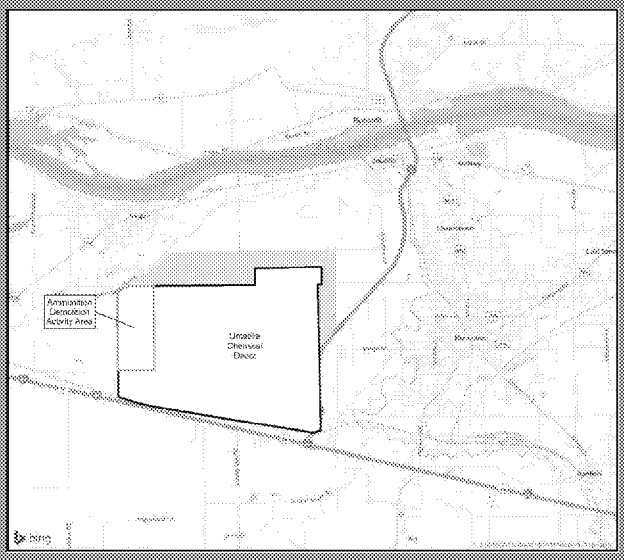
MIS/ISM Sampling for the Umatilla Army Depot Munitions OB/OD Disposal Area RD/RA Workplan

Site Location – I-84 and I-82, Eastern Oregon



Umatilla Army Depot Ammunition Demolition Area (ADA) Remedial Action

Background

- 1,750 acre (3 square miles) site used for open burning/open detonation (OB/OD) disposal of unserviceable and obsolete munitions after WW II.
- Previously surface cleared of UXO/DMM (~ $2.5 M)
- 30,000 tons of explosives and metals contaminated soils in selected areas were previously excavated.
- Soils treated by solidification/stabilization, and disposed of in on-site RCRA Subtitle D Landfill (~ $5 M).

Soil ROD/ESD Remediation Criteria (mg/kg)

Analyte	CAS Number	Criteria
1,3,5-Trinitrobenzene (TNB)	99-35-4	25
2,4,6-Trinitrotoluene (TNT)	118-96-7	49
2,4-Dinitrotoluene (2,4-DNT)	121-14-2	2.7
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	19
Antimony	7440-36-0	820
Arsenic	7440-38-2	15
Barium	7440-39-3	3300
Beryllium	7440-41-7	8.1
Cadmium	7440-43-9	213
Chromium	7440-47-3	40
Cobalt	7440-48-4	25
Lead	7440-92-1	500
Thallium	7440-28-0	160

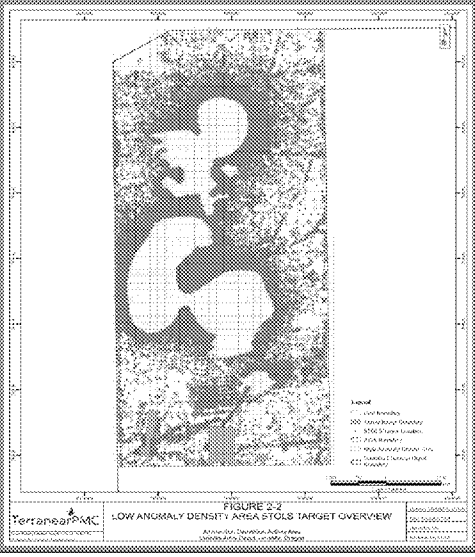
Umatilla Army Depot Ammunition Demolition Area (ADA) Remedial Action (cont.)

Geophysics

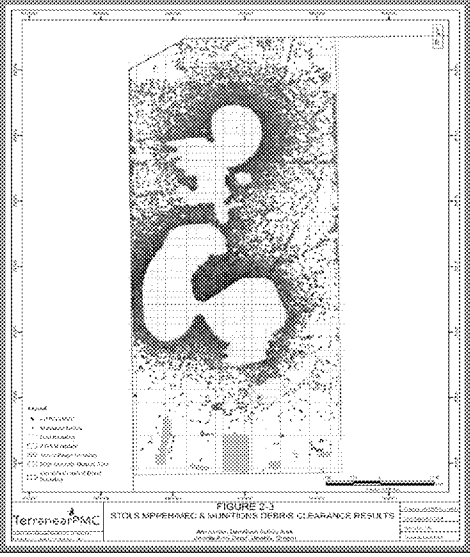
- Towed array magnetometer (STOLS) survey conducted over 1750 acres (~$2.5 M)
- STOLS survey identified 50,000 subsurface geophysical anomalies in "Kick-Out" area.
- 600 total, 39 surface and 561 subsurface UXO/DMM munitions items removed to date from the Kick Out area (~ $5 M)
- ~ 355 acres identified as saturated geophysics
- ~ 34 acres identified as burial pits and trenches

Remedial Action – Unexploded Ordnance (UXO)

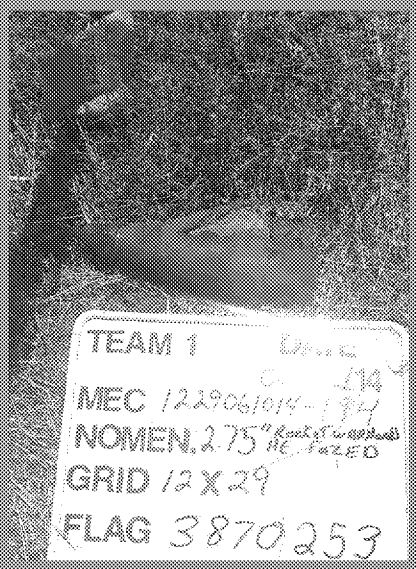
Magnetometer Geophysical Survey

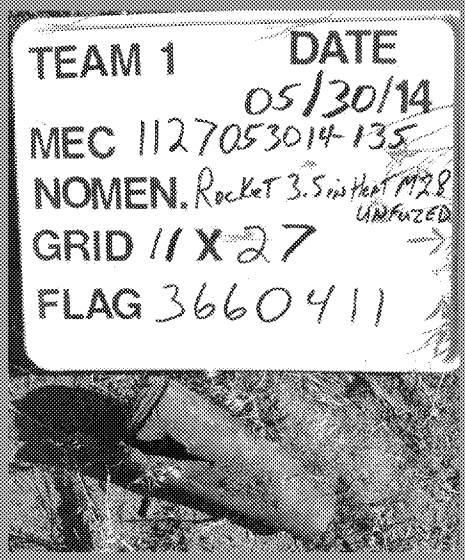


Subsurface Recovery of Anomalies



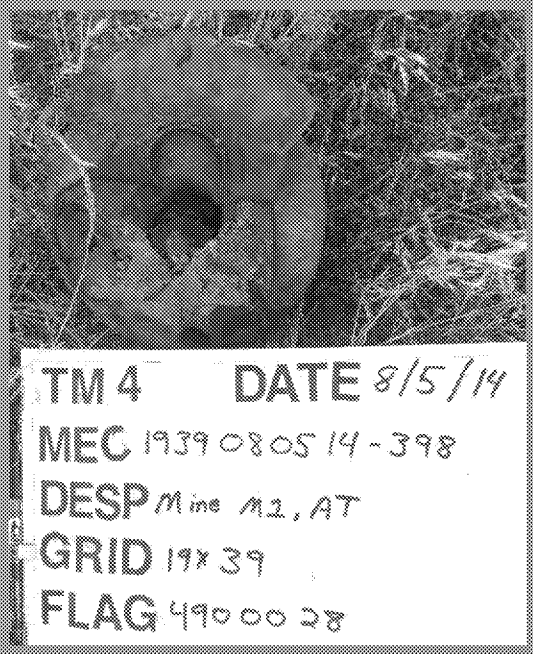
Compromised ("split open") Munitions





Compromised Munitions (cont.)

- Attempted detonation has peeled back the metal cover of this anti-tank (AT) land mine without detonating the explosive filler.
- Explosive filler is TNT or Composition B (TNT/RDX mixture), as shown in the yellowish, waxy material inside the mine.



EXAMPLE FOR POTENTIAL GROUNDWATER CONTAMINATION FROM EXPLOSIVE FILLERS

- AT Mine - ~ 10 kg TNT Filler
- TNT expected to remain for 100's to 1000's of years.
- Dissolution of explosives fillers is complex – filler, particle size, and total amount specific.
- TNT solubility in water is ~ 150,000 ug/L.
- TNT is classified by EPA as a Group C (possible human) carcinogen.
- EPA Lifetime Drinking Water Health Advisory for TNT is 2 ug/L.
- Quantity of TNT in AT mine (10 kg) is enough to contaminate 5 billion liters (1.29 billion gallons) of groundwater at the LHA level of 2 ug/L.

MIS Sampling Design for Remedial Action

Multi-Increment Sampling (MIS)/Incremental Sampling Methodology (ISM) used for evaluate of explosives and metals concentrations in soils in remaining areas.

ROD Cleanup Levels for explosives and metals in soil based on a future industrial land use scenario by the National Guard Bureau/Oregon National Guard under BRAC.

Analytical Methods – Explosives (Method 8330B) and Metals (Method 6010C).

Sampling Design – Decision Units (DU)

- Blow-in-Place (BIP) Grids, 5 x 5 ft. – 32 ISM increments
- Consolidated Detonation (CD) Grids, 10 x 10 ft. – 32 ISM increments
- 100 x 100 ft. Grids – 32 ISM increments
- 200 x 200 ft. Grids – 64 ISM increments

- Systematic Random Sampling used for field replicates within grids

MIS Sampling Design for Remedial Action (cont.)

Lab Handling Procedures

- Receive 1 to 2 kg ISM samples
- Air Dry, Sieve < 2mm, and puck mill grind samples as per EPA Method 8330B
- Ground samples split for explosives and metals analysis
- Weigh oversize (> 2 mm) explosive or metals chunks, confirm chemical composition with EXPRAY or colorimetric methods for explosives.

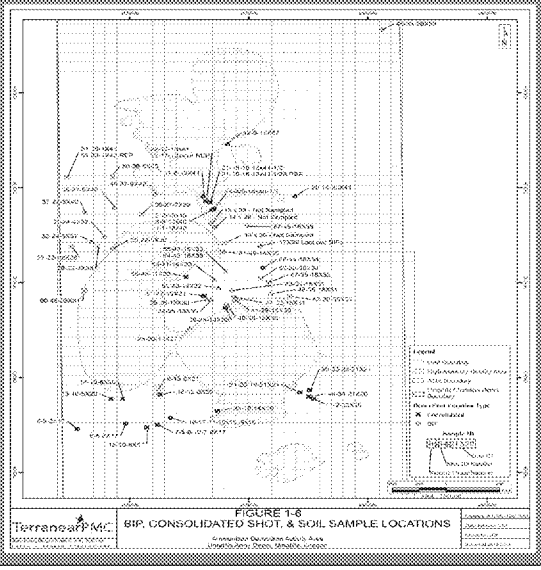
Quality Assurance Evaluation

- Field Triplicate Samples on selected ISM Grids
- Laboratory Triplicate Subsamples on selected samples

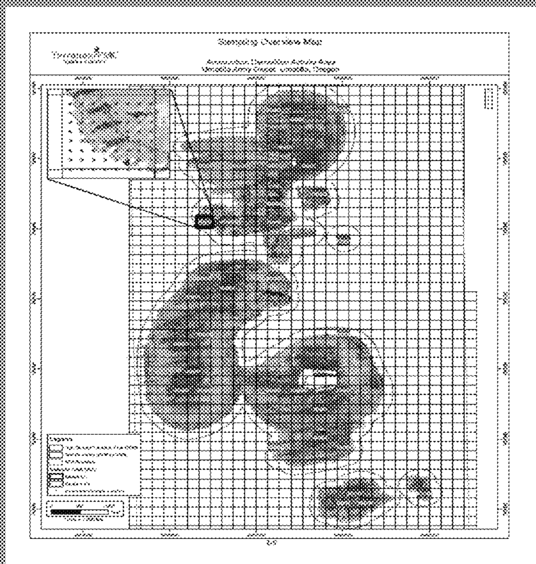
Blow in Place (BIP) (5' x 5') & Consolidated Detonation (10' x 10') MIS Sampling Grids

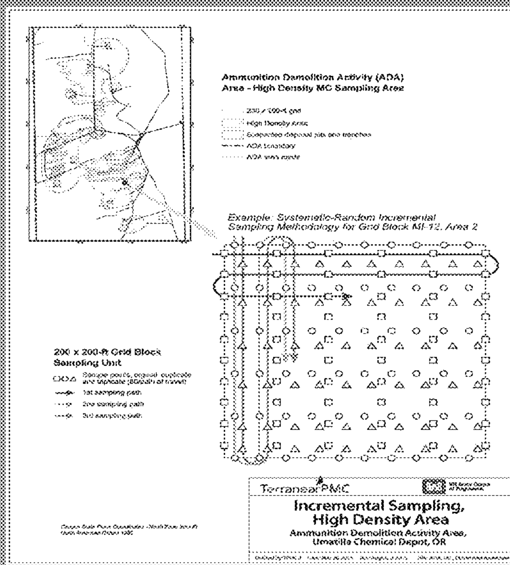
Sampling Results Summary

- 2 post detonation BIP/CD grids exceeded TNT cleanup level for soil (49 mg/kg).
- 1 grid exceeded cleanup level for 2,4-DNT (2.7 mg/kg)



MIS Sampling Design – 200' x 200' grids





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Field Triplicate Results (2015) – 200' x 200' Grids Explosives – 64 increments

17X27-L2

Compounds	T1 (mg/kg)	T2 (mg/kg)	T3 (mg/kg)	LOQ (mg/kg)	%RSD
2,4-dinitrotoluene	0.050	0.10	<0.037	0.098	**53**
RDX	0.93	6.4	0.16	0.20	**136**
2,4,6-trinitrotoluene	0.036	0.71	<0.037	0.098	**149**
1,3,5-trinitrotoluene	<0.040	0.058	<0.037	0.098	25

Field Triplicate Results (2015) – 200' x 200' Grids Metals – 64 increments

Precision

Precision was evaluated using the RSD obtained from the field triplicate sample results.

All metals in the field triplicate samples with concentrations above the DL are listed below:

17X23-L1

Metals	T1 (mg/kg)	T2 (mg/kg)	T3 (mg/kg)	%RSD	LOQ (mg/kg)
Antimony	0.50	0.42	0.39	13	1.5
Arsenic	2.4	2.4	2.5	2.4	2.0
Barium	260	230	210	11	0.99
Cadmium	0.42	0.46	0.99	**51**	0.50
Chromium	77	57	82	18	1.5
Cobalt	6.0	6.0	6.0	0	0.99
Lead	6.0	5.7	5.2	7.2	0.79

Cadmium was the only metal with a non-compliant %RSD > 30%. All cadmium concentrations were < 5 x LOQ, and the difference between the highest and the lowest concentration (0.99 and 0.42) was less than 2.5 x LOQ; therefore, no flags were applied.

Field Triplicate Results – 200' x 200' Grids Metals – 64 increments (cont.)

All metals in the field triplicate samples with concentration above the DL are listed below.

14X51-L4

Metals	T1 (mg/kg)	T2 (mg/kg)	T3 (mg/kg)	%RSD	LOQ (mg/kg)
Antimony	0.73	0.62	0.56	14	1.5
Arsenic	3.1	2.8	3.3	8.2	2.0
Barium	320	320	150	**37**	0.99
Cadmium	2.9	1.4	0.78	**64**	0.50
Chromium	96	60	85	23	1.5
Cobalt	6.6	6.6	6.5	0.88	0.99
Lead	28	72	25	**63**	0.79
Thallium	0.65	0.78	0.64	11	1.2

Barium, cadmium, and lead had %RSDs > 30%. All barium and lead triplicate results were > 5 x LOQ. Only one cadmium triplicate result was > 5 x LOQ; however, the absolute difference between the highest and lowest cadmium result was > 2.5 x LOQ. "J" flags were applied to all three metal results of each of the triplicate samples.

Laboratory Subsample Precision (n = 3) Explosives

Precision

Precision was evaluated using the relative percent difference (RPD) obtained from the MS/MSD concentrations. The lab performed an MS/MSD with sample 18-12-9X20 and 37-27-3X40. Also lab performed triplicate analysis with sample 18-12-9X20.

%RPDs of MS/MSD were compliant for both sets.

Detected results of the lab triplicates are listed below:

18-12-9X20

Compound	Parent (mg/kg)	Duplicate (mg/kg)	Triplicate (mg/kg)	%RSD
2,4-Dinitrotoluene	0.32	0.32	0.32	0
1,3,5-Trinitrobenzene	0.45	0.45	0.45	0
2,4,6-Trinitrobenzene	88	88.3	87.3	0.6

All %RSDs were compliant.

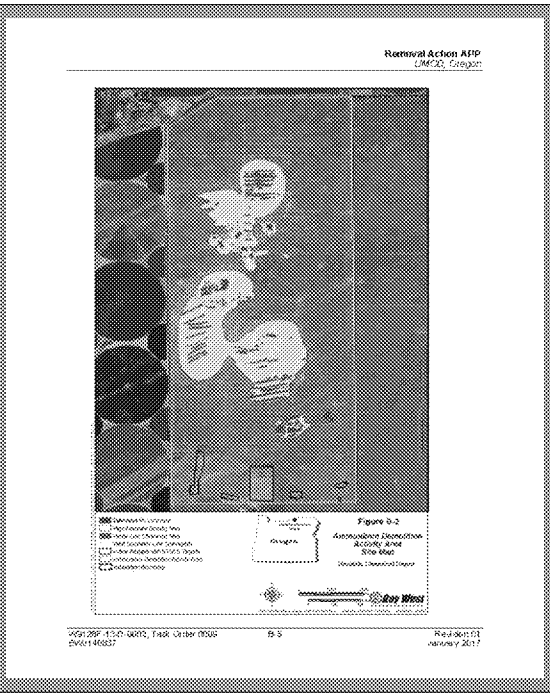
And then the Remedial Action Contractor walked off the job….

- Claimed "changed conditions" in the High Anomaly Density Area (HADA)
- Contractor wanted modification that was ~ 10X the original contract amount on the original "performance based, guaranteed fixed price contract" of ~ $10-11M.
- Contract ended without satisfying the original RD/RA Workplan scope.
- New RA contract issued by the Corps that was ~ 10X the original contract execution amount (~$5-6M vs. $46M)
- New contract required a new RD/RA Workplan for remaining sampling work

Remaining Sampling HADA

New Decision Units (DU)

- Compromised Munitions
- Blow in Place (BIP)
- Consolidated Detonation (CD)
- Trenches – 34 acres
- Stockpiles (500 cy ea), ~500,000 cy to sift, 355 acres



Challenge of Integration of 2 RA Workplans

Decision Units (size/vol)	Terranear Final RD 1st RA Contract	BayWest draft RD 2nd RA Contract	EPA Comment 2nd draft RA Contract	BayWest Draft final RD 2nd RA Contract	Terranear Explosive Precision DQO Met?	Terranear Metals Precision DQO Met?	BayWest Expected to meet Explosive Precision DQO?	BayWest Expected to meet Metals Precision DQO?
BIP (5'x5')	32 Inc.	30 Inc.	80-100 Inc.	30 Inc.	Yes	Yes	Yes	No[2]
CD (10'x10')	32 Inc.	30 Inc.	80-100 Inc.	30 Inc.	Yes	Yes	Yes	No[2]
200x200' Grids (0.91 ac., 484 cy)	64 Inc.				No 6 of 6 (100%) > 30% RSD	Most - 5 of 29 (17%) > 30% RSD		
Trenches (No size)		30 Inc.	50-60 Inc./acre	At least 30 Inc.			No[1]	No[2]
Stockpile (500 cy)		30 Inc.	100 Inc.	At least 30 Inc.			No[1]	No[2]
ISM Mass (kg)	~ 1.5	1.0 – 1.5	1.5	1.0 - 1.5				
Sample Depth	4 in.	2 in.	NC	2 in.				
Sample Grinding								
Explosive	Yes	Yes	Yes	Yes	Yes 100%		Yes[3]	
Metals	Yes	No	Yes	No		Most 83%		No[2]
Lab Precision DQO	< 20 % RSD	< 20 % RSD	NC	< 20 % RSD	Yes – 4 of 4 (100%) < 20% RSD	No Data - Ground sample[2]	Yes[3]	No[2]
Field Triplicate DQO	< 30 % RSD	< 30 % RSD	NC	< 30 % RSD	Small DUs Yes Large DUs No	Most - 5 of 29 (17%) > 30% RSD	Small DU Yes Large DU No[1]	No[2]

Conclusions with Regard to MIS/ISM Sampling

- Rationale layout of DUs for original RA Contract
- Sample grinding of explosives and metals showed excellent lab subsample triplicate precision (<< 20 %RSD)
- Good field triplicate precision for small (< 10' x 10') DUs
- Fair (metals) to poor (explosives) field triplicate precision (e.g. > 30 %RSD) for larger DUs (200' x 200', 0.9 acre)

Recommendations

- Lab sample grinding is highly effective for multiple COCs.
- Need to increase number of increments (e.g. 50 – 100) for larger DUs to increase field triplicate sampling precision (e.g. < 30 %RSD)

QUESTIONS?

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