Per the Federal Facility Agreement for Iowa Army Ammunition Plant, Article X.B.1, the attached document is the final version of the submitted document.

IOWA ARMY AMMUNITION PLANT

DRAFT FINAL

Brush Creek Point Source Control Treatment System Design

Iowa Army Ammunition Plant
Middletown, Iowa

MAY 2005

Prepared for:
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Middletown, IA 52638

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BRUSH CREEK POINT SOURCE CONTROL WORK PLAN
for
IOWA ARMY AMMUNITION PLANT
MIDDLETOWN, IA

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CONTENTS

SECTION **PAGE**

1. 0 INTRODUCTION AND BACKGROUND....1-1
1.1 INTRODUCTION....1-1
1.2 FACILITY LOCATION, DESCRIPTION, AND OPERATIONAL HISTORY....1-1
1.3 EXISTING SITE CONDITIONS....1-2
1.3.1 Historical Point Source Discharge Information 2003 - 2004....1-2
2. 0 CONTROL OF POINTS SOURCES....2-1
2.1 CONTAMINATION CONTROL....2-1
2.1.1 Load Lines Discharges....2-1
2.1.1.1 Process Description....2-1
2.1.1.2 Design....2-2
2.1.1.3 Assumptions....2-3
2.1.1.4 Sampling and Analysis....2-3
2.1.1.5 Discharge Limits....2-3
2.1.2 WasteWater Treatment Plant Discharge....2-3
2.1.2.1 Process Description....2-3
2.1.2.2 Preliminary Design....2-5
2.1.2.3 Technical Notes....2-8
2.1.2.4 Sampling and Analysis....2-9
2.1.2.5 Disposal....2-9
2.1.2.6 Operation and Maintenance....2-9
2.1.2.7 Discharge Limits and Brush Creek Surface Water Sampling....2-10
3. 0 REFERENCES....3-1

TABLE

Number

1-1 Point Source RDX Discharge Results
2-1 Pre-Design WWTP Discharge and Brush Creek Surface Water Sample Results
2-2 Initial 6-Month Sampling Frequency–WWTP

FIGURES

Number

1-1 Facility Map
1-2 Location of Point Source Discharges on Brush Creek
2-1 Process Flow Diagram, WWTP Point Source

APPENDICES

APPENDIX A (HISTORICAL BRUSH CREEK DOCUMENTS) A-1
APPENDIX A-1 (DRAFT – FINAL TECHNICAL MEMORANDUM, EVALUATION OF CONTAMINANT SOURCES TO SURFACE STREAMS)
APPENDIX A-2 (SAMPLING AND RECONNAISSANCE OF BRUSH CREEK)

APPENDIX B (CALCULATIONS)... B-1
APPENDIX B-1 (EQUALIZATION TANK)
APPENDIX B-2 (GAC COLUMNS)

APPENDIX C (CARBON ADSORPTION EQUIPMENT INFORMATION)...................................... C-1
APPENDIX C-1 (CARBON COLUMN PLAN AND ELEVATIONS)
APPENDIX C-2 (CARBON COLUMN TECHNICAL SPECIFICATIONS)

APPENDIX D (EPA COMMENTS AND ARMY RESPONSES) D-1

ACRONYMS

AEC	Atomic Energy Commission
AMCCOM	Armament, Munitions, and Chemical Command
AO	American Ordnance
BAECP	Burlington Atomic Energy Commission Plant
BOD	Biological Oxygen Demand
COC	contaminant of concern
EPA	Environmental Protection Agency
GAC	Granular Activated Carbon
gpd	gallons per day
gpm	gallons per minute
HMX	high melt explosive
IAAAP	Iowa Army Ammunition Plant
IDNR	Iowa Department of Natural Resources
IOC	Industrial Operations Command
LAP	load, assemble, and pack
NPDES	National Pollutant Discharge Elimination System
PFD	Process Flow Diagram
PLC	Programmable Logic Control
QC	quality control
RDX	Royal Demolition Explosive
TSS	Total Suspended Solids
WWTP	Wastewater Treatment Plant
µg/L	micrograms per liter

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1. 0 INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION

The Iowa Army Ammunition Plant (IAAAP) is a government-owned, contractor-operated facility under the command of the U.S. Army Operations Support Command, Rock Island, Illinois. The current operating contractor is American Ordnance (AO). Production of munitions began in 1941, and the facility remains in operation. Production activities at IAAAP currently include load, assemble, and pack (LAP) munitions, including projectiles, mortar rounds, warheads, demolition charges, anti-tank mines, and anti-personnel mines. The LAP operations use explosive materials and lead-based initiating compounds.

There is contaminated groundwater off site, south of the installation. This contaminated groundwater is due to infiltration of water from Brush Creek, which drains a substantial portion of the facility. Brush Creek contains concentrations of Royal Demolition Explosive (RDX) above the health advisory limit and is the off-site contaminant of concern (COC).

There are numerous known and potential sources of RDX in the Brush Creek watershed including contaminated groundwater, contaminated soils, and wastewater discharges. This report presents the work plan for controlling RDX contamination from the point sources, from which discharges of process and wastewater are occurring to the Brush Creek.

1.2 FACILITY LOCATION, DESCRIPTION, AND OPERATIONAL HISTORY

IAAAP is a government facility, owned by the United States Army (Army) and operated by a private contractor. The IAAAP is located in the southeastern part of Iowa, near the town of Middletown, Des Moines County, approximately 10 miles west of the Mississippi River. The IAAAP is a secured facility covering approximately 19,000 acres in a rural setting (Figure 1-1). Approximately 7,751 acres are currently leased for agricultural use, 7,500 acres are forested land, and the remaining area is used for administrative and industrial operations.

IAAAP was initially developed in 1941, and it has undergone modernization and expansion since then. Production of supplies for World War II at the facility began in September 1941 and ended in August 1945. Production was resumed in 1949 and has continued to the present. In the 1960s and early 1970s, the IAAAP produced supplies for wars in southeast Asia. During peacetime, activities at the plant continue at a reduced level. Also, from 1946 to 1950, nitrogen fertilizer was produced at Line 8. From 1948 through mid 1975, the former Atomic Energy Commission (AEC) operated facilities on the site, which then reverted to Army control in 1975 (Ecology and Environment, Inc. 1987).

IAAAP is currently operating to LAP ammunition items, including projectiles, mortar rounds, warheads, demolition charges, anti-tank mines, anti-personnel mines, and the components of these munitions, including primers, detonators, fuses, and boosters. The LAP operations use explosive material and lead-based initiating compounds. Only a few of the production lines are in operation.

IAAAP is a contractor-operated installation under command of the Army Industrial Operations Command (IOC), formerly the U.S. Armament, Munitions, and Chemical Command (AMCCOM), Rock Island, Illinois. The principal mission of IAAAP has been LAP operations dealing with a variety of conventional ammunition and fusing systems. LAP lines were operated at high production rates during the periods 1941 through 1945 and 1949 through 1952. Munitions production rates have varied from 1952 to the present time. In 1947, the IAAAP was selected as the first production facility for manufacturing of high explosives components for weapons under the Atomic Energy commission. A portion of Line 1, the Explosives Disposal Area Sites, Yards C, G, and L, and the Firing Site Area came under control of the Atomic Energy Commission and their contractor, Silas Mason Company, last known as Mason & Hanger - Silas Mason Co. Inc. The AEC is also thought to have operated at the Security Command Center, Emergency Response Command Post and Deactivation Furnace Sites. These areas occupied approximately 1,630 acres within the IAAAP and became known as the Burlington Atomic Energy Commission Plant (BAECP). The BAECP closed in July 1975 and control of the areas reverted to the IAAAP under the direction of the Army.

1.3 EXISTING SITE CONDITIONS

1.3.1 HISTORICAL POINT SOURCE DISCHARGE INFORMATION 2003 - 2004

There are several point sources that have discharged to Brush Creek that are known to have historically contributed RDX. Information concerning these discharge points has been documented in monthly National Pollutant Discharge Elimination System (NPDES) reports provided to the Iowa Department of Natural Resources (IDNR) by IAAAP (AO, 2004), as well as other reports prepared for study activities at the facility. The study activity reports consist of the following:

- Evaluation of Contaminant Sources to Surface Streams (HARZA, 2001 [see Appendix A-1]),
- Remedial Action Alternatives Analysis reports for Lines 2 and 3 (URS, 2002a, b), and
- Sampling and Reconnaissance of Brush Creek (Johnson et al. 2004 [see Appendix A-2]).

Based on a review of the available information, it is evident that many of the discharge points historically utilized by IAAAP are no longer used. In 2003 and 2004, three NPDES outfalls were still active for the discharge of treated process water to Brush Creek and one NPDES treated sanitary wastewater outfall was actively discharging treated water to Brush Creek (Johnson et al, 2004; AO, 2004). The focus of the work described in this work plan is to control the current point sources discharging into Brush Creek. As such, the following sections will focus on information pertinent to the evaluation and control of the current NPDES discharges.

The primary report utilized to evaluate the potential RDX impacts on Brush Creek was the 2004 report for the sampling and reconnaissance of Brush Creek. Surface water, outfall, and sediment samples were collected and analyzed for RDX concentrations at detection levels capable of supplying meaningful results, in particular for comparison of RDX water analyses to the health advisory level of 2 micrograms per liter (μg/L). The overall objective of the study was to quantify the contributions of RDX from various potential sources so that a prioritization of future remedial/abatement efforts could be established.

The operating load lines generate process wastewater that contains RDX. This process water is treated, stored and discharged intermittently. During 2003, there were three such active discharges: Line 2 (discharge #021), Line 3-Point 1 (discharge #032), and Line 3-Point 2 (discharge #033). A review of the NPDES monitoring data from January through October 2003 indicated that typically each line discharges 1, 2, or 3 days per month. Line 3-Point 2 had not discharged at all during the first 10 months of 2003. Line 3-Point 1 discharged on 4 days in this 10-month period. Line 2 discharged on 14 days in this 10-month period. The average volume discharged was 800 gallons (3,030 liters) for Line 2 and 5,200 gallons (19,700 liters) from Line 3-Point 1. Water samples were collected from the storage tanks at the three load line discharge points and analyzed for explosives (Table 1-1). The Line 2 storage tank water had an RDX concentration of 138 µg/L. Samples from the Line 3-Point 1 and Line 3-Point 2 storage tanks had RDX concentrations less than the limit of detection (0.196 µg/L) (Johnson et al, 2004).

The average daily load of RDX to Brush Creek from Line 2 during the first 10 months of 2003 was 7E-5 lbs/day (0.03 grams/day) (Johnson et al, 2004). This was calculated by multiplying the average volume discharged times the number of days of discharge times the measured RDX concentration of 138 µg/L, and then dividing by the number of days in 10 months. This is less than 0.2 percent of the RDX load in Brush Creek at the installation boundary. No RDX was detected in the Line 3-Point 1 storage tank, so the contribution of RDX from Line 3-Point 1 to Brush Creek is even smaller. Even if it was assumed that the Line 3-Point 1 discharge had an RDX concentration equal to that in the Line 2 storage tank, 138 µg/L, the contribution to the RDX load in Brush Creek would be less than 0.3 percent.

Sanitary wastewater at the IAAAP is treated at the wastewater treatment plant (WWTP). The WWTP is a continuous discharge. Based on NPDES monitoring data from the first 9 months of 2003, the average daily discharge was 273,000 gallons per day (1.03 E6 liters per day) (Johnson et al, 2004). A review of historical discharge from the WWTP since January 2003 indicates that daily flow ranges from approximately 100,000 to 600,000 gallons per day (gpd) [70 to 420 gallons per minute (gpm)]. Flows greater than 500 gpm (720,000 gpd) have not been observed since the sewer line upgrade project was completed in December 2003. Brief peaks in discharge over 500 gpm, prior to the sewer line upgrade project, were caused by significant infiltration issues correlative with high rainfall events. A water sample and field duplicate collected at the discharge point on October 12, 2003 had an average RDX concentration of 3.3 µg/l (Table 1-1). The loading of RDX from the WWTP calculated using this sample and the average discharge was 7.5E-3 lbs/day (3.4 grams/day, amounting to 21 percent of the RDX load in Brush Creek at the installation boundary).

Figure 1-2 shows the locations of the point source discharges. The process water discharges are not on the main channel of Brush Creek. These discharges are to ditches which ultimately flow into Brush Creek. The WWTP discharge is directly to Brush Creek at point 13 south of the WWTP (Figure 1-2). However, the WWTP is a significant contributor to overall flow in Brush Creek and RDX loading during low flow periods (Johnson et al, 2004).

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2. 0 CONTROL OF POINTS SOURCES

The primary objective is to remove/reduce RDX contamination from the point sources to below 2 µg/L before being discharged into Brush Creek and to ultimately determine the impact of the NPDES discharge on RDX loading. To accomplish this objective, carbon adsorption is identified as an appropriate treatment technology.

2.1 CONTAMINATION CONTROL

2.1.1 <u>LOAD LINES DISCHARGES</u>

2.1.1.1 Process Description

The active load lines (Line 2, Line 3-Point 1, and Line 3-Point 2) generate process wastewater that contains RDX contamination. Presently, RDX is removed in the treatment system set up at the respective load lines (Line 2, Line 3-Point 1, and Line 3-Point 2).

Existing Treatment System At Line 2, Line 3-Point 1 and Line 3-Point 2

Line 2

The treatment system at Line 2 consists of a 2,000 gallon influent holding tank, diatomaceous earth filters, two carbon columns in series, and the 1,200-gallon effluent holding tank. Additionally, there is a third carbon column in standby in case the lead operating carbon column approaches breakthrough. The process water from Line 2 is stored in the influent holding tank as it is generated. The contaminated water is treated and discharged intermittently as the storage approaches approximately 1,200 gallons. The treated water is discharged in the drainage ditch that flows on the west side of the building to the Brush Creek. The treated water is tested for explosives and Total Suspended Solids (TSS) before discharge. The maximum design flow rate to the treatment system is 20 gpm. The carbon columns are 2 feet in diameter and 10 feet high, each containing 600 pounds of carbon (Carroll, 2004). The carbon columns are capable of removing explosives to levels below the AO detection limit of 50µg/L. However, the NPDES permit allows for monthly maximum discharge of 750 µg/L and daily discharge of 2,250 µg/L for the combination of high melt explosive (HMX) and RDX.

Line 3-Point 1

The treatment system at Line 3-Point 1 consists of two carbon columns in series and a recycle system 30,000-gallon holding tank. When the recycle system reaches 20,000 gallons, the water is discharged in 5,000 gallons intervals. Additionally, there is a third carbon column in standby, in case the lead operating carbon column approaches breakthrough. The process water from Line 3-Point 1 is stored in the influent holding tank as it is generated. The contaminated water is treated and discharged intermittently as the storage approaches approximately 1,200 gallons. The treated water can either be discharged in the drainage ditch that flows on the side of the building to the Brush Creek, or can be recirculated for reuse. The treated water is tested for explosives and TSS before discharge. The maximum design flow rate to the treatment system is 20 gpm. The carbon columns are 2 feet in diameter and 10 feet high, each containing 600 pounds of carbon (Carroll, 2004). The carbon columns are capable of removing explosives to levels below the AO detection limit of 50 µg/L. However, the NPDES permit allows for monthly maximum discharge of 750 µg/L and daily discharge of 2,250 µg/L for the combination of HMX and RDX

Line 3-Point 2

The treatment system at Line 3-Point 2 consists of a 2,000-gallon influent holding tank, two carbon columns in series and a recycle system 30,000-gallon effluent holding tank. When the recycle system reaches 20,000 gallons, the water is discharged in 5,000 gallons intervals. Additionally, there is a third carbon column in standby in case the lead operating carbon column approaches breakthrough. The process water from Line 3-Point 2 is stored in the influent holding tank as it is generated. The contaminated water is treated and discharged intermittently as the storage approaches approximately 1,200 gallons. The treated water can either be discharged in the drainage ditch that flows on the south side of the building to the Brush Creek or can be recirculated for reuse. The treated water is tested for explosives and TSS before discharge. The maximum design flow rate to the treatment system is 20 gpm. The carbon columns are 2 feet in diameter and 10 feet high, each containing 600 pounds of carbon (Carroll, 2004). The carbon columns are capable of removing explosives to levels below the AO detection limit of 50 µg/L. However, the NPDES permit allows for monthly maximum discharge of 750 µg/L and daily discharge of 2,250 µg/L for the combination of HMX and RDX.

Proposed System

As part of the point source control plan, Tetra Tech proposes to transfer the RDX contaminated water stored in the effluent holding tank at Lines 2, 3-Point 1, and 3-Point 2 to an equalization tank of an existing carbon treatment system at the IAAAP. The NPDES Compliant water from Lines 2, 3-Point 1, and 3-Point 2 will be pumped into a 6,200 gallon tanker truck. The tanker truck will transport the water to the equalization tank of an existing carbon treatment system where it will be processed through a carbon adsorption process to remove the RDX contamination.

2.1.1.2 Design

The tanker truck used to transport the partially treated water at Lines 2, 3-Point 1, and 3-Point 2 is already available through a subcontract. It is assumed that the water at Line 2 will need to be transported and treated twice a year with a total of four trips during the period of two years. Additionally, a total of six trips will be needed to transport and treat the water at Line 3 during the period of two years. Two years is the operational time frame specified by the Army for the point source control project. (See Specification 01351-Environmental Protection for spill control measures.)

2.1.1.3 Assumptions

This treatment of RDX contaminated water at Lines 2, 3-Point 1, and 3-Point 2 is required for the period of 2 years. Two years is the operational time frame specified by the Army for the point source control project.

2.1.1.4 Sampling and Analysis

Since the water is transported and treated intermittently, the influent sample will be collected once the water in the existing effluent holding tank at Lines 2, 3-Point 1, and 3-Point 2 is at the mark of being transported and treated. The influent sample will be collected prior to startup of pumping into the tanker truck. The effluent sample will be collected during each treatment and discharge event. The samples will be analyzed for nitroaromatic explosives using EPA Method 8330 on a 30-day turnaround time basis. Samples will be analyzed by Laucks Testing Labs, Inc. in Seattle, Washington according to the quality control (QC) criteria specified in the *Facility-Wide Work Plan* (URS, 2002c).

2.1.1.5 Discharge Limits

The treated water will be discharged at a RDX concentration of less than 2 µg/L.

2.1.2 WASTEWATER TREATMENT PLANT DISCHARGE

2.1.2.1 Process Description

The sanitary wastewater at the IAAAP is treated at the wastewater treatment plant (WWTP) before it is discharged to the Brush Creek. Based on NPDES monitoring data during the first 9 months of 2003, a water sample collected at the discharge point indicated an average RDX concentration of 3.3 µg/L. Presently, RDX is not removed from the treated wastewater discharged to the Brush Creek.

WWTP

The main treatment units of the sanitary WWTP at IAAAP consist of in-pond collection system, trickling filter, and clarifying system. The WWTP generates approximately 15 tons of solids per year. The treated wastewater is analyzed for Biological Oxygen Demand (BOD), TSS, ammonia, and silver (Carroll, 2004).

Pre-Design Confirmation Sampling

As per a Tetra Tech conversation with an AO representative (Carroll, 2004), there have been upgrades in the collection system of the WWTP that should result in a decrease in the concentration of RDX passing through the WWTP, and eventually discharging into Brush Creek. Therefore, additional sampling of the treated wastewater discharge will be conducted and analyzed for nitroaromatic explosives using EPA Method 8330 with a 30-day turnaround time. Explosives analyses will determine the effects of the sewer upgrade on RDX discharging from the WWTP into Brush Creek. Analyses will be conducted in accordance with the *Facility-Wide Work Plan* (URS, 2002c).

Two rounds of pre-design WWTP discharge and Brush Creek sampling data were collected in the timeframe between submission of the draft and draft-final versions of this work plan. The effluent samples were collected during low and high WWTP discharge conditions to evaluate the presence and range of RDX being discharged and the need for a treatment system to remove RDX from treated wastewater before being discharged to Brush Creek. These samples were collected within the WWTP concrete contact chamber just before the treated wastewater exits the facility and enters the discharge pipe leading to Brush Creek and within a 1-month period to estimate a reasonable range in discharge concentrations. Analytical results show RDX at similar or higher concentrations than observed in October 2003 by Johnson et al (2004). Detected concentrations range from 3.2 to 7.5 µg/L in September 2004 (Table 2-1), as compared with 3.5 µg/L (maximum) in October 2003. RDX and HMX concentrations detected during elevated WWTP discharge (255,000 gpd) on September 16, 2004 were higher than the corresponding concentrations detected during relatively normal WWTP discharge (119,000 gpd) on October 5, 2004 (Table 2-1).

At the same time as WWTP discharge sampling, three surface water samples were collected from Brush Creek upstream and downstream of the discharge to determine the corresponding concentration trend associated with high and low WWTP discharge. Surface water samples were collected from three locations in Brush Creek using a telescoping grab sampler. This device allows sample bottles to be attached directly to an aluminum telescoping pole that can access the water within the central portion of a creek while standing on the creek bank. One sample location (BCSW0004) represents RDX and HMX concentrations from approximately 280 feet upstream of the WWTP discharge. One sample location (BCSW0003) represents RDX and HMX concentrations from approximately 140 feet downstream of the WWTP discharge. One additional sample (BCSW0006) was collected over 10,000 feet downstream of the WWTP just upstream of the bridge where Plant Road K crosses Brush Creek. The BCSW0006 location was sampled to provide a synoptic concentration from a region of Brush Creek far downstream of any known or suspected RDX source areas and upstream of the plant property boundary. This location provides a synoptic measurement of RDX concentrations that approximate those leaving the facility. These data were collected primarily to assess the existence of RDX at concentrations exceeding the health advisory level of 2 µg/L in WWTP discharge and the localized effect on Brush Creek.

Surface water RDX and HMX results from sample locations upstream and downstream of the WWTP discharge demonstrate that concentration fluctuations are tied more strongly with the timeframe (relative to rainfall events) of collection rather than position within Brush Creek relative to the WWTP discharge. RDX and HMX surface water results upstream, downstream, and at the WWTP discharge were consistently higher on September 16, 2004 than October 5, 2004. The higher RDX and HMX concentrations are associated with a rainfall event (thunderstorms) during the 2 days prior to sampling. On September 14, 2004, 0.15 inch of rainfall was recorded in Burlington, Iowa and on September 15, 2004, 1.38 inches of rainfall were recorded. Rainfall was not recorded for the 3 days prior to the October 5, 2004 sampling event. Given these results, higher RDX and HMX concentrations in Brush Creek and the WWTP are interpreted to be the result of increased nonpoint source load being added to Brush Creek and the WWTP collection system during a rainfall event. During the October 5, 2004 sampling event (no rainfall), RDX and HMX concentrations discharged from the WWTP were equivalent to those detected in upstream and downstream Brush Creek surface water sampling locations**.**

Based on the pre-design analytical results where RDX was consistently detected greater than 2 µg/L), the WWTP treatment system will be installed to control RDX discharges into Brush Creek. The representative maximum concentration of RDX (7.5 µg/L) will be used to design a treatment system for RDX removal. A design is presented in the following sections based on the average RDX concentration of 3.3 µg/L detected at the NPDES monitoring point during the one-time sampling event in October 2003. The average RDX concentration in the October 2003 discharge was 3.3 µg/L with a range of 3.05 to 3.58 µg/L (original and duplicate sample results). Although the preliminary design was based on 3.3 µg/L of RDX, the design parameters are not sensitive to the high influent concentration detected in 2004. Higher influent concentrations will merely cause faster carbon usage, and therein necessitate more frequent carbon changeouts. The need for carbon changeout will be monitored through effluent (post-carbon) explosives analysis.

Treatment System

It is proposed to add a treatment unit that would capture the treated water from the WWTP to remove the residual RDX contamination before discharging to Brush Creek. The treated wastewater with the residual RDX contamination will be captured/intercepted in the new manhole between the secondary clarifier and the existing manhole (that connects to the parshall flume) and collected in the equalization tank before pumping through the treatment system as shown in the Process Flow Diagram (PFD). The treated wastewater will be pumped from the equalization tank to influent filtration system consisting of two 10 micron bag filters in parallel for redundancy capable of handling up to 500 gpm flow. The wastewater from the influent filtration system will then pass through the carbon columns consisting of two parallel trains with the treatment flow capacity of 250 gpm for each train. The treated water from the carbon columns will be passed through the 10 micron effluent bag filter and discharged to the existing manhole as shown in the PFD. The proposed treatment system is designed such that the wastewater from the WWTP is captured and discharged at the same point so that it can undergo all the required treatment processes before it is finally discharged to the Brush Creek. The capacity of the equalization tank will be approximately 15,000 gallons. A treatment train is designed based on the average flow capacity of approximately 250 gpm from the WWTP. However, an additional train would be operated if the flow from the WWTP is greater than 250 gpm and less than 500 gpm. Any flow greater than 500 gpm occurring mostly during brief peak flows will bypass the treatment system to the existing manhole.

2.1.2.2 Design

Equalization Tank

An equalization tank will receive flow from the WWTP discharge through the new manhole to minimize flow variations and provide constant flow to the carbon column. The tank will also minimize fluctuations in the chemical composition of the stream to achieve optimum performance of the treatment system. The lid to the tank will have six – 4’x4’ openings with grating over the openings.

The equalization tank will be an approximately 15,000-gallon, horizontal, in ground, precast concrete vault. The interior dimensions are 25 feet long, 10 feet wide and 8 feet deep. The tank is sized to provide a 40-minute detention time at the design operating flow (Appendix B-1).

The water level in the equalization tank will be monitored and controlled so that the tank influent and effluent flows will be approximately matched. Level switches in the equalization tank will be connected to the control relay or programmable logic control (PLC) to monitor and control the water level in the tank. All switches will be mounted in a stilling well to minimize water-level fluctuations near the switches.

Influent Transfer Pumping System

The influent transfer pumping system will consist of two submersible pumps, each with 250-gpm capacity that will pump the water from the equalization tank to the two treatment trains. If the flow from the WWTP is less than or equal to 250 gpm, pump P-1 will pump wastewater to treatment train 1. However, if the flow from the WWTP is greater than 250 gpm but less than 500 gpm, pumps P-1 and P-2 will operate and pump wastewater to treatment train 1 and 2, respectively.

Influent Filtration Unit

Equalized water will be pumped through the influent filtration unit F-1 or F-2 to remove suspended solids from the water and prevent fouling of downstream units. The filter units consist of a bag filter to capture suspended solid particles larger than 10 microns. The filtration units will have a stainless-steel filter housing. The pressure drop across the operating filter will be monitored and dirty filter bags will be replaced when the pressure differential exceeds a preset level. Dirty filter bags will be dried inside the building and disposed of at a local sanitary landfill.

Liquid-Phase GAC Adsorption

The equalized water is pumped through the influent filtration unit to the liquid-phase GAC system. The purpose of liquid-phase GAC adsorption is to remove the residual RDX contamination in the treated wastewater from the WWTP. The process will consist of passing the water through a bed of activated carbon to allow adsorption of the RDX onto the carbon. Periodically, the GAC may become saturated and will be exchanged for fresh carbon. The exhausted GAC will be returned to the vendor for regeneration or will be disposed of at an appropriate facility.

In general, highly substituted organic compounds with low water solubility are best adsorbed by GAC. The usage rate of carbon depends on the actual carbon demand by the residual RDX contamination and naturally-occurring humic compounds remaining in the water. It is estimated that approximately 36 lbs/day of carbon (for one column based on 250 gpm flow capacity) will be used for the adsorption of residual RDX contamination. The treatment system would consist of two parallel trains with the treatment flow capacity of 250 gpm for each train. Each train will consist of one GAC column as shown in Figure 2-1. Each GAC column will be approximately 8 feet in diameter and 10 feet high, containing 10,000 lbs of GAC (see calculations in Appendix B-2). The elevation and plan view of the carbon column is attached in Appendix C-1. The technical specification of the carbon column is presented in Appendix C-2.

Inside each adsorption column, the water will flow downward through a bed of GAC that will be approximately 6 feet deep. When analysis of the adsorption/GAC vessel effluent detects a significant contaminant breakthrough (RDX > 1.0 µg/L), the operating column will be taken out of service for GAC replacement. The water will be passed through the column in the standby treatment train until fresh carbon is loaded in the exhausted carbon column. The treatment train with freshly loaded carbon in carbon column will be in standby mode.

GAC replacement will be performed by an approved subcontractor providing a regenerated load of GAC, and taking away the spent GAC for regeneration or disposal. Based on the estimated GAC consumption, replacement of the GAC in the adsorption column will be required approximately every 7 months, if operated continuously. (See Appendix B-2 for calculations).

To unload the spent GAC from the out-of-service adsorption column, this column will be pressurized with compressed air from the service air system. The spent GAC will be pushed out of the column as a slurry and conveyed to an empty transfer truck. Conveying of the spent GAC slurry from the out-of-service column to the transfer truck will be accomplished with the permanent hard piping and valving of the liquid-phase GAC system manifolds and the GAC replacement subcontractor will provide temporary flexible hosing and connections.

To load fresh GAC into the empty adsorption column, treated water from the equalization tank will be pumped into a truck full of fresh GAC to create a slurry. The slurried GAC will then be gently pushed out of the truck to the empty column with compressed air. This transfer will be accomplished using the same combination of permanent and temporary piping, valving, and connections as used for the unloading of the out-of-service adsorption column, except in a reverse sequence. The newly-filled adsorption column will then be in stand by mode.

Exceeding the pre-set differential pressure across the GAC column will result in the activation of the differential pressure alarm indicating immediate need for a change in the activated carbon. If the differential pressure alarm is activated, the water would be passed through the standby treatment train using automatic controls to allow change out of the activated carbon.

Automatic controls will be provided that will operate/energize the standby treatment train if the influent flow of the WWTP is greater than 250 gpm.

The GAC adsorption system's process-piping network will allow operation of the adsorbers in parallel flow. This also permits backwash operations to be performed on one adsorber without interrupting treatment.

The backwash system will consist of a backwash feed tank and a backwash pump. Backwash will be performed at the flow rate of approximately 600 gpm by the backwash pump to attain the required bed expansion. The backwash water will be pumped to the beginning of the Imhoff tank for processing by WWTP.

Effluent Filtration System

The treated effluent water from the carbon column will flow through the effluent filter unit F-3 or F-4 to remove carbon fines present in the water. The filter units consist of a bag filter to capture carbon fines larger than 10 microns. The filtration units will have a stainless-steel filter housing. The pressure drop across the operating filter will be monitored and dirty filter bags will be replaced when the pressure differential exceeds a preset level. Dirty filter bags will be dried inside the building and disposed of at a local sanitary landfill.

Treatment Building

The treatment system will be housed in a new post framed building with the approximate dimensions of 30 feet wide by 50 feet long by 18 feet high. The building will be heated. The concrete slab floor of the treatment building will be designed as a containment zone for potential spills. The treatment building containment structure will include the floor (with a grate-covered drain), the building sump, one sump pump, and sump level control switches.

The purpose of the containment system will be to control treatment building drainage from component failure and normal wash down operations. Drainage resulting from the cleaning of minor spills, wash water, and drainage from the GAC transfer trucks will be collected in the treatment building sump. The treatment building floor will be slanted to grated drains that will route flow by gravity to the building sump. The drainage collected in the sump will be pumped to the equalization tank for treatment.

2.1.2.3 Technical Notes

- The treatment system will be installed and operated for the period of 2 years. This is the operational period of the point source control project as specified by the Army.

- The design of the carbon system is based on the maximum influent RDX concentration of 7.5 μg/L and average flow of approximately 250 gpm (360,000 gpd) through one treatment train. During the first 9 months of 2003, water samples collected at the discharge point indicated an average RDX concentration of 3.3 μg/L and average daily discharge of 273,000 gpd. If the flow from the WWTP is greater than 250 gpm and less than 500 gpm, a standby treatment train will be used to treat the additional wastewater. Any flow greater than 500 gpm, occurring mostly during brief peak flows, will bypass the treatment system and discharge to Brush Creek.

- Dirty filter bags will be dried inside the building and disposed of at a local sanitary landfill.

- Tetra Tech will be responsible for operating any new treatment system components that will be coupled with the existing treatment system. Coordination will occur between Tetra Tech and AO to ensure the safe and effective operation of the new treatment system. Unexpected WWTP peak flow bypasses that may be initiated by AO will also bypass the Tetra Tech GAC treatment system.

- The new treatment system will be located in an appropriate area accessible by road and near available power and the connection to the WWTP. The treatment building will be heated. Details regarding the connection to the WWTP will be coordinated with American Ordnance.

2.1.2.4 Sampling and Analysis

As shown in Figure 2-1, the water samples will be collected from the following sample ports:

Sample Port 1 (SP-1) -	Influent (from Equalization Tank (T-1)
Sample Port 2 (SP-2) -	Effluent (from Train 1)
Sample Port 3 (SP-3) -	Effluent (from Train 2, if operating)
Sample Port 4 (SP-4) -	Effluent (from Effluent of Filtration System)

The influent sample (SP-1) will be collected every 3 months (quarterly) and the effluent samples [if both columns are operating (SP-2 and SP-3) if only one column is operating (SP-4)] will be collected monthly. The samples will be analyzed for nitroaromatic explosives using EPA Method 8330 on a 30-day turnaround time basis. Samples will be analyzed by Laucks Testing Labs, Inc. in Seattle, Washington according to the QC criteria specified in the *Facility-Wide Work Plan* (URS, 2002c).

2.1.2.5 Disposal

- Dirty filter bags will be dried inside the building and disposed of at a local sanitary landfill.

- The carbon columns along with carbon will be returned to the vendor for proper disposal.

2.1.2.6 Operation and Maintenance

The operator will perform the duties described below.

- Enter building in accordance with the *Facility-Wide Work Plan* (URS, 2002c).
- Check the emergency shower and eyewash for proper operations.
- Monitor the PLC and motor control center and make process adjustments, as required.
- Check all pumps and flow meters for proper operations.
- Supervise GAC replacement.
- Replace filter bags.
- Cycle all pumps.
- Wash down tanks and floor, as necessary.
- Complete and distribute operating log and maintenance reports.
- The operation and maintenance will be performed weekly.

The following tasks must be performed periodically:

- Grounds maintenance (e.g., lawn mowing, litter pickup, etc.),
- Building inspection and maintenance,
- Snow removal, and
- Access road maintenance.

O&M activities will be performed in accordance with the O&M Manual being prepared as an addendum to this work plan and the *Facility-Wide Work Plan* (URS, 2002c).

2.1.2.7 Discharge Limits and Brush Creek Surface Water Sampling

The treated water will be discharged to Brush Creek with an RDX concentration less than 2 µg/L up to a maximum flow of 500 gpm. Any flow greater than 500 gpm, occurring mostly during peak hours, will bypass the treatment system and discharge to Brush Creek at the existing RDX contamination level.

To assess the impact of limiting discharge from the WWTP to less than 2 µg/L, surface water samples will be collected from Brush Creek upstream and downstream of the WWTP discharge point. Samples will be collected during the initial 6 months of operation according to sampling techniques specified in Table 2-2. All sampling and analytical procedures/methods will be performed in accordance with the *Facility-Wide Work Plan* (URS, 2002c) and will be analyzed for nitroaromatic explosives by Method 8330. Detection limits for nitroaromatic explosives, including RDX, will be according to the *Facility-Wide Work Plan* (URS, 2002c).

Following the initial 6-month evaluation period, sampling will be reduced for the remaining 18-month operational period of the point source control project to those time periods correlated with the maximum RDX concentrations. Based on an evaluation of historical discharge data, this is anticipated to be associated with periods of high rainfall.

3. 0 REFERENCES

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Carroll, 2004. Telephone Conversation with Mr. Carroll, American Ordnance, July 14, 2004.

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URS. 2002a. *Line 3 Groundwater Remedial Alternatives Analysis*, Iowa Army Ammunition Plant, Middletown, Iowa, prepared for the U.S. Army Corps of Engineers, January.

URS. 2002b. *Line 2 Groundwater Remedial Alternatives Analysis*, Iowa Army Ammunition Plant, Middletown, Iowa, prepared for the U.S. Army Corps of Engineers, February.

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TABLES

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Table 1-1: Point Source RDX Discharge Results

Sample ID Number	Location	Surface Water RDX Result (µg/L)	Water Detection Limit (µg/L)
WWTP- OUT-1AW	WWTP	3.05	0.196
WWTP- OUT-1BW	WWTP (Dup)	3.58	0.196
L2-1	Line 2	138	0.196
L3-1	Line 3-Point 1	ND	0.196
L3-2	Line 3-Point 2	ND	0.196

Source: (Johnson et al, 2004).

Table 2-1. Pre-Design WWTP Discharge and Brush Creek Surface Water Sample Results

Sample Location	Sample Location ID	WWTP Discharge	Analytical Method (SW 846)	Sample Collection Date	RDX Concentration (µg/L)	HMX Concentration (µg/L)	Comments
WWTP Discharge	BCSW0002	High (255,000 gpd)	8330	9/16/04	7.5 (7.6)	3.1 (3.2)	WWTP discharge water from contact chamber prior to entering Brush Creek
		Normal (119,000 gpd)	8330	10/05/04	3.2	1.8	WWTP discharge water from contact chamber prior to entering Brush Creek
Upstream of WWTP Discharge	BCSW0004	High (255,000 gpd)	8330	9/16/04	13.0	7.4	Brush Creek surface water; approximately 280 feet upstream of WWTP discharge
		Normal (119,000 gpd)	8330	10/05/04	2.2	1.2	Brush Creek surface water; approximately 280 feet upstream of WWTP discharge
Downstream of WWTP Discharge	BCSW0003	High (255,000 gpd)	8330	9/16/04	8.3	4.3	Brush Creek surface water; approximately 140 feet downstream of WWTP discharge
		Normal (119,000 gpd)	8330	10/05/04	2.9 (2.8)	1.5 (1.5)	Brush Creek surface water; approximately 140 feet downstream of WWTP discharge
Downstream of WWTP Discharge	BCSW0006	High (255,000 gpd)	8330	9/16/04	4.1	1.7	Brush Creek surface water; approximately 10,000 feet downstream of WWTP discharge just upstream of Plant Road K over Brush Creek
		Normal (119,000 gpd)	8330	10/05/04	2.4	1.4	Brush Creek surface water; approximately 10,000 feet downstream of WWTP discharge just upstream of Plant Road K over Brush Creek

Notes: RDX and HMX reporting limits are 0.5 µg/L. Values in parentheses represent field duplicate QC results.

Table 2-2. Initial 6-Month Sampling Frequency–WWTP

Sample Location	Sample ID	Frequency	Analytical Method	Comments
WWTP Discharge	BCSW0002	High and low discharge	8330	Discharge water; after carbon and before entering Brush Creek
Upstream of WWTP Discharge	BCSW0004	High and low discharge	8330	Brush Creek surface water; approximately 280 feet upstream of WWTP discharge
Downstream of WWTP Discharge	BCSW0003	High and low discharge	8330	Brush Creek surface water; approximately 140 feet downstream of WWTP discharge

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