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Baltimore District

SIBERIA AREA LANDFARMING PILOT STUDY



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Siberia Area Landfarming Pilot Study

- **Pilot Study conducted from August 2000 to October 2001**
- **1,600 cu.yds soil from burn pit combined with 1,600 cu.yds of in situ soil**
- **Two active treatment (mixing) periods separated by 8-months MNA**
- **Added 500 cubic yards wood chips and 1200 lbs fertilizer**
- **Goals:**
 - Reduce initial PAHs by 75%**
 - Reduce initial TPH by 75%**



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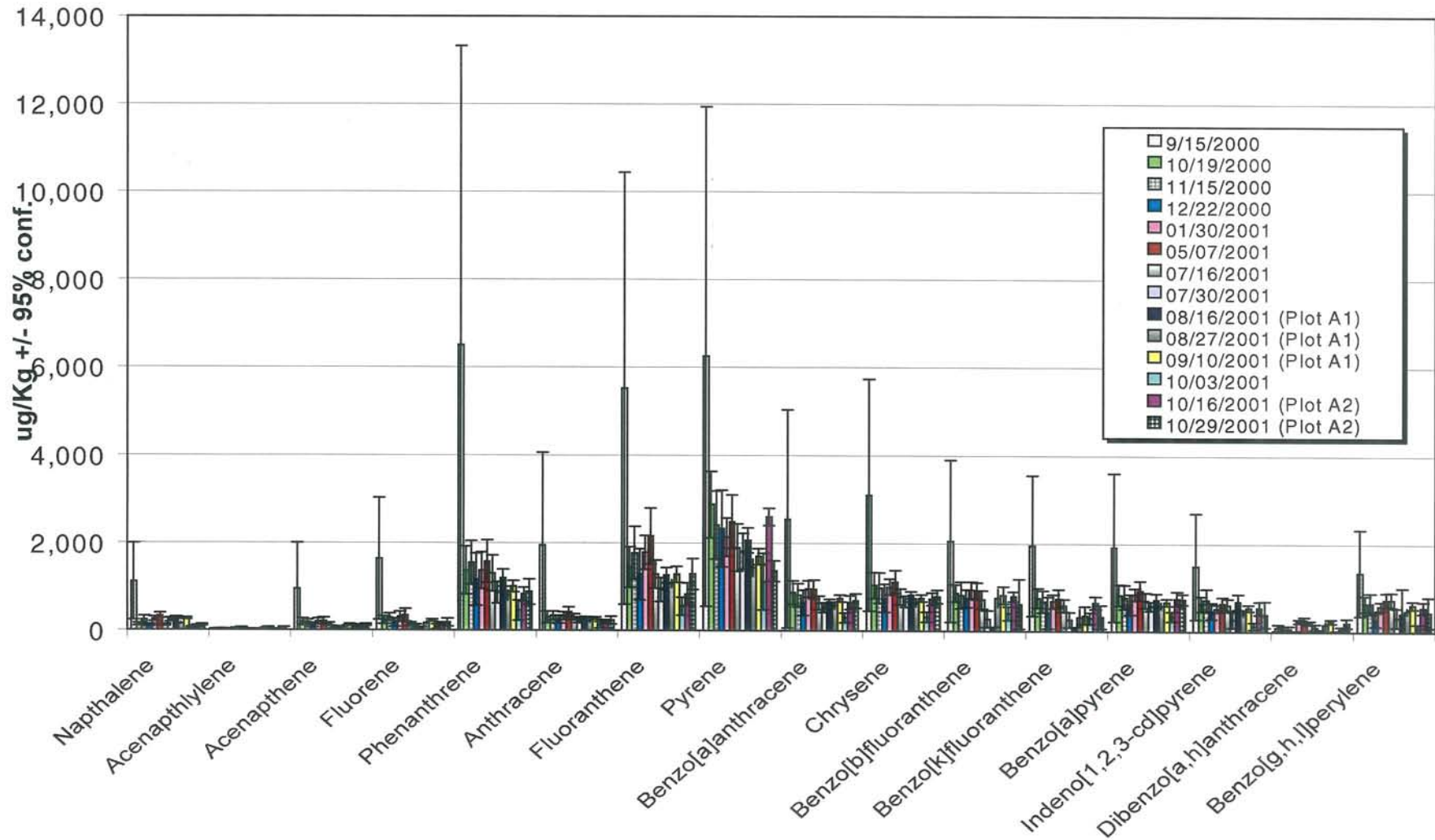
Vermeer 955 Mixer





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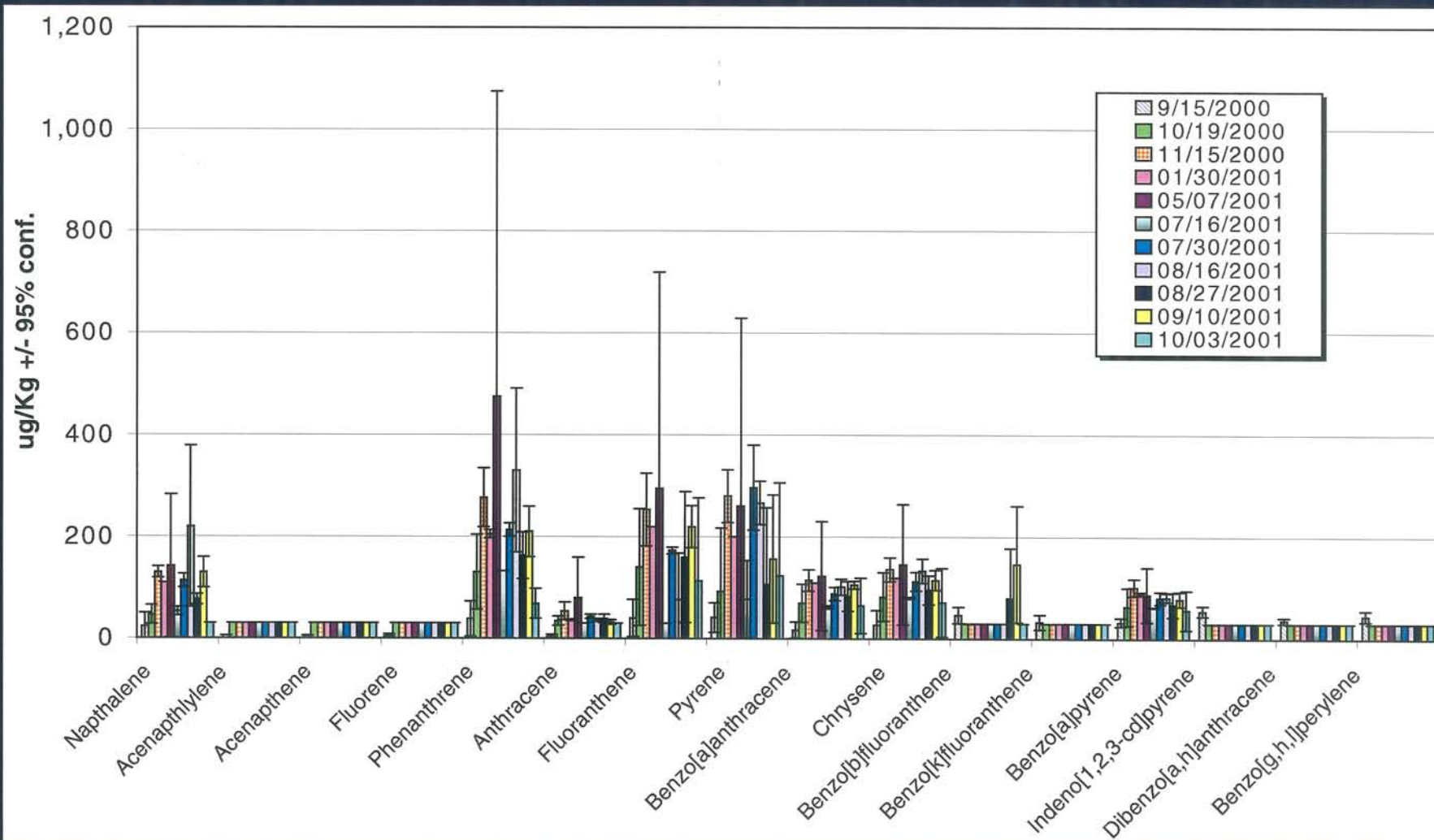
Pilot Study PAH Results - Plot A





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Pilot Study PAH Results - Plot B





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Plot A - PAH Percent Reduction

	Avg. Sept.'00 Conc. -Plot A (mg/kg)	Avg. Aug.'01 Conc. -Plot A (mg/kg)	Plot A % Reduction
Naphthalene	1.111	0.162	85%
Acenaphthene	0.948	0.110	88%
Acenaphthylene	0.023	0.050	N/C
Anthracene	1.942	0.223	89%
Fluorene	1.636	0.175	89%
Phenanthrene	6.497	0.843	87%
Benzo(a)anthracene	2.548	0.602	76%
Chrysene	3.095	0.658	79%
Fluoranthene	5.520	1.117	80%
Pyrene	6.246	1.483	76%
Benzo(a)pyrene	1.917	0.615	68%
Benzo(b) fluoranthene	2.051	0.783	62%
Benzo(k) fluoranthene	1.953	0.337	83%
Dibenzo(a,h)anthracene	0.100	0.173	N/C
Benzo(g,h,i)perylene	1.352	0.500	63%
Indeno(1,2,3-cd)pyrene	1.487	0.443	70%

N/A = Not Applicable

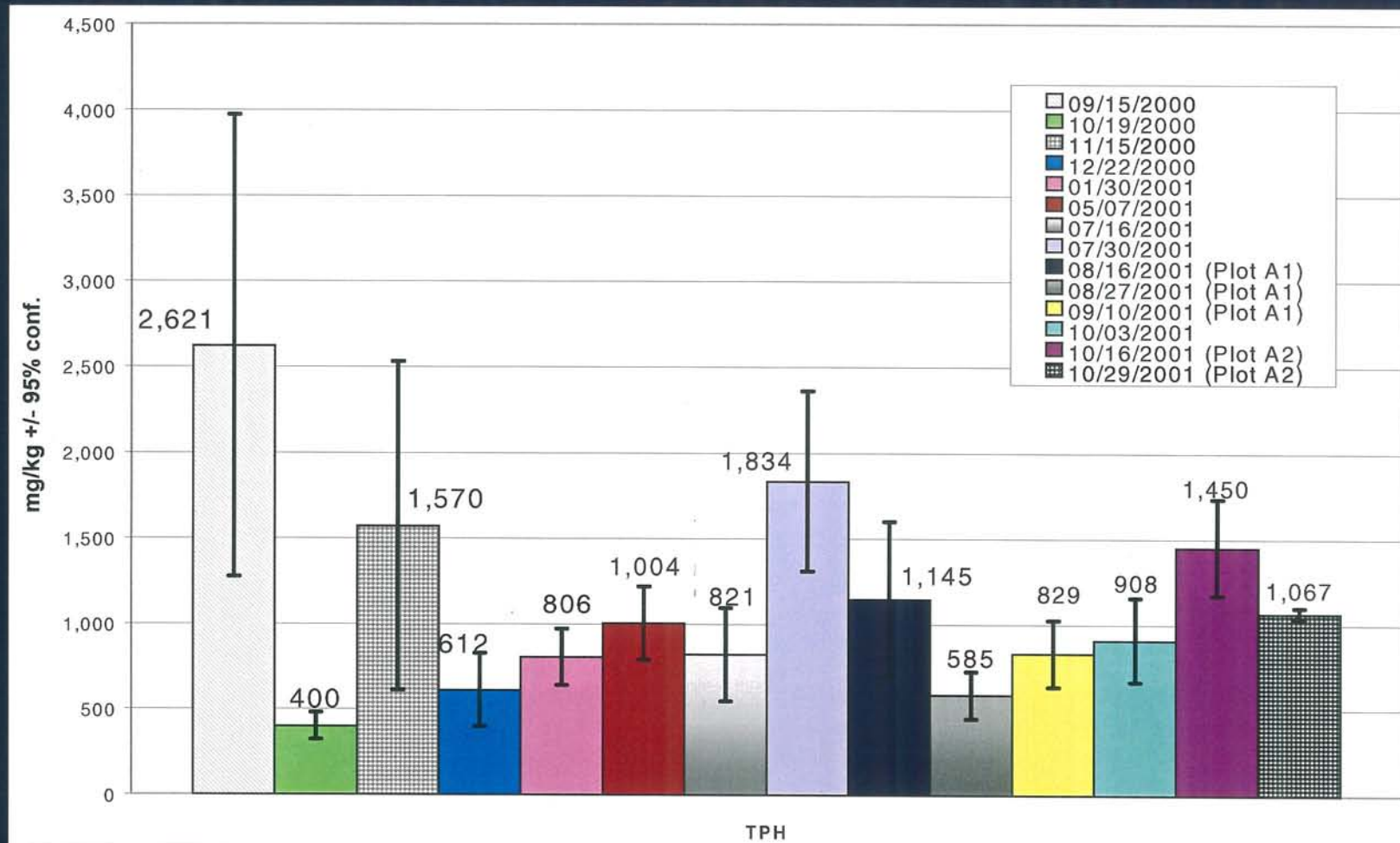
N/C = Not Calculated (most results were ND)

78% Avg. PAH Reduction



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Plot A - Pilot Study TPH Results





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PLFA Analyses

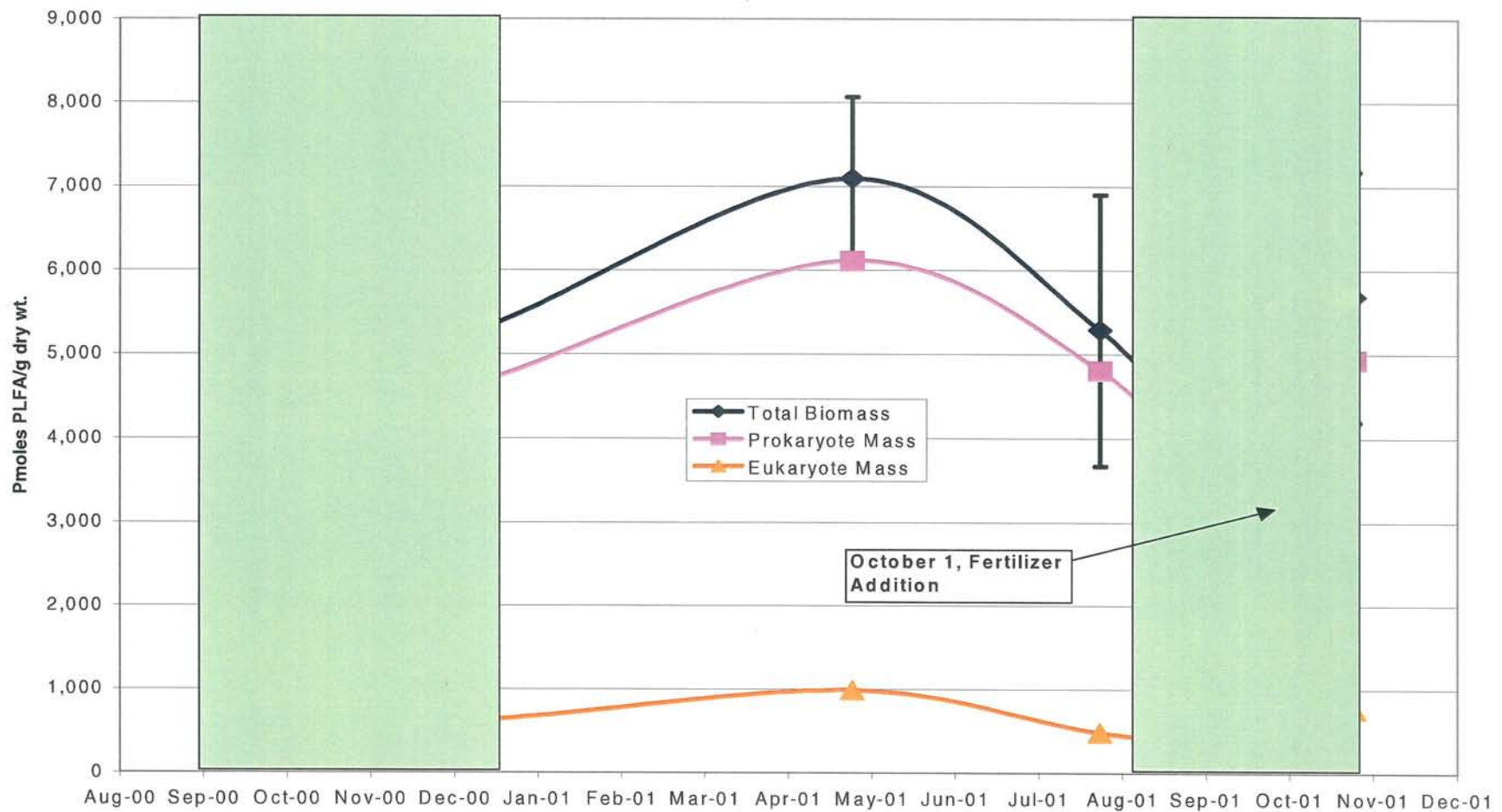
- **Phospholipid Fatty Acid Analysis:**
 - Viable biomass
 - Community structure
 - Metabolic activity
- **Microbial communities primarily Gram negative bacteria - use wide range of carbon sources**
- **Gram negative communities had low ratios of trans/cis fatty acids**



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PLFA Analyses

Biomass Changes over Time for Area A

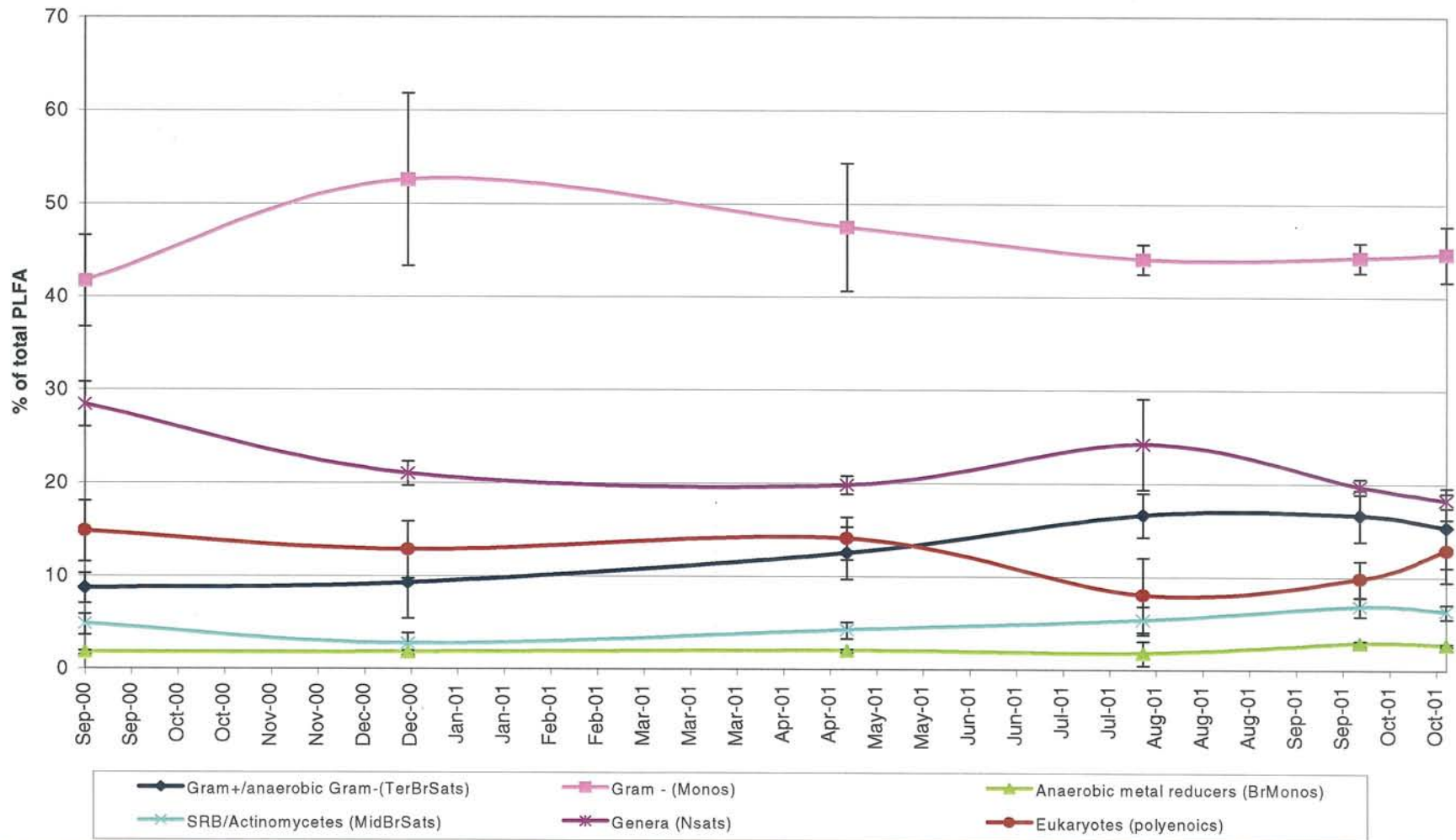




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PLFA Analyses

Changes in Community Structure at Plot A





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Environmentally Acceptable Endpoints (EAEs)

- **EAE Concept - The longer chemicals remain in soil:**
 - Less readily removed by solvents (including water)
 - Less available to microbes (i.e., less bioavailable)
 - Lower toxicity to higher organisms (e.g., earthworms)
- **EAE is reached when:**
 - Chemicals remaining have no adverse effect on human health and environment
 - Chemicals that are slowly released from soil are managed by natural assimilation in soil
- **EAE concept leads to development of less stringent CAOs**



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SIBERIA AREA SOILS CORRECTIVE ACTION OBJECTIVES



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CAO Development History

- **CMS Screening Report (August, 1999)**
 - Risk-based Site-Specific Target Levels
 - Adjusted TAGMs (based on site TOC)
 - Soil Saturation Concentrations (ensure that no free product remains)
- **Practical/Achievable CAOs**
 - Technology based
 - Variability in contaminant concentrations
 - Heterogeneity in soil types
 - Environmentally Acceptable Endpoints (EAEs)



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Proposed CAOs for PAHs

TABLE 1 - PROPOSED CORRECTIVE ACTION OBJECTIVES (CAOs) FOR THE SIBERIA AREA SOILS

	NYSDEC TAGM 4046 Value (mg/kg)	RFI-Adjusted TAGM Value ¹ (mg/kg)	On-Site Surface Soil SSTL (mg/kg)	All On-Site Soil SSTL (mg/kg)	Avg. Sept.'00 Conc. -Plot A (mg/kg)	Avg. Aug.'01 Conc. -Plot A (mg/kg)	Proposed CAO's (mg/kg)
Naphthalene	13	50	N/C	N/C	1.111	0.162	50
Acenaphthene	50	N/A	>SSC	>SSC	0.948	0.110	50
Acenaphthylene	41	50	N/C	N/C	0.023	0.050	50
Anthracene	50	N/A	>SSC	>SSC	1.942	0.223	50
Fluorene	50	N/A	>SSC	>SSC	1.636	0.175	50
Phenanthrene	50	N/A	N/C	N/C	6.497	0.843	50
Benzo(a)anthracene	0.224 or MDL	N/A	3.15	46.27	2.548	0.602	1.0
Chrysene	0.4	3.2	>SSC	>SSC	3.095	0.658	3.2
Fluoranthene	50	N/A	>SSC	>SSC	5.520	1.117	50
Pyrene	50	N/A	>SSC	>SSC	6.246	1.483	50
Benzo(a)pyrene	0.061 or MDL	N/A	0.31	4.63	1.917	0.615	1.0
Benzo(b)fluoranthene	0.220 or MDL	N/A	3.15	46.27	2.051	0.783	1.0
Benzo(k)fluoranthene	0.220 or MDL	N/A	31.49	>SSC	1.953	0.337	1.0
Dibenzo(a,h)anthracene	0.014 or MDL	N/A	0.31	4.63	0.100	0.173	1.0
Benzo(g,h,i,)perylene	50	N/A	N/C	N/C	1.352	0.500	50
Indeno(1,2,3-cd)pyrene	3.2	25.6	>SSC	>SSC	1.487	0.443	25.6

Note 1 = Adjusted TAGM values based on soil organic carbon content of 8%, as presented in the RCRA Facility Investigation Report, Siberia Watervliet Arsenal, Watervliet, NY. Malcolm Pirnie, Inc. December 1997
TAGMs derived from USEPA Health-Based Criteria or the generic criteria for individual semi-volatile compounds (50mg/kg) were not adjusted.

N/A = Not Applicable

N/C = Not Calculated

>SSC = SSTL is greater than the soil saturation concentration

Proposed CAOs that deviate from the TAGM values



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SIBERIA AREA SOILS REMEDIAL DESIGN



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STI[®] Treatability Study

- **STI[®] is a proprietary calcium-oxide based powder**
- **Acts as catalyst to cleave hydrocarbon bonds**
- **Enhances bioremediation by indigenous microbes**
- **Study goals:**
 - **Evaluate whether STI[®] reduces soils treatment time**
 - **Determine appropriate dosage for full-scale application**



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STI[®] Treatability Study

- **Utilizes soils from two areas:**
 - Southeast Quadrant - Representative of site contamination; 2 test cells
 - SubStation Area - Heavily contaminated; 5 test cells
- **0 to 10 pounds STI[®] /ton soil added to test cells containing 1 cu.yd. soil**
- **Mixed and sampled every week for four weeks**
- **Results will be available mid-May**



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STI[®] Treatability Study

STI[®] Test Cell Construction

Test Pit Excavation



Soil Screening



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Siberia Soils Remedial Design

Treatment Area Summary

Area ID	Quadrant	Treatment Area (square feet)	Treatment Depth (feet)	Approximate Volume		Proposed Treatment
				(cubic feet)	(cubic yards)	
1	SW	11,400	4	45,600	1,700	Tilling or Disposal
2	SW	30,400	4	121,600	4,500	Screening/Ex Stu Tilling
3	SW	31,400	4	125,600	4,700	Capping ⁽¹⁾
4	SE	82,000	4	328,000	12,200	Screening/In Stu Tilling
5	NE	16,000	2	32,000	1,200	Screening/In Stu Tilling
6	NE	113,500	1	113,500	4,200	Screening/In Stu Tilling
7	NW	39,600	1	39,600	1,500	Capping
8	NW	11,900	4	47,600	1,800	Capping
9	NW	18,200	1	18,200	700	Screening/Ex Stu Tilling
10	SW	22,000	4	88,000	3,300	Inaccessible
11	NW	3,300	2	6,600	250	Screening/Ex Stu Tilling

(1) Contaminated material along the edge of Area 3 may be excavated and treated



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Siberia Area Soils Design - General Concepts

- **PAH-contaminated soils will be excavated, screened (2-inch), and oversize material processed and re-used or disposed.**
- **Treatment will occur either in place, or soils will be moved to the existing landfarming plot and mixed**
- **Fertilizer and/or STI[®] will be added**
- **Treatment times governed by approved CAOs**
- **Anticipated time frame: 2 - 3 years**



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Siberia Area Soils Design - Preliminary Phasing Plan

- **Year 1:**
 - Excavate soils from Areas 9 (drainage ditch) and 11; bring on site for treatment or off-site disposal (depending on metals CAOs)
 - Excavate Areas 1 and 2 - Screen soils and move to existing plot for treatment. Process oversize materials for reuse
 - Backfill Areas 1 and 2 with treated pilot soils
- **Year 2:**
 - If required, continue treatment from previous year
 - Excavate areas 4, 5, and 6 - screen the soils, backfill the excavations, and till/treat in place
- **Year 3:**
 - Cap Areas 3, 7, and 8