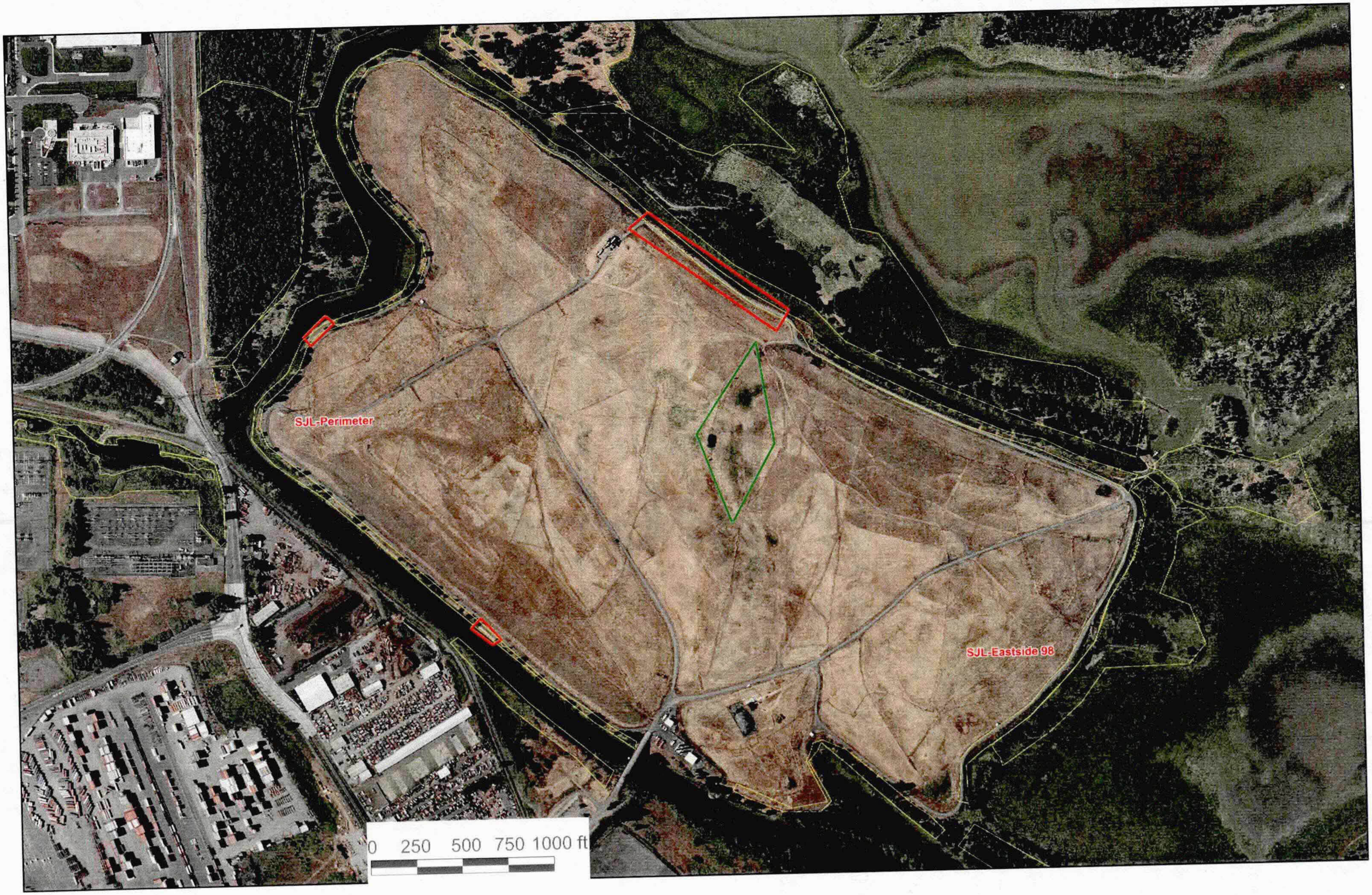
Please consider how this proposal for protection of vegetation cover attained and further restoration efforts fits with your goals for SJL management and role in the Smith and Bybee Lakes Wildlife Area.

Sincerely,

Lynn Barlow

Lynn Barlow
Projects Manager, Columbia Slough Watershed
Watershed Revegetation Program

Cc: Elaine Stewart, SBLWA
Maurice Neyman, SJL


SJL-Perimeter
SJL-Eastside 98
0 250 500 750 1000 ft

Watershed Revegetation Program

Sponsor: Metro - REM
Acres: 15.2

Cost:	
FY 04	$35,666
FY 05	$15,833
FY 06	$11,255
TOTAL COST:	$62,753

BES proposed budget for further revegetation efforts at the St. John Landfill for March 2003 through August 2005.

Project Name: *SJL Perimeter + SJL Eastside 98*
Project Number: *1248 + 1246*

Phase	Item/Task	Mo-Yr	FY	Unit	Units/Acre	Acres Treated
Establish 1	*Broadcast Spray - **PAID BY EPA GRANT***	*Mar-03*	*FY 03*	*Ac*	*1*	*15.2*
Establish 1	Spot Spray	Jul-03	FY 04	Ac	1	15.2
Establish 1	Manual Cut	Aug-03	FY 04	Ac	1	15.2
Establish 1	Native Seed - PARKS MIX	Oct-03	FY 04	Lb	28	5
Establish 1	Contract Seeding	Oct-03	FY 04	Ac	1	5
Planting	Native Plants (hw/con/shrub)	Feb-04	FY 04	Ea	800	15.2
Planting	Mycorrhizal Dip	Feb-04	FY 04	Ea	800	15.2
Planting	Contract Planting (tree/shrub)	Feb-04	FY 04	Ea	800	15.2
Planting	Bamboo Stakes-Large	Feb-04	FY 04	Ea	800	15.2
Planting	Bamboo Stakes-Small	Feb-04	FY 04	Ea	400	15.2
Planting	Vexar Tubes	Feb-04	FY 04	Ea	400	15.2
Planting	Contract Tubing	Feb-04	FY 04	Ea	400	15.2
Planting	Contract Staking	Feb-04	FY 04	Ea	800	15.2
Establish 2	Broadcast Spray	Mar-04	FY 04	Ac	1	15.2
Establish 2	Spot Spray	Jul-04	FY 05	Ac	1	15.2
Establish 2	Manual Cut	Aug-04	FY 05	Ac	1	15.2
Maintenance 1	Broadcast Spray	Mar-05	FY 05	Ac	1	15.2
Maintenance 1	Spot Spray	Jul-05	FY 06	Ac	1	15.2
Maintenance 1	Manual Cut	Aug-05	FY 06	Ac	1	15.2

As of 11/04/2002

Completed Treatment List Report

Site #: **1248** **SJL-Perimeter**	Site Acres: **13.00**	Site Mgr **Lynn Barlow**	Maint Mgr: **Lynn Barlow**

Treatment	***Treated Acres:***	***Init'ls:***	***Completed Date:***	***Dominant Weed:***	***Weed Types:***	***Notes:***
Spray maint brdcst	7.00	js	05/09/2002	PHAR		rcg component only
Spray maint brdcst	11.00	dc	04/28/2002	RUDI		broadlf component only
Miscellaneous materials	0.00	kf	12/17/2001			direct cost for materials for beaver cages.
Miscellaneous labor	0.00	kf	12/17/2001			hourly labor for installing 70 beaver cages.
Miscellaneous labor	0.00	kf	12/14/2001			hourly labor for installing 165 beaver cages.
Miscellaneous materials	0.00	kf	12/14/2001			direct cost of materials for beaver cages.
Monitor annual formal	13.60	ct	10/04/2001		hbb	wapato in blind slough
Monitor Annual-Informal	7.00	lb	09/17/2001			
Cut maint hand	7.00	gk	07/03/2001			
Spray maint brdcst	7.00		06/06/2001			
Mulch wood appl	13.60		06/27/2000		0	scalped/mulched cuttings
Mulch wood appl	2.00		06/27/2000		0	interplant
Tube inst	0.00		02/28/2000			
Bamboo inst	0.00		02/28/2000			
Live pole inst	0.00		02/28/2000			
Plant inst	0.00		02/28/2000			
Cut maint hand	7.00		10/17/1999		0	Perimeter
Seed appl	2.00		10/14/1999			
Cut maint hand	0.50		09/28/1999		0	
Cut maint hand	2.00		09/28/1999		0	
Spray maint spot	2.00		09/01/1999		0	
Mulch wood appl	0.30		04/12/1999		0	
Cut maint hand	2.00		10/31/1998		0	Eastside
Cut maint hand	8.00		10/31/1998		0	Perimeter
water	1.00		08/18/1998		0	1804
Cut maint hand	2.00		08/07/1998		0	Eastside
Mulch wood appl	1.00		05/30/1998		0	1804
Cut maint hand	2.00		05/21/1998		0	East side
Cut maint hand	1.00		05/18/1998		0	Blind Slough
Bamboo inst	1.00		03/01/1998		0	300
Tube inst	1.00		02/18/1998		0	1804

Completed Treatment List Report

Tube inst	1.00	02/11/1998	0	4615
Cut prep hand	1.80	11/05/1997	0	Eastside
Cut maint hand	8.00	09/17/1997	0	Perimeter
water	4.00	08/20/1997	0	Perimeter
Cut maint hand	6.00	07/16/1997	0	Perimeter
Cut maint hand	6.00	05/21/1997	0	Perimeter
Mulch wood appl	1.00	05/14/1997	0	15723
Plant inst	7.00	03/11/1997		
Plant inst	1.00	03/07/1997		
Tube inst	1.00	03/07/1997	0	1044
Cut prep hand	3.00	11/12/1996	0	Perimeter
Cut maint hand	10.00	10/20/1996	0	Perimeter
water	7.00	08/18/1996	0	Perimeter
Cut maint hand	10.00	08/08/1996	0	Perimeter
water	7.00	08/06/1996	0	Perimeter
Cut maint hand	4.00	06/06/1996	0	Perimeter
Cut prep hand	7.00	03/20/1996	0	Perimeter
Plant inst	7.00	03/01/1996		

Characterization of Subsoil Properties Affecting the Transport of Toxic Metals, Ammonia, and Hydrophobic Organic Compounds at the St. Johns Landfill Site

FINAL REPORT

William Fish

Center for Coastal and Land Margin Research
Department of Environmental Science and Engineering
Oregon Graduate Institute of Science & Technology
Portland, Oregon 97291-1000

July 1994

OREGON GRADUATE INSTITUTE
OF
SCIENCE & TECHNOLOGY

levels of K^+ and Na^+. The agreement among these analyses lessens the possibility of artifactual peaks.

The upper (oxic) samples depict a similar general pattern but one that is not as pronounced (Figure 20). We believe the upper layers are more influenced by rain, tidal inundation, mechanical disruption, and the oxidation of NH_4^+. Furthermore, the heavy Fe-oxyhydroxide deposits on the upper soils may hinder the exchange process on the underlying clays. Note however that the bimodal distribution of contamination can be easily detected in the upper samples in the same pattern as in the lower samples.

Concentrations of acid-extractable Fe and %OC for the north half of the transect shows a pattern that mimics the flow of contamination suggested by the exchangeable cations. Fe (which is mostly due to oxyhydroxide coatings) is most pronounced at the center, where the leachate intensity is the greatest, and in the upper samples, where O_2 is available to precipitate the Fe-oxyhydroxides (Figure 21). Interestingly, %OC follows a similar pattern and probably for an analogous but not identical reason (Figure 22). Leachate-borne organic compounds typically are soluble and are not expected to precipitate onto surfaces. However, those organic materials can support extensive bacterial growth, enhanced perhaps by the presence of NH_4^+. The high %OC near the center of the seep is likely due to stimulated bacterial populations in that region; the enrichment of organic carbon in the upper region is explained by the more rapid growth of bacteria under aerobic conditions.

The high levels of both Fe-oxyhydroxides and %OC in the most contaminated portion of the surface of the seep has implications for the movement of certain contaminants in the seep zone. Metals such as Ni, Cu, or Pb adsorb strongly to both Fe-oxyhydroxides and cellular organic carbon. Thus, the seeps may possess a "cap" that attenuates the outflow of metal contamination. Fortuitously, this cap may form approximately in proportion to the intensity of the leachate flux. Similarly, hydrophobic organic compounds (HOCs) adsorb strongly to cellular organic carbon and would likewise be attenuated in the cap zone. In addition, the high bacterial populations and the presence of ample co-metabolic substrates in this region could facilitate the rapid, aerobic degradation of any HOCs that might emerge from the seep. (Indeed, a preliminary experiment with seep material indicated rapid degradation of toluene by microorganisms from this region and that this biodegradation was maximum when diluted leachate was added to the incubations). Further work is warranted to better understand the contaminant-attenuating features of the surface regions of the seeps.

D. Survey Sampling of Perimeter Seeps. The detailed transect of the seep at Blind Slough showed that the exchangeable cations are a useful indicator of the extent of soil exposure to leachate. We extended this assay to a wider but less detailed survey of other known seeps. The goal was to obtain a semi-quantitative measure of the relative intensity of leachate strength at the major seeps in the perimeter.

The sampling strategy was to visit six seepage areas and collect two cores at each: one from what appeared to be the zone of greatest seepage and one from an adjacent soil that appeared to be relatively "clean" and outside of the main seep area. Our intent was for the "clean" sample to serve as an internal control to compare with the magnitude of the leachate signal registered in the "seep" sample. Cores were collected as at Blind Slough but only the lower (anoxic) sections were analyzed because they appear to reflect contamination more reliably than the oxic samples. The six seeps sampled are identified in the map in Figure 23 and are labelled as Blind Slough (BS), South Slough (SS), West Slough (WS), North Slough 1 (NS1), North Slough 2 (NS2), and Moss Pond (MP). "Moss Pond" is our term for a seepy area at the head of

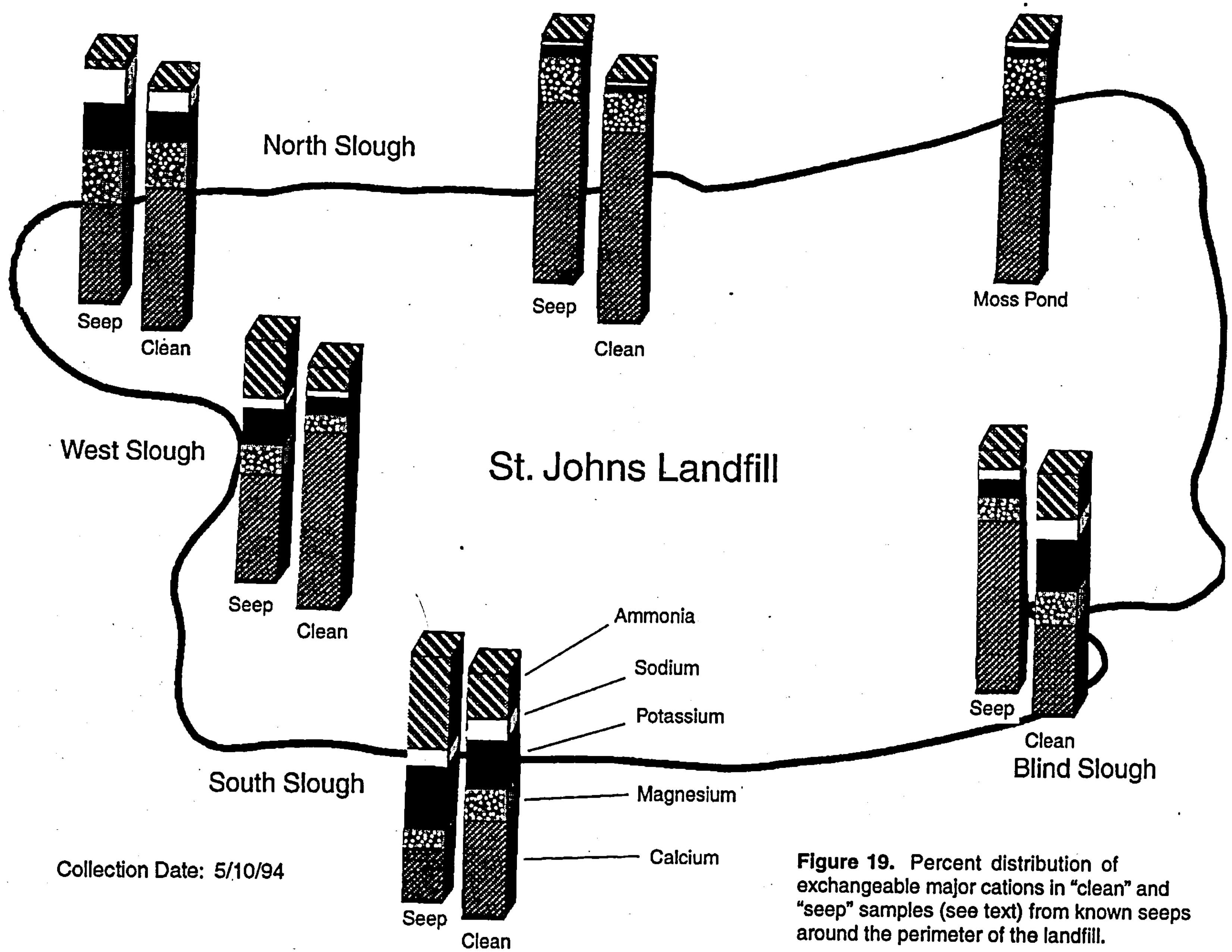


Figure 19. Percent distribution of exchangeable major cations in "clean" and "seep" samples (see text) from known seeps around the perimeter of the landfill.

North Slough that resembled a leachate seep but which was thought to be actually unrelated to leachate seepage. The "clean" sample for Moss Pond was inadvertently lost, so only a "seep" sample was analyzed for that site. Each core was subdivided into replicate subsamples and the data shown are the mean values of the replicates. Relative variability in exchangeable cations between replicates was always less than 10%.

The BS, SS, WS, and NS1 samples showed distinctly elevated levels of monovalent cations and depleted Ca^{2+} in the seep samples as compared to the "clean" samples (Figure 23). Mg^{2+} showed no consistent difference between the clean and contaminated samples. Of these sites, SS appears the most contaminated: approximately 70% of the exchanger is occupied by NH_4^+, Na^+, and K^+. Nearly 40% of the sites are occupied by NH_4^+ alone. The "clean" SS sample shows less substitution by monovalent leachate ions than the SS seep sample but the extent of monovalent substitution is significantly greater than we typically observed for soils near the landfill that are known to be unaffected by leachate (e.g., soil from the north bank of North Slough). We conclude that diffusion of leachate-borne ions occurs over a wider area than is visually evident as a seepage zone. This finding reinforces the importance of using chemical rather than purely visual methods for mapping leachate seepage.

Monovalent substitution in the WS samples is less extensive than for the SS samples, for both seep and clean cores. However, the WS seep sample still has nearly half of its exchanger sites occupied by NH_4^+, Na^+, and K^+. The BS samples are nearly identical in cation composition to the WS samples but with slightly higher overall monovalent substitution.

The NS1 seep sample is similar to the WS seep in magnitude of total monovalent substitution but shows a greater proportion of Na^+ and K^+ and comparatively little NH_4^+. Similar ratios of monovalent ions are observed in the clean NS1 sample at lower total loading. This pattern indicates that leachate seepage probably occurs at NS1 but suggests that the leachate is either elevated in Na^+ and K^+ or depleted in NH_4^+ compared to the other sampling sites. The relative lack of NH_4^+ in leachate from this part of the landfill may reflect some chemical peculiarity of the underlying refuse, or, it may indicate that the leachate here is subject to an unusually high level of some ammonia-depleting process such as aerobic nitrification.

The MP seep, as suspected, revealed no evidence of leachate contamination and displayed the characteristic "native" pattern of nearly complete exchanger saturation with divalent cations. Interestingly, the NS2 seep likewise showed no evidence of leachate contamination. NS2 seep and clean samples both were nearly saturated with divalent cations. Thus, while this survey cannot be considered exhaustive, our results suggest that there is little direct input of leachate into North Slough. More comprehensive sampling is needed to clearly establish this finding.

This survey in no way quantifies the actual *flux* of leachate from any of the seeps. However, the survey results do indicate the relative importance of seeps as *potential* source of leachate release. From these limited findings we have made preliminary conclusions that are presented at the end of the following section.