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APPENDIX A

CALCULATIONS

SURFACE SOIL
AND
SEDIMENT
ACTION LEVEL CALCULATIONS

NUS CORPORATION AND SUBSIDIARIES — STANDARD CALCULATION SHEET

CLIENT: EPA	FILE NO.: 9851	BY: A&M	PAGE 1 OF 3
SUBJECT: Action Levels - C&R Battery Site		CHECKED BY: DKJ 8-18-89	DATE: 8/18/89

The risk from As to offsite receptors, as determined in Appendix H of the RI report, is 5.1×10^{-5}
This is based on the use of the ISC-LT Model and concentrations of arsenic in the onsite surface soils.

The ISC-LT Model showed that As, at an average concentration of 16 mg/kg in surface soils, resulted in an emission rate of 0.0082 $\mu g/m^3$ at a receptor 200 m South of the site.

Applying the same ratio to the other 2 carcinogenic compounds found on site (Cadmium and Nickel), we see the following emission rates:

	Avg. Conc. (mg/kg)	Ann. Avg. Emission Rate (mg/m^3)
As	16	8.2×10^{-6}
Cd	5.7	2.9×10^{-6}
Ni	7.0	3.6×10^{-6}

Risk is determined as follows:

$$\text{Risk} = \frac{\text{CPF}\ \frac{\text{kg-day}}{\text{mg}} \left| \text{BR}\ \frac{\text{m}^3}{\text{day}} \right| \text{C}\ \frac{\text{mg}}{\text{m}^3} \left| \text{AF} \right.}{\text{BW kg}}$$

where CPF = carcinogenic potency factor
BR = breathing rate
C = contaminant concentration in emissions
AF = absorption fraction = 0.4375
BW = body weight

This assumes a continual lifetime exposure, and is calculated for the annual average emissions

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AR302381

For 3 carcinogens, it is common practice to assume that each contributes 1/3 of the total risk. In this case, we can set our desired total risk = 1×10^{-6}, so that each chemical contributes 1/3 of the risk, or 3.3×10^{-7}.

Therefore,

$$3.3 \times 10^{-7} = \frac{(CPF)(BR)(C)(AF)}{BW}$$

for As: $$3.3 \times 10^{-7} = \frac{\left(50 \frac{kg\text{-}day}{mg}\right)\left(20 \frac{m^3}{day}\right)\left(C \frac{mg}{kg}\right)(0.4375)}{70\ kg}$$

$$C = 5.3 \times 10^{-8}\ mg/m^3$$

Similarly

for Cd: $$3.3 \times 10^{-7} = \frac{(6.1)(20)(C)(0.4375)}{70} \qquad C = 4.3 \times 10^{-7}\ mg/m^3$$

for Ni: $$3.3 \times 10^{-7} = \frac{(0.84)(20)(C)(0.4375)}{70} \qquad C = 3.1 \times 10^{-6}\ mg/m^3$$

To determine a desired soil concentration, a simple ratio is used:

for As: $$\frac{8.2 \times 10^{-6}\ mg/m^3}{16\ mg/kg} : \frac{5.3 \times 10^{-8}\ mg/m^3}{X\ mg/kg}$$

$$X = 0.10\ mg/kg$$

This value is < background concentration of arsenic in surface soils (3.8 mg/kg), therefore "background" should be the cleanup goal for 10^{-6} risk

AR302382

CLIENT: EPA	FILE NO.: 9851	BY: AEH	PAGE 3 OF 3
SUBJECT: Action Levels - C&R Battery Site		CHECKED BY: 8-18-89	DATE: 8/18/89

Similarly, for Cd: $\frac{2.9 \times 10^{-6}}{5.7} = \frac{4.3 \times 10^{-7}}{X}$

X = 0.84 mg/kg, which is also less than background concentrations of Cd (1.1 mg/kg)

for Ni: $\frac{3.6 \times 10^{-6}}{7.0} = \frac{3.1 \times 10^{-6}}{X}$

X = 6.0 mg/kg Ni was not detected in background surface soils, but was detected at 28 mg/kg in background subsurface soils

Action Levels - Summary

	Total 1×10^{-6} Risk	Total 1×10^{-4} Risk
As	background ~4 mg/kg	10 mg/kg
Cd	background ~1 mg/kg	84 mg/kg - no action required
Ni	~6 mg/kg	600 mg/kg - no action required

AR302383

NUS CORPORATION AND SUBSIDIARIES — STANDARD CALCULATION SHEET

CLIENT: EPA	FILE NO.: 9851	BY: AEH	PAGE 1 OF 1
SUBJECT: Action Levels - C+R Battery Site		CHECKED BY: BKJ 8-18-89	DATE: 8/18/89

Antimony has no inhalation effects documented in the literature. Therefore, we need an action level set for possible ingestion scenarios

True risk-based action levels should incorporate potential noncarcinogenic health effects from lead, and would assume that each chemical contributes 50% of the total Hazard Index, and should be <1.

Desired HI = $\frac{0.99}{2} = 0.495$ for each; $\leq \frac{\text{Dose}}{\text{RfD}} = \text{HI}$, ∴

RfD × HI = dose

Sb: $4 \times 10^{-4} \times 0.495 = 1.98 \times 10^{-4}$ mg/kg-day

Pb: $1.4 \times 10^{-3} \times 0.495 = 6.9 \times 10^{-4}$

$$\text{Dose} = \frac{\left(C \frac{\text{mg}}{\text{kg}}\right)\left(IR \frac{\text{g}}{\text{day}}\right)\left(\frac{\text{kg}}{1000\,\text{g}}\right)\left(ED \frac{\text{day}}{365\,\text{day}}\right)}{BW\ \text{kg}}$$

where C = contaminant concentration
IR = ingestion rate
ED = exposure duration
BW = body weight

- for children weighing 30 kg + ingesting 0.25 g/day
  112 day/yr:

for Sb: $1.98 \times 10^{-4} = \frac{(C)(0.25)(112)}{(30)(1000)(365)}$ C = 77.4 mg/kg, which accounts for Pb

If Pb is ignored, $4 \times 10^{-4} = \frac{(C)(0.25)(112)}{(30)(1000)(365)}$ C = 156 mg/kg, which does not account for Pb.

NUS 155A REVISED 0285

CLIENT: EPA - III	FILE NO.: 9851	BY: AEH	PAGE 1 OF 2
SUBJECT: Action Level - Sediment in Drainage Ditch - C+R Battery		CHECKED BY:	DATE: 6/19/89

Pb : SW03 total 2.25 mg/l , 2.26 mg/l } avg = 2.24 mg/l ✓
dissolved 2.21 mg/l , 2.23 mg/l }

Because these concentrations are so similar, it was assumed that the water + sediment are in equilibrium. This is not necessarily indicative of conditions in flowing water after a storm, but no water was in the ditch during sampling except for this ponded water.

SD 03 1,060 mg/kg 1,250 mg/kg } avg = 1155 mg/kg ✓

$$K_d = \frac{C_{soil}}{C_{water}} = \frac{1155 \frac{mg}{kg} \cdot \frac{kg}{1000\,g}}{2.24 \frac{mg}{l} \cdot \frac{l}{1000\,ml}} = 515 \frac{ml}{g} \checkmark$$

if $515 \frac{ml}{g}$ (or $515 \frac{l}{kg}$) is a reasonable K_d,

then we can calculate a sediment concentration based on AWQC for lead

$$AWQC\,(lead) = e^{(1.266 \ln(hardness) - 4.661)}$$

AR302385

NUS CORPORATION AND SUBSIDIARIES — STANDARD CALCULATION SHEET

CLIENT: EPA	FILE NO.: 9851	BY: AEH	PAGE 2 OF 2
SUBJECT: Action Level – Sediment in Drainage Ditch – CER Battery Site		CHECKED BY: RJH	DATE: 6/19/89

calculate hardness:

	total (mg/l)		dissolved (mg/l)		
Ca	156	158	155	153	avg = 155 mg/l
Mg	12	12.1	12	11.8	avg = 11.975 mg/l

hardness:

$$epm_{Ca} = \frac{155 \times 2}{40.08} = 7.73 \checkmark \qquad epm_{Mg} = \frac{11.975 \times 2}{24.32} = 0.98 \checkmark$$

$$TH = (7.73 + 0.98)\,50.04 = 436 \text{ mg/l} \checkmark$$

$$AWQC = e^{(1.266\,\ln(436) - 4.661)} \approx 20 \text{ µg/l} \checkmark$$

$$\left(\frac{soil}{water}\right) \quad \frac{1155 \text{ ppm}}{2.2 \text{ ppm}} = \frac{x \text{ ppm}}{0.02 \text{ ppm}} \quad \left(\frac{sed}{water}\right)$$

$$X = \frac{(1155)(0.02)}{2.2} = \boxed{10.5 \text{ ppm}} \checkmark$$

OR approximately background concentrations of lead

AR302386

NUS CORPORATION AND SUBSIDIARIES — STANDARD CALCULATION SHEET

CLIENT: EPA	FILE NO.: 9851	BY: AEH	PAGE 1 OF 2
SUBJECT: Action Level – Sediment in Drainage Ditch C&R Battery Site		CHECKED BY: 8-18-89	DATE: 6/19/89

Cd	SW03	total	34.2	µg/l	26.9 µg/l } avg = 31.6 µg/l	
		dissolved	30.2		35.0 }	
	SD03		2.8	mg/kg	2.6 mg/kg } avg = 2.7 mg/kg	

$$K_d = \frac{C_{soil}}{C_{water}} = \frac{2.7}{0.0316} = 85.4 \frac{ml}{g}$$

Chronic AWQC $_{Cd} = e^{(0.7852\,(\ln(\text{hardness}))\,-3.490}$

hardness = 436 mg/l

AWQC = 3.6 µg/l

$$\frac{2.7 \text{ ppm}}{0.0316 \text{ ppm}} = \frac{X \text{ ppm}}{0.0036 \text{ ppm}}$$

X = 0.3 ppm. eg. ND

Zn:	SW03	~~total~~ diss	0.288	0.286	} 0.294
		total	0.296	0.305	
	SD03		37.5	47.3	} 42.4

Chron. AWQC $_{Zn} = e^{(0.8473\,\ln(\text{hardness}) + 0.7614)} = 369$ µg/l

$$\frac{42.4}{0.294} = \frac{X}{0.369}$$

X = 53 mg/kg

NUS 155A REVISED 0286

AR302387

CLIENT: EPA	FILE NO.: 9851	BY: KLG	PAGE 2 OF 2
SUBJECT: Action Level – Sediment in Drainage Ditch C&R Battery Site		CHECKED BY: BLZ 8-18-89	DATE: 6/19/89

As; SW total 0.0042 0.0044 } 0.0042
diss. 0.0044 0.0039 }

Sd. 17.4 23.2 = 20.3

chronic AWQC. 190 µg/l.

$\frac{20.3}{0.0042} = \frac{X}{0.190}$ X = 918 mg/kg

MEDIA QUANTITY
CALCULATIONS

Offsite Surface Soil Areas (square feet)
For Page 1 calculations

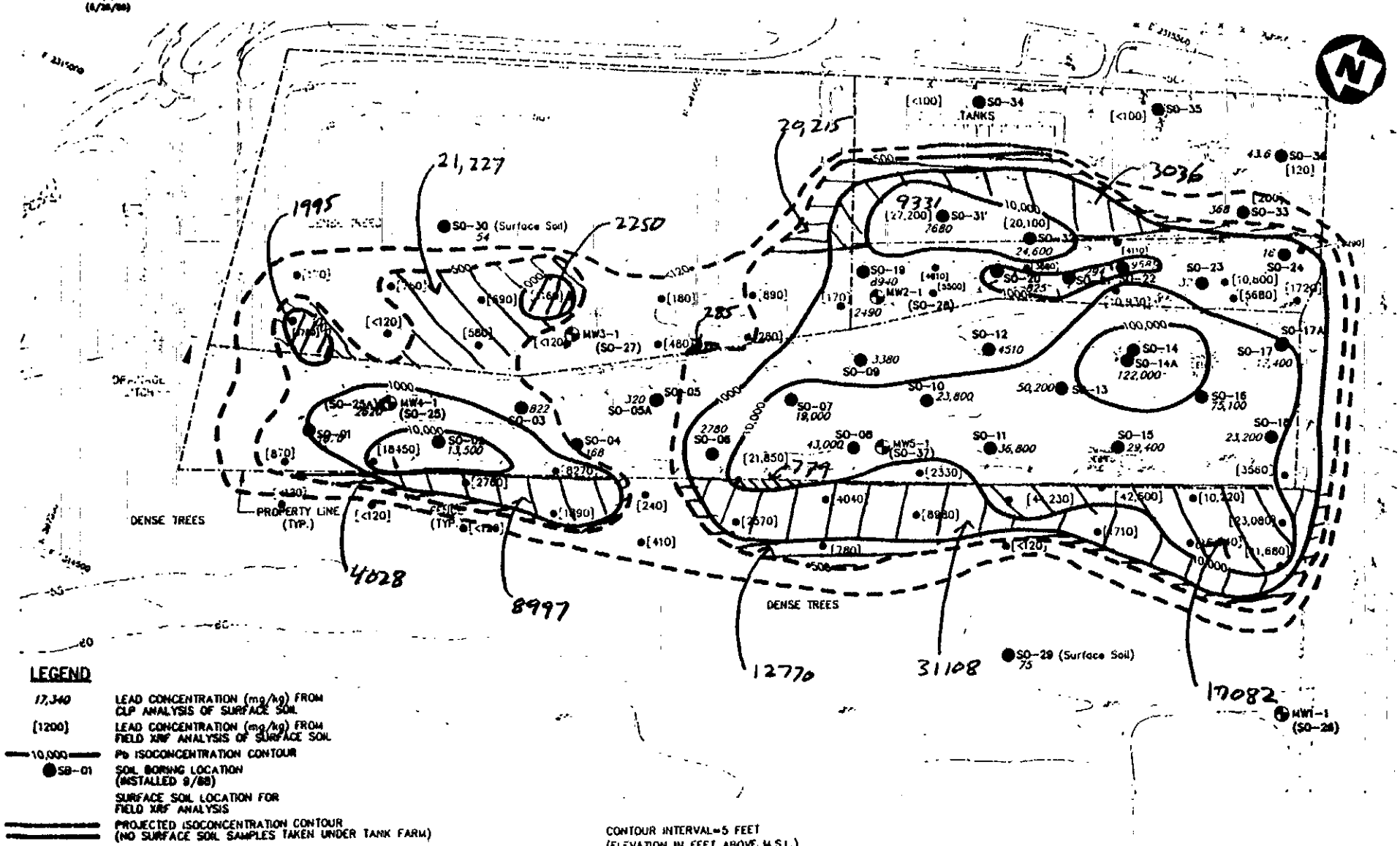


FIGURE 2-1

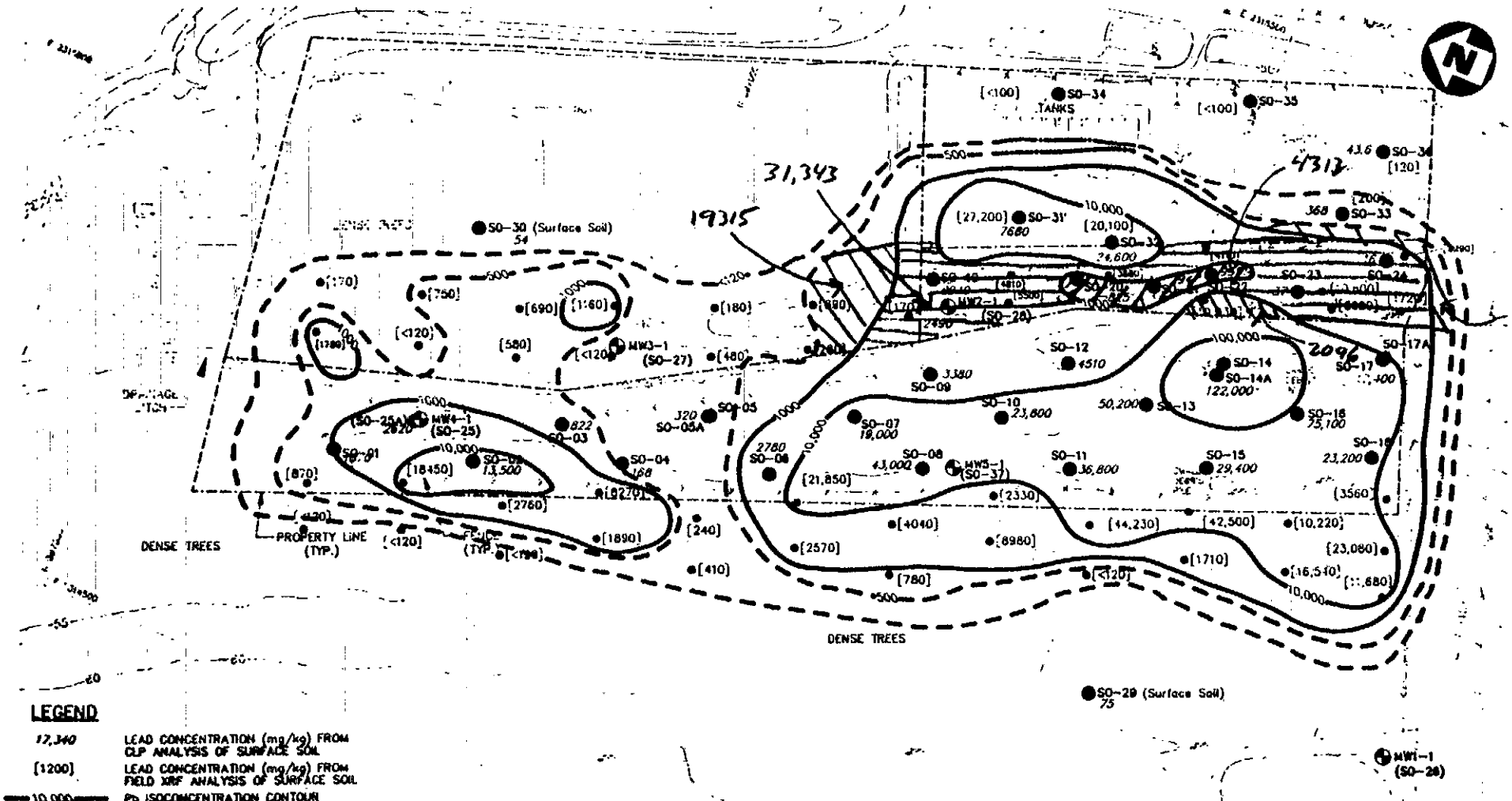
LEAD ISOCONCENTRATION MAP FOR SURFACE SOILS
C & R BATTERY SITE, CHESTERFIELD CO., VIRGINIA

SCALE IN FEET 0 100 200

NUS CORPORATION

ER302360

Offsite Subsurface Soil Areas (square feet)
For P. 2 calculations



LEGEND

12,340	LEAD CONCENTRATION (mg/kg) FROM CLP ANALYSIS OF SURFACE SOIL
[1200]	LEAD CONCENTRATION (mg/kg) FROM FIELD XRF ANALYSIS OF SURFACE SOIL
10,000	Pb ISOCONCENTRATION CONTOUR
SB-01	SOIL BORING LOCATION (INSTALLED 9/88)
	SURFACE SOIL LOCATION FOR FIELD XRF ANALYSIS
	PROJECTED ISOCONCENTRATION CONTOUR (NO SURFACE SOIL SAMPLES TAKEN UNDER TANK FARM)

CONTOUR INTERVAL=5 FEET
(ELEVATION IN FEET ABOVE M.S.L.)

FIGURE 2-1

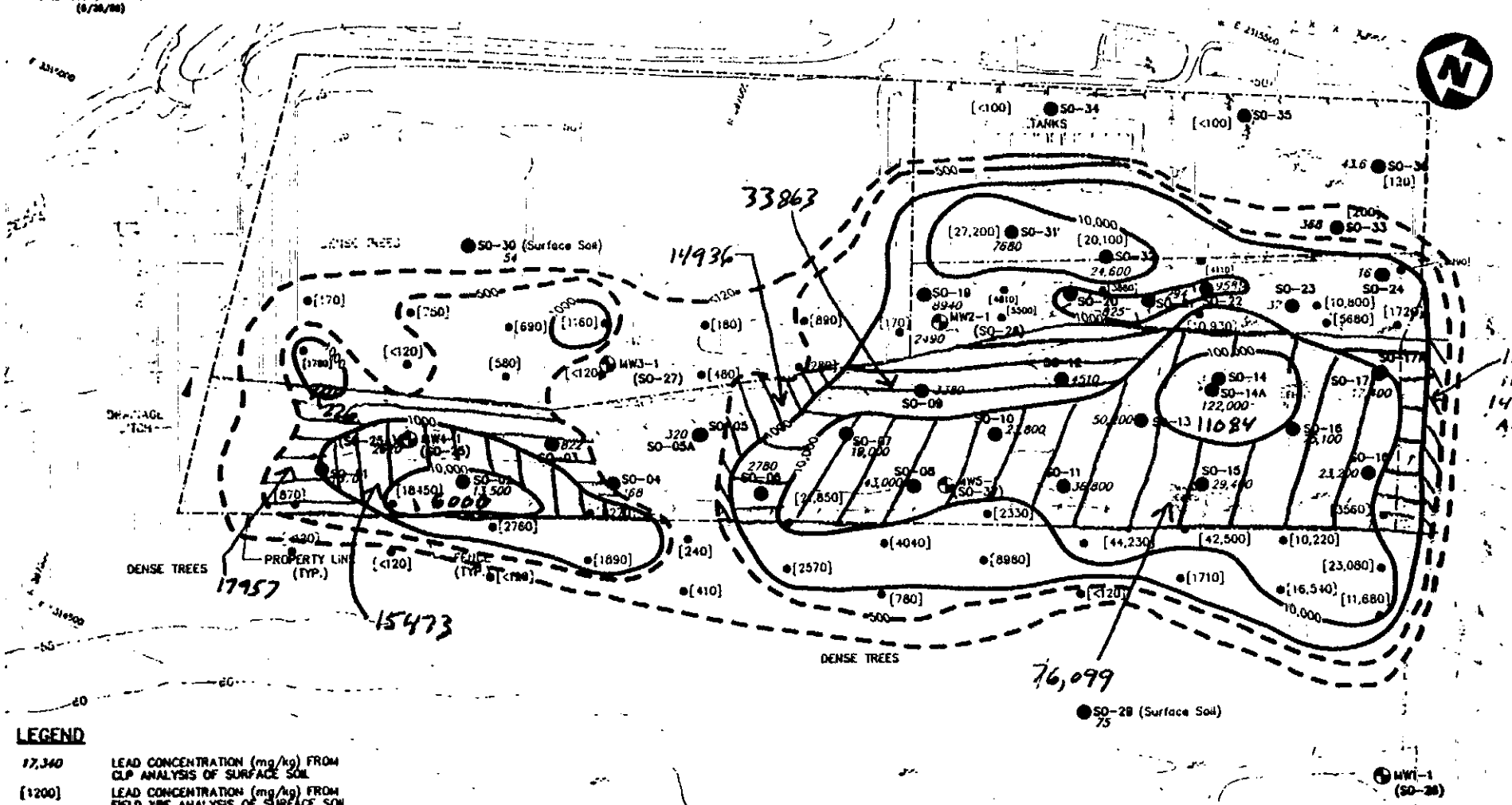
LEAD ISOCONCENTRATION MAP FOR SURFACE SOILS
C & R BATTERY SITE, CHESTERFIELD CO., VIRGINIA

0 100 200
SCALE IN FEET

NUS CORPORATION

ER302391

Onsite Subsurface Soil Areas (square feet)
For P.3a Calculations



LEGEND

17,340	LEAD CONCENTRATION (mg/kg) FROM CLP ANALYSIS OF SURFACE SOIL
[1200]	LEAD CONCENTRATION (mg/kg) FROM FIELD XRF ANALYSIS OF SURFACE SOIL
10,000	Pb ISOCONCENTRATION CONTOUR
SB-01	SOIL BORING LOCATION (INSTALLED 9/88)
	SURFACE SOIL LOCATION FOR FIELD XRF ANALYSIS
	PROJECTED ISOCONCENTRATION CONTOUR (NO SURFACE SOIL SAMPLES TAKEN UNDER TANK FARM)

CONTOUR INTERVAL=5 FEET
(ELEVATION IN FEET ABOVE M.S.L.)

FIGURE 2-1

LEAD ISOCONCENTRATION MAP FOR SURFACE SOILS
C & R BATTERY SITE, CHESTERFIELD CO., VIRGINIA

NUS CORPORATION

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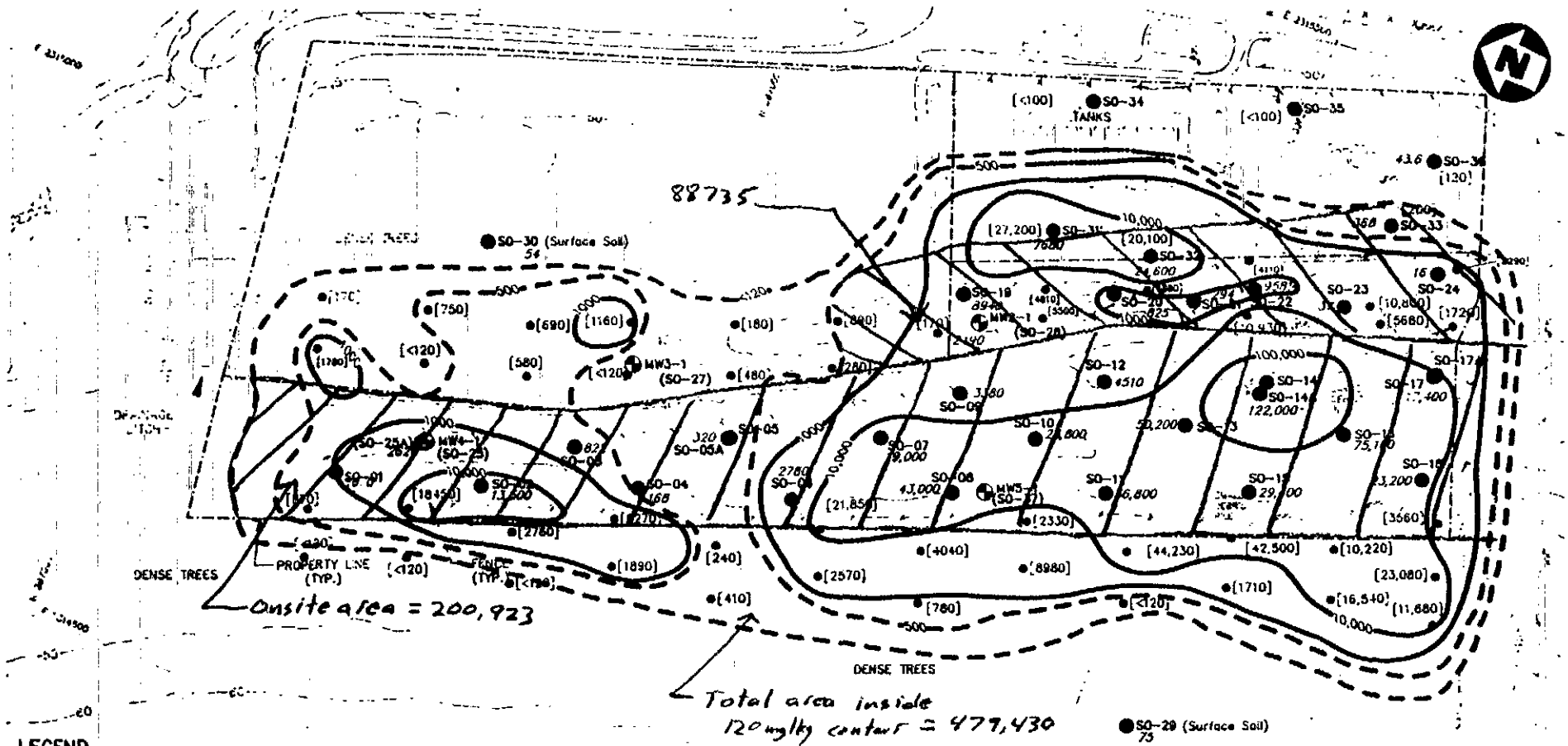
Offsite Surface Soil Areas (square feet)
For P 19 Calculations



LEGEND

- 17,340 — LEAD CONCENTRATION (mg/kg) FROM CLP ANALYSIS OF SURFACE SOIL
- [1200] — LEAD CONCENTRATION (mg/kg) FROM FIELD XRF ANALYSIS OF SURFACE SOIL
- 10,000 — Pb ISOCONCENTRATION CONTOUR
- SB-01 — SOIL BORING LOCATION (INSTALLED 9/88)
- SURFACE SOIL LOCATION FOR FIELD XRF ANALYSIS
- PROJECTED ISOCONCENTRATION CONTOUR (NO SURFACE SOIL SAMPLES TAKEN UNDER TANK FARM)

CONTOUR INTERVAL=5 FEET
(ELEVATION IN FEET ABOVE M.S.L.)

FIGURE 2-1

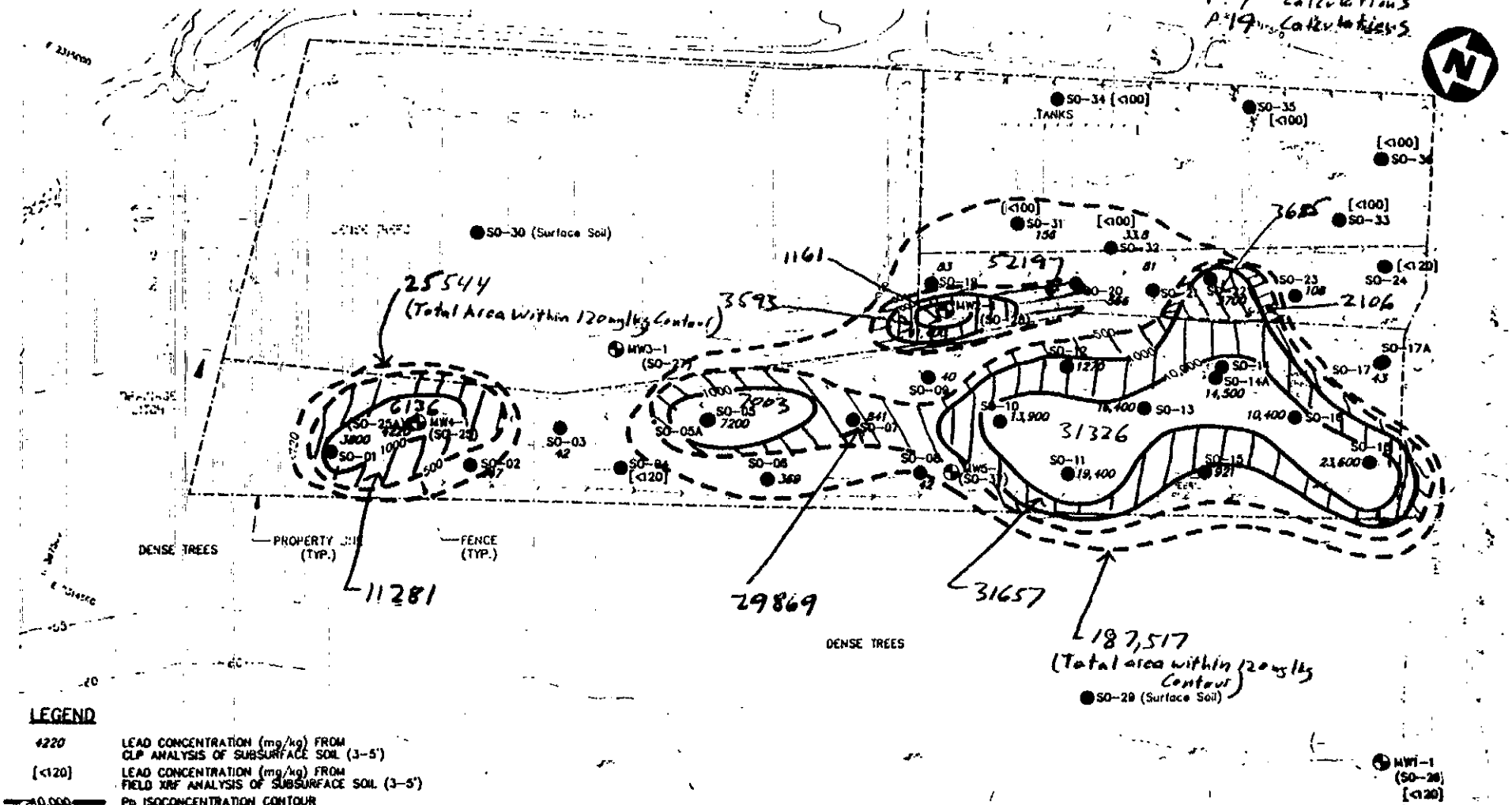
LEAD ISOCONCENTRATION MAP FOR SURFACE SOILS
C & R BATTERY SITE, CHESTERFIELD CO., VIRGINIA

SCALE IN FEET 0 100 200

NUS CORPORATION

AR302393

Onsite & Offsite Subsurface Soil Areas (Square feet)
2.5-5.5 ft depth
P. 2 Calculations
P. 4 Calculations
P. 19 Calculations



LEGEND

4220	LEAD CONCENTRATION (mg/kg) FROM CLP ANALYSIS OF SUBSURFACE SOIL (3-5')
[<120]	LEAD CONCENTRATION (mg/kg) FROM FIELD XRF ANALYSIS OF SUBSURFACE SOIL (3-5')
10,000	Pb ISOCONCENTRATION CONTOUR
SB-01	SOIL BORING LOCATION (INSTALLED 9/88)

CONTOUR INTERVAL=5 FEET
(ELEVATION IN FEET ABOVE M.S.L.)

FIGURE 2-2

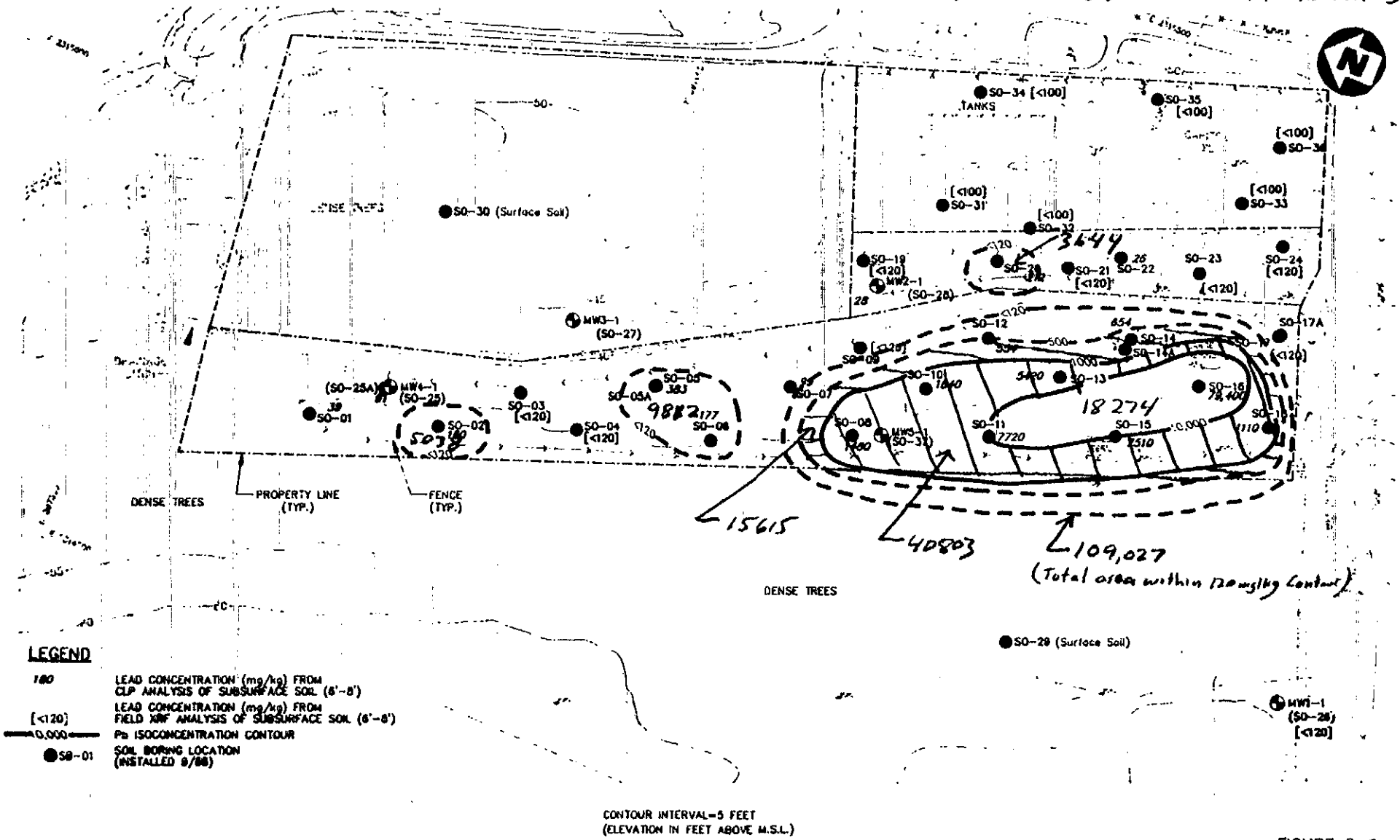
LEAD ISOCONCENTRATION MAP FOR SUBSURFACE SOILS (3'-5')
C & R BATTERY SITE, CHESTERFIELD CO., VIRGINIA

SCALE IN FEET 0 100 200

NUS CORPORATION

AR302365

Subsurface Soil Areas (Square feet)
5,5-8.5 ft Depth P. 4 & 19 Calculations



LEGEND

180	LEAD CONCENTRATION (mg/kg) FROM CLP ANALYSIS OF SUBSURFACE SOIL (6'-8')
[<120]	LEAD CONCENTRATION (mg/kg) FROM FIELD XRF ANALYSIS OF SUBSURFACE SOIL (6'-8')
10,000	Pb ISOCONCENTRATION CONTOUR
SB-01	SOIL BORING LOCATION (INSTALLED 9/88)

CONTOUR INTERVAL=5 FEET
(ELEVATION IN FEET ABOVE M.S.L.)

FIGURE 2-3

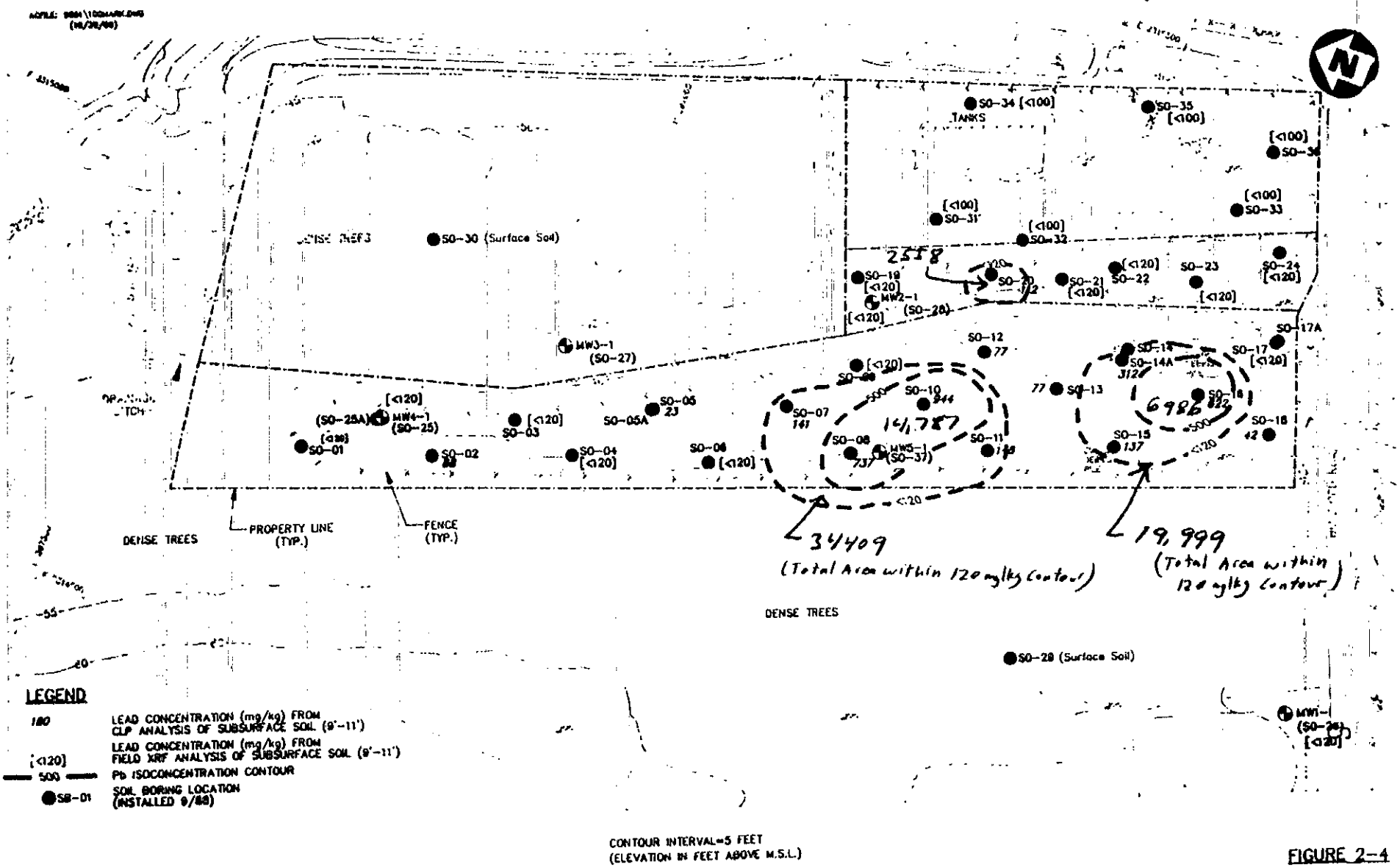
LEAD ISOCONCENTRATION MAP FOR SUBSURFACE SOILS (6'-8')
C & R BATTERY SITE, CHESTERFIELD CO., VIRGINIA

0 100 200
SCALE IN FEET

NUS CORPORATION

ER023095

Subsurface Soil ... eas ... et)
8.5-12 ft P.S.A.19 calculations



LEGEND

180	LEAD CONCENTRATION (mg/kg) FROM CLP ANALYSIS OF SUBSURFACE SOIL (9'-11')
[<120]	LEAD CONCENTRATION (mg/kg) FROM FIELD XRF ANALYSIS OF SUBSURFACE SOIL (9'-11')
500	Pb ISOCONCENTRATION CONTOUR
SB-01	SOIL BORING LOCATION (INSTALLED 9/88)

CONTOUR INTERVAL=5 FEET
(ELEVATION IN FEET ABOVE M.S.L.)

FIGURE 2-4

0 100 200
SCALE IN FEET

NUS CORPORATION

LEAD ISOCONCENTRATION MAP FOR SUBSURFACE SOILS (9'-11')
C & R BATTERY SITE, CHESTERFIELD CO., VIRGINIA

AR302396

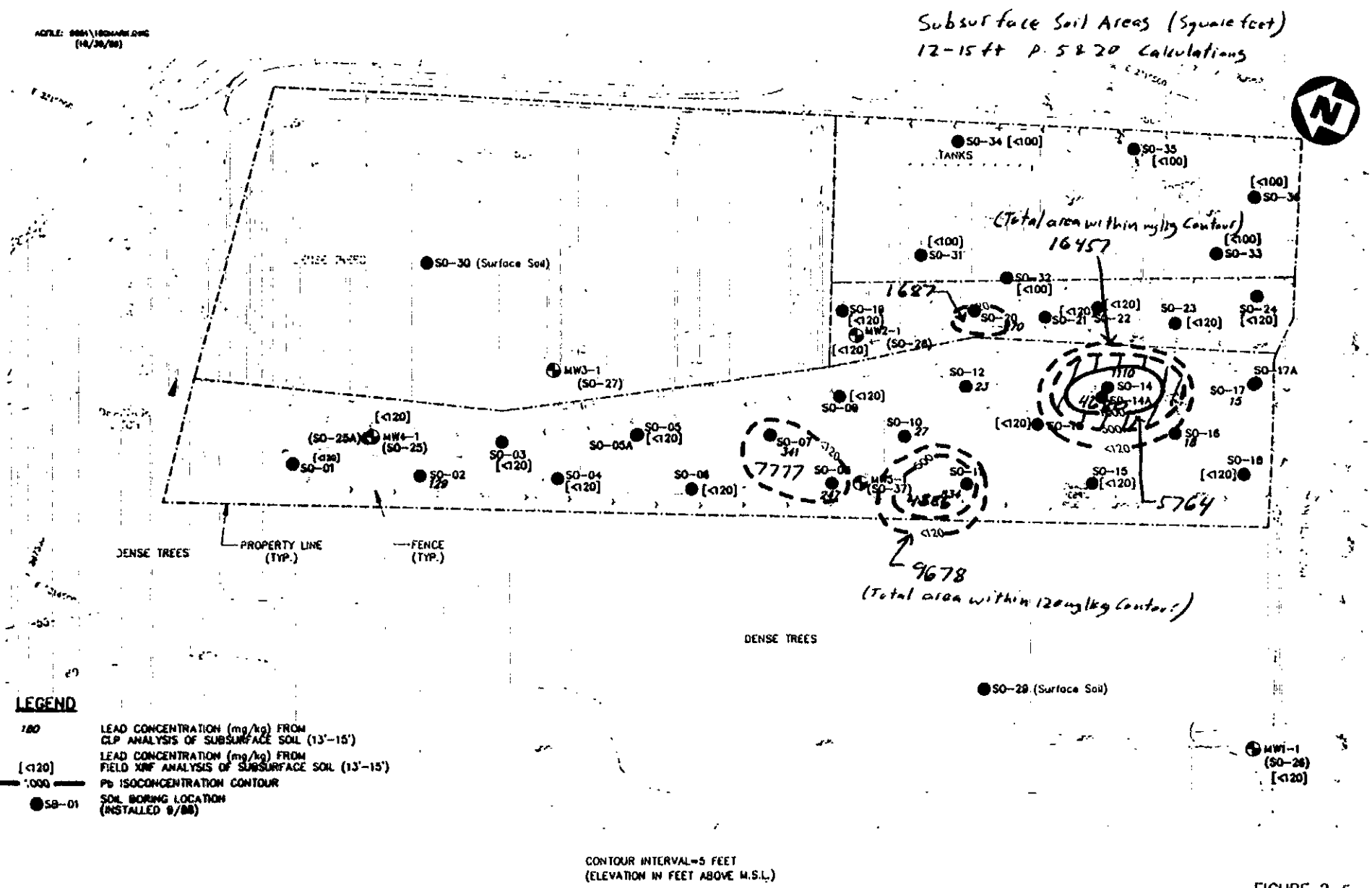


FIGURE 2-5

LEAD ISOCONCENTRATION MAP FOR SUBSURFACE SOILS (13'-15')
C & R BATTERY SITE, CHESTERFIELD CO., VIRGINIA

NUS CORPORATION

AR302397

NUS CORPORATION AND SUBSIDIARIES			STANDARD CALCULATION SHEET
CLIENT: EPA	FILE NO.: 9851	BY: Gordon Ruggaber	PAGE 1 OF 61
SUBJECT: C&R Battery Site - Lead Quantities		CHECKED BY: W C Isner	DATE: 5-8-89

Sample Number	Dry Density (Acf)
CR-5025-33B	99.0
CR-5025-33D	109.0

Average = 104.0 Acf = 1.4 tons/cy

Offsite Surface Soils - Area overlying uncontaminated subsurface soil
ie., excluding surface soils overlying contaminated offsite subsurface soils that are contained in 0.0-2.5 ft subsurface soil calculation on p. 2

Contour (mg/kg)	Area (SF)	Arithmetic Average (mg/kg)
Inside 10,000	9331	(24,000+10,000)/2 = 17,000
10,000-1000	31108+8997+3036 = 43,141	5,500
Inside 1000	1995+2250 = 4245	1000
1000-500	20,215+285+24,227+4028+12770 = 58,525	750
100,000-10,000	779+17082 = 17861	55,000

Total Area = 9331+43,141+4245+58,525+17861 = 133,103 SF

Average Pb Conc (mg/kg) = [(9331)(17,000)+(43,141)(5,500)+(4245)(1000)+(58,525)(750)
+(17861)(55,000)]/133,103

= [158637000+237275500+4245000+43893750+982355000]/133,103

[Pb] = 10,716 mg/kg

Total Lead in Top 6 inches = (10,716 mg/kg)(1g/1000mg)(1kg/1000g)(104 lb/cf)(0.5ft)(133,103 SF)
×(1 ton/2000lb)

Total Pb = 371 tons

Total Pb including Pb in dike soils (see p. 6) = 371 tons + 8.3 tons
= 454 tons

AR302398

Offsite Subsurface Soils 0.0 ft – 2.5 ft

Contour (mg/kg)	Area (SF)	Arithmetic Average Pb Conc. (mg/kg)
100,000 – 10,000	2096	55,000
10,000 – 1,000	31343	5,500
1000 – 500	19315	750
Inside 1000	4313	(10,000 + 1000)/2 = 5,500

Total Area = 2096 + 31343 + 19315 + 4313 = 57067

Average Lead Conc. (mg/kg) $= [(2096)(55{,}000) + (31343)(5{,}500) + (19315)(250) + (4313)(5500)] / 57067$

$= [11528 \times 10^4 + 172386500 + 14486250 + 23721500] / 57067$

$[\bar{Pb}] = 5710.4$ mg/kg

Total Quantity of Pb (Tons) $= (5710.4\ mg/kg)(1\ kg/1000\ mg)(lb/2000\ g)(104\ lb/cf)(2.5\ ft)(57067\ SF) \times (1\ ton/2000\ lb)$

Total Pb = 42.4 tons

Offsite Subsurface Soils 2.5 ft – 5.5 ft

Contour (mg/kg)	Area (SF)	Arithmetic Average (mg/kg)
Inside 10,000	1161	55,000
10,000 – 1000	3593 + 3685 = 7278	5,500
1000 – 500	5219 + 2106 = 7325	750

Total Area = 1161 + 7278 + 7325 = 15,764 SF

Average Pb Conc. (mg/kg) $= [(1161)(55{,}000) + (7278)(5{,}500) + (7325)(750)] / 15{,}764$

$= [63855000 + 40029000 + 5493750] / 15{,}764$

$[\bar{Pb}] = 6938.5$ mg/kg

Offsite Subsurface Soils 2.5 ft - 5.5 ft (con't)

Total Pb = (6938.5 mg/kg)(1 g/1000 mg)(1 kg/1000 g)(104 ft²/ac)(2.0 ft)(15,764 SF)(1 ton/2000 lb)

Total Pb = 17.1 tons

Total Lead in offsite Subsurface Soils = 42.4 tons + 17.2 tons

= 60.1 tons

Total Lead in offsite Surface (0-0.5 ft) soils = 45.4 tons

Total lead in offsite soils = 60.1 tons + 45.4 tons = 105.5 tons

Onsite Soils 0.0 - 2.5 ft.

Contour (mg/kg)	Area (SF)	Arithmetic Average (mg/kg)
Inside 100,000	11,084	100,000
100,000 - 10,000	26,099	55,000
Inside 10,000	6000	10,000
10,000 - 1000	15,473 + 33863 = 49336	5,500
Inside 1000	226	1000
1000 - 500	37957 + 24,936 = 32893	750

Total Area = 11,084 + 26,099 + 6000 + 49,336 + 226 + 32893

= 175638 SF

Average Lead Conc. (mg/kg) = [(11,084)(100,000) + (26,099)(55,000) + (6000)(10,000) + (49336)(5,500) + (226)(1000) + (32,893)(750)] / 175638

= [11084 × 10⁵ + 418544500 + 6 × 10⁷ + 271348000 + 226,000 + 24669750] / 175638

[Pb] = 32,169 mg/kg

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Offsite surface soils (Total Area within 1000 mg/kg contour)

Area = Total area − area between 500 and 1000 mg/kg contour

Area = (133,103 SF − 58,525 SF) + (57,067 SF − 19315 SF)
(p.1) (p.2)

= 74578 SF (above uncontaminated subsurface soil) + 37,752 (above contaminated subsurface soil)

Total = 112,330 SF (offsite)

Onsite surface soils (Total Area within 1000 mg/kg contour)
(above contaminated subsurface soil)

Area = 175638 SF − 32,893 SF = 142,745 SF
(p.3a) (p.3a)

Total Onsite & Offsite Surface Soil Above 1000 mg/kg Contour

= 112,330 SF + 142,745 SF

= 255,075 SF

Offsite surface soils (Total Area within 10,000 mg/kg Contour)

Area = 9331 SF + 17861 (p.1) + 2096 SF (above contaminated subsurface soil)
(above uncontaminated subsurface soil)

Total = 27,192 SF + 2096 SF

= 29,288 SF

AR302401

Onsite Surface Soils (Total Area within 10,000 mg/kg Contour)
(above contaminated soil)

Area = 11,094 SF + 76,099 SF + 6000 SF

= 93,183 SF

Total Onsite & Offsite surface Soil Above 10,000 mg/kg Contour

Total = 29,288 SF + 93,183 SF

Total = 122,471 SF

Surface Soil Volumes (Above Uncontaminated Subsurface Soil)
(assume 0.5 ft depth)

120 mg/kg action level: (P. 19) Area = 189,772 SF
Volume = (0.5 ft)(189,772 SF)(1 CY/27 CF)
= 3514 CY

1000 mg/kg action level: Volume = (0.5 ft)(74,578 SF)(1 CY/27 CF)

= 1381 CY

10,000 mg/kg action level: Volume = (0.5 ft)(27,192 SF)(1 CY/27 CF)

= 504 CY

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Onsite Soils 0.0 - 2.5 ft. (con't)

Total Pb = (32,169 mg/kg)(1g/1000mg)(1lb/454g)(104 lb/cf)(2.5 ft)(175638 SF)(1 ton/2000lb)

Total Pb = 734.5 tons

Onsite Soils 2.5 ft - 5.5 ft

Contour (mg/kg)	Area (SF)	Arithmetic Ave. (mg/kg)
Inside 10,000	31326	(20,000+10,000)/2 = 15,000
10,000-1000	31657	5,500
Inside 1000	7003+6136 = 13139	(5750+1000)/2 = 3350
1000-500	29869 + 11281 = 41,150	750

Total Area = 31326 + 31657 + 13139 + 41,150 = 117272

Average Pb Conc (mg/kg) = $\frac{[(31326)(15,000) + (31657)(5,500) + (13139)(3350) + (41150)(750)]}{117272}$

$= [469890000 + 174113500 + 44075650 + 30862500] / 117272$

$\overline{[Pb]}$ = 6130.0 mg/kg

Total Pb = (6130.0 mg/kg)(1g/1000mg)(1kg/1000g)(104 lb/cf)(2.5 ft)(117272 SF)(1 ton/2000lb)

Total Pb = 112.1 tons

Onsite Soils 5.5 - 8.5 ft

* Assumes high level (79,400 mg/kg) of lead in boring 16 is an anomaly - it does not follow decreasing trend, similar to other borings.

Contour (mg/kg)	Area (SF)	Arithmetic Ave. (mg/kg)
Inside 10,000	18274	10,000*
10,000-1000	40803	5,500
1000-500	15615	750

Total Area = 18274 + 40803 + 15615 = 74692

Onsite Soils 5.5-8.5 ft (con't)

Average Pb (mg/kg) $= [(18274)(10,000) + (40803)(3,500) + (15615)(350)] / 74692$

$= [18274 \times 10^4 + 22441650 + 11711250] / 74692$

$[\overline{Pb}] = 5607.9$ mg/kg

Total Pb $= (5607.9 \text{ mg/kg})(\frac{1g}{1000mg})(\frac{1kg}{1000g})(104\ lb/CF)(3.0\ ft)(74692)(\frac{1\ Ton}{2000\ lb})$

Total Pb = 65.3 Tons

Onsite Soils 8.5 ft - 12 ft

Contour (mg/kg)	Area (SF)	Arithmetic Average
1000-500	14787	(1000+500)/2 = 750
inside 500	6986	500

Total Area = 21773

Average Pb Conc (mg/kg) $= [(14787)(750) + (6986)(500)] / 21773$

$[\overline{Pb}] = [11090250 + 3493000] / 21773$

$[\overline{Pb}] = 669.8$ mg/kg

Total Pb $= (669.8 \text{ mg/kg})(\frac{1g}{1000mg})(\frac{1kg}{1000g})(104\ lb/CF)(3.5\ ft)(21773\ SF)(\frac{1\ Ton}{2000\ lb})$

Total Pb = 2.7 tons

Onsite Soils 12 ft - 15 ft

Contour (mg/kg)	Area (SF)	Arithmetic Average (mg/kg)
Inside 1000	4680	1000
1000-500	5764	750
Inside 500	4886	500

Onsite Soils - 12ft - 15ft (cont)

Total Area = 4680 + 5764 + 4886

= 15330 sf

Average Pb Conc. = [(4680)(1000) + (5764)(750) + (4886)(500)] / 15330

= [468 x 10⁴ + 4323000 + 2443000] / 15330

$[\bar{Pb}]$ = 746.6 mg/kg

Total Pb = (746.6 mg/kg)(1g/1000mg)(1kg/1000g)(104 lb/cf)(3.0 ft)(15330 sf)(1 ton/2000 lb)

Total Pb = 1.8 Tons

Total lead in onsite soils = 734.5 tons + 117.1 tons + 65.3 tons + 2.7 tons + 1.8 tons

= 916.4 tons

Lead quantity in dike volume

Due to high concentration of battery casing observed in dike, assume average concentration of lead is the same as average lead concentration in onsite soils at depth 0-2.5 ft.

from p 3 $[\bar{Pb}]$ = 32,169 mg/kg

dike volume = 183.5 c.y. (see Appendix J of RI)

Total lead = (32,169 mg/kg)(1g/1000mg)(1kg/1000g)(183.5 cy)(27 cf/cy)(104 lb/cf)(1 ton/2000 lb)

Total lead = 8.3 tons

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Debris Piles - assume average dry density is same as soils.

Large debris pile volume = 229.0 C.Y. (see Appendix J of RI)

Small debris pile volume = 4.3 C.Y. (see Appendix J of RI)

Total volume = 233.3 C.Y.

Average lead concentration = 63,375 mg/kg

Total lead = $(63{,}375\ mg/kg)(1g/1000mg)(1kg/1000g)(233.3\ CY)(27\ CF/CY)(104\ lb/CF)(1\ ton/2000\ lb)$

Total lead = 20.8 tons

Drainage Ditch* - assume average dry density is same as soils

Estimated sediment area = 18,900 SF

Sediment volume = $(0.5\ ft)(18{,}900\ SF)(1\ CY/27\ CF) = 350\ CY$

Assume depth of contamination = 0.5 ft

Average lead concentration = 3618 mg/kg

Total lead = $(3618\ mg/kg)(1g/1000mg)(1kg/1000g)(18{,}900\ SF)(0.5\ ft)(104\ lb/CF)(1\ ton/2000\ lb)$

Total lead = 18 tons

* Note: Most of sediment volume is included in onsite soils volume estimate, but this volume will be added into costing calculations as a conservative approach

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Soil Volume within 500 mg/kg Contour

From pages 1-7:

Offsite surface soil volume = (133,103 SF)(0.5 ft)($\frac{1 C.Y.}{27 CF}$)

= 2464.9 C.Y.

Offsite subsurface soil volume (0-2.5 ft) = (57062 SF)(2.5 ft)($\frac{1 C.Y.}{27 CF}$)

= 5284.0 C.Y.

Offsite subsurface soil volume (2.5-5.5 ft) = (15,764)(3.0 ft)($\frac{1 C.Y.}{27 CF}$)

= 1751.6 C.Y.

Onsite soil volume (0-2.5 ft) = (175638 SF)(2.5 ft)($\frac{1 C.Y.}{27 CY}$)

= 16,262.8 C.Y.

Onsite subsurface soil volume (2.5-5.5 ft) = (117272 SF)(3.0 ft)($\frac{1 C.Y.}{27 CF}$)

= 13030.2 C.Y.

Onsite subsurface soil volume (5.5-8.5 ft) = (74,692 SF)(3.0 ft)($\frac{1 C.Y.}{27 CF}$)

= 8299.1 C.Y.

Onsite subsurface soil volume (8.5-12 ft) = (21,223 SF)(3.5 ft)($\frac{1 C.Y.}{27 CF}$)

= 2822.4 C.Y.

Onsite subsurface soil volume (12-15 ft) = (15,330 SF)(3 ft)($\frac{1 C.Y.}{27 CF}$)

= 1703.3 C.Y.

Total Soil Volume = 2464.9 + 5284.0 + 1751.6 + 16,262.8 + 13030.2 + 8299.1 + 2822.4 + 1703.3 (Within 500 mg/kg Contour)

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Total Soil Volume = 51618.3 C.Y. (within 500 mg/kg contour)

Total Soil Volume including debris piles & dike volume

= 51618.3 C.Y. + 183.5 C.Y. (dike) + 233.2 C.Y. (piles)

= 52,035 C.Y.

Total offsite Volume within 500 mg/kg Contour

= 2464.9 cy + 5284 cy + 1751.6 cy

= 9500.5 cy

Total Onsite Volume within 500 mg/kg Contour

= 51618.3 cy − 9500.5 cy

= 42,118 cy

Onsite - offsite Distribution in subsurface soils

From p. 3 : Total lead in offsite subsurface soils = 60.1 tons

From A.6 : Total lead onsite subsurface soils.

= 916.4 tons

Total lead = 916.4 tons + 60.1 tons = 976.5 tons

Percentage of total lead in onsite subsurface soils = (916.4)/976.5 x 100

= 93.8 %

Percentage of total lead in offsite subsurface soils = 100% - 93.8% = 6.2%

Vertical Distribution in Soils

Depth (ft)	lead (tons)	% of total lead in layer	% of total lead in combined layers	% of total volume in layer	% of total volume in combined layers
0-2.5*	822.3	80.5	80.5	46.5	46.5
2.5-5.5	129.2	12.7	93.2	28.6	75.2
5.5-8.5	65.3	6.4	99.6	16.1	91.2
8.5-12	2.7	0.3	99.8	5.5	96.7
12-15	1.8	0.2	100	3.3	100

*Excludes sediments & debris piles but includes dike and surface soils.

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NUS CORPORATION AND SUBSIDIARIES			STANDARD CALCULATION SHEET
CLIENT: EPA	FILE NO.: 9851	BY: Gordon Ruggober	PAGE 1 OF 6
SUBJECT: C & R Battery site - Battery Casings		CHECKED BY: W. C. Isner	DATE: 5-12-89

Distribution of Battery Casing Fragments in Subsurface Soils - From Boring Log Observations

Boring No	Casings Observed (Yes or No)		
1	Yes	0-5'	
2*	Yes	0-5'	
3	Yes	0-2'	some
4	Yes	0-1'	
5	Yes	0-2'	High
6	Yes	0-1'	
7	Yes	0-3.5'	
8	Yes	0-1'	
9	Yes	0-1'	
10	Yes	0-5'	High
11	Yes	0-3.5'	High
12*	Yes	0-5'	High
13	No	0	
14	Yes	0-5'	High
15	Yes	0-2'	some
16	Yes	0-2'	
17	Yes	0-2'	
18	Yes	0-2'	
19	Yes	0-5'	High
20	Yes	0-4'	High
21*	Yes	0-5'	High
22	Yes	0-3.5	High
23	No	0	
24	No	0	
25	Yes	0-5	

* Battery casings observed at 8 ft are assumed to have fallen from upper soils as a result of boring operation.

Average depth = 2.8'

Specific gravity of Polypropylene = 1.933

Specific gravity of Vulcanized rubber = 1.2 - 1.95

assume 1.6 as an average

NUS 155A REVISED 0285

Battery Casing Fragment Distribution - Con't

Based on field observations, assume average concentration of battery casing fragments in top 2.8 ft of soil is approximately 10% by volume

From p. 8 offsite subsurface area (0-2.5 ft) = 57067 SF
Onsite subsurface area (0-2.5 ft) = 175638 SF

Total area = 232705 SF

Total Volume of casing fragments = $(.10)(232705\ SF)(2.8\ ft)\left(\frac{1\ CY}{27\ SF}\right)$

= 2413 CY

Total weight of casing fragments = $(.10)(232705\ SF)(2.8\ ft)(1.6)(62.4\ lb/CF) \times (1\ ton/2000\ lb)(.81)$ ①

$+ (.10)(232705\ SF)(2.8\ ft)(1.93)(62.4\ lb/CF) \times (1\ ton/2000\ lb)(.19)$ ①

= 2634.7 tons + 745.5 tons

Total weight = 3380 tons

① Estimated from U.S. Bureau of Mines treatability study RMIS No. 231 - Treatment of Lead-Bearing Wastes, April Summary Report. 1989.

AR302411

Offsite Subsurface Soils 0-2.5 ft

From Page 2

Total area inside 1000 mg/kg contour = 37252 SF

Ave. Lead Conc (mg/kg) = [115.28×10⁴ + 172386500 + 23721500] / 37252 SF

= 311388000 / 37252 = 8248.3 mg/kg

Total Pb = (8248.3 mg/kg)(10⁻⁶)(104)(2.5)(37252)(1/2000)

= 40.5 tons

Total area inside 10,000 mg/kg contour = 2096 SF

Ave. Lead Conc = 55,000 mg/kg

Total Pb = (55,000)(10⁻⁶)(104)(2.5)(2096)(1/2000)

= 15.0 tons

Offsite Subsurface Soils 2.5-5.5 ft

From P. 2

Total area inside 1000 mg/kg contour = 8439 SF

Ave. Lead Conc. = [63855000 + 40029000] / 8439

= 12310.0 mg/kg

Total Pb = (12310.0)(10⁻⁶)(104)(3)(8439)(1/2000) = 16.2 tons

Total Area inside 10,000 mg/kg contour = 1161 SF

Ave Lead Conc. = 55,000 mg/kg

Total Pb = (55,000)(10⁻⁶)(104)(3)(1161)(1/2000) = 10.0 tons

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Onsite subsurface soils 0-2.5 ft

From page 3:

Area inside 1000 mg/kg contour = 142745 SF

Ave Pb Conc. = [11084x10^5 + 418544500 + 6x10^7 + 271348000 + 226,000)/ 142745 SF

= 562541900/142745 SF = 3940 8.9 mg/kg

Total Pb = (3940 8.9)(10^-6)(104)(2.5)(142745)(1/2000) = 731.3 tons

Area inside 10,000 mg/kg contour = 93183 SF

Ave Pb Conc. = [11084x10^5 + 418544500 + 6x10^7] / 93183 SF

= 535384500/93183 = 5745 5.2 mg/kg

Total Pb = (5745 5.2)(10^-6)(104)(2.5)(93183)(1/2000) = 696.0 tons

Onsite Subsurface Soils 2.5-5.5 ft

From p 4

Area inside 1000 mg/kg contour = 76122 SF

Ave Pb Conc = [46989x10^4 + 12411350 + 44015650]/76122

= 68801915 0/76122 = 9038.4 mg/kg

Total Pb = (9038.4)(10^-6)(104)(3.0)(76122)(1/2000) = 107.3 tons

Area inside 10,000 mg/kg contour = 31326 SF Ave Pb conc = 15,000 mg/kg

Total Pb = (15,000)(10^-6)(104)(3.0)(31326)(1/2000) = 73.3 tons

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Onsite Subsurface Soils 5.5 - 8.5 ft.

From p. 4a5

Area inside 1000 mg/kg contour = 59077 SF

Ave Pb conc. = [18274x10⁴ + 22441650Ø] / 59077 SF

= 407156500 / 59077 = 6892.0 mg/kg

Total Pb = (6892)(10⁻⁶)(104)(3)(59077)(1/2000) = 63.5 tons

Area inside 10,000 mg/kg contour = 18274 SF

Ave Pb conc = 10,000 mg/kg

Total Pb = (10,000)(10⁻⁶)(104)(3)(18274)(1/2000) = 28.5 tons

Onsite Subsurface Soils 8.5 - 12 ft. — no soils with Pb > 1000 mg/kg

From p. 5

Onsite Subsurface Soils 12 - 15 ft.

Area inside 1000 mg/kg contour = 4680 SF

Ave Pb conc. = 1000 mg/kg

Total Pb = (1000)(10⁻⁶)(104)(3)(4680)(1/2000) = 0.7 tons

Total Lead inside 1000 mg/kg Contour (Subsurface Soils)

= 40.5 + 16.2 + 231.3 + 107.3 + 63.5 + 0.7 = 459.5 tons

Total lead inside 10,000 mg/kg Contour =

15.0 + 10.0 + 696.0 + 73.3 + 28.5 = 822.8 tons

Subsurface Soil Volume Inside 1000 mg/kg Contour

= Total Volume inside 500 mg/kg contour − Volume outside 1000 mg/kg Contour

Offsite Subsurface Soils: 0-2.5 ft

From A2

$V_1 = (19315\ SF)(2.5\ ft)(1/27) = 1788.4\ CY$

2.5-5.5 ft

$V_2 = (7325\ SF)(3.0\ ft)(1/27) = 813.9\ CY$

Onsite Subsurface Soils

P3 0-2.5 ft $V_3 = (32893\ SF)(2.5\ ft)(1/27) = 3045.6\ CY$

P4 2.5-5.5 ft $V_4 = (41150)(3.0\ ft)(1/27) = 4572.2\ CY$

5.5-8.5 ft $V_5 = (15615\ SF)(3.0\ ft)(1/27) = 1735\ CY$

P5 8.5-12 ft $V_6 = (21773)(2.5\ ft)(1/27) = 2016\ CY$

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Onsite Subsurface Soils (cont)

12-15 ft $V_7 = 1703.3$ CY.

Total Volume outside 1000 mg/kg contour = $V_1 + V_2 + V_3 + V_4 + V_5 + V_6 + V_7$

$= 1788.4 + 813.9 + 3045.6 + 4572.2 + 1735 + 2016 + 1703$

$= 15674$ CY

Total Volume inside 1000 mg/kg contour = 51618.3 - 15674

Offsite Volume = 95005 - $(V_1 + V_2)$ = 35944 CY (includes surface soil)

$= 95005 - (1788.4 + 813.9)$

$= 68982$ CY.

Onsite Volume = 35944 CY - 6898 CY = 29,046 CY

Subsurface Soil Volume Inside 10,000 mg/kg Contour

From P 2

Offsite Subsurface Soils: 0-2.5 ft

$V_1 = (20963\text{ SF})(2.5\text{ ft})(1/27) = 194.1$ CY

2.5-5.5 ft: $V_2 = (1161\text{ SF})(3\text{ ft})(1/27) = 129$ CY

Total = 323

Onsite Subsurface Soils: 0-2.5 ft: $V_3 = (110841 + 76,099)(25)(1/27)$

From A 3-5

$V_3 = 8072.5$ CY

2.5-5.5 ft $V_4 = (73,326\text{ SF})(3\text{ ft})(1/27) = 3480.7$ CY

5.5 ft - 8.5 ft $V_5 = (18274\text{ SF})(3.\text{ ft})(1/27) = 2030.4$ CY

8.5-15 ft - No Volume

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Total subsurface volume inside 10,000 mg/kg contour =

$V_1 + V_2 + V_3 + V_4 + V_5 = 194.1 + 129.0 + 8072.5 + 3480.7 + 2030.4$

$= 13906.7$ CY

AR302417

"BACKGROUND" SOIL VOLUMES - [Pb] ≤ 120 mg/kg

Offsite Surface Soils - Area overlying uncontaminated subsurface soil

$V_1 = (0.5\,ft)(1\,cy/27\,cf)[479{,}430\,sf_{Total} - 88735\,sf_{offsite\ Subsoils} - 200{,}923\,sf_{onsite}]$

$= (0.5\,ft)(1/27)(189{,}772\,sf)$

$V_1 = 3514\,cy$

(Total offsite area = 479,430 − 200,923 = 278507 sf)

Subsurface Soil Volume (0-2.5 ft)

$V_2 = (2.5\,ft)(1\,cy/27\,cf)[200{,}923\,sf_{onsite\ area} + 88735\,sf_{offsite\ area}]$

$= 18604_{onsite} + 8216_{offsite}\,cy$

$V_2 = 26{,}820\,cy$

Subsurface Soil Volume (2.5 - 5.5 ft)

$V_3 = (3.0\,ft)(1\,cy/27\,cf)(25{,}544\,sf + 187{,}517\,sf)$

$V_3 = 23{,}673\,cy$

Subsurface Soil Volume (5.5 - 8.5 ft)

$V_4 = (3.0\,ft)(1\,cy/27\,cf)(5038\,sf + 9882\,sf + 109027\,sf + 3644\,sf)$

$V_4 = 14{,}177\,cy$

Subsurface Soil Volume (8.5 ft - 12 ft)

$V_5 = (3.5\,ft)(1\,cy/27\,cf)(34409\,sf + 2558\,sf + 19{,}999\,sf)$

$V_5 = 7384\,cy$

AR302418

"Background" Soil Volumes - Con't

Subsurface Soil Volume (12-15 ft)

$V_6 = (3.0\ ft)\left(\frac{1\ CY}{27\ CF}\right)(7777\ SF + 9678\ SF + 16,875\ SF + 16,457\ SF)$

$V_6 = 3955\ CY$

Total Volume $= V_1 + V_2 + V_3 + V_4 + V_5 + V_6$

$= 3514\ CY + 26,820\ CY + 23,673\ CY + 14,172\ CY + 7384\ CY + 3955\ CY$

Total Volume $= 79,523\ CY$

$\approx 80,000\ CY$

AR302419

LEAD QUANTITY WITHIN "BACKGROUND" CONTOUR

Average Pb conc. between 500 mg/kg and 120 mg/kg Contour

$= (500\ mg/kg + 120\ mg/kg)/2 = 310\ mg/kg$

Total subsurface soil volume within 120 mg/kg Contour

$= 79,523\ cy$ (A 20)

Total subsurface soil volume within 500 mg/kg Contour

$= 51,618\ cy - 2465\ cy$
(1.9) (1.8)

$= 49,153\ cy$

Subsurface Soil Volume Between 500 and 120 mg/kg Contour

$= (79,523\ cy - 49,153\ cy)$

$= 30370\ cy$

Amount of lead in soil volume between 500 and 120 mg/kg Contour

$= (310\ mg/kg)\left(\frac{1g}{1000mg}\right)\left(\frac{1kg}{1000g}\right)\left(104\ lb/cf\right)\left(\frac{27\ cf}{cy}\right)(30,370\ cy)\left(\frac{1\ ton}{2000\ lb}\right)$

$= 13.2\ tons$

Total lead inside 120 mg/kg Contour $= 976.5\ tons$ (A 10) $+ 13.2\ tons$

$= 989.7\ tons$

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Soil Volume and Lead Quantity Inside 100,000 mg/kg Contour

P. 3a Area = 11,084 SF
Depth = 2.5 ft

Volume = (2.5 ft)(11,084 SF)(1 CY/27 CF)

= 1026 CY

Lead Quantity = (100,000 mg/kg)(1 g/1000 mg)(1 kg/1000 g)(104 lb/CF)(1026 CY)
× (27 CF/CY)(1 ton/2000 lb)

= 144 tons

Average Lead Concentration in Surface Soils above 1000 mg/kg contour
(For Sec. 2.3.1.1 text - surface soils)

Volume = 3514 CY (P. 19)
Weight of Lead = 38.1 tons (P. 5) + [illegible] mg/kg)(1 g/1000 mg)(1 kg/1000 g)(104 lb/CF)(27 CF/CY)(3514 CY)(1 ton/2000 lb)
= 37.8 tons + 1.5 tons = 38.6 tons

38.6 tons = (Conc mg/kg)(1 g/1000 mg)(1 kg/1000 g)(104 lb/CF)(27 CF/CY)(3514 CY)(1 ton/2000 lb)

Conc = 7824 mg/kg

AR302421

Subsurface Soil Lead Distribution

Percent of Total Lead Inside 500 mg/kg Contour = 976.5 tons (p. 10) / 989.7 tons (p. 21) × 100 %

= 98.7 %

Percent of Total Lead Inside 1000 mg/kg Contour = 959.5 tons (p. 15) / 989.7 tons × 100

= 96.9 %

Percent of Total Lead Inside 10,000 mg/kg Contour = 822.8 tons (p. 15) / 989.7 tons × 100

= 83.1 %

Percent of Total Lead Inside 100,000 mg/kg Contour = 144 tons (p. 22) / 989.7 tons × 100

= 14.5 %

AR302422

Distance from James River to site = 650 ft.

Length of site = 800 ft. North to South

Elevation of James River = 0 ft.

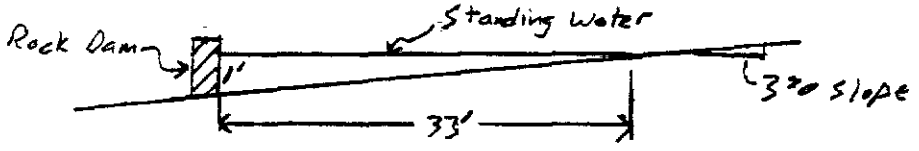
Elevation at South end of site = ~ 45 ft.

Approximate Grade = $[(45\text{ ft} - 0\text{ ft})/(650\text{ ft} + 800\text{ ft})] \times 100$

$= (45/1450)(100)$

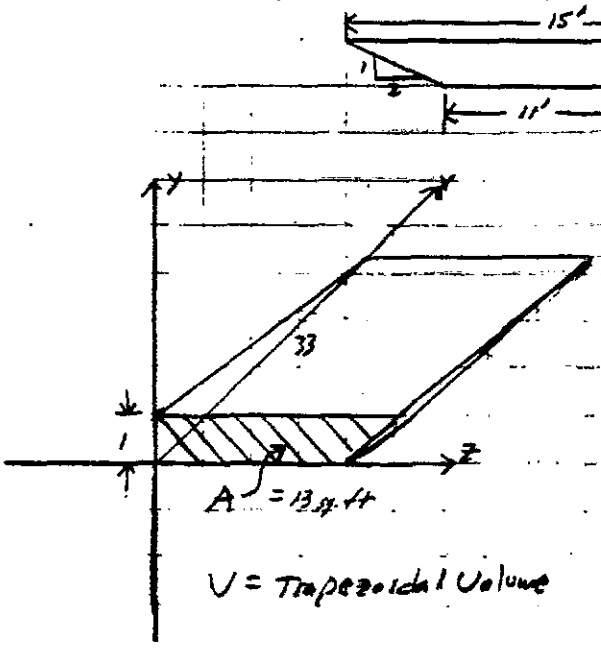
$= \sim 3\%$

Assume Maximum Depth of Standing Water = 1.0 ft



Assume Average Width (1 foot height) of Channel = 15 ft

Assume Trapezoidal Shape as shown below:



Cross-Sectional Area = 13 sq ft

$z = 11$, $x = 33$ $y = 1$

$A = 11y + 2y^2$

$y = 0.03x$

$A = .33x + .0018x^2$

$V = \int_{x=0}^{x=33} A\,dx = \int_{x=0}^{x=33} (.33x + .0018x^2)\,dx$

$V = \left[\frac{.33x^2}{2} + \frac{.0018x^3}{3}\right]_0^{33}$

$V = 179.685 + 21.56$

V = Trapezoidal Volume

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SUBJECT: C&R Battery Site - Drainage Ditch Vol		CHECKED BY: JJB	DATE: 5/9/89

Trapezoidal Volume (Con't)

$V = 201$ cu ft

$V = (201 \text{ cu ft})(7.481 \text{ gal/cu ft}) = 1504 \text{ gal}$

Drainage Ditch contains 4 rock dams

Total Volume of standing Water = $4 \times (1504 \text{ gal})$

Total Volume = 6016 gal

AR302424

TECHNOLOGY & ALTERNATIVE CALCULATIONS

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CAP AREA OF (Used For Section 2 Discussion)
INDUSTRIAL WASTE-TYPE LANDFILL

Areas

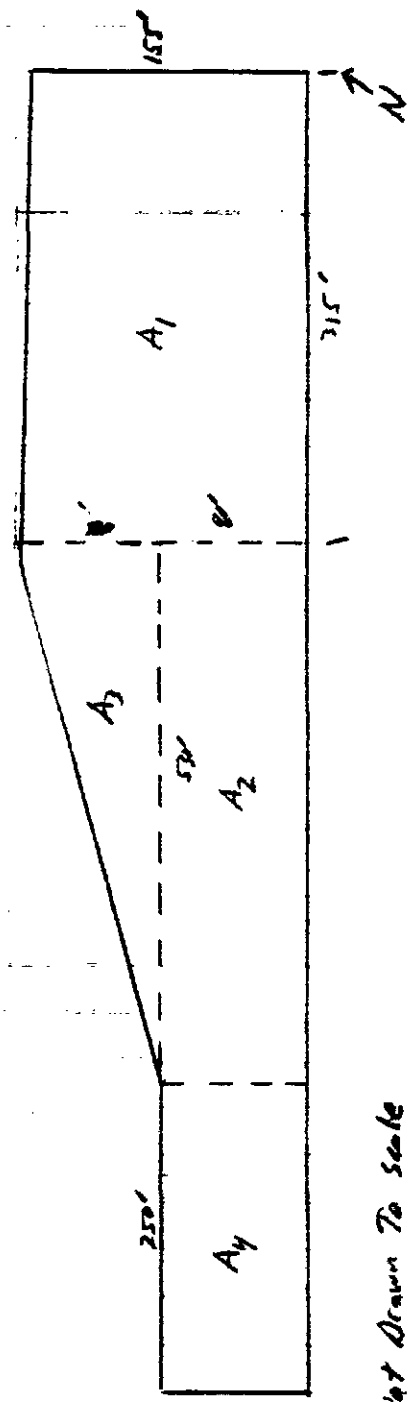
A_1 : 315' x 155' = 48825 SF

A_2 : 530' x 80' = 42,400 SF

A_3 : ½ x 530' x 80' = 21,200 SF

A_4 : 80' x 250' = 20,000 SF

Total = 132425 SF



Not Drawn To Scale

AR302426

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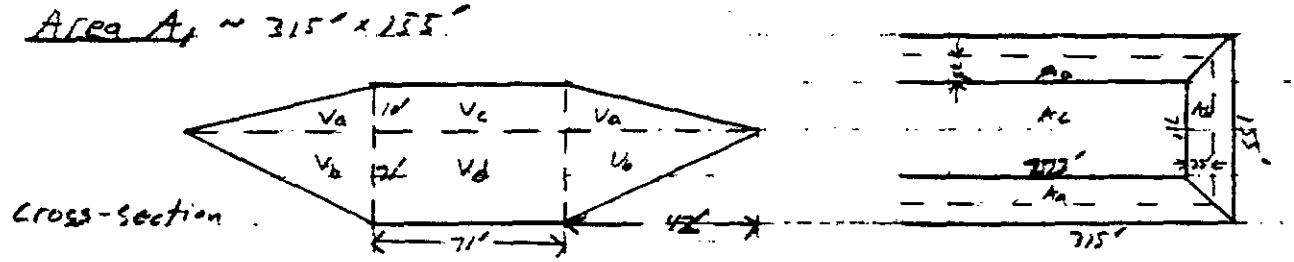
Hazardous Waste/Industrial Waste Landfill Volumes & Areas

Raw Soil Volume = 52393 CY (500 mg/kg) Solidified Soil Volume = 2(52393 CY) = 104786 CY

Top View - Bottom Liner

Area A_f ~ 315' x 155'



Above-Ground Volume = $V_c + V_a$ = (10 x 71 x 273)(1/27) + (1/2 x 10 x 42 x 729)(1/27)

= 7179 CY + 5670 CY = 12,849 CY

Subsurface Volume = $V_d + V_b$ = (21 x 71 x 273)(1/27) + (1/2 x 21 x 42 x 729)(1/27)

= 15076 CY + 11,907 CY = 26,983 CY

Total Volume, V_f = 39,832 CY

Bottom Surface Area = $2A_a + A_b + A_c$

A_c: $273 \times 71 + 2\left(\sqrt{42^2+21^2}\right)(315) + \left(\sqrt{42^2+21^2}\right)(155)$ = 19383 SF + 29610 SF + 7285 SF

Bottom Surface Area = 56,278 SF

Top Surface Area = $273 \times 71 + 2\left(\sqrt{42^2+10^2}\right)(315) + \left(\sqrt{42^2+10^2}\right)(155)$

= 19383 SF + 27090 SF + 6665 SF

Top Surface Area = 53,138 SF

AR302427

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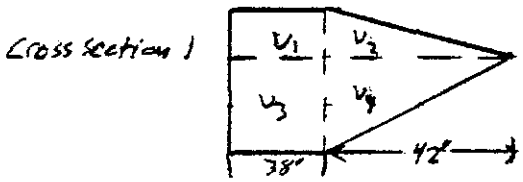
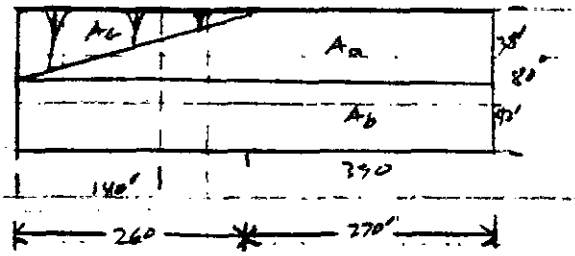
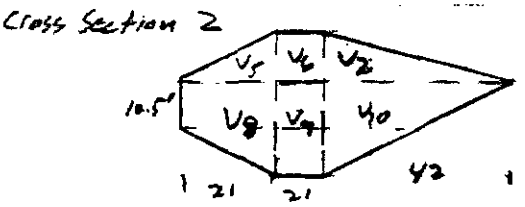
Area A_2 530' x 80'

Top View - Bottom Liner







Above-ground volume = $V_1 + V_2 + V_5 + V_6 + V_7$

$= (38 \times 10 \times 390)(1/27) + 1/2(42 \times 10 \times 390)(1/27) + 1/2(10 \times 21 \times 140)(1/27)$

$+ (21 \times 10 \times 140)(1/27) + 1/2(42 \times 10 \times 140)(1/27)$

$= 5489 cy + 3033 cy + 544 cy + 1089 cy + 1089 cy$

Above-Ground Vol. = 12244 cy.

Subsurface volume = $V_3 + V_4 + V_8 + V_9 + V_{10}$

$= (38 \times 21 \times 390)(1/27) + 1/2(42 \times 21 \times 390)(1/27) + 140\left[\frac{1}{2}(10.5)(21) + (10.5)(21)\right](1/27)$

$+ (21)(21)(140)(1/27) + 1/2(42 \times 21 \times 140)(1/27)$

$= 11,527 cy + 6370 cy + 1715 cy + 2287 cy + 2287 cy$

Subsurface Vol = 24,186 cy Total Volume = 12244 cy + 24186 cy

V_2 = 35430 cy

AR302428

Area A_2 (cont'd) Bottom Surface Area = $A_a + A_b + A_c$

$= (270 \times 38 + 260 \times 38 \times \frac{1}{2}) + 530 \times \sqrt{42^2 + 21^2}$

$+ \frac{2}{3} \times 260 \times (\sqrt{38^2 + 21^2})$

$= 15,200\ SF + 24,910\ SF + 7453\ SF$

$= \underline{47,563\ SF}$

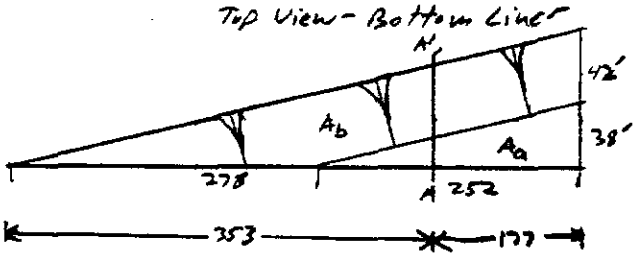
Top surface Area = $15,200\ SF + 530\sqrt{42^2 + 10^2} + \frac{2}{3} \times 260\sqrt{38^2 + 10^2}$

$= 15,200\ SF + 22790\ SF + 6760\ SF$

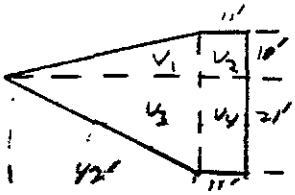
$= \underline{44750\ SF}$

Area A_3

Top View - Bottom Liner



Cross Section A-A'



Above-ground volume = $V_1 + V_2 \approx (\frac{1}{2} \times 42 \times 10 \times 353)(\frac{1}{27}) + (10 \times 11 \times 353)(\frac{1}{27})$

$\approx 2746\ CY + 1438\ CY = 4184\ C.Y$

Subsurface Volume = $(\frac{1}{2} \times 42 \times 21 \times 353)(\frac{1}{27}) + (11 \times 21 \times 353)(\frac{1}{27})$

$= 5766\ C.Y + 3020\ CY = 8786\ C.Y$

Total Volume, V_3 = $8786\ CY + 4184\ CY$

$V_3 \approx \underline{12,970\ C.Y}$

AR302429

Area A_3 (con't)

Bottom Liner Area = $A_a + A_b \approx \frac{1}{2}(38 \times 252) +$

$(\sqrt{42^2+21^2})(536)$

$\approx 4788\ SF + 25192\ SF$

$\approx \underline{29980\ SF}$

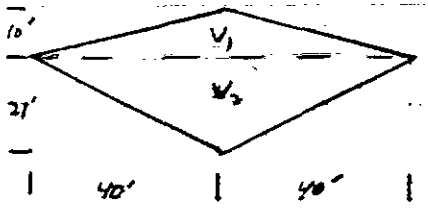
Top Liner Area $\approx 4788\ SF + (\sqrt{42^2+10^2})(536)$

$\approx 4788\ SF + 23048\ SF$

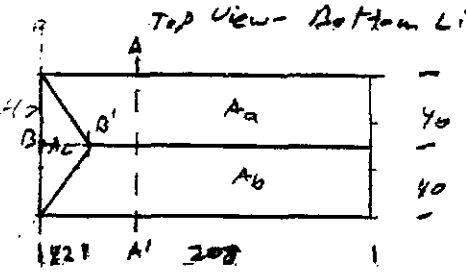
$\approx \underline{27836\ SF}$

Area A_4 80 x 250

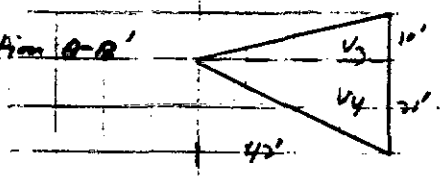
Cross-Section A-A'



Top View - Bottom Liner



Cross-Section B-B'



Aboveground Volume = $V_1 + V_3$

$\approx (10 \times 40 \times 208)(\frac{1}{27}) + \frac{2}{3}(\frac{1}{2} \times 21 \times 42 \times 40)(\frac{1}{27})$

$\approx 3081\ cy + 415\ cy = 3496\ cy$

Subsurface Volume $\approx V_2 + V_4 \approx (21 \times 40 \times 208)(\frac{1}{27}) + \frac{2}{3}(21 \times \frac{1}{2} \times 42 \times 40)(\frac{1}{27})$

$\approx 6471\ cy + 871\ cy = 7342\ cy$

Total Volume, V_4 = 3496 cy + 7342 cy

$V_4 \approx \underline{10,838\ C.Y.}$

AR302430

Area Ay (cont'd) Bottom Liner Area = $A_a + A_b + A_c$

$\approx 250 \times \left(\sqrt{21^2+40^2}\right) + 250\left(\sqrt{21^2+40^2}\right) + 80\left(\sqrt{21^2+40^2}\right)$

$\approx 11250 + 11250 + 3600$

$= 26100$ SF

Top Liner Area $= 250\left(\sqrt{10^2+40^2}\right) + 250\left(\sqrt{10^2+40^2}\right) + 80\sqrt{10^2+40^2}$

$= 10250 + 10250 + 3280$

$= 23780$ SF

Total Above-ground Volume of Landfill

$V_{T_1} = 12,849$ CY $+ 13344$ CY $+ 4184$ CY $+ 3496$ CY

$V_{T_1} = 33873$ CY

Total Subsurface Volume: $V_{T_2} = 26,983$ C.Y $+ 24,186$ CY $+ 8786$ CY $+ 7342$ CY

$V_{T_2} = 67,297$ C.Y.

Total Volume = 33873 CY + 67,297 CY = 101,170 CY

Note: This volume is slightly smaller than required 104,328 C.Y., therefore the difference of 3158 CY will be added to subsurface volume. The additional depth required $\pi(\text{illegible})(1ft)/32425$ SF ≈ 1 ft

Total Bottom Liner Area = 56,228 + 47,563 + 29980 + 23780

= 157,604 SF

Total Top Liner Area = 53,138 + 44,250 + 27836 + 23780

= 149504 SF

AR302431

Additional Subsurface Depth Required for Single Liner System

Liner Cross Section

12" sand

6" sand

~6" soil

Liner thickness = 12 in + 6 in + 6 in

= 24 in = 2 ft

Total subsurface depth = 21 ft + 1 ft + 2 ft

= 24 ft

For Double Liner System, add another 1 foot depth.

Total depth = 25 ft.

Total Aboveground Landfill Height with Cap

Height of fill material = 10 ft

Cap Cross Section

6 in Topsoil

18" soil

6" sand

6" soil

Cap Thickness = 3 ft

Total aboveground height = 10 ft + 3 ft

= 13 ft.

AR302432

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Groundwater Monitoring Requirements - Alternatives 1-6

First Year - Quarterly monitoring

1 well x 4 measurements/well For Indicator Parameters
4 wells x 1 measurement/well For Quality Parameters
4 wells x 1 measurement/well For Total Metals

Annual Cost For Year 1

Indicator Parameters: (4 samples/year x 1 well x 4 meas/well) x $107/sample (1)

= $1712/yr

Quality Parameters: (4 samples/yr x 4 wells x 1 meas/well) x $70/sample (1)

= $1120/yr

Total Metals: (4 samples/yr x 4 wells x 1 meas/well) x $630 (1)/yr = $10080

Total Annual Cost (Year 1) = $12,912

Years 2-30 - Semi Annual Monitoring

4 wells x 4 measurements/well x 2 samples/yr x $107/sample = $3424/yr
4 wells x 1 measurement/well x 1 sample/yr x $70/sample = $280/yr
4 wells x 1 measurement/well x 2 samples/yr x $630/yr = $5040/yr
1 duplicate, 1 blank/year (Total Metals) 2 x $630/yr = $1260/yr

Total Annual Cost (Years 2-30) = $10,004, use $12,000

(1) 1988 Price Book, Laboratory Services Group, NUS Corporation

AR302433

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Dismantlement / Disposal of storage shed - Alternatives 2-6

Dimensions (Approximate):
40 ft x 30 ft x 15 ft (height)

Material: Corrugated Sheet Metal, No Foundation

Dispose in local sanitary Landfill (15 mi.) $30/ton

Disposal of Tires and other Misc. Debris - Alternatives 2-6

Volume of material (estimated) 40 CY.
Solit open Tires Prior To Disposal 20 CY.
Dispose in local Sanitary Landfill (15 mi) $30/ton

Demolish Concrete Pad and Disposal Alternatives 2-6

Pad size (approximate) = 150 ft x 150 ft = 22500 SF

Average Pad Thickness = 1.0 ft

Volume of Concrete = (22500 SF)(1.0 ft)(1/27) = 833 CY

Weight of Concrete = $(22500\ CF)(150\ \#/CF)\left(\frac{1\ ton}{2000\ \#}\right)$

= 1688 tons

Dispose in local sanitary landfill (15 mi) $30/ton

AR302434

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Alternative 2
RCRA Cap - 120 mg/kg Action Level

Cap area is same as onsite landfill cap (see p. 26) = 132,450 SF

Onsite Surface Area = 4.5 acres ≈ 196,000 SF

Excavation Required

Sediments = 350 CY (p7)
Offsite Surface Soils = 3514 CY (p.19)
Offsite Subsurface Soils = 8216 CY (p.19)

Approximate avenge onsite depth of contamination not included in cap area = 4 ft.

Onsite Subsurface soils not under cap area

= [(196,000 SF - 132,450 SF)(4 ft)] / 27 CY/CF

= 9415 CY

Total excavation required = 3514 CY + 8216 CY + 9415 CY + 350 CY

= 21,495 CY does not include sediments

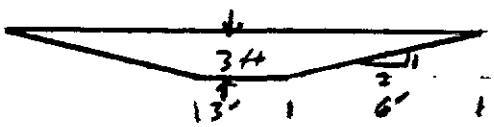
Backfill Required (assume 20% compaction) = 1.2 (21,145 CY)

= 25,374 CY

Excavate Drainage Channel → - 1300 (drainage ditch)

= 24,074 CY

V = [(2½ × 3 × 6 + 3 × 3) 1300 ft] / 27



V = 1300 CY

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Alternative 2 - Con't

Topsoil For Offsite Areas (3" layer) = (479,430 SF (p. 19) − 200,923 SF (p. 19))(3/12)(1/27)

= 2579 CY

Topsoil For Onsite Area (Excluding Cap Area) (3" layer)

= (196,000 SF − 132,450 SF)(1/27)(3/12)

= 588 CY

Revegetate Offsite Areas = (479,430 SF − 200,923 SF)

= 278,507 SF

Revegetate Onsite Area = (196,000 SF − 132,450 SF)

= 63,550 SF

Cap Materials

Soil	(2.0)(132,450 SF)(1/27)	= 9811 CY
Sand	(1.0)(132,450 SF)(1/27)	= 4906 CY
Topsoil	(0.5)(132,450 SF)(1/27)	= 2453 CY
60 mil PVC		= 132,450 SF
Filter Fabric	132,450 SF / 90%	= 14,717 SY
Vegetation		= 132,450 SF

AR302436

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Alternative 3A - Stabilization (Low Action Level/Offsite Disposal)

Excavation Required

Sediments	350 cy
dike	184 cy
debris piles	233 cy
soil	79,523 cy

Excavate Drainage channel = 1300 cy

Total = 80,290 cy

× 1.2 swell = 96,348 cy

Volume Increase = 20% (swell factor) + 80% (stabilization) = 100%

Volume of stabilized soil = 2 × 80,290 cy = 160,580 cy

Approximate Bulk Density of Stabilized soil = 1.6 ton/cy*

* Hazcon, Inc, Stabilization/Solidification Treatability Study Final Report.

Weight of Stabilized Soil = 1.6 ton/cy × 160,580 cy

= 256,928 tons

Number of Truck loads = 256,928 ton / 20 ton/load

= 12847 loads

Backfill Required = (1.2)(79,523 cy) = 95428 cy

20% Compaction

- 1300 (drainage channel)

= 94128 cy

Topsoil Required = 2579 cy (offsite p. 36)

+ (196,000 SF)(1/12)(1/27)

= 1815 cy + 2579 cy = 4394 cy

Revegetation = 278,502 sq ft + 196,000 SF = 474,502 SF

AR302437

NUS CORPORATION AND SUBSIDIARIES			STANDARD CALCULATION SHEET
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revised 10/31/89
MPJ 11/6/89

Stabilization Costs

Solidification Blend with lowest volume increase will be most cost-effective, From treatability study results[1]:

Blend No.	Soil	Weight Ratios Type II Portland Cement	Lime	Sodium Silicate
C-3	1	0.6	—	0.03

Material Costs: Type II Portland Cement = $52/ton
Sodium Silicate (3.22-3.25 ratio) = $350/ton

Total unit cost = (0.6)($52/ton) + (0.03)($350/ton)

= $42/ton × 1.4 ton/cy = $59/cy

Assume 10% additional for material preparation & proprietary ingredients charges
Total cost = $65/cy
Assume mob/setup/demob = $200,000

Total Costs

120 mg/kg Action Level: Volume of material = 80,300 cy

Total Cost = $65/cy + $200,000/80,300 cy = $67.49/cy, use $67/cy

1000 mg/kg Action Level: Volume = 36,900 cy

Total Cost = $65/cy + $200,000/36,900 cy = 70.4/cy, use $70/cy

10,000 mg/kg Action Level: Volume = 14,700 cy, Cost = $65/cy + 200,000/cy
= $78.6/cy, use $80/cy

(1) Hazen, Inc, C&R Battery Site, Chesterfield County, VA, Stabilization/Solidification Treatability Study Final Report. May 1989.

AR302438

120 mg/kg Action Level

Alternative 3B - Soil Washing/Onsite Disposal

Soil = 79,523 cy

Total Excavation = 80,290 cy (0.37)

Volume Increase = (1.2)(80,290 cy) = 96,348 cy
20% Swell

Place, Spread, & Compact 1.2 x 79,523 cy = 95,428 cy

Topsoil Required = 43,941 cy (0.37)

Revegetation = 474,507 sf (0.37)

Disposal of battery casings = 3380 tons (0.12)

Treatment Cost: Assume capital cost to build soil washing plant is similar to USE soil washing plant*

From Table 4. Plant Cost ≈ $10,000,000

From Table 8 Operating Cost = 168.77 + 10.93 + 2.05 + 2.05** ≈ $185/cy

Total Cost Per Cubic Yard = $10,000,000 / 96,348 cy + $85/cy

= $104/cy + 185/cy

= $289/cy

** Assume reclamation profit of PbO_4 sludge balances transportation cost of sludge

* U.S. Bureau of Mines, Process Evaluation of the USE Superfund Site May, 1988

AR302439

Alternative 3C - In Situ Vitrification

Excavation Required

Offsite Soils: surface 3514 cy + subsurface 8216 cy = 11,730 cy (p. 19)

Place, Spread & Compact: 1.2 x 11,730 cy = 14,076 cy (20% swell)

Vitrification: Area = 200,923 sf (p 19), Volume = 80,290 cy; 80290 cy x 1.4 ton/cy = 112,406 tons

Processing Depth = (11,730 cy)(27 cf/cy)/(200,923) + 15 ft (below grade) (above grade)

= 1.6 ft + 15 ft

= 16.6 ft

Assume 20% shrinkage after vitrification

Depth below grade = -(.2)(16.6 ft) + 1.6 ft

= -1.7 ft

Backfill required (20% compaction) = (1.2)(1.7 ft)(200,923 sf)(1/27) onsite + (1.2)(11,730 cy) offsite

= 15,181 cy + 14,076 cy = 29257 cy

- 1300 (from drainage channel) p.35

= 27,957 cy

Topsoil Required = 4394 cy p.32

Revegetation Required = 424,507 sf p.32

AR302440

NUS CORPORATION AND SUBSIDIARIES			STANDARD CALCULATION SHEET
CLIENT: EPA	FILE NO.: 9851	BY: Gordon Ruggaber	PAGE 4 OF 6
SUBJECT: C&R Battery Site		CHECKED BY: MPD	DATE: 10/31/89

Alternatives 3G-6G, Vitrification Costs

From: Geosafe Corporation, July 10 1989. Cost Estimate From Dale M. Timmons

Unit cost of vitrification operation (excluding mob/demob, to and from site)

Case 1: 52,393 C.Y. of material (500 mg/kg action level)

$255/ton

Case 2: 14,300 C.Y. of material (10,000 mg/kg action level)

$275/ton

For 1000 mg/kg mg/kg action level (36,412 cy of material) use linear interpolation to determine operating cost.

slope = (255 − 275) / (52,393 − 14,300)

$= -5.25 \times 10^{-4}$

intercept = $225 + (5.25 \times 10^{-4})(14,300) = 282.5$

cost = $(-5.25 \times 10^{-4})(36,412) + 282.5$

cost = $263.4/ton

For 50 mg/kg action level (80,290 cy)

Treatment cost = $(-5.25 \times 10^{-4})(80,290\ cy) + 282.5$

= $240.3/ton

NUS CORPORATION AND SUBSIDIARIES			STANDARD CALCULATION SHEET
CLIENT: EPA	FILE NO.: 9851	BY: Gordon Ruggaber	PAGE 41 OF 61
SUBJECT: C & R Battery Site		CHECKED BY: MPS	DATE: 11/6/89

Alternative 4A - Stabilization 1000 mg/kg Action Level/onsite ARCSDM

Excavation Required -

		offsite	onsite
Sediments	350 c.y.		
dike	184 cy		
debris piles	233 cy	5898 cy	+ 29096 cy
soil	35,994 cy	p. 12	

Total = 36,761 cy

Volume of stabilized material = 2 × 36,761 cy = 73,522 cy (see p.37)

Weight of stabilized material = (1.6 ton/cy) (73,522 cy) (see p.37)

= 117635 tons

Number of truck loads = 117635 tons / 20 tons/truck

= 5882 loads

Backfill Required (20% Compaction) = (1.2)(35,994 cy) = 43193 cy

Consolidation and Capping of Residual Contamination (>1000 mg/kg)

Assume cap Area = 132,450 sf (p.35)

Excavation Required: offsite Excavation = (3514 cy (p.19) + 2216 cy (p.19)) = 5882 cy (p.17)

= 4832 cy

Assume approximate average onsite depth of contamination not included in cap area and not stabilized = 2 ft (above 1000 mg/kg)

Onsite Excavation = [(196000 sf - 132,450 sf)(2 ft)] / 27

= 4707 cy

AR302442

Alternative 4A - Con't Capping of Residual Contamination - Con't

Total Soil to move, place, spread, & compact = 1.2 (4832cy + 4707cy) = 11,447 cy

Excavate Drainage Channel: V = 1300 cy D.35

Backfill Required = (1.2)(4832 + 4707 cy - 1300 cy)

= 9,887 cy

Total Backfill = 9,887 cy + 43,193 cy

= 53,080 cy

Topsoil, Revegetation, and Cap Materials - Same as Alt 2 (p. 36)

AR302443

Alternative 4B Soil Washing 1000 mg/kg Action Level / Onsite Disposal

Excavation Required = 36,761 CY p. 41

Volume to be treated = (1.2)(36,761 CY)
20% Swell
= 44113 CY

Consolidation and Capping of Residual Contamination

Same as Alt. 4A, except backfill = 9,882 CY

Topsoil, Revegetation and cap material - same as Alt 2

Treatment Costs - See Alt. 3B p. 38

Plant Cost = 10,000,000
Operating Cost = $185/CY

Total Cost/C.Y = $10,000,000/44,113 CY + $185/CY
= $227/CY + $185/CY
= $412/CY

Disposal of Battery Casings

Assume most of casings are in soil with [Pb] > 1000 mg/kg,
therefore, weight of casings = 3380 tons (4.1.3)

AR302444

Alternative 4C Vitrification 1000 mg/kg Action Level / Onsite Disposal

Vitrification Area = 175638 SF − 32,893 SF = 142,745 SF

Volume = 36,761 (1.4) Weight = 36,761 CY × 1.4 Ton/CY = 51,465 Tons

Excavation Required (for Vitrification)

Offsite Soils = 6898 CY

(20% Swell) × 1.2 = 8278 CY

Place, Spread, & Compact 8278 CY (= backfill required)

Depth = (6898 CY)(27 CF/CY) / (142,745 SF) + 9 ft (below grade)

(Processing) (above ground)

= 1.3 ft + 9 ft = 10.3 ft

Assume 20% shrinkage upon vitrification

Depth Below Grade = −(.2)(10.3 ft) + 2.1 ft

= 0.04 ft (No Backfill required on top of vitrified area)

Consolidation & Capping of Residual Contamination (>120 mg/kg)

Everything is same as Alt. 4A (A-41-42), except total backfill = 19,882 CY

A-42

AR302445

NUS CORPORATION AND SUBSIDIARIES			STANDARD CALCULATION SHEET
CLIENT: EPA	FILE NO.: 9851	BY: Gordon Ruggaber	PAGE 45 OF 61
SUBJECT: C&R Battery Site		CHECKED BY: MPR	DATE: 11/6/89

Alternatives 5A-5C - Onsite Treatment (1000 mg/kg Action Level) / offsite Disposal

Excavation ..... Required For Treated Soil Volume are same as Alts 4A-4C p 41-44

Additional Excavation of Residual Contamination

= 80,290 cy (nonsilty vol.) p. 37 − 36,761 cy p 41

= 43,529 cy

× 1.2 (20% swell) = 52235 cy to be disposed ← Also backfill required

weight of excavated soil = (52,235 cy)(1.4 Ton/cy)

= 73,129 tons

number of truck loads = 73,129 tons / 20 ton/truck

= 3657 loads

Topsoil & Revegetation Required = Same as Alt 3A (p. 32)

Total Backfill Required = 94128 cy same as Alt 3A (p. 32)

AR302446

NUS CORPORATION AND SUBSIDIARIES			STANDARD CALCULATION SHEET
CLIENT: EAA	FILE NO.: 9851	BY: Gordon Ruggaber	PAGE 46 OF 61
SUBJECT: C&R Battery Site		CHECKED BY: MPL	DATE: 11/6/89

Alternative 6A - Stabilization (10,000 mg/kg Action Level/offsite disposal)

Excavation Required

Sediments	350 cy
dike	184 cy
debris piles	233 cy
soil	13907 cy p.18

Total = 14674 cy x 1.2 swell = 17,609 cy

Volume of stabilized material = 2 x 14674 cy = 29,348 cy
see p.37

Weight of stabilized material = (1.6 ton/cy)(29,348 cy)
see p.37
= 46957 tons

Number of Truckloads = 46957 tons / 20 ton/truck
= 2348 trucks

Back Fill required = (1.2)(13,907 cy) = 16,688 cy
20% swell

Consolidation and Capping of Residual Contamination (7120 mg/kg)
Cap Area = 132,450 sf (p.35)

Excavation Required: offsite Excavation = (351 cy p.19 + 8216 cy p.19 - 323 cy p.19)
= 11,407 cy

Assume approximate average depth of contamination not included in cap area = 3.5 ft (above 10 mg/kg) and not stabilized

Onsite Excavation = [(196,000 sf - 132,450 sf)(3.5 ft)]/27 = 8238 cy

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AR302447

Alt. 6A:

Capping of Residual Contamination - Cont'd

Total soil to move, place, spread & compact over area to be capped

$= (1.2)(11{,}407\ cy + 8238\ cy) = 23570\ cy$ (1.2 ← swell factor)

Excavate drainage channel: $V = 300\ cy$ p.35

Backfill Required $= (1.2)(23570_{cy} - 300\ cy)$

$= 26724\ cy$

Total Backfill needed $= 26724\ cy + 16{,}688\ cy$ p.46

$= 43{,}412\ cy$

Topsoil, Revegetation, and Cap Materials — Same as Alt 2 (p.36)

AR302448

Alternative 6B - Soil Washing - 10,000 mg/kg Action Level / Onsite Disposal

Excavation Required = 14,674 cy p. 46
Volume to be treated = (1.2)(14,674 cy)
(20% swell)
= 17609 cy

Consolidation and Capping of Residual Contamination

Total backfill = 26,724 cy p. 47

Topsoil, Revegetation, & Cap Materials same as Alt 2

Disposal of Battery Casings

Bulk Density of casings = 3380 tons / 2443 cy = 1.4 tons/cy
p. 12

Volume of Casings = (.1)(2.8 ft)(2a96 sqft offsite + 11084 sqft onsite + 76,099 sqft) (1/27)
p. 12 p. 17 p. 17

= 726 cy
@ 1.4 tons/cy = 1296 tons

Treatment Costs see p. 38

Total Cost / cy = $10,000,000 / 17609 cy + $185/cy
= $568/cy + $185/cy
= $753/cy

AR302449

Alternative 6C - In situ Vitrification - 10,000 mg/kg Action Level

Vitrification Area = (11,084 SF + 76,099 SF)

= 87,183 SF

Weight of Soil to Vitrify = (1.4 tons/cy)(14674 cy) = 20,544 tons

Excavation Required (For Vitrification)

offsite Soils = 323 cy
× 1.2 swell
= 388 cy = backfill required
= place, spread & compact over area to be vitrified

Processing depth = (323 cy)(27 cf/cy)/87,183 SF ± 8 ft

= 8.1 ft

With 20% shrinkage upon vitrification.

Depth below grade = (-.2)(8.1 ft) + 0.1 ft = 1.5 ft

(Soil from residual contamination areas will be placed over vitrified area for backfill prior to capping)

Backfill Required = 26,724 p.47 Alt 6A

Capping, Topsoil, & Revegetation - Same as Alt 6A p.47

AR302450

NUS CORPORATION AND SUBSIDIARIES			STANDARD CALCULATION SHEET
CLIENT: EPA	FILE NO.: 9851	BY: Gordon Ruggaber	PAGE 50 OF 61
SUBJECT: C&R Battery Site		CHECKED BY: MPd	DATE: 11/6/89

Decontamination Fluid Quantities

Assumptions: 20 person crew (includes contractor, subcontractor & health & safety personnel)
1 gal/person/day decon
5 gal/truck decon
4000 - 5000 tanker trucks for decon transport

Alternative 1 - No Action; No Decon Fluids Generated

Alternative 2 Capping

From p. 36

Total Quantity of Imported Cap Materials: 9811 cy
4906 cy
2453 cy
+ Backfill 24,074
+ Topsoil 582
~~2577~~

Total Volume = ~~44,077~~ cy.
~ 45,000 cy.

Number of Trucks = 45,000 cy / 20 cy/truck = 2250 Trucks

p 53 Remediation Time = 3 mo. * 25 days/mo. = 75 days

Decon Fluid = (20 people)(1 gal/person/day)(75 days) + (5 gal/truck)(2250 tr.)

= 1500 gal + 11250 gal = ~~12750~~ gal
≈ 3 tanker trucks

Assume 3 tanker trucks, 15,000 gallons for all remaining alternatives (125,100 lbs) ← Density = 8.34 lb/gal

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AR302451

Remediation Times

Alternative 1 – No Action – not Applicable

Alternative 2 – RCRA Cap – 3acres

Total material (Cap) = 9811cy + 4906 cy + 2453 cy p36
= 17170 cy

Number of trucks = 17170 cy/20cy/truck
= 859 trucks

Assume 16 trucks/day : Number of days = 859/16 trk/day
= 54 days

Assume 6 days/week No. of weeks = 9 weeks

Total time to build cap ≈ 3 months

Alternative 3A – Onsite Stabilization – 120 mg/kg action level

Volume of material = 80,290 cy p37a

Time to excavate = 80,290cy / 820 cy/day
= 100 days

Treatment Time = 80,290 cy / 610 cy/day
= 134 days

Time to transport stabilized soil : assume 30 trucks/day (local landfill)
= 12847 loads / 30 loads/day
limiting factor = 428 days
= 428 days / 300 d/yr ≈ 1.4 yr

+ .1 year for reclamation = 1.5 yrs (18 mo)
mob + demob

AR302452

CLIENT: EPA	FILE NO.: 9851	BY: Gordon Ruggaber	PAGE 52 OF 61
SUBJECT: C & R Battery Site		CHECKED BY: MPL	DATE: 11/6/89

Remediation Times (Con't)

Alternative 3B - Soil Washing - 120 mg/kg action level

Volume = 80,290 cy

Assume Processing Rate of 10 cy/hr
Continuous operation : Rate = 240 cy/day

Treatment time = 80,290 cy / 240 cy/day

= 335 days

+ 60 days set-up
+ 30 days demob & reclamation

* Includes downtime = 425 days / 300 day/yr*

≈ 1.5 yrs

Alternative 3C - Vitrification - 120 mg/kg action level

*Volume treated per setting = (3 ft x 3 ft x 15 ft) / 27 cf/cy = 55.4 cy

Number of settings = 80,290 cy / 55.4 cy = 1450 settings

Treatment time = 5 days/setting x 1450 settings

** Includes downtime = 7250 days / 300 days/yr

≈ 24.5 yrs (Assume reclamation occurs concurrently with treatment)

* Based on cost estimate from Geraghty & Miller, July 10, 1989

AR302453

Remediation Times (Con't)

Alternative 4A - stabilization - 1000 mg/kg action level

Volume of material = 36,761 cy x 1.2 = 44,113 cy p.41

Treatment Time = 44,113 cy / 600 cy/day

= 74 days

Transportation Time = 5882 loads / 30 load/day *

* Assuming local landfill = 196 days

+ 60 days for mob & setup

+ 30 days cap installation & demob

= 288 days

~ 1yr total

Alternative 4B - Soil washing - 1000 mg/kg action level

volume of material = 44,113 cy

Treatment Time = 44,113 cy / 240 cy/day

= 184 days

+ 90 days (mob/demob & cap installation)

= 274 days

= 274 days / 300 days/yr

= .91 yr ~ 1yr

+ .1 yr cap

AR302454

Remediation Times con't

Alternative 4C - In Situ Vitrification - 1000 mg/kg Action Level

Volume treated per setting = 534 cy (A.52)

Number of settings = 36,800 CY / 534 cy/setting = 69 settings

Treatment Time = 5 days/setting x 69 settings

* includes downtime = 345 days / *300 days/yr

= 1.15 yrs

+ 60 days for setup, cap & demob ~ 1.5 yr

Alternatives 5A - 5C - Approximately same times as Alt's 4A - 4C

Alternative 6A - Stabilization - 10,000 mg/kg

Volume of material = 14674 cy x 1.2 = 17609 cy

Treatment Time = 17609 cy / 600 cy/day

= 29 days

Transportation Time = 2348 loads / 30 load/day (assuming local landfill)

= 78 days

+ 30 days mob & setup
+ 45 days cap
= 153 days

~ 6 months

AR302455

Remediation Times Cont

Alternative 6B - Soil Washing - 10,000 mg/kg Action Level

Volume of material = 17609 cy

Treatment Time = 17,609 cy / 240 cy/day

= 73 days

+ 90 days (mob/demob & Cap installation)

= 163 days

~ 6 months

Alternative 6C - Vitrification - 10,000 mg/kg Action Level

Number of settings = 14,700 cy / 534 cy/setting

= 28 settings

× 5 days/setting = 140 days

+ 60 days for setup, cap installation, & demob

= 200 days

* includes downtime = 200 days / 25 d/month*

= 8 months

AR302456

CLIENT: EPA	FILE NO.: 9851	BY: Gordon Ruggaber	PAGE: 56 OF 61
SUBJECT: CAR Battery Site — Soil Wash Study PEI Associates		CHECKED BY: JLE	DATE: 6-22-89

Water Wash	approximate orginal wt	#10 sieve	#60 sieve	Au + Filter
IIIs - B1	528.1	163.5	140.4	224.2
IIIs - B2	527.9	176.5	154.2	197.2
IIIs - A1	529	178.9	128.4	221.7
IIIs - A2	540.5	184.2	147.9	208.4

Surfactant wash				
IIIs-A1	532.7	188.9	152.5	191.4
IIIs-A2	497.6	172.5	164.9	160.2
IIIs-B1	528	119.3	181.3	227.4
IIIs-B2	516.2	158.1	146.4	211.7

EDTA Wash				
IIIs-A1	486.7	131.6	126.3	228.8
IIIs-A2	489.4	101.8	161.4	226.2
IIIs-B1	492.8	72.6	173.4	246.8
IIIs-B2	503.9	72.9	181.5	244.5

AR302457

Water Wash - From P. 49 (PE) soil washing study)

Sample sizes = 500g for

III S-B. Total lead = (70,100 mg/g)(63.5+126.5g) + (66,400)(B1+B2)

(140.4g + 154.2g) + (45,600)(224.2 + 197.2)

= 23834 mg + 19561.4 + 19215.8

= 62611 mg / per 1000 g of soil (2 500 g samples)

= 62611 mg / kg.

III S-A Total lead = (30,200 mg/g)(128.4+184.2) + (38,000)(A1+A2)

(128.4 + 142.9) + (53,400)(221.7 + 208.4)

= 10965.6 mg + 10499.4 mg + 22967.3 mg

= 44432.3 mg

Average Concentration of Lead - Samples III S-A and III S-B

= (62611 + 444323)/2

= 53,522 mg/kg

AR302458

Surfactant + Wash

III 5-A (A1+A2) Total Lead = (52,200)(188.8+172.5)
+ (50,040)(152.5+164.9)
+ (54,700)(224.2+197.2)
= 18959.9 mg + 15882.7 mg
+ 23050.6 mg = 57,793.2 mg
= 57,793.2 mg/kg of sample

III 5-B (B1+B2) Total Lead = (80,800)(119.3+158.1)
+ (49,300)(181.3+146.4)
+ (49,500)(227.4+211.7)
= 22413.9 + 16155.6 + 21735.5
= 60305 mg
= 60305 mg/kg of sample

Average = (57,793.2+60305)/2
= 59,049 mg/kg of sample

AR302459

EDTA Wash

III S-A Total lead = (31,300 mg/kg)(228.8g + 226.3g)

+ (52,900)(126.3g + 161.4g)

+ (160,400 mg/kg)(131.6g + 101.8g)

= 14,241.5 + 15219.3 + 37,437.4

= 66898 mg

= 66898 mg/kg of sample

III-S-B Total lead = (168,000)(150.5) + (61,800)(354.9)

+ (17040)(491.3)

= 25284000 +
21932820 +
8371752

55,589 mg

= 55,589 mg/kg of sample

Average = (66899 + 55,589)/2

= 61244 mg/kg

AR302460

NUS CORPORATION AND SUBSIDIARIES			STANDARD CALCULATION SHEET
CLIENT: EPA	FILE NO.: 9851	BY: Gordon Ruggaber	PAGE 60 OF 61
SUBJECT: C & R Battery Site		CHECKED BY: JLE	DATE: 6-22-89

Percent Removals - Soil Washing Treatability Study - USBM

Total lead in raw soil (pH 7) 15800 mg/kg

(pH 9) 17,100 mg/kg

Total lead in battery casing fragments (hard rubber) 966 mg/kg

(plastic) 2,806 mg/kg

Casing Wash Results - 1pct nitric solution
4 h wash 3/8 in material

	EP Tox. (mg/l)	Treated casings (mg/kg)
hard rubber	0.15	277
plastic	2.63	157

% Removals: hard rubber: $[(966 - 277)/966] \times 100$

$= 71.3\%$

plastic: $[(2806 - 157)/2806] \times 100$

$= 94.4\%$

Soil Wash Results	EP Tox (mg/l)	Treated soil (mg/kg)
[1] pH 7 soil 5pct HNO_3	0.33	141
[2] pH 9 soil 15pct HNO_3	0.46	127

% Removals: pH 7 soil: $[(15800 - 141)/15800] \times 100 = 99.1\%$

pH 9 soil: $[(17,100 - 127)/17,100] \times 100 = 99.3\%$

[1] Average of two samples, [2] Average of three samples

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NUS CORPORATION AND SUBSIDIARIES			STANDARD CALCULATION SHEET
CLIENT: EPA	FILE NO.: 9851	BY: Gordon Ruggaber	PAGE 61 OF 61
SUBJECT: C & R Battery site		CHECKED BY: JRE	DATE: 6-22-89

Percent Removals - Soil Washing Treatability study - PEI

Lead Concentrations in wash fluid following extraction:

Water Wash	Surfactant Wash	Chelate wash
0.24 mg/l [1]	16.5 mg/l [1]	942 mg/l [1]
1.2 mg [2]	82.5 mg [2]	4710 mg [2]

[1] Average of two samples

[2] Total lead in 5 l of wash solution

Lead concentration in raw soil = 53,400 ug/g

Sample size = 500g

Total lead in sample = (53,400 ug/g)(500g)

= 26,700,000 ug = 26,700 mg

Percent Removals

Water Wash: % Removal = (1.2 mg/26,700 mg) x 100

= 4.5×10^{-3} % ≈ 0

Surfactant Wash: % Removal = (82.5 mg/26,700 mg) x 100

= 0.3 %

Chelate Wash: % Removal = [(4710 mg)/(26,700 mg)] x 100

= 17.6 %

AR302462

APPENDIX B

COST ESTIMATES
CAPITAL, O&M, AND PRESENT-WORTH COSTS

AR302462a

ALTERNATIVE 1

NO ACTION

C & R BATTERY SITE
Chesterfield Co., Virginia
No Action
Alternative No. 1
Post Remedial Monitoring
(O&MCR1)

Annual Costs

ITEM	ITEM $ ANNUAL SAMPLING	ITEM $ COST FOR 5 YEARS	NOTES
1. Sampling	1600.00		4 groundwater, 3 sediment and 1 surface water sample 24 manhours per sampling period plus travel, living sample shipping costs.
2. Analysis	10000.00		40 samples per year (inc. blank & duplicate), Inorganics, Water Quality & Indicator Parameters
3. Reporting	950.00		20 manhours per report plus other direct costs.
4. Fence Maintenance	1000.00		Fence Maintenance
5. Analysis Review		20000.00	Analysis Review performed for years 5,10,15,20,25,30
TOTAL ANNUAL COST	13550.00	20000.00	Post Remedial monitoring will be performed annually for years 1 thru 30

C & R BATTERY SITE
Chesterfield co., Virginia
No Action
Alternative No. 1
(PWACR1)
265

PRESENT WORTH ANALYSIS

COST/YEAR COST OCCURS ($000'S)

COST COMPONENT	0	1	2	3	4	5	6	7	8	9	10	11
1. CAPITAL COST	0											
2. O & M COSTS	---	13.6										
3. ANNUAL COSTS	0	13.6	13.6	13.6	13.6	33.6	13.6	13.6	13.6	13.6	33.6	13.6
4. ANNUAL DISCOUNT RATE=5%	1	.952	.907	.864	.823	.784	.746	.711	.677	.645	.614	.585
PRESENT WORTH =	0	13	12	12	11	26	10	10	9	9	21	8

	12	13	14	15	16	17	18	19	20	21	22	23
O & M COSTS	13.6	13.6	13.6	33.6	13.6	13.6	13.6	13.6	33.6	13.6	13.6	13.6
ANNUAL DISCOUNT RATE=5%	.557	.53	.505	.481	.458	.436	.416	.396	.377	.359	.342	.326
PRESENT WORTH =	8	7	7	16	6	6	6	5	13	5	5	4

	24	25	26	27	28	29	30	TOTAL PRESENT WORTH (000'S)
O & M COSTS	13.6	33.6	13.6	13.6	13.6	13.6	33.6	
ANNUAL DISCOUNT RATE=5%	.31	.295	.281	.268	.255	.243	.231	
PRESENT WORTH =	4	10	4	4	3	3	8	265

AR302465

ALTERNATIVE 2

RCRA CAP - 120 mg/kg ACTION LEVEL

C & h [illegible]TERY SITE
Chesterfield Co., Virginia
RCRA Cap
120 mg/kg Action Level
Alternative No. 2
(CRS2)
Page 1 Of 2

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
EXCAVATION												
1) Excavate Soil	21145	CY			.80	1.50			16916	31718	48634	
a) Place, Spread & Compact	21145	CY			.84	2.67			17762	56457	74219	Sheepsfoot Roller
2) Regrade Debris Pile	350	CY			.80	1.50			280	525	805	
3) Excavate Sediments	233	CY			.80	1.50			186	350	536	
4) Excavate Drainage Channel	1300	CY			.80	1.50			1040	1950	2990	
5) Monitoring Wells	280	LF	100.00				28000				28000	4 @ 70'
DISMANTLEMENT/DISPOSAL												
6) Dismantle Storage Shed												
a) Dismantle Shed	60	MH			20.00	20.00			1200	1200	2400	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	2	TON	30.00				60				60	Local Landfill
7) Dispose Tires & Misc. Debris												
a) Split Open Tires	80	MH			20.00	20.00			1600	1600	3200	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	10	TON	30.00				300				300	Local Landfill
8) Treat Drainage Ditch Water												
a) Hauling (2 Trucks @ 500 Mi.)	1000	MI	4.00				4000				4000	RCRA
b) Treatment	50070	LB	.08				4006				4006	Treatment Facility
9) Treat Decon Fluids												
a) Hauling (3 Trucks @ 500 Mi.)	1500	MI	4.00				6000				6000	RCRA
b) Treatment	100080	LB	.08				8006				8006	Treatment Facility
RECLAMATION												
10) Backfill Excavated Areas	24074	CY		3.50	2.70	7.43		84259	65000	178870	328129	20 mi. R.T.
a) Place, Spread & Compact	24074	CY			.84	2.67			20222	64278	84500	Sheepsfoot Roller
11) Topsoil - 3"(Offsite)	2579	CY		6.00	2.70	7.43		15474	6963	19162	41599	20 mi. R.T.
a) Place & Spread	2579	CY			.63	.57			1625	1470	3095	
12) Topsoil - 3"(Onsite)	588	CY		6.00	2.70	7.43		3528	1588	4369	9484	20 mi. R.T.
a) Place & Spread	588	CY			.63	.57			370	335	706	
13) Revegetation												
a) Offsite Area	279	MSF		24.60	5.60	4.45		6863	1562	1242	9667	
b) Onsite Area (Excluding Cap)	63.6	MSF		24.60	5.60	4.45		1565	356	283	2204	
CAPPING												
14) Soil - 6"	2453	CY		3.50	2.70	7.43		8586	6623	18226	33434	20 mi. R.T.
a) Place, Spread & Compact	2453	CY			.84	2.67			2061	6550	8610	Sheepsfoot Roller
15) Synthetic Liner	132450	SF	1.00				132450				132450	60 mil
16) Sand - 6"	2453	CY		7.50	2.70	7.43		18398	6623	18226	43246	20 mi. R.T.
a) Place & Spread	2453	CY			.63	.57			1545	1398	2944	
17) Filter Fabric	14717	SY		1.20	.30			17660	4415		22076	
18) Soil - 18"	9811	CY		3.50	2.70	7.43		34339	26490	72896	133724	20 mi. R.T.
a) Place, Spread & Compact	9811	CY			.84	2.67			8241	26195	34437	Sheepsfoot Roller
19) Topsoil - 6"	2453	CY		6.00	2.70	7.43		14718	6623	18226	39567	20 mi. R.T.
a) Place & Spread	2453	CY			.63	.57			1545	1398	2944	
20) Revegetation	132	MSF		24.60	5.60	4.45		3247	739	587	4574	
BATTERY DISPOSAL												
21) Drain Ni/Cd Batteries		LS			320.00				320		320	350 Batteries
22) Package Batteries In Drum	8	DR		100.00	80.00	40.00		800	640	320	1760	
23) Vermiculite Packing	10	BAGS		15.00	10.00			150	100		250	
24) Laboratory Analysis		LS	650.00				650				650	TAL Metals
25) Hauling	480	MI	4.00				1920				1920	480 Mi.
26) Treatment/Disposal Landfill	7000	LB	4.60				32200				32200	Buffalo, N.Y.
							217892	209586	202637	527829	1157944	

AR302467

C & R BATTERY SITE
Chesterfield Co., Virginia
RCRA Cap
120 mg/kg Action Level
Alternative No. 2
(CRS2)
Page 2 Of 2

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
Page 1 Total							217892	209586	202637	527829	1157944	
Burden @ 13% of Labor Cost									26343		26343	
Labor @ 15% of Labor Cost									30396		30396	
Material @ 5% of Material Cost								10479			10479	
Subcontract @ 10% of Sub. Cost							21789				21789	
Total Direct Cost							239681	220065	259375	527829	1246950	
Indirects @ 75% of Total Direct Labor Cost									194531		194531	
Profit @ 10% Total Direct Cost											124695	
											1566177	
Health & Safety Monitoring @ .14											219265	
Total Field Cost											1785441	
Contingency @ 20% of Total Field Cost											357088	
Engineering @ 12% of Total Field Cost											214253	
TOTAL COST THIS PAGE											2356783	

AR302468

C & R BATTERY SITE
Chesterfield Co., Virginia
RCRA Cap - 120 mg/kg Action Level
Alternative No. 2
Post Remedial Monitoring
(O&MCR2)

Annual Costs

ITEM	ITEM $ ANNUAL SAMPLING	ITEM $ COST FOR 5 YEARS	NOTES
1. Sampling	1600.00		4 groundwater samples, 24 manhours per sampling period plus travel, living sample shipping costs.
2. Analysis	10000.00		40 samples per year (inc. blank & duplicate), Inorganics, Water Quality & Indicator Parameters
3. Reporting	950.00		20 manhours per report plus other direct costs.
4. Cap Maintenance	6000.00		Inspection, Erosion Control, Mowing and Revegetation
5. Analysis Review		20000.00	Analysis Review performed for years 5,10,15,20,25,30
TOTAL ANNUAL COST	18550.00	20000.00	Post Remedial monitoring will be performed annually for years 1 thru 30

C & R B[illegible] SITE
Chesterfield co., Virginia
RCRA Cap - 120 mg/kg ActionLevel
Alternative No. 2
(PWACR2)
2698

PRESENT WORTH ANALYSIS

COST/YEAR COST OCCURS ($000'S)

COST COMPONENT	0	1	2	3	4	5	6	7	8	9	10	11
1. CAPITAL COST	2356.8											
2. O & M COSTS	---	18.6										
3. ANNUAL COSTS	2356.8	18.6	18.6	18.6	18.6	38.6	18.6	18.6	18.6	18.6	38.6	18.6
4. ANNUAL DISCOUNT RATE=5%	1	.952	.907	.864	.823	.784	.746	.711	.677	.645	.614	.585
PRESENT WORTH =	2357	18	17	16	15	30	14	13	13	12	24	11

	12	13	14	15	16	17	18	19	20	21	22	23
O & M COSTS	18.6	18.6	18.6	38.6	18.6	18.6	18.6	18.6	38.6	18.6	18.6	18.6
ANNUAL DISCOUNT RATE=5%	.557	.53	.505	.481	.458	.436	.416	.396	.377	.359	.342	.326
PRESENT WORTH =	10	10	9	19	9	8	8	7	15	7	6	6

	24	25	26	27	28	29	30	TOTAL PRESENT WORTH (000'S)
O & M COSTS	18.6	38.6	18.6	18.6	18.6	18.6	38.6	
ANNUAL DISCOUNT RATE=5%	.31	.295	.281	.268	.255	.243	.231	
PRESENT WORTH =	6	11	5	5	5	5	9	2698

AR302470

ALTERNATIVE 3a

STABILIZATION - 120 mg/kg ACTION LEVEL, OFFSITE DISPOSAL IN SANITARY/INDUSTRIAL WASTE LANDFILL

C & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization/Offsite Disposal In Sanitary Landfill
120 mg/kg Action Level
Alternative No. 3a1
(CRS3a1)
Page 1 Of 2

Item	Qty	Unit	Unit Cost				Total Cost				Total Direct Cost	Comments
			Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.		
EXCAVATION												
1) Excavate Soil	79523	CY			.80	1.50			63618	119285	182903	
2) Excavate Dike	184	CY			.80	1.50			147	276	423	
3) Excavate Sediments	350	CY			.80	1.50			280	525	805	
4) Excavate Debris Pile	233	CY			.80	1.50			186	350	536	
5) Excavate Drainage Channel	1300	CY			.80	1.50			1040	1950	2990	Temporary
6) Excavate Drainage Channel	1300	CY			.80	1.50			1040	1950	2990	Permanent
7) Clear & Grub	4	AC			4000.00	5500.00			16000	22000	38000	
8) Chain Link Fence - 6"	400	LF	12.00				4800				4800	Temporary
9) Relocate Existing Fence	1100	LF	10.00				11000				11000	Temporary
10) Relocate fence To Orig. Location	1100	LF	10.00				11000				11000	
DISMANTLEMENT/DISPOSAL												
11) Dismantle Storage Shed												
a) Dismantle Shed	60	MH			20.00	20.00			1200	1200	2400	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	2	TON	30.00				60				60	Local Landfill
12) Dismantle Concrete Pad												
a) Dismantle Concrete Pad	833	CY			48.00	28.00			39984	23324	63308	
b) Hauling	85	LD	150.00				12750				12750	15 mi.
c) Disposal	1688	TON	30.00				50640				50640	Local Landfill
13) Dispose Tires & Misc. Debris												
a) Split Open Tires	80	MH			20.00	20.00			1600	1600	3200	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	10	TON	30.00				300				300	Local Landfill
14) Treat Drainage Ditch Water												
a) Hauling (2 Trucks @ 500 Mi.)	1000	MI	4.00				4000				4000	RCRA
b) Treatment	50070	LB	.08				4006				4006	Treatment Facility
15) Treat Decon Fluids												
a) Hauling (3 Trucks @ 500 Mi.)	1500	MI	4.00				6000				6000	RCRA
b) Treatment	125100	LB	.08				10008				10008	Treatment Facility
STABILIZATION												
16) Waste Soil Stabilization	96348	CY	67.00				6455316				6455316	
17) Soil Analyses (Every 100 C.Y.)	1606		100.00				160600				160600	Every 100 C.Y.
DISPOSAL												
18) Loading Stabilized Soil	160580	CY			.32	.52			51386	83502	134887	Front End Loader
19) Hauling - 20 CY Truck	12847	LD	150.00				1927050				1927050	15 mi.
20) Disposal	256928	TON	30.00				7707840				7707840	Local Landfill
RECLAMATION												
21) Backfill Excavated Areas	94128	CY		3.50	2.70	7.43		329448	254146	699371	1282965	20 mi. R.T.
a) Place, Spread & Compact	94128	CY			.84	2.67			79068	251322	330389	Sheepsfoot Roller
22) Topsoil - 3"	4394	CY		6.00	2.70	7.43		26364	11864	32647	70875	20 mi. R.T.
a) Place & Spread	4394	CY			.63	.57			2768	2505	5273	
23) Topsoil - 3"(Cleared Area)	1613	CY		6.00	2.70	7.43		9678	4355	11985	26018	20 mi. R.T.
a) Place & Spread	1613	CY			.63	.57			1016	919	1936	
24) Revegetation												
a) Excavated Area	474.5	MSF		24.60	5.60	4.45		11673	2657	2112	16441	
b) Cleared Area	174.2	MSF		24.60	5.60	4.45		4285	976	775	6036	
							16365670	381448	533331	1257596	18538044	

AR302472

C & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization/Offsite Disposal In Sanitary Landfill
120 mg/kg Action Level
Alternative No. 3a1
(CRS3a1)
Page 2 Of 2

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
Page 1 Total							16365670	381448	533331	1257596	18538044	
BATTERY DISPOSAL												
25) Drain Ni/Cd Batteries		LS			320.00				320		320	350 Batteries
26) Package Batteries In Drum	8	DR		100.00	80.00	40.00		800	640	320	1760	
27) Vermiculite Packing	10	BAGS		15.00	10.00			150	100		260	
28) Laboratory Analysis		LS	650.00				650				650	TAL Metals
29) Hauling	480	MI	4.00				1920				1920	480 Mi.
30) Treatment/Disposal Landfill	7000	LB	4.60				32200				32200	Buffalo, N.Y.
							16400440	382398	534391	1257916	18575144	
Burden @ 13% of Labor Cost									69471		69471	
Labor @ 15% of Labor Cost									80159		80159	
Material @ 5% of Material Cost								19120			19120	
Subcontract @ 10% of Sub. Cost							1640044				1640044	
Total Direct Cost							18040484	401518	684020	1257916	20383938	
Indirects @ 75% of Total Direct Labor Cost									513015		513015	
Profit @ 10% Total Direct Cost											2038394	
											22935347	
Health & Safety Monitoring @ .039											894479	
Total Field Cost											23829825	
Contingency @ 20% of Total Field Cost											4765965	
Engineering @ 4% of Total Field Cost											953193	
TOTAL COST THIS PAGE											29548983	

AR302473

T & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization, Offsite Disposal In Sanitary Landfill
120 mg/kg Action Level
Alternative No. 3a1
Post Remedial Monitoring
(O&MCR3a1)

Annual Costs

ITEM	ITEM $ ANNUAL SAMPLING	ITEM $ COST FOR 5 YEARS	NOTES
1. Analysis Review		20000.00	Analysis Review performed for years 5,10,15,20,25,30
TOTAL ANNUAL COST	.00	20000.00	Analysis Review performed for years 5,10,15,20,25,30

C & R B[illegible]Y SITE
Chesterfield co., Virginia
Stabilization, Offsite Disposal In Sanitary Landfill
120 mg/kg Action Level
Alternative No. 3a1
(PWACR3a1)
29605

PRESENT WORTH ANALYSIS

COST COMPONENT	COST/YEAR COST OCCURS ($000'S) 0	1	2	3	4	5	6	7	8	9	10	11
1. CAPITAL COST	29549											
2. O & M COSTS	---	0										
3. ANNUAL COSTS	29549	0	0	0	0	20	0	0	0	0	20	0
4. ANNUAL DISCOUNT RATE=5%	1	.952	.907	.864	.823	.784	.746	.711	.677	.645	.614	.585
PRESENT WORTH =	29549	0	0	0	0	16	0	0	0	0	12	0

	12	13	14	15	16	17	18	19	20	21	22	23
O & M COSTS	0	0	0	20	0	0	0	0	20	0	0	0
ANNUAL DISCOUNT RATE=5%	.557	.53	.505	.481	.458	.436	.416	.396	.377	.359	.342	.326
PRESENT WORTH =	0	0	0	10	0	0	0	0	8	0	0	0

	24	25	26	27	28	29	30	TOTAL PRESENT WORTH (000'S)
O & M COSTS	0	20	0	0	0	0	20	
ANNUAL DISCOUNT RATE=5%	.31	.295	.281	.268	.255	.243	.231	
PRESENT WORTH =	0	6	0	0	0	0	5	29605

AR302475

ALTERNATIVE 3a (OPTION 2)

STABILIZATION - 120 mg/kg ACTION LEVEL, OFFSITE DISPOSAL IN HAZARDOUS WASTE LANDFILL

C & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization/Offsite Disposal In Hazardous Waste Landfill
120 mg/kg Action Level
Alternative No. 3a2
(CRS3a2)

Item	Qty	Unit	Unit Cost				Total Cost				Total Direct Cost	Comments
			Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.		
EXCAVATION												
1) Excavate Soil	79523	CY			.80	1.50			63618	119285	182903	
2) Excavate Dike	184	CY			.80	1.50			147	276	423	
3) Excavate Sediments	350	CY			.80	1.50			280	525	805	
4) Excavate Debris Pile	233	CY			.80	1.50			186	350	536	
5) Excavate Drainage Channel	1300	CY			.80	1.50			1040	1950	2990	Temporary
6) Excavate Drainage Channel	1300	CY			.80	1.50			1040	1950	2990	Permanent
7) Clear & Grub	4	AC			4000.00	5500.00			16000	22000	38000	
8) Chain Link Fence - 6"	400	LF	12.00				4800				4800	Temporary
9) Relocate Existing Fence	1100	LF	10.00				11000				11000	Temporary
10) Relocate Fence To Orig. Location	1100	LF	10.00				11000				11000	
DISMANTLEMENT/DISPOSAL												
11) Dismantle Storage Shed												
a) Dismantle Shed	60	MH			20.00	20.00			1200	1200	2400	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	2	TON	30.00				60				60	Local Landfill
12) Dismantle Concrete Pad												
a) Dismantle Concrete Pad	833	CY			48.00	28.00			39984	23324	63308	
b) Hauling	85	LD	150.00				12750				12750	15 mi.
c) Disposal	1688	TON	30.00				50640				50640	Local Landfill
13) Dispose Tires & Misc. Debris												
a) Split Open Tires	80	MH			20.00	20.00			1600	1600	3200	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	10	TON	30.00				300				300	Local Landfill
14) Treat Drainage Ditch Water												
a) Hauling (2 Trucks @ 500 Mi.)	1000	MI	4.00				4000				4000	RCRA
b) Treatment	50070	LB	.08				4006				4006	Treatment Facility
15) Treat Decon Fluids												
a) Hauling (3 Trucks @ 500 Mi.)	1500	MI	4.00				6000				6000	RCRA
b) Treatment	125100	LB	.08				10008				10008	Treatment Facility
STABILIZATION												
16) Waste Soil Stabilization	96348	CY	67.00				6455316				6455316	
17) Soil Analyses (Every 100 C.Y.)	1606		100.00				160600				160600	Every 100 C.Y.
DISPOSAL												
18) Loading Stabilized Soil	160580	CY			.32	.52			51386	83502	134887	Front End Loader
19) Hauling - 20 CY Truck	5909620	MI	4.00				23638480				23638480	460 mi.
20) Disposal	256928	TON	150.00				38539200				38539200	Model City, N.Y.
RECLAMATION												
21) Backfill Excavated Areas	94128	CY		3.50	2.70	7.43		329448	254146	699371	1282965	20 mi. R.T.
a) Place, Spread & Compact	94128	CY			.84	2.67			79068	251322	330389	Sheepsfoot Roller
22) Topsoil - 3"	4394	CY		6.00	2.70	7.43		26364	11864	32647	70875	20 mi. R.T.
a) Place & Spread	4394	CY			.63	.57			2768	2505	5273	
23) Topsoil - 3"(Cleared Area)	1613	CY		6.00	2.70	7.43		9678	4355	11985	26018	20 mi. R.T.
a) Place & Spread	1613	CY			.63	.57			1016	919	1936	
24) Revegetation												
a) Excavated Area	474.5	MSF		24.60	5.60	4.45		11673	2657	2112	16441	
b) Cleared Area	174.2	MSF		24.60	5.60	4.45		4285	976	775	6036	
							68908460	381448	533331	1257596	71080834	

AR302477

C & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization/Offsite Disposal In Hazardous Waste Landfill
120 mg/kg Action Level
Alternative No. 3a2
(CRS3a2)
Page 2 Of 2

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
Page 1 Total							68908460	381448	533331	1257596	71080834	
BATTERY DISPOSAL												
25) Drain Ni/Cd Batteries		LS			320.00				320		320	350 Batteries
26) Package Batteries In Drums	8	DR		100.00	80.00	40.00		800	640	320	1760	
27) Vermiculite Packing	10	BAGS		15.00	10.00			150	100		250	
28) Laboratory Analysis		LS	650.00				650				650	TAL Metals
29) Hauling	480	MI	4.00				1920				1920	460 MI.
30) Treatment/Disposal Landfill	7000	LB	4.60				32200				32200	Buffalo, N.Y.
							68943230	382398	534391	1257916	71117934	
Burden @ 13% of Labor Cost									69471		69471	
Labor @ 15% of Labor Cost									80159		80159	
Material @ 5% of Material Cost								19120			19120	
Subcontract @ 10% of Sub. Cost							6894323				6894323	
Total Direct Cost							75837553	401518	684020	1257916	78181007	
Indirects @ 75% of Total Direct Labor Cost									513015		513015	
Profit @ 10% Total Direct Cost											7818101	
											86512123	
Health & Safety Monitoring @ .0115											994889	
Total Field Cost											87507012	
Contingency @ 20% of Total Field Cost											17501402	
Engineering @ 1.5% of Total Field Cost											1312605	
TOTAL COST THIS PAGE											106321020	

AR302478

C & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization, Offsite Disposal In
Hazardous Waste Landfill
120 mg/kg Action Level
Alternative No. 3a2
Post Remedial Monitoring
(O&MCR3a2)

Annual Costs

ITEM	ITEM $ ANNUAL SAMPLING	ITEM $ COST FOR 5 YEARS	NOTES
1. Analysis Review		20000.00	Analysis Review performed for years 5,10,15,20,25,30
TOTAL ANNUAL COST	.00	20000.00	Analysis Review performed for years 5,10,15,20,25,30

C & R B Y SITE
Chesterfield co., Virginia
Stabilization, Offsite Disposal In Hazardous Waste Landfill
120 mg/kg Action Level
Alternative No. 3a2
(PWACR3a2)
106377

PRESENT WORTH ANALYSIS

COST/YEAR COST OCCURS ($000'S)

COST COMPONENT	0	1	2	3	4	5	6	7	8	9	10	11
1. CAPITAL COST	106321											
2. O & M COSTS	---	0										
3. ANNUAL COSTS	106321	0	0	0	0	20	0	0	0	0	20	0
4. ANNUAL DISCOUNT RATE=5%	1	.952	.907	.864	.823	.784	.746	.711	.677	.645	.614	.585
PRESENT WORTH =	106321	0	0	0	0	16	0	0	0	0	12	0

	12	13	14	15	16	17	18	19	20	21	22	23
O & M COSTS	0	0	0	20	0	0	0	0	20	0	0	0
ANNUAL DISCOUNT RATE=5%	.557	.53	.505	.481	.458	.436	.416	.396	.377	.359	.342	.326
PRESENT WORTH =	0	0	0	10	0	0	0	0	8	0	0	0

	24	25	26	27	28	29	30	TOTAL PRESENT WORTH (000'S)
O & M COSTS	0	20	0	0	0	0	20	
ANNUAL DISCOUNT RATE=5%	.31	.295	.281	.268	.255	.243	.231	
PRESENT WORTH =	0	6	0	0	0	0	5	106377

AR302480

ALTERNATIVE 3b

SOIL WASHING - 120 mg/kg ACTION LEVEL,ONSITE NONHAZARDOUS DISPOSAL

C & R BATTERY SITE
Chesterfield Co., Virginia
Soil Washing/Onsite Nonhazardous Disposal
120 mg/kg Action Level
Alternative No. 3b
(CRS3b)

Item	Qty	Unit	Unit Cost Sub.	Mat.	Labor	Equip.	Total Cost Sub.	Mat.	Labor	Equip.	Total Direct Cost	Comments
EXCAVATION												
1) Excavate Soil.	79523	CY			.80	1.50			63618	119285	182903	
2) Excavate Dike	184	CY			.80	1.50			147	276	423	
3) Excavate Sediments	350	CY			.80	1.50			280	525	805	
4) Excavate Debris Pile	233	CY			.80	1.50			186	350	536	
5) Excavate Drainage Channel	1300	CY			.80	1.50			1040	1950	2990	Temporary
6) Clear & Grub	4	AC			4000.00	5500.00			16000	22000	38000	
7) Chain Link Fence - 6"	400	LF	12.00				4800				4800	Temporary
8) Relocate Existing Fence	1100	LF	10.00				11000				11000	Temporary
9) Relocate Fence To Orig. Location	1100	LF	10.00				11000				11000	
DISMANTLEMENT/DISPOSAL												
10) Dismantle Storage Shed												
a) Dismantle Shed	60	MH			20.00	20.00			1200	1200	2400	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	2	TON	30.00				60				60	Local Landfill
11) Dismantle Concrete Pad												
a) Dismantle Concrete Pad	833	CY			48.00	28.00			39984	23324	63308	
b) Hauling	85	LD	150.00				12750				12750	15 mi.
c) Disposal	1688	TON	30.00				50640				50640	Local Landfill
12) Dispose Tires & Misc. Debris												
a) Split Open Tires	80	MH			20.00	20.00			1600	1600	3200	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	10	TON	30.00				300				300	Local Landfill
13) Dispose Battery Casings												
a) Hauling	169	LD	150.00				25350				25350	15 mi.
b) Disposal	3380	TON	30.00				101400				101400	Local Landfill
14) Treat Drainage Ditch Water												
a) Hauling (2 Trucks @ 500 Mi.)	1000	MI	4.00				4000				4000	RCRA
b) Treatment	50070	LB	.08				4006				4006	Treatment Facility
15) Treat Decon Fluids												
a) Hauling (3 Trucks @ 500 Mi.)	1500	MI	4.00				6000				6000	RCRA
b) Treatment	125100	LB	.08				10008				10008	Treatment Facility
SOIL WASHING												
16) Waste Soil Soil Washing	96348	CY	289.00				27844572				27844572	
17) Soil Analysis(Every 100 C.Y.)	963		100.00				96300				96300	Every 100 C.Y.
RECLAMATION												
18) Backfill Treated Soil												
a) Place, Spread & Compact	95428	CY			.84	2.67			80160	254793	334952	Sheepsfoot Roller
19) Topsoil - 3"	4394	CY		6.00	2.70	7.43		26364	11864	32647	70875	20 mi. R.T.
a) Place & Spread	4394	CY			.63	.57			2768	2505	5273	
20) Revegetation												
a) Excavated Area	474.5	MSF		24.60	5.60	4.45		11673	2657	2112	16441	
b) Cleared Area	174.2	MSF		24.60	5.60	4.45		4285	976	775	6036	
BATTERY DISPOSAL												
21) Drain Ni/Cd Batteries		LS			320.00				320		320	350 Batteries
22) Package Batteries In Drum	8	DR		100.00	80.00	40.00		800	640	320	1760	
23) Vermiculite Packing	10	BAGS		15.00	10.00			150	100		250	
24) Laboratory Analysis		LS	650.00				650				650	TAL Metals
25) Hauling	480	MI	4.00				1920				1920	460 Mi.
26) Treatment/Disposal Landfill	7000	LB	4.60				32200				32200	Buffalo, N.Y.
							28217256	43272	223540	463660	28947728	

AR302482

C & R BATTERY SITE
Chesterfield Co., Virginia
Soil Washing/Onsite Nonhazardous Disposal
120 mg/kg Action Level
Alternative No. 3b
(CRS3b)
Page 2 Of 2

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
Page 1 Total							28217256	43272	223540	463660	28947728	
Burden @ 13% of Labor Cost									29060		29060	
Labor @ 15% of Labor Cost									33531		33531	
Material @ 5% of Material Cost								2164			2164	
Subcontract @ 10% of Sub. Cost							2821726				2821726	
Total Direct Cost							31038981	45436	286132	463660	31834209	
Indirects @ 75% of Total Direct Labor Cost									214599		214599	
Profit @ 10% Total Direct Cost											3183421	
											35232228	
Health & Safety Monitoring @ .028											986502	
Total Field Cost											36218731	
Contingency @ 20% of Total Field Cost											7243746	
Engineering @ 4% of Total Field Cost											1448749	
TOTAL COST THIS PAGE											44911226	

AR302483

C & R BATTERY SITE
Chesterfield Co., Virginia
Soil Washing/Onsite Nonhazardous Disposal
120mg/kg Action Level
Alternative No. 3b
Post Remedial Monitoring
(O&MCR3b)

Annual Costs

ITEM	ITEM $ ANNUAL SAMPLING	ITEM $ COST FOR 5 YEARS	NOTES
1. Analysis Review		20000.00	Analysis Review performed for years 5,10,15,20,25,30
TOTAL ANNUAL COST	.00	20000.00	Analysis Review performed for years 5,10,15,20,25,30

C & R [illegible]ERY SITE
Chesterfield Co., Virginia
Soil Wahing/Onsite Nonhazardous Disposal
120 mg/kg Action Level
Alternative No. 3b
(PWACR3b)
41967

PRESENT WORTH ANALYSIS

COST/YEAR COST OCCURS ($000'S)

COST COMPONENT	0	1	2	3	4	5	6	7	8	9	10	11
1. CAPITAL COST	44911.2											
2. O & M COSTS	---	0										
3. ANNUAL COSTS	44911.2	0	0	0	0	20	0	0	0	0	20	0
4. ANNUAL DISCOUNT RATE=5%	1	.952	.907	.864	.823	.784	.746	.711	.677	.645	.614	.585
PRESENT WORTH =	44911	0	0	0	0	16	0	0	0	0	12	0

	12	13	14	15	16	17	18	19	20	21	22	23
O & M COSTS	0	0	0	20	0	0	0	0	20	0	0	0
ANNUAL DISCOUNT RATE=5%	.557	.53	.505	.481	.458	.436	.416	.396	.377	.359	.342	.326
PRESENT WORTH =	0	0	0	10	0	0	0	0	8	0	0	0

	24	25	26	27	28	29	30	TOTAL PRESENT WORTH (000'S)
O & M COSTS	0	20	0	0	0	0	20	
ANNUAL DISCOUNT RATE=5%	.31	.295	.281	.268	.255	.243	.231	
PRESENT WORTH =	0	6	0	0	0	0	5	44967

AR302485

ALTERNATIVE 3c

IN-SITU VITRIFICATION - 120 mg/kg ACTION LEVEL

C & R BATTERY SITE
Chesterfield Co., Virginia
In-Situ Vitrification
120 mg/kg Action Level
Alternative No. 3c
(CRS3c)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
EXCAVATION												
1) Excavate Soil	11730	CY			.80	1.50			9384	17595	26979	
2) Excavate Sediments	350	CY			.80	1.50			280	525	805	
3) Excavate Dike	184	CY			.80	1.50			147	276	423	
4) Regrade Debris Pile	233	CY			.80	1.50			186	350	536	
5) Excavate Drainage Channel	1300	CY			.80	1.50			1040	1950	2990	Temporary
6) Chain Link Fence - 6"	400	LF	12.00				4800				4800	Temporary
7) Relocate Fence To Orig. Location	1100	LF	10.00				11000				11000	
8) Monitoring Wells	280	LF	100.00				28000				28000	4 @ 70'
DISMANTLEMENT/DISPOSAL												
9) Dismantle Storage Shed												
a) Dismantle Shed	60	MH			20.00	20.00			1200	1200	2400	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	2	TON	30.00				60				60	Local Landfill
10) Dispose Tires & Misc. Debris												
a) Split Open Tires	80	MH			20.00	20.00			1600	1600	3200	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	10	TON	30.00				300				300	Local Landfill
11) Treat Drainage Ditch Water												
a) Hauling (2 Trucks @ 500 Mi.)	1000	MI	4.00				4000				4000	RCRA
b) Treatment	50070	LB	.08				4006				4006	Treatment Facility
12) Treat Decon Fluids												
a) Hauling (3 Trucks @ 500 Mi.)	1500	MI	4.00				6000				6000	RCRA
b) Treatment	125100	LB	.08				10008				10008	Treatment Facility
IN-SITU VITRIFICATION												
13) Waste Soil	14076	CY			.41	1.17			5771	16469	22240	1 mi. R.T.
a) Place, Spread & Compact	14076	CY			.84	2.67			11824	37583	49407	Sheepsfoot Roller
14) Treatability Testing		LS	100000.00				100000				100000	
15) Mobilization/Demobilization		LS	250000.00				250000				250000	
16) In-Situ Vitrification	112406	TON	240.00				26977440				26977440	
RECLAMATION												
17) Backfill Onsite Area	15181	CY		3.50	2.70	7.43		53134	40989	112795	206917	20 mi. R.T.
a) Place, Spread & Compact	15181	CY			.84	2.67			12752	40533	53285	Sheepsfoot Roller
18) Backfill Offsite Area	14076	CY		3.50	2.70	7.43		49266	38005	104585	191856	20 mi. R.T.
a) Place, Spread & Compact	14076	CY			.84	2.67			11824	37583	49407	Sheepsfoot Roller
19) Topsoil - 3" Onsite & Offsite	4394	CY		6.00	2.70	7.43		26364	11864	32647	70875	20 mi. R.T.
a) Place & Spread	4394	CY			.63	.57			2768	2505	5273	
20) Revegetation												
a) Onsite & Offsite Area	474.5	MSF		24.60	5.60	4.45		11673	2657	2112	16441	
BATTERY DISPOSAL												
21) Drain Ni/Cd Batteries		LS			320.00				320		320	350 Batteries
22) Package Batteries In Drum	8	DR		100.00	80.00	40.00		800	640	320	1760	
23) Vermiculite Packing	10	BAGS		15.00	10.00			150	100		250	
24) Laboratory Analysis		LS	650.00				650				650	TAL Metals
25) Hauling	480	MI	4.00				1920				1920	460 Mi.
26) Treatment/Disposal Landfill	7000	LB	4.60				32200				32200	Buffalo, N.Y.
							27430684	141386	153352	410627	28136048	

AR302487

C & R BATTERY SITE
Chesterfield Co., Virginia
In-Situ Vitrification
120 mg/kg Action Level
Alternative No. 3c
(CRS3c)
Page 2 Of 2

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
Page 1 Total							27430684	141386	153352	410627	28136048	
Burden @ 13% of Labor Cost									19936		19936	
Labor @ 15% of Labor Cost									23003		23003	
Material @ 5% of Material Cost								7069			7069	
Subcontract @ 10% of Sub. Cost							2743068				2743068	
Total Direct Cost							30173752	148456	196290	410627	30929124	
Indirects @ 75% of Total Direct Labor Cost									147218		147218	
Profit @ 10% Total Direct Cost											3092912	
											34169254	
Health & Safety Monitoring @ .049											1674293	
Total Field Cost											35843547	
Contingency @ 20% of Total Field Cost											7168709	
Engineering @ 3% of Total Field Cost											1075306	
TOTAL COST THIS PAGE											44087563	

AR302488

C & R BATTERY SITE
Chesterfield Co., Virginia
In-Situ Vitrification
120mg/kg Action Level
Alternative No. 3c
Post Remedial Monitoring
(O&MCR3c)

Annual Costs

ITEM	ITEM $ ANNUAL SAMPLING	ITEM $ COST FOR 5 YEARS	NOTES
1. Sampling	1600.00		4 groundwater, 3 sediment and 1 surface water sample 24 manhours per sampling period plus travel, living sample shipping costs.
2. Analysis	10000.00		40 samples per year (inc. blank & duplicate), Inorganics, Water Quality & Indicator Parameters
3. Reporting	950.00		20 manhours per report plus other direct costs.
4. Cap & Fence Maintenance	2000.00		Inspection, Erosion Control, Revegetation & Fence Maintenance
5. Analysis Review		20000.00	Analysis Review performed for years 5,10,15,20,25,30
TOTAL ANNUAL COST	14550.00	20000.00	Post Remedial monitoring will be performed annually for years 1 thru 30

C & R BATTERY SITE
Chesterfield co., Virginia
In-Situ Vitrification
120 mg/kg Action Level
Alternative No. 3c
(PWACR3c)
44368

PRESENT WORTH ANALYSIS

COST COMPONENT	COST/YEAR COST OCCURS ($000'S) 0	1	2	3	4	5	6	7	8	9	10	11
1. CAPITAL COST	44087.6											
2. O & M COSTS	---	14.6										
3. ANNUAL COSTS	44087.6	14.6	14.6	14.6	14.6	34.6	14.6	14.6	14.6	14.6	34.6	14.6
4. ANNUAL DISCOUNT RATE=5%	1	.952	.907	.864	.823	.784	.746	.711	.677	.645	.614	.585
PRESENT WORTH =	44088	14	13	13	12	27	11	10	10	9	21	9

	12	13	14	15	16	17	18	19	20	21	22	23
O & M COSTS	14.6	14.6	14.6	34.6	14.6	14.6	14.6	14.6	34.6	14.6	14.6	14.6
ANNUAL DISCOUNT RATE=5%	.557	.53	.505	.481	.458	.436	.416	.396	.377	.359	.342	.326
PRESENT WORTH =	8	8	7	17	7	6	6	6	13	5	5	5

	24	25	26	27	28	29	30	TOTAL PRESENT WORTH (000'S)
O & M COSTS	14.6	34.6	14.6	14.6	14.6	14.6	34.6	
ANNUAL DISCOUNT RATE=5%	.31	.295	.281	.268	.255	.243	.231	
PRESENT WORTH =	5	10	4	4	4	4	8	44368

AR302490

ALTERNATIVE 4a

STABILIZATION - 1,000 mg/kg ACTION LEVEL, OFFSITE DISPOSAL IN SANITARY/INDUSTRIAL WASTE LANDFILL, RCRA CAP OVER RESIDUAL CONTAMINATION

C & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization/Offsite Disposal In Sanitary Landfill
1000 mg/kg Action Level
Alternative No. 4a1
(CRS4a1)

Item	Qty	Unit	Unit Cost Sub.	Mat.	Labor	Equip.	Total Cost Sub.	Mat.	Labor	Equip.	Total Direct Cost	Comments
EXCAVATION												
1) Excavate Soil	35994	CY			.80	1.50			28795	53991	82786	
2) Excavate Dike	184	CY			.80	1.50			147	276	423	
3) Excavate Sediments	350	CY			.80	1.50			280	525	805	
4) Excavate Debris Pile	233	CY			.80	1.50			186	350	536	
5) Excavate Drainage Channel	1300	CY			.80	1.50			1040	1950	2990	Temporary
6) Excavate Drainage Channel	1300	CY			.80	1.50			1040	1950	2990	Permanent
7) Clear & Grub	4	AC			4000.00	5500.00			16000	22000	38000	
8) Chain Link Fence - 6"	400	LF	12.00				4800				4800	Temporary
9) Relocate Existing Fence	1100	LF	10.00				11000				11000	Temporary
10) Relocate Fence To Orig. Location	1100	LF	10.00				11000				11000	
DISMANTLEMENT/DISPOSAL												
11) Dismantle Storage Shed												
a) Dismantle Shed	60	MH			20.00	20.00			1200	1200	2400	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	2	TON	30.00				60				60	Local Landfill
12) Dismantle Concrete Pad												
a) Dismantle Concrete Pad	833	CY			48.00	28.00			39984	23324	63308	
b) Hauling	85	LD	150.00				12750				12750	15 mi.
c) Disposal	1688	TON	30.00				50640				50640	Local Landfill
13) Dispose Tires & Misc. Debris												
a) Split Open Tires	80	MH			20.00	20.00			1600	1600	3200	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	10	TON	30.00				300				300	Local Landfill
14) Treat Drainage Ditch Water												
a) Hauling (2 Trucks @ 500 Mi.)	1000	MI	4.00				4000				4000	RCRA
b) Treatment	50070	LB	.08				4006				4006	Treatment Facility
15) Treat Decon Fluids												
a) Hauling (3 Trucks @ 500 Mi.)	1500	MI	4.00				6000				6000	RCRA
b) Treatment	125100	LB	.08				10008				10008	Treatment Facility
STABILIZATION												
16) Waste Soil Stabilization	44113	CY	70.00				3087910				3087910	
17) Soil Analyses (Every 100 CY)	735		100.00				73500				73500	Every 100 C.Y.
DISPOSAL												
18) Loading Stabilized Soil	73522	CY			.32	.52			23527	38231	61758	Front End Loader
19) Hauling - 20 CY Truck	5882	LD	150.00				882300				882300	15 mi.
20) Disposal	117635	TON	30.00				3529050				3529050	Local Landfill
							7687624	0	113800	145397	7946820	

AR302492

C & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization/Offsite Disposal In Sanitary Landfill
1000 mg/kg Action Level
Alternative No. 4a1
(CRS4a1)
Page 2 Of 2

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
Page 1 Total							7687624	0	113800	145397	7946820	
RECLAMATION												
21) Backfill Excavated Areas	53080	CY		3.50	2.70	7.43		185780	143316	394384	723480	20 mi. R.T.
a) Place, Spread & Compact	53080	CY			.84	2.67			44587	141724	186311	Sheepsfoot Roller
22) Topsoil - 6"	8788	CY		6.00	2.70	7.43		52728	23728	65295	141750	20 mi. R.T.
a) Place & Spread	8788	CY			.63	.57			5536	5009	10546	
23) Topsoil - 3"(Cleared Area)	1613	CY		6.00	2.70	7.43		9678	4355	11985	26018	20 mi. R.T.
a) Place & Spread	1613	CY			.63	.57			1016	919	1936	
24) Revegetation												
a) Excavated Area	474.5	MSF		24.60	5.60	4.45		11673	2657	2112	16441	
b) Cleared Area	174.2	MSF		24.60	5.60	4.45		4285	976	775	6036	
BATTERY DISPOSAL												
25) Drain Ni/Cd Batteries		LS			320.00				320		320	350 Batteries
26) Package Batteries In Drum	8	DR		100.00	80.00	40.00		800	640	320	1760	
27) Vermiculite Packing	10	BAGS		15.00	10.00			150	100		250	
28) Laboratory Analysis		LS	650.00				650				650	TAL Metals
29) Hauling	480	MI	4.00				1920				1920	480 Mi.
30) Treatment/Disposal Landfill	7000	LB	4.60				32200				32200	Buffalo, N.Y.
							7722394	265094	341031	767920	9096438	
Burden @ 13% of Labor Cost									44334		44334	
Labor @ 15% of Labor Cost									51155		51155	
Material @ 5% of Material Cost								13255			13255	
Subcontract @ 10% of Sub. Cost							772239				772239	
Total Direct Cost							8494633	278349	436520	767920	9977421	
Indirects @ 75% of Total Direct Labor Cost									327390		327390	
Profit @ 10% Total Direct Cost											997742	
											11302553	
Health & Safety Monitoring @ .057											644246	
Total Field Cost											11946799	
Contingency @ 20% of Total Field Cost											2389360	
Engineering @ 8% of Total Field Cost											955744	
TOTAL COST THIS PAGE											15291902	

AR302493

C & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization/Offsite Disposal In Sanitary Landfill,
1000 mg/kg Action Level
Alternative No. 4a1
Post Remedial Monitoring
(O&MCR4a1)

Annual Costs

ITEM	ITEM $ ANNUAL SAMPLING	ITEM $ COST FOR 5 YEARS	NOTES
1. Sampling	1600.00		4 groundwater samples, 24 manhours per sampling period plus travel, living sample shipping costs.
2. Analysis	10000.00		40 samples per year (inc. blank & duplicate), Inorganics, Water Quality & Indicator Parameters
3. Reporting	950.00		20 manhours per report plus other direct costs.
4. Site Maintenance	2000.00		Inspection, Erosion Control, Mowing and Revegetation, Fence Maintenance
5. Analysis Review		20000.00	Analysis Review performed for years 5,10,15,20,25,30
TOTAL ANNUAL COST	14550.00	20000.00	Post Remedial monitoring will be performed annually for years 1 thru 30

C & R BATTERY SITE
Chesterfield co., Virginia
Stabilization, Offsite Disposal In Sanitary Landfill
1000 mg/kg Action Level
Alternative No. 4a1
(PWACR4a1)
15572

PRESENT WORTH ANALYSIS

COST/YEAR COST OCCURS ($000'S)

COST COMPONENT	0	1	2	3	4	5	6	7	8	9	10	11
1. CAPITAL COST	15291.9											
2. O & M COSTS	---	14.6										
3. ANNUAL COSTS	15291.9	14.6	14.6	14.6	14.6	34.6	14.6	14.6	14.6	14.6	34.6	14.6
4. ANNUAL DISCOUNT RATE=5%	1	.952	.907	.864	.823	.784	.746	.711	.677	.645	.614	.585
PRESENT WORTH =	15292	14	13	13	12	27	11	10	10	9	21	9

	12	13	14	15	16	17	18	19	20	21	22	23
O & M COSTS	14.6	14.6	14.6	34.6	14.6	14.6	14.6	14.6	34.6	14.6	14.6	14.6
ANNUAL DISCOUNT RATE=5%	.557	.53	.505	.481	.458	.436	.416	.396	.377	.359	.342	.326
PRESENT WORTH =	8	8	7	17	7	6	6	6	13	5	5	5

	24	25	26	27	28	29	30	TOTAL PRESENT WORTH (000'S)
O & M COSTS	14.6	34.6	14.6	14.6	14.6	14.6	34.6	
ANNUAL DISCOUNT RATE=5%	.31	.295	.281	.268	.255	.243	.231	
PRESENT WORTH =	5	10	4	4	4	4	8	15572

AR302195

ALTERNATIVE 4a (OPTION 2)

STABILIZATION - 1,000 mg/kg ACTION LEVEL, OFFSITE DISPOSAL IN HAZARDOUS WASTE LANDFILL, RCRA CAP OVER RESIDUAL CONTAMINATION

C & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization/Offsite Disposal In Hazardous Waste Landfill
1000 mg/kg Action Level
Alternative No. 4a2
(CRS4a2)

Item	Qty	Unit	Unit Cost				Total Cost				Total Direct Cost	Comments
			Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.		
EXCAVATION												
1) Excavate Soil	35994	CY			.80	1.50			28795	53991	82786	
2) Excavate Dike	184	CY			.80	1.50			147	276	423	
3) Excavate Sediments	350	CY			.80	1.50			280	525	805	
4) Excavate Debris Pile	233	CY			.80	1.50			186	350	536	
5) Excavate Drainage Channel	1300	CY			.80	1.50			1040	1950	2990	Temporary
6) Excavate Drainage Channel	1300	CY			.80	1.50			1040	1950	2990	Permanent
7) Clear & Grub	4	AC			4000.00	5500.00			16000	22000	38000	
8) Chain Link Fence - 6"	400	LF	12.00				4800				4800	Temporary
9) Relocate Existing Fence	1100	LF	10.00				11000				11000	Temporary
10) Relocate Fence To Orig. Location	1100	LF	10.00				11000				11000	
DISMANTLEMENT/DISPOSAL												
11) Dismantle Storage Shed												
a) Dismantle Shed	60	MH			20.00	20.00			1200	1200	2400	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	2	TON	30.00				60				60	Local Landfill
12) Dismantle Concrete Pad												
a) Dismantle Concrete Pad	833	CY			48.00	28.00			39984	23324	63308	
b) Hauling	85	LD	150.00				12750				12750	15 mi.
c) Disposal	1688	TON	30.00				50640				50640	Local Landfill
13) Dispose Tires & Misc. Debris												
a) Split Open Tires	80	MH			20.00	20.00			1600	1600	3200	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	10	TON	30.00				300				300	Local Landfill
14) Treat Drainage Ditch Water												
a) Hauling (2 Trucks @ 500 Mi.)	1000	MI	4.00				4000				4000	RCRA
b) Treatment	50070	LB	.08				4006				4006	Treatment Facility
15) Treat Decon Fluids												
a) Hauling (3 Trucks @ 500 Mi.)	1500	MI	4.00				6000				6000	RCRA
b) Treatment	125100	LB	.08				10008				10008	Treatment Facility
STABILIZATION												
16) Waste Soil Stabilization	44113	CY	70.00				3087910				3087910	
17) Soil Analyses (Every 100 CY)	735		100.00				73500				73500	Every 100 C.Y.
DISPOSAL												
18) Loading Stabilized Soil	73522	CY			.32	.52			23527	38231	61758	Front End Loader
19) Hauling - 20 CY Truck	2705720	MI	4.00				10822880				10822880	460 mi.
20) Disposal	117635	TON	150.00				17645250				17645250	Model City, N.Y.
							31744404	0	113800	145397	32003600	

AR302497

C & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization/Offsite Disposal In Hazardous Waste Landfill
1000 mg/kg Action Level
Alternative No. 4a2
(CRS4a2)
Page 2 Of 2

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
Page 1 Total							31744404	0	113800	145397	32003600	
RECLAMATION												
21) Backfill Excavated Areas	53080	CY		3.50	2.70	7.43		185780	143316	394384	723480	20 mi. R.T.
a) Place, Spread & Compact	53080	CY			.84	2.67			44587	141724	186311	Sheepsfoot Roller
22) Topsoil - 6"	8788	CY		6.00	2.70	7.43		52728	23728	65295	141750	20 mi. R.T.
a) Place & Spread	8788	CY			.63	.57			5536	5009	10546	
23) Topsoil - 3"(Cleared Area)	1613	CY		6.00	2.70	7.43		9678	4355	11985	26018	20 mi. R.T.
a) Place & Spread	1613	CY			.63	.57			1016	919	1936	
24) Revegetation												
a) Excavated Area	474.5	MSF		24.60	5.60	4.45		11673	2657	2112	16441	
b) Cleared Area	174.2	MSF		24.60	5.60	4.45		4285	976	775	6036	
BATTERY DISPOSAL												
25) Drain Ni/Cd Batteries		LS			320.00				320		320	350 Batteries
26) Package Batteries In Drum	8	DR		100.00	80.00	40.00		800	640	320	1760	
27) Vermiculite Packing	10	BAGS		15.00	10.00			150	100		250	
28) Laboratory Analysis		LS	650.00				650				650	TAL Metals
29) Hauling	480	MI	4.00				1920				1920	480 Mi.
30) Treatment/Disposal Landfill	7000	LB	4.60				32200				32200	Buffalo, N.Y.
							31779174	265094	341031	767920	33153218	
Burden @ 13% of Labor Cost									44334		44334	
Labor @ 15% of Labor Cost									51155		51155	
Material @ 5% of Material Cost								13255			13255	
Subcontract @ 10% of Sub. Cost							3177917				3177917	
Total Direct Cost							34957091	278349	436520	767920	36439879	
Indirects @ 75% of Total Direct Labor Cost									327390		327390	
Profit @ 10% Total Direct Cost											3643988	
											40411257	
Health & Safety Monitoring @ .017											686991	
Total Field Cost											41098248	
Contingency @ 20% of Total Field Cost											8219650	
Engineering @ 3% of Total Field Cost											1232947	
TOTAL COST THIS PAGE											50550845	

BR3024498

C & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization/Offsite Disposal In Hazardous Waste Landfill,
1000 mg/kg Action Level
lternative No. 4a2
Post Remedial Monitoring
(O&MCR4a2)

Annual Costs

ITEM	ITEM $ ANNUAL SAMPLING	ITEM $ COST FOR 5 YEARS	NOTES
1. Sampling	1600.00		4 groundwater samples, 24 manhours per sampling period plus travel, living sample shipping costs.
2. Analysis	10000.00		40 samples per year (inc. blank & duplicate), Inorganics, Water Quality & Indicator Parameters
3. Reporting	950.00		20 manhours per report plus other direct costs.
4. Site Maintenance	2000.00		Inspection, Erosion Control, Mowing and Revegetation, Fence Maintenance
5. Analysis Review		20000.00	Analysis Review performed for years 5,10,15,20,25,30
TOTAL ANNUAL COST	14550.00	20000.00	Post Remedial monitoring will be performed annually for years 1 thru 30

C & R BATTERY SITE
Chesterfield co., Virginia
Stabilization, Offsite Disposal In Hazardous Waste Landfill
1000 mg/kg Action Level
Alternative No. 4a2
(PWACR4a2)
50834

PRESENT WORTH ANALYSIS

COST/YEAR COST OCCURS ($000'S)

COST COMPONENT	0	1	2	3	4	5	6	7	8	9	10	11
1. CAPITAL COST	50550.8											
2. O & M COSTS	---	14.6										
3. ANNUAL COSTS	50550.8	14.6	14.6	14.6	14.6	34.6	18.6	14.6	14.6	14.6	34.6	14.6
4. ANNUAL DISCOUNT RATE=5%	1	.952	.907	.864	.823	.784	.746	.711	.677	.645	.614	.585
PRESENT WORTH =	50551	14	13	13	12	27	14	10	10	9	21	9

	12	13	14	15	16	17	18	19	20	21	22	23
O & M COSTS	14.6	14.6	14.6	34.6	14.6	14.6	14.6	14.6	34.6	14.6	14.6	14.6
ANNUAL DISCOUNT RATE=5%	.557	.53	.505	.481	.458	.436	.416	.396	.377	.359	.342	.326
PRESENT WORTH =	8	8	7	17	7	6	6	6	13	5	5	5

	24	25	26	27	28	29	30	TOTAL PRESENT WORTH (000'S)
O & M COSTS	14.6	34.6	14.6	14.6	14.6	14.6	34.6	
ANNUAL DISCOUNT RATE=5%	.31	.295	.281	.268	.255	.243	.231	
PRESENT WORTH =	5	10	4	4	4	4	8	50834

AR302500

ALTERNATIVE 4b

SOIL WASHING - 1,000 mg/kg ACTION LEVEL, ONSITE NONHAZARDOUS DISPOSAL, RCRA CAP OVER RESIDUAL CONTAMINATION

C & R BATTERY SITE
Chesterfield Co., Virginia
Soil Washing/Onsite Nonhazardous Disposal
1000 mg/kg Action Level
Alternative No. 4b
(CRS4b)

Item	Qty	Unit	Unit Cost				Total Cost				Total Direct Cost	Comments
			Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.		
EXCAVATION												
1) Excavate Soil	35994	CY			.80	1.50			28795	53991	82786	
2) Excavate Dike	184	CY			.80	1.50			147	276	423	
3) Excavate Sediments	350	CY			.80	1.50			280	525	805	
4) Excavate Debris Pile	233	CY			.80	1.50			186	350	536	
5) Excavate Drainage Channel	1300	CY			.80	1.50			1040	1950	2990	Temporary
6) Clear & Grub	4	AC			4000.00	5500.00			16000	22000	38000	
7) Chain Link Fence - 6"	400	LF	12.00				4800				4800	Temporary
8) Relocate Existing Fence	1100	LF	10.00				11000				11000	Temporary
9) Relocate Fence To Orig. Location	1100	LF	10.00				11000				11000	
DISMANTLEMENT/DISPOSAL												
10) Dismantle Storage Shed												
a) Dismantle Shed	60	MH			20.00	20.00			1200	1200	2400	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	2	TON	30.00				60				60	Local Landfill
11) Dismantle Concrete Pad												
a) Dismantle Concrete Pad	833	CY			48.00	28.00			39984	23324	63308	
b) Hauling	85	LD	150.00				12750				12750	15 mi.
c) Disposal	1688	TON	30.00				50640				50640	Local Landfill
12) Dispose Tires & Misc. Debris												
a) Split Open Tires	80	MH			20.00	20.00			1600	1600	3200	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	10	TON	30.00				300				300	Local Landfill
13) Dispose Battery Casings												
a) Hauling	169	LD	150.00				25350				25350	15 mi.
b) Disposal	3380	TON	30.00				101400				101400	Local Landfill
14) Treat Drainage Ditch Water												
a) Hauling (2 Trucks @ 500 Mi.)	1000	MI	4.00				4000				4000	RCRA
b) Treatment	50070	LB	.08				4006				4006	Treatment Facility
15) Treat Decon Fluids												
a) Hauling (3 Trucks @ 500 Mi.)	1500	MI	4.00				6000				6000	RCRA
b) Treatment	125100	LB	.08				10008				10008	Treatment Facility
SOIL WASHING												
16) Waste Soil Soil Washing	44113	CY	412.00				18174556				18174556	
17) Soil Analyses (Every 100 CY)	441		100.00				44100				44100	Every 100 C.Y.
							18460270	0	89233	105216	18654718	

AR302502

C & R BATTERY SITE
Chesterfield Co., Virginia
Soil Washing/Onsite Nonhazardous Disposal
1000 mg/kg Action Level
Alternative No. 4b
(CRS4b)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
Page 1 Total							18460270	0	89233	105216	18654718	
RECLAMATION												
18) Backfill Treated Soil												
a) Place, Spread & Compact	43193	CY			.84	2.67			36282	115325	151607	Sheepsfoot Roller
19) Backfill Clean Soil	9887	CY		3.50	2.70	7.43		34605	26695	73460	134760	20 mi. R.T.
a) Place, Spread & Compact	9887	CY			.84	2.67			8305	26398	34703	Sheepsfoot Roller
20) Topsoil - 6"	8788	CY		6.00	2.70	7.43		52728	23728	65295	141750	20 mi. R.T.
a) Place & Spread	8788	CY			.63	.57			5536	5009	10546	
21) Topsoil - 3"(Cleared Area)	1613	CY		6.00	2.70	7.43		9678	4355	11985	26018	20 mi. R.T.
a) Place & Spread	1613	CY			.63	.57			1016	919	1936	
22) Revegetation												
a) Excavated Area	474.5	MSF		24.60	5.60	4.45		11673	2657	2112	16441	
b) Cleared Area	174.2	MSF		24.60	5.60	4.45		4285	976	775	6036	
BATTERY DISPOSAL												
23) Drain Ni/Cd Batteries		LS			320.00				320		320	350 Batteries
24) Package Batteries In Drum	8	DR		100.00	80.00	40.00		800	640	320	1760	
25) Vermiculite Packing	10	BAGS		15.00	10.00			150	100		250	
26) Laboratory Analysis		LS	650.00				650				650	TAL Metals
27) Hauling	480	MI	4.00				1920				1920	480 Mi.
28) Treatment/Disposal Landfill	7000	LB	4.60				32200				32200	Buffalo, N.Y.
							18495040	113919	199843	406814	19215615	
Burden @ 13% of Labor Cost									25980		25980	
Labor @ 15% of Labor Cost									29976		29976	
Material @ 5% of Material Cost								5696			5696	
Subcontract @ 10% of Sub. Cost							1849504				1849504	
Total Direct Cost							20344544	119614	255799	406814	21126771	
Indirects @ 75% of Total Direct Labor Cost									191849		191849	
Profit @ 10% Total Direct Cost											2112677	
											23431298	
Health & Safety Monitoring @ .029											679508	
Total Field Cost											24110805	
Contingency @ 20% of Total Field Cost											4822161	
Engineering @ 6% of Total Field Cost											1446648	
TOTAL COST THIS PAGE											30379615	

AR302503

C & R BATTERY SITE
Chesterfield Co., Virginia
Soil Washing/Onsite Nonhazardous Disposal,
1000 mg/kg Action Level
Alternative No. 4b
Post Remedial Monitoring
(O&MCR4b)

Annual Costs

ITEM	ITEM $ ANNUAL SAMPLING	ITEM $ COST FOR 5 YEARS	NOTES
1. Sampling	1600.00		4 groundwater samples, 24 manhours per sampling period plus travel, living sample shipping costs.
2. Analysis	10000.00		40 samples per year (inc. blank & duplicate), Inorganics, Water Quality & Indicator Parameters
3. Reporting	950.00		20 manhours per report plus other direct costs.
4. Site Maintenance	2000.00		Inspection, Erosion Control, Mowing and Revegetation, Fence Maintenance
5. Analysis Review		20000.00	Analysis Review performed for years 5,10,15,20,25,30
TOTAL ANNUAL COST	14550.00	20000.00	Post Remedial monitoring will be performed annually for years 1 thru 30

C & R BATTERY SITE
Chesterfield Co., Virginia
Soil Washing/Onsite Nonhazardous Disposal
1000 mg/kg Action Level
Alternative No. 4b
(PWACR4b)
30660

PRESENT WORTH ANALYSIS

COST/YEAR COST OCCURS ($000'S)

COST COMPONENT	0	1	2	3	4	5	6	7	8	9	10	11
1. CAPITAL COST	30379.6											
2. O & M COSTS	---	14.6										
3. ANNUAL COSTS	30379.6	14.6	14.6	14.6	14.6	34.6	14.6	14.6	14.6	14.6	34.6	14.6
4. ANNUAL DISCOUNT RATE=5%	1	.952	.907	.864	.823	.784	.746	.711	.677	.645	.614	.585
PRESENT WORTH =	30380	14	13	13	12	27	11	10	10	9	21	9

	12	13	14	15	16	17	18	19	20	21	22	23
O & M COSTS	14.6	14.6	14.6	34.6	14.6	14.6	14.6	14.6	34.6	14.6	14.6	14.6
ANNUAL DISCOUNT RATE=5%	.557	.53	.505	.481	.458	.436	.416	.396	.377	.359	.342	.326
PRESENT WORTH =	8	8	7	17	7	6	6	6	13	5	5	5

	24	25	26	27	28	29	30	TOTAL PRESENT WORTH (000'S)
O & M COSTS	14.6	34.6	14.6	14.6	14.6	14.6	34.6	
ANNUAL DISCOUNT RATE=5%	.31	.295	.281	.268	.255	.243	.231	
PRESENT WORTH =	5	10	4	4	4	4	8	30660

AR302505

ALTERNATIVE 4c

IN-SITU VITRIFICATION - 1,000 mg/kg ACTION LEVEL, RCRA CAP OVER RESIDUAL CONTAMINATION

C & R BATTERY SITE
Chesterfield Co., Virginia
In-Situ Vitrification
1000 mg/kg Action Level
Alternative No. 4c
(CRS4c)

Item	Qty	Unit	Unit Cost				Total Cost				Total Direct Cost	Comments
			Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.		
EXCAVATION												
1) Excavate Soil	6898	CY			.80	1.50			5518	10347	15865	
2) Excavate Dike	184	CY			.80	1.50			147	276	423	
3) Excavate Sediments	350	CY			.80	1.50			280	525	805	
4) Excavate Debris Pile	233	CY			.80	1.50			186	350	536	
5) Excavate Drainage Channel	1300	CY			.80	1.50			1040	1950	2990	Temporary
6) Chain Link Fence - 6"	400	LF	12.00				4800				4800	Temporary
7) Relocate Existing Fence	1100	LF	10.00				11000				11000	
8) Monitoring Wells	280	LF	100.00				28000				28000	4 @ 70'
DISMANTLEMENT/DISPOSAL												
9) Dismantle Storage Shed												
a) Dismantle Shed	60	MH			20.00	20.00			1200	1200	2400	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	2	TON	30.00				60				60	Local Landfill
10) Dispose Tires & Misc. Debris												
a) Split Open Tires	80	MH			20.00	20.00			1600	1600	3200	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	10	TON	30.00				300				300	Local Landfill
11) Treat Drainage Ditch Water												
a) Hauling (2 Trucks @ 500 Mi.)	1000	MI	4.00				4000				4000	RCRA
b) Treatment	50070	LB	.08				4006				4006	Treatment Facility
12) Treat Decon Fluids												
a) Hauling (3 Trucks @ 500 Mi.)	1500	MI	4.00				6000				6000	RCRA
b) Treatment	125100	LB	.08				10008				10008	Treatment Facility
IN-SITU VITRIFICATION												
13) Waste Soil	8278	CY			.41	1.17			3394	9685	13079	1 mi. R.T.
a) Place, Spread & Compact	8278	CY			.84	2.67			6954	22102	29056	Sheepsfoot Roller
14) Treatability Testing		LS	100000.00				100000				100000	
15) Mobilization/Demobilization		LS	250000.00				250000				250000	
16) In-Situ Vitrification	51465	TON	263.00				13535295				13535295	
							13953769	0	20320	48035	14022123	

AR302507

C & R BATTERY SITE
Chesterfield Co., Virginia
In-Situ Vitrification, Cap Residual Contamination
1000 mg/kg Action Level
Alternative No. 4c
(CRS4c)
Page 2 Of 2

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
Page 1 Total							13953769	0	20320	48035	14022123	
RECLAMATION												
17) Backfill Excavated Areas	9887	CY		3.50	2.70	7.43		34605	26695	73460	134760	20 mi. R.T.
a) Place, Spread & Compact	9887	CY			.84	2.67			8305	26398	34703	Sheepsfoot Roller
18) Topsoil - 3"	8788	CY		6.00	2.70	7.43		52728	23728	65295	141750	20 mi. R.T.
a) Place & Spread	8788	CY			.63	.57			5536	5009	10546	
19) Topsoil - 3"(Cleared Area)	1613	CY		6.00	2.70	7.43		9678	4355	11985	26018	20 mi. R.T.
a) Place & Spread	1613	CY			.63	.57			1016	919	1936	
20) Revegetation												
a) Excavated Area	474.5	MSF		24.60	5.60	4.45		11673	2657	2112	16441	
BATTERY DISPOSAL												
21) Drain Ni/Cd Batteries		LS			320.00				320		320	350 Batteries
22) Package Batteries In Drum	8	DR		100.00	80.00	40.00		800	640	320	1760	
23) Vermiculite Packing	10	BAGS		15.00	10.00			150	100		250	
24) Laboratory Analysis		LS	650.00				650				650	TAL Metals
25) Hauling	480	MI	4.00				1920				1920	480 Mi.
26) Treatment/Disposal Landfill	7000	LB	4.60				32200				32200	Buffalo, N.Y.
							13988539	109633	93672	233533	14425377	
Burden @ 13% of Labor Cost									12177		12177	
Labor @ 15% of Labor Cost									14051		14051	
Material @ 5% of Material Cost								5482			5482	
Subcontract @ 10% of Sub. Cost							1398854				1398854	
Total Direct Cost							15387392	115115	119900	233533	15855941	
Indirects @ 75% of Total Direct Labor Cost									89925		89925	
Profit @ 10% Total Direct Cost											1585594	
											17531460	
Health & Safety Monitoring @ .057											262972	
Total Field Cost											17794432	
Contingency @ 20% of Total Field Cost											3558886	
Engineering @ 6% of Total Field Cost											1423555	
TOTAL COST THIS PAGE											22776873	

AR302508

C & R BATTERY SITE
Chesterfield Co., Virginia
In-Situ Vitrification
1000 mg/kg Action Level
Alternative No. 4c
Post Remedial Monitoring
(O&MCR4c)

Annual Costs

ITEM	ITEM $ ANNUAL SAMPLING	ITEM $ COST FOR 5 YEARS	NOTES
1. Sampling	1600.00		4 groundwater samples, 24 manhours per sampling period plus travel, living sample shipping costs.
2. Analysis	10000.00		40 samples per year (inc. blank & duplicate), Inorganics, Water Quality & Indicator Parameters
3. Reporting	950.00		20 manhours per report plus other direct costs.
4. Site Maintenance	2000.00		Inspection, Erosion Control, Mowing and Revegetation, Fence Maintenance
5. Analysis Review		20000.00	Analysis Review performed for years 5,10,15,20,25,30
TOTAL ANNUAL COST	14550.00	20000.00	Post Remedial monitoring will be performed annually for years 1 thru 30

C & R BATTERY SITE
Chesterfield co., Virginia
In-Situ Vitrification
1000 mg/kg Action Level
Alternative No. 4c
(PWACR4c)
23057

PRESENT WORTH ANALYSIS

COST/YEAR COST OCCURS ($000'S)

COST COMPONENT	0	1	2	3	4	5	6	7	8	9	10	11
1. CAPITAL COST	22776.9											
2. O & M COSTS	---	14.6										
3. ANNUAL COSTS	22776.9	14.6	14.6	14.6	14.6	34.6	14.6	14.6	14.6	14.6	34.6	14.6
4. ANNUAL DISCOUNT RATE=5%	1	.952	.907	.864	.823	.784	.746	.711	.677	.645	.614	.585
PRESENT WORTH =	22777	14	13	13	12	27	11	10	10	9	21	9

	12	13	14	15	16	17	18	19	20	21	22	23
O & M COSTS	14.6	14.6	14.6	34.6	14.6	14.6	14.6	14.6	34.6	14.6	14.6	14.6
ANNUAL DISCOUNT RATE=5%	.557	.53	.505	.481	.458	.436	.416	.396	.377	.359	.342	.326
PRESENT WORTH =	8	8	7	17	7	6	6	6	13	5	5	5

	24	25	26	27	28	29	30	TOTAL PRESENT WORTH (000'S)
O & M COSTS	14.6	34.6	14.6	14.6	14.6	14.6	34.6	
ANNUAL DISCOUNT RATE=5%	.31	.295	.281	.268	.255	.243	.231	
PRESENT WORTH =	5	10	4	4	4	4	8	23057

AR302510

ALTERNATIVE 5a

STABILIZATION - 1,000 mg/kg ACTION LEVEL, OFFSITE DISPOSAL IN SANITARY/INDUSTRIAL WASTE LANDFILL, OFFSITE DISPOSAL OF RESIDUAL CONTAMINATION IN SANITARY/INDUSTRIAL WASTE LANDFILL

C & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization/Offsite Disposal In Sanitary Landfill, Dispose Residual Contamination
1000 mg/kg Action Level
Alternative No. 5a1
(CRS5a1)

Item	Qty	Unit	Unit Cost				Total Cost				Total Direct Cost	Comments
			Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.		
EXCAVATION												
1) Excavate Soil (Above 1000mg/kg)	35994	CY			.80	1.50			28795	53991	82786	
2) Excavate Residual Soil	43529	CY			.80	1.50			34823	65294	100117	
3) Excavate Dike	184	CY			.80	1.50			147	276	423	
4) Excavate Sediments	350	CY			.80	1.50			280	525	805	
5) Excavate Debris Pile	233	CY			.80	1.50			186	350	536	
6) Excavate Drainage Channel	1300	CY			.80	1.50			1040	1950	2990	Temporary
7) Excavate Drainage Channel	1300	CY			.80	1.50			1040	1950	2990	Permanent
8) Clear & Grub	4	AC			4000.00	5500.00			16000	22000	38000	
9) Chain Link Fence - 6"	400	LF	12.00				4800				4800	Temporary
10) Relocate Existing Fence	1100	LF	10.00				11000				11000	Temporary
11) Relocate Fence To Orig. Location	1100	LF	10.00				11000				11000	
DISMANTLEMENT/DISPOSAL												
12) Dismantle Storage Shed												
a) Dismantle Shed	60	MH			20.00	20.00			1200	1200	2400	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	2	TON	30.00				60				60	Local Landfill
13) Dismantle Concrete Pad												
a) Dismantle Concrete Pad	833	CY			48.00	28.00			39984	23324	63308	
b) Hauling	85	LD	150.00				12750				12750	15 mi.
c) Disposal	1688	TON	30.00				50640				50640	Local Landfill
14) Dispose Tires & Misc. Debris												
a) Split Open Tires	80	MH			20.00	20.00			1600	1600	3200	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	10	TON	30.00				300				300	Local Landfill
15) Treat Drainage Ditch Water												
a) Hauling (2 Trucks @ 500 Mi.)	1000	MI	4.00				4000				4000	RCRA
b) Treatment	50070	LB	.08				4006				4006	Treatment Facility
16) Treat Decon Fluids												
a) Hauling (3 Trucks @ 500 Mi.)	1500	MI	4.00				6000				6000	RCRA
b) Treatment	125100	LB	.08				10008				10008	Treatment Facility
STABILIZATION												
17) Waste Soil Stabilization	44113	CY	70.00				3087910				3087910	
18) Soil Analyses (Every 100 CY)	735		100.00				73500				73500	Every 100 C.Y.
DISPOSAL												
19) Loading Stabilized Soil	73522	CY			.32	.52			23527	38231	61758	Front End Loader
20) Hauling - 20 CY Truck	5882	LD	150.00				882300				882300	15 mi.
21) Disposal	117635	TON	30.00				3529050				3529050	Local Landfill
22) Loading Residual Soil	52235	CY			.32	.52			16715	27162	43877	Front End Loader
23) Hauling - 20 CY Truck	3657	LD	150.00				548550				548550	15 mi.
24) Disposal	73129	TON	30.00				2193870				2193870	Local Landfill
							10430044	0	165338	237853	10833234	

AR302512

C & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization/Offsite Disposal In Sanitary Landfill, Dispose Residual Contamination
1000 mg/kg Action Level
Alternative No. 5a1
(CRS5a1)
Page 2 Of 2

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
Page 1 Total							10430044	0	165338	237853	10833234	
RECLAMATION												
25) Backfill Excavated Areas	94128	CY		3.50	2.70	7.43		329448	254146	699371	1282965	20 mi. R.T.
a) Place, Spread & Compact	94128	CY			.84	2.67			79068	251322	330389	Sheepsfoot Roller
26) Topsoil - 3"	4394	CY		6.00	2.70	7.43		26364	11864	32647	70875	20 mi. R.T.
a) Place & Spread	4394	CY			.63	.57			2768	2505	5273	
27) Topsoil - 3"(Cleared Area)	1613	CY		6.00	2.70	7.43		9678	4355	11985	26018	20 mi. R.T.
a) Place & Spread	1613	CY			.63	.57			1016	919	1936	
28) Revegetation												
a) Excavated Area	474.5	MSF		24.60	5.60	4.45		11673	2657	2112	16441	
b) Cleared Area	174.2	MSF		24.60	5.60	4.45		4285	976	775	6036	
BATTERY DISPOSAL												
29) Drain Ni/Cd Batteries		LS			320.00				320		320	350 Batteries
30) Package Batteries In Drum	8	DR		100.00	80.00	40.00		800	640	320	1760	
31) Vermiculite Packing	10	BAGS		15.00	10.00			150	100		250	
32) Laboratory Analysis		LS	650.00				650				650	TAL Metals
33) Hauling	480	MI	4.00				1920				1920	480 Mi.
34) Treatment/Disposal Landfill	7000	LB	4.60				32200				32200	Buffalo, N.Y.
							10464814	382398	523247	1239808	12610267	
Burden @ 13% of Labor Cost									68022		68022	
Labor @ 15% of Labor Cost									78487		78487	
Material @ 5% of Material Cost								19120			19120	
Subcontract @ 10% of Sub. Cost							1046481				1046481	
Total Direct Cost							11511295	401518	669757	1239808	13822378	
Indirects @ 75% of Total Direct Labor Cost									502317		502317	
Profit @ 10% Total Direct Cost											1382238	
											15706933	
Health & Safety Monitoring @ .043											675398	
Total Field Cost											16382331	
Contingency @ 20% of Total Field Cost											3276466	
Engineering @ 6% of Total Field Cost											982940	
TOTAL COST THIS PAGE											20641737	

AR302513

C & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization, Offsite Disposal In Sanitary Landfill
1000 mg/kg Action Level
Alternative No. 5a1
Post Remedial Monitoring
(O&MCR5a1)

Annual Costs

ITEM	ITEM $ ANNUAL SAMPLING	ITEM $ COST FOR 5 YEARS	NOTES
1. Analysis Review		20000.00	Analysis Review performed for years 5,10,15,20,25,30
TOTAL ANNUAL COST	.00	20000.00	Analysis Review performed for years 5,10,15,20,25,30

C & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization, Offsite Disposal In Sanitary Landfill
1000 mg/kg Action Level
Alternative No. 5a1
(PWACR5a1)
20697

PRESENT WORTH ANALYSIS

COST/YEAR COST OCCURS ($000'S)

COST COMPONENT	0	1	2	3	4	5	6	7	8	9	10	11
1. CAPITAL COST	20641.7											
2. O & M COSTS	---	0										
3. ANNUAL COSTS	20641.7	0	0	0	0	20	0	0	0	0	20	0
4. ANNUAL DISCOUNT RATE=5%	1	.952	.907	.864	.823	.784	.746	.711	.677	.645	.614	.585
PRESENT WORTH =	20642	0	0	0	0	16	0	0	0	0	12	0

	12	13	14	15	16	17	18	19	20	21	22	23
O & M COSTS	0	0	0	20	0	0	0	0	20	0	0	0
ANNUAL DISCOUNT RATE=5%	.557	.53	.505	.481	.458	.436	.416	.396	.377	.359	.342	.326
PRESENT WORTH =	0	0	0	10	0	0	0	0	8	0	0	0

	24	25	26	27	28	29	30	TOTAL PRESENT WORTH (000'S)
O & M COSTS	0	20	0	0	0	0	20	
ANNUAL DISCOUNT RATE=5%	.31	.295	.281	.268	.255	.243	.231	
PRESENT WORTH =	0	6	0	0	0	0	5	20697

AR302515

ALTERNATIVE 5a (OPTION 2)

STABILIZATION - 1,000 mg/kg ACTION LEVEL, OFFSITE DISPOSAL IN HAZARDOUS WASTE LANDFILL, OFFSITE DISPOSAL OF RESIDUAL CONTAMINATION IN HAZARDOUS WASTE LANDFILL

C & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization/Offsite Disposal In Hazardous Waste Landfill
1000 mg/kg Action Level
Alternative No. 5a2
(CRS5a2)
Page 1 Of 2

Item	Qty	Unit	Unit Cost				Total Cost				Total Direct Cost	Comments
			Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.		
EXCAVATION												
1) Excavate Soil (Above 1000mg/kg)	35994	CY			.80	1.50			28795	53991	82786	
2) Excavate Residual Soil	43529	CY			.80	1.50			34823	65294	100117	
3) Excavate Dike	184	CY			.80	1.50			147	276	423	
4) Excavate Sediments	350	CY			.80	1.50			280	525	805	
5) Excavate Debris Pile	233	CY			.80	1.50			186	350	536	
6) Excavate Drainage Channel	1300	CY			.80	1.50			1040	1950	2990	Temporary
7) Excavate Drainage Channel	1300	CY			.80	1.50			1040	1950	2990	Permanent
8) Clear & Grub	4	AC			4000.00	5500.00			16000	22000	38000	
9) Chain Link Fence - 6"	400	LF	12.00				4800				4800	Temporary
10) Relocate Existing Fence	1100	LF	10.00				11000				11000	Temporary
11) Relocate Fence To Orig. Location	1100	LF	10.00				11000				11000	
DISMANTLEMENT/DISPOSAL												
12) Dismantle Storage Shed												
a) Dismantle Shed	60	MH			20.00	20.00			1200	1200	2400	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	2	TON	30.00				60				60	Local Landfill
13) Dismantle Concrete Pad												
a) Dismantle Concrete Pad	833	CY			48.00	28.00			39984	23324	63308	
b) Hauling	85	LD	150.00				12750				12750	15 mi.
c) Disposal	1688	TON	30.00				50640				50640	Local Landfill
14) Dispose Tires & Misc. Debris												
a) Split Open Tires	80	MH			20.00	20.00			1600	1600	3200	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	10	TON	30.00				300				300	Local Landfill
15) Treat Drainage Ditch Water												
a) Hauling (2 Trucks @ 500 Mi.)	1000	MI	4.00				4000				4000	RCRA
b) Treatment	50070	LB	.08				4006				4006	Treatment Facility
16) Treat Decon Fluids												
a) Hauling (3 Trucks @ 500 Mi.)	1500	MI	4.00				6000				6000	RCRA
b) Treatment	125100	LB	.08				10008				10008	Treatment Facility
STABILIZATION												
17) Waste Soil Stabilization	44113	CY	70.00				3087910				3087910	
18) Soil Analyses (Every 100 CY)	735		100.00				73500				73500	Every 100 C.Y.
DISPOSAL												
19) Loading Stabilized Soil	73522	CY			.32	.52			23527	38231	61758	Front End Loader
20) Hauling - 20 CY Truck	2705720	MI	4.00				10822880				10822880	460 mi.
21) Disposal	117635	TON	150.00				17645250				17645250	Model City, N.Y.
22) Loading Residual Soil	52235	CY			.32	.52			16715	27162	43877	Front End Loader
23) Hauling - 20 CY Truck	1682220	MI	4.00				6728880				6728880	460 mi.
24) Disposal	73129	TON	150.00				10969350				10969350	Model City, N.Y.
							49442634	0	165338	237853	49845824	

AR302517

C & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization/Offsite Disposal In Hazardous Waste Landfill
1000 mg/kg Action Level
Alternative No. 5a2
(CRS5a2)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
Page 1 Total							49442634	0	165338	237853	49845824	
RECLAMATION												
25) Backfill Excavated Areas	94128	CY		3.50	2.70	7.43		329448	254146	699371	1282965	20 mi. R.T.
a) Place, Spread & Compact	94128	CY			.84	2.67			79068	251322	330389	Sheepsfoot Roller
26) Topsoil - 3"	4394	CY		6.00	2.70	7.43		26364	11864	32647	70875	20 mi. R.T.
a) Place & Spread	4394	CY			.63	.57			2768	2505	5273	
27) Topsoil - 3"(Cleared Area)	1613	CY		6.00	2.70	7.43		9678	4355	11985	26018	20 mi. R.T.
a) Place & Spread	1613	CY			.63	.57			1016	919	1936	
28) Revegetation												
a) Excavated Area	474.5	MSF		24.60	5.60	4.45		11673	2657	2112	16441	
b) Cleared Area	174.2	MSF		24.60	5.60	4.45		4285	976	775	6036	
BATTERY DISPOSAL												
29) Drain Ni/Cd Batteries		LS			320.00				320		320	350 Batteries
30) Package Batteries In Drum	8	DR		100.00	80.00	40.00		800	640	320	1760	
31) Vermiculite Packing	10	BAGS		15.00	10.00			150	100		250	
32) Laboratory Analysis		LS	650.00				650				650	TAL Metals
33) Hauling	480	MI	4.00				1920				1920	480 Mi.
34) Treatment/Disposal Landfill	7000	LB	4.60				32200				32200	Buffalo, N.Y.
							49477404	382398	523247	1239808	51622857	
Burden @ 13% of Labor Cost									68022		68022	
Labor @ 15% of Labor Cost									78487		78487	
Material @ 5% of Material Cost								19120			19120	
Subcontract @ 10% of Sub. Cost							4947740				4947740	
Total Direct Cost							54425144	401518	669757	1239808	56736227	
Indirects @ 75% of Total Direct Labor Cost									502317		502317	
Profit @ 10% Total Direct Cost											5673623	
											62912167	
Health & Safety Monitoring @ .011											692034	
Total Field Cost											63604201	
Contingency @ 20% of Total Field Cost											12720840	
Engineering @ 2% of Total Field Cost											1272084	
TOTAL COST THIS PAGE											77597125	

AR302518

C & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization, Offsite Disposal In
Hazardous Waste Landfill
1000 mg/kg Action Level
Alternative No. 5a2
Post Remedial Monitoring
(O&MCR5a2)

Annual Costs

ITEM	ITEM $ ANNUAL SAMPLING	ITEM $ COST FOR 5 YEARS	NOTES
1. Analysis Review		20000.00	Analysis Review performed for years 5,10,15,20,25,30
TOTAL ANNUAL COST	.00	20000.00	Analysis Review performed for years 5,10,15,20,25,30

C & R [illegible]RY SITE
Chesterfield co., Virginia
Stabilization, Offsite Disposal In Hazardous Waste Landfill
1000 mg/kg Action Level
Alternative No. 5a2
(PWACR5a2)
77653

PRESENT WORTH ANALYSIS

COST/YEAR COST OCCURS ($000'S)

COST COMPONENT	0	1	2	3	4	5	6	7	8	9	10	11
1. CAPITAL COST	77597.1											
2. O & M COSTS	---	0										
3. ANNUAL COSTS	77597.1	0	0	0	0	20	0	0	0	0	20	0
4. ANNUAL DISCOUNT RATE=5%	1	.952	.907	.864	.823	.784	.746	.711	.677	.645	.614	.585
PRESENT WORTH =	77597	0	0	0	0	16	0	0	0	0	12	0

	12	13	14	15	16	17	18	19	20	21	22	23
O & M COSTS	0	0	0	20	0	0	0	0	20	0	0	0
ANNUAL DISCOUNT RATE=5%	.557	.53	.505	.481	.458	.436	.416	.396	.377	.359	.342	.326
PRESENT WORTH =	0	0	0	10	0	0	0	0	8	0	0	0

	24	25	26	27	28	29	30	TOTAL PRESENT WORTH (000'S)
O & M COSTS	0	20	0	0	0	0	20	
ANNUAL DISCOUNT RATE=5%	.31	.295	.281	.268	.255	.243	.231	
PRESENT WORTH =	0	6	0	0	0	0	5	77653

AR302520

ALTERNATIVE 5b

SOIL WASHING - 1,000 mg/kg ACTION LEVEL,ONSITE NONHAZARDOUS DISPOSAL, OFFSITE DISPOSAL OF RESIDUAL CONTAMINATION IN SANITARY/INDUSTRIAL WASTE LANDFILL

C & H BATTERY SITE
Chesterfield Co., Virginia
Soil Washing/Onsite Nonhazardous Disposal, Dispose Residual Contamination
1000 mg/kg Action Level
Alternative No. 5b
(CB5b)
Page 1 Of 2

Item	Qty	Unit	Unit Cost Sub.	Mat.	Labor	Equip.	Total Cost Sub.	Mat.	Labor	Equip.	Total Direct Cost	Comments
EXCAVATION												
1) Excavate Soil	35994	CY			.80	1.50			28795	53991	82786	
2) Excavate Residual Soil	43529	CY			.80	1.50			34823	65294	100117	
3) Excavate Dike	184	CY			.80	1.50			147	276	423	
4) Excavate Sediments	350	CY			.80	1.50			280	525	805	
5) Excavate Debris Pile	233	CY			.80	1.50			186	350	536	
6) Excavate Drainage Channel	1300	CY			.80	1.50			1040	1950	2990	Temporary
7) Clear & Grub	4	AC			4000.00	5500.00			16000	22000	38000	
8) Chain Link Fence - 6"	400	LF	12.00				4800				4800	Temporary
9) Relocate Existing Fence	1100	LF	10.00				11000				11000	Temporary
10) Relocate Fence To Orig. Location	1100	LF	10.00				11000				11000	
DISMANTLEMENT/DISPOSAL												
11) Dismantle Storage Shed												
a) Dismantle Shed	60	MH			20.00	20.00			1200	1200	2400	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	2	TON	30.00				60				60	Local Landfill
12) Dismantle Concrete Pad												
a) Dismantle Concrete Pad	833	CY			48.00	28.00			39984	23324	63308	
b) Hauling	85	LD	150.00				12750				12750	15 mi.
c) Disposal	1688	TON	30.00				50640				50640	Local Landfill
13) Dispose Tires & Misc. Debris												
a) Split Open Tires	80	MH			20.00	20.00			1600	1600	3200	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	10	TON	30.00				300				300	Local Landfill
14) Dispose Battery Casings												
a) Hauling	169	LD	150.00				25350				25350	15 mi.
b) Disposal	3380	TON	30.00				101400				101400	Local Landfill
15) Treat Drainage Ditch Water												
a) Hauling (2 Trucks @ 500 Mi.)	1000	MI	4.00				4000				4000	RCRA
b) Treatment	50070	LB	.08				4006				4006	Treatment Facility
16) Treat Decon Fluids												
a) Hauling (3 Trucks @ 500 Mi.)	1500	MI	4.00				6000				6000	RCRA
b) Treatment	125100	LB	.08				10008				10008	Treatment Facility
SOIL WASHING												
17) Waste Soil Soil Washing	44113	CY	412.00				18174556				18174556	
18) Soil Analyses (Every 100 CY)	441		100.00				44100				44100	Every 100 C.Y.
DISPOSAL												
19) Loading Residual Soil	52235	CY			.32	.52			16715	27162	43877	Front End Loader
20) Hauling - 20 CY Truck	3657	LD	150.00				548550				548550	15 mi.
21) Disposal Residual Soil	73129	TON	30.00				2193870				2193870	Local Landfill
							21202690	0	140771	197671	21541132	

AR302522

C & R BATTERY SITE
Chesterfield Co., Virginia
Soil Washing/Onsite Nonhazardous Disposal, Dispose Residual Contamination
1000 mg/kg Action Level
Alternative No. 5b
(CRS5b)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
Page 1 Total							21202690	0	140771	197671	21541132	
RECLAMATION												
22) Backfill Treated Soil												
a) Place, Spread & Compact	43193	CY			.84	2.67			36282	115325	151607	Sheepsfoot Roller
23) Backfill Clean Soil	50935	CY		3.50	2.70	7.43		178273	137525	378447	694244	20 mi. R.T.
a) Place, Spread & Compact	50935	CY			.84	2.67			42785	135996	178782	Sheepsfoot Roller
24) Topsoil - 3"	4394	CY		6.00	2.70	7.43		26364	11864	32647	70875	20 mi. R.T.
a) Place & Spread	4394	CY			.63	.57			2768	2505	5273	
25) Topsoil - 3"(Cleared Area)	1613	CY		6.00	2.70	7.43		9678	4355	11985	26018	20 mi. R.T.
a) Place & Spread	1613	CY			.63	.57			1016	919	1936	
26) Revegetation												
a) Excavated Area	474.5	MSF		24.60	5.60	4.45		11673	2657	2112	16441	
b) Cleared Area	174.2	MSF		24.60	5.60	4.45		4285	976	775	6036	
BATTERY DISPOSAL												
27) Drain Ni/Cd Batteries		LS			320.00				320		320	350 Batteries
28) Package Batteries In Drum	8	DR		100.00	80.00	40.00		800	640	320	1760	
29) Vermiculite Packing	10	BAGS		15.00	10.00			150	100		250	
30) Laboratory Analysis		LS	650.00				650				650	TAL Metals
31) Hauling	480	MI	4.00				1920				1920	480 Mi.
32) Treatment/Disposal Landfill	7000	LB	4.60				32200				32200	Buffalo, N.Y.
							21237460	231223	382059	878703	22729444	
Burden @ 13% of Labor Cost									49668		49668	
Labor @ 15% of Labor Cost									57309		57309	
Material @ 5% of Material Cost								11561			11561	
Subcontract @ 10% of Sub. Cost							2123746				2123746	
Total Direct Cost							23361206	242784	489036	878703	24971728	
Indirects @ 75% of Total Direct Labor Cost									366777		366777	
Profit @ 10% Total Direct Cost											2497173	
											27835677	
Health & Safety Monitoring @ .025											695892	
Total Field Cost											28531569	
Contingency @ 20% of Total Field Cost											5706314	
Engineering @ 5% of Total Field Cost											1426578	
TOTAL COST THIS PAGE											35664462	

AR302523

C & R BATTERY SITE
Chesterfield Co., Virginia
Soil Washing/Onsite Nonhazardous Disposal
1000 mg/kg Action Level
Alternative No. 5b
Post Remedial Monitoring
(O&MCR5b)

Annual Costs

ITEM	ITEM $ ANNUAL SAMPLING	ITEM $ COST FOR 5 YEARS	NOTES
1. Analysis Review		20000.00	Analysis Review performed for years 5,10,15,20,25,30
TOTAL ANNUAL COST	.00	20000.00	Analysis Review performed for years 5,10,15,20,25,30

C & R BAT[illegible] SITE
Chesterfield Co., Virginia
Soil Wahing/Onsite Nonhazardous Disposal
1000 mg/kg Action Level
Alternative No. 5b
(PWACR5b)
35720

PRESENT WORTH ANALYSIS

COST COMPONENT	COST/YEAR COST OCCURS ($000'S) 0	1	2	3	4	5	6	7	8	9	10	11
1. CAPITAL COST	35664.5											
2. O & M COSTS	---	0										
3. ANNUAL COSTS	35664.5	0	0	0	0	20	0	0	0	0	20	0
4. ANNUAL DISCOUNT RATE=5%	1	.952	.907	.864	.823	.784	.746	.711	.677	.645	.614	.585
PRESENT WORTH =	35665	0	0	0	0	16	0	0	0	0	12	0

	12	13	14	15	16	17	18	19	20	21	22	23
O & M COSTS	0	0	0	20	0	0	0	0	20	0	0	0
ANNUAL DISCOUNT RATE=5%	.557	.53	.505	.481	.458	.436	.416	.396	.377	.359	.342	.326
PRESENT WORTH =	0	0	0	10	0	0	0	0	8	0	0	0

	24	25	26	27	28	29	30	TOTAL PRESENT WORTH (000'S)
O & M COSTS	0	20	0	0	0	0	20	
ANNUAL DISCOUNT RATE=5%	.31	.295	.281	.268	.255	.243	.231	
PRESENT WORTH =	0	6	0	0	0	0	5	35720

AR302525

ALTERNATIVE 5c

IN-SITU VITRIFICATION - 1,000 mg/kg ACTION LEVEL, OFFSITE DISPOSAL OF RESIDUAL CONTAMINATION IN SANITARY/INDUSTRIAL WASTE LANDFILL

C & R BATTERY SITE
Chesterfield Co., Virginia
In-Situ Vitrification, Dispose Residual Contamination
1000 mg/kg Action Level
Alternative No. 5c
(CRS5c)

Item	Qty	Unit	Unit Cost				Total Cost				Total Direct Cost	Comments
			Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.		
EXCAVATION												
1) Excavate Soil	6898	CY			.80	1.50			5518	10347	15865	
2) Excavate Residual Soil	43529	CY			.80	1.50			34823	65294	100117	
3) Excavate Dike	184	CY			.80	1.50			147	276	423	
4) Excavate Sediments	350	CY			.80	1.50			280	525	805	
5) Excavate Debris Pile	233	CY			.80	1.50			186	350	536	
6) Excavate Drainage Channel	1300	CY			.80	1.50			1040	1950	2990	Temporary
7) Chain Link Fence - 6"	400	LF	12.00				4800				4800	Temporary
8) Relocate Fence To Orig. Location	1100	LF	10.00				11000				11000	
9) Monitoring Well	280	LF	100.00				28000				28000	4 @ 70'
DISMANTLEMENT/DISPOSAL												
10) Dismantle Storage Shed												
a) Dismantle Shed	60	MH			20.00	20.00			1200	1200	2400	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	2	TON	30.00				60				60	Local Landfill
11) Dispose Tires & Misc. Debris												
a) Split Open Tires	80	MH			20.00	20.00			1600	1600	3200	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	10	TON	30.00				300				300	Local Landfill
12) Treat Drainage Ditch Water												
a) Hauling (2 Trucks @ 500 Mi.)	1000	MI	4.00				4000				4000	RCRA
b) Treatment	50070	LB	.08				4006				4006	Treatment Facility
13) Treat Decon Fluids												
a) Hauling (3 Trucks @ 500 Mi.)	1500	MI	4.00				6000				6000	RCRA
b) Treatment	125000	LB	.08				10000				10000	Treatment Facility
IN-SITU VITRIFICATION												
14) Waste Soil	8278	CY			.41	1.17			3394	9685	13079	1 mi. R.T.
a) Place, Spread & Compact	8278	CY			.84	2.67			6954	22102	29056	Sheepsfoot Roller
15) Treatability Testing		LS	100000.00				100000				100000	
16) Mobilization/Demobilization		LS	250000.00				250000				250000	
17) In-Situ Vitrification	51465	TON	263.00				13535295				13535295	
18) Soil Analysis (Every 100 CY)	522		100.00				52200				52200	
DISPOSAL												
19) Loading Residual Soil	52235	CY			.32	.52			16715	27162	43877	Front End Loader
20) Hauling - 20 CY Truck	3657	LD	150.00				548550				548550	15 mi.
21) Disposal Residual Soil	73129	TON	30.00				2193870				2193870	Local Landfill
							16748381	0	71858	140491	16960729	

AR302527

C & R BATTERY SITE
Chesterfield Co., Virginia
In-Situ Vitrification, Dispose Residual Contamination
1000 mg/kg Action Level
Alternative No. 5c
(CRS5c)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
Page 1 Total							16748381	0	71858	140491	16960729	
RECLAMATION												
22) Backfill Excavated Area	60513	CY		3.50	2.70	7.43		211796	163385	449612	824792	20 mi. R.T.
a) Place, Spread & Compact	60513	CY			.84	2.67			50831	161570	212401	Sheepsfoot Roller
23) Topsoil - 3"	4394	CY		6.00	2.70	7.43		26364	11864	32647	70875	20 mi. R.T.
a) Place & Spread	4394	CY			.63	.57			2768	2505	5273	
24) Topsoil - 3"(Cleared Area)	1613	CY		6.00	2.70	7.43		9678	4355	11985	26018	20 mi. R.T.
a) Place & Spread	1613	CY			.63	.57			1016	919	1936	
25) Revegetation												
a) Excavated Area	474.5	MSF		24.60	5.60	4.45		11673	2657	2112	16441	
BATTERY DISPOSAL												
26) Drain Ni/Cd Batteries		LS			320.00				320		320	350 Batteries
27) Package Batteries In Drum	8	DR		100.00	80.00	40.00		800	640	320	1760	
28) Vermiculite Packing	10	BAGS		15.00	10.00			150	100		250	
29) Laboratory Analysis		LS	650.00				650				650	TAL Metals
30) Hauling	480	MI	4.00				1920				1920	480 Mi.
31) Treatment/Disposal Landfill	7000	LB	4.60				32200				32200	Buffalo, N.Y.
							16783151	260460	309794	802160	18155565	
Burden @ 13% of Labor Cost									40273		40273	
Labor @ 15% of Labor Cost									46469		46469	
Material @ 5% of Material Cost								13023			13023	
Subcontract @ 10% of Sub. Cost							1678315				1678315	
Total Direct Cost							18461466	273483	396537	802160	19933645	
Indirects @ 75% of Total Direct Labor Cost									297403		297403	
Profit @ 10% Total Direct Cost											1993365	
											22224412	
Health & Safety Monitoring @ .046											1022323	
Total Field Cost											23246735	
Contingency @ 20% of Total Field Cost											4649347	
Engineering @ 5% of Total Field Cost											1162337	
TOTAL COST THIS PAGE											29058419	

AR302528

C & R BATTERY SITE
Chesterfield Co., Virginia
In-Situ Vitrification
1000 mg/kg Action Level
Alternative No. 5c
Post Remedial Monitoring
(O&MCR5c)

Annual Costs

ITEM	ITEM $ ANNUAL SAMPLING	ITEM $ COST FOR 5 YEARS	NOTES
1. Sampling	1600.00		4 groundwater, 3 sediment and 1 surface water sample 24 manhours per sampling period plus travel, living sample shipping costs.
2. Analysis	10000.00		40 samples per year (inc. blank & duplicate), Inorganics, Water Quality & Indicator Parameters
3. Reporting	950.00		20 manhours per report plus other direct costs.
4. Cap & Fence Maintenance	2000.00		Inspection, Erosion Control, Revegetation & Fence Maintenance
5. Analysis Review		20000.00	Analysis Review performed for years 5,10,15,20,25,30
TOTAL ANNUAL COST	14550.00	20000.00	Post Remedial monitoring will be performed annually for years 1 thru 30

C & R BAT[illegible] SITE
Chesterfield Co., Virginia
In-Situ Vitrification
1000 mg/kg Action Level
Alternative No. 5c
(PWACR5c)
29339

PRESENT WORTH ANALYSIS

COST COMPONENT	COST/YEAR COST OCCURS ($000'S) 0	1	2	3	4	5	6	7	8	9	10	11
1. CAPITAL COST	29058.4											
2. O & M COSTS	---	14.6										
3. ANNUAL COSTS	29058.4	14.6	14.6	14.6	14.6	34.6	14.6	14.6	14.6	14.6	34.6	14.6
4. ANNUAL DISCOUNT RATE=5%	1	.952	.907	.864	.823	.784	.746	.711	.677	.645	.614	.585
PRESENT WORTH =	29058	14	13	13	12	27	11	10	10	9	21	9

	12	13	14	15	16	17	18	19	20	21	22	23
O & M COSTS	14.6	14.6	14.6	34.6	14.6	14.6	14.6	14.6	34.6	14.6	14.6	14.6
ANNUAL DISCOUNT RATE=5%	.557	.53	.505	.481	.458	.436	.416	.396	.377	.359	.342	.326
PRESENT WORTH =	8	8	7	17	7	6	6	6	13	5	5	5

	24	25	26	27	28	29	30	TOTAL PRESENT WORTH (000'S)
O & M COSTS	14.6	34.6	14.6	14.6	14.6	14.6	34.6	
ANNUAL DISCOUNT RATE=5%	.31	.295	.281	.268	.255	.243	.231	
PRESENT WORTH =	5	10	4	4	4	4	8	29339

AR302530

ALTERNATIVE 6a

STABILIZATION - 10,000 mg/kg ACTION LEVEL, OFFSITE DISPOSAL IN SANITARY/INDUSTRIAL WASTE LANDFILL, RCRA CAP OVER RESIDUAL CONTAMINATION

C & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization/Offsite Disposal In Sanitary Landfill, Cap Residual Contamination
10000 mg/kg Action Level
Alternative No. 6a1
(CRS6a1)

Item	Qty	Unit	Unit Cost				Total Cost				Total Direct Cost	Comments
			Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.		
EXCAVATION												
1) Excavate Soil	13907	CY			.80	1.50			11126	20861	31986	
2) Excavate Dike	184	CY			.80	1.50			147	276	423	
3) Excavate Sediments	350	CY			.80	1.50			280	525	805	
4) Excavate Debris Pile	233	CY			.80	1.50			186	350	536	
5) Excavate Drainage Channel	1300	CY			.80	1.50			1040	1950	2990	Temporary
6) Excavate Drainage Channel	1300	CY			.80	1.50			1040	1950	2990	Permanent
7) Chain Link Fence - 6"	400	LF	12.00				4800				4800	Temporary
8) Relocate Existing Fence	1100	LF	10.00				11000				11000	Temporary
9) Relocate Fence To Orig. Location	1100	LF	10.00				11000				11000	
DISMANTLEMENT/DISPOSAL												
10) Dismantle Storage Shed												
a) Dismantle Shed	60	MH			20.00	20.00			1200	1200	2400	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	2	TON	30.00				60				60	Local Landfill
11) Dismantle Concrete Pad												
a) Dismantle Concrete Pad	833	CY			48.00	28.00			39984	23324	63308	
b) Hauling	85	LD	150.00				12750				12750	15 mi.
c) Disposal	1688	TON	30.00				50640				50640	Local Landfill
12) Dispose Tires & Misc. Debris												
a) Split Open Tires	80	MH			20.00	20.00			1600	1600	3200	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	10	TON	30.00				300				300	Local Landfill
13) Treat Drainage Ditch Water												
a) Hauling (2 Trucks @ 500 Mi.)	1000	MI	4.00				4000				4000	RCRA
b) Treatment	50070	LB	.08				4006				4006	Treatment Facility
14) Treat Decon Fluids												
a) Hauling (3 Trucks @ 500 Mi.)	1500	MI	4.00				6000				6000	RCRA
b) Treatment	125100	LB	.08				10008				10008	Treatment Facility
STABILIZATION												
15) Waste Soil Stabilization	17609	CY	80.00				1408720				1408720	
16) Soil Analyses (Every 100 CY)	293		100.00				29300				29300	Every 100 C.Y.
DISPOSAL												
17) Loading Stabilized Soil	29348	CY			.32	.52			9391	15261	24652	Front End Loader
18) Hauling - 20 CY Truck	2348	LD	150.00				352200				352200	15 mi.
19) Disposal	46957	TON	30.00				1408710				1408710	Local Landfill
CAPPING												
20) Residual Contaminated Soil												
a) Excavate	19645	CY			.80	1.50			15716	29468	45184	
b) Place, Spread & Compact	23570	CY			.84	2.67			19799	62932	82731	Sheepsfoot Roller
21) Soil - 6"	2453	CY		3.50	2.70	7.43		8586	6623	18226	33434	20 mi. R.T.
a) Place, Spread & Compact	2453	CY			.84	2.67			2061	6550	8610	Sheepsfoot Roller
22) Synthetic Liner	132450	SF	1.00				132450				132450	60 mil
23) Sand - 6"	2453	CY		3.50	2.70	7.43		8586	6623	18226	33434	20 mi. R.T.
a) Place & Spread	2453	CY			.63	.57			1545	1398	2944	
24) Filter Fabric	14717	SY		1.20	.30			17660	4415		22076	
25) Soil - 18"	9811	CY		3.50	2.70	7.43		34339	26490	72896	133724	20 mi. R.T.
a) Place, Spread & Compact	9811	CY			.84	2.67			8241	26195	34437	Sheepsfoot Roller
26) Topsoil - 6"	2453	CY		6.00	2.70	7.43		14718	6623	18226	39567	20 mi. R.T.
a) Place & Spread	2453	CY			.63	.57			1545	1398	2944	
27) Revegetation	132	MSF		24.60	5.60	4.45		3247	739	587	4574	
							3446244	97135	166115	323397	4023191	

AR302533

C & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization/Offsite Disposal In Sanitary Landfill, Cap Residual Contamination
10000 mg/kg Action Level
Alternative No. 6a1
(CRS6a1)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
Page 1 Total							3446244	87135	166415	323397	4023191	
RECLAMATION												
28) Backfill Excavated Areas	43412	CY		3.50	2.70	7.43		151942	117212	322551	591706	20 mi. R.T.
a) Place, Spread & Compact	43412	CY			.84	2.67			36466	115910	152376	Sheepsfoot Roller
29) Topsoil - 3"(excluding Cap Area)	3167	CY		6.00	2.70	7.43		19002	8551	23531	51084	20 mi. R.T.
a) Place & Spread	3167	CY			.63	.57			1995	1805	3800	
30) Revegetation												
a) Excavated Area(Excl.Cap Area)	342.6	MSF		24.60	5.60	4.45		8428	1919	1525	11871	
BATTERY DISPOSAL												
31) Drain Ni/Cd Batteries		LS			320.00				320		320	350 Batteries
32) Package Batteries In Drum	8	DR		100.00	80.00	40.00		800	640	320	1760	
33) Vermiculite Packing	10	BAGS		15.00	10.00			150	100		250	
34) Laboratory Analysis		LS	650.00				650				650	TAL Metals
35) Hauling	480	MI	4.00				1920				1920	480 Mi.
36) Treatment/Disposal Landfill	7000	LB	4.60				32200				32200	Buffalo, N.Y.
							3481014	267457	333618	789039	4871128	
Burden @ 13% of Labor Cost									43370		43370	
Labor @ 15% of Labor Cost									50043		50043	
Material @ 5% of Material Cost								13373			13373	
Subcontract @ 10% of Sub. Cost							348101				348101	
Total Direct Cost							3829115	280830	427031	789039	5326015	
Indirects @ 75% of Total Direct Labor Cost									320274		320274	
Profit @ 10% Total Direct Cost											532602	
											6178890	
Health & Safety Monitoring @ .057											352197	
Total Field Cost											6531087	
Contingency @ 20% of Total Field Cost											1306217	
Engineering @ 14% of Total Field Cost											914352	
TOTAL COST THIS PAGE											8751657	

AR302533

C & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization/Offsite Disposal In Sanitary Landfill,
Cap Residual Contamination
10000 mg/kg Action Level
Alternative No. 6a1
Post Remedial Monitoring
(O&MCR6a1)

Annual Costs

ITEM	ITEM $ ANNUAL SAMPLING	ITEM $ COST FOR 5 YEARS	NOTES
1. Sampling	1600.00		4 groundwater samples, 24 manhours per sampling period plus travel, living sample shipping costs.
2. Analysis	10000.00		40 samples per year (inc. blank & duplicate), Inorganics, Water Quality & Indicator Parameters
3. Reporting	950.00		20 manhours per report plus other direct costs.
4. Cap & Fence Maintenance	6000.00		Inspection, Erosion Control, Mowing and Revegetation, Fence Maintenance
5. Analysis Review		20000.00	Analysis Review performed for years 5,10,15,20,25,30
TOTAL ANNUAL COST	18550.00	20000.00	Post Remedial monitoring will be performed annually for years 1 thru 30

C & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization, Offsite Disposal In Sanitary Landfill, Cap Residual Contamination
10000 mg/kg Action Level
Alternative No. 6a1
(PWACR6a1)
9093

PRESENT WORTH ANALYSIS

COST/YEAR COST OCCURS ($000'S)

COST COMPONENT	0	1	2	3	4	5	6	7	8	9	10	11
1. CAPITAL COST	8751.7											
2. O & M COSTS	---	18.6										
3. ANNUAL COSTS	8751.7	18.6	18.6	18.6	18.6	38.6	18.6	18.6	18.6	18.6	38.6	18.6
4. ANNUAL DISCOUNT RATE=5%	1	.952	.907	.864	.823	.784	.746	.711	.677	.645	.614	.585
PRESENT WORTH =	8752	18	17	16	15	30	14	13	13	12	24	11

	12	13	14	15	16	17	18	19	20	21	22	23
O & M COSTS	18.6	18.6	18.6	38.6	18.6	18.6	18.6	18.6	38.6	18.6	18.6	18.6
ANNUAL DISCOUNT RATE=5%	.557	.53	.505	.481	.458	.436	.416	.396	.377	.359	.342	.326
PRESENT WORTH =	10	10	9	19	9	8	8	7	15	7	6	6

	24	25	26	27	28	29	30	TOTAL PRESENT WORTH (000'S)
O & M COSTS	18.6	38.6	18.6	18.6	18.6	18.6	38.6	
ANNUAL DISCOUNT RATE=5%	.31	.295	.281	.268	.255	.243	.231	
PRESENT WORTH =	6	11	5	5	5	5	9	9093

AR302535

ALTERNATIVE 6a (OPTION 2)

STABILIZATION - 10,000 mg/kg ACTION LEVEL, OFFSITE DISPOSAL IN HAZARDOUS WASTE LANDFILL, RCRA CAP OVER RESIDUAL CONTAMINATION

C & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization/Offsite Disposal In Hazardous Waste Landfill, Cap Residual Contamination
10000 mg/kg Action Level
Alternative No. 6a2
(CRS6a2)
Page 1 Of 2

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
EXCAVATION												
1) Excavate Soil	13907	CY			.80	1.50			11126	20861	31986	
2) Excavate Dike	184	CY			.80	1.50			147	276	423	
3) Excavate Sediments	350	CY			.80	1.50			280	525	805	
4) Excavate Debris Pile	233	CY			.80	1.50			186	350	536	
5) Excavate Drainage Channel	1300	CY			.80	1.50			1040	1950	2990	Temporary
6) Excavate Drainage Channel	1300	CY			.80	1.50			1040	1950	2990	Permanent
7) Chain Link Fence - 6"	400	LF	12.00				4800				4800	Temporary
8) Relocate Existing Fence	1100	LF	10.00				11000				11000	Temporary
9) Relocate Fence To Orig. Location	1100	LF	10.00				11000				11000	
DISMANTLEMENT/DISPOSAL												
10) Dismantle Storage Shed												
a) Dismantle Shed	60	MH			20.00	20.00			1200	1200	2400	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	2	TON	30.00				60				60	Local Landfill
11) Dismantle Concrete Pad												
a) Dismantle Concrete Pad	833	CY			48.00	28.00			39984	23324	63308	
b) Hauling	85	LD	150.00				12750				12750	15 mi.
c) Disposal	1688	TON	30.00				50640				50640	Local Landfill
12) Dispose Tires & Misc. Debris												
a) Split Open Tires	80	MH			20.00	20.00			1600	1600	3200	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	10	TON	30.00				300				300	Local Landfill
13) Treat Drainage Ditch Water												
a) Hauling (2 Trucks @ 500 Mi.)	1000	MI	4.00				4000				4000	RCRA
b) Treatment	50070	LB	.08				4006				4006	Treatment Facility
14) Treat Decon Fluids												
a) Hauling (3 Trucks @ 500 Mi.)	1500	MI	4.00				6000				6000	RCRA
b) Treatment	125100	LB	.08				10008				10008	Treatment Facility
STABILIZATION												
15) Waste Soil Stabilization	17609	CY	80.00				1408720				1408720	
16) Soil Analyses (Every 100 CY)	293		100.00				29300				29300	Every 100 C.Y.
DISPOSAL												
17) Loading Stabilized Soil	29348	CY			.32	.52			9391	15261	24652	Front End Loader
18) Hauling - 20 CY Truck	1080080	MI	4.00				4320320				4320320	460 mi.
19) Disposal	46957	TON	150.00				7043550				7043550	Model City, N.Y.
CAPPING												
20) Residual Contaminated Soil												
a) Excavate	19645	CY			.80	1.50			15716	29468	45184	
b) Place, Spread & Compact	23570	CY			.84	2.67			19799	62932	82731	Sheepsfoot Roller
21) Soil - 6"	2453	CY		3.50	2.70	7.43		8586	6623	18226	33434	20 mi. R.T.
a) Place, Spread & Compact	2453	CY			.84	2.67			2061	6550	8610	Sheepsfoot Roller
22) Synthetic Liner	132450	SF	1.00				132450				132450	60 mil
23) Sand - 6"	2453	CY		3.50	2.70	7.43		8586	6623	18226	33434	20 mi. R.T.
a) Place & Spread	2453	CY			.63	.57			1545	1398	2944	
24) Filter Fabric	14717	SY		1.20	.30			17660	4415		22076	
25) Soil - 18"	9811	CY		3.50	2.70	7.43		34339	26490	72896	133724	20 mi. R.T.
a) Place, Spread & Compact	9811	CY			.84	2.67			8241	26195	34437	Sheepsfoot Roller
26) Topsoil - 6"	2453	CY		6.00	2.70	7.43		14718	6623	18226	39567	20 mi. R.T.
a) Place & Spread	2453	CY			.63	.57			1545	1398	2944	
27) Revegetation	132	MSF		24.60	5.60	4.45		3247	739	587	4574	
							13049204	82135	166415	323397	13626151	

AR302537

C & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization/Offsite Disposal In Hazardous Waste Landfill, Cap Residual Contamination
10000 mg/kg Action Level
Alternative No. 6a2
(CRS6a2)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
Page 1 Total							13049204	87135	166415	323397	13626151	
RECLAMATION												
28) Backfill Excavated Areas	43412	CY		3.50	2.70	7.43		151942	117212	322551	591706	20 mi. R.T.
a) Place, Spread & Compact	43412	CY			.84	2.67			36466	115910	152376	Sheepsfoot Roller
29) Topsoil - 3"(excluding Cap Area)	3167	CY		6.00	2.70	7.43		19002	8551	23531	51084	20 mi. R.T.
a) Place & Spread	3167	CY			.63	.57			1995	1805	3800	
30) Revegetation												
a) Excavated Area(Excl.Cap Area)	342.6	MSF		24.60	5.60	4.45		8428	1919	1525	11871	
BATTERY DISPOSAL												
31) Drain Ni/Cd Batteries		LS			320.00				320		320	350 Batteries
32) Package Batteries In Drum	8	DR		100.00	80.00	40.00		800	640	320	1760	
33) Vermiculite Packing	10	BAGS		15.00	10.00			150	100		250	
34) Laboratory Analysis		LS	650.00				650				650	TAL Metals
35) Hauling	480	MI	4.00				1920				1920	480 Mi.
36) Treatment/Disposal Landfill	7000	LB	4.60				32200				32200	Buffalo, N.Y.
							13083974	267457	333618	789039	14474088	
Burden @ 13% of Labor Cost									43370		43370	
Labor @ 15% of Labor Cost									50043		50043	
Material @ 5% of Material Cost								13373			13373	
Subcontract @ 10% of Sub. Cost							1308397				1308397	
Total Direct Cost							14392371	280830	427031	789039	15889271	
Indirects @ 75% of Total Direct Labor Cost									320274		320274	
Profit @ 10% Total Direct Cost											1588927	
											17798472	
Health & Safety Monitoring @ .021											373768	
Total Field Cost											18172240	
Contingency @ 20% of Total Field Cost											3634448	
Engineering @ 6% of Total Field Cost											1090334	
TOTAL COST THIS PAGE											22897022	

AR302538

C & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization/Offsite Disposal In Hazardous Waste Landfill,
Cap Residual Contamination
10000 mg/kg Action Level
Alternative No. 6a2
Post Remedial Monitoring
(O&MCR6a2)

Annual Costs

ITEM	ITEM $ ANNUAL SAMPLING	ITEM $ COST FOR 5 YEARS	NOTES
1. Sampling	1600.00		4 groundwater samples, 24 manhours per sampling period plus travel, living sample shipping costs.
2. Analysis	10000.00		40 samples per year (inc. blank & duplicate), Inorganics, Water Quality & Indicator Parameters
3. Reporting	950.00		20 manhours per report plus other direct costs.
4. Cap & Fence Maintenance	6000.00		Inspection, Erosion Control, Mowing and Revegetation, Fence Maintenance
5. Analysis Review		20000.00	Analysis Review performed for years 5,10,15,20,25,30
TOTAL ANNUAL COST	18550.00	20000.00	Post Remedial monitoring will be performed annually for years 1 thru 30

C & R BATTERY SITE
Chesterfield Co., Virginia
Stabilization, Offsite Disposal In Hazardous Waste Landfill, Cap Residual Contamination
10000 mg/kg Action Level
Alternative No. 6a2
(PWACR6a2)
23239

PRESENT WORTH ANALYSIS

COST/YEAR COST OCCURS ($000'S)

COST COMPONENT	0	1	2	3	4	5	6	7	8	9	10	11
1. CAPITAL COST	22897											
2. O & M COSTS	---	18.6										
3. ANNUAL COSTS	22897	18.6	18.6	18.6	18.6	38.6	18.6	18.6	18.6	18.6	38.6	18.6
4. ANNUAL DISCOUNT RATE=5%	1	.952	.907	.864	.823	.784	.746	.711	.677	.645	.614	.585
PRESENT WORTH =	22897	18	17	16	15	30	14	13	13	12	24	11

	12	13	14	15	16	17	18	19	20	21	22	23
O & M COSTS	18.6	18.6	18.6	38.6	18.6	18.6	18.6	18.6	38.6	18.6	18.6	18.6
ANNUAL DISCOUNT RATE=5%	.557	.53	.505	.481	.458	.436	.416	.396	.377	.359	.342	.326
PRESENT WORTH =	10	10	9	19	9	8	8	7	15	7	6	6

	24	25	26	27	28	29	30	TOTAL PRESENT WORTH (000'S)
O & M COSTS	18.6	38.6	18.6	18.6	18.6	18.6	38.6	
ANNUAL DISCOUNT RATE=5%	.31	.295	.281	.268	.255	.243	.231	
PRESENT WORTH =	6	11	5	5	5	5	9	23239

AR302540

ALTERNATIVE 6b

SOIL WASHING - 10,000 mg/kg ACTION LEVEL, ONSITE NONHAZARDOUS DISPOSAL, RCRA CAP OVER RESIDUAL CONTAMINATION

C & R BATTERY SITE
Chesterfield Co., Virginia
Soil Washing/Onsite Nonhazardous Disposal, Cap Residual Contamination
10000 mg/kg Action Level
Alternative No. 6b
(CRS6b)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
EXCAVATION												
1) Excavate Soil	13907	CY			.80	1.50			11126	20861	31986	
2) Excavate Dike	184	CY			.80	1.50			147	276	423	
3) Excavate Sediments	350	CY			.80	1.50			280	525	805	
4) Excavate Debris Pile	233	CY			.80	1.50			186	350	536	
5) Excavate Drainage Channel	1300	CY			.80	1.50			1040	1950	2990	Temporary
6) Chain Link Fence - 6"	400	LF	12.00				4800				4800	Temporary
7) Relocate Existing Fence	1100	LF	10.00				11000				11000	Temporary
8) Relocate Fence To Orig. Location	1100	LF	10.00				11000				11000	
DISMANTLEMENT/DISPOSAL												
9) Dismantle Storage Shed												
a) Dismantle Shed	60	MH			20.00	20.00			1200	1200	2400	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	2	TON	30.00				60				60	Local Landfill
10) Dismantle Concrete Pad												
a) Dismantle Concrete Pad	833	CY			48.00	28.00			39984	23324	63308	
b) Hauling	85	LD	150.00				12750				12750	15 mi.
c) Disposal	1688	TON	30.00				50640				50640	Local Landfill
11) Dispose Tires & Misc. Debris												
a) Split Open Tires	80	MH			20.00	20.00			1600	1600	3200	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	10	TON	30.00				300				300	Local Landfill
12) Dispose Battery Casings												
a) Hauling	169	LD	150.00				25350				25350	15 mi.
b) Disposal	3380	TON	30.00				101400				101400	Local Landfill
13) Treat Drainage Ditch Water												
a) Hauling (2 Trucks @ 500 Mi.)	1000	MI	4.00				4000				4000	RCRA
b) Treatment	50070	LB	.08				4006				4006	Treatment Facility
14) Treat Decon Fluids												
a) Hauling (3 Trucks @ 500 Mi.)	1500	MI	4.00				6000				6000	RCRA
b) Treatment	125100	LB	.08				10008				10008	Treatment Facility
SOIL WASHING												
15) Waste Soil Soil Washing	17609	CY	753.00				13259577				13259577	
16) Soil Analyses (Every 100 CY)	176		100.00				17600				17600	Every 100 C.Y.
CAPPING												
17) Residual Contaminated Soil												
a) Excavate	19645	CY			.80	1.50			15716	29468	45184	
b) Place, Spread & Compact	23570	CY			.84	2.67			19799	62932	82731	Sheepsfoot Roller
18) Soil - 6"	2453	CY		3.50	2.70	7.43		8586	6623	18226	33434	20 mi. R.T.
a) Place, Spread & Compact	2453	CY			.84	2.67			2061	6550	8610	Sheepsfoot Roller
19) Synthetic Liner	132450	SF	1.00				132450				132450	60 mil
20) Sand - 6"	2453	CY		3.50	2.70	7.43		8586	6623	18226	33434	20 mi. R.T.
a) Place & Spread	2453	CY			.63	.57			1545	1398	2944	
21) Filter Fabric	14717	SY		1.20	.30			17660	4415		22076	
22) Soil - 18"	9811	CY		3.50	2.70	7.43		34339	26490	72896	133724	20 mi. R.T.
a) Place, Spread & Compact	9811	CY			.84	2.67			8241	26195	34437	Sheepsfoot Roller
23) Topsoil - 6"	2453	CY		6.00	2.70	7.43		14718	6623	18226	39567	20 mi. R.T.
a) Place & Spread	2453	CY			.63	.57			1545	1398	2944	
24) Revegetation	132	MSF		24.60	5.60	4.45		3247	739	587	4574	
							13651241	87135	155984	306186	14200546	

AR302542

C & R BATTERY SITE
Chesterfield Co., Virginia
Soil Washing/Onsite Nonhazardous Disposal, Cap Residual Contamination
10000 mg/kg Action Level
Alternative No. 6b
(CRS6b)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
Page 1 Total							13651241	87135	155984	306186	14200546	
RECLAMATION												
25) Backfill Treated Soil												
a) Place, Spread & Compact	16688	CY			.84	2.67			14018	44557	58575	Sheepsfoot Roller
26) Backfill Clean Soil	26724	CY		3.50	2.70	7.43		93534	72155	198559	364248	20 mi. R.T.
a) Place, Spread & Compact	26724	CY			.84	2.67			22448	71353	93801	Sheepsfoot Roller
27) Topsoil - 3"(excluding Cap Area)	3167	CY		6.00	2.70	7.43		19002	8551	23531	51084	20 mi. R.T.
a) Place & Spread	3167	CY			.63	.57			1995	1805	3800	
28) Revegetation												
a) Excavated Area(Excl.Cap Area)	342.6	MSF		24.60	5.60	4.45		8428	1919	1525	11871	
BATTERY DISPOSAL												
29) Drain Ni/Cd Batteries		LS			320.00				320		320	350 Batteries
30) Package Batteries In Drum	8	DR		100.00	80.00	40.00		800	640	320	1760	
31) Vermiculite Packing	10	BAGS		15.00	10.00			150	100		250	
32) Laboratory Analysis		LS	650.00				650				650	TAL Metals
33) Hauling	480	MI	4.00				1920				1920	480 Mi.
34) Treatment/Disposal Landfill	7000	LB	4.60				32200				32200	Buffalo, N.Y.
							13686011	209049	278129	647836	14821025	
Burden @ 13% of Labor Cost									36157		36157	
Labor @ 15% of Labor Cost									41719		41719	
Material @ 5% of Material Cost								10452			10452	
Subcontract @ 10% of Sub. Cost							1368601				1368601	
Total Direct Cost							15054612	219502	356006	647836	16277955	
Indirects @ 75% of Total Direct Labor Cost									267004		267004	
Profit @ 10% Total Direct Cost											1627795	
											18172755	
Health & Safety Monitoring @ .021											381628	
Total Field Cost											18554382	
Contingency @ 20% of Total Field Cost											3710876	
Engineering @ 8% of Total Field Cost											1484351	
TOTAL COST THIS PAGE											23749610	

AR302543

C & R BATTERY SITE
Chesterfield Co., Virginia
Soil Washing/Onsite Nonhazardous Disposal,
Cap Residual Contamination
10000 mg/kg Action Level
Alternative No. 6b
Post Remedial Monitoring
(O&MCR6b)

Annual Costs

ITEM	ITEM $ ANNUAL SAMPLING	ITEM $ COST FOR 5 YEARS	NOTES
1. Sampling	1600.00		4 groundwater samples, 24 manhours per sampling period plus travel, living sample shipping costs.
2. Analysis	10000.00		40 samples per year (inc. blank & duplicate), Inorganics, Water Quality & Indicator Parameters
3. Reporting	950.00		20 manhours per report plus other direct costs.
4. Cap & Fence Maintenance	6000.00		Inspection, Erosion Control, Mowing and Revegetation, Fence Maintenance
5. Analysis Review		20000.00	Analysis Review performed for years 5,10,15,20,25,30
TOTAL ANNUAL COST	18550.00	20000.00	Post Remedial monitoring will be performed annually for years 1 thru 30

C & R Ba[illegible] SITE
Chesterfield Co., Virginia
Soil Washing/Onsite Nonhazardous Disposal, Cap Residual Contamination
10000 mg/kg Action Level
Alternative No. 6b
(PWACR6b)
24091

PRESENT WORTH ANALYSIS

COST COMPONENT	COST/YEAR COST OCCURS ($000'S) 0	1	2	3	4	5	6	7	8	9	10	11
1. CAPITAL COST	23749.6											
2. O & M COSTS	---	18.6										
3. ANNUAL COSTS	23749.6	18.6	18.6	18.6	18.6	38.6	18.6	18.6	18.6	18.6	38.6	18.6
4. ANNUAL DISCOUNT RATE=5%	1	.952	.907	.864	.823	.784	.746	.711	.677	.645	.614	.585
PRESENT WORTH =	23750	18	17	16	15	30	14	13	13	12	24	11

	12	13	14	15	16	17	18	19	20	21	22	23
O & M COSTS	18.6	18.6	18.6	38.6	18.6	18.6	18.6	18.6	38.6	18.6	18.6	18.6
ANNUAL DISCOUNT RATE=5%	.557	.53	.505	.481	.458	.436	.416	.396	.377	.359	.342	.326
PRESENT WORTH =	10	10	9	19	9	8	8	7	15	7	6	6

	24	25	26	27	28	29	30	TOTAL PRESENT WORTH (000'S)
O & M COSTS	18.6	38.6	18.6	18.6	18.6	18.6	38.6	
ANNUAL DISCOUNT RATE=5%	.31	.295	.281	.268	.255	.243	.231	
PRESENT WORTH =	6	11	5	5	5	5	9	24091

AR302545

ALTERNATIVE 6c

IN-SITU VITRIFICATION - 10,000 mg/kg ACTION LEVEL, RCRA CAP OVER RESIDUAL CONTAMINATION

C & R BATTERY SITE
Chesterfield Co., Virginia
In-Situ Vitrification, Cap Residual Contamination
10000 mg/kg Action Level
Alternative No. 6c
(CRS6c)

Item	Qty	Unit	Unit Cost				Total Cost				Total Direct Cost	Comments
			Sub.	Mat.	Labor	Equip.	Sub.	Mat.	Labor	Equip.		
EXCAVATION												
1) Excavate Soil	323	CY			.80	1.50			258	485	743	
2) Excavate Dike	184	CY			.80	1.50			147	276	423	
3) Excavate Sediments	350	CY			.80	1.50			280	525	805	
4) Excavate Debris Pile	233	CY			.80	1.50			186	350	536	
5) Excavate Drainage Channel	1300	CY			.80	1.50			1040	1950	2990	Temporary
6) Chain Link Fence - 6"	400	LF	12.00				4800				4800	Temporary
7) Relocate Existing Fence	1100	LF	10.00				11000				11000	
8) Monitoring Wells	280	LF	100.00				28000				28000	4 @ 70'
DISMANTLEMENT/DISPOSAL												
9) Dismantle Storage Shed												
a) Dismantle Shed	60	MH			20.00	20.00			1200	1200	2400	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	2	TON	30.00				60				60	Local Landfill
10) Dispose Tires & Misc. Debris												
a) Split Open Tires	80	MH			20.00	20.00			1600	1600	3200	
b) Hauling	1	LD	150.00				150				150	15 mi.
c) Disposal	10	TON	30.00				300				300	Local Landfill
11) Treat Drainage Ditch Water												
a) Hauling (2 Trucks @ 500 Mi.)	1000	MI	4.00				4000				4000	RCRA
b) Treatment	50070	LB	.08				4006				4006	Treatment Facility
12) Treat Decon Fluids												
a) Hauling (3 Trucks @ 500 Mi.)	1500	MI	4.00				6000				6000	RCRA
b) Treatment	125100	LB	.08				10008				10008	Treatment Facility
IN-SITU VITRIFICATION												
13) Waste Soil	388	CY			.41	1.17			159	454	613	1 mi. R.T.
a) Place, Spread & Compact	388	CY			.84	2.67			326	1036	1362	Sheepsfoot Roller
14) Treatability Testing		LS	100000.00				100000				100000	
15) Mobilization/Demobilization		LS	250000.00				250000				250000	
16) In-Situ Vitrification	20544	TON	275.00				5649600				5649600	
CAPPING												
17) Residual Contaminated Soil												
a) Excavate	19645	CY			.80	1.50			15716	29468	45184	
b) Place, Spread & Compact	23570	CY			.84	2.67			19799	62932	82731	Sheepsfoot Roller
18) Soil - 6"	2453	CY		3.50	2.70	7.43		8586	6623	18226	33434	20 mi. R.T.
a) Place, Spread & Compact	2453	CY			.84	2.67			2061	6550	8610	Sheepsfoot Roller
19) Synthetic Liner	132450	SF	1.00				132450				132450	60 mil
20) Sand - 6"	2453	CY		3.50	2.70	7.43		8586	6623	18226	33434	20 mi. R.T.
a) Place & Spread	2453	CY			.63	.57			1545	1398	2944	
21) Filter Fabric	14717	SY		1.20	.30			17660	4415		22076	
22) Soil - 18"	9811	CY		3.50	2.70	7.43		34339	26490	72896	133724	20 mi. R.T.
a) Place, Spread & Compact	9811	CY			.84	2.67			8241	26195	34437	Sheepsfoot Roller
23) Topsoil - 6"	2453	CY		6.00	2.70	7.43		14718	6623	18226	39567	20 mi. R.T.
a) Place & Spread	2453	CY			.63	.57			1545	1398	2944	
24) Revegetation	132	MSF		24.60	5.60	4.45		3247	739	587	4574	
							6200524	87135	105618	263976	6657252	

HR03254

C & R BATTERY SITE
Chesterfield Co., Virginia
In-Situ Vitrification, Cap Residual Contamination
10000 mg/kg Action Level
Alternative No. 6c
(CRS6c)

Item	Qty	Unit	Unit Cost Sub.	Unit Cost Mat.	Unit Cost Labor	Unit Cost Equip.	Total Cost Sub.	Total Cost Mat.	Total Cost Labor	Total Cost Equip.	Total Direct Cost	Comments
Page 1 Total							6200524	87135	105618	263976	6657252	
RECLAMATION												
25) Backfill Excavated Areas	26724	CY		3.50	2.70	7.43		93534	72155	198559	364248	20 mi. R.T.
a) Place, Spread & Compact	26724	CY			.84	2.67			22448	71353	93801	Sheepsfoot Roller
26) Topsoil - 3"(excluding Cap Area)	3167	CY		6.00	2.70	7.43		19002	8551	23531	51084	20 mi. R.T.
a) Place & Spread	3167	CY			.63	.57			1995	1805	3800	
27) Revegetation												
a) Excavated Area(Excl.Cap Area)	342.6	MSF		24.60	5.60	4.45		8428	1919	1525	11871	
BATTERY DISPOSAL												
28) Drain Ni/Cd Batteries		LS			320.00				320		320	350 Batteries
29) Package Batteries In Drum	8	DR		100.00	80.00	40.00		800	640	320	1760	
30) Vermiculite Packing	10	BAGS		15.00	10.00			150	100		250	
31) Laboratory Analysis		LS	650.00				650				650	TAL Metals
32) Hauling	480	MI	4.00				1920				1920	480 Mi.
33) Treatment/Disposal Landfill	7000	LB	4.60				32200				32200	Buffalo, N.Y.
							6235294	209049	213745	561069	7219157	
Burden @ 13% of Labor Cost									27787		27787	
Labor @ 15% of Labor Cost									32062		32062	
Material @ 5% of Material Cost								10452			10452	
Subcontract @ 10% of Sub. Cost							623529				623529	
Total Direct Cost							6858823	219502	273594	561069	7912988	
Indirects @ 75% of Total Direct Labor Cost									205195		205195	
Profit @ 10% Total Direct Cost											791299	
											8909482	
Health & Safety Monitoring @ .055											490021	
Total Field Cost											9399503	
Contingency @ 20% of Total Field Cost											1879901	
Engineering @ 8% of Total Field Cost											751960	
TOTAL COST THIS PAGE											12031364	

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C & R BATTERY SITE
Chesterfield Co., Virginia
In-Situ Vitrification
Cap Residual Contamination
10000 mg/kg Action Level
Alternative No. 6c
Post Remedial Monitoring
(O&MCR6c)

Annual Costs

ITEM	ITEM $ ANNUAL SAMPLING	ITEM $ COST FOR 5 YEARS	NOTES
1. Sampling	1600.00		4 groundwater samples, 24 manhours per sampling period plus travel, living sample shipping costs.
2. Analysis	10000.00		40 samples per year (inc. blank & duplicate), Inorganics, Water Quality & Indicator Parameters
3. Reporting	950.00		20 manhours per report plus other direct costs.
4. Cap & Fence Maintenance	6000.00		Inspection, Erosion Control, Mowing and Revegetation, Fence Maintenance
5. Analysis Review		20000.00	Analysis Review performed for years 5,10,15,20,25,30
TOTAL ANNUAL COST	18550.00	20000.00	Post Remedial monitoring will be performed annually for years 1 thru 30

C & R BATTERY SITE
Chesterfield Co., Virginia
In-Situ Vitrification, Cap Residual Contamination
10000 mg/kg Action Level
Alternative No. 6c
(PWACR6c)
12373

PRESENT WORTH ANALYSIS

COST COMPONENT	COST/YEAR COST OCCURS ($000'S) 0	1	2	3	4	5	6	7	8	9	10	11
1. CAPITAL COST	12031.4											
2. O & M COSTS	---	18.6										
3. ANNUAL COSTS	12031.4	18.6	18.6	18.6	18.6	38.6	18.6	18.6	18.6	18.6	38.6	18.6
4. ANNUAL DISCOUNT RATE=5%	1	.952	.907	.864	.823	.784	.746	.711	.677	.645	.614	.585
PRESENT WORTH =	12031	18	17	16	15	30	14	13	13	12	24	11

	12	13	14	15	16	17	18	19	20	21	22	23
O & M COSTS	18.6	18.6	18.6	38.6	18.6	18.6	18.6	18.6	38.6	18.6	18.6	18.6
ANNUAL DISCOUNT RATE=5%	.557	.53	.505	.481	.458	.436	.416	.396	.377	.359	.342	.326
PRESENT WORTH =	10	10	9	19	9	8	8	7	15	7	6	6

	24	25	26	27	28	29	30	TOTAL PRESENT WORTH (000'S)
O & M COSTS	18.6	38.6	18.6	18.6	18.6	18.6	38.6	
ANNUAL DISCOUNT RATE=5%	.31	.295	.281	.268	.255	.243	.231	
PRESENT WORTH =	6	11	5	5	5	5	9	12373

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