NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

AND

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION-2

DRAFT STATEMENT OF BASIS

WATERVLIET ARSENAL
SIBERIA AREA
WATERVLIET, NEW YORK 12801
EPA I.D. NO.: NY7213820940

Announcement of Proposed Final Remedies

This Statement of Basis has been developed by the New York State Department of Environmental Conservation (NYSDEC) and the United States Environmental Protection Agency, Region-2 (USEPA) [Regulating Agencies] under the authority of the Solid Waste Disposal Act, as amended, and more commonly referred to as the Resource Conservation and Recovery Act, or RCRA. This Statement of Basis addresses the proposed final remedies for both the soils and groundwater in the Watervliet Arsenal Siberia Area. The Siberia Area, impacted by past releases of hazardous constituents from facility operations, is a relatively isolated area of the facility. This Statement of Basis presents a summary of the following pertinent information and data associated with the Siberia Area:

- Background and regulatory history;
- Description of the area;
- Contamination found in the Siberia Area;
- Potential environmental and human health risks; and
- Proposed final remedies.

The proposed final remedies, which have been implemented as Interim Corrective Measures, were developed through the use of an all encompassing Corrective Measure Study. The Corrective Measures Study proposes the following remedies (which are acceptable to the Regulating Agencies) for the following individual Solid Waste Management Units:

Site wide soil treatment:

- Enhanced bioremediation via land farming;
- Excavation and off-site disposal; and
- Capping of contaminated soil;

Burn Pit:

- Excavation and treatment by enhanced bioremediation during the landfarming pilot study.

Groundwater:

- Treatment of volatile organic contamination by a permeable reactive wall,
- Treatment of the isolated bedrock volatile organic hotspot (underneath the Burn Pit) by enhanced natural attenuation; and
- monitored natural attenuation of low levels of petroleum hydrocarbons in groundwater.

The Regulating Agencies welcome public comments on the proposed final remedies in the Siberia Area. Public comments can influence the Regulating Agencies final remedy selection if new substantive information and arguments are presented to the Regulating Agencies. Therefore, the public is encouraged to review and provide comment on this Statement of Basis.

Background and Regulatory History

A Corrective Action Order (effective October 12, 1993) was issued to the Watervliet Arsenal pursuant to Section 3008(h) of the Resource Conservation and Recovery Act (RCRA,) as amended by the Hazardous and Solid Waste Amendments of 1984, 42 U.S.C. § 6901 et seq. and Section 71-2727 of the New York State Environmental Conservation Law . This order required Watervliet Arsenal to identify and fully investigate the nature, rate, and extent of contamination at its facility, perform the necessary corrective measures studies, corrective measures implementation and interim corrective measures. The end point of this process is to implement the required final remedies.

The following reports were issued as part of this process:

RCRA Facility Assessment Report

A RCRA Facility Assessment (RFA) report, prepared by the NYSDEC in December 1986, updated in December 1987, and again in March 1992, identified several solid waste management units at the Watervliet Arsenal. In addition, several small-scale investigations were conducted in the late 1980s through the early 1990s. Based on the RFA Report and the results of these studies, the Regulatory Agencies determined that additional, more detailed sampling was needed.

RCRA Facility Investigation

The required sampling was done as part of a RCRA Facility Investigation (RFI) at the Siberia Area from 1995-1997. The results of the RFI have been presented in the Final RCRA Facility Investigation Report, Siberia Area, Watervliet Arsenal, Watervliet, New York, dated December 1997.

Chlorinated volatile organic compounds, petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), and metals were detected in the groundwater and soil at the Siberia Area during the RFI. Based on the results of the RFI, the regulatory agencies determined that a Corrective Measures Study was necessary to evaluate and recommend remedial alternatives for the impacted portions of the Siberia Area.

RCRA Corrective Measures Study

As a preliminary step in the Corrective Measures Study (CMS) process, additional investigations were conducted to further define the extent of soil and groundwater contamination. These data are presented in the Corrective Measures Study Field Data Report, Siberia Area, Watervliet Arsenal, Watervliet, New York, dated October 1998. Based on the results of the RFI and CMS investigations, a preliminary screening of appropriate corrective measure technologies for the Siberia Area was completed and presented in the Corrective Measures Study Preliminary Screening Report, Watervliet Arsenal, Siberia Area, Watervliet, New York, dated August 1999.

Human Health and Ecological Exposure Assessment

Concurrent with the Corrective Measures Study, a human health and ecological exposure assessment was completed to evaluate and document potential risks resulting from environmental conditions at the Siberia Area. The results of the exposure assessment were presented in the Final Exposure Assessment, Siberia Area, Watervliet Arsenal, Watervliet, New York dated April 1998.

Focused Corrective Measures Study

Based upon information in the preliminary screening report and the exposure assessment, bench scale and pilot scale treatability studies were conducted to evaluate the applicability and effectiveness of various technologies for treatment of soil and groundwater. Since there were positive results for the enhanced bioremediation of soils (land farming) and treatment of ground water by passage through a permeable reactive wall, they were continued as Interim Corrective Measures (ICMs). Monitoring of these ICMs provided an extensive amount of information that allowed the regulatory agencies to determine that a Focused Corrective Measures Study would be sufficient to select proposed final corrective measures for the Siberia Area. The Focused CMS Report summarized the results of the interim corrective measures and pilot studies, and recommended the final remedies for the Siberia Area that are being proposed in this Statement of Basis.

Description of the Area

Watervliet Arsenal
The Watervliet Arsenal is a 140-acre government-owned installation under the command of the U.S. Army Tank Automotive and Armaments Command. The Arsenal is located in the City of Watervliet, New York, 3 ½ miles northeast of the City of Albany and adjacent to the Hudson River. A site location map is attached as Figure 1.

Watervliet Arsenal is the nation's oldest cannon factory. The entire facility is a Registered Historic Landmark. The manufacturing of tubes and tube assemblies for cannons, cannon components, mortars, recoilless rifles, and other systems has occurred on-site. The Arsenal remains an active U.S. Army facility.

Watervliet Arsenal consists of two areas: (1) Main Manufacturing Area and (2) Siberia Area. The Main Manufacturing Area is primarily used for manufacturing and administrative operations. A site map delineating the Main Manufacturing Area and Siberia Area is attached as Figure 2.

Siberia Area
The 15-acre Siberia Area was purchased by the Watervliet Arsenal in the early 1940s. The Siberia Area was subsequently filled in with debris consisting of slag, cinders, wood, brick and other available debris of unknown origin. The Siberia Area is now used for the interim storage of raw materials, hazardous materials, finished goods, and supplies brought in from the Main Manufacturing Area.

Historically, metal chips coated with cutting oils, salvaged scrap metals and scrap lumber were stored in the Siberia Area. All of these practices occurred directly on the ground surface and may have contributed to groundwater and soil contamination in the Siberia Area. In addition, the Watervliet Arsenal has reported that mixtures of oils and solvents removed from underground storage tanks were sprayed on the ground for dust control. Current practices preclude all of these activities.

In addition to these activities conducted by Arsenal personnel, the Perfection Plating Company manufactured metal plates for brake pads in their facility, which is located hydraulically and topographically up gradient of the Siberia Area. This facility is believed to have caused elevated levels of chromium and lead that have been detected in the soil and groundwater in the northeastern section of the Siberia Area. This chromium and lead contamination is currently under remediation by the NYSDEC. This corrective action is not included in the scope of this Statement of Basis.

Contamination found in the Siberia Area

Soil Contamination
Soil contamination has been detected throughout the Siberia Area. Organic contamination in the soil is primarily petroleum hydrocarbons and associated polycyclic aromatic hydrocarbons (PAHs). Chromium, lead, and arsenic are the primary inorganic

contaminants of concern in the soil. Organic analytes detected in the Siberia Area are summarized below. Areas impacted by petroleum hydrocarbons and associated PAH contamination are:

- the Main Substation area;
- the Chip Handling Facility;
- the former Burn Pit in the NE Quadrant; and
- an area in the SE Quadrant near the former lumber yard (currently the National Guard vehicle storage area).

The highest PAH concentrations detected in the soil were found in the Main Substation area. These include:

PAH (Main Substation Area)	Maximum Concentration (ug/kg) [PPB]	Average Concentration (ug/kg) [PPB]
Pyrene	180,000	25,822
Fluoranthene	150,000	25,457
Phenanthrene	89,000	16,962
2-Methylnaphthalene	82,000	23,062
Benzo(b)fluoranthene	79,000	11,787
Chrysene	63,000	9,258
Benzo(a)pyrene	58,000	9,056
Benzo(a)anthracene	51,000	7,902
Benzo(k)fluoranthene	51,000	8,707
Indeno(1,2,3-cd)pyrene	41,000	10,431
Naphthalene	36,000	9,307
Fluorene	26,000	10,474
Benzo(g,h,i)perylene	17,000	4,339
Acenaphthene	16,000	10,100
Dibenzo(a,h)anthracene	15,000	5,023
Anthracene	13,000	3,638

PPB: part per billion

Inorganic contamination in the soil is the most prevalent in the NE and SW areas of the Siberia Area. Chromium is the most extensive and widespread inorganic contaminant, with the maximum concentrations detected in the NE and SW (Main Substation area) Quadrants. The locations of the maximum detected inorganic concentrations in the Siberia Area soil are listed below:

Metal	Maximum Concentration (mg/kg) [PPM]	Average Concentration (mg/kg) [PPM]	Location Of Maximum Concentration
Arsenic	42.1	11.9	NE Quadrant
Barium	439	155.8	NE Quadrant
Cadmium	23.8	2.0	NW Quadrant
Chromium	2490	105.4	NE Quadrant
Lead	2530	196.8	SW Quadrant
Mercury	4	0.4	SW Quadrant
Selenium	30.1	2.5	NE Quadrant
Silver	10.5	1.3	NW Quadrant

PPM: part per million

Lead contamination in the soil is the most extensive along the eastern fence line and in the Main Substation area. Arsenic contamination is widespread, though the maximum concentrations in the surface and shallow soil were almost exclusively located along the eastern, northern, and western fence lines. Chromium, lead, and arsenic concentrations in the soil generally decrease with increasing depth.

Soil and sediment samples (in a drainage ditch) were collected off of the Watervliet Arsenal property adjacent to the NE and NW Quadrants during the RFI and Corrective Measures Study field activities to assess the impacts of the Siberia Area contamination on the surrounding area. Consistent with the nature of the contamination in the Siberia Area, elevated concentrations of PAHs and inorganic analytes were detected in the off-site surface soil and sediment samples; however, these concentrations were significantly lower than the maximum concentrations detected within the Siberia Area.

Groundwater

Petroleum hydrocarbons were detected in groundwater samples collected throughout the Siberia Area, but predominantly in the area of the Main Substation, Chip Handling Area, the former Burn Pit, and the former lumber yard. A sheen and petroleum odors were noted during monitoring well development and groundwater sampling activities within these areas. However, analytical results for these samples showed relatively few contaminants present at concentrations greater than groundwater standards (see Table 1 [attached]).

Those PAHs exceeding the NYSDEC Class GA groundwater standards were benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, bis(2-ethylhexyl)phthalate, chrysene, indeno(1,2,3-cd)pyrene, naphthalene, and phenol. The greatest concentrations of benzo(a)anthracene, chrysene, ideno(1,2,3-cd)pyrene, and naphthalene were detected in groundwater samples from monitoring well MW-32, which was located in the former burn pit area of the NE Quadrant. The highest concentrations of benzo(b)fluoranthene, benzo(b)fluoranthene, and bis(2-ethyhexyl)phthalate were detected in monitoring wells located on the southern border of the NE Quadrant.

Volatile organic compounds detected at concentrations greater than the NYSDEC Class GA Standards are contained in both overburden and bedrock groundwater within the NE Quadrant of the Siberia Area. (See Table 2 [attached]) As shown in monitoring well SA-MW-41 (see table below) the following contaminants: tetrachloroethene (PCE), trichoroethene (TCE) cis-1,2 dichloroethene (DCE), and vinyl chloride (VC), were primarily found in the shallow weathered bedrock groundwater, migrating northward from their source, at the former Burn Pit, towards the property line.

Summary of VOCs detected in Bedrock Monitoring Well SA-MW-41				
VOC (ug/l) [PPB]	**Depth Below Ground Surface**			
	14-34 feet	34-54 feet	54-74 feet	74-94 feet
1,1-Dichloroethene	5	ND	ND	ND
1,2,4-Trimethylbenzene	3.5	ND	ND	ND
1,2-Dichloroethene	ND	ND	ND	9
1,3,5-Trimethylbenzene	1.7	ND	ND	ND
Acetone	ND	ND	ND	10
Benzene	11	ND	ND	ND
Chloroform	88	ND	ND	ND
cis-1,2-Dichloroethene	950	1300	50	ND
Methylene Chloride	ND	ND	ND	13
Tetrachloroethene	1100	170	1.7	ND
trans-1,2-Dichloroethene	4.9	ND	ND	ND
Trichloroethene	140	900	1.1	ND
Vinyl Chloride	2400	340	ND	19

ND: Not detected

Potential Environmental and Human Health Risks

Surface Soil

The majority of the surface soil contaminated with petroleum hydrocarbons and/or metals have been removed or treated as part of the interim corrective measures conducted at the Siberia Area in 2002 and 2003. This includes removal of contaminated soils in off-site areas. Areas of surface soil that could not be treated or removed were covered with clean fill, crushed stone and/or capped with asphalt. As such, there is no exposure pathway for any of the remaining contaminants in the surface soil other than the potential for occasional contact exposure by construction workers working in or around subsurface excavations in the capped areas. A site map delineating the soil and groundwater interim corrective measures that have been implemented in the Siberia Area is attached as Figure 3.

Groundwater

Groundwater at the Siberia Area contains concentrations of volatile organic compounds, presumed to be associated with the former Burn Pit, at concentrations greater than NYSDEC Class GA standards. Groundwater in some areas of the Siberia Area also contains visual evidence of petroleum contamination, although concentrations of regulated compounds are, for the most part, less than Class GA Standards. The material in the Burn Pit was excavated in 2000 as a source removal interim corrective measure.

To prevent discharge of volatile organic compounds from the Siberia Area, an in-situ permeable iron reactive wall system, consisting of two walls, was constructed down gradient of the former Burn Pit to intercept and treat the volatile organic compounds remaining in the overburden and weathered bedrock groundwater after the source removal. Subsequent monitoring has demonstrated that the reactive wall system is successfully preventing the discharge of volatile organic compounds from the Siberia Area. As such, there is no pathway for exposure to volatile organic compounds in groundwater leaving the Siberia Area.

The long term groundwater monitoring program has shown that contaminant concentrations in the Siberia Area are stable or decreasing – indicating no ongoing sources of contamination. In addition, since the Watervliet Arsenal and all surrounding properties are serviced by public potable water supplies provided by the City of Watervliet and the Town of Colonie, there is no pathway for ingestion or contact with contaminated groundwater for all receptors except for the potential for occasional contact exposure by construction workers working in or around subsurface excavations.

Proposed Final Remedy

Assessment Criteria

Siberia Area Soils: The principal remedial technology implemented as an interim corrective measure and proposed to become a final remedy is enhanced bioremediation (land farming). This technology was chosen because of its low cost ($20 to $80 per cubic yard), it destroys petroleum hydrocarbons and PAH's, and pilot studies had shown that it is reasonable to expect it to achieve the CAO's.

Bio-treatability studies indicated that naturally occurring bio-degrading organisms exist onsite and are using the total petroleum hydrocarbons and PAH's as a source of carbon (food). To assure removal of recalcitrant PAH's down to the CAO's, bio-enhancement was used. This entailed the addition of fertilizer, moisture, a bulking agent (wood chips) and mixing of the soil on a routine basis.

The Corrective Action Objectives (CAO's) for the soils, which were developed with the concurrence of the New York State Department of Health, are as follows:

Corrective Action Objectives For The Siberia Area Soils					
PAH*	CAO (mg/kg) [PPM]	PAH	CAO (mg/kg) [PPM]	Inorganic	CAO (mg/kg) [PPM]
Napthalene	50	Fluoranthene	50	Arsenic	23
Acenapthene	50	Pyrene	50	Chromium	390
Acenapthylene	50	Benzo(a)pyrene	1.0	Lead	500
Anthracene	50	Benzo(b)fluoranthene	8.8		
Fluorene	50	Benzo(k)fluoranthene	8.8		
Phenantherene	50	Dibenzo(a,h)anthracene	1.0		
Benzo(a)anthrecene	1.0	Benzo(g,h,i)perylene	50		
Chrysene	3.2	Indeo(1,2,3)pyrene	25.6		

* Polycyclic Aromatic Hydrocarbon
PPM: part per million

Siberia Area Groundwater: The principal remedial technology implemented as an interim corrective measure and proposed to become a final remedy is removal of the source at the former Burn Pit and passage of contaminated ground water through a reactive iron wall. This technology was chosen because it is cost effective at destroying volatile organic compounds, the principal contaminant in the groundwater. It is a passive technology which does not require active pumping and other than monitoring, there are no other costs during it's expected life span (approximately 10 years). If efficiency decreases, the iron particles can be reactivated by agitation to remove any biological coating or chemical precipitation.

The United State Army Corps of Engineers (the federal agency providing oversight for remediation at military sites) has a program that gives preference for implementation of "innovative technologies". The proposed final remedies use technologies that are considered to be "innovative technologies" which gave them an additional preference.

Discussion of Corrective Measures For The Siberia Area

The Regulating Agencies have approved the following interim corrective measures's which have been implemented and are recommended to become the final remedy:

Siberia Area Soils:

The primary technology used to destroy organic contaminants in the soils is enhanced bioremediation (land farming). This technology uses microorganisms to degrade organic contaminants in excavated soil, sludge, and solids. The microorganisms break down contaminants by using them as a food source.

The plans and specifications to implement bioremediation (land farming) as an Interim

Corrective Measure were approved on February 28, 2003. However, due to possible loss of funding, the facility started preliminary site work prior to this approval. During September 2002, the following was accomplished: site surveys, utility relocation, preparation of on site facilities, erosion control measures and asphalt pavement removal.

During the winter of 2002, the following field work was conducted: soil excavation and screening; post-excavation sampling; off-site disposal on soil that could not be treated; and construction of land farming treatment cells and placement of contaminated soils in the cells.

During the summer of 2003 the land farming treatment cells were actively treating contaminated soils. This active treatment of contaminated soils continued into the summer of 2004. Grading and gravel placement was completed at Landfarming Area A in August 2004 and in Landfarming Areas C and D in January 2005. Capping of areas receiving an asphalt cover was completed during July 2004. In an attempt to achieve the CAO's for the recalcitrant PAH's, monitored natural attenuation is being conducted at Landfarming Areas C and D. Sampling will be conducted to determine if these goals have been met.

Approximately 125,000 square feet (2.9 acres) was covered with crushed stone and an asphalt cap was placed on approximately 90,000 square feet (2.1 acres). During the enhanced bioremediation (land farming), approximately 13,300 cubic yards of soil were treated and approximately 3,500 cubic yards of soil not amenable to bioremediation were disposed of off-site. Institutional controls through land use restrictions will be imposed to limit future use of the site.

A Construction Certification Report detailing the Siberia Area soil remedy activities will be prepared after site restoration activities are completed. The anticipated submittal date is during the summer of 2006.

Groundwater:

Permeable Reactive Wall

WVA proposed to treat overburden groundwater contaminated by volatile organics using permeable reactive wall technology. This was implemented as an Interim Corrective Measure and is proposed to become the final remedy. On December 14, 1998 WVA completed installation of the dual permeable reactive wall system in the North East Quadrant of the Siberia Area. Dual walls were chosen over a longer single wall as a more cost effective way to intercept the existing plume and any new contamination originating from the source.

The permeable reactive wall is made up of zero-valent iron that degrades chlorinated contaminants such as trichloroethylene (TCE) and perchloroethylene (PCE) into non-

toxic byproducts using oxidation-reduction reactions. As the iron is oxidized, a chlorine atom is removed from the compound using electrons supplied by the oxidation of iron.

The wall consists of a mix of granular iron particles free of oxidation, mixed with sand in a 1:1 ratio by weight. Wall "A" (the southern most) is approximately 205 feet long and varies in depth from approximately 8.5 to 12 feet. Wall "B" is approximately 80 feet long and varies in depth from approximately 8 to 11.5 feet. Both walls have a width that varies between 2 to 3 feet. The iron particle/sand mix in each wall is covered with fill material and topped with a 2 inch crushed stone layer. The base of the wall sits on competent bedrock so that all of the shallow groundwater flow zones are intercepted.

Burn Pit

As an ICM for the Burn Pit area, all contaminated soils and other materials disposed in the area of the Burn Pit were excavated and treated by enhanced bioremediation during the landfarming pilot study. This removed the source of contamination. In addition, a low-permeability clay layer was used as the first lift of backfill material in the excavation to restrict groundwater infiltration through materials that may have contained residual VOC contaminants leached from the Burn Pit.

Definition of Technical Terms Used in This Statement of Basis

Volatile Organic Compounds (VOC): This category includes solvents that easily change phases, or evaporate. This attribute often makes the compound easier to detect and remove. Very frequently, these compounds are chlorinated. Typical contaminants of this type are trichloroethene (TCE) and its daughter products such as vinyl chloride.

Semi-volatile Organic Compounds (SVOC): This category includes contaminants that are more difficult to remove because they do not easily change phases, and often adsorb onto soil particles. Typical contaminants of this type are polychlorinated biphenyls (PCB), and polynuclear aromatic hydrocarbons (PAHs), such as coal tars and creosote.

Metals: This category includes metals such as lead, chromium and arsenic.

Soil: This is the zone either at or below the ground surface that is above saturated zones (water table). This is referred to as the unsaturated subsurface or the vadose zone.

In-situ Treatment: After it is determined that contamination is present, one of the first questions that is asked is whether the contaminants can be treated in place (i.e., in-situ). Treatment could include destruction, or reduction in mobility or mass. Typical in-situ methods range from phytoremediation (absorption and metabolism by plants) to permeable barrier walls (walls of material that react with an agent to render it harmless).

Removal: If contaminants cannot be successfully treated or destroyed in place, they have to be removed and treated, contained, or disposed of.

Containment: Containment is a remediation strategy that is selected when treatment is impractical. It is often used, or in combination with in-situ treatment. The most common containment measures are capping landfills and placing barriers in the subsurface to impede migration.

List of Supporting Documents

Malcolm Pirnie (1997), Final RCRA Facility Investigation Report, Siberia Area, Watervliet Arsenal, Watervliet, New York, December 1997.

Malcolm Pirnie (1998a), Corrective Measures Study Field Data Report, Siberia Area, Watervliet Arsenal, Watervliet, New York, October 1998.

Malcolm Pirnie (1998b), Exposure Assessment, Siberia Area, Watervliet Arsenal, Watervliet, New York, April 1998.

Malcolm Pirnie (1998c), Final Work Plan and Addenda, Permeable Reaction Wall Pilot Treatment System, Watervliet Arsenal, Siberia Area NE Quadrant, Watervliet, New York, September 1998.

Malcolm Pirnie (1999a), Draft Corrective Measures Study (CMS) Preliminary Screening Report, Watervliet Arsenal, Siberia Area, Watervliet, New York, August 1999.

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Malcolm Pirnie (2000a), Draft Final Biological Treatability Studies of Siberia Area, Watervliet Arsenal, Watervliet, New York, April 2000.

Malcolm Pirnie (2000), Work Plan for the Landfarming Pilot Treatment System, Watervliet Arsenal, Siberia Area, NE Quadrant, Watervliet, New York, June 2000.

Malcolm Pirnie (2001), Certification Report, Former Burn Pit Removal, Watervliet Arsenal Siberia Area, Watervliet, New York, April 2001.

Malcolm Pirnie (2002), Landfarming Pilot Treatment System Report, Siberia Area, Watervliet Arsenal, Watervliet, New York, July 2002.

Malcolm Pirnie (2002), Long-Term Monitoring Data Summary Report (1999-2001), Watervliet Arsenal, Watervliet, New York, June 2002.

Malcolm Pirnie (2002), Plans and Specifications, Interim Corrective Measures Work Plan,


draft