HGL
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Exceeding Expectations

Redactions-CBI

Kansas City Operations

September 30, 2011

Mr. Jim Seiler
AES Project Officer
U.S. Environmental Protection Agency, Region 7
901 North 5th Street
Kansas City, KS 66101

RE: Revised Final Basis of Design Report for Operable Unit 1 at the Garvey Elevator Site, Hastings, Nebraska
U.S. EPA Region 7 AES Contract No. EP-S7-05-05; Task Order No. 0046
EPA Task Order Project Officer: Brian Zurbuchen, Ph.D.

Dear Mr. Seiler:

HydroGeoLogic, Inc. (HGL) is pleased to submit two hard copies (with electronic copies on CD) of the Revised Final Basis of Design Report for Operable Unit 1 (OU-1) at the Garvey Elevator Site, Hastings, Nebraska. One hard copy contains the original engineering seals and signatures. This document was prepared in accordance with Task Order 0046, our EPA-approved Task Order Proposal Revision 1 submitted on July 7, 2010; and EPA comments dated September 27, 2011.

As requested by EPA, two additional hard copies of the Revised Final Basis of Design Report will be sent to Laurie Brunner at the Nebraska Department of Environmental Quality. Should you have any questions or comments, please contact us at 913-317-8860.

Sincerely,

[redacted] P.G.
HGL [redacted] Order M[redacted]

[redacted], P.G., CHMM
AES Program Manager

Enclosures

6340 Glenwood, Suite 200, building #7, Overland Park, KS 66202
Phone: (913) 317-8860 Fax: (913) 317-8868
www.hgl.com

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REVISED FINAL
BASIS OF DESIGN
GARVEY ELEVATOR SITE
OPERABLE UNIT 1
HASTINGS, NEBRASKA

Prepared for:

U.S. Environmental Protection Agency Region 7
901 North 5th Street
Kansas City, KS 66101

Architect and Engineering Services Contract EP-S7-05-05
Task Order: 0046

September 2011

HydroGeoLogic, Inc

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Prepared for:

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Prepared by:

HydroGeoLogic, Inc
6340 Glenwood, Suite 200
Building #7
Overland Park, KS 66202

September 2011

TABLE OF CONTENTS

Section **Page**

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

AES	Architect and Engineering Services
AGP	Ag Processing, Incorporated
ANSI	American National Standards Association
AOC	Administrative Order on Consent
ARAR	applicable or relevant and appropriate requirement
AST	above ground storage tank
ASTM	ASTM International
AWG	American Wire Gauge
BACT	best available control technology
bgs	below ground surface
CCP	central control panel
CDM	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfm	cubic feet per minute
CFR	Code of Federal Regulations
COC	contaminant of concern
CPT	cone penetration test
DNAPL	dense non-aqueous phase liquid
EC	electrical conductivity
EPA	U. S. Environmental Protection Agency
ESA	Environmental Site Assessment
FFS	focused feasibility study
FM	factory manual
FS	feasibility study
ft/day	feet per day
ft/ft	feet per foot
GET	groundwater extraction and treatment
gpd/ft	gallons per day per foot
gpm	gallons per minute
GRS	galvanized rigid steel
HDPE	high density polyethylene
HGL	HydroGeoLogic, Inc.
HICA	Hastings Institutional Control Area
HMI	human machine interface
hp	horsepower
HWS	HWS Consulting Group, Inc.

ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronic Engineers
INW	Instrumentation Northwest, Inc.
I/O	input/output
LDR	Land Disposal Requirements
MCL	maximum contaminant level
μg/L	micrograms per liter
μg/m^3	micrograms per cubic meter
NDEQ	Nebraska Department of Environmental Quality
NDHHS	Nebraska Department of Health and Human Services
NDNR	Nebraska Department of Natural Resources
NEMA	National Electrical Manufacturers Association
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRS	Nebraska Revised Statutes
NTP	notice to proceed
O&F	operational and functional
O&M	operation and maintenance
OSHA	Occupational Safety and Health Administration
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
PA	preliminary assessment
PID	proportional-integral-derivative
PLC	programmable logic controller
POTW	publically owned treatment works
PRG	preliminary remediation goal
psia	pounds per square inch absolute
PVC	polyvinyl chloride
RA	remedial action
RAC	Remedial Action Classification
RAO	remedial action objective
RAPMA	Remedial Action Plan Monitoring Act
RCRA	Resource Conservation and Recovery Act
RD	remedial design
RI	remedial investigation
ROD	record of decision

scfm	standard cubic feet per minute
SDWA	Safe Drinking Water Act
SI	site inspection
Site	Garvey Elevator Superfund Site
START	Superfund Technical Assessment & Response Team
SVE	soil vapor extraction
TBC	to be considered
TetraTech	TetraTech EM, Inc.
THM	trihalomethanes
TSD	treatment, storage, and disposal
UIC	underground injection control
UL	Underwriters Laboratory
U.S.C	United States Code
V	volt
VCP	Voluntary Cleanup Program
VFD	variable frequency drive
VOC	volatile organic compound

BASIS OF DESIGN
GARVEY ELEVATOR SITE OPERABLE UNIT 1
HASTINGS, NEBRASKA

1.0 INTRODUCTION

The U.S. Environmental Protection Agency (EPA) Region 7 Superfund Division tasked HydroGeologic Inc. (HGL), to develop an interim Remedial Design (RD) for the Garvey Elevator Superfund Site (Site), Operable Unit (OU) 1 in Hastings, Nebraska, in accordance with the agency's interim Record of Decision (ROD) for the Site (EPA, 2010). This work is being executed under Architect and Engineering Services (AES) Contract EP-S7-05-05, Task Order 0046. CDM Federal Programs Corporation (CDM) is a team subcontractor to HGL on the AES contract and has a key role on the project. This document provides the basis of the remedial action (RA) design and design related activities including preparing specifications and plans, cost estimates, schedules, and other documents required to implement this RA.

1.1 PROJECT DESCRIPTION

The former Garvey Elevators, Inc. storage facility is located southwest and outside of the limits of the city of Hastings in Adams County, Nebraska (Figure 1.1). The facility is located on a 22-acre portion (Parcel ID – 010003207) of the 106-acre site property. The grain storage facility, where fumigant was stored and used (Figure 1.2), is an active 8-million bushel capacity grain elevator currently owned and operated by Ag Products, Incorporated (AGP).

The Site includes the former Garvey Elevators, Inc. property and downgradient areas underlain by the contaminated groundwater plume that originates from the grain storage facility. EPA has designated OU 1 as the area of soil and groundwater contamination on and immediately off the former Garvey Elevators, Inc. property. OU 2 is defined as contaminated groundwater farther downgradient from the grain storage facility that extends approximately 4.3 miles to the east. The known contaminants of concern (COCs) at the Site are carbon tetrachloride and chloroform.

A soil vapor extraction (SVE) system and a groundwater extraction and treatment (GET) system were installed in 1998 and are currently operating at the Site. The SVE system consists of eight vapor extraction wells. The GET system consists of eight groundwater extraction wells, an air stripper and two injection wells that return treated water to the aquifer. Both of these treatment systems are discussed in more detail in Section 2.0.

A focused feasibility study (FFS) was prepared to support an early action for OU 1 to mitigate an ongoing source to groundwater contamination and provide containment of contaminated groundwater. The FFS (HGL, 2009b) and information from the Interim Data Summary Report (HGL, 2009a) were used by EPA as a basis for selecting a remedy to mitigate certain threats to human health and the environment posed by the contaminated soil and groundwater beneath the source area at the Site. EPA issued an interim ROD for the Garvey Elevator OU 1 Superfund Site on June 30, 2010. The Interim ROD for OU 1 addresses contaminated soil and groundwater beneath the grain storage facility.

A remedial investigation (RI) for Site wide soil and groundwater contamination was completed in 2011. After the completion of the Site wide feasibility study (FS), EPA will prepare a Proposed Plan and will ultimately issue the final action ROD to address Site wide soil and groundwater contamination. The interim action will be consistent with the final action. The final action ROD is planned to be completed in 2012.

The interim RD for OU 1 addresses soil and contaminated groundwater at the grain storage facility; however, there are no construction components associated with the existing SVE system. The Interim RD will expand the capture zone of contaminated groundwater from OU 1 and prevent its downgradient migration and reduce concentrations of contaminants in OU 1 groundwater, thereby reducing the risk to human health and the environment. The interim RD, which is presented in this Basis of Design report, includes the following elements:

- Replacing existing flow meters with magnetic flow meters
- Making minor upgrades to electrical infrastructure
- Updating programmable logic controller (PLC) programming for system operation

1.2 SCOPE AND CONTENT

This document has been prepared to address the design needed to implement the interim RA. The final Basis of Design report is organized as follows:

Section 1 – Introduction: Provides a brief overview of the site history, site location, and project objective.

Section 2 – Site Background: Provides a description of the geology, hydrogeology, hydrology, topography, climate, and nature and extent of contamination.

Section 3 – Remedial Action Execution: Provides a more detailed description of the interim RA components and their implementation.

Section 4 – Permitting and Access Requirements: Identifies required permits and property access considerations.

Section 5 – Remedial Action Execution: Provides a summary of the activities needed to implement the interim RA as well as cost estimates and preliminary construction schedule for the interim RA work

Section 6 – References: Provides a list of references used throughout this document.

Appendix A – Calculations

Appendix B – Specifications

Appendix C – Contract Drawings

FIGURES

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Project: EP9046.02.40.06.00.00
Revised: 08/19/11 RL
Source: ESRI StreetMap USA
Nebraska DNR

HGL HydroGeoLogic, Inc

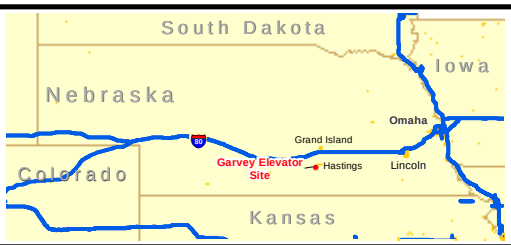
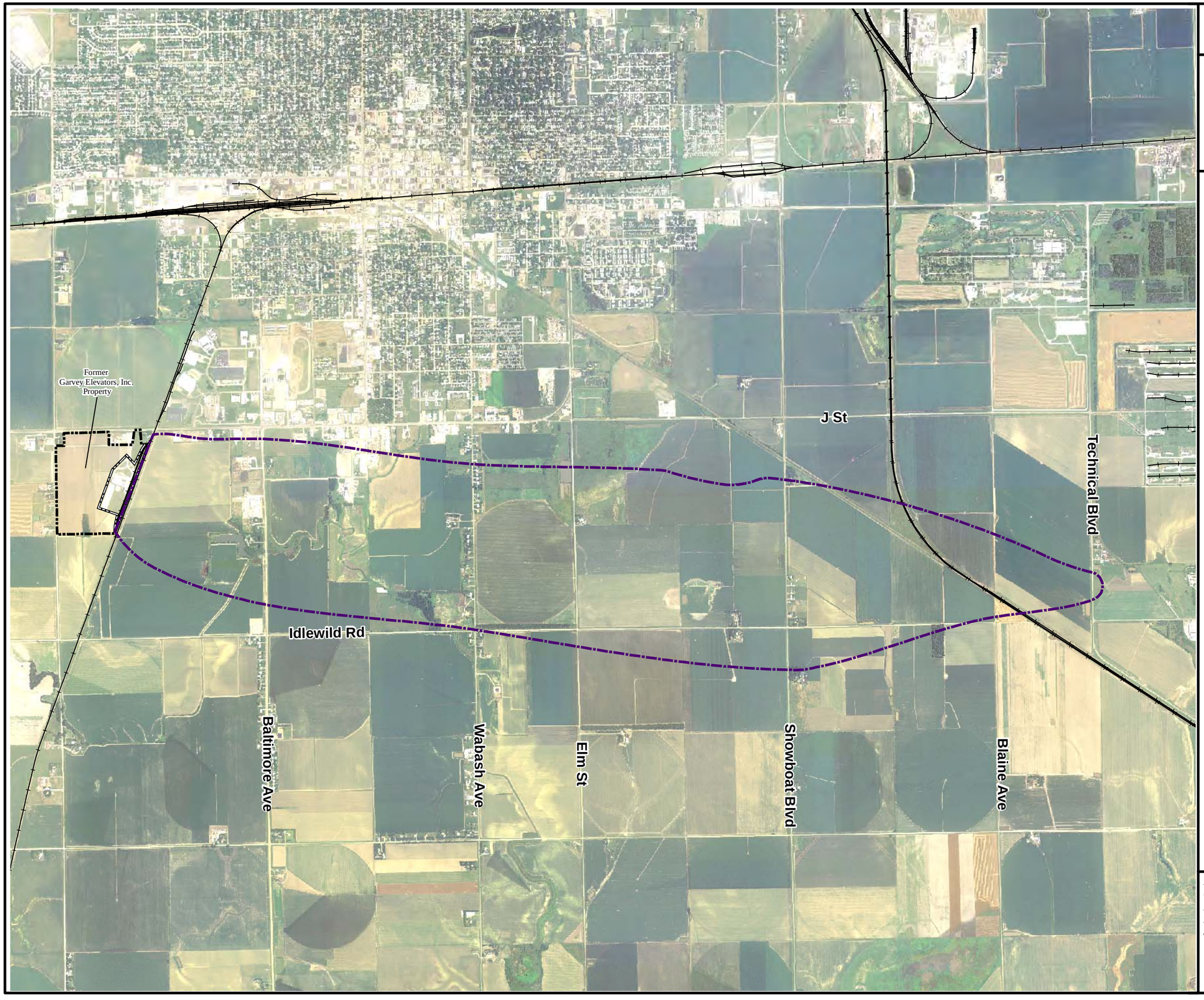


Figure 1.1
Site Location Map
Garvey Elevator
Superfund Site
Hastings, NE

Figure 1.2
General Extent of Carbon Tetrachloride Contamination



Legend

- Former Garvey Elevators, Inc. Property Boundary
- Garvey Elevator Site, OU1 Boundary
- Garvey Elevator Site, OU2 Boundary
- Railroad

0 2,500 5,000
Feet

N

Filename: X:/EPA009/Garvey/GIS/MXDs
Cross_Section_CarbonTet_Plume.mxd
Project: EP9034.01.22.02.02
Revised: 03/14/11 ST
Source: ENSR GDB 2008, DNR

United States Environmental Protection Agency

HGL HydroGeoLogic, Inc

CDM

Figure 1.3
Current Site Map

Legend

- Former Garvey Elevators, Inc. Property Boundary
- Garvey Elevator Site, OU1 Boundary
- Concrete Paved Area
- Buildings
- Railroad

0 200 400 800
Feet

N

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Revised: 9/23/11 ST
Source: ENSR GDB 2008, DNR

HGL HydroGeoLogic, Inc

2.0 BASIS OF DESIGN OVERVIEW

2.1 SITE LOCATION AND DESCRIPTION

The Site is located southwest of the City of Hastings in Adams County, Nebraska. The 110-acre property formerly owned by former Garvey Elevators, Inc. is located in the NW1/4 of Section 23, T7N, R10W, approximately seven miles west of the Adams County/Clay County line (Figure 1.1). The 106-acre property, consisting of an 84-acre parcel and a 22-acre parcel, is bounded on the north by U.S. Highway 6 and business and residential properties, on the east by the Burlington Northern and Santa Fe railroad track, on the west by Marion Road, and on the south by farmland (EPA, 2010). The Site is located in a predominately rural area with sparse distribution of residential properties north, east, and west of the site, the closest no less than 1/4 mile away. One municipal well and more than 35 private drinking water wells have been impacted by the volatile organic compound (VOC)-contaminated groundwater. The facility continues to operate as a grain storage facility under new ownership and management.

Twenty-two acres of the former Garvey Elevators, Inc. property is designated as the grain storage facility consisting of a concrete headhouse and elevator, flat storage building, steel storage bins, and associated buildings for facility maintenance, offices, and chemical storage (Figure 1.2). The majority of the remaining 84 acres of the former Garvey Elevators, Inc. property is used for crop production. The area surrounding the grain storage facility is rural with a sparse distribution of residential properties to the north, east, and west. The nearest residence is immediately adjacent to northeast property boundary, approximately 1,200 feet north of the grain storage facility.

2.2 SITE HISTORY

Garvey Elevators, Inc. began operation as a grain storage facility in 1959. In their responses to the Request for Information Pursuant to Section 104 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Garvey Elevators, Inc. stated that they used a liquid mixture of carbon tetrachloride and carbon disulfide as a grain fumigant from 1959-1985 (Garvey, 2003). The fumigant mixture is known as 80-20 fumigant (80 percent carbon tetrachloride and 20 percent carbon disulfide.) Some formulations of the 80-20 fumigant may also have contained a minor amount of ethylene dibromide.

In 1960, Garvey Elevators, Inc., installed an approximately 3,000-gallon aboveground storage tank (AST) to the north of the silos to store the liquid fumigant. Fumigant was piped from the AST up to the grain gallery via an underground pipe that exited the subsurface and extended up the north side of the silos to the gallery. Fumigant was applied from the top of the elevator gallery (HGL, 2008). According to one background document in the project file, a buried portion of this delivery pipe was found to be leaking and was replaced sometime before 1986 when the tank was removed (ENSR, 2005). However, during the 2008 interviews conducted by EPA and HGL in support of the RI, none of the five former employees of Garvey Elevators, Inc. interviewed could recall that the broken piping had been replaced. Four of the five interviewees stated that the fittings leaked, or that staining was observed beneath the tanks fittings and around the tank (HGL, 2008). Use of the liquid fumigant was discontinued in 1985.

Garvey Elevators, Inc. was first identified as a source of carbon tetrachloride contamination in 1994 when a water sample collected during a Phase I Environmental Site Assessment (ESA) conducted as part of AGP's due diligence procedures before purchasing the Garvey Elevators, Inc. property. During the ESA, carbon tetrachloride was reported in a water supply well located on the grain storage facility at 199 micrograms per liter (μg/L) (Terracon, 1994). This concentration exceeded the EPA maximum contaminant level (MCL) of 5 μg/L. Garvey Elevators, Inc. subsequently conducted several environmental investigations in the vicinity of the grain storage facility to determine the extent of carbon tetrachloride in soils and groundwater near the elevator, evaluate remedial alternatives, and estimate costs to conduct a RA.

From 1994 through 2007, Garvey Elevators, Inc. installed 47 groundwater monitoring wells and completed numerous soil and soil gas sample borings. In 1999, Garvey Elevators, Inc. installed an SVE system and GET system in response to the soil and groundwater contamination. Garvey Elevators, Inc. also began sampling private wells at residences and businesses, and providing alternative water supplies for wells affected by the carbon tetrachloride originating from the grain storage facility.

2.2.1 Regulatory History

The release of carbon tetrachloride was first discovered at former Garvey Elevators, Inc. property during a 1994 Phase I ESA. The chronology of subsequent regulatory actions at the Site is summarized below:

April 1995. Garvey Elevators, Inc. entered the Nebraska Department of Environmental Quality (NDEQ) Remedial Action Plan Monitoring Act (RAPMA) Voluntary Cleanup Program (VCP). While in the VCP, Garvey Elevators, Inc. conducted further site characterization, installed the GET and SVE systems in the source area, and provided alternative drinking water sources to impacted residents.

April 2003. NDEQ conducted a preliminary assessment/site inspection (PA/SI) of the former Garvey Elevators, Inc. Site to assess whether there was a potential threat to health and the environment and identify the sources of groundwater contamination (TetraTech, 2003).

May 2003. Garvey Elevators, Inc. indicated that they would not remediate the entire contaminated groundwater plume while participating in the VCP (EPA, 2010).

December 9, 2003. NDEQ requested EPA assistance because they were concerned about the ability of Garvey Elevators, Inc. to address the contamination associated with the grain elevator property (EPA, 2008).

September 14, 2005. The Garvey Elevator Superfund Site was placed on the National Priorities List (NPL).

October 2005. Garvey Elevators, Inc. signed an Administrative Order on Consent (AOC) with EPA to conduct RAs and an RI/FS (EPA, 2005). In the AOC, Garvey Elevators, Inc. agreed to conduct investigation and source area treatment activities at the Garvey Elevator Superfund Site. In a separate Agreement with AGP, Garvey Elevators, Inc. placed money into an escrow account to fund response actions at the Site.

March 27, 2008. Garvey Elevators, Inc. filed a voluntary petition for liquidation pursuant to Chapter 7 of the United States Bankruptcy Code in the United States Bankruptcy Court for the Northern District of Texas, Fort Worth Division. Following this development, in April 2008, EPA directed the former Garvey Elevators, Inc. and its contractors to halt work at the Site.

May 19, 2008. EPA initiated fund-lead RAs to address the immediate threat to human health posed by the contaminated private wells and to implement source control measures to prevent further impacts to the groundwater at the source area. These activities, which are ongoing, include providing alternate water systems or municipal water hookup for impacted and potential impacted residential/business private well users. It also includes source control measures of maintaining and operating the existing SVE and GET systems.

October 2008. EPA Fund-lead RIs began.

February 2010. The proposed plan for the interim remedy at OU 1 of the Site was made available to the public for review and comment. A public meeting to present the proposed plan was held on February 24, 2010, in Hastings, Nebraska.

June 30, 2010. An Interim ROD for the OU 1 interim remedy was issued.

2.2.2 Remedial Design Investigation

The 2010 Interim ROD concluded that a selected interim remedy would include continued operation of the existing GET system, and possibly expanding the system to improve performance. After the interim ROD was issued, further information was needed to develop an interim remedy. An RD field investigation was conducted from November 2010 through May 2011 to close data gaps.

Three nested wells in a single borehole were installed at five locations to support the evaluation of the influence of the GET system on the upper and medial aquifers. Telemetry stations were installed into 15 new monitoring wells and 4 existing multilevel well locations off facility property to wirelessly transmit transducer data to the GET system PLC for compilation. Additional programming was added to the PLC to carry out and gather data from step-drawdown, constant-rate, and full GET system pumping tests.

A GET system pump test was conducted and water levels were monitored in 36 monitoring wells throughout the Site. Separate pump testing to estimate aquifer properties was completed for RW-2 and RW-7. Step-drawdown tests were performed concurrently at both wells to determine optimal pumping rates for the constant-rate tests.

The data collected was used to estimate aquifer parameters for the upper and medial aquifers, develop a numerical groundwater flow model to evaluate GET system effectiveness to contain contaminated groundwater to the site and identify ideal location and depth for additional recovery wells.

2.3 PHYSICAL SETTING

2.3.1 Topography

The topography of the area is relatively flat, with a slight slope to the east-southeast. The Site is located within the Loess Plains, a portion of the Great Plains physiographic province. The Platte River valley lies 15 miles north of the Site and flows to the northeast, and the Little Blue River valley lies 10 miles to the south and flows toward the east. Figure 2.1 shows the topography of the site and surrounding area in 5-foot intervals.

2.3.2 Surface Water Hydrology

The local drainage basin consists of gently rolling loess plains and small meandering streams that occupy wide shallow valleys. Regionally, surface water flow is toward the south-southeast to the Little Blue River. The nearest named perennial surface water feature to the Site is Pawnee Creek, which is located about 0.5 miles south-southeast of the Site. There are no storm drains on the Site; therefore, surface water drainage generally follows topography. Drainage is poor in the area north of the silos in the area of the maintenance and storage buildings and office because the Site sits on a generally flat area that likely ponds water. Drainage to the east is curtained by the railroad tracks, which diverts surface waters on the very eastern portion of the Site property between the rail spur and the railroad tracks northward toward Highway 6. The area surrounding the flat storage grain building in the middle of the property drains surface water to the south-southwest from both the east and west.

2.3.3 Geology

2.3.3.1 Regional Geology

Adams County lies adjacent to the north-south axis of the Salina Basin, which was formed by deformation of crystalline Precambrian rocks. The Salina Basin extends from central Nebraska into north-central Kansas, and the thickest sedimentary rock accumulations in Nebraska are found within the Salina Basin (Miller and Appel, 1997). The crystalline Precambrian rocks are overlain by the Upper Cretaceous-Age Niobrara Formation, which consists of yellow and light- to dark-gray marine chalky shale and chalk. The Niobrara surface in the area slopes to the southwest at an approximate gradient of 0.01 foot per foot. In the north-central portion of Adams County, the Niobrara Formation is overlain by the Upper Cretaceous-Age Pierre Shale, which can be described as a gray to black marine shale, and chalky shale. The uppermost portions are weathered and contain gray silty clay (Woodward-Clyde, 1990).The Tertiary Ogallala Formation occurs only as buried knobs in the south and western portions of Adams County (Keech and Dreeszen, 1968).

The Adams County area is underlain by approximately 100 to 500 feet of unconsolidated Pleistocene age deposits lying unconformably on the Pierre Shale, or the Niobrara Formation where the Pierre Shale is absent. The unconsolidated deposits consist of the Peoria Loess, Loveland Loess, and other Pleistocene sand and gravel deposits. The Peoria and Loveland loess consist of silts and clayey silts that were deposited during the Wisconsin and Illinois glaciations, respectively. An interglacial soil named the Loveland Soil (known in Illinois as the Sangamon soil) separates the loess units (Condra et al., 1947). Pleistocene sands and gravels occur below the loess units and range in thickness from 130 to 200 feet. These are stream-deposited sands and gravels containing thick, regionally discontinuous layers of clay and silt. Gravel beds occur within this unit and can be as thick as 10 feet. The local groundwater table usually occurs within this unit.

2.3.3.2 Site-Specific Geology

The following description of sediments consists of lithologic information from the monitoring wells completed on and downgradient of the grain storage facility during earlier Site investigations; downgradient monitoring wells completed for the RI; electrical conductivity (EC) logs collected from borings during the RI; cone penetration test (CPT) logs from past investigations; and from the Revised Final RI Report for the West Highway 6 & Highway 281 Site located approximately one-half to three-fourths of a mile to the northeast (HGL, 2011a).

The geology underlying the grain storage facility is summarized on Figure 2.2, which presents a generalized site-specific stratigraphic column based on descriptions of the soil cores, drilling cuttings, and EC logging.

The thickness of the surficial silts and clays ranges from 33 feet to 82.75 feet. The average thickness of these sediments across the study area is 63.9 feet. The coloration observed in the surficial silts and clays is variable, ranging from black to various shades of brown and gray. Iron oxide staining is locally superimposed on the base soil color. Lenses/layers of fine sand or silty/clayey fine sand are observed within the surficial silts and clays. These sands are predominantly quartz, and poorly graded. The seven CPT borings emplaced by ENSR in 2006 were approximately 85 feet deep. The CPT logs characterize the surficial materials as interbedded silts, clays, and sands (HGL, 2011b).

Underlying the surficial materials and extending to an approximate depth of 130 feet below ground surface (bgs) are numerous sand and gravel units that range from silty fine sands to poorly graded sands to well graded sands to silty gravels to well graded gravels with sands. These sand and gravel deposits comprise the upper zone of the Pleistocene aquifer. The observed coloration of the sand and gravel layers was various shades of gray, yellow, brown, and olive brown. The sands are predominantly quartz, with subangular to rounded grains and varying percentages of multicolored feldspar and other dark mineral grains. The gravels are granitic in nature, and predominantly fine gravels (less than 8 millimeters).

Underlying the upper zone of sands and gravels in the vicinity of former Garvey Elevators, Inc. property is an upper fine-grained unit (aquitard) of variable composition and thickness. Over the study area the upper aquitard was encountered at depths ranging from 115 to 138.5 feet bgs, depending on the ground surface elevation. Figure 2.3 shows the elevation contours

of the top surface of the upper aquitard. In general, this unit dips to the east and downgradient from the Site.

Electroconductivity logs from DPT soil borings and monitoring well lithologic logs indicate that this unit consists of silt, silty clay, clayey silt, sandy silt, silty clayey sand, and sandy clay, the thickness ranges from 0.1 feet to 4 feet depending on location. Downgradient of the grain storage facility, thicknesses ranging from 0.45 feet to 7.3 feet were observed in EC borings. As Figure 2.4 illustrates, the thickness of the upper aquitard generally appears to undulate from north to south across the Site area.

The upper aquitard was consistently observed beneath the grain storage facility in both monitoring well borings drilled to or beneath it, and in the EC borings (except SB-32) completed during the RI. However, it was not reported in multilevel well MW-31 completed along the east perimeter of the Site (ENSR/AECOM, 2007).

In the downgradient direction (east/southeast) from the grain storage facility, the upper aquitard was not present at the MW-12, MW-17, and MW-18, according to their boring logs. It was observed in 8 of the 10 EC borings along the off-Site transects, and in the drill cuttings at 5 of the 7 new RI monitoring well locations.

It should be noted that discrepancies in detection of the upper aquitard may be the result of its relatively minor thickness, and the finer resolution of the EC logging compared to logging wash cuttings from mud drilling as was done at MW-12, MW-17, and MW-18. Additionally, the composition of the aquitard in certain areas may be almost indistinguishable from the surrounding sands if the gradational zone was extensive.

The medial aquifer zone at the Site consists of fine to coarse sands, silty sands, and sand-fine gravel mixtures from the bottom of the upper aquitard at approximately 132 feet bgs to approximately 150 feet bgs on Site.

Both the medial aquifer zone and the lower aquifer zone to the top of the Niobrara Formation at approximately 240 feet bgs, consist of alternating layers of poorly-graded fine sand and well-graded fine to coarse sand with gravel. At selected locations, discontinuous lenses of well-graded gravel, silty sand, clayey sand, and clay were encountered. These sand and gravel deposits comprise the lower zone of the Pleistocene aquifer.

Coloration of the fine sands is in various shades of gray and brown with occasional localized iron oxide staining. The fine sands are subangular to rounded, loose to moderately dense, and consist primarily of quartz grains with varying percentages of feldspars and other dark minerals.

Coloration in the well graded sands is in various shades of gray, yellow, and brown with occasional localized iron oxide staining. The well graded sands are also subangular to rounded, loose, and consisted primarily of quartz with varying percentages of feldspars and other dark minerals. Gravel in the well graded sands and gravel lenses range from <1 to 6 centimeters, is granitic in nature, with larger clasts flattened and elongated.

Separating the medial and lower aquifer zones in some areas is a lower aquitard. As with the upper aquitard, this lower aquitard has a variable composition and thickness. On Site, the lower aquitard was observed at depths ranging from 147.7 bgs at SB-32 feet to 169.5 feet bgs at test well MW-33. This existing test well is located at the northwest corner of the Site property at an elevation about 10 feet higher than the ground surface at the elevator buildings.

Figures 2.5 and 2.6 illustrate the lower aquitard surface elevation and thickness, respectively. The thickness of the lower aquitard ranged from 0.7 feet to 3 feet in thickness. In general, the thickness of the lower aquitard was less than that of the upper aquitard. According to existing well logs, it has been described as sandy clayey silt, clayey silt, silt and fine sand, and silty clayey sand with gravel.

This lower aquitard was observed in 18 of the 25 existing monitoring well locations or RI EC boring, and 3 of 7 new RI monitoring well locations within the study area. Generally, it does appear to be laterally continuous across the study area; however it does not appear to extend northward. It was not observed in borings during the drilling and EC logging for the West Highway 6 & 281 Site (HGL, 2011a).

The unconsolidated materials are underlain by the Cretaceous age Niobrara Formation. The Niobrara generally consists of interbedded, soft, light grey calcareous shale and chalk. The Niobrara was encountered at depths of approximately 240 to 250 feet bgs at the Site and consisted of a weathered yellow to pale red shale with calcium carbonate veins to a grayish brown clay.

2.3.4 Hydrogeology

2.3.4.1 Regional Hydrogeology

Based on depth to water measurements made in new and existing groundwater monitoring wells, groundwater typically occurs between 105 feet to 125 feet bgs across the Site area. The aquifer beneath the Site was divided into aquifer zones for the purposes of the RI. The zones are as follows:

- upper aquifer zone – Zones A/B
- medial aquifer zones – Zone C
- lower aquifer zone
  - upper portion – Zone D
  - lower portion – Zone E

Lithologic logging conducted during the RI and previous investigations generally confirmed that three aquifer zones exist at the Site, which are separated by intervening aquitards. Generally these aquitards do appear continuous throughout the study area. However, the presence of these aquitards would not greatly inhibit the downward migration of contaminants due to the variation in thickness and composition of the aquitards, vertical hydraulic gradients,

and the physical nature of the Site contaminants. This is confirmed by the presence of contaminants in all three aquifer zones at the Site and in the plume downgradient of the source areas. Figures 2.3 and 2.5 illustrate the elevation contours of the top of the upper aquitard and lower aquitard, respectively. Figures 2.4 and 2.6 show the thickness of the upper aquitard and lower aquitard, respectively.

The actual depths at which the aquifer zones and intervening aquitards are encountered vary with the monitoring point elevation. In general, the upper aquifer zone is unconfined and extends from the water table at approximately 115 feet bgs to approximately 130 feet bgs on Site. The upper aquitard, which occurs at 130 feet bgs to approximately 132 feet bgs on site, forms the base of the upper aquifer zone.

The medial aquifer zone extends from approximately 132 feet bgs to about 150 feet bgs on site. This aquifer zone is semiconfined by the overlying upper aquitard and an underlying lower aquitard that is the lower fine-grained unit. The lower aquitard extends from approximately 150 feet to 152 feet bgs on site.

The lower aquifer zone also is semiconfined and extends from the base of the lower aquitard to the top of the bedrock surface which is at approximately 233 feet bgs. The weathered shale of the Niobrara Formation forms the base of the lower aquifer zone.

2.3.4.2 Site-Specific Hydrogeology

Historical assessments on the availability of groundwater have indicated that aquifer transmissivity generally ranges from less than 50,000 gallons per day per foot (gpd/ft) in the northeastern corner and southernmost portions of the county, to more than 200,000 gpd/ft in the central part of the county.

Groundwater flow in the upper, intermediate, and lower aquifer zones is in an east-southeast direction based on water level measurements in the more than 30 monitoring wells distributed across the Site. The hydraulic gradient ranges from 0.0015 to 0.0020 feet per foot (ft/ft). The current local groundwater flow direction, in the area outside the influence of the GET system, is generally consistent with that observed before the installation of the GET system. The vertical hydraulic gradient between the upper and intermediate aquifer varies seasonally due to aquifer stresses created by irrigation wells in the area. During the irrigation season, the vertical hydraulic gradient is consistently downward in wells at the Site, with an average magnitude of 0.019 ft/ft. During the nonirrigation period, the vertical hydraulic gradient is not in a consistent direction at the site, but the magnitudes of the gradient are similar.

Based on four pumping tests with various configurations, pumping rates, and durations, the hydraulic conductivity in the upper aquifer has been estimated to be approximately 100 feet per day (ft/day). Hydraulic conductivity in the intermediate and lower aquifer was estimated to be approximately 270 ft/day. Based on the above aquifer properties, the hydraulic gradient, and an effective porosity of 0.30, the groundwater flow rate is estimated to be 0.5 ft/day in the upper aquifer and 1.4 ft/day in the intermediate/lower aquifer.

2.3.5 Existing Utilities

SVE and GET system treatment equipment and pipe terminations are housed in a pre-existing corrugated metal building. A concrete pad with a secondary containment curb was constructed for all the GET piping and equipment. Another concrete pad was constructed for the SVE system equipment. Electric power and potable water are available at the treatment system building. Potable water for emergency shower/eyewash station is available. A telephone line also exists.

2.4 NATURE AND EXTENT OF CONTAMINATION

The contamination associated with the Site consists of VOC-contaminated soils and groundwater beneath the 22-acre parcel and an associated groundwater contaminant plume approximately 4.3 miles long that extends from the property in an east-southeasterly direction.

The known COCs at the Site are carbon tetrachloride and chloroform. Chloroform is also a degradation product of carbon tetrachloride. The extent of carbon tetrachloride is more widespread across OU 1 than is chloroform. Figure 2.7 and Figure 2.8 show current levels of contamination at the Site in the upper and medial aquifers, respectively.

Carbon tetrachloride is a colorless, highly VOCs that quickly evaporates when exposed to the atmosphere. Carbon tetrachloride is a nonflammable chemical that is slightly soluble in water. In the subsurface, carbon tetrachloride behaves as a dense non-aqueous phase liquid (DNAPL), due to its high specific gravity and low solubility. Carbon tetrachloride does not bind to soil and may leach into groundwater.

Chloroform is a colorless, volatile liquid. It is a nonflammable chemical that is slightly soluble in water. Because chloroform is relatively volatile, it tends to escape from contaminated water or soil into air. It may also be released in vapor from some types of industrial or chemical operations. Chloroform appears to be ubiquitous in the environment. It is derived primarily from various industrial arid chemical processes, or as a by-product of disinfecting water with chlorine. Chloroform is a breakdown product of carbon tetrachloride.

Garvey Elevators, Inc. used a liquid mixture of 80 percent carbon tetrachloride, and 20 percent chloroform as a grain fumigant (commonly known as 80-20 fumigant) from 1959 to 1985. The only identified point source for the liquid fumigant contamination is the area beneath the former fumigant AST and the underground piping that transferred the fumigant from the tank to the side of the grain elevator (see Figure 1.2). Other potential source areas include structures where the fumigant was or may have been applied: the grain silos, former and current steel grain bins, the railroad spur running within the former Garvey Elevators, Inc. property (treatment of loaded grain cars), and the flat storage building. The fumigant applicator wash area at the rear (west end) of the office, and shop building are also potential source areas. Based on the presence of carbon tetrachloride in soil gas, additional potential source areas for fumigant contamination are the area within the drive loop at the grain storage facility, the former construction debris disposal pit, the former Garvey Elevators, Inc. water supply well, and the area east/southeast of the flat storage building.

During the 1995 site characterization effort conducted by HWS Consulting Group, Inc. (HWS), a network of 36 monitoring wells were installed in the upper, medial, and lower aquifer both on site and off site (HWS, 1995). The well designations indicate the following: A-wells are completed across the water table and B-wells are completed at the uppermost fine-grained unit, both of these zones are in the upper aquifer zone. C-wells are completed in the medial aquifer zone between the upper and lower fine-grained units. D-wells are complete in the upper portion of the lower aquifer zone, and E-wells are completed in the lower portion of the lower aquifer zone.

The initial analytical results included in the 1995 Site Characterization report showed that carbon tetrachloride was detected in 19 of the 36 wells. The highest concentration of 29,943 μg/L was detected in MW-3B located north of the shop building approximately 250 feet. Carbon tetrachloride was detected above its MCL of 5 μg/L in well MW-2A, which is crossgradient approximately 800 feet north and northwest of the facility buildings. It also was detected above the MCL in well MW-18D approximately 4,800 feet downgradient to the southeast.

Part of the Site background information provided to HGL included analytical data from roughly 2002 and 2004 that was illustrated by ENSR. The data are from approximately 2002, and show that numerous private wells downgradient to the southeast of the site had been contaminated with carbon tetrachloride. The extent of contamination that can likely be attributed to former Garvey Elevator, Inc. appears to extend approximately 4.3 miles downgradient to the east-southeast. The 2004 annual monitoring well sampling event showed that the carbon tetrachloride at most locations had decreased significantly from the 1995 HWS detections. For instance, at MW-3B where carbon tetrachloride was detected at 29,943 μg/L in 1995, it was detected at a decreased concentration of 280 μg/L in 2004.

In 2007, ENSR conducted vertical profiling of carbon tetrachloride in groundwater at the Site as part of a system evaluation. At 120 feet carbon tetrachloride concentrations >50 μg/L were noted in two areas. The first area is located in proximity to the former fumigant AST. The second area of higher groundwater contamination was directly east of the MW-3 well cluster where high carbon tetrachloride concentrations have previously been observed (ENSR/AECOM, 2007).

At 130 feet bgs, carbon tetrachloride concentrations increased around DPT22D, which contained carbon tetrachloride at 626 μg/L. No other 130-foot interval samples were collected to the west, but to the north and south, concentrations dropped to below 50 μg/L at DP23D which is within 125 feet of DPT22D to the west. Below 130 feet bgs, concentrations in the DPT samples did not exceed 50 μg/L.

Low levels of the carbon tetrachloride degradation compound chloroform were detected in six samples. The highest concentration of 5.7 μg/L was detected in MW-31A. The only other target VOC detected was carbon disulfide, which was observed at low levels in three samples: MW-30D, MW-30E, and MW-31A. Chloromethane, dichloromethane, and EDB were not detected in any samples.

2.5 EXISTING SOURCE CONTROLS

A SVE and GET system were installed at the Site while it was under State oversight. These systems were installed in 1998, and began operation in 1999. The locations of the SVE and GET system wells are shown in Figure 2.9.

2.5.1 Groundwater Recovery

Garvey Elevators, Inc. also installed the GET system in 1998, which commenced operation in 1999. The objective of the GET system was to prevent contaminated groundwater from migrating off site that return treated water to the aquifer. The system includes eight groundwater recovery wells, a packed tower air stripper, and two injection wells. Since this system came on-line in 1999, it has been operational only sporadically due to various system malfunctions and mechanical problems. As shown on Figure 2.9, the recovery wells are located in a rough north-south trending line downgradient to the east of the source areas, except for RW-05. RW-05 is located in close proximity to the location of the former carbon tetrachloride AST.

2.5.1.1 Recovery Wells

Five of the recovery wells (RW-01, RW-02, RW-03, RW-04, and RW-05) are screened in the upper aquifer (A and B zones) between approximately 116 feet to 130 feet bgs. Each of these shallow recovery wells has 10-foot screens (EMCON, 1998). The remaining three recovery wells (RW-06, RW-07, and RW-08) are completed in the medial aquifer (C zone) from approximately 135 feet to 150 feet bgs. These deeper recovery wells have 15-foot screens. All eight wells have 0.040-inch slot, stainless steel screens (EMCON, 1998).

2.5.1.2 Submersible Pumps

Grundfos®, 460 volt (V), three-phase, submersible pumps are installed in each recovery well. Pump speeds are controlled by variable-frequency drives (VFDs) located in the control panel. Originally, the 5 wells screened in the upper aquifer had 5 horsepower (hp) pumps capable of pumping approximately 40 gallons per minute (gpm) at 245 feet of head and the medial aquifer wells had 10 hp pumps capable of pumping approximately 100 gpm, at 260 feet of head. Due to malfunctioning equipment, all submersible pumps (except RW-2) have been replaced with a new model. Table 2.1 presents past and current pump information.

2.5.1.3 Pressure Transmitters (Submersible)

Water levels in the recovery wells are monitored by Instrumentation Northwest, Inc. (INW), absolute pressure transmitters, Model PS9000, with 4-20 milliamp output. Transmitters in shallow wells have a range of 0 to 30 pounds per square inch absolute (psia) while transmitters in medial wells have a range of 0 to 50 psia. The two injection wells are equipped with 0 to 100 psia pressure transmitters.

2.5.1.4 Barometric Pressure Transmitter

To compensate for fluctuating barometric pressure without the use of vented tubing and desiccant chambers, an INW barometric pressure transmitter, Model BV-9000, with 4-20 milliamp output was mounted on the outside of the GET system control panel.

2.5.1.5 Flow Meters

Flow meters are located in the groundwater treatment room. The flow meters were placed at the influent into the treatment room prior to the common header pipe. In RW-4 and RW-8, a Signet Rotor-X0 P51530-P1 flow sensor and Signet 8512 flow rate transmitter is installed. Installed in the rest of the recovery wells is a Signet 3-8510-XX paddlewheel flow sensor and Signet 8512 flow rate transmitter. Flow sensors were installed in schedule 80 polyvinyl chloride (PVC) saddles provided by Signet and mounted using Signet 8010 integral mounting kits, which allow for reading water velocities from 1.0 to 20.0 feet per second. A k-factor programmed into the Signet 8512 transmitter automatically calculates and displays the flow rate in gpm based on the pipe diameter and water velocity. A Signet Rotor-X1 P51530-P1 paddlewheel flow sensor and transmitter was installed in-line with the groundwater discharge piping after the packed lower air stripper. This sensor was installed in a 6-inch diameter Schedule 80 PVC tubing saddle, which allows for reading total system flow rate.

The transmitters internally totalize and record total flow. The units can either display the current flow rate or total flow. In addition, the flow rate from each meter is transmitted to the PLC, which allows for logging and remote monitoring via the Human Machine Interface (HMI) software.

2.5.2 Groundwater Treatment

Groundwater treatment is accomplished by aeration in a packed column air stripper. The treated groundwater is discharged into two upgradient groundwater injection wells under a permit with the NDEQ. A Carbonair® Model OS-500 packed tower air stripper is used to remove VOCs from the groundwater. A 2.0 hp, 3-phase general purpose fan manufactured by The New York Blower Company® is used to force air through the packing located inside the air stripper. The blower moves approximately 2000 cubic feet per minute (cfm) of air at 3 inches of water pressure (EMCON, 1999). A horizontal end suction pump is used to transfer the treated system effluent to the injection wells.

2.5.3 SVE System

The SVE systems consist of 8 vapor extraction wells and liquid knock-out tanks and blowers. Wells SVE-1, SVE-3, SVE-4, SVE-7, and SVE-8 are screened in the upper vadose zone (20 to 50 feet bgs), and wells SVE-9, SVE-10, and SVE-11 are screened in the lower vadose zone (60 to 110 feet bgs). Based on information obtained during a pilot test, the SVE wells have an expected radius of influence of 25 to 30 feet in the shallow vadose zone (predominantly silts and clays) and 150 to 180 feet in the deeper vadose zone (predominantly sand).

The systems operate using two separate blowers, one for the set of shallow wells (SVE System 1), and one for the set of deeper wells (SVE System 2). Combined, the two blowers are capable of moving air at approximately 800 standard cubic feet per minute (scfm) at optimum vacuums. As originally operated, vapors from the eight wells were combined and passed through a catalytic oxidation unit and scrubber for treatment of the contaminated vapors. However, contaminant levels in the vapor stream have subsequently decreased such that treatment of the vapors is no longer required (in accordance with state air regulations) prior to discharge. The SVE systems are optimized to capture contamination from those wells which have consistently exhibited the highest concentrations of carbon tetrachloride. Of the shallow wells, only SVE-7 and SVE-8 are currently open; SVE-1, SVE-3, and SVE-4 were closed in February 2011. Of the deep wells, only SVE-9 and SVE-11 are currently open; SVE-10 was closed in February 2011. The total system flow is approximately 800 scfm.

2.5.4 Programmable Logic Controller

A PLC controls the groundwater treatment system equipment. The system is equipped with HMI computer software. The HMI software provides an interface with the PLC to monitor and control the groundwater treatment system.

The system equipment is controlled by an Allen-Bradley CompactLogix Control System PLC, located in the control panel. The PLC uses Rockwell RSLinx OEM software to control a variety of system functions on the basis of equipment inputs, and to transfer system data to the HMI software. A proportional, integral, and derivative co-processor is included for groundwater elevation and air stripper sump setpoint control. This system and software were installed in August 2010 by the Superfund Technical Assessment & Response Team (START) contractor, TetraTech EM, Inc. (TetraTech), to update the existing PLC system.

2.5.5 Repairs and Modifications

The SVE and GET systems were installed in 1998 by Garvey Elevators, Inc., to prevent contaminated groundwater from migrating off site. The consistency of system operation between 1999 and 2004 is unknown; however, between 2004 and 2008 operation was sporadic due to various system malfunctions and mechanical problems. Beginning in 2008, the EPA START contractor TetraTech took over operation of the GET/SVE system and made numerous repairs and modifications. Major repairs and modifications were completed by START from August 2008 through May 2011 and are summarized below.

2008 - An initial assessment of the GET/SVE system revealed several malfunctioning or non-functioning components. New pumps were installed at three wells (RW-1, RW-3, and RW-4) due to inoperable pump motors. Four wells were redeveloped after found to have at least 50 percent of the screened interval plugged. RW-5 was found to be partially collapsed and determined irreparable.

Minor repairs, such as rewiring the air stripper blower, installing new o-rings and filters in the particulate filter canisters, repairing cracks and leaks, and minor electrical repairs were made. A high-level alarm system was installed in the air stripper, along with emergency shut-off for the groundwater treatment system. An equipment room build out for the groundwater treatment

room and the control panel room was constructed to prevent equipment from freezing during winter months and to protect electronic equipment from dust and extreme temperatures.

In the SVE System 2, the existing blower motor and a breaker in the control panel were replaced.

2009 - Reported failures in RW-1 led to replacing existing wiring between RW-1 and RW-6 vaults. RW-6 and RW-7 exhibited reduced performance in 2009, prompting well screens being cleaned with acid wash and redeveloped. Routine maintenance to fix leaks and cracks in system pipes occurred.

The low-level float switch in the SVE System 2 knockout tank was replaced, which was causing the transfer pump from the tank to run continuously. Due to a rebuilding error in the past, the blower in SVE System 2 failed and was replaced with a 15 hp motor. The air stripper blower belt was replaced.

New VFDs were installed for the recovery wells and upgrades were made to the PLC and associated operational software. A larger cooling unit to provide better climate control in the equipment control room was installed to accommodate the new VFDs installed, which appeared to create more heat than the old VFDs. Transducers in RW-1 and RW-4, and flow sensors in RW-1 and RW-8 were replaced (TetraTech, 2011).

2.6 COMPLIANCE WITH ARARs

The applicable or relevant and appropriate requirements (ARARs) are identified in the interim ROD. ARARs are classified as chemical-specific, location-specific, or action-specific. The ARARs and to be considered (TBCs) associated with the Site are presented in Table 2.2. The interim RD will be compliant with ARARs.

2.7 REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) provide a general description of what the response, action is expected to accomplish for OU 1. The short-term RAOs for the Interim ROD are:

- To prevent or minimize the release of contaminants from the unsaturated OU 1 source area soils to groundwater at concentrations that would cause exceedances of the cleanup levels for groundwater. The soils described in this RAO include only those within the zone of treatment of the existing SVE system.

- To prevent further migration of contaminated groundwater in excess of the cleanup levels from the OU 1 source area.

- To provide an interim remedy that does not interfere with the future effectiveness of other long-term RA alternatives that might warrant detailed evaluation in the Site wide FS, such as in situ treatment technologies for groundwater restoration.

- To provide a remedy which that achieves the long-term objectives when combined with a suitable remedy that addresses all the OU 1 source area soils. EPA anticipates that all the OU 1 source area soils will be addressed as part of the final action for the Site.

- To reduce the contaminants in the groundwater beneath the OU 1 source area to concentrations less than or equal to the cleanup levels: within a reasonable time frame, so that the aquifer is restored to its beneficial use.

The basis and rationale for the RAOs is the current and reasonably anticipated future land use and potential beneficial groundwater use as a drinking water source. This remedy is termed an Interim RA under CERCLA because the nature and extent of soil and groundwater contamination at OU 1 have not been fully determined and the selected remedy may not be expected to achieve the long-term objectives. However, the remedy is expected to help in achieving the long-term objectives and to be one component of several response actions that, together, will accomplish these objectives. The cleanup level for carbon tetrachloride in groundwater is 5 μg/L, which is the federal and state MCL. The cleanup level for choloform is 80 μg/L. Choloform is one of a group of compounds called trihalomethanes (THM). Choloform is the only THM that has been observed at a level of concern. EPA does not have an MCL for chloroform but has established an MCL of 80 μg/L for total THMs. The cleanup level for chloroform is based on the MCL for total THMs.

The cleanup levels for groundwater are based on promulgated standards and/or risk assessments which consider the various exposure scenarios to the groundwater itself. Establishing cleanup levels for soil and/or soil gas at OU 1 is not straightforward. At OU 1, the soil contamination is not suspected of causing risk through exposure to the soil itself. Instead, there is the potential for contaminants within the soil matrix to leach to the groundwater and cause an exceedance of the MCL at a downgradient location.

Soil gas concentrations have been found to be a more reliable indicator of contamination in the vadose zone than soil concentrations at OU 1. Soil gas cleanup levels for this interim action were derived on the basis of equilibrium partitioning theory in the vadose zone and the generic risk-based soil screening levels for the protection of groundwater. The cleanup levels for carbon tetrachloride in the unsaturated soil gas are 54,000 micrograms per cubic meter ($\mu g/m^{3)}$ and 77,000 $\mu g/m^3$ for the fine- and coarse-grained soils, respectively. The cleanup levels for chloroform in the unsaturated soil gas are 1,500 $\mu g/m^3$ and 2,100 $\mu g/m^3$ for the fine- and coarse-grained soils, respectively. These soil gas cleanup levels are considered interim cleanup levels and may be adjusted during the final remedy. The soil gas cleanup levels are applicable only within the areas being remediated by the existing SVE system and have been established to determine when cleanup is achieved for these areas. The interim RA will be monitored carefully to collect detailed information regarding the aquifer response to remediation. This information will be used to develop final cleanup levels that accurately reflect the particular conditions at the Site.

A summary of the cleanup levels for groundwater and soil gas for each contaminant of concern is provided in Table 2.3.

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TABLES

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Table 2.1 Submersible Pumps Information

Recovery Well ID	Pump Type	Manufacturer	Model Number	Power (hp)	Rated Capacity (gpm)
RW-01	Submersible	Grundfos	40S50-12	5	40
RW-02	Submersible	Grundfos	40S50-12	5	40
RW-03	Submersible	Grundfos	40S50-12	5	40
RW-04	Submersible	Grundfos	40S50-12	5	40
RW-05	Submersible	Grundfos	Unknown	1.5	25
RW-06	Submersible	Grundfos	150S100-5	10	150
RW-07	Submersible	Grundfos	150S100-5	10	150
RW-08	Submersible	Grundfos	150S100-5	10	150

Table 2.2 Applicable or Relevant and Appropriate Requirements

Statute and Regulatory Citation	ARAR Determination	Description	Comment	Media of Concern		Type of ARAR		
				Soil	Groundwater	Chemical	Location	Action
Federal ARARs								
Safe Drinking Water Act (SDWA), 42 United States Code (U.S.C) § 300f, et seq., National Primary and Secondary Drinking Water Regulations, 40 Code of Federal Regulations (CFR) Parts 141 and 142	Relevant and Appropriate	The National Primary and Secondary Drinking Water Regulations (40 CFR Parts 141 and 142) establish MCLs for chemicals in drinking water distributed in public water systems. These are enforceable in Nebraska under Nebraska Revised Statutes (NRS) § 81-1505(1)(2), et seq., § 71-5301 to 71-53 13 (SDWA), Nebraska Department of Health and Human Services (NDHHS) Title 179, and NDEQ Title 118, Chapter 4.	The Preamble to the NCP clearly states that MCLs are relevant and appropriate for groundwater that is a current source of drinking water. See 55 Federal Register 8750, March 8, 1990, and 40 CFR § 300.430(e)(2)(I)(B). MCLs developed under the SDWA. A generally are ARARs for current or potential drinking water sources. See EPA Guidance on Remedial Action for Contaminated Groundwater at Superfund Sites, Office of Solid Waste and Emergency Response (OSWER) Directive Number 9283.1-2, December 1988.		X	X		
Federal Surface Water Quality Requirements, Clean Water Act, 33 U.S.C. 125 1, et	Applicable	As provided under Section 303 of the Clean Water Act, 33 U.S.C. § 13 13, the State of Nebraska has promulgated water quality standards.	No Comments		X	X		
Air Emission Standards for Process Vents, 40 CFR 264, Subpart AA	Relevant and Appropriate	This provision establishes standards for air emissions of VOCs during air stripping operations.	No Comments	X	X	X		
Air Emission Standards for Equipment Leaks, 40 CFR 264, Subpart BB	Relevant and Appropriate	This provision establishes standards for air emissions for equipment leaks.	No Comments	X	X	X		
Resource Conservation and Recovery Act (RCRA) and regulations, 40 CFR § 264. 18 (a) and (b)	Relevant and Appropriate	Regulations promulgated under NRS § 81-1505(13), et seq., specify requirements that apply to the location of any solid waste.	No Comments	X	X	X		
RCRA Deed Notice for Hazardous Wastes Remaining On-site After Closure - 40 CFR 264. 119 and 265.119	Relevant and Appropriate	Deed restrictions.	No Comments	X	X	X		

Table 2.2 Applicable or Relevant and Appropriate Requirements

Statute and Regulatory Citation	ARAR Determination	Description	Comment	Media of Concern		Type of ARAR		
				Soil	Groundwater	Chemical	Location	Action
Clean Water Act Point Source Discharges Requirements, 33 U.S.C. § 1342	Applicable	Section 402 of the Clean Water Act, 33 U.S.C. § 1342, et seq., authorizes the issuance of permits for the "discharge" of any "pollutant." This includes stormwater discharges associated with "industrial activity." See 40 CFR § 122. 1 (b)(2)(iv). "Industrial activity" includes inactive mining operations that discharge stormwater contaminated the by contact with, or that has come into contact with any overburden with, any over burden, raw material, intermediate products, finished products, byproducts, or waste products located on the site of such operations, see 40 CFR § 122.26 (b)(l4)(iii); landfills, land application sites, and open dumps that receive or have received any industrial wastes including those subject to regulation under RCRA Subtitle D, see 40 CFR § 122.26 (b)(14)(x).	Because the State of Nebraska has been delegated the authority to implement the Clean Water Act, these requirements are enforced in Nebraska through the Nebraska Pollutant Discharge Elimination System (NPDES). The NPDES requirements are set forth below. EPA is not required to obtain permits from federal, state, or local entities but must still meet the substantive requirements of the permits.		X			X
Groundwater Monitoring 40 CFR Part 264 and Part 265 Subpart F and Part 270.14 (c)	Applicable	Set forth requirements for groundwater monitoring.	The groundwater monitoring requirements found at 40 CFR 264 and Part 265 Subpart F and Part 270.14 (c) are incorporated in Nebraska Title 128 (hazardous waste regulations).		X			X
On-Site Groundwater Treatment 40 CFR Part 264 and Part 265 Subparts I and J	Applicable	Sets forth requirements for on-site treatment of hazardous waste.	The treatment requirements found at 40 CFR Part 264 and Part 265 Subparts I and J are incorporated in Nebraska Title 128 (Hazardous Waste Regulations).		X			X
Closure and Post-Closure/Disposal of Soils 40 CFR Part 264 and Part 265 Subpart G	Applicable	Sets forth requirements for closure and post-closure care (including disposal of soils) for hazardous waste treatment facilities.	The closure and post-closure requirements found at 40 CFR Part 264 and Part 265 Subparts I and J are incorporated in Nebraska Title 128 (Hazardous Waste Regulations).	X	X			X
Occupational Safety and Health Act Regulations 29 CFR Part 1910, Occupational Safety and Health Administration (OSHA) Standards	Relevant and Appropriate	Contains health and safety requirements that must be met during implementation of any remedial action. These standards are intended to protect construction and utility workers at the site. Contains health and safety training requirements for on-site workers and permissible exposure limits for conducting work at a site.	No comments	X	X			X
Financial Assurance Requirements 40 CFR Part 264 and Part 265	Applicable	Regulations promulgated under Title 123 and Title 132, Chapter 8 also specify requirements that apply to financial assurance.	The financial assurance requirements found in 40 CFR Part 264 and Part 265 are incorporated by reference in Title 128, Chapters 21 and 22.					

Table 2.2 Applicable or Relevant and Appropriate Requirements

Statute and Regulatory Citation	ARAR Determination	Description	Comment	Media of Concern		Type of ARAR		
				Soil	Groundwater	Chemical	Location	Action
State of Nebraska ARARs								
Regulations Governing Water Well Contraction, Pump Installation, and Water Well Abandonment Neb. Rev. Stat. §46-602, Title 178, Chapter 10, and Title 456, Chapter 12	Applicable	Groundwater wells must be registered with the Department of Water Resources within the Nebraska Department of Natural Resources (NDNR).	If the well is to be located in a groundwater management area, a permit is required from the local Natural Resources District prior to construction if it pumps more than 50 gpm. However, EPA is only required to meet the substantive requirements of said permit. Hastings Ordinance No. 3754 contains certain restrictions and requirements on well installations within the Hastings Institutional Control Area (HICA) or within a tow mile extraterritorial jurisdictional area (Hastings City Code Section 32-6 16).		X			X
Regulations Governing Water Well Contraction, Pump Installation, and Water Well Abandonment Standards Neb. Rev. Stat. §46-602 and Title 178, Chapter 10	Applicable	Relates to the licensure of water well contractors and pump installation contractors and to the certification of water well drilling supervisors, pump installation supervisors, natural resources groundwater technicians, and water well monitoring technicians.	No comments		X			X
Water Well Standards and Contractor's Practice Act, Neb. Rev. Stat. §46-1201 to §46-1241, Title 178, Chapter 10, and Title 456, Chapter 9	Applicable	The purposes of the Water Well Standards and Contractors' Practice Act are to: (1) Provide for the protection of groundwater through the licensing and regulation of water well contractors, pump installation contractors, water well drilling supervisors, pump installation supervisors, water well monitoring technicians, and natural resources groundwater technicians in the State of Nebraska; (2) protect the health and general welfare of the citizens of the state; (3) protect groundwater resources from potential pollution by providing for proper siting and construction of water wells and proper decommissioning of water wells; and (4) provide data on potential water supplies through well logs which will promote the economic and efficient utilization and management of the water resources of the state.	No comments		X			X
Well Spacing Requirements Neb. Rev. Stat. §46-651 to §46-655	Relevant and Appropriate	Well spacing requirements.	No comments		X		X	X
The Industrial Ground Water Regulatory Act Neb. Rev. Stat. §46-675 through 46-690 and Title 456, Chapter 4 and 7	Relevant and Appropriate	Requires a permit for the withdrawal and transfer of groundwater for other than domestic or agricultural use. The permit must be obtained prior construction of the extraction well(s). The permit program is administered by the NDNR.	EPA is only required to meet the substantive requirements of the groundwater use permit.		X			X

Table 2.2 Applicable or Relevant and Appropriate Requirements

Statute and Regulatory Citation	ARAR Determination	Description	Comment	Media of Concern		Type of ARAR		
				Soil	Groundwater	Chemical	Location	Action
Municipal and Rural Domestic Ground Water Transfers Permit Act Neb. Rev. Stat. §46-638 to §46-650	Relevant and Appropriate	Relates to protective permitting for public water supplies.	EPA is only required to meet the substantive requirements of protective permitting for public water supplies.		X		X	X
Restrictive Covenants Title 128, Chapter 21 and 22	Applicable	Institutional controls are generally land use restrictions designed to restrict access, future use, and interference with a selected remedy for a contaminated area. They are typically methods to manage risk during the implementation of a remedy and do not eliminate risk entirely. An institutional control enacted as a remedy should be compliant with the Uniform Environmental Covenants Act pursuant to The Nebraska Uniform Covenants Act, March 2005, Neb. Rev. Stat. §76-260 1 to 76-2613. For groundwater, the goal of an institutional control would be to prevent situations from occurring in which humans or animals might inadvertently consume or otherwise be exposed to contaminated groundwater.	Groundwater in Nebraska is considered to be publicly owned. Property owners only have the right to use the groundwater underlying their property. There is no ability under Nebraska State law to restrict the use of groundwater by prohibiting access. Public entities with zoning authority may be able to restrict access to groundwater from certain surface areas within the zoning jurisdiction of the entity, but groundwater use cannot be prohibited, and existing wells could still probably continue as non-conforming uses. Condemnation might be a possibility to remove these existing wells from use. Some limitations on use may be established by a local Natural Resource District to protect the quantity and in certain circumstances preserve water quality, but only if a Groundwater Management Area has been established pursuant to Neb. Rev. Stat. §46-656 et seq. This authority, however, cannot be used to restrict the use of contaminated groundwater. Long-term effectiveness and enforcement concerns make this component much less reliable than other methods of active remediation.	X	X		X	X
Air Quality Regulations Title 129 Chapter 17, Section 001	Applicable	Depending on the size of the unit and the potential to emit criteria pollutants and/or toxic or hazardous pollutants, a pre-construction review and permit may be required under Title 129 (Air Quality Regulations) specifically, Chapter 17, Section 001. Potential to emit is defined in Title 129, Chapter 1, as the maximum capacity of a stationary source to emit a pollutant under its physical and operational design.	A risk analysis may be required on a case-by-case basis. Depending on the potential to emit, a Class I or Class II operating permit may be required. See specifically Title 129, Chapter 5 for determining applicability. If applicable, EPA would only be required to meet substantive requirements of an operating permit. Best Available Control Technology (BACT) is required if the emissions unit has a potential to emit equal to or more than 2112 tons per year of any hazardous air pollutant or an aggregate of 10 tons per year of hazardous air pollutants. See Title 129, Chapter 27, 002. It must be utilized continuously while the emissions unit is operating. If the emissions unit meets the threshold limits for construction/operating permits, annual emissions must be reported if requested by the Department. See Title 129, Chapter 6.	X	X	X		X

Table 2.2 Applicable or Relevant and Appropriate Requirements

Statute and Regulatory Citation	ARAR Determination	Description	Comment	Media of Concern		Type of ARAR		
				Soil	Groundwater	Chemical	Location	Action
Disposal of Activated Carbon Used as Air Emission Control Title 128, Chapter 2	Relevant and Appropriate	If activated carbon is used as an air emission control, the spent carbon may be required to be handled as a hazardous waste in accordance with Title 128 requirements.	The spent carbon, ion-exchange resin, and granular media meet the definition of solid waste in Title 128, Chapter 2. Air permits may also be required for carbon regeneration or reactivation depending on potential to emit (construction and/or operating permits - see Title 129). However, EPA would only be required to meet the substantive requirements of the construction and/or operating permit.	X	X	X		X
Integrated Solid Waste Management Regulations Title 132, Chapter 13	Relevant and Appropriate	If aerobic or anaerobic biological treatment is used for groundwater treatment, waste from the treatment process may be required to be handled and disposed of as special waste in accordance with Title 132 requirements.	No comments	X	X	X		X
Excavation of Contaminated Soil Title 128, Chapter 4	Relevant and Appropriate	Soil excavated and removed with the intent of disposal meets the definition of solid waste in Title 128, Chapter 4.	No comments	X				X
Disposal of Hazardous Waste Title 128, Chapter 4	Relevant and Appropriate	A hazardous waste determination must be made in accordance with Title 128, Chapter 4, 002. If material is a hazardous waste, it must be handled in accordance with all hazardous waste management requirements in Title 128, Chapters 8, 9, and 10. If material is hazardous waste, it must be disposed of in a permitted treatment, storage, and disposal (TSD) facility as required under Title 128, Chapter 8, 9, and 10. However, generators subject to the requirements of Chapter 8 (conditionals exempt small quantity generator) have disposal options.	If the material which caused the contamination was a hazardous waste then the closure and post-closure requirements of 40 CFR Part 264 or Part 265, Subpart G, as incorporated by reference in Title 128, Chapter 21 and 22 are applicable. If the generator intends to store the hazardous waste for more than 90 days (more than 180 days for small quantity generators; or more than 270 days if small quantity generator must transport the waste, or offer the waste for transportation over a distance of 200 miles or more) or intends to treat said waste on-site, the requirements of Title 128, Chapters 12 through 15, 21, and 22 apply. If the generator is also acting as the transporter, then it must follow the transporter requirements found in Title 128, Chapter 11.	X	X	X	X	X
Land Disposal Requirements (LDRs) Title 128, Chapter 20	Relevant and Appropriate	On-site treatment of those wastes that are determined to be hazardous would have to be conducted in a tank or container meeting requirements of 40 CFR Part 264, Subparts I and J.	No comments	X				X
Disposal of Nonhazardous Waste Title 132, Chapter 1	Relevant and Appropriate	Nonhazardous waste may be a special waste as deemed in Title 132, Chapter 1 and the generator must follow the requirements of Title 132, Chapter 12, and may only be disposed at a licensed landfill which is operated and maintained in compliance with NDEQ regulations and that is approved to accept special waste. Department and landfill approval required.	No comments	X				X

Table 2.2 Applicable or Relevant and Appropriate Requirements

Statute and Regulatory Citation	ARAR Determination	Description	Comment	Media of Concern		Type of ARAR		
				Soil	Groundwater	Chemical	Location	Action
Disposal of Surface Water During Excavation	Relevant and Appropriate	If sumps are necessary during excavation to dewater, the water to be discharged either to the surface of the ground or a stream, then a permit and/or discharge limits must be obtained from the Department in accordance with Title 119 (NPDES regulations), Title 121 (NPDES effluent guidelines and standards), and Title 117 (Surface Water Quality Standards) or Title 127 Publicly Owned Treatment Works (POTW) pretreatment rules and regulations). If the water is to be reinjected, it must be done in accordance with Title 122 (underground injection control [UIC] regulations).	No comments	X		X		
Rules and Regulations for Design, Operations and Maintenance (O&M) of Wastewater Treatment Works Title 123	Relevant and Appropriate	Flocculation and sedimentation, reverse osmosis, enhanced oxidation, and precipitation are wastewater treatment processes for which submission and review of plans and specifications and a construction permit are required.	No comments		X			X
Nebraska Pollutant Discharge Elimination System	Relevant and Appropriate	Any surface discharge of contaminated or treated water is subject to the requirements of Title 119 - Rules and Regulations Pertaining to the Issuance of Discharge Elimination System Permits, Title 121 - Effluent Guidelines and Standards, Title 117 - Nebraska Surface Water Quality Standards. Any reinjection of contaminated water or treated water is subject to the requirements of Title 122 - Rules and Regulations for Underground Injections and Mineral Production Wells and Title 118 - Ground Water Quality and Use Classification (Department of Environmental Quality).	If applicable, EPA would only be required to meet the substantive requirements of the NPDES permit.		X	X		
Nebraska Surface Water Quality Standards Title 117	Applicable	Established the water quality standards applicable to surface waters in the State of Nebraska, including wetlands.	No comments		X	X		
Rules and Regulations for Underground Injection and Mineral Production Wells Title 122	Relevant and Appropriate	The UIC program issues and reviews permits, conducts inspections, and performs compliance reviews for wells used to inject fluids into the subsurface.	Infiltration and/or reinjection of groundwater and injection of substances or nutrients would require a UIC permit or review under Title 122 or review of plans and specifications under Title 123. Underground injection may also require an NPDES permit under Title 119 and 121 based on the potential impact to groundwater. However, EPA would only be required to meet the substantive requirements of the UIC and NPDES permits.	X	X		X	X

Table 2.2 Applicable or Relevant and Appropriate Requirements

Statute and Regulatory Citation	ARAR Determination	Description	Comment	Media of Concern		Type of ARAR		
				Soil	Groundwater	Chemical	Location	Action
Groundwater Quality Standards Title 118	Relevant and Appropriate	Establishes narrative and numerical standards for contaminants introduced to groundwater either directly or indirectly by human activity Provides that any groundwater whose existing quality is better than the MCLs must be maintained at the higher quality; however the State may choose, after public notice and public hearing and based upon necessary economic or social development, to allow degradation that does not interfere with existing uses. Established a procedure for determining the needed action for groundwater pollution occurrences. This protocol includes assessment of the degree and extent of the contamination, setting preliminary cleanup levels, and developing remedial actions.	The narrative and numerical requirements of Title 118 are relevant and appropriate to the groundwater at the Site. It is likely that any discharge limits would be based on groundwater quality standards because of the conjunctive relationship of groundwater and surface water. Under Title 118, a Remedial Action Classification (RAC) of "1" is assigned automatically any time a public or private drinking water supply has been contaminated. Minimum requirements imposed upon the responsible party in a RAC-1 area include the cleanup of readily removable contaminants. Mitigation may also be required. If additional cleanup is not required, the remaining contaminated groundwater will be managed and monitored to prevent any further damage. Preliminary cleanup levels in RAC-l areas are typically MCLs. If an MCL has not been established for a particular contaminant, the Department can consider EPA's Ambient Water Quality Criteria, Health Advisories, and other documents in setting the preliminary cleanup level. The level will be set at the concentration which is estimated to result in a 1 x 10^{6} excess cancer risk or the laboratory detection limit, if higher and within an acceptable range. The time frame for any required corrective action is established, subject to appeal with adequate justification, as the period of potential exposure in the absence of any remedial action or 20 years, whichever timeframe is less.		X	X		X
Flood Plain Management	Relevant and Appropriate	The Flood Plain Management Act, Neb. Rev. Stat. §31-1001 to §31-1031, and Title 258 - Rules Governing Flood Plain Management, govern certain activities occurring in flood plains.	No comments	X	X		X	X
Endangered and Threatened Species	Relevant and Appropriate	The Nebraska Nongame and Endangered Species Act, Neb. Rev. Stat. §37-801 to §37-811 (recodified in 1998 and Title 163, Chapter 4, 012, require consultation with the Nebraska Game and Parks Commission regarding actions which may affect threatened or endangered species and their critical habitat (Nebraska Game and Parks Commission).	No comments	X	X		X	X

Table 2.3 Cleanup Levels for OU 1 of the Garvey Elevator Superfund Site

Contaminant	Groundwater[1] (μg/L)	Soil Gas[2] (μg/m^3)	
		Fine-Grained[3]	Coarse-Grained[4]
Carbon Tetrachloride	5	54,000	77,000
Chloroform	80	1,500	2,100

Notes:

(1) EPA Drinking Water Standards MCL

(2) Calculated using the soil remedial goal and the assumption of equilibrium partitioning. Derivation is discussed in the Final Interim Data Summary Report (HGL, 2009a)

(3) Fine-grained material defined as the upper 85 feet of loess and interbedded alluvium beneath OU 1

(4) Coarse-grained material defined as the Pliestocene sands and gravels from 85 feet to the water table

FIGURES

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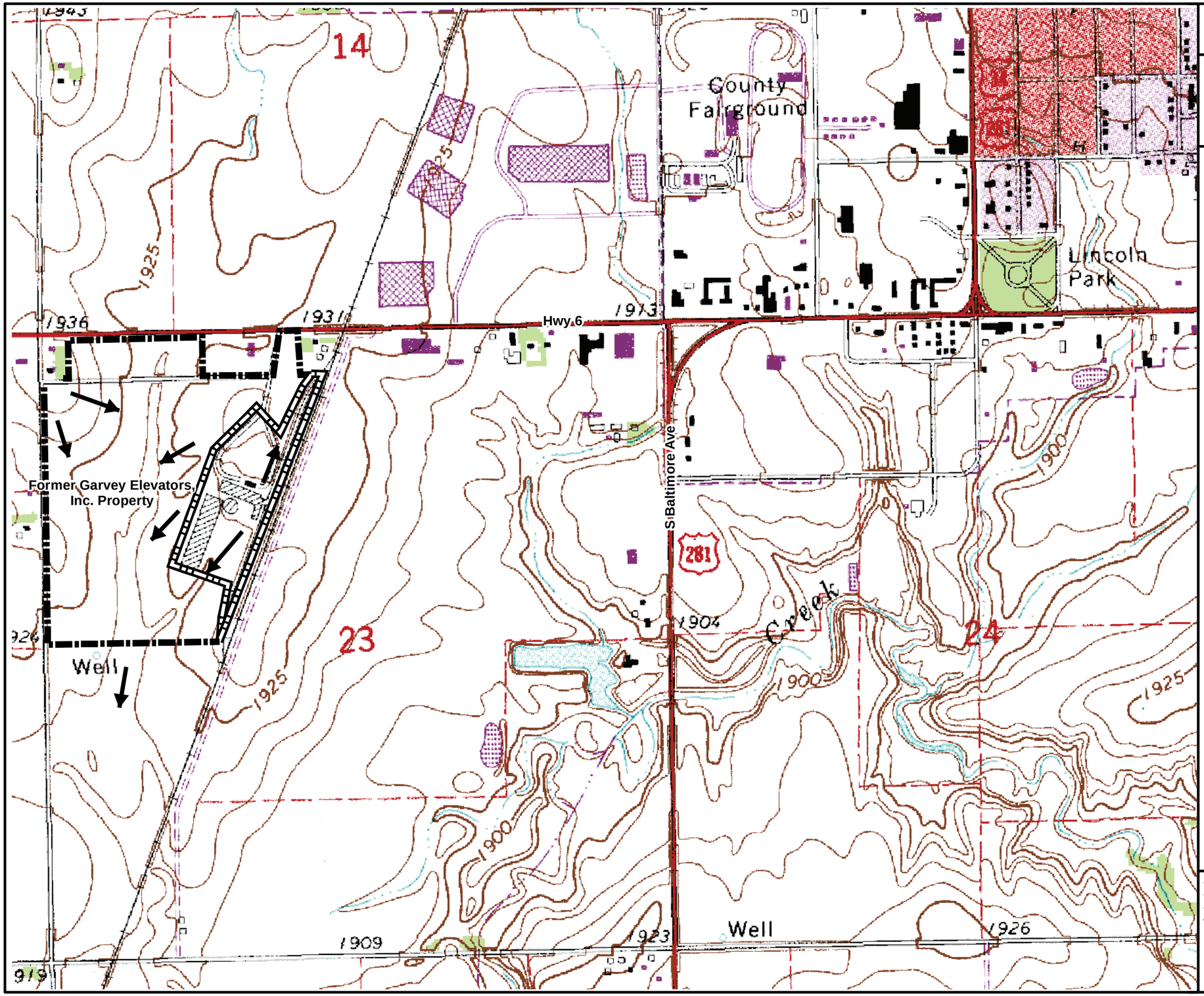


HGL—Interim Remedial Design Report, Garvey Elevator Site—Hastings, NE

Figure 2.1
Garvey Elevator Site
Topography/Hydrology

Legend

- Former Garvey Elevators, Inc. Property
- Garvey Elevator Site, OU1 Boundary
- Surface Water Flow

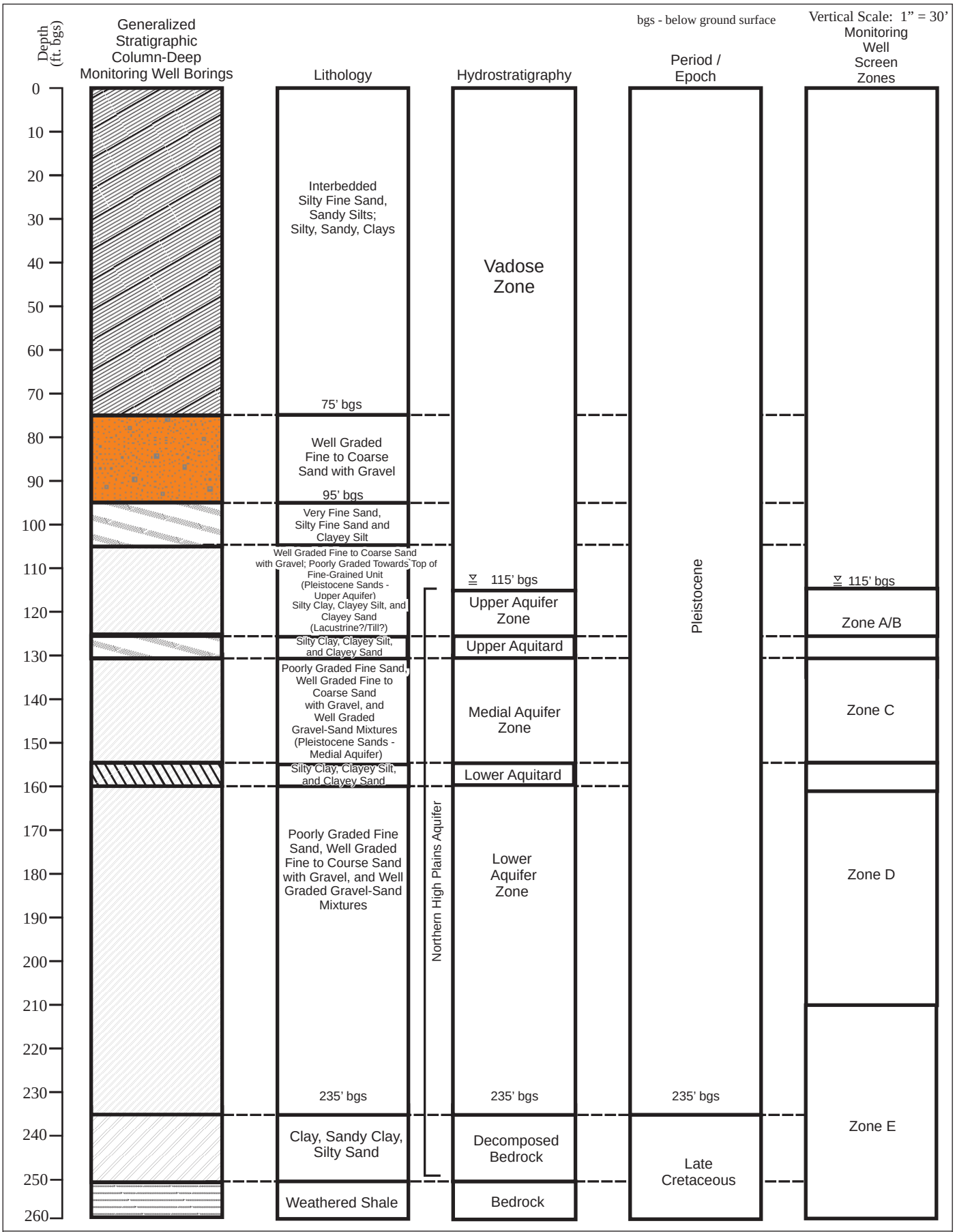
N

0 437.5 875 1,750

Feet

Filename: X:/EPA009/Garvey/RI/TopoMap.mxd
Project: EP9046.02.40.06.00.00
Revised: 09/20/11 ST
Source: USGS, 1983

HGL HydroGeoLogic, Inc



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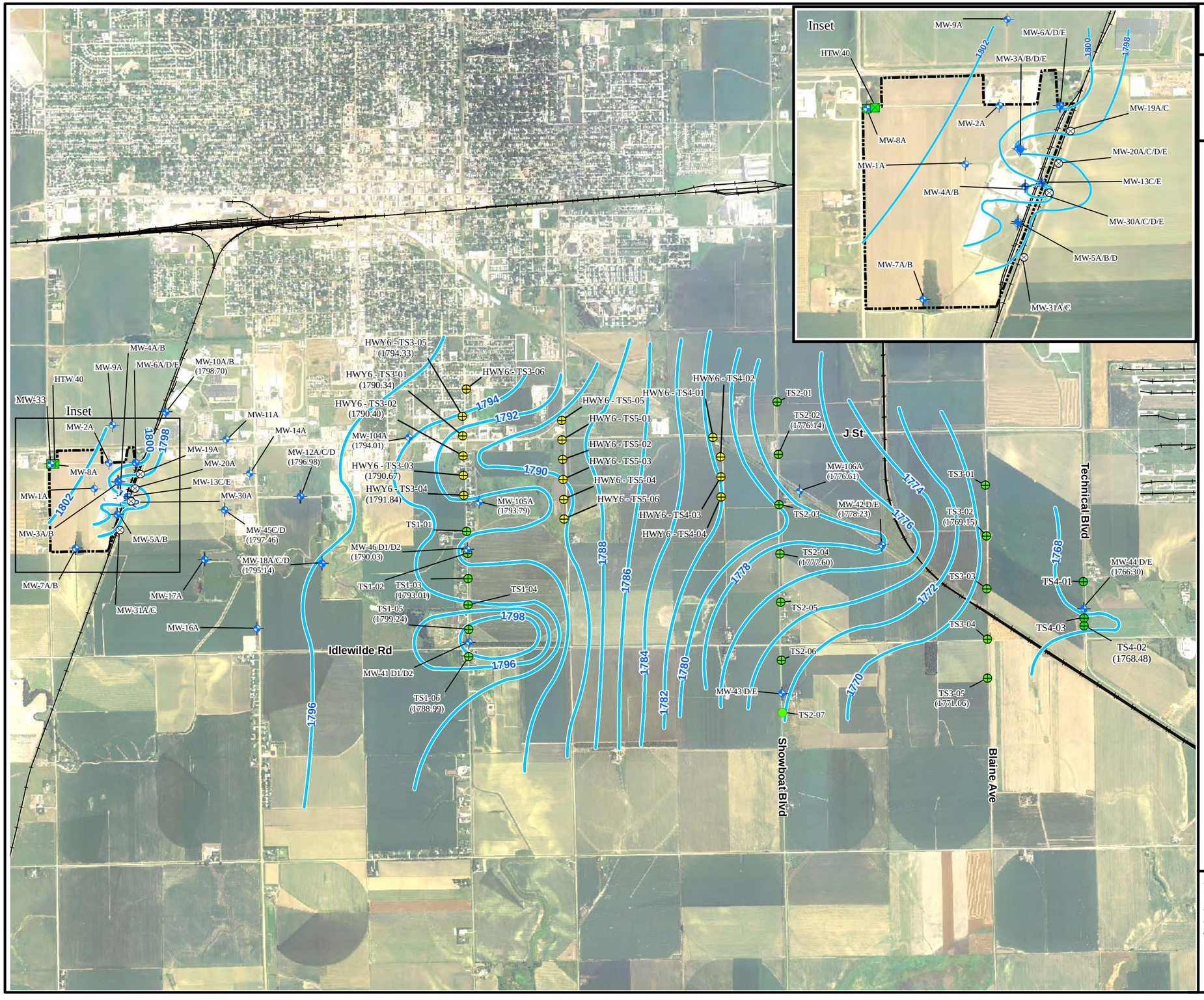
Project: EP9012.01.55.01
Revised: 04/05/11 ST
Source: HGL

HGL HydroGeoLogic, Inc

Figure 2.2
Generalized Stratigraphic Column

Figure 2.3
Upper Aquitard Surface Contour Map



Legend

- Garvey Property Boundary
- Railroad
- Monitoring Well
- Multilevel Well
- Hydraulic Conductivity Well
- Garvey Elevator Site Transect Boring
- West Highway 6 & Highway 281 Site Transect Boring
- 1778 — Upper Aquitard Surface Elevation (feet above mean sea level)

0 2,500 5,000
Feet

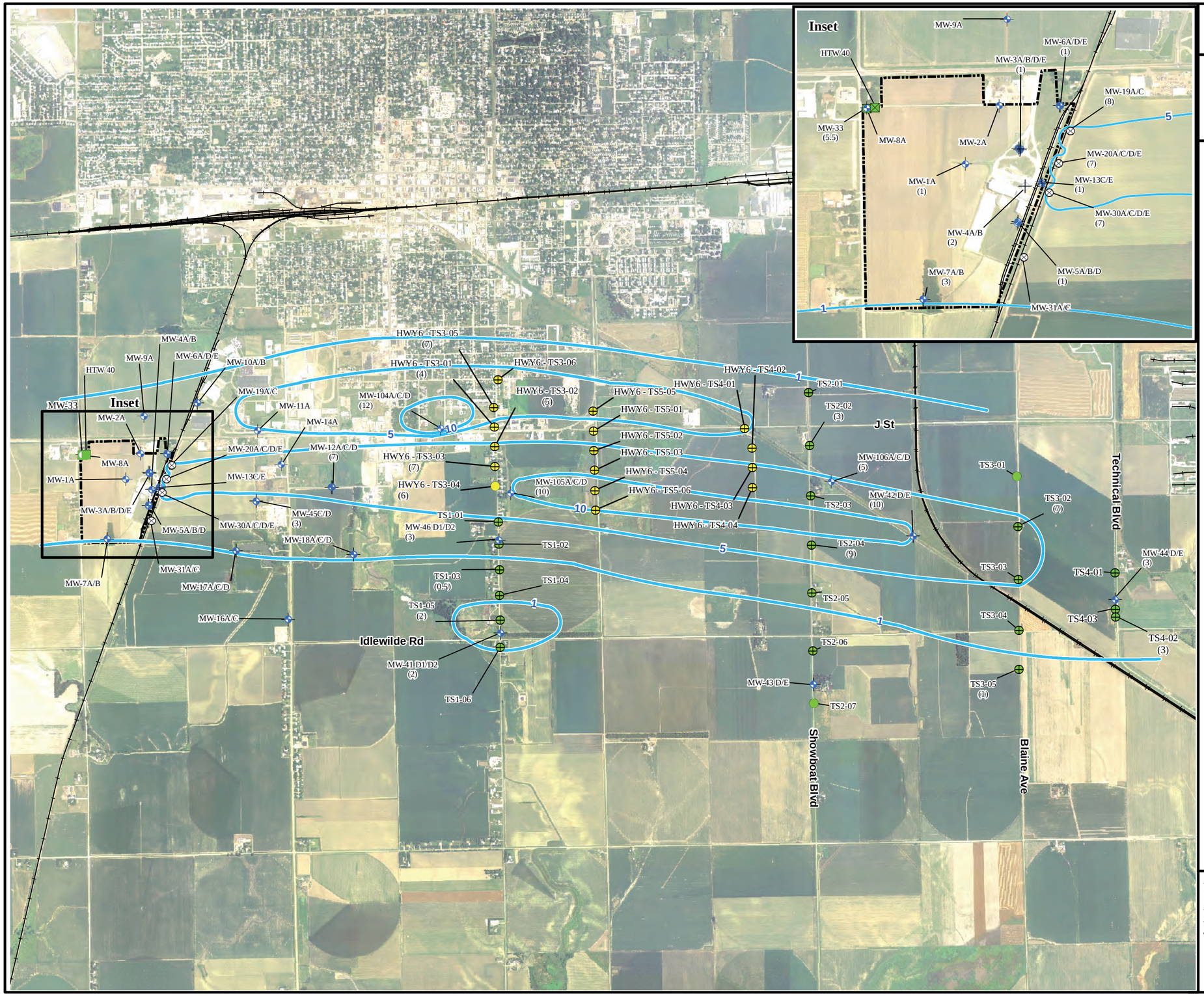
N

Filename: X:/EPA009/Garvey/RI UpperAquitardContourMap.mxd
Project: EP9046.02.40.06.00.00
Revised: 08/19/11 RL
Source: ENSR GDB 2008, DNR

United States Environmental Protection Agency

HGL HydroGeoLogic, Inc CDM

Figure 2.4
Upper Aquitard Thickness Map



Legend

- Garvey Property Boundary
- Railroad
- Monitoring Well
- Multilevel Well
- Hydraulic Conductivity Well
- Garvey Elevator Site Transect Boring
- West Highway 6 & Highway 281 Site Transect Boring
- Upper Aquitard Thickness (feet)

N

0 2,500 5,000
Feet

Filename: X:/EPA009/Garvey/RI UpperAquitardThicknessMap.mxd
Project: EP9046.02.40.06.00.00
Revised: 8/19/11 RL
Source: ENSR GDB 2008, DNR

United States Environmental Protection Agency

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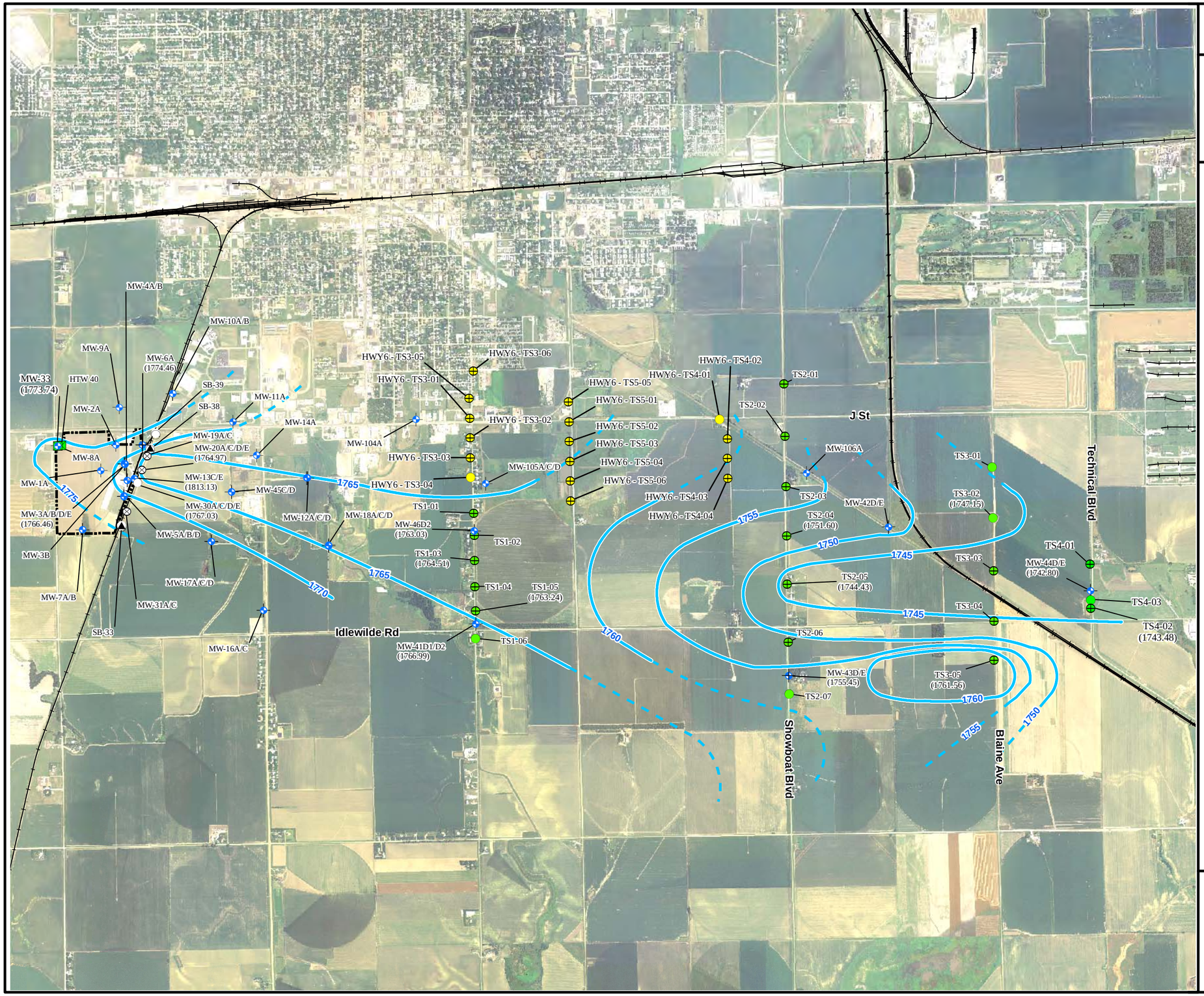
CDM

Figure 2.5
Lower Aquitard
Surface Contour Map
June 2010



Legend

- Garvey Property Boundary
- Railroad
- Monitoring Well
- Multilevel Well
- Garvey Elevator Site Transect Boring
- West Highway 6 & Highway 281 Site Transect Boring
- Hydraulic Conductivity Well
- December 2009 DPT Groundwater Boring
- 1788 — Lower Aquitard Surface Elevation (feet above mean sea level)
- Inferred Contour

Note: Current data from West Highway 6 & Highway 281 site to the north does not indicate the presence of a lower aquitard.

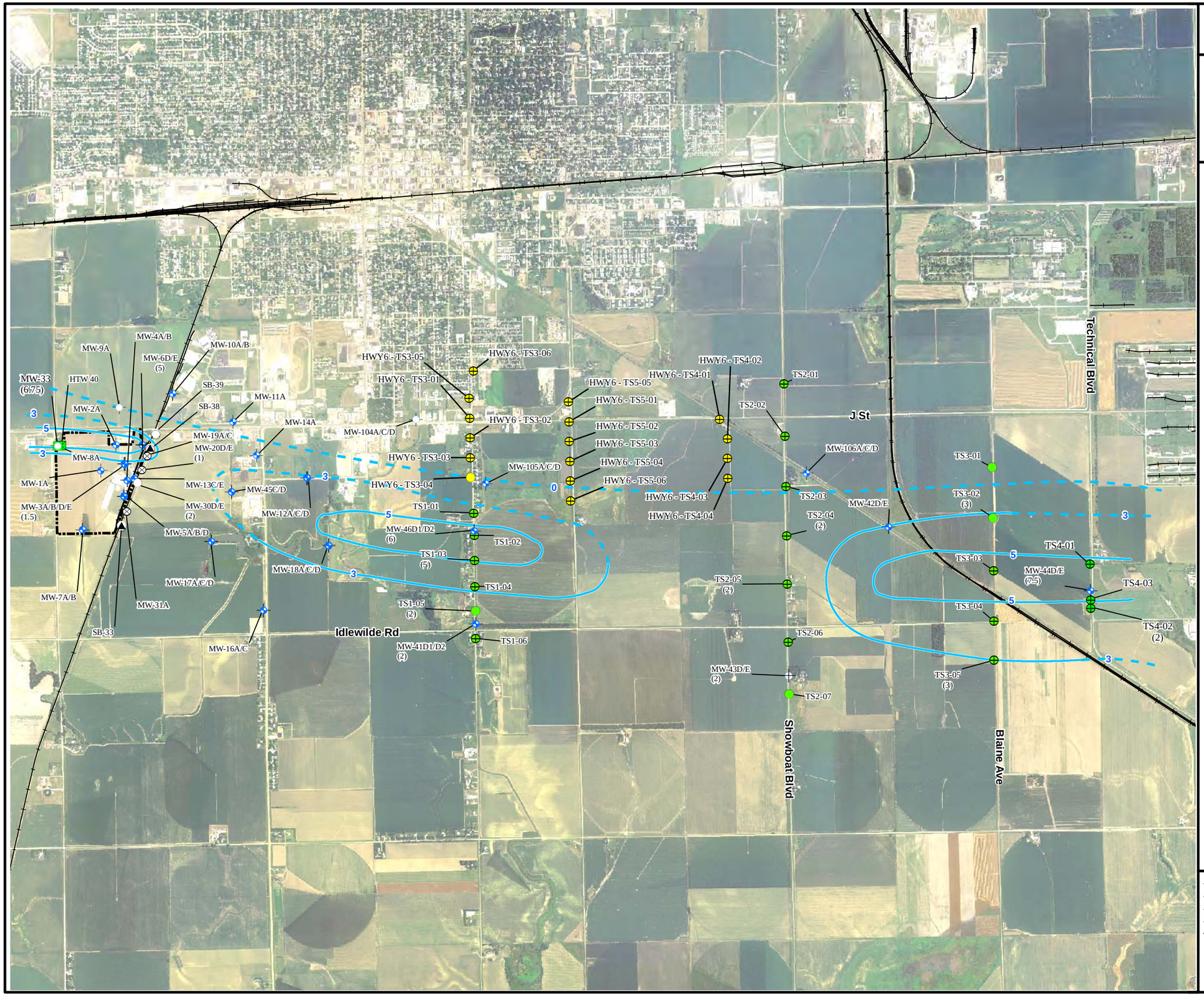
0 2,500 5,000
Feet

N

Filename: X:/EPA009/Garvey/RI Lower_Aquitard_Surface_Map.mxd
Project: EP9046.02.40.06.00.00
Revised: 8/19/11 RL
Source: ENSR GDB 2008, DNR

HGL HydroGeoLogic, Inc CDM

Figure 2.6
Lower Aquitard Thickness Map
June 2010



Legend

- Garvey Property Boundary
- Railroad
- Monitoring Well
- Multilevel Well
- Garvey Elevator Site Transect Boring
- West Highway 6 & Highway 281 Site Transect Boring
- Hydraulic Conductivity Well
- December 2009 DPT Groundwater Boring
- 3 — Lower Aquitard Thickness (feet)
- Inferred Thickness

Note: There is not sufficient data to the south to define the thickness of the lower aquitard.

0 2,500 5,000
Feet

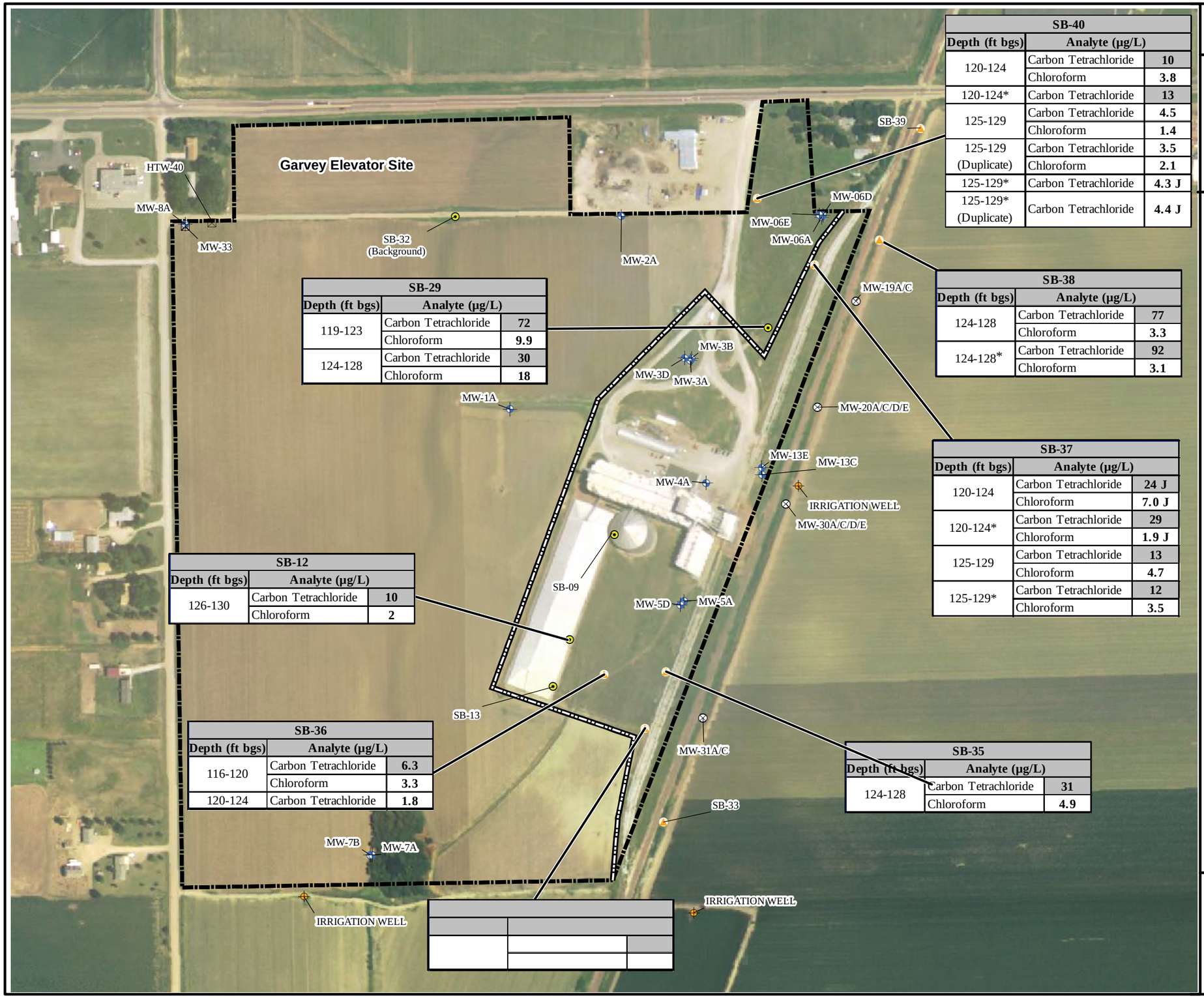
N

Filename: X:/EPA009/Garvey/RI Lower_Aquitard_Surface_Map.mxd
Project: EP9046.02.40.06.00.00
Revised: 8/19/11 RL
Source: ENSR GDB 2008, DNR

United States Environmental Protection Agency

HGL HydroGeoLogic, Inc CDM

Figure 2.7
On-Site Carbon Tetrachloride and Chloroform Concentrations in Groundwater in the Upper Aquifer A/B Zone



SB-40		
Depth (ft bgs)	**Analyte (µg/L)**	
120-124	Carbon Tetrachloride	**10**
	Chloroform	**3.8**
120-124*	Carbon Tetrachloride	**13**
125-129	Carbon Tetrachloride	**4.5**
	Chloroform	**1.4**
125-129 (Duplicate)	Carbon Tetrachloride	**3.5**
	Chloroform	**2.1**
125-129*	Carbon Tetrachloride	**4.3 J**
125-129* (Duplicate)	Carbon Tetrachloride	**4.4 J**

SB-38		
Depth (ft bgs)	**Analyte (µg/L)**	
124-128	Carbon Tetrachloride	**77**
	Chloroform	**3.3**
124-128*	Carbon Tetrachloride	**92**
	Chloroform	**3.1**

SB-37		
Depth (ft bgs)	**Analyte (µg/L)**	
120-124	Carbon Tetrachloride	**24 J**
	Chloroform	**7.0 J**
120-124*	Carbon Tetrachloride	**29**
	Chloroform	**1.9 J**
125-129	Carbon Tetrachloride	**13**
	Chloroform	**4.7**
125-129*	Carbon Tetrachloride	**12**
	Chloroform	**3.5**

SB-29		
Depth (ft bgs)	**Analyte (µg/L)**	
119-123	Carbon Tetrachloride	**72**
	Chloroform	**9.9**
124-128	Carbon Tetrachloride	**30**
	Chloroform	**18**

SB-12		
Depth (ft bgs)	**Analyte (µg/L)**	
126-130	Carbon Tetrachloride	**10**
	Chloroform	**2**

SB-36		
Depth (ft bgs)	**Analyte (µg/L)**	
116-120	Carbon Tetrachloride	**6.3**
	Chloroform	**3.3**
120-124	Carbon Tetrachloride	**1.8**

SB-35		
Depth (ft bgs)	**Analyte (µg/L)**	
124-128	Carbon Tetrachloride	**31**
	Chloroform	**4.9**

Legend

- Garvey Property Boundary
- OU1 Boundary
- Hydraulic Conductivity Well
- Multi-Level Well
- Monitoring Well
- Irrigation Well
- August 2009 DPT Groundwater Boring
- December 2009 DPT Groundwater Boring

Notes:

* Denotes Chemsolutions Sample
µg/L - mic rograms per liter
ft bgs - f eet below ground surface
Shaded results indicate that the results exceed the Preliminary Remediation Goal (PRG).

All samples and the analytes they were sampled for are listed on Table 3.7.

N

0 175 350 700
Feet

Filename: X:/EPA009/Garvey/RI Carbon_Tet_GW_Aquitard.mxd
Project: EP9046.02.40.06.00.00
Revised: 08/19/11 RL
Source: ENSR GDB 2008, DNR

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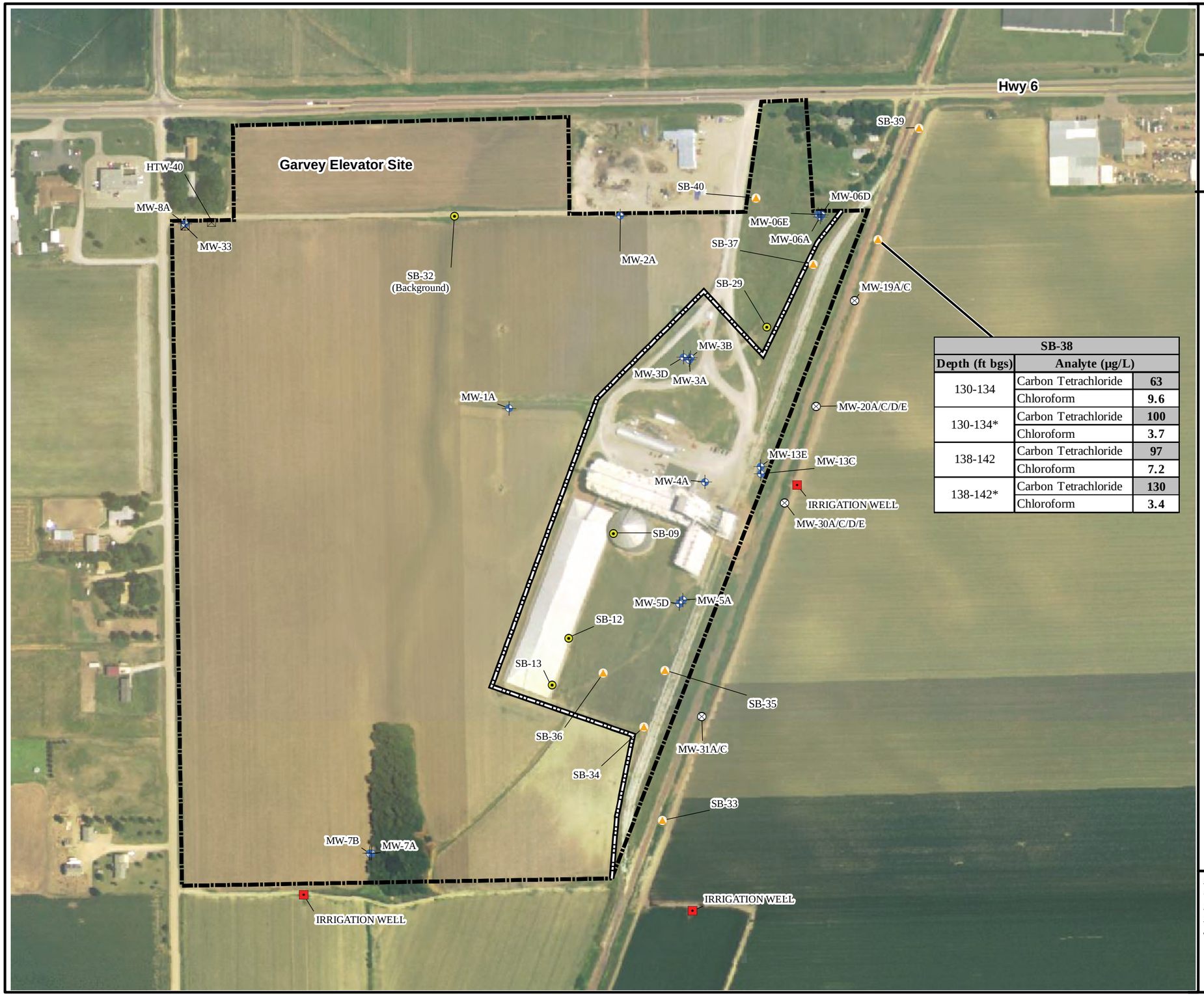
Figure 2.8
On-Site Carbon Tetrachloride and Chloroform Concentrations in Groundwater Below the Upper Aquitard Medial Aquifer C Zone



SB-38		
Depth (ft bgs)	**Analyte (µg/L)**	
130-134	Carbon Tetrachloride	**63**
	Chloroform	**9.6**
130-134*	Carbon Tetrachloride	**100**
	Chloroform	**3.7**
138-142	Carbon Tetrachloride	**97**
	Chloroform	**7.2**
138-142*	Carbon Tetrachloride	**130**
	Chloroform	**3.4**

Legend

- Garvey Property Boundary
- OU1 Boundary
- Hydraulic Conductivity Well
- Multi-Level Well
- Monitoring Well
- Irrigation Well
- August 2009 DPT Groundwater Boring
- December 2009 DPT Groundwater Boring

Notes:

* Denotes Chemsolutions Sample
µg/L -mic rograms per liter
ft bgs -f eet below ground surface
Shaded results indicate that the results exceed the Preliminary Remediation Goal (PRG).

All samples and the analytes they were sampled for are listed on Table 3.7.

N

0 170 340 680
Feet

Filename: X:/EPA009/Garvey/RI Carbon_Tet_GW_Aquitard_Medial_Aquifer.mxd
Project: EP9046.02.40.06.00.00
Revised: 8/19/11 RL
Source: ENSR GDB 2008, DNR

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Figure 2.9
Existing GET and SVE System Well and Pipeline Locations

Legend

- Former Garvey Elevators, Inc. Property
- Garvey Elevator Site, OU1 Boundary
- Pack Tower Stripper
- GET and SVE System Piping
- Recovery Wells
- Hydraulic Conductivity Well
- Multi-Level Well Installed
- Injection Well
- Soil Vapor Extraction Well
- Monitoring Well
- Irrigation Well

N

0 185 370 740
Feet

Filename: X:/EPA009/Garvey/MXDs/GET_SVE.mxd
Project: EP9046.02.40.06.00.00
Revised: 09/20/11 ST
Source: ENSR GDB 2008, DNR

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3.0 REMEDIAL ACTION IMPLEMENTATION

3.1 REMEDIAL ACTION OVERVIEW

The objective of this design for the Garvey Elevator Superfund Site OU 1 is to define the criteria, requirements, and procedures required to implement the RA defined in the interim ROD (EPA, 2010). The selected remedy defined in the interim ROD includes collection and on-site treatment of VOC-contaminated groundwater, injection of treated groundwater into the aquifer, SVE, and monitoring of groundwater and soil vapor, installation of additional recovery wells and associated piping, and modification of the groundwater treatment system, as necessary.

This interim RD includes the following elements:

- Replacement of existing flow meters with magnetic flow meters
- Replacement of GET system header piping
- Replacement of the pressure transducer in IW-02
- Minor upgrades to electrical infrastructure
- Integration of magnetic flow meters and IW-02 pressure transducer to the PLC and an update of PLC programming for system operation

Components of design are broken into design categories. Assumptions, design criteria, and other requirements are presented, and the methodology for completion is presented in the following sections.

3.2 REMEDIAL DESIGN INVESTIGATION RESULTS

The data collected during the RD investigation activities (outlined in Section 2.2.2) was used to estimate aquifer parameters for the upper and medial aquifers The results of the field investigation activities were presented in the Final Remedial Design Field Investigation Report (HGL, 2011c). Based on the data collected during the remedial design investigation a numerical groundwater flow model was developed using MODFLOW-2000) and calibrated to assist in establishing capture zone(s) in the vicinity of the site. Two independent capture zone analyses were conducted: one for the upper aquifer and one for the medial aquifer. The results of the ground water flow modeling indicated that that both models are well calibrated when compared with actual measurement data (HGL, 2011d). Once a flow-system model is calibrated, the simulated head distribution approximates the measured field values and the probable flow paths may be ascertained with particle tracking analyses. These simulations involve placing particles within the model that are subsequently moved by advective flow resulting in a series of flow paths. Particle tracking analyses were performed on the predicted head fields for both the shallow and medial aquifers. The simulation results indicate that the capture zone(s) created by the existing extraction wells extend beyond the boundaries of the on-site contaminant plume(s). Therefore, no additional on-site extraction wells are required. A

detailed description of the groundwater flow modeling is presented in the Groundwater Flow Model Results Memorandum (HGL, 2011d).

3.3 DESIGN CONSIDERATIONS

Design criteria includes electrical and instrumentation upgrades for the GET system, including minor upgrades to electrical infrastructure and PLC programming, re-configuration of system piping, replacement of existing flow meters and valves, and upgrades to the electrical infrastructure of six of the eight existing recovery well vaults. The final design was based on the following considerations:

- Interim ROD requirements
- Groundwater modeling results
- O&M considerations

3.3.1 Process and Mechanical Design Considerations

3.3.1.1 Design Assumptions, Criteria, and Requirements

Piping and Valves

Recovery well piping enters the treatment plant as high density polyethylene (HDPE) pipe. A flanged connection transitions the piping to Schedule 80 PVC piping. Each recovery well line consists of a flow meter, ball valve, and sample port. All recovery wells are combined in a common header. As part of the improvements for this project, system piping within the treatment building will be re-configured, and new piping, isolation valves, check valves, and flow meters will be installed. See the contract drawings and specifications for further information.

The header for the recovery wells will be removed and replaced to ensure that manufacturer recommendations for straight run of pipe before and after the flow meters are achieved. Piping and valves for new work will use similar materials as the existing construction.

Unions will be installed in piping systems wherever they will expedite maintenance or removal of equipment and valves. All piping connections to structures will use flexible couplings and/or sleeve-type couplings to minimize the possibility of breakage due to settlement.

Valves will be manually operated ball valves. Piping will have heat tracing and insulation to prevent freezing.

Flow Meters

As part of the improvements for this project, the existing flow meters will be replaced. Existing flow meters are Signet Rotor or Signet paddlewheel type flow meters and Signet flow rate transmitters. Section 2.5.1.5 provides additional detail regarding the existing flow meters being used.

Existing rotor and paddlewheel flow meters will be replaced with magnetic flow meters to provide greater accuracy in flow measurement, particularly at lower flow rates. Magnetic flow meters will be sized to the pipe size and flow conditions. Flow rate transmitters will be replaced to be compatible with the new magnetic flow meters.

Magnetic flow meter sizes and upstream and downstream pipe diameters were calculated for the shallow and intermediate recovery wells (Appendix A) for minimum flow velocity of 1 foot per second. A 1-inch flow meter and pipe diameter is recommended for the shallow recovery wells. A 3-inch flow meter and pipe diameter is recommended for the intermediate recovery wells. See the contract drawings and specifications for further information.

3.3.1.2 Design Methodology

Hydraulic Model Development

A hydraulic model was developed using WaterCad software to support the sizing of submersible pumps and to determine if an equalization tank is needed. In addition to the information presented above for the existing recovery wells and pumps, supplemental data were obtained for the hydraulic model from both the O&M manual for the former Garvey Elevators, Inc. Interim Corrective Measure GET system and the *Summary of Repairs to the Soil Vapor Extraction and Groundwater Recovery Systems* report (TetraTech EM, 2011).

The system consists of eight existing recovery wells pumping through an individual pump line to the treatment building where they combine in a single header and are pumped through bag filters and to the air stripping unit. See the drawings for pipe routing and sizing information. The two skid mounted influent bag filters manufactured by Krystil Klear are operated in parallel or individually during bag changes. The filters are sized at maximum three psi of headloss at a 500 gpm flowrate. The airstripper is a Carbonair Model OS-500 packed tower air stripper sized to operate at a 500 gpm flow rate pipe inlet at approximately 44.7 feet above the floor.

The modeling results are presented in Appendix A. The Grundfos model 10S07-12, ¾ hp pumps are also recommended for shallow recovery wells. The EPA removal contractor will be replacing the shallow recovery well submersible pumps; therefore, submersible pump replacements are not included in this RD.

3.3.2 Electrical Design Considerations

3.3.2.1 Design Assumptions, Criteria, and Requirements

Electrical work will comply with all the applicable, electrical, building and safety code requirements, as well as any utility requirements. The National Electrical Manufacturers Association (NEMA) classification for the treatment building and in the recovery well vaults will be classified according to the applicable National Fire Protection Association (NFPA) codes. All the electrical items, including light fixtures, control panels, and motors will be suitable for the environment in which they are installed.

Minor Upgrades

Minor Upgrades to the electrical system include:

- Pull boxes
- Treatment system power and control re-wiring
- Heat Trace

Design and construction of the electrical system will be based upon the following criteria:

- Heavy-duty industrial type quality
- Easy accessibility and maintainability for electrical equipment
- Safety
- Match existing construction

The design, equipment, and installation will comply with the National Electrical Code (NEC) and with the latest editions of the applicable standards and codes of the following associations:

- National Electrical Safety Code
- American National Standards Association (ANSI)
- NEMA
- Institute of Electrical and Electronic Engineers (IEEE)
- NFPA
- Insulated Cable Engineers Association (ICEA)
- OSHA
- ASTM International (ASTM)
- International Electrical Testing Association (NETA)
- Factory Manual (FM)
- Underwriters Laboratory (UL)

Equipment, materials, and installation will also comply with the requirements of the local authority having jurisdiction.

Electrical Service

Existing electrical distribution system will be used to provide power for the proposed loads.

Raceway System:

Table 3.1 outlines the specific raceway application requirements for different locations.

Wire and Cable

All 600 V wires and cables will be of annealed, 98 percent conductivity, soft drawn copper. All conductors will be stranded. Except for control, instrumentation, and signal circuits, wire smaller than No. 12 American Wire Gauge (AWG) will not be used. Cable installed on cable trays will be rated for cable tray installation. 600 V wire for power and control circuits will be Type THHN/THWN. Instrumentation wire will be shielded with 600 V PVC insulation and PVC jacket. Instrumentation wire will be single pair, three-conductor, or multiple pair cable, as required. Conductors will be stranded and twisted, no smaller than No. 16 AWG.

Power and control conductors will be color coded, or coded using electrical tape in sizes where colored insulation is not available. All wiring will be tagged and coded with an identification number. Coding will be typed on a permanent, non-smearing, solvent-resistant, heat-shrinkable sleeve applied to each termination end.

3.3.3 Instrumentation Design Considerations

3.3.3.1 Design Assumptions, Criteria, and Requirements

This section discusses the overall control philosophy, including control system hardware, level of automation, supervisory control, and field instrumentation. The existing control system, consist of a central control panel (CCP) and a PLC, performs supervisory control functions for the treatment system and will be updated to integrate the new recovery wells.

The unattended facility will operate with automatic startup and shutdown of the system for normal operation as it did prior to this system expansion. The groundwater treatment facility status indication and alarms will be centralized on the CCP.

The existing control system is based on an Allen-Bradley CompactLogix PLC and Allen-Bradley RSView32 HMI software on a personal computer. The PLC input/output (I/O) signals are based on 24 V direct current for discrete signals and 4-20 milliamps for analog signals. The HMI allows monitoring and control. Reports that are generated by the HMI are stored on the personal computer.

Currently the following parameters are monitored and controlled for the existing recovery wells:

- Well drawdown level (submersible pressure transducer)
- Well withdrawal flow rate (propeller flow meter)

- Well pump VFD – overload signal
- Well pump VFD – run status
- Well pump VFD – pump start command
- Well pump VFD – speed control command
- Well pump speed – PLC level proportional-integral-derivative (PID) control logic

The currently existing control system consists of the following:

- Panel containing Powerflex VFD drives, PLC, and HMI computer
- Allen-Bradley CompactLogix PLC with 1796 I/O modules
- Allen-Bradley RSView32 HMI software to monitor and control the well pumps

3.3.3.2 Design Methodology

The existing control system will not be replaced, but will be modified to control recovery well pumps based on operational pumping rate instead of level PID. The existing paddlewheel flow meters for the wells' withdrawal flow rate will be replaced with magnetic flow meters. A pressure transducer will be installed in injection well IW-02 to monitor groundwater level conditions at the injection point and assure that an undesirable groundwater level condition does not develop.

3.4 REMEDIAL ACTION IMPLEMENTATION

The primary implementation of the RA will be the installation of recovery wells, upgrades to existing recovery wells, integrating new recovery wells into the existing GET system, and replacing existing pumps, flow meters, and valves to optimize system operation. A summary of the general implementation activities to be performed during the treatment aspect of this RA is as follows:

Pre-Mobilization

- Complete permit, license, or other project documentation and coordination efforts with EPA, the State of Nebraska, the City of Hastings, and AGP, as applicable.

Site Mobilization

- Set up support facilities and logistics.
- Establish equipment and materials lay-down and storage areas.
- Deliver all equipment and materials required to complete the installation.

Site Work

- Establish work zones.
- Set up equipment and personnel decontamination facilities.
- Install new valves, piping, and flow meters in treatment building.
- Complete minor upgrades to electrical system.
- Install new pressure transducer in injection well IW-02.
- Update the existing PLC system with new programming to accommodate treatment system upgrades and operational preferences.
- Complete system start-up after upgrades are integrated into system.
- Dispose of all generated wastes (includes non-hazardous debris and trash).

Demobilization Work

- Complete disposal of all non-hazardous debris and trash generated.
- Complete demobilization of site personnel, equipment, and materials.

Operations and Maintenance

Equipment is expected to operate continuously with minimal O&M. The system should run in automatic mode without further adjustments, with the exception of routine maintenance procedures, adjustments to increase system performance, and system monitoring requirements. Discharge to the injection wells will be controlled by the existing transfer pump. Pumps, wells, and other equipment will require periodic inspection as well as normal routine lubrication and similar maintenance.

Major maintenance, such as equipment replacement, will be required if that equipment fails. To keep major maintenance minimal, routine maintenance will be done as required by the equipment manufacturer. Upgrades to the system identified in this interim RA will help prevent major maintenance actions in the future.

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TABLES

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Table 3.1 Electrical Raceway Application Guideline

Location/Circuit Type	Raceway Type
All locations - Class 2 and 3 signal wiring and 4-20 milliamp instrumentation cables, non-fiber (copper) data highway.	• Exposed - Galvanized rigid steel (GRS) conduit. Concealed - GRS conduit. • Underground - GRS conduit in concrete reinforced ductbank. Use PVC coated steel conduit for single conduit direct burial applications.
Clean, dry non-finished areas - Eelectrical rooms, generator rooms, mechanical rooms, shops, dry storage, etc.	• Exposed conduit for power wiring, lighting, switch, and receptacle circuits - GRS. • Concealed conduit for power wiring, lighting, switch, and receptacle circuits - Schedule 40 PVC conduit when embedded within concrete floor slabs. GRS when embedded within masonry block walls.
Process areas - Non-corrosive, non-hazardous locations designated as DAMP or WET on the Drawings.	• Exposed conduit for power wiring, lighting, switch, and receptacle circuits – GRS. • Concealed conduit for power wiring, lighting, switch, and receptacle circuits - Schedule 40 PVC conduit when embedded within concrete floor slabs. GRS when embedded within masonry block walls.
Outdoor areas - All locations.	• Exposed conduit for power wiring, lighting, switch, and receptacle circuits - GRS. PVC conduit shall not be used exposed. • Concealed conduit for power wiring, lighting, switch, and receptacle circuits - Schedule 40 PVC conduit when embedded within concrete structures.

4.0 PERMITTING AND ACCESS REQUIREMENTS

4.1 REQUIRED PERMITS

The interim RA is being performed on site and therefore is excluded under CERCLA from having to obtain permits for on-site activities. However, compliance with the substantive requirements of the ARARs (summarized in Section 2) will need to be maintained during the implementation of the RA. Prior to the implementation of the interim RA activities, the contractor implementing the interim RA will prepare documentation of the planned activities for EPA. This information will be forwarded to NDEQ, the site owner AGP, and other appropriate and local officials for review and approval to ensure that the requirements of the interim RA are being addressed and fulfilled and no additional documentation (e.g., permit application information) is required. During the implementation of the interim RA, the contractor will maintain all required contractor licenses and ensure that all insurance requirements and documentation are current and present on the project site.

4.2 ACCESS CONDITIONS

The Site is an active grain storage and distribution facility. The Site is frequented by large tractor trailer trucks hauling grain to and from the facility. Although site work is not expected to impact the facility operations, the contractor will be required to coordinate construction activities with AGP such that access to the facility is not hindered.

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5.0 REMEDIAL ACTION EXECUTION

The execution of this interim RA shall involve the implementation of the following activities:

- Pre-design investigation
- Design preparation
- Contract document preparation
- Contractor procurement
- Site Management Plan preparation
- RA implementation
- Monitoring

The responsibilities associated with the implementation of this interim RA have been assigned as follows:

- EPA (lead governing agency): provide review and approval of remedial activities, preparation of contract documents, procurement of the contractor, provide oversight of the contracted interim RA field activities, and provide evaluation of the monitoring data and subsequent remedial action activities.
- NDEQ (State regulatory agency): provide review and approval of remedial activities.
- HGL and CDM: performance of a pre-design field investigation, preparation of design documents; and implementation of post-design support activities.
- Contractor: preparation and implementation of site management plans and implementation of interim RA activities in accordance with the design and associated contract documents (e.g., the technical plans and specifications).

The following subsection (Section 5.1) provides a more detailed summary of implementation activities.

5.1 REMEDIAL ACTION IMPLEMENTATION ACTIVITIES

5.1.1 Pre-Design Investigation

Pre-design investigation efforts were performed to confirm the current understanding of the extent of the groundwater plume. Efforts included analysis of groundwater samples collected throughout the known groundwater plume area using the existing monitoring well network and a treatability study and groundwater model to determine design criteria for the expansion of the treatment system.

5.1.2 Design Preparation

The design will consist of the preparation of the Basis of Design Report (this report) and the preparation of Technical Specifications and Contract Drawings (Appendix B and Appendix C) which consists of specifications and figures drawings illustrating locations of proposed piping modifications, and system hardware and instrumentation modifications required to support the implementation of the interim RA.

5.1.3 Contract Document Preparation

The contract documents will be prepared to implement the interim RA field activities. With the exception of the technical specifications and plans, all contract documents will be prepared by EPA. Typical elements of the contract documents are listed below.

Bidding Requirements

Typically includes the *Invitations to Bid* and *Instructions to Bidders*.

Bid Form/Documentation

Typically includes the bid form and the bid requirements/documentation (representations and certifications regarding contractor/subcontractor status [small business contractor, women owned business, minority business, etc.]; lower tier subcontractor listing; experience and safety listings; and certification of training, medical, and safety requirements).

Contract Forms

Typically includes the Agreement, Scope of Work, General and Special Contract Clauses, Insurance Requirements, General and Special Terms and Conditions, and Safety and Health Requirements.

Technical Specifications and Plans

The technical specifications will include written requirements of the work to be performed. The plans (drawings) will include drawings of the locations where the interim RA is to be implemented.

5.1.4 Contractor Procurement

The implementation of this interim RA will be provided for EPA by a contractor qualified to perform the interim RA services specified in the contract documents. Following preparation of the contract documents, EPA will procure a contractor. Procurement activities shall include the solicitation of bids, the evaluation of bids, selection of the most cost-effective responsive and qualified bidder, and contract award.

5.1.5 Site Management Plans Preparation

Several site management plans will be required for use during the implementation of the interim RA. These plans will be prepared by the contractor. Specific plans to be prepared by the contractor will include a *Site Management Plan* and a *Health & Safety Plan*.

5.1.6 Field Implementation

The contractor will perform the field implementation phase of the interim RA. The specific activities to be performed will include those defined in Section 3.3 of this report.

5.2 COST ESTIMATE

The cost estimate for the final design will be provided under separate cover.

5.3 PROJECT SCHEDULE

The project construction is assumed to be approximately 61 working days (working day is defined as an 8-hour day Monday through Friday excluding major holidays) or approximately 4 months. The preliminary construction schedule for implementation of the interim RA is presented in Figure 5.1. It is assumed that actual project duration is approximately 7 months from notice to proceed (NTP), with 4 months of construction performed, not including the 1 year operational and functional period. Based on a design completion in September 2011 and procurement period from October 2011 through February 2012 and an award date in March 2012, an NTP date in March 2012 was assumed.

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FIGURES

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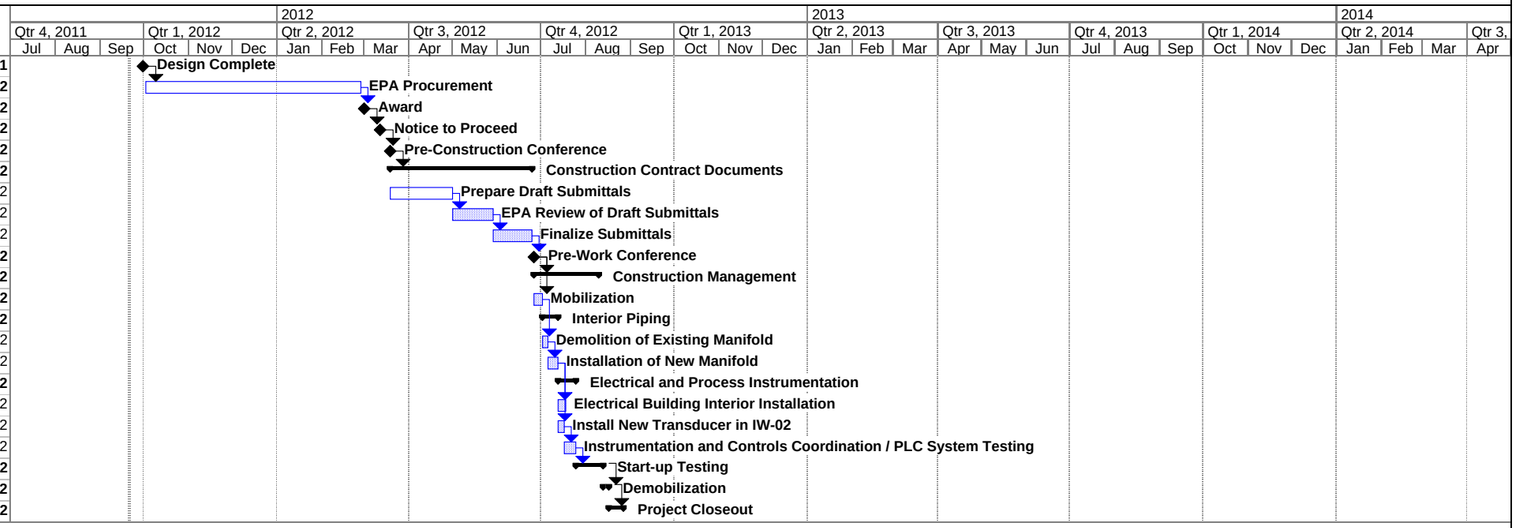
Figure 5.1 Preliminary Construction Schedule, Interim Remedial Design, Garvey Elevator Site, OU 1, Hastings, Nebraska

ID	Task Name	Duration	Start	Finish
1	**Design Complete**	**0 days**	**Fri 9/30/11**	**Fri 9/30/11**
2	**EPA Procurement**	**85 days**	**Mon 10/3/11**	**Tue 2/28/12**
3	**Award**	**0 days**	**Thu 3/1/12**	**Thu 3/1/12**
4	**Notice to Proceed**	**0 days**	**Mon 3/12/12**	**Mon 3/12/12**
5	**Pre-Construction Conference**	**0 days**	**Mon 3/19/12**	**Mon 3/19/12**
6	**Construction Contract Documents**	**55 days**	**Mon 3/19/12**	**Mon 6/25/12**
7	Prepare Draft Submittals	25 days	Mon 3/19/12	Tue 5/1/12
8	EPA Review of Draft Submittals	15 days	Tue 5/1/12	Tue 5/29/12
9	Finalize Submittals	15 days	Tue 5/29/12	Mon 6/25/12
10	**Pre-Work Conference**	**0 days**	**Tue 6/26/12**	**Tue 6/26/12**
11	**Construction Management**	**25 days**	**Tue 6/26/12**	**Fri 8/10/12**
12	**Mobilization**	**3 days**	**Tue 6/26/12**	**Mon 7/2/12**
13	**Interior Piping**	**6 days**	**Mon 7/2/12**	**Fri 7/13/12**
14	Demolition of Existing Manifold	2 days	Mon 7/2/12	Fri 7/6/12
15	Installation of New Manifold	4 days	Fri 7/6/12	Fri 7/13/12
16	**Electrical and Process Instrumentation**	**7 days**	**Fri 7/13/12**	**Wed 7/25/12**
17	Electrical Building Interior Installation	3 days	Fri 7/13/12	Wed 7/18/12
18	Install New Transducer in IW-02	2 days	Fri 7/13/12	Tue 7/17/12
19	Instrumentation and Controls Coordination / PLC System Testing	5 days	Tue 7/17/12	Wed 7/25/12
20	**Start-up Testing**	**10 days**	**Wed 7/25/12**	**Mon 8/13/12**
21	**Demobilization**	**3 days**	**Mon 8/13/12**	**Fri 8/17/12**
22	**Project Closeout**	**5 days**	**Fri 8/17/12**	**Mon 8/27/12**



Project: GRVY_PD_CNSCH_082011.m
Date: Wed 9/21/11

Task Progress Milestone Summary

NOTE: Duration is in working days and not calendar days.

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Appendix A

Calculations

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CDM

		COMPUTER FILE and Location #:	C:\Documents and Settings\schlebuschm\My Documents\CDM Work\GarveyElevator\OU1 RD\[Garvey OU1 Calcs Package
CLIENT:	U.S. EPA Region 7	**JOB #:**	78218
PROJECT:	Garvey OU1 Interim Remedial Design	**CALC BY:**	R. Jim
DETAIL:	Modeling Input and Results	**CALC DATE:**	8/24/2011
		OVERALL PROCEDURAL REVIEWED BY:	SAS **DATE:** 8/24/2011
		DETAILED MATH & OTHER CHECKS BY:	BJE **DATE:** 8/24/2011

1.0 PURPOSE/ OBJECTIVE

1.1 Determine the input parameters for the hydraulic model of the GET system.

1.2 Use results developed from the hydraulic model to estimate the overall flow and pressures of the expanded GET system.

2.0 PROCEDURE / APPROACH

2.1 Determine the minor losses associated with fittings from the eight existing extraction wells to the header.
(Worksheets: RW-1, RW-2, RW-3, RW-4, RW-5, RW-6, RW-7, RW-8)

2.2 Determine elevations of the extraction wells, pump intake, fittings, valves, and significant pipe connections.
(Worksheet: Elevation Data)

2.3 Compile pump curves to be used in the model for the existing GET system and proposed expanded GET system.
(Worksheet: Existing pump curves, Proposed pump curves)

2.4 Calibrate the hydraulic model.

2.5 Run the hydraulic model with the specified parameters and determine flows and pressures for various C-values.
(Worksheet: WaterCad Results)

2.6

3.0 DATA & REFERENCES

See also references on calcs attached

3.1 As-Built Drawings
3.2 O&M Manual
3.3 Site Photos
3.4 CDM Hydraulic Handbook
3.5 Pump Station Design 4th Edition (Sanks)
3.6 Camerons

4.0 ASSUMPTIONS/ LIMITATIONS

4.1 The more conservative K-Values where choosen from CDM Hydraulic Handbook, Sanks, and Cameron resources.
4.2 The pipe lengths and elevations were estimated using the as-built drawings and O&M manual.
4.3 The pump curve for RW-5 was assumed due to limited information provided in the O&M manual.
4.4 The new submersible pumps for RW-1, RW-2, RW-3, and RW-4 were recommended by Preferred Pump & Equipment, a distributor of Grundfos pumps.
4.5

5.0 CALCULATIONS

See the attached/enclosed Calculation Sheets

6.0 CONCLUSIONS/ RESULTS

Minor Losses & Pipe Lengths

Pipe Segment	Flow (gpm)	Sum of K-Values for Minor Losses	Pipe Length (ft)
RW-1	6	10.05	999
RW-2	9	9.45	670
RW-3	8	9.45	738
RW-4	12	8.88	1020
RW-5	6	8.88	261
RW-6	92	9.32	819
RW-7	70	8.51	606
RW-8	95	9.02	904

For elevation results see the attached/enclosed sheets
For WaterCad hydraulic model results see the attached/enclosed sheets

CDM

COMPUTER FILE and Location #: C:\Documents and Settings\schlebuschm\My Documents\CDM Work\GarveyElevator\OU1 RD\[Garvey OU1 Calcs Package

CLIENT: U.S. EPA Region 7
PROJECT: Garvey OU1 Interim Remedial Design

JOB #: 78218
CALC BY: R. Jim
CALC DATE: 7/12/2011

DETAIL: Minor Loss Calcs - Extraction Wells

OVERALL PROCEDURAL REVIEWED
BY: SAS **DATE:** 8/24/2011
DETAILED MATH & OTHER CHECKS BY:
BY: BJE **DATE:** 8/24/2011

ASSUMPTIONS:

1) The most conservative K-Values where choosen from Degremont, CDM Hydraulic Handbook, Sanks, and Cameron sources. (For example, if there where multiple K-values for the same type of fitting then the most conservative number was referenced on the K-Value Worksheet.)
2) See cover sheet assumptions

Flow Path	Station	Item Description	Pipe Diameter D in	Pipe Length L ft	Fitting K Value
Inside the EW vault	1	***Flow path is from EW-1 to manifold***			
	2	**Piping - Existing**	**1.917**	**2.3**	-
	3	**Valve - Swing Check**	**1.917**		2.50
	4	**Piping - Existing**	**1.917**	**117**	-
	5	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	6	**Piping - Existing**	**1.917**	**1**	-
	7	**Valve - Gate (double disc)**	**1.917**		0.20
	8	**Piping - Existing**	**1.917**	**1**	-
	9	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	10	**Piping - Existing**	**1.917**	**2**	-
	11	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
EW to Shop	12	**Piping - Existing**	**1.917**	**80**	-
	13	**Elbow - 22 1/2 deg**	**1.917**		0.30
	14	**Piping - Existing**	**1.917**	**40**	-
	15	**Elbow - 22 1/2 deg**	**1.917**		0.30
	16	**Piping - Existing**	**1.917**	**130**	-
	17	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	18	**Piping - Existing**	**1.917**	**280**	-
	19	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	20	**Piping - Existing**	**1.917**	**280**	-
	21	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	22	**Piping - Existing**	**1.917**	**60**	-
Inside the Shop	23	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	24	**Piping - Existing**	**1.061**	**2**	-
	25	**Reducer**	**1.061**		0.50
	26	**Piping - Existing**	**1.061**	**0.333333**	-
	27	**Increaser**	**1.061**		1.00
	28	**Piping - Existing**	**1.061**	**1.5**	-
	29	**Valve - 2" Ball/Cone**	**1.061**		0.06
	30	**Piping - Existing**	**1.061**	**1.5**	-
	31	**Tee - Branch to Main (inlet connection)**	**1.061**		1.20
		TOTAL		*999*	*10.05*

CDM

COMPUTER FILE and Location #: C:\Documents and Settings\schlebuschm\My Documents\CDM Work\GarveyElevator\OU1 RD\[Garvey OU1 Calcs Package

JOB #: 78218

CLIENT: U.S. EPA Region 7 **CALC BY:** R. Jim

PROJECT: Garvey OU1 Interim Remedial Design **CALC DATE:** 7/12/2011

DETAIL: Minor Loss Calcs - Extraction Wells

OVERALL PROCEDURAL REVIEWED
BY: SAS **DATE:** 8/24/2011
DETAILED MATH & OTHER CHECKS BY:
BY: BJE **DATE:** 8/24/2011

ASSUMPTIONS:

1) The most conservative K-Values where choosen from Degremont, CDM Hydraulic Handbook, Sanks, and Cameron sources. (For example, if there where multiple K-values for the same type of fitting then the most conservative number was referenced on the K-Value Worksheet.)
2) See cover sheet assumptions

Flow Path	Station	Item Description	Pipe Diameter D in	Pipe Length L ft	Fitting K Value
Inside the EW vault	1	*Flow path is from EW-2 to manifold*			
	2	**Piping - Existing**	**1.917**	**2.3**	-
	3	**Valve - Swing Check**	**1.917**		2.50
	4	**Piping - Existing**	**1.917**	**118**	-
	5	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	6	**Piping - Existing**	**1.917**	**1**	-
	7	**Valve - Gate (double disc)**	**1.917**		0.20
	8	**Piping - Existing**	**1.917**	**1**	-
	9	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	10	**Piping - Existing**	**1.917**	**2**	-
	11	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
EW to Shop	12	**Piping - Existing**	**1.917**	**50**	-
	13	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	14	**Piping - Existing**	**1.917**	**150**	-
	15	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	16	**Piping - Existing**	**1.917**	**280**	-
	17	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	18	**Piping - Existing**	**1.917**	**60**	-
Inside the Shop	19	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	20	**Piping - Existing**	**1.061**	**2**	-
	21	**Reducer**	**1.061**		0.50
	22	**Piping - Existing**	**1.061**	**0.333333**	-
	23	**Increaser**	**1.061**		1.00
	24	**Piping - Existing**	**1.061**	**1.5**	-
	25	**Valve - 2" Ball/Cone**	**1.061**		0.06
	26	**Piping - Existing**	**1.061**	**1.5**	-
	27	**Tee - Branch to Main (inlet connection)**	**1.061**		1.20
		TOTAL	*670*		*9.45*

CDM

COMPUTER FILE and Location #: C:\Documents and Settings\schlebuschm\My Documents\CDM Work\GarveyElevator\OU1 RD\[Garvey OU1 Calcs Package

JOB #: 78218

CLIENT: U.S. EPA Region 7
PROJECT: Garvey OU1 Interim Remedial Design

CALC BY: R. Jim
CALC DATE: 7/12/2011

DETAIL: Minor Loss Calcs - Extraction Wells

OVERALL PROCEDURAL REVIEWED
BY: SAS **DATE:** 8/24/2011
DETAILED MATH & OTHER CHECKS BY:
BY: BJE **DATE:** 8/24/2011

ASSUMPTIONS:

1) The most conservative K-Values where choosen from Degremont, CDM Hydraulic Handbook, Sanks, and Cameron sources. (For example, if there where multiple K-values for the same type of fitting then the most conservative number was referenced on the K-Value Worksheet.)
2) See cover sheet assumptions

Flow Path	Station	Item Description	Pipe Diameter D in	Pipe Length L ft	Fitting K Value
Inside the EW vault	1	*Flow path is from EW-3 to manifold*			
	2	**Piping - Existing**	**1.917**	**2.3**	-
	3	**Valve - Swing Check**	**1.917**		2.50
	4	**Piping - Existing**	**1.917**	**116**	-
	5	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	6	**Piping - Existing**	**1.917**	**1**	-
	7	**Valve - Gate (double disc)**	**1.917**		0.20
	8	**Piping - Existing**	**1.917**	**1**	-
	9	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	10	**Piping - Existing**	**1.917**	**2**	-
	11	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
EW to Shop	12	**Piping - Existing**	**1.917**	**10**	-
	13	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	14	**Piping - Existing**	**1.917**	**100**	-
	15	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	16	**Piping - Existing**	**1.917**	**440**	-
	17	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	18	**Piping - Existing**	**1.917**	**60**	-
Inside the Shop	19	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	20	**Piping - Existing**	**1.061**	**2**	-
	21	**Reducer**	**1.061**		0.50
	22	**Piping - Existing**	**1.061**	**0.333333**	-
	23	**Increaser**	**1.061**		1.00
	24	**Piping - Existing**	**1.061**	**1.5**	-
	25	**Valve - 2" Ball/Cone**	**1.061**		0.06
	26	**Piping - Existing**	**1.061**	**1.5**	-
	27	**Tee - Branch to Main (inlet connection)**	**1.061**		1.20
		TOTAL	*738*		*9.45*

CDM

COMPUTER FILE and Location #: C:\Documents and Settings\schlebuschm\My Documents\CDM Work\GarveyElevator\OU1 RD\[Garvey OU1 Calcs Package

CLIENT: U.S. EPA Region 7
PROJECT: Garvey OU1 Interim Remedial Design

JOB #: 78218
CALC BY: R. Jim
CALC DATE: 7/12/2011

DETAIL: Minor Loss Calcs - Extraction Wells

OVERALL PROCEDURAL REVIEWED
BY: SAS **DATE:** 8/24/2011
DETAILED MATH & OTHER CHECKS BY:
BY: BJE **DATE:** 8/24/2011

ASSUMPTIONS:

1) The most conservative K-Values where choosen from Degremont, CDM Hydraulic Handbook, Sanks, and Cameron sources. (For example, if there where multiple K-values for the same type of fitting then the most conservative number was referenced on the K-Value Worksheet.)
2) See cover sheet assumptions

Flow Path	Station	Item Description	Pipe Diameter D in	Pipe Length L ft	Fitting K Value
Inside the EW vault	1	*Flow path is from EW-4 to manifold*			
	2	**Piping - Existing**	**1.917**	**2.3**	-
	3	**Valve - Swing Check**	**1.917**		2.50
	4	**Piping - Existing**	**1.917**	**118**	-
	5	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	6	**Piping - Existing**	**1.917**	**1**	-
	7	**Valve - Gate (double disc)**	**1.917**		0.20
	8	**Piping - Existing**	**1.917**	**1**	-
	9	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	10	**Piping - Existing**	**1.917**	**2**	-
	11	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
EW to Shop	12	**Piping - Existing**	**1.917**	**390**	-
	13	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	14	**Piping - Existing**	**1.917**	**440**	-
	15	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	16	**Piping - Existing**	**1.917**	**60**	-
Inside the Shop	17	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	18	**Piping - Existing**	**1.061**	**2**	-
	19	**Reducer**	**1.061**		0.50
	20	**Piping - Existing**	**1.061**	**0.333333**	-
	21	**Increaser**	**1.061**		1.00
	22	**Piping - Existing**	**1.061**	**1.5**	-
	23	**Valve - 2" Ball/Cone**	**1.061**		0.06
	24	**Piping - Existing**	**1.061**	**1.5**	-
	25	**Tee - Branch to Main (inlet connection)**	**1.061**		1.20
		TOTAL	*1020*		*8.88*

CDM

COMPUTER FILE and Location #: C:\Documents and Settings\schlebuschm\My Documents\CDM Work\GarveyElevator\OU1 RD\[Garvey OU1 Calcs Package

CLIENT: U.S. EPA Region 7
PROJECT: Garvey OU1 Interim Remedial Design

JOB #: 78218
CALC BY: R. Jim
CALC DATE: 7/12/2011

DETAIL: Minor Loss Calcs - Extraction Wells

OVERALL PROCEDURAL REVIEWED
BY: SAS **DATE:** 8/24/2011
DETAILED MATH & OTHER CHECKS BY:
BY: BJE **DATE:** 8/24/2011

ASSUMPTIONS:

1) The most conservative K-Values where choosen from Degremont, CDM Hydraulic Handbook, Sanks, and Cameron sources. (For example, if there where multiple K-values for the same type of fitting then the most conservative number was referenced on the K-Value Worksheet.)
2) See cover sheet assumptions

Flow Path	Station	Item Description	Pipe Diameter D in	Pipe Length L ft	Fitting K Value
Inside the EW vault	1	***Flow path is from EW-5 to manifold***			
	2	**Piping - Existing**	**1.917**	**2.3**	-
	3	**Valve - Swing Check**	**1.917**		2.50
	4	**Piping - Existing**	**1.917**	**124**	-
	5	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	6	**Piping - Existing**	**1.917**	**1**	-
	7	**Valve - Gate (double disc)**	**1.917**		0.20
	8	**Piping - Existing**	**1.917**	**1**	-
	9	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	10	**Piping - Existing**	**1.917**	**2**	-
	11	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
EW to Shop	12	**Piping - Existing**	**1.917**	**20**	-
	13	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	14	**Piping - Existing**	**1.917**	**45**	-
	15	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	16	**Piping - Existing**	**1.917**	**60**	-
Inside the Shop	17	**Elbow - 2" 90 deg Standard radius**	**1.917**		0.57
	18	**Piping - Existing**	**1.061**	**2**	-
	19	**Reducer**	**1.061**		0.50
	20	**Piping - Existing**	**1.061**	**0.333333**	-
	21	**Increaser**	**1.061**		1.00
	22	**Piping - Existing**	**1.061**	**1.5**	-
	23	**Valve - 2" Ball/Cone**	**1.061**		0.06
	24	**Piping - Existing**	**1.061**	**1.5**	-
	25	**Tee - Branch to Main (inlet connection)**	**1.061**		1.20
		TOTAL	*261*		*8.88*

CDM

COMPUTER FILE and Location #: C:\Documents and Settings\schlebuschm\My Documents\CDM Work\GarveyElevator\OU1 RD\[Garvey OU1 Calcs Package

CLIENT: U.S. EPA Region 7
PROJECT: Garvey OU1 Interim Remedial Design

JOB #: 78218
CALC BY: R. Jim
CALC DATE: 7/12/2011

DETAIL: Minor Loss Calcs - Extraction Wells

OVERALL PROCEDURAL REVIEWED
BY: SAS **DATE:** 8/24/2011
DETAILED MATH & OTHER CHECKS BY:
BY: BJE **DATE:** 8/24/2011

ASSUMPTIONS:

1) The most conservative K-Values where choosen from Degremont, CDM Hydraulic Handbook, Sanks, and Cameron sources. (For example, if there where multiple K-values for the same type of fitting then the most conservative number was referenced on the K-Value Worksheet.)
2) See cover sheet assumptions

Flow Path	Station	Item Description	Pipe Diameter D in	Pipe Length L ft	Fitting K Value
Inside the EW vault	1	***Flow path is from EW-6 to manifold***			
	2	**Piping - Existing**	**2.826**	**2.3**	-
	3	**Valve - Swing Check**	**2.826**		2.50
	4	**Piping - Existing**	**2.826**	**147**	-
	5	**Elbow - 4" 90 deg Standard radius**	**2.826**		0.51
	6	**Piping - Existing**	**2.826**	**1**	-
	7	**Valve - Gate (double disc)**	**2.826**		0.20
	8	**Piping - Existing**	**2.826**	**1**	-
	9	**Elbow - 4" 90 deg Standard radius**	**2.826**		0.51
	10	**Piping - Existing**	**2.826**	**2**	-
	11	**Elbow - 4" 90 deg Standard radius**	**2.826**		0.51
EW to Shop	12	**Piping - Existing**	**2.826**	**20**	-
	13	**Elbow - 4" 90 deg Standard radius**	**2.826**		0.51
	14	**Piping - Existing**	**2.826**	**20**	-
	15	**Elbow - 22 1/2 deg**	**2.826**		0.30
	16	**Piping - Existing**	**2.826**	**280**	-
	17	**Elbow - 4" 90 deg Standard radius**	**2.826**		0.51
	18	**Piping - Existing**	**2.826**	**280**	-
	19	**Elbow - 4" 90 deg Standard radius**	**2.826**		0.51
	20	**Piping - Existing**	**2.826**	**60**	-
Inside the Shop	21	**Elbow - 4" 90 deg Standard radius**	**2.826**		0.51
	22	**Piping - Existing**	**2.826**	**2**	-
	23	**Reducer**	**2.826**		0.50
	24	**Piping - Existing**	**2.825**	**0.333333**	-
	25	**Increaser**	**2.826**		1.00
	26	**Piping - Existing**	**2.826**	**1.5**	-
	27	**Valve - 4" Ball/Cone**	**2.826**		0.05
	28	**Piping - Existing**	**2.826**	**1.5**	-
	29	**Tee - Branch to Main (inlet connection)**	**2.826**		1.20
		TOTAL		*819*	*9.32*

CDM

COMPUTER FILE and Location #: C:\Documents and Settings\schlebuschm\My Documents\CDM Work\GarveyElevator\OU1 RD\[Garvey OU1 Calcs Package

CLIENT: U.S. EPA Region 7
PROJECT: Garvey OU1 Interim Remedial Design

JOB #: 78218
CALC BY: R. Jim
CALC DATE: 7/12/2011

DETAIL: Minor Loss Calcs - Extraction Wells

OVERALL PROCEDURAL REVIEWED
BY: SAS **DATE:** 8/24/2011
DETAILED MATH & OTHER CHECKS BY:
BY: BJE **DATE:** 8/24/2011

ASSUMPTIONS:

1) The most conservative K-Values where choosen from Degremont, CDM Hydraulic Handbook, Sanks, and Cameron sources. (For example, if there where multiple K-values for the same type of fitting then the most conservative number was referenced on the K-Value Worksheet.)
2) See cover sheet assumptions

Flow Path	Station	Item Description	Pipe Diameter D in	Pipe Length L ft	Fitting K Value
Inside the EW vault	1	***Flow path is from EW-7 to manifold***			
	2	**Piping - Existing**	**2.826**	**2.3**	-
	3	**Valve - Swing Check**	**2.826**		2.50
	4	**Piping - Existing**	**2.826**	**144**	-
	5	**Elbow - 4" 90 deg Standard radius**	**2.826**		0.51
	6	**Piping - Existing**	**2.826**	**1**	-
	7	**Valve - Gate (double disc)**	**2.826**		0.20
	8	**Piping - Existing**	**2.826**	**1**	-
	9	**Elbow - 4" 90 deg Standard radius**	**2.826**		0.51
	10	**Piping - Existing**	**2.826**	**2**	-
	11	**Elbow - 4" 90 deg Standard radius**	**2.826**		0.51
EW to Shop	12	**Piping - Existing**	**2.826**	**20**	-
	13	**Elbow - 4" 90 deg Standard radius**	**2.826**		0.51
	14	**Piping - Existing**	**2.826**	**370**	-
	15	**Elbow - 4" 90 deg Standard radius**	**2.826**		0.51
	16	**Piping - Existing**	**2.826**	**60**	-
Inside the Shop	17	**Elbow - 4" 90 deg Standard radius**	**2.826**		0.51
	18	**Piping - Existing**	**2.826**	**2**	-
	19	**Reducer**	**2.826**		0.50
	20	**Piping - Existing**	**2.825**	**0.333333**	-
	21	**Increaser**	**2.826**		1.00
	22	**Piping - Existing**	**2.826**	**1.5**	-
	23	**Valve - 4" Ball/Cone**	**2.826**		0.05
	24	**Piping - Existing**	**2.826**	**1.5**	-
	25	**Tee - Branch to Main (inlet connection)**	**2.826**		1.20
		TOTAL		*606*	*8.51*

CDM

COMPUTER FILE and Location #: C:\Documents and Settings\schlebuschm\My Documents\CDM Work\GarveyElevator\OU1 RD\[Garvey OU1 Calcs Package

CLIENT: U.S. EPA Region 7
PROJECT: Garvey OU1 Interim Remedial Design

JOB #: 78218
CALC BY: R. Jim
CALC DATE: 7/12/2011

DETAIL: Minor Loss Calcs - Extraction Wells

OVERALL PROCEDURAL REVIEWED
BY: SAS **DATE:** 8/24/2011
DETAILED MATH & OTHER CHECKS BY:
BY: BJE **DATE:** 8/24/2011

ASSUMPTIONS:

1) The most conservative K-Values where choosen from Degremont, CDM Hydraulic Handbook, Sanks, and Cameron sources. (For example, if there where multiple K-values for the same type of fitting then the most conservative number was referenced on the K-Value Worksheet.)
2) See cover sheet assumptions

Flow Path	Station	Item Description	Pipe Diameter D in	Pipe Length L ft	Fitting K Value
Inside the EW vault	1	***Flow path is from EW-8 to manifold***			
	2	**Piping - Existing**	**2.826**	**2.3**	-
	3	**Valve - Swing Check**	**2.826**		2.50
	4	**Piping - Existing**	**2.826**	**142**	-
	5	**Elbow - 4" 90 deg Standard radius**	**2.826**		0.51
	6	**Piping - Existing**	**2.826**	**1**	-
	7	**Valve - Gate (double disc)**	**2.826**		0.20
	8	**Piping - Existing**	**2.826**	**1**	-
	9	**Elbow - 4" 90 deg Standard radius**	**2.826**		0.51
	10	**Piping - Existing**	**2.826**	**2**	-
	11	**Elbow - 4" 90 deg Standard radius**	**2.826**		0.51
EW to Shop	12	**Piping - Existing**	**2.826**	**10**	-
	13	**Elbow - 4" 90 deg Standard radius**	**2.826**		0.51
	14	**Piping - Existing**	**2.826**	**240**	-
	15	**Elbow - 4" 90 deg Standard radius**	**2.826**		0.51
	16	**Piping - Existing**	**2.826**	**440**	-
	17	**Elbow - 4" 90 deg Standard radius**	**2.826**		0.51
	18	**Piping - Existing**	**2.826**	**60**	-
Inside the Shop	19	**Elbow - 4" 90 deg Standard radius**	**2.826**		0.51
	20	**Piping - Existing**	**2.826**	**2**	-
	21	**Reducer**	**2.826**		0.50
	22	**Piping - Existing**	**2.825**	**0.333333**	-
	23	**Increaser**	**2.826**		1.00
	24	**Piping - Existing**	**2.826**	**1.5**	-
	25	**Valve - 4" Ball/Cone**	**2.826**		0.05
	26	**Piping - Existing**	**2.826**	**1.5**	-
	27	**Tee - Branch to Main (inlet connection)**	**2.826**		1.20
		TOTAL		*904*	*9.02*

C:\Documents and Settings\schlebuschm\My Documents\CDM Work\GarveyElevator\OU1

JOB #:

CLIENT:
PROJECT:
DETAIL: K-Values Reference

CALC BY:
CALC DATE:
OVERALL PROCEDURAL REVIEWED BY: N/A DATE:
DETAILED MATH & OTHER CHECKS BY: N/A DATE:

K VALUES FOR VALVES , FITTINGS AND MINOR LOSSES

Use this reference table to obtain K values for input into the TH Worksheet.

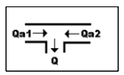
For use in this spreadsheet: numbers referenced for possible use are indicated in Green Highlight below (see K-Value Summary to the right)

For larger and more complicated pipe- see British Hydrodynamics

For smaller diameter - consider equivalent lengths

Other references noted if different than Original CDM spread sheet

(b) Sanks says to increase K by 5% for each 1" below 12" (say 30% at 6" daim)
expect k values to vary -20 to +30%

ITEM		K Values				Per Cameron Hyd Data (below 4" see handbook & consider using equivalent lengths instead of Ks)							
		Per R. Toland (original sprd sht)	Per CDM Hyd Manual (apndx F)	(b) Per Sanks Tbl B-6	Pipe Diameter [inches] 1	2	4	6	8 &10	12 to 16	18 to 24	All sizes
PIPE ENTRANCE & EXIT												
a.	**Flush entrance-sharp edged**	0.50		0.80								0.78
b.	**Inward Projection**	1.00										
c.	**Slightly rounded entrance**	0.25										
d.	**Bellmouth**	0.04	0.05									
e.	**Exit (all)**	1.00										
	Bellmouth		0.10									
TEES, CROSS, WYES & ELBOWS		Qm= main flow before branch										
a.	**Tees:** Branch Flow (Qa) / Main Flow (Qm)	*Main K*	*Branch K*									
	Run of Main 0 / 1	0.00	(0.6 or 1.0)*	0.30			0.34	0.30	0.28	0.26	0.24	
	* Branch to Main (inlet connection)											
	1 / 0	0.55	1.20									
	Q_a/Q 0.5 / 0.5	0.53	0.46									
	* Main to Branch (outlet connection)			0.75			1.02	0.9	0.84	0.78	0.72	
	1 / 0	0.40	1.45									
	Q_a/Q *0.5* / 0.5	0.10	1.09									
	* Symmetrical, converging flow	K_{r1}	K_{r2}									
	Q_{a1}/Q / Q_{a2}/Q											
	1 / 0	5.0	-1.00									
	0.5 / 0.5	1.25	1.25									
	$K_{r1} = 2 + 3\left[\left(\frac{Q_{a1}}{Q}\right)^2 - \frac{Q_{a2}}{Q}\right]$											
	$K_{r2} = 2 + 3\left[\left(\frac{Q_{a2}}{Q}\right)^2 - \frac{Q_{a1}}{Q}\right]$											
												
	**for more details on this see the Water Treatment Handbook (Degremont), 6th edition, Vol I Chptr 8*											
b.	**Cross (X)**											
	Straight Through			0.5								
	Branch Flow			0.75			(use same as Tee- thru branch)					
c.	**Wyes:**											
	Run of Main	0.6										
	Branch to Main (Obtuse)	1.0	0.45									
	Main to Branch (Obtuse)	1.2										
d.	**Elbows:**			(also has losses for rounded 90 degrees - based on r/d)								
	90 deg Standard radius	0.3	if d ≤ 10	0.25	0.69	0.57	0.51	0.45	0.42	0.39	0.36	
		greater than 10 in diam	0.2									
	90 deg Long radius	0.2	if d < 10	0.18	0.37	0.3	0.20	0.18	0.17	0.16	0.14	
		greater than 10 in diam	0.1									
	90 deg 2-pc mitered	1.1	1.27				1.02	0.90	0.84	0.78	0.79	
	90 deg 5-pc mitered (most common)	0.45										
	45 deg	0.15	0.1	0.18	0.37	0.3	0.27	0.24	0.22	0.21	0.19	
	22 1/2 deg	0.1	0.05									
	11 1/4 deg	*0.03* =estimate										
FLOW METERS **[Consult Instrumentation Engineer]**												
a.	**Magnetic (line size)**	0.0										
b.	**Venturi**	(Approx 5 to 10% of pressure differential)										
c.	**Orifice**	(Application dependent...See Instr. Engr)										
SLEEVE COUPLINGS		*Per Degremont Book*	*.02-.07*									
REDUCERS & INCREASERS												
a.	**Reducer**	0.5	*diff calc*									
	Gradual conical		0.1	0.03						(sudden)	0.5	
b.	**Increaser**	1.0	*diff calc*									
	Gradual conical			0.25								

(minor loss equals K* (Hv1-Hv2) and v1 is the higher velocity)

Conservative K-Value Summary Choices

K-Value Descriptions for Drop-down menus

		K-Value referenced in Green
1	Cross - Branch Flow	0.75
2	Cross - Straight Through	0.50
3	Elbow - 11 1/4 deg	0.03
4	Elbow - 12" to 16" 45 deg	0.21
5	Elbow - 12" to 16" 90 deg Long radius	0.16
6	Elbow - 12"to 16" 90 deg Standard radius	0.39
7	Elbow - 18" to 24" 45 deg	0.19
8	Elbow - 18" to 24" 90 deg Standard radius	0.36
9	Elbow - 18" to 24" deg Long radius	0.14
10	Elbow - 22 1/2 deg	0.10
11	Elbow - 1" 45 deg Standard radius	0.37
12	Elbow - 1" 90 deg Standard radius	0.69
13	Elbow - 1" 90 deg Long radius	0.37
14	Elbow - 2" 45 deg Standard radius	0.3
15	Elbow - 2" 90 deg Standard radius	0.57
16	Elbow - 2" 90 deg Long radius	0.3
17	Elbow - 4" 45 deg	0.27
18	Elbow - 4" 90 deg Long radius	0.20
19	Elbow - 4" 90 deg Standard radius	0.51
20	Elbow - 6" 45 deg	0.24
21	Elbow - 6" 90 deg Long radius	0.18
22	Elbow - 6" 90 deg Standard radius	0.45
23	Elbow - 8" & 10" 45 deg	0.22
24	Elbow - 8" & 10" 90 deg Long radius	0.17
25	Elbow - 8" & 10" 90 deg Standard radius	0.42
26	Elbow - 90 deg 2-pc mitered	1.27
27	Elbow - 90 deg 5-pc mitered (most common)	0.45
28	Entrance - Bellmouth	0.05
29	Entrance - Flush entrance-sharp edged	0.50
30	Entrance - Inward Projection	1.00
31	Entrance - Slightly rounded entrance	0.25
32	Exit - Bellmouth	0.10
33	Exit (all)	1.00
34	Flow meter - Magnetic	0.00
35	Flow meter - Orifice	(Application dependent...See Instr. Engr)
36	Flow meter - Venturi	(Approx 5 to 10% of pressure differential)
37	Increaser	1.00
	Nozzle	Assume 10 psi is the loss
32	Piping - Existing	-
33	Piping - New	-
34	Pressure Sensor	0.00
35	Reducer	0.50
36	Tee - 12" to 16" Run to Main	0.26
37	Tee - 18" to 24" Run to Main	0.24
38	Tee - 4" Run to Main	0.34
39	Tee - 6" Run to Main	0.30
40	Tee - 8" & 10" Run to Main	0.28
41	Tee - Branch to Main (inlet connection)	1.20
42	Tee - Main to Branch (outlet connection)	1.45
43	Tee - Symmetrical, converging flow	need calculation
44	Valve - 12" to 16" Angle	1.95
45	Valve - 12" to 16" Ball/Cone	0.04
46	Valve - 12" to 16" Butterfly	0.35
47	Valve - 12" to 16" Foot	1.00
48	Valve - 12" to 16" Gate	0.10
49	Valve - 12" to 16" Globe	4.40
50	Valve - 12" to 16" Tilting Disk	1.20
51	Valve - 150 lbs class Butterfly	0.35
52	Valve - 18" to 24" Angle	1.80
53	Valve - 18" to 24" Ball/Cone	0.04
54	Valve - 18" to 24" Butterfly	0.30
55	Valve - 18" to 24" Foot	0.90
56	Valve - 18" to 24" Gate	0.10
57	Valve - 18" to 24" Globe	4.10
58	Valve - 18" to 24" Tilting Disk	0.72
59	Valve - 25 lbs class Butterfly	0.16
60	Valve - 1" Ball/Cone	0.07
61	Valve - 2" Ball/Cone	0.06
62	Valve - 4" Angle	2.55
63	Valve - 4" Ball/Cone	0.05

C:\Documents and Settings\schlebuschm\My Documents\CDM Work\GarveyElevator\OU1

CLIENT: **JOB #:**
PROJECT: **CALC BY:**
DETAIL: K-Values Reference **CALC DATE:**
OVERALL PROCEDURAL REVIEWED
BY: N/A **DATE:**
DETAILED MATH & OTHER CHECKS BY:
BY: N/A **DATE:**

VALVES (use Cv for most accurate & control valves)

						Tbl B-7 (note: Sanks & Cameron Hyd have many other Valve types)							
a.	**Plug**			1.0	2.8(a)								
		eccentric type	rectangular (80%) opening- usally used			1							
			full bore opening		0	0.5							
b.	**Gate**			0.1					0.14	0.12	0.11	0.10	0.10	
			double disc	0.2		.1-.2								
			resilent seat			0.3								
	Knife Gate		metal seat			0.2								
			resilent seat			0.3								
c.	**Butterfly**			0.4	.3 to 1				0.77	0.68	0.63	0.35	0.3	
			25 lb class			0.16								
			75 lb class			0.27								
			150 lb class			0.35								
d.	**Angle**		(90 degree?)	2.0		1.8-2.9			2.55	2.25	2.1	1.95	1.8	
e.	**Globe**			12.0	5.5-6	4-6			5.80	5.10	4.8	4.4	4.1	
f.	**Ball/Cone**		line size	0.0		0.04	0.07	0.06	0.05	0.05	0.04	0.04	0.04	(appears this)
					2.8 (a)									
e.	**Check Valves:**													
	Swing			2.5	2-2.5 (add if spring)	0.6-2.2	2.3	1.9	1.70 (using L/D=100; min vel for disc lift=4.4 fps)	1.50	1.4	1.3	1.2	
	Tilting Disk			0.4	1.1	.25-2	-	-	2.00 (using 15 deg. Dis angle; min vel for disc lift=3.8 fps)	1.80	1.7	1.2	0.72	
f.	**Foot**	swing type	(w/strainer - size of holes???)		0.8	1-1.4			1.40	1.30	1.1	1	0.9	

(a)- K if valve diam is much less than pipe; if v diam = pipe K=0)

64	Valve - 4" Butterfly	0.77
65	Valve - 4" Foot	1.40
66	Valve - 4" Gate	0.14
67	Valve - 4" Globe	5.80
68	Valve - 4" Tilting Disk	2.00
69	Valve - 6" Angle	2.25
70	Valve - 6" Ball/Cone	0.05
71	Valve - 6" Butterfly	0.68
72	Valve - 6" Foot	1.30
73	Valve - 6" Gate	0.12
74	Valve - 6" Globe	5.10
75	Valve - 6" Tilting Disk	1.80
76	Valve - 75 lbs class Butterfly	0.27
77	Valve - 8" & 10" Angle	2.10
78	Valve - 8" & 10" Ball/Cone	0.04
79	Valve - 8" & 10" Butterfly	0.63
80	Valve - 8" & 10" Foot	1.10
81	Valve - 8" & 10" Globe	4.80
82	Valve - 8" & 10" Tilting Disk	1.70
83	Valve - 8"&10" Gate	0.11
84	Valve - Gate (double disc)	0.20
85	Valve - Gate (resilent seat)	0.30
86	Valve - Knife Gate (metal seat)	0.20
87	Valve - Knife Gate (resilent seat)	0.30
88	Valve - Plug	1.00
89	Valve - Swing Check	2.50
90	Wye - Branch to Main (Obtuse)	1.00
91	Wye - Main to Branch (Obtuse)	1.20
92	Wye - Run of Main	0.60

A.0 WATERCAD HYDRAULIC MODEL

A.1 MODEL CALIBRATION

Following incorporation of infrastructure data of the hydraulic model platform, the hydraulic model was calibrated to represent hydraulics under existing conditions. This process involves adjusting model input parameters, such as pump flow parameters and minor losses in the piping system to match the flow information observed during the flow monitoring period.

Recent pumping data (May 2011 through July 2011) were used to establish the current capacity of each pump at each respective extraction well. The results of the tests were used to set the operating flow rate for each pump in the model. A summary of the information utilized in the hydraulic model to describe the operation of each modeled pump is provided in Table A.1. For the pumps where adequate information was not provided an assumption was made for the pump curve. The hydraulic model is continually being updated as new information becomes available.

Table A.1 Recent Submersible Pump Data at Each Extraction Well

Pump	Pump Intake Elevation (feet)	Groundwater Elevation[3] (feet)	Design TDH (feet)	Average Flow Rate Setting for Past 3 mos.[2] (gpm)
RW-1	1811.01	1,813.36	245	6.0
RW-2	1808.02	1,809.87	245	8.0
RW-3	1810.34	1,810.74	245	7.5
RW-4	1807.22	1,809.60	245	12.0
RW-5[1]	1806.19	1,812.14	245	6.0
RW-6	1780.19	1,817.00	260	92
RW-7	1784.48	1,788.39	260	70
RW-8	1786.21	1,801.43	260	95

Notes:

1 Pump model information for the RW-5 pump was not provided in the report therefore the design flow rate was assumed according to recent flow rate data.

2 Pumping data at 10-minute intervals from 5/12/2011 through 8/12/2011.

3 Full system test on 4/31/11.

Pressure data was taken at the inlet and outlet of the influent bag filter and at two pressure gauges installed at well head RW-2 and RW-7. In the model, junctions were used to represent the inlet and outlet of the influent bag filter and an isolation valve to represent the ball valve at each well head. Overall, the pressure readings in the hydraulic model at these points were similar to those taken in the field (see Table A.2) showing that the model accurately represents the existing system. Consequently, the calibrated model was used to model the expanded GET system.

Table A.2 Pressure Field and Model Data Comparison

Point	Field Reading (psi)	Model Reading (psi)
Inlet to Influent Bag Filter	20.6	20.4
Outlet to Influent Bag Filter	20.7	19.7
RW-2 well head	20	22.2
RW-7 well head	23	25.2

CDM

CLIENT: U.S. EPA Region 7
PROJECT: Garvey OU1 Interim Remedial Design
DETAIL: Elevation Calcs

COMPUTER FILE and Location #: C:\Documents and Settings\schlebuschm\My Documents\CDM Work\GarveyElevator\OU1 RD\[Garvey OU1 Calcs Package 092011.xlsx]MagFlowMeter
JOB #: 78218
CALC BY: R. Jim
CALC DATE: 7/12/2011
OVERALL PROCEDURAL REVIEWED
BY: SAS **DATE:** 8/24/2011
DETAILED MATH & OTHER CHECKS BY:
BY: BJE **DATE:** 8/24/2011

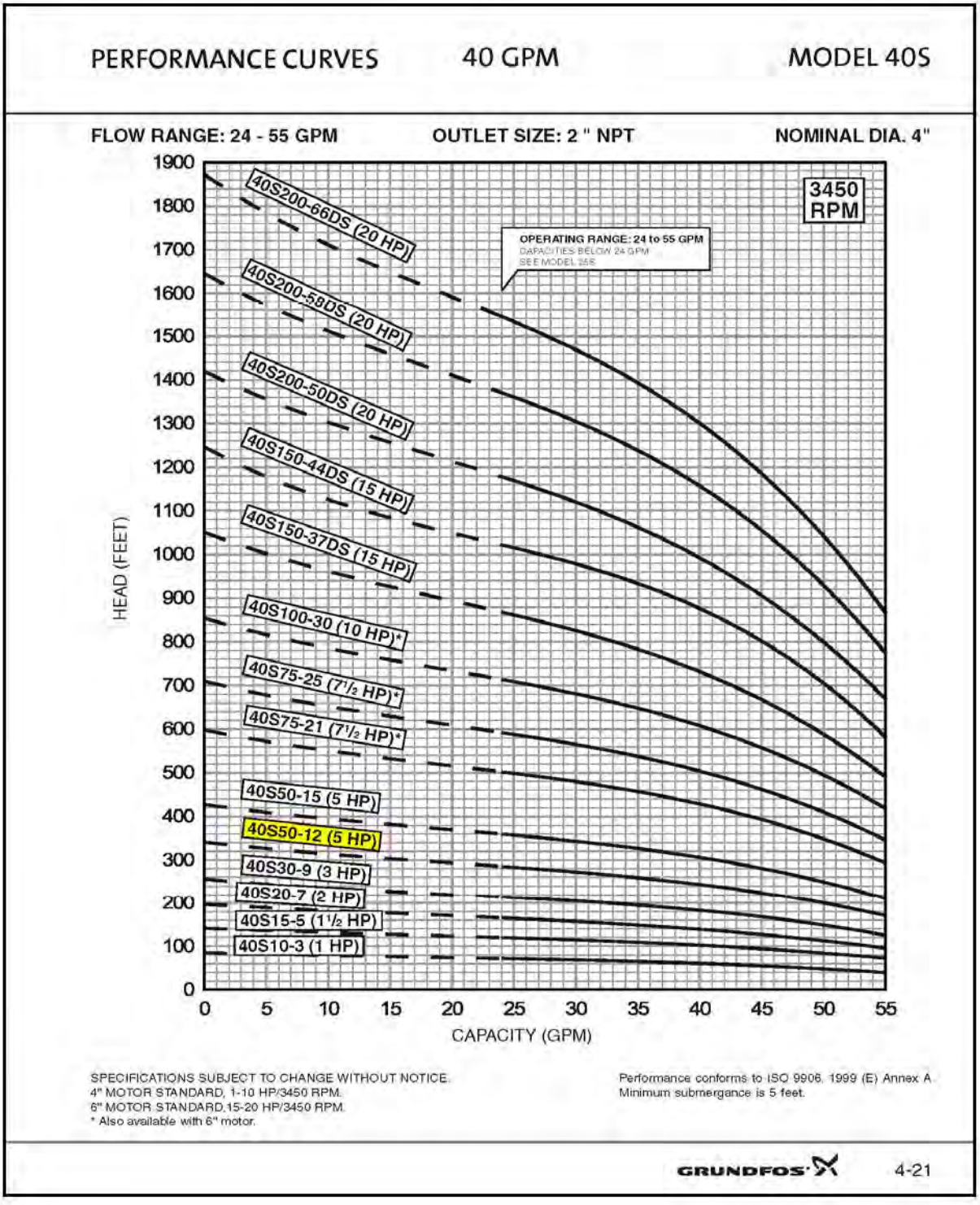
ASSUMPTIONS:

1) See cover sheet assumptions

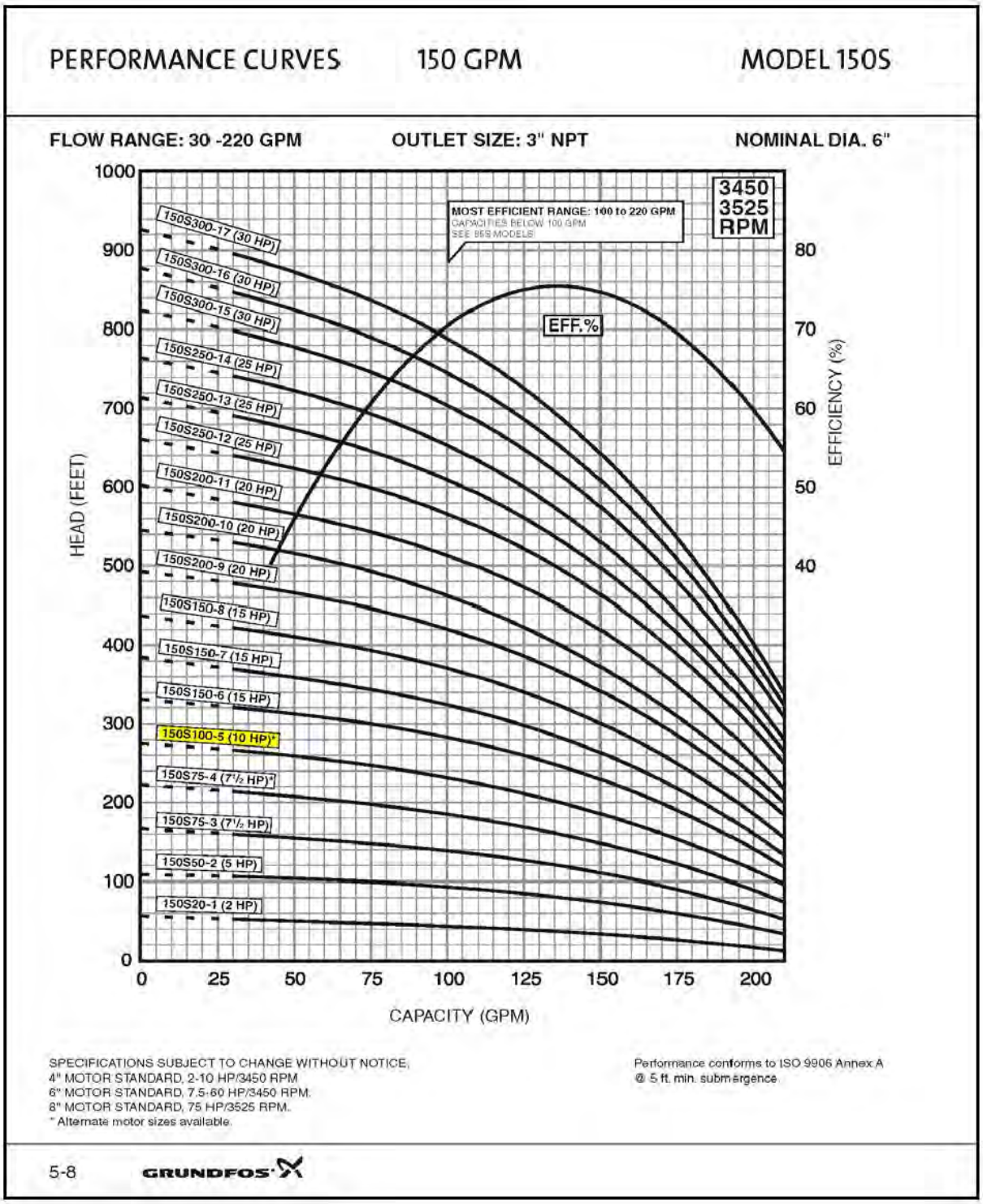
Well No.	TOC Elev.	Total Depth of Well (TOC)	Total Depth of Well (TOC) Elev.	Water Depth (TOC)	Water Depth (TOC) Elev.	Pump Intake	Pump Intake Elev.	Check Valve	Check Valve Elev (TOC)	Gate Valve Elev (TOC)	Vertical Distance between CV and GV	Ball Valve Elev	BFV Elev	Groundwater Setpoint (TOC)	Groundwater Elev. Setpoint	Flow (gpm) - Full System Test 04/31/11	WSE (ft) - Full System Test 04/31/12	GES Operating Data (5/12 to 8/12 2011) Avg Flow Rate (gpm)
RW-1	1932.01	125	1807.01	111	1821.01	121	1811.01	118.69	1813.32	1930.51	117	1933.5	n/a	118.01	1814	0.016	1813.358	6.0
RW-2	1930.02	126	1804.02	108	1822.02	122	1808.02	119.69	1810.33	1928.52	118	1933.5	n/a	119.02	1811	0.640	1809.869	8.0
RW-3	1930.34	124	1806.34	107	1823.34	120	1810.34	117.69	1812.65	1928.84	116	1933.5	n/a	117.34	1813	3.190	1810.738	7.5
RW-4	1929.22	126	1803.22	107	1822.22	122	1807.22	119.69	1809.53	1927.72	118	1933.5	n/a	119.22	1810	15.852	1809.599	12.0
RW-5	1932.69	129	1803.69	109	1823.69	126.5	1806.19	125.38	1807.32	1931.19	124	1933.5	n/a	119.69	1813	7.158	1812.137	6.0
RW-6	1930.77	153.4	1777.37	110	1820.77	150.58	1780.19	148.17	1782.60	1929.27	147	1933.5	n/a	113.77	1817	90.411	1778.910	92.0
RW-7	1931.98	152.3	1779.68	111	1820.98	147.5	1784.48	145.09	1786.89	1930.48	144	1933.5	n/a	124.98	1807	88.444	1788.388	70.0
RW-8	1932.21	152	1780.21	112	1820.21	146	1786.21	143.59	1788.62	1930.71	142	1933.5	n/a	119.21	1813	102.293	1801.432	95.0
I-1	1927.64	225	1702.64	103	1824.64	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1923.81	n/a	n/a	n/a	n/a	n/a
I-2	1927.40	225	1702.4	101	1826.4	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1923.57	n/a	n/a	n/a	n/a	n/a
Header to Influent BF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1930.92	n/a	n/a	n/a	n/a	n/a
Influent BF to Air Stripper	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1930.92	n/a	n/a	n/a	1930.92	n/a	n/a	n/a	n/a	n/a

Evaluation Point	Floor Elev.	Height from Floor (ft)	Inlet Elev.
Sump	1930	0.52	1930.52
RW-X to Header Tee	1930	5.00	1935.00
Discharge Pump	1930	0.62	1930.62
Influent Bag Filter	1930	4.18	1934.18
Effluent Bag Filter	1930	4.18	1934.18
Air Stripper	1930.62	44.67	1975.29

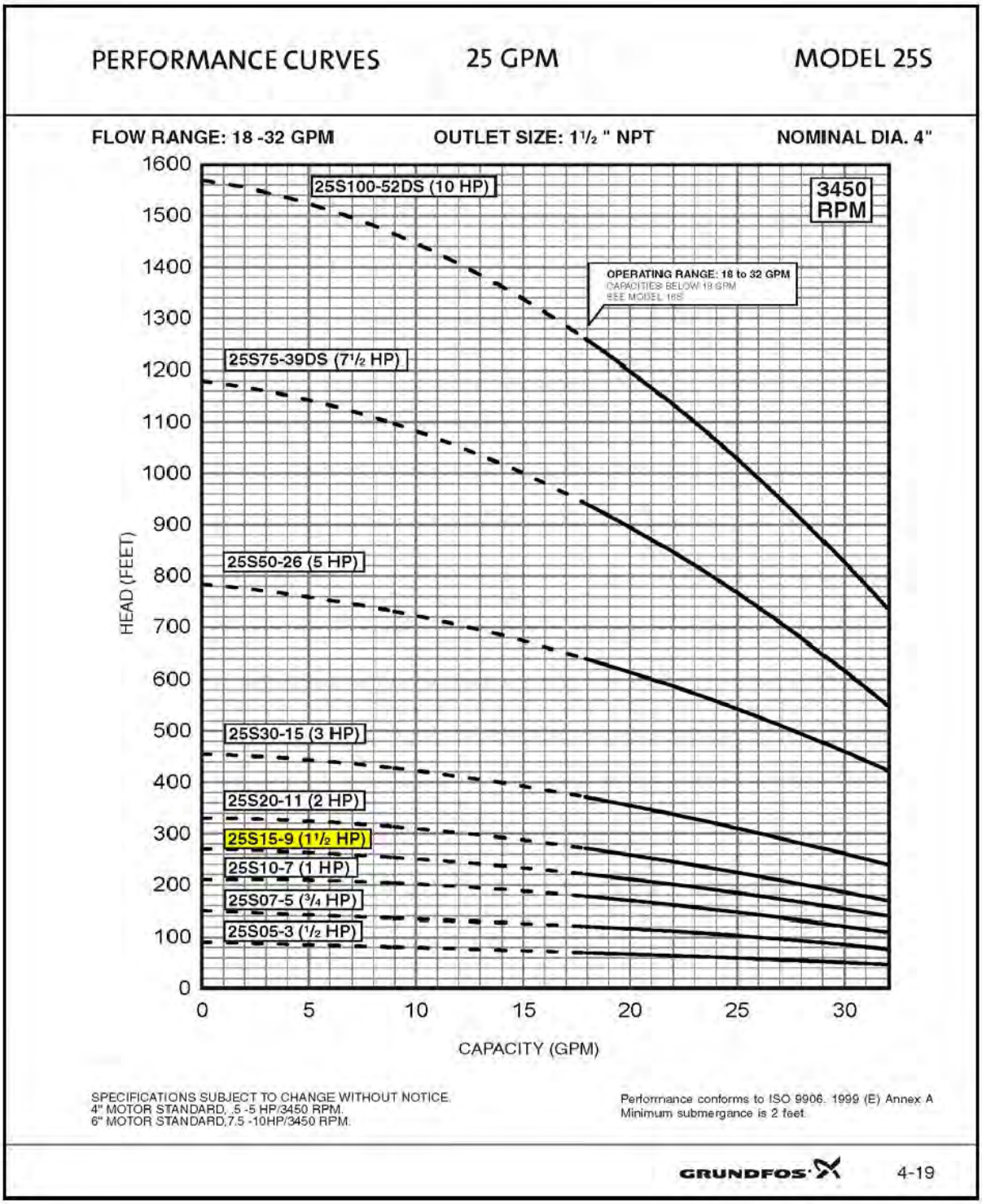
Pump curve for existing extraction wells: RW-1, RW-2, RW-3, RW-4
Existing pump model is highlighted in the diagram below.



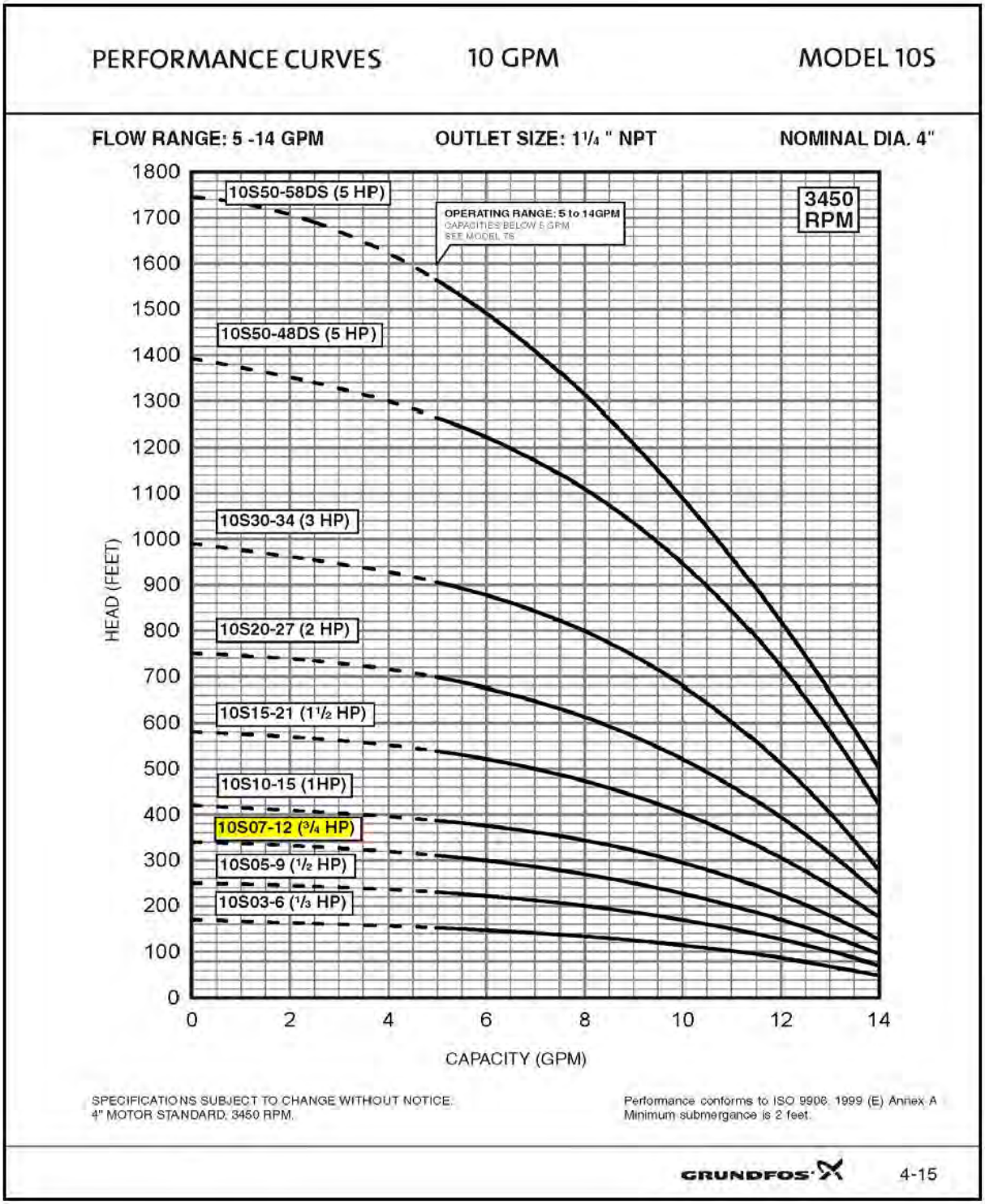
Pump curve for existing extraction wells: RW-6, RW-7, RW-8
Existing pump model is highlighted in the diagram below.



Pump curve for existing extraction wells: RW-5
Assumed pump model is highlighted in the diagram below.



Pump curve for proposed extraction wells: RW-1, RW-2, RW-3, RW-4
Pump model is highlighted in the diagram below.



CDM

COMPUTER FILE and Location #: C:\Documents and Settings\schlebuschm\My Documents\CDM Work\GarveyElevator\OU1 RD\[Garvey OU1 Calcs

CLIENT: U.S. EPA Region 7
PROJECT: Garvey OU1 Interim Remedial Design
DETAIL: WaterCad Results

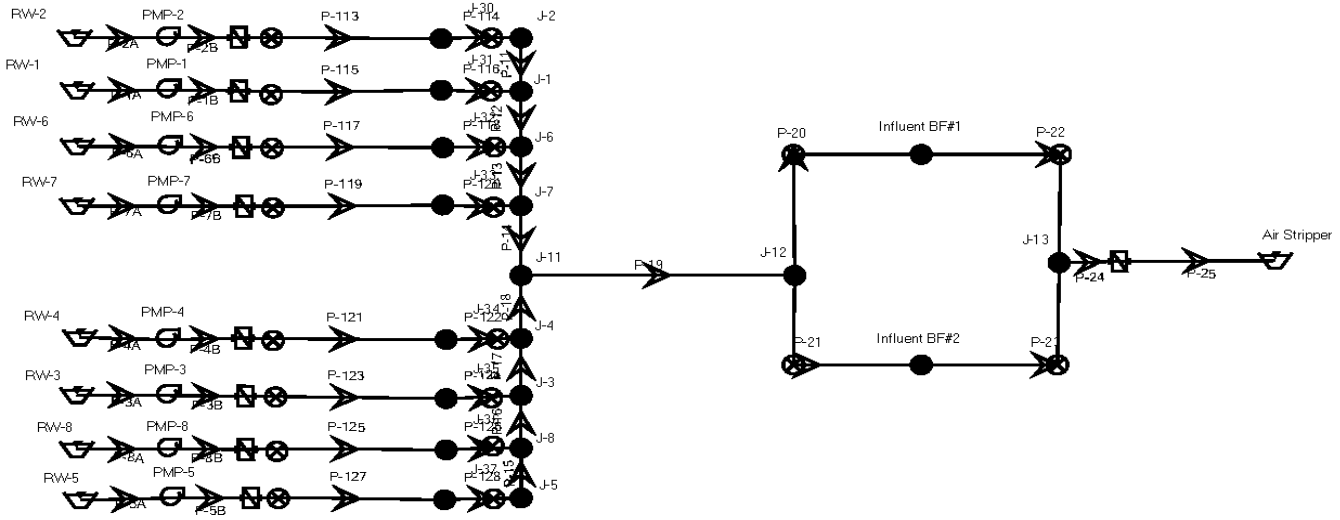
JOB #: 78218
CALC BY: R. Jim
CALC DATE: 7/12/2011
OVERALL PROCEDURAL REVIEWED BY: SAS **DATE:** 8/24/2011
DETAILED MATH & OTHER CHECKS BY: BJE **DATE:** 8/24/2011

ASSUMPTIONS:

1) See cover sheet assumptions

			C=120			C=130			C=140			C=150		
Id	Label	Elevation (ft)	Flow (gpm)	Hydraulic Grade (ft)	Pump Head (ft)	Flow (gpm)	Hydraulic Grade (ft)	Pump Head (ft)	Flow (gpm)	Hydraulic Grade (ft)	Pump Head (ft)	Flow (gpm)	Hydraulic Grade (ft)	Pump Head (ft)
236	Air Stripper	1,975.29	-296.04	1,975.29	-	-296.07	1,975.29	-	-296.1	1,975.29	-	-296.12	1,975.29	-
89	RW-1	1,813.36	6	1,813.36	167.23	6	1,813.36	166.93	6	1,813.36	166.69	6	1,813.36	166.5
87	RW-2	1,809.87	8	1,809.87	171.11	8	1,809.87	170.77	8	1,809.87	170.49	8	1,809.87	170.26
97	RW-3	1,810.74	7.5	1,810.74	170.15	7.5	1,810.74	169.82	7.5	1,810.74	169.55	7.5	1,810.74	169.33
95	RW-4	1,809.60	11.56	1,809.60	175.65	11.59	1,809.60	174.76	11.61	1,809.60	174.04	11.63	1,809.60	173.45
101	RW-5	1,812.14	6	1,812.14	167.18	6	1,812.14	167.05	6	1,812.14	166.96	6	1,812.14	166.88
91	RW-6	1,817.00	92	1,817.00	198.08	92	1,817.00	193.46	92	1,817.00	189.75	92	1,817.00	186.73
93	RW-7	1,788.39	70	1,788.39	206.78	70	1,788.39	204.69	70	1,788.39	203.02	70	1,788.39	201.66
99	RW-8	1,801.43	95	1,801.43	219.44	95	1,801.43	214.04	95	1,801.43	209.71	95	1,801.43	206.17

WaterCad Hydraulic Model Schematic:



CDM

COMPUTER FILE and Location #: C:\Documents and Settings\schlebuschm\My Documents\CDM Work\GarveyElevator\OU1 RD\[Garvey OU1 Calcs Package

CLIENT: U.S. EPA Region 7
PROJECT: Garvey OU1 Interim Remedial Design
DETAIL: Magnetic Flow Meter

JOB #: 78218
CALC BY: S. Lindell
CALC DATE: 9/13/2011
OVERALL PROCEDURAL REVIEWED BY: MS **DATE:** 9/15/2011
DETAILED MATH & OTHER CHECKS BY: MS **DATE:** 9/15/2011

Well	Flow Rate (GPM)		Flow Rate (CFS)		pipe size (in.)	pipe area (sq ft)	Velocity (ft/sec)	
	Min	Max	Min	Max			Min	Max
1	6	12	0.0134	0.0267	1	0.0055	2.452	4.905
2	6	12	0.0134	0.0267	1	0.0055	2.452	4.905
3	6	12	0.0134	0.0267	1	0.0055	2.452	4.905
4	6	12	0.0134	0.0267	1	0.0055	2.452	4.905
5	6	12	0.0134	0.0267	1	0.0055	2.452	4.905
6	70	90	0.1560	0.2005	3	0.0491	3.179	4.087
7	70	90	0.1560	0.2005	3	0.0491	3.179	4.087
8	70	90	0.1560	0.2005	3	0.0491	3.179	4.087

1.0 ft/sec mag meter lower range limit
30 ft/sec mag meter upper range limit

Appendix B

Specifications

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SPECIFICATIONS

Section No. ***Title***

Division 0 – Bid Requirements

Division 0 specifications are not included with this submittal. Division 0 consists of contract language specifications. These specifications will be included in the bid package.

Division 1 – General Requirements

01010	Summary of Work
01460	Spill Control
01490	Environmental Protection
01720	Project Record Documents
01770	Project Closeout

Division 2 - Site Work

02100	Site Preparation

Division 13 – Special Construction

13300	Instrumentation and Controls – General Provisions

Division 15 – Mechanical

15055	Process Piping, Valves and Appurtenances

Division 16 – Electrical

16000	Electrical – General Provisions
16110	Raceways, Boxes, Fittings and Supports
16120	Wires and Cables (600 Volt Maximum)
16141	Wiring Devices
16191	Miscellaneous Equipment
16471	Panelboard Modifications
16859	Electrical Heat Trace System

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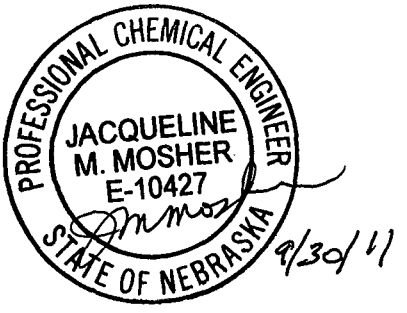
I hereby certify that the Technical Specifications contained herein and that the attached Drawings prepared as part of the Bidding Documents for the Operable Unit 1 Interim Remedial Design, Garvey Elevator Superfund Site, Hastings, Nebraska were prepared by me or under my direct supervision. I am a duly registered Engineer under the laws of the State of Nebraska.

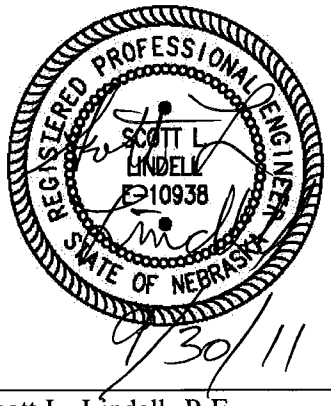


Jacqueline M. Mosher, P.E.
September 2011

I hereby certify that the Technical Specifications contained herein and that the attached Drawings prepared as part of the Bidding Documents for the Operable Unit 1 Interim Remedial Design, Garvey Elevator Superfund Site, Hastings, Nebraska were prepared by me or under my direct supervision. I am a duly registered Engineer under the laws of the State of Nebraska.

Vincent J. Plansky, P.E.
September 2011

I hereby certify that the Technical Specifications contained herein and that the attached Drawings prepared as part of the Bidding Documents for the Operable Unit 1 Interim Remedial Design, Garvey Elevator Superfund Site, Hastings, Nebraska were prepared by me or under my direct supervision. I am a duly registered Engineer under the laws of the State of Nebraska.



Scott L. Lindell, P.E.
September 2011

Division 1

General Requirements

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SECTION 01010

SUMMARY OF WORK

PART 1 – GENERAL

1.1 DEFINITIONS

Contract - The Contract is the executed agreement between the Contractor and Government.

Contractor - The Contractor is the General Contractor and its subcontractors performing the work described herein and within the Specifications and the Contract Drawings for the U. S. Environmental Protection Agency (EPA) under this Contract.

Contracting Officer (CO) - The EPA Representative for contract administration.

Contracting Officer's Representative (COR) - The EPA Representative for field oversight.

Government - The Government, for purposes of the work herein, is the EPA Region 7.

Project Officer (PO) - The EPA Representative for project management and the technical aspects of the project.

1.2 SITE LOCATION AND DESCRIPTION

The former Garvey Elevators, Inc. grain storage facility is located southwest and outside of the limits of the city of Hastings in Adams County, Nebraska. The facility is located on a 22-acre portion of the 106-acre site property where fumigant was stored and used. The grain storage facility is an active 8-million bushel capacity grain elevator currently owned and operated by Ag Products, Incorporated (AGP).

The Site includes the former Garvey Elevators, Inc. property and downgradient areas underlain by the contaminated groundwater plume that originates from the grain storage facility. EPA has designated OU 1 as the area of soil and groundwater contamination on and immediately off the former Garvey Elevators, Inc. property. OU 2 is defined as contaminated groundwater farther downgradient from the grain storage facility that extends approximately 4.3 miles to the east. The known contaminants of concern (COCs) at the Site are carbon tetrachloride (CCl_4) and chloroform ($CHCl_3$).

A soil vapor extraction (SVE) system and a groundwater extraction system (GET) system were installed in 1998 and are currently operating at the site. The SVE system consists of eight vapor extraction wells, liquid knock-out tanks, and blowers. The GET system consists of eight groundwater recovery wells, an air stripper and two injection wells that return treated water to the aquifer.

A focused feasibility study (FFS) was prepared to support an early action for OU 1 to mitigate an ongoing source to groundwater contamination and provide containment of contaminated groundwater. The FFS and information from the Interim Data Summary Report were used by EPA as a basis for selecting a remedy to mitigate certain threats to human health and the environment posed by the contaminated soil and groundwater beneath the source area at the site. EPA issued an interim Record of Decision (ROD) for the Garvey Elevator OU 1 Superfund Site approved June 30, 2010. The interim ROD for OU 1 addresses contaminated soil and groundwater beneath the grain storage facility.

1.3 BASIS OF DESIGN

This interim remedial design (RD) includes the following elements:

- Replacement of existing flow meters with magnetic flow meters
- Replacement of GET system header piping
- Replacement of the pressure transducer in IW-02.
- Minor upgrades to electrical infrastructure
- Integration of magnetic flow meters and IW-02 pressure transducer to the programmable logic controller (PLC) and an update of PLC programming for system operation

1.4 WORK COVERED BY CONTRACT DOCUMENTS

The work specified by the Contract Documents (Performance Work Statement, Quality Assurance Surveillance Plan, Specifications and Contract Drawings) shall include, but is not limited to: replacement of process piping header and flow meters, minor upgrades to electrical infrastructure, integration of flow meters to the PLC, and updating PLC programming. Refer to the Performance Work Statement for additional information.

1.5 NOT USED

1.6 CODES AND STANDARDS

Codes and Standards that may apply to the project work include:

- American Association of State Highway and Transportation Officials (AASHTO) Standards
- American National Standards Institute (ANSI) Standards
- ASTM International (ASTM) Standards
- American Water Works Association (AWWA) Standards
- Code of Federal Regulations (CFR)
- U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Standards
- Nebraska Department of Transportation (NDOT) Standards
- Nebraska Department of Environmental Quality (NDEQ) Standards
- U.S. Environmental Protection Agency (EPA) Standards
- U.S. Department of Agriculture (USDA) Standards
- U.S. Department of Transportation (DOT)
- State of Nebraska and Adams County Codes and Standards

1.7 LIST OF CONTRACT DRAWINGS

The Contract Drawings include the following:

Sheet No.	Drawing
C-01	Cover Sheet
C-02	General Site Plan, Notes, and Legend
C-03	Treatment Room Layout
P-01	Process Flow Diagram
E-01	Electrical Symbols, Abbreviations, and General Notes I
E-02	Electrical Symbols, Abbreviations, and General Notes II
E-03	Electrical Site Plan
E-04	Treatment Building Electrical Room Plan, Details, and Riser Diagrams

E-05 Recovery Well Site Electrical Existing and Modification Plan
EZ-01 Electrical Details
I-01 General Notes and Legend
I-02 Instrument Mounting Details
I-03 Groundwater Recovery Wells
I-04 Groundwater Treatment System

1.8 EXISTING CONDITIONS

1.8.1 The Contractor shall examine the site for the proposed work prior to submitting a bid, and ascertain that the location, size and depth of surface structures, including roadway and permanent/temporary structures, landscaping and utilities, as shown on the Contract Drawings and described herein, represent the actual conditions.

1.8.2 The Contractor shall immediately report any discrepancies between the details shown on the Contract Drawings and the actual field conditions or any omissions to the Contract Drawings and/or other documents to the COR and/or the PO.

1.9 SITE INSPECTION DURING BIDDING

1.9.1 The Contractor shall inspect the site and note all existing conditions and make note of the arrangements needed for access during construction, traffic control, maintenance of supplies and interference with existing utilities.

1.9.2 The Contractor shall obtain clarification from the CO, COR, and/or PO when the meaning of the Contract Drawings and the Specifications are in doubt, prior to submitting the bid.

1.9.3 After submission of the bid, no claim will be considered on the grounds that there was any misunderstanding with respect to the conditions imposed by the Contract Documents.

1.9.4 Verbal conversation or agreement made at any time with an agency or employee of the Government or the CO, COR, and/or PO shall not affect or modify any of the terms or obligations under the Contract.

1.10 DIRECTION OF THE WORK

1.10.1 The CO, COR, and/or PO will not be responsible for the Contractor's means, methods, techniques, sequences or procedures of construction, or for the supervision of the Contractor's performance of this Contract, or for the failure to perform the Work in accordance with the Contract. However, if at any time the CO, COR, and/or PO is of the opinion that the number of workmen, pieces of equipment; or quality of machinery, tools, plant, and equipment or articles is inefficient or insufficient to meet the schedule; the CO, COR, and/or PO may so advise the Contractor. The Contractor shall promptly make the necessary changes to ensure that the schedule is adhered to.

1.10.2 Pursuant to the provisions of the General Conditions of the Contract, while it is intended that the Contractor shall be allowed in general to carry out the Contract in such a manner that may appear to be the most desirable, the CO, COR, and/or PO may direct the order in which the work shall be undertaken. This control shall be exercised in the interest of the Government and it is intended that an agreement be reached between all parties prior to the commencement of the Contract.

1.11 SECURITY

1.11.1 Neither the Government, nor the CO, COR, or PO will be responsible for any loss or damage to property of the Contractor. The Contractor shall furnish any additional security measures as deemed necessary for the duration of the project.

1.12 CONTRACTOR'S USE OF PREMISES

1.12.1 The Contractor shall limit onsite operations to necessary portions of the project boundaries.

1.12.2 Other areas are not to be used by the Contractor unless approved by COR and/or PO.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 EXAMINATION OF THE SITE

The Contractor shall familiarize himself with the site, surface, subsurface, and groundwater conditions at the site. No Contract adjustment will be made because of the failure of the Contractor to review and understand all existing site data.

3.2 HEALTH AND SAFETY PROTECTION

U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) regulations (29 Code of Federal Regulations [CFR] 1910.120) specify worker health and safety protection requirements applicable to work at the site. Contractor shall conduct work in strict accordance with the Site Safety and Health Plan (SSHP) prepared by the Contractor to meet applicable OSHA regulations.

3.3 CONTRACTOR QUALITY ASSURANCE/QUALITY CONTROL

Quality workmanship and performance are essential in this project. Contractor shall also fully support and cooperate with all EPA Representatives in the implementation of the overall project quality control. The Contractor will be required to furnish documentation of materials supplied to the project, calibration of measuring equipment used, as-built items, and similar equipment items.

3.4 EXECUTION OF WORK

The Contractor shall complete all work in accordance with the Performance Work Statement, Quality Surveillance Plan, Contract Drawings and the Specifications.

END OF SECTION

SECTION 01460

SPILL CONTROL

PART 1 – GENERAL

1.1 SCOPE OF WORK

1.1.1 Develop, implement, maintain, supervise, and be responsible for comprehensive spill control procedures. This information shall be included in the Spill and Discharge Control Plan. The Spill and Discharge Control Plan shall provide contingency measures for potential release of contaminated soil and debris, contents of drums, stormwater run-off, and any other potentially contaminated and/or hazardous materials. In the event of a spill, the Contractor shall be required to follow the procedures established in the Spill and Discharge Control Plan.

1.1.2 Provide equipment and personnel to perform emergency measures required to contain any spillages and to remove spilled materials and soils or liquids that become contaminated due to spillage. The collected spill material shall be properly disposed of at the Contractor's expense. This includes spillage during fueling of equipment caused by Contractor operations.

1.2 SUBMITTALS

The Contractor shall submit the following in accordance with the Performance Work Statement.

1.2.1 Spill and Discharge Control Plan

The Spill and Discharge Control Plan shall be implemented in the event of an accidental release of potentially hazardous materials. The Spill and Discharge Control Plan shall contain the following elements:

a. Preventive Measures: The Contractor shall provide methods, means, and facilities required to prevent contamination of soil, water, atmosphere, uncontaminated structures, equipment, or material by the discharge of wastes from spills due to the Contractor's operations. Shovels, brooms, non-combustible absorbent materials, polyethylene sheeting, and PPE shall be maintained in accessible locations.

b. Emergency Measures: The Contractor shall provide equipment and personnel to perform emergency measures required to contain any spillage and to remove spilled materials, soils, or liquids that become contaminated due to spillage. This collected spill material shall be properly disposed of at the Contractor's expense.

c. Decontamination Measures: The Contractor shall provide the equipment and personnel to perform decontamination measures that may be required to remove spillage from previously uncontaminated structures, equipment, or material. Confirmation sampling following remediation will be required by the Contractor. Two samples from the affected area shall be collected and analyzed for the spilled contaminants of concern. The results shall be compared to a third background sample collected from an unaffected area of the spill. Disposal of decontamination residues and confirmation samples shall be performed at the Contractor's expense.

d. Notification Procedures: The Contractor shall notify the EPA Field Representative and Project Officer immediately after the release of potentially hazardous materials. Petroleum releases greater than 25 gallons shall also be reported. The Contractor shall notify the following agencies:

Nebraska Department of Environmental Quality (NDEQ)
1200 N Street, Suite 400
P.O. Box 98922
Lincoln, Nebraska 68509
877-253-2603 (Monday through Friday, 8 AM to 5 PM)
402-471-4545 (After hours, weekends, and holidays)

Adams County Emergency Management
1313 North Hastings
Hastings, Nebraska 68901
Phone: 402-461-2360
Fax: 402-461-2367

United States Environmental Protection Agency (EPA) - Region 7 Spill Line
913-281-0991 (24-hour), 913-551-7003 (non-emergency)

National Spill Response Center (NRC)
800-424-8802

The following information shall be reported, at a minimum, with each spill:

- The material spilled
- When the spill occurred
- The location of the spill
- The quantity spilled
- Any measures taken to remediate the spill
- The reporter's name and contact information

PART 2 – PRODUCTS

2.1 MATERIALS

2.1.1 Provide methods, means and facilities required to prevent contamination of soil, water, air, structures, equipment, or material by spills from the Contractor's operations.

2.1.2 Provide for the control of any unexpected spills as required by the Contractor's Spill and Discharge Control Plan.

PART 3 – EXECUTION

3.1 SPILL CONTROL

3.1.1 If a spill occurs, the Contractor shall:

3.1.1.1. Notify the Contracting Officer's Representative (COR) and/or the Project Officer (PO) immediately. The Contractor shall also notify NDEQ and EPA of the spill through the contact numbers in Paragraph 1.2.1.

3.1.1.2. Take immediate measures to control, contain, and remediate the spill within the work area boundaries such that levels of contamination are similar to the levels that were present before the spill.

3.2 NOTIFICATION OF SPILLS

3.2.1 If the spill or discharge is reportable, and/or human health or the environment are threatened, the Contractor shall immediately implement spill control measures as required by the Contractor's Environmental Protection Plan and the Contractor's Spill and Discharge Control Plan.

3.3 DECONTAMINATION PROCEDURES

3.3.1 Decontamination procedures may be required after cleanup to eliminate traces of the substance spilled or reduce it to an acceptable level subject to review by the COR and/or PO. The Contractor shall provide equipment and personnel to perform decontamination measures.

3.3.2. Personnel decontamination should be completed as soon as possible and in accordance with the Contractor's Environmental Protection Plan and the Contractor's Spill and Discharge Control Plan.

3.4 SPILL REPORT

3.4.1 Submit a notification form after each spill, which shall be outlined in the Spill and Discharge Control Plan discussed in Paragraph 1.2.1.

END OF SECTION

SECTION 01490

ENVIRONMENTAL PROTECTION

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

The Contractor shall perform the work minimizing environmental pollution and damage as the result of construction operations. Environmental pollution and damage is the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the utility of the environment for aesthetic, cultural and/or historical purposes. The control of environmental pollution and damage requires consideration of land, water, and air, and includes management of visual aesthetics, noise, solid waste, as well as other pollutants. The environmental resources within the project boundaries and those affected outside the limits of permanent work as defined on the Contract Drawings shall be protected during the entire duration of this Contract. The Contractor shall ensure compliance with this section by subcontractors.

1.1.1 Submittals

The Contractor shall submit the following in accordance with the Performance Work Statement.

1.1.1.1 Environmental Protection Plan

The Environmental Protection Plan shall include, but shall not be limited to, the following:

- Pertinent regulations (federal, state, and local)
- Protection of natural resources
- Protection of historical, archaeological, and cultural resources
- Control and disposal of solid and sanitary wastes
- Control and disposal of petroleum products
- Methods of reducing noise and dust pollution during construction activities

1.2 LAND RESOURCES

The Contractor shall confine all activities to areas defined by the Contract Drawings and Specifications. Prior to the beginning of any construction, the Contractor shall identify the land resources to be preserved within the work areas. Except in areas indicated on the Contract Drawings or specified to be cleared, the Contractor shall not remove, cut, deface, injure, or destroy land resources including crops, grasses, topsoil, and land forms without permission. Where such emergency use is permitted, the Contractor shall provide effective protection for land and vegetation resources at all times as defined in the following subparagraphs of this Specification Section. Stone, earth or other material displaced into uncleared areas shall be removed.

1.2.1 Work Area Limits

Prior to any construction, the Contractor shall mark the areas that need not be disturbed under this contract. Isolated areas within the general work area which are to be saved and protected shall also be marked or fenced. Monuments and markers shall be protected before construction operations commence. Where construction operations are to be conducted during darkness, the markers shall be visible. The

Contractor's personnel shall be knowledgeable of the purpose for marking and/or protecting particular objects.

1.2.2 Contractor Facilities and Work Areas

The Contractor's field offices, staging areas, and temporary buildings shall be placed within the work areas shown on the Contract Drawings unless otherwise approved by the Contracting Officer's Representative (COR) and/or Project Officer (PO). Borrow areas shall be managed to minimize erosion and to prevent sediment from entering nearby waters. Spoil areas shall be managed and controlled to limit spoil intrusion into undisturbed areas and to prevent erosion of soil or sediment from entering nearby waters.

1.3 WATER RESOURCES

The Contractor shall keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters. Surveillance of water areas affected by construction shall be the Contractor's responsibility. All water areas affected by construction activities shall be monitored by the Contractor.

1.4 AIR RESOURCES

Equipment operation and activities or processes performed by the Contractor in accomplishing the specified construction shall be in accordance with applicable emission and performance laws and standards. Ambient Air Quality Standards set by the U.S. Environmental Protection Agency shall be maintained. Monitoring of air quality shall be the Contractor's responsibility. All air areas affected by the construction activities shall be monitored by the Contractor as described in the Site Safety and Health Plan (SSHP) prepared in accordance with the Performance Work Statement.

1.4.1 Dust Control

Dust particles, aerosols and gaseous by-products from construction activities shall be controlled at all times, including weekends, holidays and hours when work is not in progress. The Contractor shall maintain excavations, haul routes, permanent and temporary access roads, and other work areas within or outside the project boundaries free from particulates which would cause the ambient air quality standards to be exceeded or which would cause a hazard or a nuisance. Water spray, to be efficient, must be repeated to keep the disturbed area damp at all times. The Contractor must have sufficient, suitable equipment available to accomplish these tasks. Particulate control shall be performed as the work proceeds and whenever a particulate nuisance or hazard occurs. Dust levels shall be monitored by the Contractor in accordance with the SSHP. At a minimum, air shall be monitored for fugitive dusts using appropriate dust monitoring equipment.

1.4.2 Noise Control

The Contractor shall keep construction activities under surveillance and control to minimize environment damage by noise. Contractor shall coordinate work hours with the facility operator.

All equipment shall be well-maintained and equipped with muffler systems that effectively control engine noise.

1.5 WASTE DISPOSAL

1.5.1 Solid Wastes

Solid wastes shall be placed in containers which are emptied on a regular schedule. Handling and disposal shall be conducted to prevent contamination. Segregation measures shall be employed so that no hazardous or toxic waste will become co-mingled with solid waste. Solid waste shall be disposed in accordance with state and local laws and regulations. Containers shall be kept closed with a weather-tight lid when not loading or removing wastes.

1.5.2 Chemical Wastes

Chemicals, fuels, and oil shall be dispensed ensuring no spillage to ground or water. Periodic inspections of dispensing areas to identify leakage and initiate corrective action shall be performed and documented. Wastes shall be disposed of in accordance with Federal, state, and local laws and regulations.

1.6 HISTORICAL, ARCHEOLOGICAL, AND CULTURAL RESOURCES

No existing historical, archeological, and cultural resources within the Contractor's work areas have been identified.

1.7 POST CONSTRUCTION CLEANUP

The Contractor shall clean up all areas used for construction and restore them to pre-construction conditions.

1.8 RESTORATION OF LANDSCAPE DAMAGE

The Contractor shall restore landscape features damaged or destroyed during construction operations outside the limits of the approved work areas.

1.9 TRAINING OF CONTRACTOR PERSONNEL

The Contractor's personnel shall be trained in all phases of environmental protection, as required by the Performance Work Statement and contract documents. The training shall include methods of detecting and avoiding pollution, familiarization with pollution standards, both statutory and contractual, and installation and care of devices, vegetative covers, and instruments required for monitoring purposes to ensure adequate and continuous environmental pollution control.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01720

PROJECT RECORD DOCUMENTS

PART 1 – GENERAL

1.1 SCOPE OF WORK

1.1.1 In addition to the documents required in the Performance Work Statement, the Contractor shall maintain at the site one copy of each of the following documents.

1.1.1.1 Initial Construction schedule and periodic schedule updates

1.1.1.2 Contract Work Plans

1.1.1.3 Specifications

1.1.1.4 Contract Drawings

1.1.1.5 Addenda

1.1.1.6 Modifications to the Contract

1.1.1.7 Contracting Officer's, Contracting Officer's Representative (COR) and/or Project Officer (PO) Directives

1.1.1.8 Written reports of any significant Quality Control problems

1.1.1.9 Submittals

1.1.1.10 Daily work activity summary reports, including:

a. Field tests records
b. Truck load ticket and shipping papers/manifests
c. Reports on any emergency response actions
d. Records of all site work
e. Meteorological records
f. All safety and accident incidents
g. Reports on all spill incidents
h. Construction quality control daily reports

1.1.2 These documents shall be made available to the Contracting Officer, COR, and/or PO at all times upon request.

1.1.3 Where appropriate, one copy of all project record documents above shall be maintained on compact disc (CD) compatible with the Government's software.

1.2 MAINTENANCE OF DOCUMENTS

1.2.1 The Contractor shall store documents in the Contractor's administrative field office apart from documents used for work. In addition, the Contractor shall:

1.2.1.1 Provide for storage of documents

1.2.1.2 Provide locked cabinet or secure storage space

1.2.1.3 File documents and samples to facilitate retrieval

1.2.1.4 Maintain documents in a clean, dry legible condition and in good order and not use record documents for work purposes

1.2.1.5 Legibly mark each section of the Specifications and addenda to record changes made by Work Directive Change or by Change Order

1.3 SUBMITTALS

The Contractor shall submit the following in accordance with the Performance Work Statement.

1.3.1. Record Documents

- The Contractor shall submit record documents as specified in Paragraph 1.3.2 through Paragraph 1.3.4 of this Specification Section

1.3.2 At the completion of field operations, the Contractor shall deliver record documents as specified in SECTION 01770 – PROJECT CLOSEOUT to the COR and/or PO.

1.3.3 The Contractor shall transmit the submittals with a transmittal letter in duplicate, containing:

- Date
- Project title and number
- Contractor's name and address
- Title and number of each record document
- Signature of Contractor or his authorized representative

1.3.4 Documents must be submitted to the COR and/or PO at completion of Contract.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

SECTION 01770

PROJECT CLOSEOUT

PART 1 – GENERAL REQUIREMENTS

1.1 SCOPE OF WORK

This section covers the requirements for final site restoration, inspections, certificates, reports and determinations, and other procedures necessary for Contract closeout. Final site restoration shall be performed after meeting all the requirements outlined in the Contract Documents. Final restoration work shall consist of removing all equipment and performing cleanup of the site.

1.2 SUBMITTALS

The Contractor shall submit the following in accordance with the Performance Work Statement.

1.2.1 As-Built Surveys and Drawings

The Contractor shall be responsible for the development of the final As-Built Drawings. The Contractor shall record legibly in red ink, all approved changes or modifications to the Contract Drawings.

1.3 PROJECT RECORD DOCUMENTS

1.3.1 As-Built Drawings

This paragraph covers as-built drawings to be completed, as a requirement of the Contract. The terms "drawings," "contract drawings," "drawing files," "working as-built drawings" and "final as-built drawings" refer to Contract Drawings which are revised to be used for final as-built drawings.

1.3.1.1 Working As-Built and Final As-Built Drawings

The Contractor shall revise one set of paper drawings by red-line process to show the as-built conditions during the execution of the project. These working as-built marked drawings shall be kept current on a weekly basis and shall be available on the jobsite at all times. Changes from the Contract Documents which are made in the work or additional information which might be uncovered in the course of construction shall be accurately and neatly recorded as they occur by means of details and notes. The working as-built marked prints and final as-built drawings will be jointly reviewed for accuracy and completeness by the Contracting Officer's Representative (COR) and/or Project Officer (PO), and the Contractor. The working and final as-built drawings shall show, but shall not be limited to, the following information:

a. The actual location, kinds and sizes of all sub-surface utility lines.
b. Correct grade, elevations, cross section, or alignment of roads, earthwork, structures or utilities if any changes were made from Contract Documents.
c. Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor.
d. Changes or modifications which result from the final inspection.
e. Where Contract Drawings or Specifications present options, only the option selected for construction shall be shown on the final as-built prints.

1.3.1.2 Computer Aided Design and Drafting (CADD) Drawings

Survey drawings shall be prepared using the latest version of AutoCAD or an approved earlier version. The Contractor is responsible for providing the electronic survey data to the COR and/or PO. The Contractor will be responsible for preparing the As-Built Drawings.

1.4 FINAL CLEANING

All trailers, materials, equipment and debris shall be removed from the temporary storage areas. Temporary utilities shall be removed and restored to its pre-construction condition. The site shall have waste, surplus materials, and rubbish removed. The project area shall have temporary structures, barricades, project signs, and construction facilities removed.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION (NOT USED)

END OF SECTION

Division 2

Site Work

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SECTION 02100

SITE PREPARATION

PART 1 – GENERAL

1.1 SCOPE OF WORK

1.1.1 The Contractor shall furnish all labor, materials, and equipment required to perform all site preparation as specified herein.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 DEMOLITION

3.1.1 Existing site features shall be demolished or removed, where shown on the Contract Drawings or otherwise required to complete construction work. Items requiring demolition that are not shown on the Contract Drawings shall be subject to approval by the Contracting Officer's Representative (COR) and/or Project Officer (PO).

3.2 DISPOSAL

3.2.1 The Contractor shall dispose of material and debris from site preparation operations in accordance with local, state, and federal requirements.

END OF SECTION

Division 13

Special Construction

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SECTION 13300

INSTRUMENTATION AND CONTROLS – GENERAL PROVISIONS

PART 1 – GENERAL

1.1 SCOPE OF WORK

1.1.1 The Contractor shall procure the services of a single Process Control System Supplier (PCSS) to furnish and install all materials, equipment, labor and services, except for those services and materials specifically noted, required to achieve a fully integrated and operational system as specified herein and in other Specification Sections listed below.

1.1.2 Auxiliary and accessory devices necessary for system operation or performance, such as transducers, relays, signal amplifiers, intrinsic safety barriers, signal isolators, software, and drivers to interface with existing equipment or equipment provided by others under other Sections of these specifications, shall be included whether they are shown on the Drawings or not.

1.1.3 Substitutions on functions or type of equipment specified shall not be acceptable unless specifically noted. In order to confirm compatibility between all equipment, coordinate all interface requirements with mechanical and electrical systems and furnish any signal isolation devices that might be required.

1.1.4 Equipment shall be fabricated, assembled, installed and placed in operating condition in full conformity with the project Specifications, Drawings, engineering data, instructions, and recommendations of the equipment manufacturer as approved by the Contracting Officer's Representative (COR) and/or Project Officer (PO).

1.1.5 To facilitate the Owner's future operation and maintenance, similar products (e.g., differential pressure transmitters, SCADA I/O cards) shall be supplied from the same manufacturer.

1.1.6 All equipment and installations shall satisfy applicable Federal, State and local codes.

1.1.7 Provide one level transducer and the magnetic flow meters as described below. The existing flow meters shall be removed and turned over to EPA.

1.1.8 Provide PLC programming (Allen-Bradley CompactLogix with RSLogix) and HMI programming (Allen-Bradley RSView32) as described below.

1.2 RELATED WORK

1.2.1 Process & Instrumentation Diagrams (P&ID) are included in the Drawings.

1.3 SUBMITTALS

Submit in accordance with the Performance Work Statement.

1.3.1 General submittal requirements include:

1.3.1.1 Shop drawings shall be submitted as detailed herein. Shop drawings shall demonstrate that the equipment and services to be furnished comply with the provisions of these specifications and shall provide a complete record of the equipment as manufactured and delivered.

1.3.1.2 Submittals shall be complete; giving equipment specifications, details of connections, wiring, ranges, installation requirements, and specific dimensions. Submittals consisting of only general sales literature shall not be acceptable.

1.3.1.3 Submittals shall be bound in separate three-ring binders, with an index and sectional dividers, with all drawings reduced to a maximum size of 11-inch by 17-inch, then folded to 8.5 inch by 11 inch for inclusion within the binder. Maximum binder size shall be 3 inches.

1.3.1.4 The submittal drawings' title block shall include, as a minimum, the PCSS's registered business name and address, Owner and project name, drawing name, revision level, and personnel responsible for the content of the drawing.

1.3.1.5 Separate submittals shall be made as follows:

1.3.1.5.1 Field Instrument Submittal

1.3.1.5.2 Final System Documentation

1.3.2 Panel I/O Drawings

1.3.2.1 Panel drawings in AutoCad 2008 version are available and will be provided to the Contractor. At a minimum these drawings shall be updated with modifications for the new wells and submitted for approval.

1.3.3 Field Instruments Submittal

1.3.3.1 Refer to the Instruments section for submittal requirements.

1.3.4 Final System Documentation

1.3.4.1 The Final System Documentation shall consist of operations and maintenance manuals as specified herein. The manuals shall be bound in three-ring binders, maximum size of three inches, with Drawings reduced to 11 inch by 17 inch, then folded to 8.5 inch by 11 inch for inclusion. Each section shall have a uniquely numbered tab divider, and each component within each section shall have a separate binder tab divider.

1.3.4.2 The operations and maintenance manuals shall, at a minimum, contain the following information:

1.3.4.2.1 Table of Contents

1.3.4.2.1.1 A Table of Contents shall be provided for the entire manual with the specific contents of each volume clearly listed. The complete Table of Contents shall appear in each volume.

1.3.4.2.2 Instrument and Equipment Lists

1.3.4.2.2.1 The following lists shall be developed in Microsoft Excel format and provided not only as a hardcopy in O&M but also electronically on a CD.

1.3.4.2.2.2 An instrument list for all devices supplied including tag number, description, specification section and paragraph number, manufacturer, model number, serial number, range, span, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.

1.3.4.2.2.3 An equipment list for all non-instrument devices supplied listing description, specification section and paragraph number, manufacturer, model number, serial number, location, manufacturer phone number, local supplier name, local supplier phone number, completion year replacement cost, and any other pertinent data.

1.3.4.2.3 Data Sheets with Vendor Operations and Maintenance Information

1.3.4.2.3.1 ISA S20 data sheets shall be provided for all field instruments. For non-field instrumentation devices, provide a cover page for each device, piece of equipment, and OEM software that lists, at a minimum, date, specification number, product name, manufacturer, model number, Location(s), and power required. Preferred format for the cover page is ISA S20, general data sheet; however, other formats will be acceptable provided they contain all required information.

1.3.4.2.3.2 Vendor O&M documentation for each device, piece of equipment, or OEM software shall be either new documentation written specifically for this project, or modified standard vendor documentation. All standard vendor documentation furnished shall have all portions that apply clearly indicated with arrows or circles. All portions that do not apply shall be neatly lined out or crossed out. Groups of pages that do not apply at all to the specific model supplied shall be removed.

1.3.4.2.3.3 For any component requiring dip switch settings or custom software configuration, that information shall be included along with the corresponding data sheets and O&M information.

1.3.4.2.4 As-Built Drawings

1.3.4.2.4.1 Complete as-built drawings, including all drawings and diagram specified in this section under the "Submittals" section. These drawings shall include all termination points on all equipment the system in connected to, including terminal points of equipment not supplied by the PCSS.

1.3.4.2.4.2 As built documentation shall include information from submittals, as described in this Specification, updated to reflect the as-built system. Any errors in or modifications to the system resulting from the Factory and/or Functional Acceptance Tests shall be incorporated in this documentation.

1.3.4.2.5 Electronic O&M Information

1.3.4.2.5.1 In addition to the hard copy of O&M data, provide an electronic version of all equipment manuals CDROM or DVD. Electronic documents shall be supplied in Adobe Acrobat format.

1.3.4.2.5.2 Provide electronic files for all custom-developed manuals. Text shall be supplied in both Microsoft Office format and Adobe Acrobat format.

1.3.4.2.5.3 Provide electronic files for all drawings produced. Drawings shall be in AutoCAD ".dwg" format and in Adobe Acrobat format. Drawings shall be provided using the AutoCAD eTransmit feature to bind external references, pen/line styles, and fonts into individual zip files along with the drawing file.

1.3.4.2.5.4 Each computer system hardware device shall be backed up onto CDROM or DVD after Substantial Completion and shall be turned over to the Owner.

1.3.4.2.5.5 If specified in the training section, provide digital copies of all training videos. Videos shall be in a format that is readable by standard DVD players and by standard PC DVD drives. Format and shall be a minimum of 800 by 600 pixels and shall include sound.

1.3.4.3 The cover and edge of each volume shall contain the following information:

Project Name (refer to Contract Documents)
Contract Number (refer to Contract Documents)

Instrumentation and Control System
Hardware[or Applications Engineering] Operations and Maintenance Manual
Specification Sections _____, _____, _____

Subcontractor Name
Date
Volume X of Y
(Where X is the volume number and Y is the number of volumes)

1.4 COORDINATION MEETINGS

1.4.1 Schedule the mandatory coordination meetings as described herein. The meetings shall be held at the COR and/or PO's designated location and shall include attendance by the COR and/or PO, the Contractor, and the PCSS's Project Engineer. Prepare and distribute an agenda for this meeting a minimum of one week before the scheduled meeting date. Meeting shall be scheduled a minimum of one week before the requested meeting date.

1.4.1.1 A project kickoff coordination meeting shall be held within two weeks after submitting the Project Plan. The purpose of the meeting shall be to summarize the PCSS's understanding of the project; discuss any proposed substitutions or alternatives; schedule testing and delivery deadline dates; provide a forum to coordinate hardware and software related issues; and request any additional information required from the Owner. The meeting will last up to one (1) business day.

1.4.1.2 Regular on-site meetings for during time PCSS staff is at the plant site.

1.5 REFERENCE STANDARDS

1.5.1 Publications are referred to in the text by basic designation only. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition in effect at the time of bid opening shall apply.

1.5.2 International Society of Automation (ISA)

1.5.2.1 ISA S5.2 Binary Logic Diagrams for Process Operations

1.5.2.2 ISA S5.3 Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems.

1.5.2.3 ISA S5.4, Instrument Loop Diagrams.

1.5.2.4 ISA S20, Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.

1.5.2.5 ISA RP60.6, Nameplates, Labels, and Tags for Control Centers

1.5.3 National Electrical Manufacturers Association (NEMA)

1.5.4 National Fire Protection Agency (NFPA)

1.5.4.1 NFPA 70, National Electrical Code (NEC).

1.5.5 Underwriters Laboratories, Inc. (UL)

1.5.5.1 UL 508 - Industrial Control Equipment - for custom fabricated equipment

1.5.5.2 A nationally recognized testing laboratory, as approved by the Authority having jurisdiction, may substitute for UL listing on commercial off the shelf products.

1.6 QUALITY ASSURANCE

1.6.1 The PCSS shall be a "systems integrator" regularly engaged in the design and the installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry. For the purposes of this Specification Section, a "systems integrator" shall be interpreted to mean an organization that complies with all of the following criteria:

1.6.1.1 Employs personnel on this project who have successfully completed ISA or manufacturers training courses on general process instrumentation and configuration and implementation of the specific programmable controllers, computers, and software proposed for this project.

1.6.1.2 Has successfully completed work of similar or greater complexity on at least three previous projects within the last five years. Successful completion shall be defined as a finished project completed on time, without any outstanding claims or litigation involving the PCSS. Potential references shall be for projects where the PCSS's contract was of similar size to this project.

1.6.1.3 Has been actively engaged in the type of work specified in this Specification Section for a minimum of five years.

1.6.2 The PCSS shall maintain a permanent, fully staffed and equipped service facility within 200 miles of the project site with full time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. At a minimum, the PCSS shall be capable of responding to on-site problems within 12 hours of notice. Provide an on-site response within 4 hours of notification starting at two months before scheduled startup to two months after startup completion.

1.6.3 Actual installation of the instrumentation system need not be performed by the PCSS's employees; however, the PCSS as a minimum shall be responsible for the technical supervision of the installation by providing on site supervision to the installers of the various components.

1.7 DELIVERY, STORAGE, AND HANDLING

1.7.1 Shipping Precautions

1.7.1.1 Manufacturer's special instructions for field handling, storage and installation required for protection, shall be securely attached to the packaging for each piece of equipment prior to shipment. The instructions shall be stored in resealable plastic bags or other means of protection.

1.7.1.2 If any apparatus has been damaged, such damage shall be repaired at no additional cost to the owner.

1.8 NOMENCLATURE AND IDENTIFICATION

1.8.1 Field Instrument Tags

1.8.1.1 A permanent stainless steel or other non-corrosive material tag firmly attached and permanently and indelibly marked with the instrument tag number, as indicated in the Drawings, shall be provided on each piece of equipment supplied under this Section. Equipment shall be tagged before shipping to the site.

1.8.1.2 Provide 1/8-in by 3/8-in, Type 316 stainless steel button head machine screws.

1.8.1.3 All supplied field instrument transmitters and field instrument transmitter elements shall have a stainless steel identification tag attached to each transmitter and element prior to shipment. Tag shall be attached via stainless steel chain or stainless steel wire (24 gauge min) to a non-removable part of the device. The tag size shall be a minimum of 1.5 square inches. Tag shall include the ISA alphanumeric instrument number as indicated in the P&ID, loop, and detail drawings. The alphanumeric instrument number shall be stamped into the tag and shall have a minimum of 3/16-in high alphanumeric characters.

1.9 WARRANTY

1.9.1 Provide 1 year warranty on all instruments provided under this contract.

1.9.2 Include any visits to site as necessary to repair or replace defective devices.

1.10 PROJECT/SITE REQUIREMENTS

1.10.1 Environmental Requirements. Refer to SECTION 16000 – ELECTRICAL – GENERAL PROVISIONS for specific environmental and hazardous area classifications.

1.10.2 Elevation: Equipment shall be designed to operate at the project ground elevation.

1.10.3 Temperature:

1.10.3.1 Outdoor areas' equipment shall operate between -30 to 50 C degrees ambient.

1.10.3.2 Equipment located in indoor locations shall operate between 10 to 35 C degrees ambient minimum.

1.10.3.3 Storage temperatures shall range from 0 to 50 C degrees ambient minimum.

1.10.3.4 Additional cooling or heating shall be furnished if required by the equipment as specified herein.

1.10.4 Relative Humidity. Air conditioned area equipment shall operate between 20 to 95 percent relative, non-condensing humidity. All other equipment shall operate between 0 to 100 percent relative, condensing humidity.

PART 2 – PRODUCTS

2.1 PRODUCTS GENERAL

2.1.1 All instrumentation and electronic equipment shall be of the manufacturer's latest design, utilizing printed circuitry and epoxy or equal coating to prevent contamination by dust, moisture and fungus. The field mounted equipment and system components shall be designed for installation in dusty, humid and slightly corrosive service conditions.

2.1.2 All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks unless otherwise noted. Fasteners for securing control panels and enclosures to walls and floors shall be either hot-dipped galvanized after fabrication or stainless steel. Provide stainless steel fasteners only in corrosive areas rated NEMA 4X on the Drawings or as defined under Section 16000. Provide and size anchors in accordance with Division 1 as required per the seismic calculations. Provide minimum size anchor of 3/8-inch.

2.1.3 All indicators shall be linear in process units, unless otherwise noted. All transmitters shall be provided with indicators in process units, accurate to two percent or better.

2.1.4 All equipment, cabinets and devices furnished shall be heavy-duty type, designed for continuous industrial service. The system shall contain similar products of a single manufacturer, and shall consist of equipment models, which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.

2.1.5 All electronic/digital equipment shall be provided with radio frequency interference protection.

2.1.6 Electrical

2.1.6.1 Equipment shall operate on a 60 Hertz alternating current power source at a nominal 120 volts, plus or minus 10 percent, except where specifically noted. Regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.

2.1.6.2 With the exception for field device network connected devices, all electronic instrumentation shall utilize linear transmission signals of isolated 4 to 20 mA DC (milliampere direct current) capable of driving a load up to 750 ohms, unless specified otherwise. However, signals between instruments within the same panel or cabinet may be 1-5 VDC (volts direct current).

2.1.6.3 Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero based signals will be allowed.

2.1.6.4 All switches shall have double-pole double-throw contacts rated at a minimum of 600 VA, unless noted otherwise.

2.1.6.5 Switches and/or signals indicating an alarm, failure or upset condition shall be wired fail-safe to the SCADA system. A fail-safe condition is an open circuit when in an alarm state.

2.1.6.6 Materials and equipment shall be UL approved. Where components are not available with UL approval, integrate the device with ground fault protective devices, isolation transformers, fuses, or other protective equipment necessary to achieve compliance with UL 508 requirements.

2.1.6.7 All equipment furnished shall be designed and constructed so that in the event of power interruption, the systems specified herein shall go through an orderly shutdown with no loss of memory, and shall resume normal operation without manual resetting when power is restored, unless otherwise noted.

2.1.6.8 All transmitter output signals shall include signal and power source isolation.

2.2 ELECTRICAL SURGE PROTECTION

2.2.1 General - Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines from lightning, utility, or the plant electrical system. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level. Protection shall be maintenance free and self-restoring. Devices shall have a response time of less than 50 nanoseconds and be capable of handling a discharge surge current (at an 8x20µs impulse waveform) of at least 8 kA. Ground wires for all instrumentation device surge protectors shall be connected to a low resistance ground.

2.1.2 Provide protection of all analog signal (4-20 mA) circuits where any part of the circuit is outside of the building envelope. Circuits shall be protected at both the transmitter and the control system end of the circuit. Protection devices located near the transmitter shall be mounted in a separate enclosure, unless conduit mounted, and shall be Phoenix Contact PT Series, MTL Surge Technologies (Telematic) TP48, Citel TSP-10 series, or equal. Substitution of a single device to protect both 120 VAC and 4-20 mA wires to an instrument is acceptable. Protection devices in control panels shall be MTL Surge Technologies (Telematic) SD Series, Phoenix Contact PT Series, Citel DLA series, or equal.

2.2.3 Provide protection of all 120 VAC power feeds into control panels, instruments, and control room equipment. Surge arresters shall be Transtector ACP-100BW Series, Phoenix Contact "Mains-PlugTrab", MCG Surge Protection 400 Series, Citel DS40 series, or equal.

2.2.4 Non-Fiber Based Data Highway or Communications Circuits – Provide protection on all communication and data highway circuits that leave a building or are routed external to a building. Circuit protection shall be provided at both ends of the line. Surge protection devices shall be Phoenix Contact PlugTrab Series, Transtector FSP Series, MTL Surge Technologies (Telematic) NP Series, Citel DLA series or MJ8 series, or equal.

2.2.5 RF Coaxial Cable – Provide protection on communication cables between radios and antennas, mounted either inside the panel, or in the wall of the enclosure in accordance with NEMA and UL standards. Surge protection devices shall be Citel P8AX series, Polyphaser, or equal.

2.2.6 Inductive Loads – At a minimum, provide coil surge suppression devices, such as varistors or interposing relays, on all process controller outputs or switches rated 120 VA or less that drive solenoid, coil, or motor loads.

2.2.7 Telephone Circuits - At a minimum, provide Telephone Company approved line protection units for all telephone lines used for telemetry or SCADA system use under this Contract.

2.3 SPARE PARTS

2.3.1 All spare parts shall be wrapped in bubble wrap, sealed in a polyethylene bag complete with dehumidifier, then packed in cartons and labeled with indelible markings. Complete ordering information including manufacturer's contact information (address and phone number), part name, part number, part ordering information, and equipment name and number(s) for which the part is to be used shall be

supplied with the required spare parts. The spare parts shall be delivered and stored in a location directed by the COR and/or PO.

2.3.2 Furnish one of each type of installed Surge protection devices.

2.4 MAGNETIC FLOW METERS

2.4.1 Flow Element

2.4.1.1 Type:

2.4.1.1.1 Pulsed DC type.

2.4.1.2 Function/Performance:

2.4.1.2.1 Operating Temperature: Process liquid temperatures of - 10 to 70 degrees C and an ambient of -10 to 60 degrees C.

2.4.1.2.2 Accuracy (including transmitter): Plus/minus 0.25 percent of flowrate.

2.4.1.2.3 Pressure rating: Equal to piping system where meter is installed.

2.4.1.2.4 Additional: Meter shall be capable of running empty indefinitely without damage to any component.

2.4.1.2.5 Radio Frequency Interference (RFI) protection: RFI protection shall be provided as recommended by the manufacturer.

2.4.1.3 Physical:

2.4.1.3.1 Metering Tube: 304 stainless steel or equivalent.

2.4.1.3.2 Flanges: ANSI 150 lb. or DIN PN 16 carbon steel, as required by the piping system, unless otherwise indicated.

2.4.1.3.3 Liner: Polyurethane unless otherwise indicated on the Drawings or in the Instrument Device Schedule.

2.4.1.3.4 Electrodes: 316 stainless steel, bullet nosed or elliptical self-cleaning type unless otherwise noted.

2.4.1.3.5 Housing: Meters below grade shall be suitable for submergence for up to 48 hours to a depth of 30 ft (9m). Meters above grade shall be NEMA 4X (IP65). Where hazardous areas are indicated on the Drawings, the equipment shall be rated for that area.

2.4.1.3.6 Finish: All external surfaces shall have a chemical and corrosion resistant finish.

2.4.1.4 Accessories/Documentation Required:

2.4.1.4.1 Factory calibration: All meters shall be factory calibrated. A copy of the report shall be included in the O&M manual.

2.4.1.4.2 Grounding: Meter shall be grounded in accordance with the manufacturer's recommendation. Provide ground ring, ground wires, gaskets, etc. All materials shall be suitable for the liquid being measured.

2.4.1.4.3 Signal cable for installation between the flow tube and the transmitter. Transmitter shall be mounted remotely from the flow tube.

2.4.1.5 Manufacturer(s):

2.4.1.5.1 Endress+Hauser Promag 50/53 W

2.4.1.5.2 ABB Instruments MagMaster.

2.4.1.5.3 Krohne OPTIFLUX 2000.

2.4.1.5.4 Siemens SITRANS FM MAGFLO.

2.4.1.5.5 Rosemount Series 8700.

2.4.1.5.6 Or equal

2.4.2 Flow Converter/Transmitter

2.4.2.1 Type:

2.4.2.1.1 Micro processor based, intelligent transmitter compatible with flow tube provided.

2.4.2.1.2 Transmitter shall be mounted remotely from flow tube. Existing flow meters and transmitters are being replaced. Mount new transmitters at locations of existing transmitters.

2.4.2.2 Functional/Performance:

2.4.2.2.1 Accuracy (including flowtube): +/- 0.25 percent of flowrate.

2.4.2.2.2 Operating Temperature: –10 to 50 degrees C.

2.4.2.2.3 Output: Isolated 4-20 mA with HART protocol. Current output adjustable over the full range of the instrument.

2.4.2.2.4 Diagnostics: Self diagnostics with on screen display of faults.

2.4.2.2.5 Display: Digital indicator displaying flow in engineering units indicated in the Instrument Device Schedule.

2.4.2.2.6 Totalizer: A fully configurable totalizer integral to the transmitter. Totalized flow shall be displayed.

2.4.2.2.7 Empty Tube Zero: The transmitter shall include a feature that will lock the output at zero when no flow is detected. The empty tube zero feature shall be enabled automatically when the transmitter detects no flow or manually through a contact input.

2.4.2.3 Physical:

2.4.2.3.1 Transmitter shall be suitable for surface or pipe stand mounting.

2.4.2.3.2 Enclosure shall be NEMA 4X (IP65).

2.4.2.3.3 A/C power will be as specified in Section 13300.

2.4.2.4 Accessories/ Required:

2.4.2.4.1 Keypad where required for transmitter configuration.

2.4.2.5 Manufacturer(s):

2.4.2.5.1 ABB Instruments MagMaster.

2.4.2.5.2 Krohne Optiflux.

2.4.2.5.3 Siemens MAGFLO MAG 5000/6000.

2.4.2.5.4 Rosemount Series 8712.

Loop #	ISA tag	Equipment	Range	Signal	Line Size
RW-01	FIT	Recovery Well No. 1 Flow	0 - 30 gpm	4-20 mA	1”
RW-02	FIT	Recovery Well No. 2 Flow	0 - 30 gpm	4-20 mA	1”
RW-03	FIT	Recovery Well No. 3 Flow	0 - 30 gpm	4-20 mA	1”
RW-04	FIT	Recovery Well No. 4 Flow	0 - 30 gpm	4-20 mA	1”
RW-05	FIT	Recovery Well No. 5 Flow	0 - 30 gpm	4-20 mA	1”
RW-06	FIT	Recovery Well No. 6 Flow	0 - 150 gpm	4-20 mA	3”
RW-07	FIT	Recovery Well No. 7 Flow	0 - 150 gpm	4-20 mA	3”
RW-08	FIT	Recovery Well No. 8 Flow	0 - 150 gpm	4-20 mA	3”

2.5 SUBMERSIBLE LEVEL PROBES

2.5.1 Type

2.5.1.1 Submersible, hydrostatic pressure type level transmitter.

2.5.2 Function/Performance

2.5.2.1 Range: Range selected shall be the manufacturer’s standard range closest to the span to be measured.

2.5.2.2 Temperature Compensation: Temperature compensated over a range of 0 to 50 degrees C.

2.5.2.3 Accuracy: +/- 0.25 percent of range.

2.5.2.4 Over Pressure: Transducer shall be protected for over pressure of 1.5 times the span.

2.5.2.5 Output: 4-20 mA proportional to the calibrated span.

2.5.3 Physical

2.5.3.1 The sensor shall be a non-vented, absolute pressure transducer

2.5.3.2 The transmitter assembly shall be 316 stainless steel.

2.5.3.3 Sensor shall be suspended by cable.

2.5.3.4 Sensor shall be suspended with a tension-relieving mounting clamp from a four-inch (100 mm) flange. Clamp and flange shall be 316 stainless steel.

2.5.3.5 Sensor shall be submersible (IP68), and shall be CSA approved or CENELEC (EEx ia IIC T4) certified intrinsically safe when intrinsically safe barriers are provided for the instrument loop.

2.5.3.6 24 VDC loop powered.

2.5.4 Accessories Required

2.5.4.1 Sufficient manufacturer's cable for installation of the sensor as indicated on the Drawings. Cable shall be non-vented and reinforced to support the weight of the transducer and cable.

2.5.4.2 Cable clamp for suspending instrument provided by instrument supplier.

2.5.4.3 Any fittings required for pressure calibration of the instrument.

2.5.5 Manufacturer(s)

2.5.5.1 Instrumentation Northwest Model PS-9800.

2.5.5.2 Or Equal.

Loop #	ISA Tag	Equipment	Depth to Transducer	Range	Signal
IW-02	LIT	Injection Well No. 2 Level	130 ft	0 – 100 PSI	4-20 mA

2.6 APPLICATION ENGINEERING (PROGRAMMING)

2.6.1 The speed of the well pumps is currently controlled by PLC level control PID logic. The speed control of the well pumps shall be converted to a flow control PID controller. This includes modification to the PLC logic and any necessary HMI screen modifications. Modifications to the PLC logic at a minimum shall include changing the PID from level control to flow control, rescaling parameters as necessary and field tuning the PID controller parameters. Modifications to the HMI screens shall at a minimum include relabeling controller parameters/inputs/outputs, display and pop-up names, and adding any new parameters for control and monitoring.

2.6.2 Following the installation of the magnetic flow meters and the PLC flow control PID logic, the Contractor shall be responsible for a 14 day test to confirm proper operation and tuning of the flow control logic.

PART 3 – EXECUTION

3.1 GENERAL INSTALLATION

3.1.1 Instrumentation and accessory equipment shall be installed in accordance with the manufacturer's instructions. The locations of equipment, transmitters, alarms and similar devices indicated are approximate only. Exact locations of all devices shall be as approved by the COR and/or PO during construction. Obtain in the field, all information relevant to the placing of process control equipment and in case of any interference with other work, proceed as directed by the Contractor and furnish all labor and materials necessary to complete the work in an approved manner at no additional cost to the Owner.

3.1.2 The P&IDs and Drawings indicate the intent and not the precise nature of the interconnection between the individual instruments. Where indicated on the P&IDs or Drawings as not requiring installation, provide the instruments suitably packaged for storage.

3.1.3 All equipment used in areas designated as hazardous shall be designed for the Class, Group and Division as required for the locations as shown on the Drawings and specified in Division 16. All work shall be in strict accordance with codes and local rulings.

3.1.4 Unless specifically indicated, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure transmitters, 5-valve manifolds for calibration, testing and blow down service shall also be provided. For chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.

3.1.5 Brackets and hangers required for mounting of equipment shall be provided. They shall be installed as shown and not interfere with any other equipment.

3.1.6 The shield on each process instrumentation cable shall be continuous from source to destination and be grounded at only one ground point for each shield.

3.1.7 Loop Tuning - All electronic control stations incorporating PID controllers shall be tuned following device installation but prior to commencement of the field tests.

3.1.7.1 Optimal loop tuning shall be achieved either by auto-tuning software or manually by trial and error, Ziegler-Nichols step-response method, or other documented process tuning method. Assigning common PID factors for identical loops following field tuning of a single typical loop is acceptable. However, tuning documentation shall be submitted for each loop individually as specified in Part 1 of these Specifications.

3.1.7.2 Determine and configure optimal tuning parameters to assure stable, steady state operation of final control elements running under the control of field mounted, dedicated PID controllers or software based PID controllers residing as part of the programmable logic controller system. Each control loop that includes anti-reset windup features shall be adjusted to provide optimum response following startup from an integral action saturation condition.

3.1.7.3 Tune all PID control loops to eliminate excessive oscillating final control elements. Loop parameters shall be adjusted to achieve 1/4 amplitude damping or better. In addition, loop steady state shall be achieved at least as fast as the loop response time associated with critical damping.

3.1.7.4 Loop performance and stability shall be verified in the field following tuning by step changes to setpoint. Submit loop tuning methodology and verification as part of the final system documentation as specified in Part 1.

3.1.7.5 For cascade loops, tune both sets of controllers so that the cascade loop achieves the loop tuning characteristics specified herein.

END OF SECTION

Division 15

Mechanical

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SECTION 15055

PROCESS PIPING, VALVES AND APPURTENANCES

PART 1 – GENERAL

1.1 SCOPE OF WORK

The Contractor shall provide all necessary labor, supervision, materials, equipment, tools, manuals, plans, permits, and services required to design, furnish, install, test, operate, and maintain process piping, valves, and appurtenances for a complete and operational groundwater recovery and treatment system.

1.2 RELATED WORK

1.2.1 Magnetic flow meters are detailed in SECTION 13300 – INSTRUMENTATION AND CONTROLS GENERAL PROVISIONS.

1.2.2 Heat tracing for freeze protection of pipes is detailed in SECTION 16859 – ELECTRICAL HEAT TRACE SYSTEM.

1.3 SUBMITTALS

The Contractor shall submit the following in accordance with the Performance Work Statement. The general submittals for piping and piping systems are listed below.

1.3.1 Shop Drawings

1.3.1.1 Schedules of all pipe, fittings, meters, special castings, couplings, expansion joints, and other appurtenances.

1.3.2 Product Data

1.3.2.1 Product brochures and technical data on pipe, valves, fittings, and appurtenances.

1.3.2.2 Catalog cut sheets, brochures, and technical data for differential pressure gauge, air tubing, and fittings.

1.3.2.3 Catalog cuts of joints, couplings, harnesses, expansion joints, gaskets, fasteners, and other accessories.

1.3.2.4 Brochures and technical data on pipe and fitting insulation and jacketing and proposed method for application.

1.3.3 Statements of Satisfactory Installation and Thrust Restraint Methods.

1.3.4 Equipment samples as appropriate.

1.3.5 Design data and assumptions.

1.3.6 Certified Shop Tests

1.3.6.1 Test results or manufacturer certification showing compliance with appropriate standards.

1.3.7 Results of performed testing completed in accordance with Paragraph 3.8 herein.

1.3.8 Welder’s Certification

1.3.8.1 Certificates for all welders and pipe fitters performing work in accordance with American Society of Mechanical Engineers (ASME) B31.

1.3.9 Manufacturer's Certification
Certification that materials meet or exceed minimum requirements as specified and other certificates as required.

1.3.10 Equipment/System Warranty

1.3.11 All deviations from this Section shall be delineated in the submittals.

1.3.12 All submittals shall be sealed, signed, and dated by a professional engineer registered in the State of Nebraska.

1.4 REFERENCES

1.4.1 The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. Where reference is made to one of following references, the revision in effect at the time of bid opening shall apply.

American Society of Mechanical Engineers (ASME)

ASME B16.5	Pipe Flanges and Flanged Fittings
ASME B31	Standards for Pressure Piping

ASTM International (ASTM)

ASTM B75-02	Standard Specification for Seamless Copper Tube
ASTM D1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D1785	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D2464	Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2467	Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2564	Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D2855	Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D3261	Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D3350	Polyethylene Plastics Pipe and Fittings Materials
ASTM F656	Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
ASTM F2620	Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
ASTM F714	Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter

American Water Works Association (AWWA)

AWWA M23 Manual: PVC Pipe - Design and Installation

National Fire Protection Association (NFPA)

Fire Protection Guide to Hazardous Materials

1.5 QUALITY ASSURANCE

1.5.1 All materials shall be new and unused. All materials are intended to be products of proven ability for use in controlling the flow of water under pressure.

1.5.2 The Contractor shall install piping, valves, and appurtenances in accordance with applicable AWWA and NSF standards and to meet requirements of local codes.

1.5.3 The Contractor shall provide manufacturer's certification that materials meet or exceed minimum requirements as specified. Reference to standards such as ASTM and ANSI shall apply to those versions in effect at the time of bid opening.

1.5.4 The Contractor shall coordinate dimensions and drilling of flanges with flanges for valves, pumps, and other equipment to be installed in piping systems. Bolt holes in flanges shall straddle vertical centerline.

1.5.5 The Contractor shall reject materials contaminated with gasoline, lubricating oil, liquid or gaseous fuel, aromatic compounds, paint solvent, paint thinner, and acid solder.

1.5.6 Pipe-joint compound, for pipe carrying flammable or toxic gas, must bear approval of UL or FM.

1.5.7 All pipe and fittings shall be furnished by a single manufacturer who is experienced in the manufacture of the items to be furnished. The pipe and fittings shall be designed, constructed, and installed in accordance with the best practices and methods and shall be suitable for the intended service.

1.5.8 The Contractor shall be responsible for the verification of existing piping and penetrations. Prior to ordering materials, the Contractor shall expose all existing pipes that are to be connected to new pipelines. The Contractor shall verify the size, material, joint types, elevation, horizontal location, and pipe service of existing pipes, and inspect size and location of structure penetrations to verify adequacy of wall sleeves and other openings before installing connecting pipes.

1.5.9 After becoming familiar with all details of the work, the Contractor shall verify all dimensions in the field and shall advise the Contracting Officer's Representative (COR) and/or Project Officer (PO) of any discrepancy before performing the work.

1.6 DESCRIPTION OF SYSTEM

1.6.1 The system shall include all piping, valves, and appurtenances for the connection of the existing recovery wells to the existing groundwater treatment system as shown on the Contract Drawings and specified herein. Manifold piping for wells RW-01 thru RW-08 will be replaced to the extent shown on the contract drawings and as specified herein. Process instrumentation for the treatment system shall be part of the completed system and installed as shown in the contract drawings and specified in SECTION 13300 – INSTRUMENTATION AND CONTROLS GENERAL PROVISIONS. The freeze protection system will be replaced within the treatment room and in recovery well vaults for wells RW-01, RW-02, RW-03, RW-04, RW-07 and RW-08. The freeze protection system shall include heat tracing as specified in SECTION 16859 – ELECTRICAL HEAT TRACE SYSTEM, and shall include thermal insulation and PVC protective jacketing for all liquid conveying pipes. The differential pressure gauge for the existing packed column air stripper shall be replaced as part of the work.

1.7 DELIVERY, STORAGE, AND HANDLING

1.7.1 During loading, transportation, and unloading, take care to prevent damage to equipment.

1.7.2 The Contractor shall carefully load and unload each piece of equipment under control at all times. Skids or blocks shall be placed under equipment as necessary.

1.7.3 Piping, fittings, valves, and appurtenances shall be stored and handled in accordance with the manufacturer's recommendations. The storage facility shall be classified and marked in accordance with NFPA Fire Protection Guide to Hazardous Materials.

1.7.4 Piping, fittings, valves, and appurtenances shall be handled so as to ensure delivery to the installation position in sound, undamaged condition. Particular care shall be taken not to injure the pipe coating or lining.

PART 2 – PRODUCTS

2.1 HIGH DENSITY POLYETHYLENE – HDPE

2.1.1 High Density Polyethylene (HDPE) pipe shall comply with AWWA C906. All polyethylene pipe shall meet the requirements of ASTM F714.

2.1.2 Pipe shall be manufactured from HDPE base resin conforming to ASTM D3350 with a cell classification of 345464C and manufactured in accordance with ASTMF714

2.1.3 The pipe shall have a minimum hydrostatic design stress of 630 pounds per square inch (psi) at 73 degrees Fahrenheit (F) and be suitable for field cutting and heat fusion joining. Pipe shall be SDR 11 unless otherwise shown.

2.1.4 Fittings shall be the butt type for heat fusion joints conforming to ASTM D3261.

2.1.5 Heat fused joints shall be pressure rated the same as the corresponding pipe.

2.1.6 Flanges shall be one-piece solid design and compatible with ANSI B 16.5 Class 150 metal flanges. Flange gaskets shall be manufactured from ethylene propylene diene monomer (EPDM) or Viton. Flange bolts and nuts shall be grade 304 stainless steel.

2.1.7 Fittings shall be manufactured from the same HDPE base resin, conforming to ASTM D3350 with a cell classification of 345464C as is used to produce the pipe to which the fittings are to be joined.

2.1.8 All HDPE pipe and fittings shall be made from the same resin and by the same manufacturer to assure compatibility of the piping system components.

2.2 POLYVINYL CHLORIDE – PVC SCHEDULE 80

2.2.1 Polyvinyl chloride (PVC), ASTM D1784, minimum cell classification 12545-C, pipe shall be Schedule 80 conforming to ASTM D1785. Pipe shall be specially formulated with sufficient UV screeners to provide for long-term outdoor exposure with no deleterious effects.

2.2.2 The piping system shall be joined by socket-weld connections except where connecting to unions, valves, and equipment with threaded connections that may require future disassembly.

2.2.3 Connections at those points shall be threaded and back-welded. Tubing connections shall use compression fittings.

2.2.4 Fitting components that use socket-type solvent welded connections shall have socket diameters, lengths, and wall thickness as required by ASTM D2467. Components using taper pipe thread connections shall have thread lengths, diameters, and configurations in conformance with ASTM D2464.

2.2.5 Fittings shall be industrial, heavy duty, hub style.

2.2.6 Pipe fittings shall be manufactured from a PVC compound that meets the requirements of Cell Classification 12454-B polyvinyl chloride as outlined in ASTM D1784. PVC shall be gray in color. Fittings shall be specially formulated with sufficient UV screeners to provide for long-term outdoor exposure with no deleterious effects.

2.2.7 Flanges shall be one piece solid design or two-part van stone type that use the tapered, serrated face and full face gasket technique for joining and are compatible with ANSI B 16.5 Class 150 metal flanges. All flange nuts, bolts, and washers shall be grade 304 stainless steel.

2.2.8 Unions shall be O-ring seal type having interchangeable components with flange connection or true union valves for maximum system versatility.

2.2.9 Unions intended for joining dissimilar materials shall be the transition type, which use components of the two dissimilar materials, joined with an O-ring to absorb the thermal expansion coefficient differential.

2.2.10 Fittings and pipe shall be clearly marked with the manufacturer's name and trademark, material, ASTM number or alternate symbol indicating compliance with applicable standards,

2.2.11 Socket fittings shall be pressure rated the same as the corresponding size pipe prescribed by ASTM D1785. Threaded fittings shall be pressure rated at 50 percent of the rating for socket fittings.

2.2.12 Valves, unions, and flanges shall be pressure rated at 150 psi for water service at 73 degrees Fahrenheit (F), non-shock, and have a minimum burst requirement of 3.3 times the rated pressure.

2.2.13 Solvent cement: Industrial heavy bodies solvent cement having a viscosity rating of 1,600 centipoise (cps) (minimum) and of same relative color as the materials to be joined shall be used for Schedule 80 connections 6-inch size and smaller. For sizes larger than 6 inches, an extra heavy-duty solvent cement having a viscosity rating of 15,000 cps (minimum) shall be used. The solvent cement used shall be of type that uses tetrahydrofuran (THF) as the primary solvent and is in conformance with the requirements of ASTM D2564.

2.2.14 Primer: The primer shall be an organic solvent such as THF and be capable of dissolving at least 10 percent by weight of PVC resign within 60 minutes at 73 degrees F. Primer shall be tinted purple for traceability. Primer shall be in conformance with the requirements of ASTM F656.

2.3 VALVES AND APPURTENANCES

2.3.1 General

2.3.1.1 The size of the valve, working pressure, manufacturer's name, initials, or trademark shall be on the body of each valve. Connections shall be suitable for the type of pipe they are installed on.

2.3.2 Ball Valves

2.3.2.1 Ball valves shall be PVC Type I with body material in accordance with ASTM D1784, minimum cell classification 12545-C and shall be pressure rated at 150 psi for water service at 73 degrees F. Valves shall be True Union style ball valves with Buttress threaded union nuts and either flanged or socket style connections. Shall be as manufactured by Spears Manufacturing Co, or equal.

2.3.2.2 The design of the valve shall be such that it provides a double seat polypropylene handle suitable for seating in both directions. In order to determine the position of the ball within the valve (closed) there shall be an easily-visible, permanent indicator located conspicuously on the valve.

2.3.2.3 Flanges shall be one piece solid design with serrated face and full face gasket technique for joining and compatible with ANSI B 16.5 Class 150 metal flanges and shall be pressure rated at 150 psi for water service at 73 degrees F. All flange nuts, bolts, and washers shall be grade 304 stainless steel.

2.3.3 Check Valves

2.3.3.1 Check valves shall be suitable for the minimum pressure of not less than 150 psi for water service at 73 degrees F and shall be flanged swing check type as manufactured by Spears Manufacturing Co., or equal. Valves shall open to permit flow when inlet pressure is greater than the discharge pressure and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure.

2.3.3.2 Check valves shall be constructed from PVC Type I, ASTM D 1784 Cell Classification 12454. All check valve components shall be replaceable. All check valves shall have top entry access with O-ring sealed drain plug for servicing the valve in-line. All valves shall show external directional arrow.

2.3.3.3 Flanges shall be one piece solid design with serrated face and full face gasket technique for joining and compatible with ANSI B 16.5 Class 150 metal flanges and shall be pressure rated at 150 psi for water service at 73 degrees F. All flange nuts, bolts, and washers shall be grade 304 stainless steel.

2.3.4 Lab Type Sample Ball Valves

2.3.4.1 Lab type sample ball valves shall be a model 1529-002 lab ball valve by Spears Manufacturing, or equal. Shall be of PVC Type I, ASTM D 1784 Cell Classification 12454 and be pressure rated for 150 psi water at 73 degrees F. All lab type valves shall have double stop Polypropylene handle, male threaded end connection, ¼" laboratory tubing end connection, and EPDM O-rings.

2.4 PACKED COLUMN AIR STRIPPER DIFFERENTIAL PRESSURE GAUGE

2.4.1 Differential pressure gauge shall be a model Magnehelic 2010, by Dwyer Instruments, Inc., or equal. Gauge shall be scaled for differential pressures between 0 inches and 10 inches of water column. Gauge case shall be constructed of die-cast aluminum. Gauge shall be provided with NPT threaded connections for high and low pressure and suitable for air service within the specified pressure range.

2.4.2 Air tubing shall be ¼" Type L copper tubing in accordance with ASTM B75-02. Connections shall be made using brass NPT compression fittings with gaskets and appurtenances to provide an air-tight system connecting the air stripper tower and the differential pressure gauge. Clasps and fasteners to secure the copper tubing shall be copper clad, bronze, or approved non-metallic materials.

2.4.3 Support stand for differential pressure gauge shall be constructed of galvanized C-channel strut. Shall be affixed to the floor with epoxy and 3/8" 304 stainless steel allthread, bolts, and washers through a compatible galvanized baseplate for channel strut.

2.4.4 Bonding epoxy for any anchoring bolts and stainless steel allthread into the floor shall utilize HIT-RE 500-SD Epoxy Adhesive as manufactured by Hilti, or equal.

2.5 PIPE INSULATION AND FREEZE PROTECTION

2.5.1 Heat tracing, thermal insulation, and protective jacketing shall be provided for all liquid conveying pipes in the treatment room and in recovery well vaults for wells RW-01, RW-02, RW-03, RW-04, RW-07 and RW-08. This includes piping and appurtenances for the sump pump piping, proposed treatment manifold, and the existing influent and discharge piping for the air stripper in the treatment room.

2.5.2 PVC jacketing for thermal pipe insulation shall be a minimum of 0.016 inch thickness. Fitting covers shall be preformed one-piece PVC covers. Jacketing system shall be Zeston 2000 as manufactured by Johns Manville Corp., or equal. Adhesives, coatings and vapor barrier materials shall be compatible with the insulation as recommended by the insulation manufacturer and the jacketing system must provide a closely fitting, water and dust resistant protective barrier along all seams.

2.5.3 Pipe Insulation shall be INS Closed Cell Elastomeric Thermal Insulation as provided by Brisk Heat, or equal. Shall be ¾" thick closed-cell lightweight EPDM based elastomeric material. Insulation shall be sized to allow for the heat tracing line without deforming the insulation. Insulation material must provide a minimum R value of 3 and be suitable for use in conditions from -20 degrees F thru 150 degrees F. Insulation selected must be compatible with PVC jacketing and fitting covers selected.

2.5.4 Heat trace tape shall be provided for freeze protection of liquid conveying pipes in the treatment room and in recovery wells as specified. Heat tracing shall be in accordance with SECTION 16859 – ELECTRICAL HEAT TRACE SYSTEM. It shall be suitable for use with the type and size of pipe noted and complete with thermostat. It shall be suitable for maintaining the temperature of the pipe at approximately 40 degrees F when outside temperature is at -20 degrees F.

2.6 PROCESS PIPE STANDS AND STRUCTURAL SUPPORTS

2.6.1 Galvanized steel C-channel framing members shall be utilized for modifications to the existing pipe support system in the treatment room. The support frame shall be affixed to the floor with epoxy and 3/8" 304 stainless steel allthread, bolts, and washers through a compatible galvanized baseplate for attachment to channel strut.

2.6.2 Bonding epoxy for any anchoring bolts and allthread into the floor shall utilize HIT-RE 500-SD Epoxy Adhesive as manufactured by Hilti, or equal.

2.7 FLOW METERS

2.7.1 Magnetic flow meters shall be provided for the treatment system in the locations indicated on the drawings and meet the requirements of SECTION 13300 – INSTRUMENTATION AND CONTROLS GENERAL PROVISIONS.

PART 3 – EXECUTION

3.1 GENERAL

3.1.1 All dirt, scale, weld splatter, water, and other foreign matter shall be removed from the inside and outside of all pipe and sub-assemblies prior to installing.

3.1.2 All pipe joints and connections to equipment shall be made in such a manner as to produce a minimum of strain at the joint. Valves shall be supported to avoid placing loads on connecting piping until pipe supports are completed.

3.1.3 Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the COR and/or PO, cutting shall be done with an approved type mechanical cutter. Wheel cutter shall be used when practicable.

3.2 PIPING INSTALLATION REQUIREMENTS

3.2.1 All work shall be accomplished using recognized methods and procedures of pipe fabrication and in accordance with the latest revision of applicable ANSI Standards, ASME Codes, AWWA standards, and Pipe Fabrication Institute Standards.

3.2.2 Piping shall be installed in a neat manner with lines straight and parallel or at right angles to walls or column lines and with risers plumb. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no deleterious substances will enter the pipes or fittings. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored.

3.2.3 The full length of pipe shall be used except where cut lengths are necessary. The Contractor shall not spring or deform piping to make up joints.

3.2.4 Pipe shall be cut square, not upset, undersize, or out of round. Ends shall be carefully reamed and cleaned before being installed.

3.2.5 All piping interiors shall be thoroughly cleaned after installation and kept clean by approved temporary closures on all openings until the system is put in service. Closures should be suitable to withstand the hydrostatic test.

3.2.6 End caps on pre-cleaned pipe shall not be removed until immediately before assembly. All open ends shall be capped immediately after completion of installation.

3.2.7 The installation of plastic pipe shall be strictly in accordance with the manufacturer's technical data and printed instructions.

3.2.8 Joint deflections and maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the COR and/or PO, but shall not exceed 5 degrees.

3.2.9 Where connections are made between new work and existing mains, the connections shall be made by using specials and fittings to suit the actual conditions. When made under pressure, these connections shall be installed using standard methods as approved by the COR and/or PO.

3.3 HDPE PIPE

3.3.1 Joints for HDPE pipe shall be butt heat fusion. Butt heat fusion joints shall be made in accordance with the requirements of ASTM F2620. All heat fusion joints shall be done by a factory qualified joining technician as designated by the pipe manufacturer with a minimum of three years experience for the fusion equipment to be used.

3.3.2 Flanged HDPE connections shall be made up at the lowest expected operating temperature, and then the entire piping system shall be brought up to the maximum operating temperature for final installation. (Note: Packing the flanges in ice may be necessary to achieve the proper installation temperature).

3.4 PVC SCHEDULE 80 PIPE

3.4.1 PVC pipe shall be installed as specified herein and in accordance with AWWA M23.

3.4.2 Threaded connections shall be joined in accordance with the manufacturer's printed recommendations. Pure TFE tape or pure TFE paste shall be used as a thread lubricant. No other compounds shall be used.

3.4.3 Pipe less than 4 inches in diameter: Threaded joints shall be made by wrapping the male threads in accordance with Paragraph 3.4.2, then threading the joining members together. The joint shall be tightened using strap wrenches to prevent damage to the pipe and/or fitting. To avoid excessive torque, joints shall be tightened no more than one thread past hand-tight. Preformed rubber-ring gaskets for elastomeric-gasket joints shall be made in accordance with ASTM F477. Couplings shall be provided with stops or centering rings to assure that the coupling is centered on the joint. Solvent cement joints shall use sockets conforming to ASTM D2467. The solvent cement used shall meet the requirements of Paragraph 2.2.13; the joint assembly shall be made in accordance with ASTM D2855 and the manufacturer's specific recommendations.

3.5 THERMAL PIPE INSULATION

3.5.1 Preformed sectional insulation and jacketing shall be used where possible. The use of blanket insulation will be limited to fittings that cannot be insulated with sectional insulation. All joints on preformed and fabricated insulation shall be accurately fitted to eliminate voids. Voids shall be eliminated by refitting or replacing the insulation. End joints shall be firmly butted to adjoining sections of insulation.

3.5.2 Joints shall be located to prevent the entrance of water. Breaks in jacketing caused by vertical connections or instruments shall be protected by hoods or cones. Where there are breaks in the jacket, plastic moisture barriers shall be provided under the jacketing to protect the insulation. Insulation and jacketing of the valve shall be removable to allow servicing of the valve.

3.5.3 PVC plastic jacketing shall have its joints staggered from those of the insulation. Joints between jacketing and insulation shall be a minimum of 3-inches. PVC plastic jacketing shall have a minimum 3-inches of overlap on longitudinal joints and end joints. Longitudinal joints in horizontal piping shall have the outer lap of the joint pointed down to shed water. The end of the outer lap shall be located at the 5 or 7 o'clock positions.

3.5.4 Thermal insulation shall be installed in a manner that provides sufficient space around ball valve operators, sample valves, and the pressure/flow instrumentation devices to fully access and operate the appurtenances without removal of the insulation. Where insulation is terminated to accommodate operator access to appurtenances the heat tracing shall continue.

3.5.5 PVC insulation jacketing shall be provided as a barrier in all locations receiving thermal insulation. All penetrations through the jacketing barrier for pipe supports, instruments, test ports, and flanges shall be sealed to provide a complete protective barrier and conceal underlying insulation. The use of staples or other fasteners that penetrate the vapor barrier is not permitted.

3.5.6 Do not apply insulation prior to testing and acceptance of piping and/or equipment. Insulation shall not be applied to damp or frosty surface. Clean dust, dirt, grease and moisture from surfaces of pipe and ducts before applying insulation or insulation adhesives.

3.5.7 Insulation, adhesives, coatings and vapor barrier materials shall be applied in accordance with manufacturers recommendations. Do not apply these materials when ambient temperature is above or below the maximum and minimum ambient temperature respectively, specified as limits by the manufacturer.

3.5.8 Where piping is provided with electric heat tracing the insulation shall not be installed until the heat tracing has been tested and accepted. Insulation shall be sized to allow for the heat tracing line without deforming the insulation.

3.5.9 Bridge flanges and unions with block or sectional insulation wired in place. Wire shall be black steel, annealed. Stop the pipe insulation a sufficient distance to allow removal of flange bolts without disturbing the pipe insulation and extend the block, at least 2-inches over the adjacent pipe insulation. Flange covers shall be designed for removal without damaging the pipe insulation. Fill voids with blanket insulation.

3.6 PROCESS PIPING SUPPORTS

3.6.1 Contractor shall modify the existing steel c-channel frame to provide structural support of the process piping in the treatment room. Additional support members shall be of similar materials as the existing support system. Frame shall be designed to transfer the weight of the piping system to the floor and shall provide a support system which prevents movement of the piping during process operation including startup and shutdown of the well pumps.

3.6.2 Concrete drilling and setting of anchor bolts using approved epoxy shall be completed in accordance with the epoxy manufacturer's recommendations for installation. All nuts, allthread, bolts and washers shall be type 304 stainless steel.

3.7 DIFFERENTIAL PRESSURE GAUGE AND APPURTENANCES

3.7.1 Install brass compression fittings, gaskets, and copper tubing to reconnect the differential pressure system for the air stripper in a manner which provides an airtight connection between the packed column air stripper and the differential pressure gauge.

3.7.2 Copper differential air pressure tubing shall be installed in a manner which prevents pinching or restriction of the tube and shall be fastened to the air stripper influent pipe by compatible copper clad or brass fasteners no greater than 6 ft apart.

3.7.3 Contractor shall provide a galvanized steel c-channel support stand for mounting the differential pressure gauge adjacent to the packed column air stripper. Gauge shall be mounted 24 inches above the floor and shall be mounted in the vertical position. Concrete drilling and setting of anchor bolts using approved epoxy shall be completed in accordance with the epoxy manufacturer's recommendations for installation. All nuts, allthread, bolts and washers shall be type 304 stainless steel.

3.8 TESTING

3.8.1 General

3.8.1.1 The Contractor shall conduct pressure and hydrostatic testing on all types of installed pipe. Testing shall be performed as specified below. The Contractor shall furnish all labor, testing plugs or caps, pressure pumps, pipe connections, gauges, and all other equipment required. All testing shall be performed in the presence of the COR and/or PO.

3.8.1.2 The Contractor shall repair faulty joints or remove defective pipe and fittings and replace as approved by the COR and/or PO. After repairs are made, the Contractor shall retest the affected areas of the system.

3.8.2 Field Testing for Piping Systems

3.8.2.1 All pipelines shall remain undisturbed for the minimum curing or cooling time (if applicable) specified for each type of pipe material but no less than 8 hours to develop full curing and complete strength at all joints. All pipe systems shall be flushed clean and then subjected to a hydrostatic pressure test for 4 hours at a test pressure and temperature specified below. Testing procedures shall be as specified below.

3.8.2.2 Hydrostatic test shall be conducted using water at 100 psi and at ambient temperatures.

3.8.2.3 Upon approval by the COR and/or PO, segments of the piping system can be tested individually, rather than the entire system all at once. The test shall be performed by slowly filling the piping system, expelling entrapped air from all high points. The fill rate shall be controlled so that the fluid velocity within the pipe system is less than 2 feet per second. Upon completion of the filling process develop the system pressure in such a manner so as to not create shock, surge, or water hammer in the pipe system. The test duration time limit shall not begin until the full pressure specified above has been reached. The system shall maintain pressure without losing 5 psi or more from the specified value for the pressure. These tolerances shall be held for the entire duration of the test. Upon completion of the test, the pressure shall be slowly removed by opening a valve or other pressure-relieving device at a location remote to the location of the pressure monitoring equipment and the pipe be flushed clean of any debris that may have entered the pipe during installation or testing. The system shall not be connected to the treatment process prior to flushing.

3.8.2.4 The pressure test shall be monitored by a recording type pressure gauge. The entire test process shall be recorded, including the initial pressurization of the piping system. The record shall be continuous through the system test and shall show the final de-pressurization of the pipe system.

3.8.2.5 All visible leaks detected during the pressure test shall be repaired and the pressure test rerun. A successful test shall be a test in which no visible leaks are detected and the pipe system pressure can be maintained without losing 5 psi or more from the stabilized test pressure.

3.8.2.6 Prior to testing, the pipelines shall be supported in an approved manner to prevent movement during the tests.

3.9 CLEANUP

3.9.1 Upon completion of the installation of water lines and appurtenances, all debris and surplus materials resulting from the work shall be removed.

END OF SECTION

Division 16

Electrical

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SECTION 16000

ELECTRICAL - GENERAL PROVISIONS

PART 1 – GENERAL

1.1 SCOPE OF WORK

1.1.1 Furnish all labor, materials and equipment required and install complete and make operational, electrical and process instrumentation systems at the Garvey Elevators Facility as shown on the Drawings and as specified herein.

1.1.2 The work shall include furnishing, installing and testing the equipment and materials detailed in the following Sections:

Section No	Title
16000 -	ELECTRICAL - GENERAL PROVISIONS
16110 -	RACEWAYS, BOXES, FITTINGS AND SUPPORTS
16120 -	WIRES AND CABLES (600 VOLT MAXIMUM)
16141 -	WIRING DEVICES
16191 -	MISCELLANEOUS EQUIPMENT
16471 -	PANELBOARD MODIFICATIONS
16859 -	ELECTRICAL HEAT TRACING

1.1.3 The work shall include the following:

1.1.3.1 Provide conduit, wire and field connections for all motors, motor controllers, control devices, control panels and electrical equipment furnished under Divisions 13 and 15.

1.1.3.2 Provide conduit, wiring and terminations for all field-mounted instruments furnished and mounted under other Divisions, including process instrumentation primary elements, transmitters, local indicators and control panels. Lightning and surge protection equipment wiring at process instrumentation transmitters. Install vendor furnished cables specified under other Divisions.

1.1.3.3 Provide modifications to existing control systems including installation of auxiliary motor starter contacts, relays, switches, as required to provide the control functions or inputs as shown on the Drawings. Verify all existing wiring and connections for correctness. Trace the circuits in the field and develop the wiring diagrams necessary for completion of the work. Document all changes made to the wiring diagrams and return a marked-up set of Record Drawings to the Owner after the work is complete.

1.1.3.4 Coordinate the sequence of demolition with the sequence of construction to maintain plant operation. Remove and demolish equipment and materials in such a sequence that the existing and proposed plant will function properly with no disruption of treatment.

1.1.3.5 Provide modifications to existing panelboards, including the furnishing and installing of circuit breakers or disconnection of circuits as required to provide power to new and existing equipment to maintain the plant in operation.

1.1.3.6 Perform testing of the electrical equipment in accordance with the requirements of the individual specification sections.

1.1.3.7 Set the electrical protective devices in accordance with NETA standards and in accordance with the manufacturer's recommendation.

1.1.4 Each bidder or their authorized representatives shall, before preparing their proposal, visit all areas of the existing buildings and structures in which work under this sub-bid is to be performed and inspect carefully the present installation. The submission of the proposal by this bidder shall be considered evidence that their representative has visited the buildings and structures and noted the locations and conditions under which the work will be performed and that he/she takes full responsibility for a complete knowledge of all factors governing his/her work.

1.1.5 Provide electrical demolition work associated with the removal of equipment from the existing facilities. The work shall include disconnecting and removing electrical disconnect switches, electrical wiring and conduit to equipment. Make equipment scheduled for removal free of electrical shock hazard.

1.1.6 Review the electrical underground system and the civil yard piping. Install the electrical underground system in a manner that avoids conflicts with manholes, catch basins, etc. provided under other Divisions of the specifications.

1.1.7 Sequencing and Scheduling

1.1.7.1 Coordinate electrical equipment installation with other trades.

1.1.7.2 Arrange for chases, slots and openings in the building structures during the progress of construction to allow for the electrical installation.

1.1.7.3 Coordinate installing required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

1.1.7.4 Sequence, coordinate and integrate the installation of electrical materials and equipment for efficient flow of the work. Coordinate the installation of large equipment requiring position prior to closing in the building.

1.2 RELATED WORK

1.2.1 Instrumentation and control equipment is included under Division 13.

1.3 SUBMITTALS

1.3.1 Submit, in accordance with the Performance Work Statement, shop drawings for equipment, materials and other items furnished under Division 16.

1.3.2 As a minimum all equipment specified in each Section of Division 16 shall be submitted at one time. As an example all lighting fixtures shall be submitted together, all motor control centers shall be submitted together, etc. Submittals that do not comply will be returned disapproved.

1.3.3 Shop drawings shall be submitted for the following equipment:

1.3.3.1 Raceways, Boxes, Fittings and Hangers.

1.3.3.2 Wires and Cables.

1.3.3.3 Miscellaneous Equipment (as specified in SECTION 16191 – MISCELLANEOUS EQUIPMENT).

1.3.3.4 Switches, Receptacles and Covers.

1.3.3.5 Grounding Hardware and Connections.

1.3.3.6 Heat Tracing.

1.3.4 The manufacturers name and product designation or catalog numbers shall be submitted for the following material:

1.3.4.1 Raceways, Boxes, Fittings and Hangers.

1.3.4.2 Wire and Cable.

1.3.4.3 Switches, Receptacles and Covers.

1.3.4.4 Ground System Resistance Test Equipment.

1.3.5 The following shall be submitted for record:

1.3.5.1 Ground System Test Results.

1.3.5.2 Electrical System Test Results.

1.3.6 Mark submittals to clearly identify proposed equipment including accessories, options, and features and to exclude parts not applicable to the project. When manufacturer's cut sheets apply to a product series rather than a specific product, the data specifically applicable to the project shall be highlighted or clearly indicated by other means. Each submittal piece of literature and each submittal drawing shall clearly reference the Project Specification and/or Contract Drawing that the submittal is to cover. General catalogs will not be accepted as cut sheets to fulfill submittal requirements.

1.3.7 Check shop drawings for accuracy prior to submittal. Shop drawings shall be stamped with the date checked and a statement indicating that the shop drawings conform to this Section and the Drawings. This statement shall also list all exceptions to this Section and the Drawings. Mark submittals to identify proposed equipment including accessories, options and features being proposed for approval and exclude parts not to be used. Shop drawings not so checked and noted shall be returned marked NOT APPROVED.

1.3.8 The COR and/or PO check shall be for conformance with the design concept of the project and compliance with this Section and the Drawings. Errors and omissions on approved shop drawings shall not relieve the Contractor from the responsibility of providing materials and workmanship required by this Section and the Drawings.

1.3.9 All dimensions shall be field verified at the job site and coordinated with the work of all other trades.

1.3.10 Material shall not be ordered or shipped until the shop drawings have been approved. No material shall be ordered or shop work started if shop drawings are marked “APPROVED AS NOTED - CONFIRM," "APPROVED AS NOTED - RESUBMIT" or "NOT APPROVED."

1.3.11 In addition to manufacturer's equipment shop drawings, submit electrical installation working drawings containing the following:

1.3.12 Operation and Maintenance Data

1.3.12.1 Submit operations and maintenance data for equipment furnished under this Division. The manuals shall be prepared specifically for this installation and shall include catalog data sheets, drawings, equipment lists, descriptions, parts lists including replacement part numbers, to instruct operating and maintenance personnel unfamiliar with such equipment.

1.3.12.2 Manuals shall include the following as a minimum:

1.3.12.2.1 A comprehensive index.

1.3.12.2.2 A complete "As-Built" set of approved shop drawings.

1.3.12.2.3 A complete list of the equipment supplied, including serial numbers, ranges and pertinent data.

1.3.12.2.4 A table listing of the "as left" settings for all timing relays and alarm and trip setpoints.

1.3.12.2.5 System schematic drawings "As-Built," illustrating all components, piping and electric connections of the systems supplied under this Section.

1.3.12.2.6 Detailed service, maintenance and operation instructions for each item supplied.

1.3.12.2.7 Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.

1.3.12.2.8 The operating instructions shall also incorporate a functional description of the entire system, with references to the systems schematic drawings and instructions.

1.3.12.2.9 Complete parts list with stock numbers, including spare parts.

1.3.13 Exceptions for Submittals

Exceptions to the Specifications or Drawings shall be clearly defined by the Electrical Subcontractor in a separate section of each submittal package. The submittal shall contain the reason for the exception, the exact nature of the exception and the proposed substitution so that a proper evaluation may be made by the COR and/or PO. The acceptability of any device or methodology submitted as an “or equal” or “exception” to the Specifications shall be at the sole discretion of the COR and/or PO.

1.4 REFERENCE STANDARDS

1.4.1 Electric equipment, materials and installation shall comply with the National Electrical Code (NEC) and with the latest edition of the following codes and standards:

1.4.1.1 National Electrical Safety Code (NESC)

1.4.1.2 Occupational Safety and Health Administration (OSHA)

1.4.1.3 National Fire Protection Association (NFPA)

1.4.1.4 National Electrical Manufacturers Association (NEMA)

1.4.1.5 American National Standards Institute (ANSI)

1.4.1.6 Insulated Cable Engineers Association (ICEA)

1.4.1.7 The Instrumentation, Systems and Automation Society (ISA)

1.4.1.8 Underwriters Laboratories (UL)

1.4.1.9 Factory Mutual (FM)

1.4.10.10 International Electrical Testing Association (NETA)

1.4.10.11 International Energy Conservation Code (IECC)

1.4.10.12 The Building Officials and Code Administrators National Building Code (BOCA)

1.4.10.13 American Society for Testing and Materials (ASTM)

1.4.10.14 Institute of Electrical and Electronics Engineers (IEEE)

1.4.10.15 Joint Industrial Council (JIC)

1.4.2 Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 PRIORITY OF THE CONTRACT DOCUMENTS

1.5.1 If, during the performance of the work, the Contractor finds a conflict, error or discrepancy between or among one or more of the Sections or between or among one or more Sections and the Drawings, furnish the higher performance requirements. The higher performance requirement shall be considered the equipment, material, device or installation method which represents the most stringent option, the highest quality or the largest quantity.

1.5.2 In all cases, figured dimensions shall govern over scaled dimensions, but work not dimensioned shall be as directed by the COR and/or PO and work not particularly shown, identified, sized, or located shall be the same as similar work that is shown or specified.

1.5.3 Detailed Drawings shall govern over general drawings, larger scale Drawings take precedence over smaller scale Drawings, Change Order Drawings shall govern over Contract Drawings and Contract Drawings shall govern over Shop Drawings.

1.5.4 If the issue of priority is due to a conflict or discrepancy between the provisions of the Contract Documents and any referenced standard, or code of any technical society, organization or association, the provisions of the Contract Documents will take precedence if they are more stringent or presumptively cause a higher level of performance. If there is any conflict or discrepancy between standard specifications, or codes of any technical society, organization or association, or between Laws and Regulations, the higher performance requirement shall be binding on the Contractor, unless otherwise directed by the COR and/or PO.

1.5.5 In accordance with the intent of the Contract Documents, the Contractor accepts the fact that compliance with the priority order specified shall not justify an increase in Contract Price or an extension in Contract Time nor limit in any way, the Contractor's responsibility to comply with all Laws and Regulations at all times

1.6 ENCLOSURE TYPES

1.6.1 Unless otherwise required, electrical enclosures shall be NEMA Types as follows:

1.6.1.1 NEMA 1 in dry, non-process indoor above grade locations (i.e. administration areas, laboratories, control rooms, storage rooms).

1.6.1.2 NEMA 6P in outdoor locations as indicated on the drawings where rating for prolonged submersion is required.

1.6.1.3 NEMA 4X in "CORROSIVE", "WET" and outdoor locations shown on the Drawings.

1.7 Not Used

1.8 CODES, INSPECTION AND FEES

1.8.1 Equipment, materials and installation shall comply with the requirements of the local authority having jurisdiction.

1.8.2 Obtain all necessary permits and pay all fees required for permits and inspections.

1.9 Not Used

1.10 ELECTRICAL SYSTEM TESTING AND SETTINGS

1.10.1 Test and provide settings for systems and equipment furnished under Division 16 in accordance with the individual equipment sections for additional specific testing requirements. If the testing results are not within acceptable limits repair or replace all defective work and equipment at no additional cost to the Owner.

1.10.2 Make adjustments to the systems furnished under Division 16 in accordance with the equipment manufacturers requirements/recommendations

1.11 INTERPRETATION OF DRAWINGS

1.11.1 Unless specifically stated to the contrary, the Drawings do not show exact locations of conduit runs. Coordinate the conduit installation with other trades and the actual supplied equipment.

1.11.2 Install each 3 phase circuit in a separate conduit unless otherwise shown on the Drawings.

1.11.3 Conduit shown exposed shall be installed exposed; conduit shown concealed shall be installed concealed. Unless otherwise indicated install branch circuit conduits exposed in process/ industrial type spaces and concealed in finished spaces.

1.11.4 Verify the exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installation.

1.11.5 Except where dimensions are shown, the locations of equipment, fixtures, outlets and similar devices shown on the Drawings are approximate only. Exact locations shall be determined by the Contractor and approved by the COR and/or PO during construction. Obtain information relevant to the placing of electrical work and in case of any interference with other work, proceed as directed by the COR and/or PO and furnish all labor and materials necessary to complete the work in an approved manner.

1.11.6 Circuit layouts are not intended to show the number of fittings, or other installation details. Furnish all labor and materials to install and place in satisfactory operation all power, lighting and other electrical systems shown.

1.11.7 Redesign of electrical or mechanical work, which is required due to the Contractor's use of an alternate item, arrangement of equipment and/or layout other than specified herein, shall be done by the Contractor at his/her own expense. Redesign and detailed plans shall be submitted to the COR and/or PO for approval. No additional compensation will be provided for changes in the work, either his/her own or others, caused by such redesign.

1.11.8 Raceways and conductors for low voltage (120 Volts) thermostats controlling HVAC unit heaters, exhaust fans and similar equipment are not shown on the Drawings. Provide raceways and conductors between the thermostats, the HVAC equipment and the motor starters for a complete and operating system. Raceways shall be installed concealed in all finished space and may be installed concealed or exposed in process spaces. Refer to the HVAC drawings for the locations of the thermostats.

1.11.9 It is the intent of these Specifications that the Electrical Systems shall be suitable in every way for the service required. All materials and all work that may be implied as being incidental to the work of this Section shall be furnished at no additional cost to the Owner.

1.11.10 Raceways and conductors for lighting, switches, receptacles and other miscellaneous low voltage power and signal systems as specified are not shown on the Drawings. Raceways and conductors shall be provided as required for a complete and operating system. Homeruns, as shown on the Drawings, are to assist the Contractor in identifying raceways to be run exposed and raceways to be run concealed. Raceways shall be installed concealed in all finished spaces and may be installed exposed or concealed in all process spaces. Raceways installed exposed shall be near the ceiling or along walls of the areas through which they pass and shall be routed to avoid conflicts with HVAC ducts, cranes hoists, monorails, equipment hatches, doors, windows, etc. Raceways installed concealed shall be run in the center of concrete floor slabs, above suspended ceilings, or in partitions as required.

1.12 Not Used.

1.13 RECORD DRAWINGS

1.13.1 As the work progresses, legibly record all field changes on a set of Project Contract Drawings, hereinafter called the "Record Drawings."

1.13.2 Record Drawings shall accurately show the installed condition of the following items:

1.13.2.1 Raceways and pull boxes.

1.13.2.2 Conductor sizes and conduit fills.

1.13.2.3 Panel Schedule(s).

1.13.2.4 Control Wiring Diagram(s).

1.13.2.5 Plan view, sizes and locations of switchgear, distribution transformers, substations, motor control centers and panelboards.

1.13.3 Submit the record drawings and the schedule of control wiring raceways and wire numbers (or the point-to-point connection diagram) to the Owner.

1.14 EQUIPMENT INTERCONNECTIONS

1.14.1 Review shop drawings of equipment furnished under Divisions 13 and 15 and prepare coordinated wiring interconnection diagrams. Submit copies of wiring diagrams or tables with Record Drawings.

1.14.2 Furnish and install all equipment interconnections.

1.15 MATERIALS AND EQUIPMENT

1.15.1 Materials and equipment furnished under this contract shall be new.

1.15.2 Material and equipment of the same type shall be the product of one manufacturer and shall be UL listed.

1.15.3 Warrant all equipment furnished under Division 16. Refer to individual equipment sections for additional warranty items.

1.16 EQUIPMENT IDENTIFICATION

1.16.1 Identify equipment, disconnect switches, separately mounted motor starters, control stations, etc. furnished under Division 16 with the name of the equipment it serves. Motor control centers, control panels, panelboards, switchboards, switchgear, junction or terminal boxes, transfer switches, etc, shall have nameplate designations as shown on the Drawings.

1.16.2 Nameplates shall be engraved, laminated plastic, not less than 1/16-in thick by 3/4-in by 2-1/2-in with 3/16-in high white letters on a black background.

1.16.3 Nameplates shall be screw mounted to NEMA 1 enclosures. Nameplates shall be bonded to all other enclosure types using an epoxy or similar permanent waterproof adhesive. Two sided foam adhesive tape is not acceptable. Where the equipment size does not have space for mounting a nameplate the nameplate shall be permanently fastened to the adjacent mounting surface.

PART 2 – PRODUCTS (NOT USED)

PART 3 – EXECUTION

3.1 SLEEVES AND FORMS FOR OPENINGS

3.1.1 Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. Locate all slots for electrical work and form before concrete is poured.

3.1.2 Exact locations are required for stubbing-up and terminating concealed conduit. Obtain shop drawings and templates from equipment vendors or other subcontractors and locate the concealed conduit before the floor slab is poured.

3.1.3 Where setting drawings are not available in time to avoid delay in scheduled floor slab pours, the COR and/or PO may allow the installations of such conduit to be exposed. Requests for this deviation must be submitted in writing. No additional compensation for such change will be allowed.

3.1.4 Seal all openings, sleeves, penetration and slots as specified in SECTION 16110 - RACEWAYS, BOXES, FITTINGS AND SUPPORTS.

3.2 CUTTING AND PATCHING

3.2.1 Cutting and patching shall be done in a thoroughly workmanlike manner. Saw cut concrete and masonry prior to breaking out sections.

3.2.2 Core drill holes in concrete floors and walls as required.

3.2.3 Install work at such time as to require the minimum amount of cutting and patching.

3.2.4 Do not cut joists, beams, girders, columns or any other structural members.

3.2.5 Cut opening only large enough to allow easy installation of the conduit.

3.2.6 Patching to be of the same kind and quality of material as was removed.

3.2.7 The completed patching work shall restore the surface to its original appearance or better.

3.2.8 Patching of waterproofed surfaces shall render the area of the patching completely waterproofed.

3.2.9 Remove rubble and excess patching materials from the premises.

3.2.10 When existing conduits are cut at the floor line of wall line, they shall be filled with grout of suitable patching material.

3.3 INSTALLATION

3.3.1 Work not installed according to the Drawings and Specification shall be subject to change as directed by the COR and/or PO at Contractor's expense.

3.3.2 Electrical equipment shall be protected against mechanical and water damage. Store all electrical equipment in dry permanent shelters. Do not install electrical equipment in place until structures are weather-tight.

3.3.3 Damaged equipment shall be replaced or repaired by the equipment manufacturer, at the COR and/or PO's discretion and at the Contractor's expense.

3.3.4 Repaint any damage to factory applied paint finish using touch-up paint furnished by the equipment manufacturer. The entire damaged panel or section shall be repainted as required by the COR and/or PO at the Contractor's expense.

END OF SECTION

SECTION 16110

RACEWAYS, BOXES, FITTINGS AND SUPPORTS

PART 1 − GENERAL

1.1 SCOPE OF WORK

1.1.1 Furnish and install complete raceway systems as shown on the Drawings and as specified herein.

1.1.2 Raceways and conductors are not shown completely on the Drawings, including but not limited to raceways and conductors: between lighting, switches, receptacles, other miscellaneous low voltage and signal systems, except where they are required to pass through a restricted or designated spaces. Conduit and wiring descriptions are indicated on the riser diagrams for the Instrumentation Systems. Home runs indicated, are to assist the Contractor in identifying raceways to be installed concealed or exposed. Raceways and conductors shall be provided for complete and operating systems. Raceways indicated to be run exposed on the Drawings shall be run near the ceilings or along the walls of the areas through which they pass and shall be routed to avoid conflicts with HVAC ducts, cranes and hoists, lighting fixtures, doors and hatches, etc. Raceways indicated to be run concealed shall be run in the center of concrete floor slabs, in partitions, or above hung ceilings, as required.

1.1.3 Furnish all labor, materials, equipment, accessories and components and install a complete seismic restraint and support system for raceway systems as indicated on the Drawings and as specified herein.

1.1.3.1 All supports, hangers, bracing and appurtenances shall conform to the latest applicable requirements of the Nebraska State Building Code except as supplemented or modified by the requirements specified in this Section.

1.2 SUBMITTALS

1.2.1 Submit, in accordance with the Performance Work Statement, the manufacturers' names and product designation or catalog numbers with marked cut sheets of all materials specified.

1.2.2 Submittals shall include type of hanger and/or support, location, support reaction transmitted to the structure and type of anchor and other supporting appurtenance including structural fasteners.

PART 2 − PRODUCTS

2.1 RACEWAYS AND FITTINGS

2.1.1 Steel Conduit and Fittings

2.1.1.1 Rigid metal conduit (GRS), couplings, factory elbows and fittings shall be heavy wall steel tubing with a hot-dipped galvanized finish inside and out after threading and shall comply with ANSI C 80.1 and UL/6.

2.1.2 Non Metallic Conduit and Fittings

2.1.2.1 PVC conduit shall be rigid polyvinyl chloride schedule 80. Rigid PVC conduit shall comply with NEMA TC-2 and UL/651 and shall be sunlight resistant, rated for use with 90 degree C conductors in exposed and direct or concrete encased applications.

2.1.2.2 Underground utility duct, 4-in trade size and above, shall be Schedule 80 high density polyethylene (HDPE) conduit encased in concrete, rated for use with 90 degree C and comply with UC/651A and UL/651B, NEMA TC-7 and ASTM 2160

2.1.2.3 Connectors, couplings, fittings and ancillary materials shall be supplied by the conduit manufacturer. Connectors, fittings and ancillary materials shall be rated for the environment for which they are installed. Connectors, fittings and ancillary materials located in the Recovery Wells and Injection Well shall be approved watertight and suitable for maintaining the NEMA 6P submersion rating of the enclosures.

2.1.2.4 Acceptable manufacturers:

2.1.2.4.1 Carlon Corp.

2.1.2.4.2 Certained Corp.

2.1.2.4.3 Conux Pipe Systems, Inc.

2.1.2.4.4 Or equal.

2.1.3 Liquid-tight Flexible Metal Conduit, Couplings and Fittings

2.1.3.1 Liquid-tight flexible metal conduit shall be square locked, galvanized steel flexible conduit with a moisture proof, flame resistant, polyvinyl chloride jacket, for use with rigid metal conduit systems. Sealtite, Type UA, manufactured by the Anaconda Metal Hose Div.; Anaconda American Brass Co.; American Flexible Conduit Co., Inc.; Universal Metal Hose Co. or equal.

2.1.3.2 Liquid-tight conduit fittings shall be hot-dipped mechanically galvanized, positive grounding, screw in type. Provide external bonding lugs on sizes 1-1/4-in and larger. Box connectors shall have insulated throats as manufactured by the Thomas & Betts Co.; Crouse-Hinds Co. or equal.

2.1.3.3 Acceptable Manufacturers:

2.1.3.3.1 American Flexible Conduit Co.

2.1.3.3.2 Anaconda Metal Hose/ANAMET Inc.

2.1.3.3.3 Electri-flex Co.

2.1.3.3.4 Thomas & Betts

2.1.3.3.5 O-Z Gedney

2.1.3.3.6 Or equal

2.2 BOXES AND FITTINGS

2.2.1 Dry and Damp Location Boxes and Fittings

2.2.1.1 Outlet boxes shall be zinc-galvanized, extra depth, pressed steel with knockouts and of size and type suitable for the intended application.

2.2.1.2 Boxes that are less than 100 cubic inches in size used for junction or pull boxes shall be zinc galvanized pressed steel not less than 14 USS gauge with appropriate blank covers, minimum size 4-11/16-in square by 2-1/8-in deep.

2.2.1.3 Boxes that are 100 cubic inches and larger shall be constructed of hop dip galvanized sheet steel without knockouts. Covers shall be secured with round head brass machine screws. All joints shall be welded and ground smooth.

2.2.1.4 Acceptable Manufacturers:

2.2.1.4.1 Appleton

2.2.1.4.2 Raco

2.2.1.4.3 Steel City

2.2.1.4.4 Hoffman

2.2.1.4.5 Electromate Division of Robroy Ind.

2.2.1.4.6 Wiegmann

2.2.2 Wet Location Boxes and Fittings

2.2.2.1 NEMA 4X terminal boxes, junction boxes, pull boxes, etc, shall be sheet Type 316 stainless steel unless otherwise shown on the Drawings. Boxes shall have continuously welded seams and mounting feet. Welds shall be ground smooth. Boxes shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14 gauge metal and covers shall not be less than 12 gauge metal. Covers shall be gasketed and fastened with stainless steel clamps. Terminal boxes shall be furnished with hinged doors, terminal mounting straps and brackets. Terminal blocks shall be NEMA type, not less than 20 Amps, 600 Volt.

2.2.2.2 Cast or malleable iron device boxes shall be Type FD. Boxes and fittings shall have cadmium-zinc finish with cast covers and stainless steel screws.

2.2.2.3 Cast aluminum device boxes shall be Type FD. Boxes and fittings shall be copper free aluminum with cast aluminum covers and stainless steel screws.

2.2.2.4 Where called out for on Drawings NEMA 6P junction boxes and equipment enclosures shall be Fiberglass type and rated for prolonged submersion.

2.2.2.5 Acceptable Manufacturers:

2.2.2.5.1 Appleton

2.2.2.5.2 Crouse-Hinds

2.2.2.5.3 Steel City

2.2.2.5.4 Hoffman

2.2.2.5.5 Electromate - Division of Robroy Ind.

2.2.2.5.6 Or equal

2.2.3 Miscellaneous Fittings

2.2.3.1 Flexible couplings shall be type ECGJH as manufactured by the Crouse-Hinds Co.; Appleton Electric Co.; Killark Electric Manufacturing Co. or equal.

2.2.3.2 Conduit wall seals for cored holes shall be Type CSMC as manufactured by the O.Z./Gedney Co. or equal.

2.2.3.3 Conduit wall and floor seals for sleeved openings shall be Type CSMI as manufactured by the O.Z./Gedney Co. or equal.

2.2.3.4 Combination expansion-deflection fittings embedded in concrete shall be Type XD as manufactured by the Crouse-Hinds Co.; Type DX as manufactured by O.Z./Gedney Co.; Type DF as manufactured by Appleton Electric Co. or equal.

2.2.3.5 Combination expansion-deflection fittings installed exposed shall be Type XD as manufactured by Crouse-Hinds Co.; Type DX as manufactured by O.Z. Gedney Co.; Type DF as manufactured by Appleton Electric Co. or equal.

2.2.3.6 Conduit sealing bushings shall be O.Z./Gedney, Type CSB or equal.

2.2.3.7 Grounding bushings shall be malleable iron with integral insulated throat rated for 150 degrees C, with solderless lugs as manufactured by Crouse Hinds/Cooper, Series HGLL; Appleton, Series GIB; O.Z./Gedney, Type HBLG or equal.

2.3 HARDWARE

2.3.1 Conduit Mounting Equipment

2.3.1.1 In dry indoor areas, hangers, rods, backplates, beam clamps, channel, etc shall be galvanized iron or steel.

2.3.1.2 PVC coated steel channel with stainless steel hardware shall be used in areas designated "WET" on the Drawings and in outdoor locations. Fiberglass channel shall be resistant to the chemicals present in the area in which it is used.

2.3.1.3 Furnish any and all necessary supports, brackets, conduit sleeves, racks and bracing as required. All boxes and hardware shall be galvanized zinc plated steel except that stainless steel shall be used in areas designated as “WET” on the Drawings.

2.3.2 Conduit Identification Plates

2.3.2.1 Conduit identification plates shall be embossed stainless steel with stainless steel band, permanently secured to the conduit without screws.

2.3.2.2 Identification plates shall be as manufactured by the Panduit Corp. or equal.

2.3.3 Wall and Floor Slab Opening Seals

2.3.3.1 Wall and floor slab openings shall be sealed with a UL approved expending material which equals or exceeds the fire rating of the wall or floor construction as manufactured by the Thomas & Betts Corp.; Pro Set Systems; Neer Mfg. Co.; Specified Technologies, Inc. or equal.

2.3.4 Cold Galvanizing Compound

2.3.4.1 Cold galvanizing compound shall be as manufactured by ZRC Products Company, a Division of Norfolk Corp. or equal.

2.3.5 Conduit Supports

2.3.5.1 Trapezes

2.3.5.1.1 In dry indoor areas, beams, channels, struts, hangers, bracing, rods, beam clamps, accessories and components shall be galvanized steel.

2.3.5.1.2 PVC coated steel beams, channels, struts or fiberglass beams, channels, struts with stainless steel hangers, bracing, rods, beam clamps, accessories and components shall be used in areas designated “WET” where indicated and in outdoor locations. Fiberglass channels shall be resistant to the chemicals resent in the area in which it is used.

2.3.5.2 Flush Mounted Supports

2.3.5.2.1 In dry indoor areas, channels, struts, accessories and components shall be galvanized steel.

2.3.5.2.2 PVC coated steel channels, struts or fiberglass channels, struts with stainless, accessories and components shall be used in areas designated “WET“ where indicated and in outdoor locations. Fiberglass channels, struts shall be resistant to the chemicals present in the area in which it is used.

2.3.5.3 Conduit Racks

2.3.5.3.1 In dry indoor areas, conduit racks, accessories and components shall be galvanized steel.

2.3.5.3.2 PVC coated steel conduit racks or fiberglass conduit racks with stainless, accessories and components shall be shall be used in areas designated “WET” where indicated and in outdoor locations. Fiberglass channels shall be resistant to the chemicals present in the area in which it is used.

2.3.5.4 Conduit Hangers

2.3.5.4.1 In dry indoor areas, conduit clamps, rods, beam clamps, bracing, accessories and components shall be galvanized steel.

2.3.5.4.2 Stainless steel conduit clamps, rods, beam clamps, bracing, accessories and components shall be shall be used in areas designated “WET” where indicated and in outdoor locations.

2.3.5.5 Adjustable steel and plastic band hangers, adjustable band hangers, adjustable swivel ring hangers and J-hangers shall not be allowed.

2.3.5.6 All hangers, bracing, rods, beam clamps, accessories and components shall be as manufactured by the Carpenter & Paterson Inc.; Grinnell Corporation; B-Line Systems Inc. or equal.

2.3.5.7 Design of supplemental structural steel required for attachment to the building structural support system shall be the full responsibility of the Support Contracting Officer's Representative (COR) and/or Project Officer (PO).

PART 3 − EXECUTION

3.1 RACEWAY APPLICATIONS

3.1.1 Refer to Table 16110-1 for specific raceway application requirements.

3.1.2 All conduit of a given type shall be the product of one manufacturer.

3.2 BOX APPLICATIONS

3.2.1 Unless otherwise specified herein or shown on the Drawings, all boxes shall be metal.

3.2.2 Exposed switch, receptacle and lighting outlet boxes and condulet fittings shall be cast or malleable iron, except that cast aluminum shall be used with aluminum conduit and non-metallic PVC shall be used with PVC.

3.2.3 Concealed switch, receptacle and lighting outlet boxes shall be pressed steel.

3.2.4 Terminal boxes, junction boxes and pull boxes shall have NEMA ratings suitable for the location in which they are installed, as specified in SECTION 16000 - ELECTRICAL - GENERAL PROVISIONS.

3.2.5 Boxes flush in block, brick or tile walls shall be located at a course line and provided with square tile covers. Flush boxes shall not project beyond the finished surfaces nor shall surfaces project more than 1/8-in beyond the box enclosure. Wiring devices located in close proximity to each other shall be installed in one solid gang box with single cover.

3.2.6 All conduit bodies and pulling outlets shall comply with NEC wire bending space requirements. Mogul type fittings shall be used for sizes 2-1/2-in and larger.

TABLE 16110-1 *Raceway Application Guidelines*	
Location/Circuit Type	*Raceway Type*
<u>All locations</u> - Class 2 and 3 signal wiring and 4-20 mA instrumentation cables, non-fiber (copper) data highway.	▪ Exposed - Galvanized rigid steel (GRS) conduit. Concealed - Galvanized rigid steel (GRS) conduit. ▪ Underground - Galvanized rigid steel (GRS) conduit in concrete reinforced ductbank. Use PVC coated steel conduit for single conduit direct burial applications.
<u>Clean, dry non-finished areas</u> - electrical rooms, generator rooms, mechanical rooms, shops, dry storage, etc.	▪ Exposed conduit for power wiring, lighting, switch, and receptacle circuits - Galvanized rigid steel (GRS). ▪ Concealed conduit for power wiring, lighting, switch, and receptacle circuits - Schedule 80 PVC conduit when embedded within concrete floor slabs. GRS when embedded within masonry block walls.
<u>Process areas</u> - non-corrosive, non-hazardous locations designated as DAMP or WET on the Drawings.	▪ Exposed conduit for power wiring, lighting, switch, and receptacle circuits - Galvanized rigid steel (GRS) ▪ Concealed conduit for power wiring, lighting, switch, and receptacle circuits - Schedule 80 PVC conduit when embedded within concrete floor slabs. GRS when embedded within masonry block walls.
<u>Outdoor areas</u> - all locations.	▪ Exposed conduit for power wiring, lighting, switch, and receptacle circuits - Galvanized rigid steel (GRS). Schedule 80 PVC conduit shall be used exposed where indicated on the drawings. ▪ Concealed conduit for power wiring, lighting, switch, and receptacle circuits - Schedule 80 PVC conduit when embedded within concrete structures.

3.3 FITTINGS APPLICATIONS

3.3.1 Combination expansion-deflection fittings shall be used where exposed conduits cross structure expansion joints or in straight runs where expansion is anticipated. Combination expansion-deflection fittings shall be installed where embedded conduits cross structural expansion joints. Refer to Structural Drawings for expansion joint locations. Provide bonding jumpers around fittings.

3.3.2 All underground conduit penetrations at walls or other structures shall be sealed watertight. Conduit wall seals and sleeves shall be used in accordance with the manufacturer's installation instructions and the details shown on the Drawings.

3.3.3 Conduit sealing bushings shall be used to seal conduit ends exposed to the weather and at other locations shown on the Drawings.

3.3.4 Insulated throat grounding bushings shall be used where conduits stub up into electrical equipment such as MCC's, switchgear, etc.

3.4 INSTALLATION

3.4.1 No conduit smaller than 3/4-in electrical trade size shall be used, nor shall any have more than the equivalent of three 90 degree bends in any one run. Pull boxes shall be provided as required by the NEC after every 270 degrees of bends and for straight run not to exceed 200 feet or as directed.

3.4.2 No wire shall be pulled until the conduit system is complete in all details; in the case of concealed work, until all rough plastering or masonry has been completed; in the case of exposed work, until the conduit system has been completed in every detail.

3.4.3 All conduit which may under any circumstance contain liquids such as water, condensation, liquid chemicals, etc, shall be arranged to drain away from the equipment served. If conduit drainage is not possible, conduit seals shall be used to plug the conduits. The ends of all conduits shall be temporarily plugged to exclude dust, moisture and debris from entering during construction.

3.4.4 Conduit ends exposed to the weather shall be sealed with conduit sealing bushings.

3.4.5 Conduits noted as spare shall be capped or plugged at both ends with easily removable fittings.

3.4.6 Conduit terminating in NEMA 4X enclosures shall be terminated with Myers type conduit hubs.

3.4.7 Conduit terminating in pressed steel boxes shall have double locknuts and insulated bushings.

3.4.8 Conduits containing equipment grounding conductors and terminating in sheet steel boxes shall have insulated throat grounding bushings.

3.4.9 Conduits shall be installed using threaded fittings except for PVC or EMT.

3.4.10 The use of running threads is prohibited. Where such threads are necessary, a 3-piece union shall be used.

3.4.11 All conduits entering or leaving a motor control center, switchboard or other multiple compartment enclosure shall be stubbed up into the bottom horizontal wireway or other manufacturer's designated area, directly below the vertical section in which the conductors are to be terminated. The 3-in extension of conduit above the floor slab or concrete equipment pad may be reduced to a dimension that suits the equipment manufacturer's installation requirements if the 3-in stub-up interferes with the equipment being provided.

3.4.12 Rigid galvanized steel conduits buried in earth shall be completely painted with bitumastic.

3.4.13 Rigid galvanized steel conduits which have been field cut and threaded shall be painted with cold galvanizing compounds.

3.4.14 Conduit sealing and drain fittings shall be installed on all conduits entering and leaving any area containing noxious gases to prevent contamination into clean areas via the conduit system. Areas requiring this protection are: rooms where chlorine, ammonia, and ozone are stored, generated or heated. A sealing compound installation schedule shall be presented to COR and/or PO for approval. Each

installation shall be signed off by the Contractor and the RE and each fitting shall be legibly marked with red paint to indicate that the sealing compound has been installed.

3.4.15 Liquid-tight flexible metal conduit shall be used for all motor terminations, the primary and secondary of transformers, generator terminations and other equipment where vibration is present or may require removal. The length of liquid-tight flexible metal conduit shall not exceed 36" when used for vibration isolation, and shall not exceed 72" in length when attaching to luminaires. Non-metallic flexible conduit shall only be allowed for use with rigid PVC conduit systems.

3.4.16 Flexible couplings shall be used in hazardous locations for all motor terminations and other equipment where vibration is present.

3.4.17 Aluminum fittings and boxes shall be used with aluminum conduit. Aluminum conduit shall not be imbedded in concrete. Aluminum conduit shall be isolated from other metals with plastic sleeves or plastic-coated hangers. Strap wrenches shall be used for tightening aluminum conduit.

3.4.18 Flexible metallic conduit (Type MC cable) shall be used for recessed fluorescent fixtures in hung ceilings to connect fixtures to the conduit system.

3.4.19 PVC coated rigid steel conduit shall be used as a transition section where concrete embedded conduit stubs out of floor slabs or through below grade walls or where conduit installed under building slabs on grade stub out of floors. The PVC coated rigid steel conduit shall extend a minimum of 3-in into and out of the floor slab, concrete pad, or wall to allow for proper threading of the conduit.

3.4.20 PVC conduit to non-metallic box connections shall be made with PVC socket to male thread terminal adapters with neoprene O-ring and PVC round edge bushings.

3.4.21 PVC conduit shall be supported with non-metallic clamps, PVC coated steel racks and stainless steel hardware.

3.4.22 Expansion fittings shall be used on exposed runs of PVC conduit where required for thermal expansion. Installation and number of fittings shall be as recommended by manufacturer.

3.4.23 PVC boxes, conduit fittings, etc, with integral hubs shall be solvent welded directly to the PVC conduit system.

3.4.24 Non-metallic boxes with field drilled or punched holes shall be connected to the PVC conduit system with threaded and gasketed PVC Terminal Adapters.

3.4.25 Conduit supports, other than for underground raceways, shall be spaced at intervals not exceeding the distance required by the NEC to obtain rigid construction.

3.4.26 Single conduits shall be supported by means of one-hole pipe clamps in combination with one-screw back plates, to raise conduits from the surface. Multiple runs of conduits shall be supported on fabricated channel trapeze type racks with steel horizontal members and threaded hanger rods. The rods shall be not less than 3/8-in diameter. Surface mounted panel boxes, junction boxes, conduit, etc, shall be supported by spacers to provide a minimum of 1/2-in clearance between wall and equipment.

3.4.27 Conduit Supports (Other than Underground Raceways)

3.4.27.1 Trapezes

3.4.27.1.1 Conduit support trapezes shall be vertically supported every 10-ft or less, as required to obtain rigid conduit construction.
3.4.27.1.2 Lateral seismic restraints (Sway Bracing) shall be spaced 30-ft or less.

3.4.27.1.3 Horizontal seismic restraints shall be spaced at 40-ft or less. There shall be at least one horizontal restraint per horizontal run.

3.4.27.1.4 Attachment to structural steel shall be by beam clamps or welded beam attachment. C-clamps will not be allowed for vertical hangers. Side beam clamps with beam hooks shall be used for seismic restraint only.

3.4.27.1.5 Attachment to concrete shall be cast-in-place inserts, cast-in place welded plates with welded studs or stainless steel adhesive anchors.

3.4.27.2 All reinforcing bars shall be located by the Electrical Subcontractor with the use of a rebar locator prior to installing adhesive capsule type anchors. Mark the location of all reinforcing bars in an area bounded by a line drawn at least 18-in from the edge of the support bearing/weld plates on all four sides of the bearing/weld plates prior to fabricating and installing bearing/weld plates.

3.4.27.3 Where interference occurs, adjust anchor locations to clear reinforcing bars and alter support configuration at no additional cost to the Authority.

3.4.28 Miscellaneous steel for the support of fixtures, boxes, transformers, starters, contactors, panels and conduit shall be furnished and installed. Channel supports shall be ground smooth and fitted with plastic end caps.

3.4.29 Steel channels, flat iron and channel iron shall be furnished and installed for the support of all electrical equipment and devices, where required, including all anchors, inserts, bolts, nuts, washers, etc, for a rigid installation. Channel supports shall be ground smooth and fitted with plastic end caps.

3.4.30 Provide sway braces for cable trays and busducts. Sway braces shall be U-channel supports installed at a 45 degree angle from the tray or busduct and anchored to the concrete ceiling structure or structural support system. Braces shall be provided on 20-ft spacing centers. Alternate the direction of the bracing supports.

3.4.31 Conduits terminating at a cable tray or busduct shall be supported independently from the busduct or cable tray. Provide a conduit support within 1-ft of the cable tray or busduct. The weight of the conduit shall not bear on the cable tray or busduct.

3.4.32 All conduits on exposed work, within partitions and above suspended ceilings, shall be run at right angles to and parallel with the surrounding wall and shall conform to the form of the ceiling. No diagonal runs will be allowed. Bends in parallel conduit runs shall be concentric. All conduits shall be run perfectly straight and true.

3.4.33 Where conduits pass through openings in walls or floor slabs, the remaining openings shall be sealed against the passage of flame and smoke in accordance with UL requirements and the details shown on the Drawings. The sealing method shall have a UL fire rating, which equals or exceeds the fire rating of the wall or floor construction.
3.4.34 Conduits shall not cross pipe shafts, access hatches or vent duct openings. They shall be routed to avoid such present or future openings in floor or ceiling construction.

3.4.35 Conduits passing from heated to unheated spaces, exterior spaces, refrigerated spaces, cold air plenums, etc, shall be sealed with "Duxseal" as manufactured by Manville or seal fitting to prevent the accumulation of condensation.

3.4.36 Conduits shall be located a minimum of 3-in from steam or hot water piping. Where crossings are unavoidable, the conduit shall be kept at least 1-in from the covering of the pipe crossed.

3.4.37 Mandrels shall be pulled through all existing conduits which will be reused and through all new conduits 2-in in diameter and larger prior to installing conductors.

3.4.38 3/16-in polypropylene pull lines shall be installed in all new conduits noted as spares or designated for future equipment. Conduit noted as spare shall be capped or plugged at both ends with easily removable fittings.

3.4.39 Emergency (generator) source and normal (power company) source feeders shall not be run through the same pull box.

3.4.40 Where no type or size is indicated for junction boxes, pull boxes or terminal cabinets, they shall be sized in accordance with the requirements of NEC Article 314. Enclosure type and material shall be as specified herein.

3.4.41 Pull or junction boxes shall be furnished and installed where shown on the Drawings, in every 200 feet of straight conduit runs or in runs where more than the equivalent of four 90 degree bends occur or at any point necessary for wire pulling and splicing. Splices shall not be made in pulling elbows.

3.4.42 A conduit identification plate shall be installed on all power, instrumentation, alarm and control conduits at each end of the run and at intermediate junction boxes, manholes, etc. Conduit plates shall be installed before conductors are pulled into the conduits. Exact identification plate location shall be coordinated with the COR and/or PO at the time of installation to provide uniformity of placement and ease of reading. When a master conduit numbering system is used, the conduit tag numbers shall be exactly as shown on the drawings, if a master conduit numbering system is not used the conduit identification tags shall provide detailed "to" and "from" information.

3.4.43 Place inner duct in the conduit and allow to rest in place for a minimum of 72 hours prior to cutting each end to length.

3.4.44 Place the correct number of maximum sized inner ducts for the conduit with minimum 1/8-in clearance.

END OF SECTION

SECTION 16120

WIRES AND CABLES (600 VOLT MAXIMUM)

PART 1 – GENERAL

1.1 SCOPE OF WORK

1.1.1 Furnish, install and test all wire, cable and appurtenances as shown on the Drawings and as specified herein.

1.2 RELATED WORK
Conduits are included in SECTION 16110 - RACEWAYS, BOXES, FITTINGS AND SUPPORTS.

1.3 SUBMITTALS

1.3.1 Submit, in accordance with Performance Work Statement, samples of proposed wire. Each sample shall have the size, type of insulation and voltage stenciled on the jacket.

1.3.2 Approved samples will be sent to the project location for comparison by the Contracting Officer's Representative (COR) and/or Project Officer (PO) with the wire actually installed.

1.3.3 Installed unapproved wire shall be removed and replaced at no additional cost to the Owner.

1.4 DELIVERY, STORAGE AND HANDLING
Carefully handle all conductors to avoid kinks and damage to insulation.

1.5 WARRANTY
The manufacturer shall warrant the cable against defects for a period of 20 years from date of installation and shall remove and replace defective cables at his own expense during this warranty period.

PART 2 – PRODUCTS

2.1 GENERAL

2.1.1 Wires and cables shall be of annealed, 98 percent conductivity, soft drawn copper.

2.1.2 All conductors shall be stranded, except that lighting and receptacle wiring may be solid.

2.1.3 Except for control, signal and instrumentation circuits, wire smaller than No. 12 AWG shall not be used.

2.1.4 Wire shall have 600 Volt insulation except where indicated otherwise.

2.1.5 All wire of a given type shall be the product of a single manufacturer.

2.2 BUILDING WIRE

2.2.1 Wire for lighting, receptacles and other circuits not exceeding 150 Volts to ground shall be NEC type THHN/THWN as manufactured by General Cable.; American Insulated Wire Corp.; Southwire Co.; or equal.

2.2.2 Bare copper ground wire shall be stranded, annealed copper wire ASTM-B3.

2.2.3 Multi-conductor power cables shall have stranded conductors with type THHN/THWN insulated, nylon conductor covering, and an overall PVC jacket covering over the individual wires. The number of conductors shall be as indicated on the Drawings. Cable shall be TC rated meeting UL 1277 and IEEE 383 Standards. Cable shall be flame resistant, non-propagating and shall be suitable for installation in a Class I, Division II hazardous location and for direct burial in earth. Multi-conductor power cables, sizes #12 AWG and larger, shall be furnished with a green ground conductor and a white neutral conductor where required to serve phase to neutral loads. Cable shall be as manufactured by The Okonite Co.; Southwire Co.; General Cable Co., or equal.

2.2.4 Equipment grounding conductors shall be NEC Type THW green and sized in accordance with NEC Table 250-122. Ground grid conductors shall be insulated unless shown otherwise on the Drawings.

2.3 CONTROL, STATUS AND ALARM WIRE

2.3.1 Wire shall be No. 14 AWG NEC type THHN/THWN, stranded as manufactured by The Okonite Co.; General Cable.; American Insulated Wire Corp.; Southwire Co.; or equal.

2.3.2 Multi-conductor control cable, where shown on the Drawings, shall be stranded, No. 14 AWG, 600 Volt, polyvinyl chloride insulated, nylon jacket over insulation, polyvinyl chloride jacket overall, Type TC as manufactured by The Okonite Co.; General Cable ; American Insulated Wire Corp.; or equal. The number of conductors shall be as shown on the Drawings.

2.4 INSTRUMENTATION WIRE

Wire for process instrumentation signals (i.e. 1-5 VDC, 4-20 mADC), R.T.D., potentiometer and similar signals shall be:

2.4.1 Single pair cable:

2.4.1.1 Conductors: 2 No. 16 stranded and twisted on 2-in lay

2.4.1.2 Insulation: PVC with 600 Volt, 105 degrees C rating

2.4.1.3 Shield: 100% Aluminum/polyester foil with drain wire

2.4.1.4 Jacket: PVC with UL Subject 13, UL 1581 and manufacturers' identification

2.4.1.5 Max overall diameter: 0.295-in

2.4.1.6 Miscellaneous: UL Listed as Instrument Tray Cable/Power Limited Tray Cable (PLTC) for use in accordance with Article 727 and Article 725 of the NEC.

2.4.1.7 Manufacturers: Belden No. 1118A; Manhattan; General Cable; The Okanite Co.; or equal

2.5 SPLICES (POWER CONDUCTORS)

2.5.1 Unless otherwise indicated on the Drawings, splices shall not be made in the cables without prior written approval of the COR and/or PO. Where splicing is approved by the COR and/or PO, splicing materials for all 600 Volt splices shall be made with long barrel, tin plated copper compression (hydraulically pressed) connectors and insulated with heavy wall heat shrinkable tubing. The conductivity of all completed connections shall be not less than that of the uncut conductor. The insulation resistance of all completed connections of insulated conductors shall be not less than that of the uncut conductor.

2.5.2 Wire lugs shall be tin plated copper, long barrel compression type (hydraulically pressed) for wire sizes No. 8 AWG and larger. Lugs for No. 10 AWG and smaller wire shall be locking spade type with insulated sleeve. Lugs shall be as manufactured by the Thomas and Betts Co.; Burndy; Amp; or equal.

2.5.3 Compression type connectors shall be insulated with a heat shrink boot or outer covering and epoxy filling. Splice kits shall be as manufactured by Raychem (Tyco); Ideal Industries; 3M Co. or equal.

2.5.4 Solderless pressure connectors shall be self-contained, waterproof and corrosion-proof units incorporating prefilled silicone grease to block out moisture and air. Connectors shall be sized according to manufacturer's recommendations. The connectors shall be UL listed and CSA approved, as manufactured by King Innovation; Ideal Industries, Inc., or equal.

2.6 MOTOR CONNECTIONS

Motor connections shall be ring type mechanical compression terminations installed on the branch circuit wires and the motor leads and secured with bolt, nut and springwasher. Connections shall be insulated with a Raychem Type RVC, roll-on stub insulator; Thomas & Betts, Shrink-Kon MSCV20; or equal. For wire sizes N0. 8 and larger, long barrel, tin plated copper compression (hydraulically pressed) type connections Burndy Co., or equal) shall be installed on the branch circuit wires and the motor leads. Connections shall be insulated with heavy duty heat shrinkable material (Raychem Corp., or equal).

2.7 TERMINATION AND SPLICES (CONTROL, STATUS AND ALARM CONDUCTORS)

2.7.1 Termination connectors shall be of the locking fork-end (upturned leg ends) type as manufactured by Ideal Industries; 3M Co.; Panduit Corp. or equal.

2.7.2 Insulated compression type connectors shall be of the expanded vinyl insulated parallel or pigtail type as manufactured by Ideal Industries; 3M Co.; Panduit Corp. or equal.

2.7.3 Solderless pressure connectors shall be self-contained, waterproof and corrosion-proof units incorporating prefilled silicone grease to block out moisture and air. Connectors shall be sized according to manufacturer's recommendations. The connectors shall be UL listed and CSA approved, as manufactured by King Innovation; Ideal Industries, Inc or equal.

2.8 TERMINATIONS (INSTRUMENTATION CABLES)

Termination connectors shall be of the locking fork-end (upturned leg ends) type as manufactured by Ideal Industries; 3M Co.; Panduit Corp. or equal.

2.9 WIRE AND CABLE MARKERS

2.9.1 Wire and cable markers shall be "Omni-Grip" as manufactured by the W.H. Brady Co.; Thomas & Betts Co., SMS; 3M Co., STD-TAG; or equal.

2.9.2 Wire and cables with diameters exceeding the capacity of the "Omni-Grip" shall be marked with pre-printed, self-adhesive vinyl tapes as manufactured by the W.H. Brady Co.; Panduit Corp.; 3M Co.; or equal.

2.10 DIRECT BURIED CABLE WARNING TAPE

Tape shall be 6-in wide, red polyethylene not less than 0.0035-in thick. Tape shall be W.H. Brady Co., Catalog No. 91296; Harris Industries Inc. VT Series; Seton; or equal.

2.11 WALL AND FLOOR SLAB OPENING SEALS

Wall and floor slab openings shall be sealed with UL approved expanding material which equals or exceeds the fire rating of the wall or floor construction such as "FLAME-SAFE" as manufactured by the Thomas & Betts Corp.; Pro Set Systems; Neer Mfg. Co.; Specified Technologies, Inc.; or equal.

PART 3 – EXECUTION

3.1 INSTALLATION

3.1.1 Uniquely identify all wires, cables and each conductor of multi-conductor cables (except lighting and receptacle wiring) at each end and in all manholes, hand holes and pull boxes with wire and cable markers.

3.1.2 Use lubrications to facilitate wire pulling. Lubricants shall be UL approved for use with the insulation specified.

3.1.3 Provide multi-conductor control and signal cables within the underground system. Cables shall be installed continuous from building to building without splices. Individual control conductors and twisted shielded pairs signal cables will not be allowed in underground systems.

3.1.4 The crimping tools used in securing the conductor in the compression type connectors or terminal lugs shall be those made for that purpose and for the conductor sizes involved. The crimping tool shall be the ratchet type which prevents the tool from opening until the crimp action is completed. Such tools shall be a product of the connector manufacturer.

3.1.5 Install an equipment grounding conductor in all raceways.

3.1.6 Seal openings in slabs and walls through which wires and cables pass.

3.1.7 Pull cables from the direction that requires the least tension. Use a feed-in tube and sheave designed for cable installation. Use sheaves with radii that exceed the cable manufacturer’s recommended minimum bending radius. Use a dynamometer and constant velocity power puller. Velocity should not be less than 15-ft./min. or more than 50-ft./min. Do not exceed the cable manufacturer’s maximum recommended tension.

3.1.8 If cable can not be terminated immediately after installation, install heat shrinkable end caps.

3.1.9 Fireproof exposed cables in manholes, vaults, pullboxes, switchgear and other areas not protected by conduit where medium voltage cables are present. Use fire-proofing tape and glass tape in accordance with the manufacturer’s instructions. Fire-proofing tape shall be installed with one half-lapped layer of Scotch Brand 77 Electric Arc and Fireproofing Tape (3M Corp., or equal). Tape shall be secured with a two-layer band of Scotch Brand 69 Glass Electrical Tape (3M Corp., or equal) over the last wrap.

3.2 WIRE COLOR CODE

3.2.1 All wire shall be color coded or coded using electrical tape in sizes where colored insulation is not available. Where tape is used as the identification system, it shall be applied in all junction boxes, manholes and other accessible intermediate locations as well as at each termination.

3.2.2 The following coding shall be used:

System	Wire	Color
240/120 Volts Single-Phase, 3 Wire	Neutral Line 1 Line 2	White Black Red
208Y/120, Volts 3 Phase, 4 Wire	Neutral Phase A Phase B Phase C	White Black Red Blue
240/120 Volts 3 Phase, 4 Wire delta, center tap ground on phase coil A-C	Neutral Phase A Phase B (High) Phase C	White Black Orange Blue
480Y/277 Volts 3 Phase, 4 Wire	Neutral Phase A Phase B Phase C	White Brown Orange Yellow

3.2.3 Neutral or ground wires that terminate in a Panelboard and require color tape shall have the color tape extend at least 6-in from the termination point.

3.3 TERMINATIONS AND SPLICES

3.3.1 Power conductors: Unless otherwise indicated on the Drawings, no splices may be made in the cables without prior written approval of the COR and/or PO. Where splicing is approved, terminations shall be die type or set screw type pressure connectors as specified. Splices (where allowed) shall be die type compression connector and waterproof with heat shrink boot or epoxy filling for copper conductors # 4 AWG and larger. Splices shall be solderless pressure connectors with insulating covers for copper conductors # 6 AWG and smaller. Aluminum conductors (where specified) shall employ terminations and splices specifically designed for aluminum conductors.

3.3.2 Control Conductors: Termination on saddle-type terminals shall be wired directly with a maximum of two conductors. Termination on screw type terminals shall be made with a maximum of two spade connectors. Splices (where allowed) shall be made with insulated compression type connectors.

3.3.3 Instrumentation Signal Conductors (including graphic panel, alarm, low and high level signals): terminations same as for control conductors. Splices allowed at instrumentation terminal boxes only.

3.3.4 Except where permitted by the COR and/or PO no splices will be allowed in manholes, handholes or other below grade located boxes.

3.3.5 Splices shall not be made in push button control stations, control devices (i.e., pressure switches, flow switches, etc), conduit bodies, etc.

3.4 INSTRUMENTATION CABLES

3.4.1 Instrumentation cables shall be installed in rigid steel raceways as specified. All circuits shall be installed as twisted pairs or triads. In no case shall a circuit be made up using conductors from different pairs or triads. Triads shall be used wherever three wire circuits are required.

3.4.2 Terminal blocks shall be provided at all instrument cable junction and all circuits shall be identified at such junctions.

3.4.3 Shielded instrumentation wire, coaxial, data highway, I/O and fiber optic cables shall be run without splices between instruments, terminal boxes, or panels.

3.4.4 Ground shielding on instrumentation wires at one end only as recommended by the instrument manufacturer and isolated at all other locations. Terminal blocks shall be provided for inter-connecting shield drain wires at all junction boxes. Where individual circuit shielding is required, each shield circuit shall be provided with its own block.

3.4.5 Install shielded instrumentation wire in conduit and pull boxes that contain only shielded instrumentation wire. Instrumentation cables shall be separated from all other (i.e. power, control, etc.) cables in manholes by enclosing them within rigid steel raceways and boxes.

3.4.6 Shielded cable terminations at each end shall be provided with heat shrinkable tubing placed over the exposed shield and conductors. The tubing shall extend 1-in minimum over the jacket end and extend 0.5-in minimum from the jacket end over the exposed conductors.

3.5 FIELD TESTING

3.5.1 Test all 600 Volt wire insulation with a megohm meter after installation and prior to termination. Make tests at not less than 1000 Volts DC. Test duration shall be one minute. Submit a written test report of the results to the COR and/or PO. Notify the COR and/or PO in writing 48 hours prior to testing.

3.5.2 Field testing and commissioning shall be done in accordance with the latest revision of the “Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems” published by the International Electrical Testing Association (NETA Standard ATS-1999) unless otherwise modified by this Section. Minimum wire insulation resistance shall not be less than 250 Megohms.

END OF SECTION

SECTION 16141

WIRING DEVICES

PART 1 – GENERAL

1.1 SCOPE OF WORK

1.1.1 Furnish all labor, materials, and equipment and install wiring devices as shown on the Drawings and as specified herein.

1.1.2 Provide all interconnecting conduit and branch circuit wiring for receptacle circuits in accordance with the NEC.

1.2 RELATED WORK
Outlet boxes are included in SECTION 16110 - RACEWAYS, BOXES, FITTINGS AND SUPPORTS.

1.3 SUBMITTALS
Submittals shall be in accordance with Performance Work Statement.

1.4 REFERENCE STANDARDS
Wiring devices shall comply with the requirements of the National Electric Code (NEC) and shall be Underwriters Laboratories (UL) labeled.

PART 2 – PRODUCTS

2.1 MATERIALS

2.1.1 Wall switches shall be heavy duty, specification grade, toggle action, flush mounting quiet type. All switches shall conform to the latest revision of Federal Specification WS 896. Wall switches shall be suitable for the area classification indicated and shall be of the following types and manufacturer:

2.1.1.1 Single pole, 20 Amp, 120/277 Volt - Cooper Wiring Devices; Hubbell Wiring Devices-Kellems; Pass & Seymour, Inc. or equal.

2.1.2 Receptacles shall be heavy duty, specification grade of the following types and manufacturer or equal. Receptacles shall conform to Fed Spec WC596-F.

2.1.2.1 Weatherproof/corrosion resistant duplex, 20 Amp, 125 Volt, 2 Pole, 3 Wire, with cover; Crouse-Hinds Co., Catalog No. WLRD-5-20; Appleton Electric FSKD520; Pass & Seymour or equal.

2.1.2.2 Ground fault interrupter, duplex, 20 Amp, 125 Volt, 2 Pole, 3 Wire, GFCI feed thru type with "test" and "reset" buttons. Cooper Wiring Devices; Hubbell Wiring Devices-Kellems; Pass & Seymour, Inc. or equal.

2.1.3 Device Plates

2.1.3.1 Oversized plates shall be installed where standard plates do not fully cover the wall opening.

2.1.3.2 Device plates for switches mounted outdoors or indicated as weatherproof shall be gasketed, cast aluminum with provisions for padlocking switches "On" and "Off", Crouse Hinds No. DS185; Appleton FSK1VS; Pass & Seymour or equal.

2.1.3.3 Engraved device plates shall be provided where required.

2.1.3.4 Weatherproof, gasketed cover for GFI receptacle mounted in a FS/FD box shall be Cooper Crouse-Hinds; RACO (Hubbell); Pass & Seymour, Inc. or equal.

PART 3 – EXECUTION

3.1 INSTALLATION

3.1.1 Switch and receptacles outlets shall be installed flush with the finished wall surfaces in areas with stud frame and gypsum board construction, in dry areas with cement block construction or when raceways are shown as concealed on the Drawings.

3.1.2 Do not install flush mounted devices in areas designated DAMP, WET or WET/CORROSIVE on the Drawings. Provide surface mounted devices in these areas.

3.1.3 Provide weatherproof devices covers in areas designated WET or WET/CORROSIVE on the Drawings.

3.1.4 Convenience outlets shall be 18-in above the floor unless otherwise required or shown on the Drawings.

3.1.5 Convenience outlets installed outdoors and in rooms where equipment may be hosed down shall be 48-in above floor or grade or as shown on the Drawings.

3.1.6 The location of all devices is shown, in general, on the Drawings and may be varied within reasonable limits so as to avoid any piping or other obstruction without extra cost, subject to the approval of the COR and/or PO. Coordinate the installation of the devices for piping and equipment clearance.

END OF SECTION

SECTION 16191

MISCELLANEOUS EQUIPMENT

PART 1 – GENERAL

1.1 SCOPE OF WORK
Furnish and install all miscellaneous equipment as shown on the Drawings and as specified herein.

1.2 EQUIPMENT LIST
This Section provides the requirements for miscellaneous equipment typically employed in a facility, however, not all components specified in this Section are necessarily utilized on this project.

1.3 SUBMITTALS
Submit, in accordance with the Performance Work Statement, detailed catalog information or drawings describing electrical and physical characteristics of all equipment specified in sufficient detail to show compliance with the Drawings and Specifications.

1.4 REFERENCE STANDARDS
Equipment enclosures shall have NEMA ratings suitable for the location in which they are installed, as specified in SECTION 16000 - ELECTRICAL - GENERAL PROVISIONS.

PART 2 – PRODUCTS

2.1 MATERIALS

2.1.1 Manual Motor Starters

2.1.1.1 Manual starters shall be suitable for the voltage and number of phase shown on the Drawings and shall be non-reversing. NEMA sizes shall be as required for the horsepowers shown on the Drawings. Manual starters shall have motor overload protection in each phase. Built-in control stations shall be furnished as required or as shown on the Drawings. Starter shall be furnished with lock off provisions.

2.1.1.2 NEMA 4X enclosures shall be stainless steel.

2.1.1.3 Manual motor starters shall be as manufactured by the Square D Co.; General Electric; Eaton Electrical, or equal.

2.1.2 Wireway

2.1.2.1 NEMA 4 and 4X wireway shall be stainless steel with gasketed screw covers and stainless steel screws.

2.1.2.2 NEMA 4 and 4X shall be Bulletin F-22 as manufactured by the Hoffman Engineering Co.; Appleton; Killark, or equal.

PART 3 – EXECUTION

3.1 INSTALLATION

3.1.1 Mounting Stands

3.1.1.1 Field mounted disconnects, pushbutton control stations, alarm panels, enclosed starters and circuit breakers, transformers, automatic transfer switches, wireways, contactors, terminal boxes, junction and pull boxes shall be mounted on galvanized or stainless steel stands as specified. Where clearance requirements for stands may not be maintained, the COR and/or PO may direct electric control equipment to be wall-mounted adjacent to the driven equipment, but in no case shall the distance from the drive motor to the control station exceed 3-ft, all at no additional cost to the Owner.

3.1.1.2 All floor mounting stands, bracing, anchor bolts and appurtenances furnished to support equipment loads, dynamic loads, wind loads and seismic forces shall conform to the latest applicable requirements of the State Building Code in effect at the time of Bid.

3.1.1.3 All wall mounted brackets, bracing, bolts and appurtenances to support equipment loads dynamic loads, wind loads and seismic forces shall conform to the latest applicable requirements of the State Building Code in effect at the time of Bid.

3.1.1.4 Channel supports shall be ground smooth and fitted with plastic end caps.

END OF SECTION

SECTION 16471

PANELBOARD MODIFICATIONS

PART 1 – GENERAL

1.1 SCOPE OF WORK
Furnish labor, materials, equipment and incidentals required to remove and install new circuit breakers in existing panelboards as shown on the Drawings and as specified herein.

1.2 NOT USED

1.3 SUBMITTALS
Submit, in accordance with the Performance Work Statement, shop drawings and product data as follows:

1.3.1 Product data sheets and catalog numbers for overcurrent protective devices. List all options, trip adjustments, and accessories furnished specifically for this project.

1.4 REFERENCE STANDARDS
Circuit breakers shall be designed, built, and tested in accordance with the Underwriter Laboratories, Inc. UL489 and shall be so labeled. Installation shall comply with NEMA Standard for Panelboards and the National Electrical Code.

1.5 QUALITY ASSURANCE
Where possible, circuit breakers shall be the product of the manufacturer of the original panelboard in which they are installed.

PART 2 – PRODUCTS

2.1 GENERAL

2.1.1 Circuit breaker short circuit ratings shall be not be less than minimum rated device in the panel. The overall short circuit rating of the existing panel shall be maintained. Circuit breakers shall be rated for the required utilization voltage.

2.1.2 The integrity of series rated panels shall be maintained. Series combinations shall be UL listed.

2.2 CIRCUIT BREAKERS

2.2.1 Circuit breakers shall be a product of the manufacturer of the original circuit breakers in the panelboard, or shall be a UL listed replacement product.

2.2.2 Circuit breakers shall be molded case, bolt-in or plug-on type as required. Contractor shall verify the proper type.

2.2.3 Each circuit breaker used in 120/240 Volt and 120/208 Volt panelboards shall have an interrupting capacity of not less than 10,000 amperes, RMS symmetrical. Contractor shall verify the required short circuit interrupting rating and supply the correct breaker for the application.

2.2.4 GFCI (ground fault circuit interrupter) shall be provided for circuits where shown on the Drawings. GFCI units shall be 1 pole, 120 volt, molded case, bolt-on breakers, incorporating a solid state ground fault interrupter circuit insulated and isolated from the breaker mechanism. The unit shall be UL listed, Class A, Group I device (5 milliamp sensitivity, 25 millisecond trip time) and a minimum interrupting capacity of 10,000 Amperes RMS. Contractor shall verify the required short circuit interrupting rating and supply the correct breaker for the application.

2.2.5 GFCI for ground fault protection on heat trace equipment shall be provided for branch circuits where shown on the Drawings. GFCI units shall be rated properly for the intended voltage and trip setting indicated on the drawings and shall be molded case, bolt-on breakers, incorporating a solid state ground fault interrupter circuit insulated and isolated from the breaker mechanism. The unit shall be UL listed Class A Group I device (30 milliamp sensitivity, 25 millisecond trip time) and an interrupting capacity of 10,000 Amperes, RMS. Contractor shall verify the required short circuit interrupting rating and supply the correct breaker for the application.

PART 3 – EXECUTION

3.1 INSTALLATION

3.1.1 Install circuit breakers in accordance with manufacturer's instructions.

3.1.2 Connect panelboard branch circuit loads so that the load is distributed as equally as possible between the phase busses.

3.1.3 Install new circuit directory cards in each panelboard. New directories shall be heavy card stock with machine printed text. Verify all existing circuits and update circuit directories giving location and description of every load served by the panel.

END OF SECTION

SECTION 16859

ELECTRICAL HEAT TRACE SYSTEM

PART 1 – GENERAL

1.1 SCOPE OF WORK

1.1.1 Furnish all labor, materials, equipment and incidentals required and install electrical heat trace system on the piping, valves and fittings at the Garvey Elevators Facility as shown on the Contract Drawings and as specified herein.

1.1.2 The manufacturer shall design and supply the entire electrical heat trace system, including the schematic arrangements, cable, junction boxes, thermostats and controls, and other equipment necessary to complete the system as shown on the Contract Drawings and as specified herein.

1.1.3 The COR and/or PO's piping drawings, piping line list, equipment list, instrument list and insulation schedule constitute, in conjunction with this Section, the design parameters of the electrical heat trace system. The Contract Drawings are intended only to give a general layout of the electrical heat trace system. Circuit layouts are not intended to show the number of fittings, or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation a complete electric heat tracing system based on the actual piping installation and the manufactures installation drawings and recommendations.

1.1.4 Provide the manufacturer’s services described herein.

1.2 RELATED WORK

1.2.1 Piping and insulation is included in SECTION 15055 - PROCESS PIPING, VALVES, AND APPURTENANCES.

1.2.2 Pipe hangers and supports are included SECTION 15055 - PROCESS PIPING, VALVES, AND APPURTENANCES.

1.2.3 Piping lengths, diameters and other applicable information for heat trace system calculations are provided on the Contract Drawings.

1.2.4 Electrical - General Provisions are included in SECTION 16000 – ELECTRICAL – GENERAL PROVISIONS.

1.2.5 Raceways, Boxes, Fittings and Supports are included in SECTION 16110 - RACEWAYS, BOXES, FITTINGS AND SUPPORTS.

1.2.6 Wires and Cables (600 Volt Maximum) are included in SECTION 16120 - WIRES AND CABLES (600 VOLT MAXIMUM).

1.2.7 Panelboard Modifications are included in SECTION 16471 - PANELBOARD MODIFICATIONS.

1.3 SUBMITTALS

1.3.1 The Contractor shall submit the following in accordance with the Performance Work Statement:

1.3.1.1 Circuit heat loss and calculations

1.3.1.2 Electrical heat trace system circuit design and loading schedule

1.3.1.3 Bill of materials

1.3.1.4 Catalog data sheets for all components. Data sheets shall indicate the complete equipment number for each component.

1.3.1.5 Typical installation details

1.3.2 Submit the electrical heat trace system power requirements for the design condition (extreme minimum ambient at required maintain temperature) and for the normal operating temperature (normally expected minimum ambient). The calculations shall indicate the number of heating sections recommended

1.4 REFERENCE STANDARDS

1.4.1 The system shall be suitable for the specified industrial conditions, and shall be designed and installed in accordance with the latest applicable codes and standards. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply. Pertinent standards organizations are:

1.4.1.1 American National Standards Institute (ANSI)

1.4.1.2 Institute of Electrical and Electronics Engineers (IEEE)

1.4.1.3 ASTM International (ASTM)

1.4.1.4 National Fire Protection Association (NFPA)

1.4.1.5 National Electric Code (NEC)

1.4.1.6 Factory Mutual (FM)

1.4.1.7 Underwriters Laboratories (UL)

1.4.1.8 National Electrical Manufacturers Association (NEMA)

1.4.1.9 Occupational Safety and Health Administration (OSHA)

1.4.2 Furnish copies of the necessary approvals for the electrical heat trace system and verify that the approvals are current.

1.5 QUALITY ASSURANCE

1.5.1 The electrical heat trace system manufacturer shall be required to demonstrate a minimum of 5 years experience in the design and manufacture of industrial electrical heat trace systems similar to those described in this Section and shown on the Contract Drawings.

1.5.2 The system manufacturer shall employ capable personnel to provide detailed engineering, coordination, drafting and start-up services and shall provide warranty compliance for the period specified.

1.5.3 The detailed engineering, coordination and system layout shall be performed by a person holding a degree in engineering and having performed similar calculations for a minimum of three years within the last 7 years or a person having ten years of related experience.

1.5.4 All electrical heat trace system equipment furnished under this section shall be supplied by a single manufacturer having a minimum of 10 years of proven successful operation in the field within the last 12 years under environmental conditions similar to those which will be encountered under the scope of this work.

1.5.5 All electrical heat trace cables shall be capable of passing a factory 2.5 kV dielectric test for one minute (ASTM D2633).

1.5.6 Electrical heat trace system cables shall be designed for a useful life of 20 years or more with power on continuously.

1.6 MANUFACTURERS SERVICE

1.6.1 Provide manufacturer's technical and design services to layout the proposed electrical heat trace system and prepare shop drawings and information to be submitted under the requirements of this Section.

1.6.2 System testing prior to energizing.

1.7 WARRANTY

All electrical heat trace cables shall be warranted against manufacturing defects for a period of 10 years from energizing. Cables failing due to manufactures defects prior to the expiration of the warranty shall be replaced by the contactor at no additional cost to the Owner.

1.8 AREA CLASSIFICATION

1.8.1 All electrical heat trace system components shall be suitable for the area classification shown on the electrical drawings.

1.9 DESIGN REQUIREMENTS

1.9.1 Provide an electrical heat trace system capable of maintaining the specified temperature during the extreme of ambient temperature.

1.9.2 Design Parameters

1.9.2.1	Voltage Available	120 Volts 1 Phase
1.9.2.2.	Maximum Circuit Breaker Size	20 Amps
1.9.2.3.	Wind/Air Velocity	30 mph
1.9.2.4.	Max. & Min Ambient Temperature	90 & -20 degrees F
1.9.2.5.	Maintain Temperature	40 degrees F
1.9.2.6	Process Operating Temperature	55 degrees F
1.9.2.7	Maximum Heat Exposure	110 degrees F
1.9.2.8	Start Up Temperature	40 degrees F

1.9.2.9 Piping equipment lists, insulation types and thickness are specified in SECTION 15055 – PROCESS PIPING, VALVES, AND APPURTENANCES and as shown on the Contract Drawings.

1.9.3 Heat losses shall be calculated using the manufacturer's standard procedure in conjunction with the insulation requirements and equipment schedules. The design heat output of the electrical heat trace system shall include a 10 percent factor of safety. Contractor is encouraged to suggest changes in insulation thickness to optimize total system economy.

1.10 APPLICATIONS

1.10.1 The term "Freeze Protection" shall mean that the intent of the electrical heat trace system installed on equipment such as pipes, valves, pumps, gauges, tanks and controls is to prevent the process fluids from freezing when the ambient or surrounding temperature falls below the fluids freezing point if other than 32 degrees F (0 degrees C).

1.10.2 The term “process temperature maintenance shall mean that the intent of the electrical heat trace system installed on equipment such as pipes, valves, pumps, gauges, tankes and controls is to maintain a process fluids temperature defined in the processes specifications and indicated on the electrical heat trace system schedule on the Contract Drawings.

1.10.3 When heating cables are installed in hazardous areas indicated on the Contract Drawings, they shall be UL or FM listed for use in the particular atmosphere and degree of hazard involved including T-Rating and auto ignition temperature of the hazard.

1.10.4 The electrical heat trace system cables shall be automatically controlled by thermostats as indicated in the drawings and specifications. The thermostats shall switch a contactor to power the heating cables.

PART 2 – PRODUCTS

2.1 MATERIALS

2.1.1 Parallel Resistance Self-Regulating Electrical Heat Trace Cable

2.1.1.1 The electrical heat trace system cable design shall be such that it can vary its output in response to temperature variations along a pipe due to heat sinks such as fittings or pipe supports, or changes in ambient conditions such as those occurring on pipes passing into or out of buildings or process areas. This feature shall function independently along the entire length of heat trace cable.

2.1.1.2 Electrical heat trace cables shall be capable of being field cut-to-length without any cold spots.

2.1.1.3 Electrical heat trace cables shall be suitable for overlapping at all power outputs without cable failure or burning out.

2.1.1.4 The electrical heat trace system shall be capable of continuous reliable operation when hanging loose in free air during equipment removal or replacement.

2.1.1.5 The electrical heat trace system cable shall not require the use of heat transfer cement or compounds.

2.1.1.6 The electrical heat trace system cable shall operate on standard voltages without the use of special transformers. Line voltage fluctuations shall not appreciably affect the cable wattage output.

2.1.1.7 Heat tracing shall be a type which can be field designed to accommodate changes in field piping without compromising its FM or UL approvals.

2.1.1.8 Electrical heat trace system shall be manufactured by BriskHeat, Raychem Tyco Thermol Controls; Nelson Heat Tracing Systems; Thermon Manufacturing Co. or equal.

2.1.1.9 Freeze Protection Systems

2.1.1.9.1 Heating cables shall be industrial type and capable of maintaining temperatures up to 150 degrees F (65 degrees C) and withstand intermittent exposure temperatures up to 185 degrees F (85 degrees C).

2.1.1.9.2 The cables shall be suitable for use in ordinary, corrosive and classified (Class I, Div. 2) areas.

2.1.1.9.3 The cables for freeze protection shall be BriskHeat type SLCAB, Raychem type BTV; Thermon type RSX; Nelson type LT or equal.

2.1.2 Terminations

All connections components including termination fittings, splices and tees shall be suitable for use in the area of installation. All components shall be watertight rated NEMA 4X.

2.1.3 Circuit Controller and Monitor

2.1.3.1 Heat trace circuit monitoring panels shall be capable of energizing the heat trace circuit from an ambient sensing thermostat.

2.1.3.2 Ground fault protection shall be capable of monitoring ground fault currents at a minimum of 30 mA and in compliance with the latest NEC and IEEE equipment protection requirements.

2.1.3.3 Heat trace circuit controller and monitors shall be BriskHeat type TB261N, Pyrotenax, Digitrace series; Nelson, ET series or equal.

2.1.4 Control Thermostats

Control thermostats shall be UL listed, heavy duty, industrial type hermitically sealed housing. The thermostat shall be provided with independently adjustable dual switches for control and low temperature alarm. Contact rating shall be 22 Amps, 120 Volts, resistive. Control Thermostat shall be BriskHeat type TD101.

2.1.5 Power connection kits and junction boxes shall be watertight cast aluminum.

PART 3 – EXECUTION

3.1 INSTALLATION

3.1.1 Heat tracing system shall be installed where shown on the Contract Drawings and in accordance with manufacturer's approved shop drawings and recommendations.

3.1.2 Heating cables shall be run parallel to and on the bottom of the pipe at 5 o'clock or 7 o'clock only. Spiral wrapping of the heat cables around the pipes shall not be permitted.

3.1.3 Power cables for heat tracing circuits running from the supply panel to circuit junction boxes located on each pipe shall be run in conduit. The heat tracing cable shall connect to the power cable in a junction box and be routed onto the pipe through a cable feeder connector with gland nut. The connector shall be two-piece construction with a tapered neoprene bushing and recessed flame-resistant interior gland. The connector shall be attached to the pipe with stainless steel junction box support and pipe strap.

3.1.4 At each point where the junction box is attached to the lagging for heating cable entry to the pipe or device being protected and after the heating cable has been installed, the junction box stand-off shall be filled with clear Dow Corning TRV-732 compound or equal rated 500 degrees F, to provide a waterproof connection. The sealant compound shall also be forced into the voids in the insulation which were created during installation of the conduit hub. The sealant compound shall be placed to position all cables away from standoff sides and to separate cables away from one another. The sealant compound shall be applied in a clean, neat manner and in strict accordance with the manufacturer's instructions for the sealant. When the installation is complete, check that none of the compound has been left on other than the prescribed areas.

3.1.5 Install "electrically traced line" warning signs every 25-feet along the outer pipe insulation jacket.

3.2 TESTING

3.2.1 All testing shall be the responsibility of the equipment manufacturer.

3.2.2 Measure the resistance of heating cable system before and after pipe insulation.

3.2.3 Adjust and seal control thermostats to Owner's and COR and/or PO's satisfaction after installation is complete.

END OF SECTION

Appendix C

Contract Drawings

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US EPA
Region 7
Kansas City, Kansas

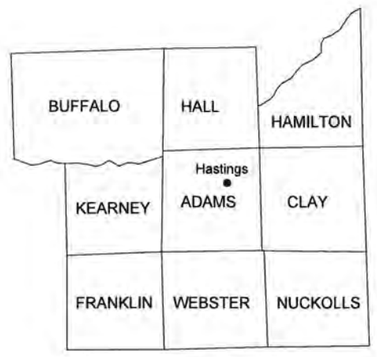
GARVEY ELEVATOR SUPERFUND SITE
OPERABLE UNIT 1 - INTERIM REMEDIAL DESIGN
HASTINGS, NEBRASKA

REVISED FINAL DESIGN SUBMITTAL
SEPTEMBER 2011

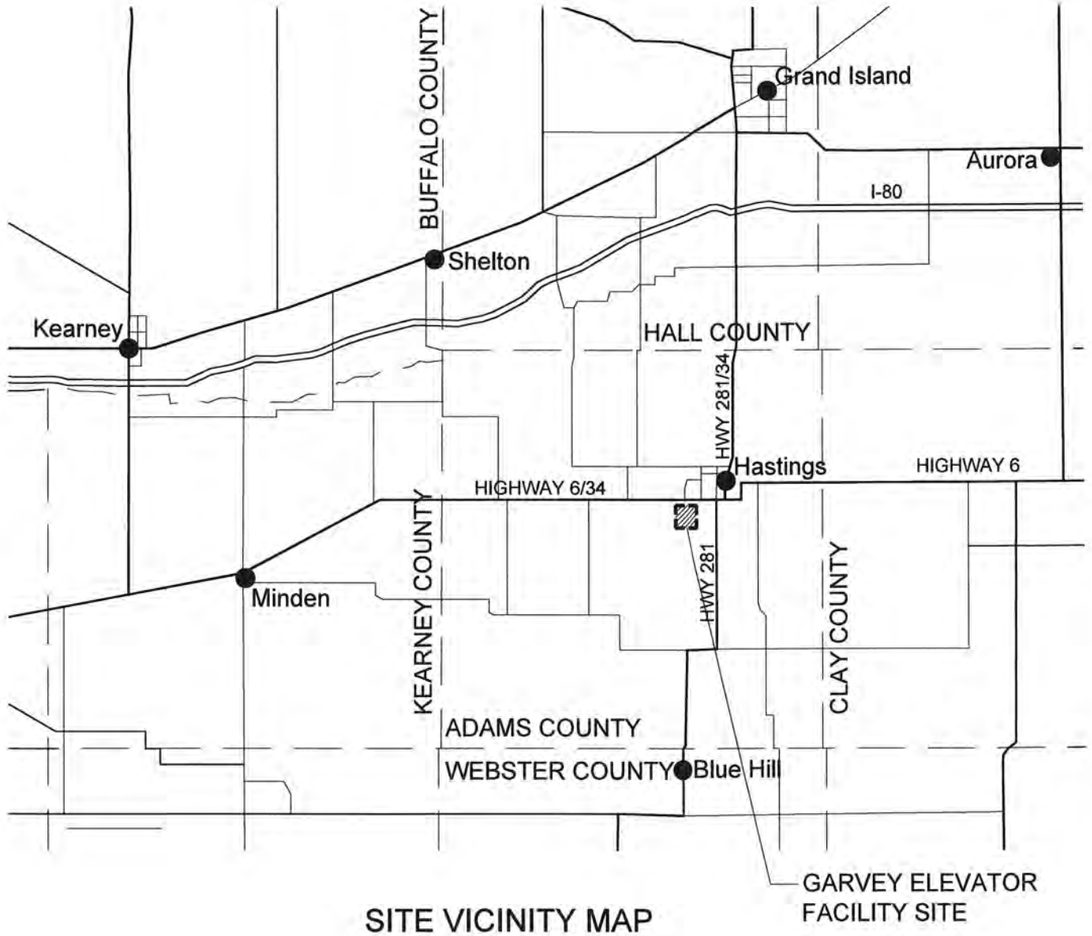
Prepared By:
CDM Federal Programs Corporation
HGL

INDEX OF DRAWINGS

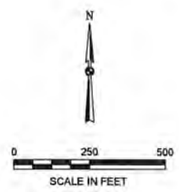
PROJECT LOCATION MAP

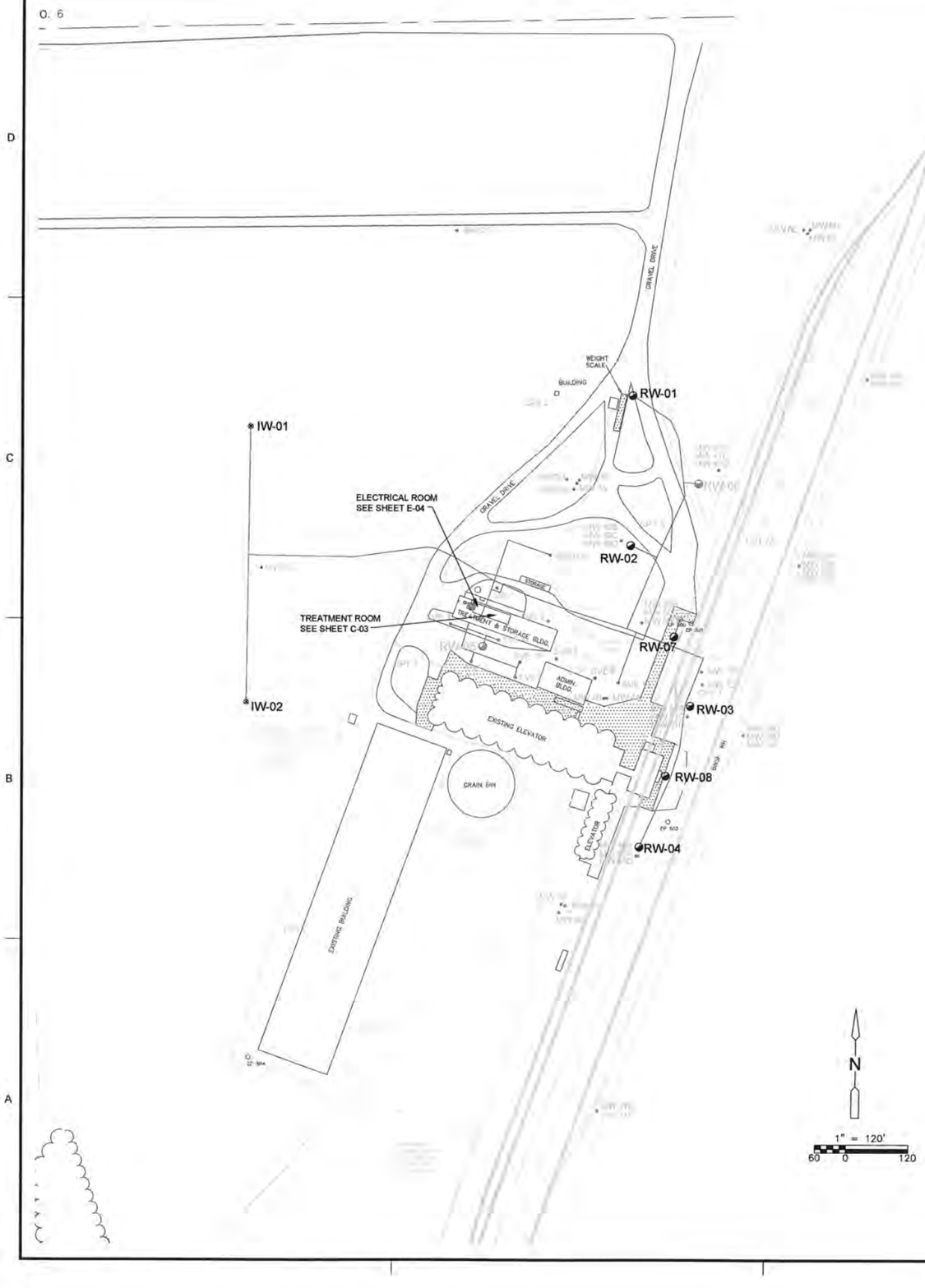


COUNTY LOCATION MAP



SITE VICINITY MAP





GENERAL NOTES:

(APPLY TO ALL SHEETS UNLESS OTHERWISE NOTED)

1. THE CONTRACTOR SHALL BECOME SATISFIED AS TO THE CONDITIONS EXISTING WITHIN EACH AREA, THE TYPE OF EQUIPMENT REQUIRED TO PERFORM THE WORK, AND THE CHARACTER, QUALITY, AND QUANTITY OF THE MATERIALS TO BE ENCOUNTERED INSOFAR AS THIS INFORMATION IS REASONABLY ASCERTAINABLE FROM AN INSPECTION OF THE SITE, AS WELL AS INFORMATION PRESENTED BY THE CONTRACT DRAWINGS AND SPECIFICATIONS.
2. THE CONTRACTOR IS RESPONSIBLE FOR LOCATING AND PROTECTING ALL EXISTING SITE IMPROVEMENTS OR STRUCTURES. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO SATISFY THEMSELVES THAT ALL THE EXISTING SITE IMPROVEMENTS, WHETHER SHOWN ON THESE CONTRACT DRAWINGS OR NOT, HAVE BEEN PROPERLY LOCATED.
3. THE CONTRACTOR IS RESPONSIBLE FOR ALL PROJECT SAFETY INCLUDING, BUT NOT LIMITED TO, EXCAVATION, TRAFFIC CONTROL, AND SECURITY.
4. THE CONTRACTOR SHALL COORDINATE WORK WITH THE FACILITY OWNER.
5. THE CONTRACTOR SHALL RESTORE ALL DAMAGED AREAS TO THEIR ORIGINAL CONDITION. ALL EXCESS MATERIALS AND SPOIL SHALL BECOME THE RESPONSIBILITY OF THE CONTRACTOR AND SHALL BE PREPARED, AS REQUIRED, PRIOR TO USE ONSITE OR DISPOSAL AT AN APPROVED OFFSITE FACILITY.
6. TABLE 1 SUMMARIZES THE WORK TO BE CONDUCTED AT EACH RECOVERY OR INJECTION WELL.
7. THE TERM 'ACCEPTABLE' SHALL MEAN WRITTEN ACCEPTANCE TO BE RECEIVED BEFORE WORK IS STARTED.
8. ANY DEVIATIONS FROM CONTRACT DRAWINGS OR SPECIFICATIONS MUST BE ACCEPTED, IN WRITING, PRIOR TO THE WORK BEING DONE. ANY DEVIATIONS PERFORMED WITHOUT ACCEPTANCE WILL NOT BE PAID FOR, AND MAY BE REQUIRED TO BE REDONE AT THE CONTRACTOR'S EXPENSE.
9. THE CONTRACTOR SHALL HAVE A COPY OF THE CONTRACT DOCUMENTS AT THE WORK SITE AT ALL TIMES.
10. SEE INDIVIDUAL SHEETS FOR ADDITIONAL ABBREVIATIONS, SYMBOLS, LEGENDS, DETAILS AND NOTES, IF ANY. NOT ALL 'STANDARD' DETAILS SHOWN MAY BE APPLICABLE TO THIS PROJECT.
11. UNLESS NOTED OTHERWISE, ALL WORK SHOWN IN THESE CONTRACT DOCUMENTS IS NEW AND TO BE PERFORMED UNDER THIS CONTRACT.
12. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING THE MINIMUM SITE SECURITY TO SECURE THE CONTRACTOR'S FACILITIES AND EQUIPMENT WITHIN THE LIMITS OF THIS CONTRACT.
13. COORDINATES USED ON CONTRACT DRAWINGS ARE NEBRASKA STATE PLANE, FIPS ZONE 2600; NAD 83.
14. ALL SYMBOLS AND ABBREVIATIONS ON THIS SHEET ARE FOR GENERAL INFORMATION AND MAY NOT NECESSARILY BE USED ON EVERY PAGE WITHIN THESE CONTRACT DOCUMENTS.

TABLE 1 - RECOVERY AND INJECTION WELL MODIFICATIONS

INJECTION OR RECOVERY WELL	NORTHING	EASTING	WELL VAULT ELECTRICAL MODIFICATIONS	PRESSURE TRANSDUCER
RW-01	270924.258	2080881.294	X	
RW-02	270636.079	2080877.866	X	
RW-03	270327.507	2080992.501	X	
RW-04	270056.710	2080895.538	X	
RW-05	270441.785	2080592.154		
RW-06	270754.887	2081007.600		
RW-07	270460.719	2080961.017	X	
RW-08	270193.287	2080946.173	X	
IW-01	270862.38	2080142.76		X
IW-02	270333.16	2080135.56		X

LEGEND

NOTE: IN GENERAL, EXISTING FEATURES ARE GREY AND NEW OR IMPORTANT FEATURES ARE BLACK. HATCHED AREAS ARE GENERALLY GREY FOR CLARITY.

- EXISTING FENCE
- EXISTING TREES AND/OR SHRUBS
- EXISTING DRAINAGE
- EXISTING BUILDING
- OHE — OVERHEAD ELECTRIC
- UGE — UNDERGROUND ELECTRIC
- UGU — UNDERGROUND UTILITY
- GAS — EXISTING GAS LINE
- EXISTING RAILROAD TRACKS
- I-01 — INJECTION WELL
- SVE-1 — SOIL VAPOR EXTRACTION WELL
- RW-01 — EXISTING RECOVERY WELL
- CONTROL POINT
- POWER POLE
- LIGHT POLE
- GM — GAS METER
- TEL — TELEPHONE RISER
- ELEC — ELECTRIC RISER
- ELECTRICAL & CONTROL PULL BOXES
- CONCRETE

STANDARD SECTION SYMBOL

SECTION NUMBER
TOP
BOT
SHEET WHERE SECTION IS SHOWN

PROFESSIONAL CHEMICAL ENGINEER
JACQUELINE M. MOSHER
E-10427
STATE OF NEBRASKA
9/30/11

EPA
U.S. Environmental Protection Agency
Region 7
Kansas City, Kansas

MARK	DESCRIPTION	DATE	APPR

MARK	DESCRIPTION	DATE	APPR

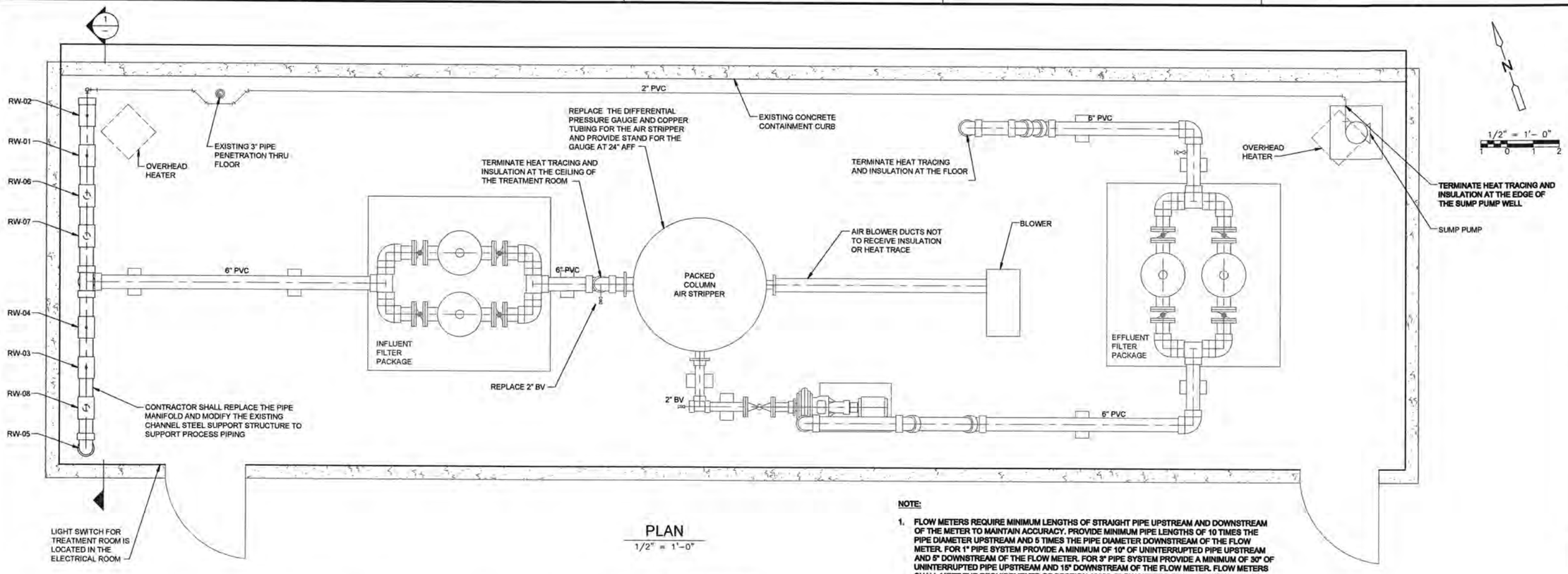
DESIGNED BY: M. SCHLEIBAUM
DWN BY: L. KLEIBE
CHKD BY: J. MOSHER
SUBMITTED BY: CDM
DATE: 09/2011
REVISION NO.: WORK PLAN
CONTRACT NO.: -
PLOT SCALE: 1"=1'
PLOT DATE: 9/29/2011
FILE NUMBER: 11-4.47209
SIZE: ANSI D
FILE NAME: C02GRAL0.dwg

HGL
CDM
CDM Federal Programs Corporation

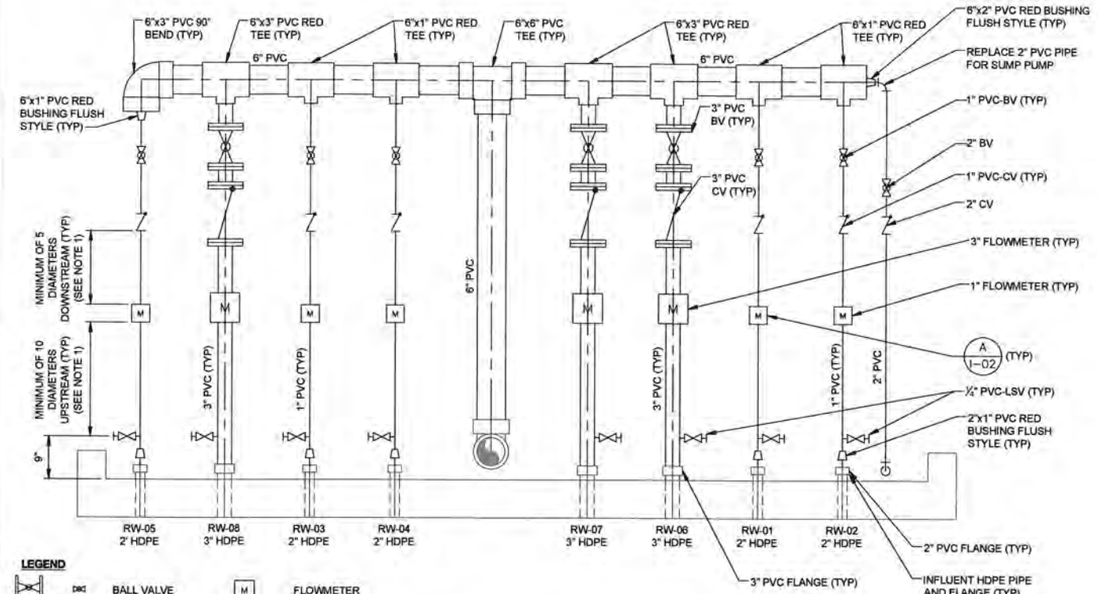
GARVEY ELEVATOR SUPERFUND SITE
OPERABLE UNIT 1 - INTERIM REMEDIAL DESIGN
HASTINGS, NEBRASKA

GENERAL SITE PLAN, NOTES, AND LEGEND

SHEET IDENTIFICATION
C-02



PLAN
1/2" = 1'-0"



LEGEND

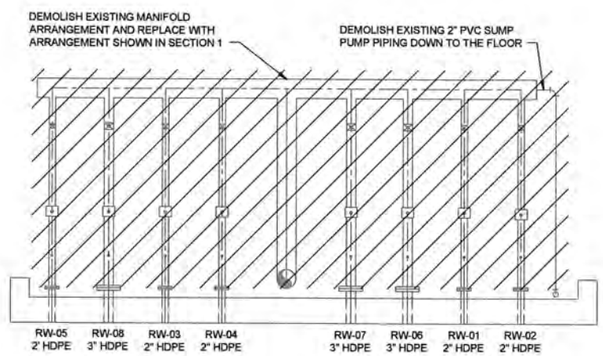
	BALL VALVE	M	FLOWMETER
	CHECK VALVE	TYP	TYPICAL
	LAB SAMPLE VALVE		REDUCER
AFF	ABOVE FINISHED FLOOR		

GROUNDWATER MANIFOLD ARRANGEMENT

SECTION 1
NTS

NOTE:

1. **FLOW METERS REQUIRE MINIMUM LENGTHS OF STRAIGHT PIPE UPSTREAM AND DOWNSTREAM OF THE METER TO MAINTAIN ACCURACY. PROVIDE MINIMUM PIPE LENGTHS OF 10 TIMES THE PIPE DIAMETER UPSTREAM AND 5 TIMES THE PIPE DIAMETER DOWNSTREAM OF THE FLOW METER. FOR 1" PIPE SYSTEM PROVIDE A MINIMUM OF 10" OF UNINTERRUPTED PIPE UPSTREAM AND 5" DOWNSTREAM OF THE FLOW METER. FOR 3" PIPE SYSTEM PROVIDE A MINIMUM OF 30" OF UNINTERRUPTED PIPE UPSTREAM AND 15" DOWNSTREAM OF THE FLOW METER. FLOW METERS SHALL MEET THE REQUIREMENTS OF SECTION 13300. FLOW METERS SHALL BE INSTALLED IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS AND SECTION 13300.**
2. **CONTRACTOR SHALL REMOVE ALL OF THE EXISTING HEAT TRACING AND PIPE INSULATION FOR THE LIQUID PROCESS PIPING INCLUDING THE SUMP PUMP PIPING AND THE FILTER SYSTEMS. INSTALL PIPE INSULATION AND HEAT TRACING ON ALL LIQUID PIPING AND APPURTENANCES IN THE TREATMENT ROOM IN ACCORDANCE WITH SECTIONS 15055 AND 16859.**
3. **ALL PIPE, FITTINGS, AND VALVES SHALL MEET THE REQUIREMENTS OF SECTION 15055.**



EXISTING GROUNDWATER MANIFOLD ARRANGEMENT DEMOLITION

DETAIL A
1/2" = 1'-0"

PROFESSIONAL CHEMICAL ENGINEER
JACQUELINE M. MOSHER E-10427
STATE OF NEBRASKA
4/3/11

U.S. Environmental Protection Agency
Region 7
Kansas City, Kansas

MARK	DESCRIPTION	DATE	APPR

MARK	DESCRIPTION	DATE	APPR

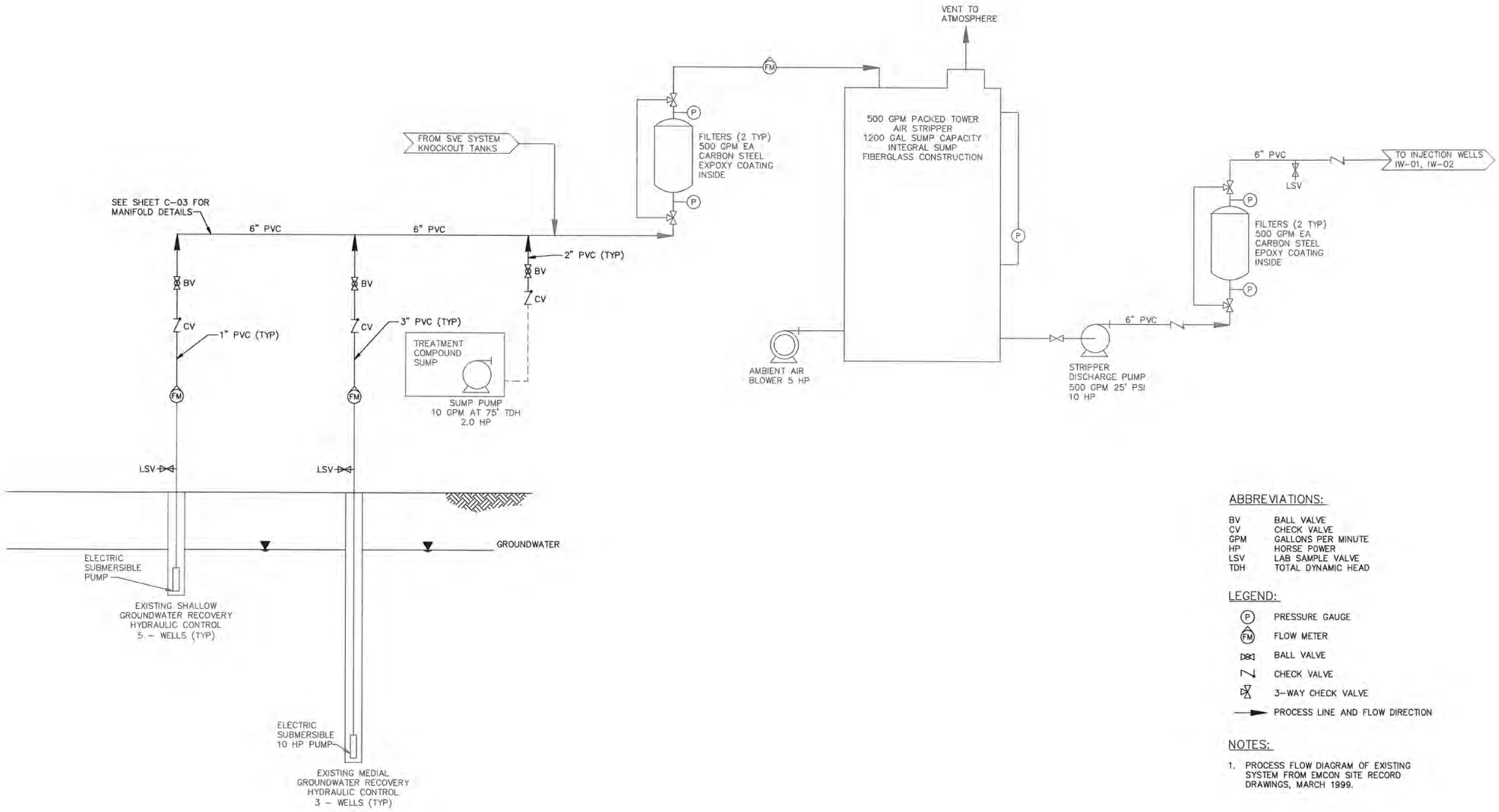
DESIGNED BY: MICHAEL BEECH
DRAWN BY: K. REESE
CHKD BY: J. MOSHER
SUBMITTED BY: CDM
PLOT SCALE: 1/2"=1'-0"
PLOT DATE: 9/29/2011
SIZE: ANSI D
DATE: 09/2011
SOLICITATION NO.: W912P4-07-R-0044
CONTRACT NO.: -
FILE NUMBER: H-4-7208
FILE NAME: C03078_1.dwg

HGL
CDM
CDM Federal Programs Corporation

GARVEY ELEVATOR SUPERFUND SITE
OPERABLE UNIT 1 - INTERIM REMEDIAL DESIGN
HASTINGS, NEBRASKA

TREATMENT ROOM LAYOUT

SHEET IDENTIFICATION
C-03



ABBREVIATIONS:

BV	BALL VALVE
CV	CHECK VALVE
GPM	GALLONS PER MINUTE
HP	HORSE POWER
LSV	LAB SAMPLE VALVE
TDH	TOTAL DYNAMIC HEAD

LEGEND:

- (P) PRESSURE GAUGE
- (FM) FLOW METER
- BALL VALVE
- CHECK VALVE
- 3-WAY CHECK VALVE
- PROCESS LINE AND FLOW DIRECTION

NOTES:

1. PROCESS FLOW DIAGRAM OF EXISTING SYSTEM FROM EMCON SITE RECORD DRAWINGS, MARCH 1999.

PROFESSIONAL CHEMICAL ENGINEER
JACQUELINE M. MOSHER
10424
STATE OF NEBRASKA
9/30/11

U.S. Environmental Protection Agency
Region 7
Kansas City, Kansas

MARK	DESCRIPTION	DATE	APPR.

DESIGNED BY: M. SCHLEICH
DRAWN BY: K. REESE
CHKD BY: J. MOSHER
SUBMITTED BY: CDM
DATE: DRAFT
SOLICITATION NO.: W912P8-07-R-0044
CONTRACT NO.: -
PLOT SCALE: NTS
PLOT DATE: 9/29/2011
FILE NAME: P001P01.dwg
SIZE: ANSI D
FILE NUMBER: 14-44-7308

HGL HydroGeoLogic, Inc.
CDM Federal Programs Corporation

GARVEY ELEVATOR SUPERFUND SITE
OPERABLE UNIT 1 - INTERIM REMEDIAL DESIGN
HASTINGS, NEBRASKA

PROCESS FLOW DIAGRAM

SHEET IDENTIFICATION
P-01

ONE LINE OR CONTROL DIAGRAM	PLAN	DESCRIPTION
52 CS	—	MEDIUM VOLTAGE DRAWOUT TYPE POWER CIRCUIT BREAKER CS=CONTROL SWITCH
TRIP FRAME	CB	LOW VOLTAGE AIR OR MOLDED CASE CIRCUIT BREAKER, 3 POLE UNLESS OTHERWISE NOTED.
		COMBINATION MOTOR CIRCUIT PROTECTOR AND MAGNETIC MOTOR STARTER, FULL VOLTAGE NON-REVERSING UNLESS OTHERWISE NOTED: * FVR – FULL VOLTAGE REVERSING RVNR – REDUCED VOLTAGE NON-REVERSING RVAT – REDUCED VOLTAGE AUTOTRANSFORMER RVSS – REDUCED VOLTAGE SOLID STATE 2S1W – TWO SPEED, ONE WINDING RS2W – TWO SPEED, TWO WINDING (DIAGRAMATICALLY SHOWN, CONTRACTOR SHALL FIELD LOCATE)
		NON-FUSIBLE DISCONNECT SWITCH, 600 VOLT, 3 POLE * AMPERE RATING NOTED IF OTHER THAN 30A (DIAGRAMATICALLY SHOWN, CONTRACTOR SHALL FIELD LOCATE)
	F	FUSIBLE DISCONNECT SWITCH, 600 VOLT, 3 POLE, * AMPERE RATING AND FUSE SIZE AS NOTED * AMPERE RATING NOTED IF OTHER THAN 30A FUSE RATING (DIAGRAMATICALLY SHOWN, CONTRACTOR SHALL FIELD LOCATE)
	P 2	MANUAL MOTOR STARTER WITH THERMAL OVERLOAD HEATER, 1 POLE UNLESS OTHERWISE NOTED "P" INDICATES WITH PILOT LIGHT "2" INDICATES TWO POLE (DIAGRAMATICALLY SHOWN, CONTRACTOR SHALL FIELD LOCATE)
	—	DRAWOUT TYPE EQUIPMENT OR DEVICE
	—	MEDIUM VOLTAGE CABLE TERMINATION
	—	MEDIUM VOLTAGE AIR INTERRUPTER SWITCH
	—	MEDIUM VOLTAGE FUSED AIR INTERRUPTER SWITCH * FUSE RATING
	—	MEDIUM VOLTAGE FUSED MOTOR CONTROLLER
VOLTS_PRI XX_KVA VOLTS_SEC 3P/4W	T	TRANSFORMER, RATINGS AND CONNECTIONS AS NOTED. UNLESS OTHERWISE NOTED ON THE SINGLE LINE DIAGRAMS, ALL DRY TYPE TRANSFORMERS SERVICING ADMINISTRATIVE AND LABORATORY SPACES SHALL HAVE A K FACTOR OF 4. ISOLATION TRANSFORMERS SHALL HAVE A K-20 RATING
* A TO 5	—	CURRENT TRANSFORMER * QUANTITY A = PRIMARY AMPERES
* V TO 120	—	CURRENT TRANSFORMER * QUANTITY V = PRIMARY VOLTAGE
	G	GENERATOR, RATINGS AND CONNECTIONS AS NOTED
ATS	—	AUTOMATIC OR MANUAL TRANSFER SWITCH NO.1 (ATS-1), (MTS-1) "N" INDICATES NORMAL OR PREFERRED SOURCE "S" INDICATES STANDBY OR ALTERNATE SOURCE 100A INDICATES CONTINUOUS CURRENT RATING
*	*	VARIABLE SPEED DRIVE CONTROLLER * D.C. = D.C. DRIVE CONTROLLER SCR = SILICON CONTROLLED RECTIFIER VFD = VARIABLE FREQUENCY DRIVE
#KW	E	UNIT HEATER – ELECTRIC HEATING COIL AND FAN # – RATING
—	U	UNIT HEATER – STEAM OR WATER HEATING COIL AND FAN
(5)	M	MOTOR, NUMERAL INDICATES HORSEPOWER
VS VM *	—	VOLTMETER WITH SWITCH, 3 PHASE
AS AM *	—	AMMETER WITH SWITCH, 3 PHASE

ONE LINE OR CONTROL DIAGRAM	PLAN	DESCRIPTION
	—	METER * WM – WATTMETER WHM – WATTHOUR METER WHDM – WATTHOUR DEMAND METER WHDR – WATTHOUR DEMAND RECORDER PF – POWER FACTOR METER ETM – ELAPSED TIME METER TRANSDUCER AX – CURRENT TRANSDUCER WX – WATT TRANSDUCER WHX – WATTHOUR TRANSDUCER
		RELAY, NO. AS INDICATED 25 – SYNCHRONISM CHECK RELAY 27 – UNDERVOLTAGE RELAY 32 – DIRECTIONAL POWER RELAY 38 – BEARING PROTECTIVE DEVICE 40 – LOSS OF EXCITATION RELAY 42 – RUNNING CONTACTOR/PILOT RELAY 46 – REVERSE PHASE/PHASE BALANCE/CURRENT RELAY 47 – PHASE SEQUENCE VOLTAGE RELAY 49 – MACHINE OR TRANSFORMER THERMAL RELAY 50/51 – INSTANTANEOUS/TIME OVERCURRENT RELAY 50G – INSTANTANEOUS GROUND 51 – TIME OVERCURRENT RELAY 51G – TIME OVERCURRENT RELAY, GROUNDING RESISTOR TYPE 51N – TIME OVERCURRENT RELAY, RESIDUAL TYPE 51V – TIME OVERCURRENT RELAY WITH VOLTAGE RESTRAINT 51X – AUXILIARY RELAY (TRIPS CB AND ALARMS) 59 – OVERVOLTAGE RELAY 60 – NEGATIVE SEQUENCE VOLTAGE RELAY 62 – TIME DELAY RELAY 63 – OVERPRESSURE RELAY 64 – GENERATOR FIELD GROUND RELAY 67 – AC DIRECTIONAL OVERCURRENT RELAY 74 – ALARM LATCHING RELAY 83 – AUTOMATIC SELECTIVE CONTROL OR TRANSFER RELAY 86 – LOCKING-OUT RELAY 87 – DIFFERENTIAL PROTECTIVE RELAY B – SUFFIX INDICATES "BUS" G – SUFFIX INDICATES "GENERATOR" GF – GROUND FAULT ST – SHUNT TRIP T – SUFFIX INDICATES "TRANSFORMER" X – SUFFIX INDICATES "AUXILIARY"
*	—	SPECIAL CAPACITOR * SC – SURGE CAPACITOR PF – POWER FACTOR CORRECTION CAPACITOR
	—	TUNED POWER FACTOR CORRECTION CAPACITOR
	—	PUSHBUTTON, MOMENTARY CONTACT, SPRING RETURN, NORMALLY CLOSED
	—	PUSHBUTTON, MOMENTARY CONTACT, SPRING RETURN, NORMALLY OPEN
	ES	EMERGENCY STOP PUSHBUTTON WITH RED MUSHROOM HEAD OPERATOR (MAINTAINED CONTACT)
STOP START	PBL	START-STOP PUSHBUTTON CONTROL STATION (MOMENTARY CONTACT) WITH LOCKOUT DEVICE ON STOP
	PBM	START-STOP PUSHBUTTON CONTROL STATION, MAINTAINED CONTACT WITH LOCKOUT DEVICE ON STOP
OFF ON	S/S	OFF/ON SELECTOR SWITCH
L R (XO) (OX)	LR	LOCAL/REMOTE SELECTOR SWITCH
A B C* (XOO) (OOX) (OOX)	*	3 POSITION SELECTOR SWITCH, MAINTAINED CONTACT O=OPEN X=CLOSED

POSITION	TOP CONTACT	MIDDLE CONTACT	BOTTOM CONTACT
A	X	O	O
B	O	O	O
C	O	O	X

NAMEPLATE (A/B/C)
HOA – HAND/OFF/AUTO
HOR – HAND/OFF/REMOTE
LOR – LOCAL/OFF/REMOTE
RSL – RAISE/STOP/LOWER
TOA – TEST/OFF/AUTO

GD/VF #	GD/VF #	GAS DETECTOR / VENTILATION FAILURE ALARM
		# INDICATES TYPE OF UNIT
		1=MASTER, 2=REMOTE

42 #	—	MOTOR STARTER COIL, NUMBER AS INDICATED TO DENOTE INTERLOCKING ONLY
CR #	—	CONTROL RELAY COIL, NUMBER AS INDICATED

ONE LINE OR CONTROL DIAGRAM	PLAN	DESCRIPTION
	—	PILOT LIGHT, COLOR AS NOTED * R – RED G – GREEN B – BLUE W – WHITE A – AMBER
	—	PILOT LIGHT, PUSH-TO-TEST TYPE, COLOR AS NOTED ABOVE.
RANGE SETPOINT		TIME DELAY RELAY RANGE AS NOTED SETPOINT AS NOTED # NUMBER AS INDICATED * TDE – TIME DELAY AFTER ENERGIZATION ON DELAY TDD – TIME DELAY AFTER DE-ENERGIZATION OFF DELAY
* NOTC		NOTC– NORMALLY OPEN, TIMED CLOSING WHEN ENERGIZED
NCTO		NCTO– NORMALLY CLOSED, TIMED OPENING WHEN ENERGIZED
NOTO		NOTO– NORMALLY OPEN, TIMED OPENING WHEN DE-ENERGIZED
NCTC		NCTC– NORMALLY CLOSED, TIMED CLOSING WHEN DE-ENERGIZED
	* - ##	FIELD INSTRUMENT, TAG NO. AS INDICATED * INDICATES INSTRUMENT TYPE DEFINED ON LOOP SHEETS OR P & ID ## INDICATES LOOP NO.
	LS OR ■	LIQUID LEVEL (FLOAT) SWITCH
		NORMALLY OPEN, CLOSES ON RISING LEVEL
		NORMALLY CLOSED, OPENS ON RISING LEVEL
	PS OR ■	PRESSURE OR VACUUM SWITCH
		NORMALLY OPEN, CLOSES ON RISING PRESSURE
		NORMALLY OPEN, CLOSES ON DROPPING PRESSURE
		NORMALLY CLOSED, OPENS ON RISING PRESSURE
		NORMALLY CLOSED, OPENS ON DROPPING PRESSURE
	TS OR (T) OR ■	TEMPERATURE SWITCH OR THERMOSTAT
		NORMALLY OPEN, CLOSES ON RISING TEMPERATURE
		NORMALLY OPEN, CLOSES ON DROPPING TEMPERATURE
		NORMALLY CLOSED, OPENS ON RISING TEMPERATURE
		NORMALLY CLOSED, OPENS ON DROPPING TEMPERATURE
	FS OR ■	FLOW SWITCH (AIR, WATER, ETC.)
		NORMALLY OPEN, CLOSES ON INCREASED FLOW
		NORMALLY CLOSED, OPENS ON INCREASED FLOW
	ZS OR ■	POSITION (LIMIT) SWITCH
		NORMALLY OPEN
		NORMALLY OPEN – HELD CLOSED
		NORMALLY CLOSED
		NORMALLY CLOSED – HELD OPEN
	TQ OR ■	TORQUE SWITCH
		NORMALLY OPEN, CLOSES ON HIGH TORQUE
		NORMALLY CLOSED, OPENS ON HIGH TORQUE
#	—	UTILIZED IN CONJUNCTION WITH OTHER CONTROL SCHEMATIC SYMBOLS TO DEPICT THE PHYSICAL LOCATION OF THE DEVICE # REPRESENTS LOCATION SEE LOCATION LEGEND ON DRAWING
	—	CONDUCTORS OR CONDUITS CROSSING PATHS BUT NOT CONNECTED
	—	CONDUCTORS ELECTRICALLY CONNECTED
	—	INDICATES LIMITS OF ELECTRICAL EQUIPMENT OR WIRING ENCLOSURE

ONE LINE OR CONTROL DIAGRAM	PLAN	DESCRIPTION
LA	—	LIGHTNING ARRESTER
		GROUND OR GROUND ROD
30A	—	FUSE, AMPERE RATING AS NOTED
	HTR	STRIP HEATER OR HEATING ELEMENT
	—	INDUCTOR
TG	TG	TACHOMETER GENERATOR
	—	CONTACT, NORMALLY OPEN (NO)
	—	CONTACT, NORMALLY CLOSED (NC)
	—	OVERLOAD RELAY HEATER
K	—	KEY INTERLOCK
TB	—	TERMINAL OR TEST BLOCK
RTD	—	RESISTANCE TEMPERATURE DETECTOR
VE OR VE	—	VIBRATION DETECTOR
DM	DM	DAMPER MOTOR
ETM	—	ELAPSED TIME METER
M	M	MOTOR OPERATED VALVE OR GATE

ABBREVIATIONS	
A	AMPS
AC	ALTERNATING CURRENT
AFF	ABOVE FINISHED FLOOR
AFG	ABOVE FINISHED GRADE
AL	ALUMINUM
AIC	AMPERE INTERRUPTING CAPACITY
AMP	AMPERE
ATS	AUTOMATIC TRANSFER SWITCH
AUTO	AUTOMATIC
AUX	AUXILIARY
AWG	AMERICAN WIRE GAUGE
BKR	BREAKER
BLDG	BUILDING
C	CONDUIT
CB	CIRCUIT BREAKER
CGD	COMBUSTIBLE GAS DETECTOR
CKT	CIRCUIT
CLB	CURRENT LIMITING BREAKER
CLF	CURRENT LIMITING FUSE
CP	CONTROL PANEL
CPT	CONTROL POWER TRANSFORMER
CR	CONTROL RELAY
CS	CONTROL SWITCH
CT	CURRENT TRANSFORMER
CU	COPPER
CWS	CONDUIT WALL SEAL
DC	DIRECT CURRENT
DIA	DIAMETER
DMU	DIGITAL METERING UNIT
DN	DOWN
EC	EMPTY CONDUIT
ELEC	ELECTRICAL

GENERAL NOTE

THIS IS A STANDARD LEGEND. SOME SYMBOLS MAY NOT APPEAR ON THE DRAWINGS.

ABBREVIATIONS (CONTINUED)	
ELEV	ELEVATION
EM	EMERGENCY
ENCL	ENCLOSURE OR ENCLOSED
EQUIP	EQUIPMENT
EWC	ELECTRIC WATER COOLER
EWH	ELECTRIC WATER HEATER
EX	EXISTING
FO	FIBER OPTIC
FU	FUSE
GCP	GENERATOR CONTROL PANEL
GEN	GENERATOR
G, GND	GROUND
GFI	GROUND FAULT INTERRUPTER
GRS	GALVANIZED RIGID STEEL
HACR	HEATING & AIR CONDITIONING RATED
HH	HANDHOLE
HT	HEIGHT
HID	HIGH INTENSITY DISCHARGE
HP	HORSEPOWER
HZ	HERTZ
INSTR	INSTRUMENT
K	KILO (PREFIX)
kcmil	1000 CIRCULAR MILS
KVA	KILOVOLT AMPERES
KW	KILOWATTS
LA	LIGHTING ARRESTER
LTG	LIGHTING
LP	LIGHTING PANEL
LV	LOW VOLTAGE
MAX	MAXIMUM
MCB	MAIN CIRCUIT BREAKER
MCC	MOTOR CONTROL CENTER
MCP	MOTOR CIRCUIT PROTECTOR
MFR	MANUFACTURER
MH	MANHOLE
MIN	MINIMUM
MLO	MAIN LUGS ONLY
MTD	MOUNTED
MTS	MANUAL TRANSFER SWITCH
MV	MEDIUM VOLTAGE
N	NEUTRAL
NC	NORMALLY CLOSED
NO	NORMALLY OPEN OR NUMBER
NTS	NOT TO SCALE
OH	OVERHEAD
PB	PULL BOX
OL	OVERLOAD
PCP	PUMP CONTROL PANEL
PH	PHASE
PMH	POWER MANHOLE
PNL	PANEL OR PANELBOARD
PR	PAIR
PRI	PRIMARY
PT	POTENTIAL TRANSFORMER
PVC	POLYVINYL CHLORIDE
RECPT	RECEPTACLE
REQD	REQUIRED
QTY	QUANTITY
SA	SURGE ARRESTER
SEC	SECONDS OR SECONDARY
SH	SHIELDED
SHH	SIGNAL HANDHOLE
SS	STAINLESS STEEL
SV	SOLENOID VALVE
SW	SWITCH
SWBD	SWITCHBOARD
SWGR	SWITCHGEAR
TC	TIME TO CLOSE OR TRAY CABLE
TEL	TELEPHONE
TO	TIME TO OPEN
TVSS	TRANSIENT VOLTAGE SURGE SUPRESSOR
TS	TWISTED SHIELDED
TYP	TYPICAL
UG	UNDERGROUND
UPS	UNINTERRUPTIBLE POWER SUPPLY
V	VOLTS
VA	VOLT AMPS
VFD	VARIABLE FREQUENCY DRIVE
W	WATTS, WIDTH, WITH, WIRE
WP	WEATHERPROOF
WPIU	WEATHERPROOF WHILE IN USE
XFMR	TRANSFORMER

U.S. Environmental Protection Agency
Region 7
Kansas City, Kansas

MARK	DESCRIPTION	DATE	APPR.

DESIGNED BY: CEG
DRAWN BY: CAD
CHKD BY: SSP
SUBMITTED BY: CDM
DATE:
SOLICITATION NO.: W912P8-07-R-0044
CONTRACT NO.: -
PLOT SCALE: NTS
PLOT DATE: 9/29/2011
FILE NUMBER: 1-44-7258
SIZE: ARCH D
FILE NAME: E01-L0000.dwg

HGL
CDM
CDM Federal Programs Corporation

GARVEY ELEVATOR SUPERFUND SITE
OPERABLE UNIT 1 - INTERIM REMEDIAL DESIGN
HASTINGS, NEBRASKA

ELECTRICAL SYMBOLS, ABBREVIATIONS AND GENERAL NOTES I

SHEET IDENTIFICATION
E-01

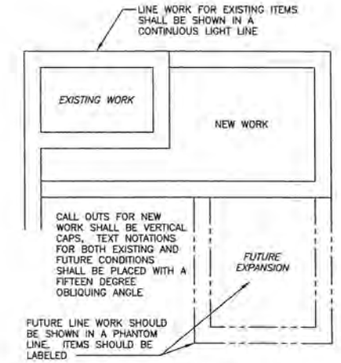
PROFESSIONAL ELECTRICAL ENGINEER
VINCENT J. PLANSKY JR.
E-9007
STATE OF NEBRASKA
9/30/11

SYMBOL	DESCRIPTION
A 3 b	INCANDESCENT, COMPACT FLUORESCENT OR H.I.D. TYPE LIGHTING FIXTURE "A" – FIXTURE TYPE (SEE LIGHTING FIXTURE SCHEDULE) "b" – CONTROLLED BY SWITCH "b" "3" – CIRCUIT NUMBER
A 3 b	FLUORESCENT TYPE LIGHTING FIXTURE, NOTATIONS SAME AS ABOVE
A 3 b	WALL MOUNTED INCANDESCENT, COMPACT FLUORESCENT OR H.I.D. TYPE LIGHTING FIXTURE, NOTATIONS SAME AS ABOVE
A 3 OR A 3	CROSS HATCH INDICATES LIGHTING FIXTURE THAT IS UNSWITCHED AND SHALL REMAIN ON AT ALL TIMES. NOTATIONS SAME AS ABOVE.
A 3 b OR A 3 b	SHADED AREA INDICATES LIGHTING FIXTURE THAT IS EQUIPPED WITH EMERGENCY BACKUP POWER SOURCE. NOTATIONS SAME AS ABOVE.
A B 3	POLE MOUNTED AREA H.I.D. TYPE LIGHTING FIXTURE, NOTATIONS SAME AS ABOVE
A 3	POLE MOUNTED ROADWAY H.I.D. TYPE LIGHTING FIXTURE, NOTATIONS SAME AS ABOVE
EM 3 (*)	EMERGENCY LIGHTING BATTERY UNIT WITH TWO LAMP HEADS "EM" – FIXTURE TYPE (SEE LIGHTING FIXTURE SCHEDULE) "3" – SUPERVISORY CIRCUIT * – FIXTURE TAG #
R-2 BU-1(*)	REMOTE EMERGENCY ADJUSTABLE WALL LIGHTING FIXTURE WITH TWO LAMP HEADS "R-2" – FIXTURE TYPE (SEE LIGHTING FIXTURE SCHEDULE) * – HOME RUN TO BATTERY UNIT INDICATED. CONDUIT SHALL BE 3/4" AND CONTAIN (2) NO. 12 AWG BRANCH CIRCUIT CONDUCTORS AND (1) NO. 12 AWG GROUND CONDUCTOR UNLESS OTHERWISE INDICATED.
A 3	COMBINATION BATTERY UNIT AND EXIT SIGN. FILLED QUADRANT REPRESENTS FACE SIDE OF SIGN.
A 3	CEILING MOUNTED EXIT SIGN, NOTATIONS SAME AS ABOVE. WHEN USED, ARROW INDICATES DIRECTION OF EGRESS. FILLED QUADRANT REPRESENTS FACE SIDE OF SIGN. (DOUBLE FACE DOUBLE CHEVRONS SHOWN)
A 3	WALL MOUNTED EXIT SIGN, NOTATIONS SAME AS ABOVE. WHEN USED, ARROW INDICATES DIRECTION OF EGRESS. FILLED QUADRANT REPRESENTS FACE SIDE OF SIGN.
RH-3 E 3 BU-1(*)	REMOTE EMERGENCY CEILING LIGHTING FIXTURE. "RH-3" – FIXTURE TYPE (SEE LIGHTING FIXTURE SCHEDULE) "3" – SUPERVISORY CIRCUIT * – HOME RUN TO BATTERY UNIT INDICATED. CONDUIT SHALL BE 3/4" AND CONTAIN 2 NO. 12 AWG BRANCH CIRCUIT CONDUCTORS AND 1 NO. 12 AWG GROUND CONDUCTOR UNLESS OTHERWISE INDICATED.
	HOME RUN TO DESIGNATED EQUIPMENT. BRANCH CIRCUIT CONDUIT WITH 2 NO. 12 AWG BRANCH CIRCUIT CONDUCTORS AND 1 NO. 12 AWG GROUND CONDUCTOR UNLESS OTHERWISE NOTED. NUMBER OF ARROWS INDICATE NUMBER OF CIRCUITS. FOR MINIMUM SIZE CONDUIT PERMITTED REFER TO THE SPECIFICATIONS.
	CONDUIT CONCEALED IN WALL, IN SLAB ABOVE, OR ABOVE CEILING.
	CONDUIT CONCEALED IN OR BELOW FLOOR OR UNDERGROUND.
	CONDUIT RUN EXPOSED. RUN PARALLEL OR PERPENDICULAR TO STRUCTURE OR WALL.
	'X' INDICATES EXPLOSION PROOF CONDUIT SEAL FITTING.
	CONCRETE ENCASED DUCTBANK. WIDTH VARIES, SEE DUCTBANK SECTION/DETAILS FOR REQUIREMENTS AND WIDTH
	CONDUIT STUBBED OUT AND CAPPED
(2) 3"C., 3#3/0, 1#2G	DENOTES A QUANTITY OF TWO (2) 3-INCH CONDUITS EACH CONTAINING THREE NO. 3/0 AWG CONDUCTORS AND 1 NO. 2 AWG GROUND CONDUCTOR.
2-2/C#16 SH	DENOTES A QUANTITY OF TWO INSTRUMENT CABLES. EACH CABLE TO CONSIST OF TWO NO. 16 AWG CONDUCTORS TWISTED TOGETHER AND COVERED WITH A METALLIC SHIELD AND AN OVERALL PROTECTIVE JACKET. REFER TO THE SPECIFICATIONS FOR THE EXACT CABLE TO BE PROVIDED.
2-3/C#16 SH	SAME AS ABOVE EXCEPT CABLE TO CONSIST OF THREE NO. 16 AWG CONDUCTORS TWISTED, SHIELDED AND COVERED WITH AN OVERALL PROTECTIVE JACKET. REFER TO THE SPECIFICATIONS FOR THE EXACT CABLE TO BE PROVIDED.
(3) 4"C.	THREE 4-INCH CONDUITS
	FLEXIBLE METAL CONDUIT "WHIP" (3/4"C., 2#12, 1#12G UNLESS OTHERWISE NOTED) FOR RECESSED LIGHTING FIXTURES AND LIQUID TIGHT MOTOR CONNECTIONS
	CONDUIT SEAL FITTING SHOWN IN OTHER THAN CODE REQUIRED LOCATIONS.
⊠	INDICATES MOTOR STARTER AND/OR MOTOR CONTROL EQUIPMENT WITHIN THE ENCLOSURE.

SYMBOL	DESCRIPTION
$a	SINGLE POLE SWITCH "a" INDICATES FIXTURES CONTROLLED.
$a2	DOUBLE POLE SWITCH "a" INDICATES FIXTURES CONTROLLED.
$c3	THREE WAY SWITCH "c" INDICATES FIXTURES CONTROLLED.
$a4	FOUR WAY SWITCH "a" INDICATES FIXTURES CONTROLLED.
$a0	DIMMER SWITCH "a" INDICATES FIXTURES CONTROLLED
$OS	SINGLE POLE SWITCH "OS" INDICATES A PASSIVE INFRARED OCCUPANCY SENSOR
$OS2	DOUBLE POLE SWITCH "OS" INDICATES PROGRAMMABLE OCCUPANCY SENSOR CAPABLE OF INBOARD/OUTBOARD SWITCHING
$DT	SINGLE POLE SWITCH "DT" INDICATES DUAL TECHNOLOGY PROGRAMMABLE OCCUPANCY SENSOR CAPABLE OF SENSING MOTION AND SOUND
C 3	LIGHTING CONTACTOR WITH NUMBER OF POLES AS INDICATED
TM	TIME SWITCH
	PUSH BUTTON STATION
TYPE A	INDICATES ALL LIGHTING FIXTURES WITHIN THE ROOM OR AREA IN WHICH THIS NOTATION APPEARS SHALL BE TYPE "A" UNLESS OTHERWISE NOTED. SEE LIGHTING FIXTURE SCHEDULE FOR TYPES
LP-#	LIGHTING PANELBOARD (LP)
PP-#	POWER PANELBOARD (PP) OR DISTRIBUTION PANELBOARD (DP)
LCP-#	LIGHTING CONTACTOR PANELBOARD (LCP)
* 4	DUPLEX RECEPTACLE, 20A, 120V, 2P, 3W * GFCI – GROUND FAULT CIRCUIT INTERRUPTER TYPE WP – WEATHERPROOF T – TRANSIENT VOLTAGE SURGE SUPPRESSOR IG – ISOLATED GROUND 4 – CIRCUIT NUMBER
* 4	DUPLEX RECEPTACLE, 20A, 120V, 2P, 3W MOUNTED ABOVE COUNTER-TOP OR 42" AFF * NOTATIONS SAME AS ABOVE
* 60 3 4W	SPECIAL PURPOSE RECEPTACLE * – VOLT RATING "3" – NUMBER OF POLES "60" – AMPERE RATING "4W" – 4 WIRES IN ADDITION TO GROUND
	MULTI-OUTLET ASSEMBLY, SYMBOL DENOTES RECEPTACLE TYPE
	FLOOR OUTLET BOX WITH TYPE OUTLET INDICATED
	UNDER FLOOR DUCT SYSTEM WITH TYPE OUTLETS INDICATED
	THREE CELL UNDER FLOOR DUCT SYSTEM JUNCTION BOX
J OR J	JUNCTION BOX
P	PULL BOX
TC	TERMINAL CABINET
OS	OCCUPANCY SENSOR
PC	PHOTOCELL
ESA	EMERGENCY EYEWASH/SHOWER ALARM STATION WITH FLOW SWITCH(ES)
	INDICATED EQUIPMENT AND MATERIALS TO BE DEMOLISHED
DUST	INDICATES THAT ALL ELECTRICAL EQUIPMENT AND MATERIALS INSTALLED WITHIN THE ROOM OR AREA IN WHICH THIS NOTATION APPEARS SHALL BE OF NEMA 12 CONSTRUCTION (OR GASKETED AND SUITABLE FOR USE IN A WET LOCATION WHERE NEMA STANDARDS DO NOT APPLY) UNLESS OTHERWISE NOTED.
DAMP OR WET	INDICATES THAT ALL ELECTRICAL EQUIPMENT AND MATERIALS INSTALLED WITHIN THE ROOM OR AREA IN WHICH THIS NOTATION APPEARS SHALL BE OF NEMA 4 CONSTRUCTION (OR GASKETED AND SUITABLE FOR USE IN A WET LOCATION WHERE NEMA STANDARDS DO NOT APPLY) UNLESS OTHERWISE NOTED.
CORROSIVE	INDICATES THAT ALL ELECTRICAL EQUIPMENT AND MATERIALS INSTALLED WITHIN THE ROOM OR AREA IN WHICH THIS NOTATION APPEARS SHALL BE OF NEMA 4X CONSTRUCTION (OR CORROSION RESISTANT CONSTRUCTION SUITABLE FOR USE IN A WET LOCATION WHERE NEMA STANDARDS DO NOT APPLY) UNLESS OTHERWISE NOTED.
CLASS I, DIV. 1 GROUP D	INDICATES THAT ALL ELECTRICAL EQUIPMENT AND MATERIALS INSTALLED WITHIN THE ROOM OR AREA IN WHICH THIS NOTATION APPEARS SHALL CONFORM TO N.E.C. REQUIREMENTS FOR THE HAZARDOUS AREA CLASSIFICATION SHOWN.

SYMBOL	DESCRIPTION
	GROUND SYSTEM GRID OR LOOP, 36" BELOW FINISHED GRADE UNLESS OTHERWISE NOTED.
	EXOTHERMIC WELD CONNECTION
	3/4" x 10'-0" GROUND ROD. UNLESS SPECIFIED OTHERWISE.
	GROUND ROD TEST WELL STATION (SEE DETAIL SHEET FOR REQUIREMENTS)
	COMMUNICATION SYSTEMS
K	TELEPHONE OUTLET FOR DESK TYPE HANDSET K = KEY SYSTEM
K	TELEPHONE OUTLET FOR WALL TYPE HANDSET (MOUNT UP 4'-6") K = KEY SYSTEM
	PAGE/PARTY TELEPHONE OUTLET FOR DESK TYPE HANDSET
	PAGE/PARTY TELEPHONE OUTLET FOR WALL TYPE HANDSET, MOUNT UP 4'-6"
S H W	PAGING SPEAKER, WALL MOUNTED H = HORN TYPE W = WIDE ANGLE TYPE
S H W	PAGING SPEAKER, WALL MOUNTED, BI-DIRECTIONAL, HORN TYPE W = WIDE ANGLE TYPE
S	PAGING SPEAKER, FLUSH MOUNTED CEILING TYPE
S	PAGING SPEAKER, SURFACE MOUNTED CEILING TYPE
VC	REMOTE WALL MOUNTED VOLUME CONTROL FOR CEILING SPEAKER, MOUNT UP 5'-0"
A	PAGING SPEAKER AMPLIFIER ASSEMBLY
TM	TELEPHONE CABINET OR BACKBOARD AS NOTED
P OR C	"C" – DATA INPUT/OUTPUT CABLE OUTLET "P" – PROCESS COMPUTER SYSTEM (CAT6 RJ-45 JACK)
	SECURITY SYSTEMS
SACP	SECURITY ALARM CONTROL PANEL
DS	SECURITY ALARM DOOR SWITCH
K	SECURITY ALARM KEY PAD
R	SECURITY SYSTEM CARD ACCESS READER
WS	SECURITY ALARM WINDOW SWITCH
	SECURITY ALARM MOTION DETECTOR
CCTV	CLOSED CIRCUIT TV CAMERA
PTZ	PAN, TILT, ZOOM CAMERA LENS CONTROLS
GB	GLASS BREAK DETECTOR
	FIRE ALARM SYSTEMS
H 200 R	FIRE ALARM HEAT DETECTOR 135 FIXED TEMPERATURE UNLESS OTHERWISE NOTED. "200" – 200 FIXED TEMPERATURE "R" – FIXED TEMPERATURE RATE-OF-RISE TYPE
S I	FIRE ALARM SMOKE DETECTOR PHOTOELECTRIC TYPE UNLESS OTHERWISE NOTED. "I" – IONIZATION TYPE.
S D	FIRE ALARM DUCT SMOKE DETECTOR
FACP	FIRE ALARM CONTROL PANEL
FV	FIRE ALARM VENTILATION PANEL WITH GRAPHIC PANEL
FA	REMOTE FIRE ALARM ANNUNCIATOR PANEL
F	FIRE ALARM MASTER BOX
F	FIRE ALARM HORN, MOUNT UP 7'-6"
15 F	FIRE ALARM STROBE, MOUNT UP 6'-8" 15 = CANDELA RATING
15 F	FIRE ALARM HORN AND STROBE LIGHT COMBINATION, MOUNT UP 6'-8" 15 = CANDELA RATING
F	FIRE ALARM MANUAL PULL STATION, MOUNT UP 4'-0"

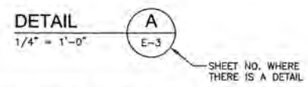
SYMBOL	DESCRIPTION
VSS	SPRINKLER VALVE SUPERVISORY SWITCH.
SFS	SPRINKLER FLOW ALARM SWITCH
F	FIRE ALARM BELL
FB	WEATHERPROOF HI-INTENSITY FIRE ALARM STROBE LIGHT WITH HORN
PIR	PASSIVE INFRARED DETECTOR
R	SMOKE BEAM DETECTOR (RECEIVER)
T	SMOKE BEAM DETECTOR (TRANSMITTER)
	FIRE ALARM SMOKE DETECTOR REMOTE INDICATOR AND TEST SWITCH



EXISTING OR FUTURE CONDITION DESIGNATION

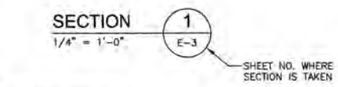
SYMBOL WHERE THERE IS A DETAIL

SYMBOL WHERE THERE IS A SECTION



SYMBOL WHERE DETAIL IS DRAWN

DETAIL SYMBOL



SYMBOL WHERE SECTION IS DRAWN

SECTION SYMBOL

GENERAL NOTE

THIS IS A STANDARD LEGEND. SOME SYMBOLS MAY NOT APPEAR ON THE DRAWINGS.

NOTES:

1. THE PLANS DO NOT SHOW RACEWAYS AND CONDUCTORS BETWEEN RECEPTACLES, AND SWITCHES. HOWEVER, THE CONTRACTOR SHALL FURNISH AND INSTALL THESE CONNECTIONS IN ACCORDANCE WITH THE ASSIGNED FIXTURE OR RECEPTACLE CIRCUIT NUMBER AND SWITCH DESIGNATIONS. HOME RUNS SHOWN CONCEALED SHALL BE INDICATIVE OF ENTIRE CIRCUIT INSTALLATION. THE SAME SHALL APPLY FOR HOME RUNS SHOWN EXPOSED. REFER TO SPECIFICATIONS FOR MATERIALS AND INSTALLATION REQUIREMENTS.
2. CONDUIT AND WIRE (NOT SHOWN) FOR SWITCHES AND/OR RECEPTACLES SHALL BE FURNISHED AND INSTALLED BY THE ELECTRICAL CONTRACTOR AND SHALL BE:
   a. 3/4" (MIN.) CONDUIT RUN
   1. EXPOSED IN UNFINISHED AREAS
   b. NO. 12 COPPER (MIN.) TYPE "THHN" NO. OF WIRES AS REQUIRED.
2. THE WIRING DIAGRAMS, QUANTITY AND SIZE OF WIRES AND CONDUIT REPRESENT A SUGGESTED ARRANGEMENT BASED UPON SELECTED STANDARD COMPONENTS OF ELECTRICAL EQUIPMENT. MODIFICATIONS ACCEPTABLE TO THE ENGINEER MAY BE MADE BY THE CONTRACTOR TO ACCOMMODATE EQUIPMENT ACTUALLY PURCHASED. THE BASIC SEQUENCE AND METHOD OF CONTROL MUST BE MAINTAINED AS INDICATED ON THE DRAWINGS AND/OR SPECIFICATIONS.
3. SWITCHES SHALL BE MOUNTED 4'-0" ABOVE FINISHED FLOOR UNLESS OTHERWISE NOTED. RECEPTACLES SHALL BE MOUNTED 4'-0" ABOVE FINISHED FLOOR UNLESS OTHERWISE NOTED, EXCEPT RECEPTACLES IN OFFICES OR AREAS WITH HUNG CEILINGS, OR AREAS WITH 9-INCH CONCRETE BLOCK WALLS, WHICH SHALL BE MOUNTED 1'-6" ABOVE FINISHED FLOOR UNLESS OTHERWISE NOTED.

EPA
U.S. Environmental Protection Agency
Region 7
Kansas City, Kansas

MARK	DESCRIPTION	DATE	APPR.	MARK	DESCRIPTION	DATE	APPR.

DESIGNED BY:
DRAWN BY: CHD
CHD BY: ISP
SUBMITTED BY: CDM
DATE:
SOLICITATION NO.: W912PH-07-R-0044
CONTRACT NO.: -
PLOT DATE: 9/29/2011
PLOT SCALE: NTS
SIZE: ANSI D
FILE NUMBER: 114-47269
FILE NAME: E02SHEET.dwg

HGL
CDM
CDM Federal Programs Corporation

GARVEY ELEVATOR SUPERFUND SITE
OPERABLE UNIT 1 - INTERIM REMEDIAL DESIGN
HASTINGS, NEBRASKA

ELECTRICAL SYMBOLS, ABBREVIATIONS AND GENERAL NOTES II

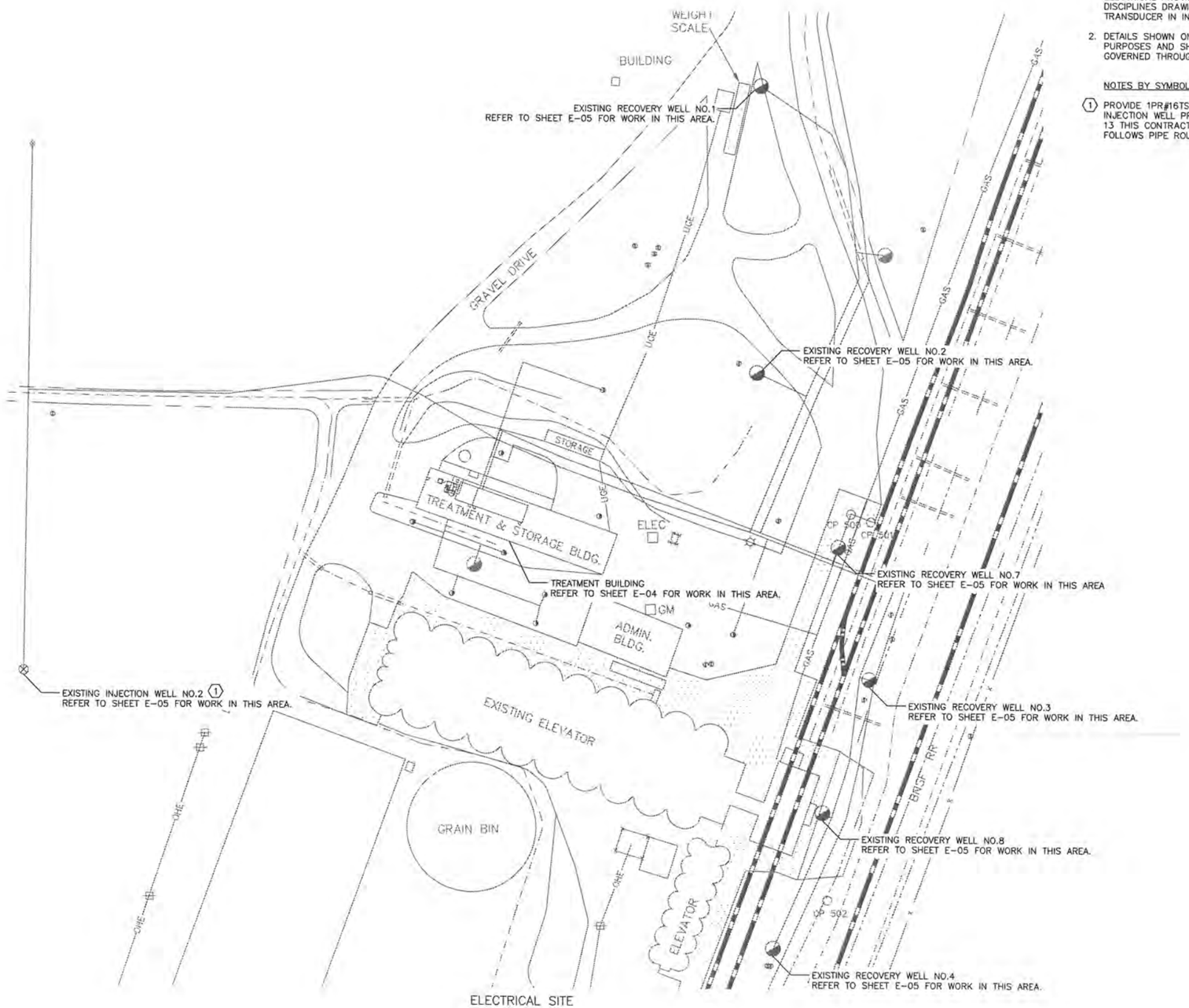
SHEET IDENTIFICATION
E-02

GENERAL NOTES:

1. THE SCOPE OF THIS PROJECT IS TO REMOVE AND REPLACE EXISTING ELECTRICAL EQUIPMENT WITH NEW EQUIPMENT IN THE RECOVERY WELL PUMPS AND INJECTION WELL PUMP NO.2 WITH MINIMAL INTERRUPTION OF PLANT OPERATIONS, PROVIDE ELECTRICAL PROVISIONS FOR HEAT TRACE AS SHOWN ON OTHER DISCIPLINES DRAWINGS, AND PROVIDE NEW WIRING FOR PRESSURE TRANSDUCER IN INJECTION WELL NO.2.
2. DETAILS SHOWN ON THIS SHEET ARE FOR DIAGRAMMATICAL PURPOSES AND SHOW INTENT. THE INSTALLATION SHALL BE GOVERNED THROUGH THE SPECIFICATIONS AND NEC.

NOTES BY SYMBOL '⬡':

(1) PROVIDE 1PR#16TSW IN EXISTING CONDUIT FROM PLC-RWS TO INJECTION WELL PRESSURE TRANSDUCER PROVIDED BY DIVISION 13 THIS CONTRACT. EXISTING CONDUIT ROUTING APPROXIMATELY FOLLOWS PIPE ROUTING.



ELECTRICAL SITE PLAN

1" = 60'

30 0 60

U.S. Environmental Protection Agency
Region 7
Kansas City, Kansas

MARK	DESCRIPTION	DATE	APPR

MARK	DESCRIPTION	DATE	APPR

DESIGNED BY: CAQ
DWN BY: CAQ
CHD BY: SBP
SUBMITTED BY:
PLOT SCALE: NTS
PLOT DATE: 9/29/2011
SIZE: ANSI D
DATE: 09/2011
SOLICITATION NO.: W912P4-11-R-0044
CONTRACT NO.:
FILE NUMBER: H44728
FILE NAME: E-03STPL.dwg

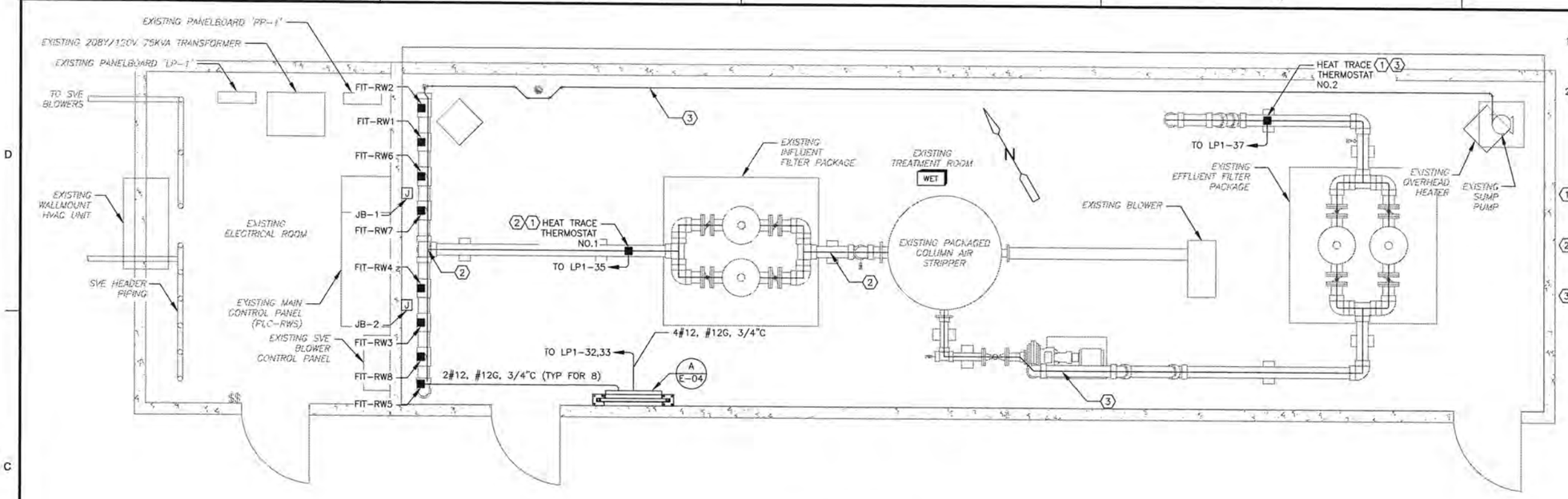
HGL
CDM
CDM Federal Programs Corporation

GARVEY ELEVATOR SUPERFUND SITE
OPERABLE UNIT 1 - INTERIM REMEDIAL DESIGN
HASTINGS, NEBRASKA

ELECTRICAL SITE PLAN

SHEET IDENTIFICATION
E-03
E-03STPL

PROFESSIONAL ELECTRICAL ENGINEER
VINCENT J. PLAWSKY JR.
E-8370
STATE OF NEBRASKA
9/30/11



TREATMENT BUILDING

PLAN

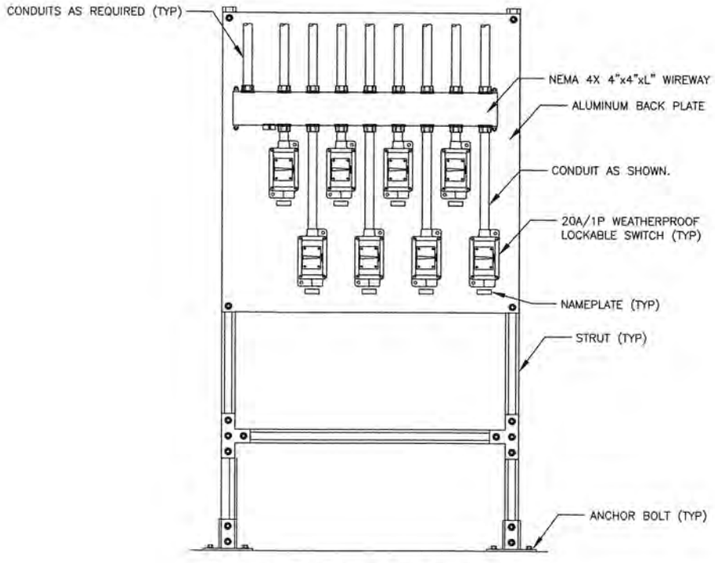
3/8" = 1'-0"

GENERAL NOTES:

1. DETAILS SHOWN ON THIS SHEET ARE FOR DIAGRAMMATICAL PURPOSES AND SHOW INTENT. THE INSTALLATION SHALL BE GOVERNED THROUGH THE SPECIFICATIONS AND NEC.
2. PIPING FROM EXISTING COLUMN AIR STRIPPER TO EXISTING BLOWER SHALL NOT BE HEAT TRACED. ALL OTHER PIPING INCLUDING MANIFOLD PIPING, FILTER PIPING, AND SUMP PUMP PIPING SHALL BE HEAT TRACED AS CALLED OUT FOR ON OTHER DISCIPLINE DRAWINGS. REFER TO C-03 FOR ADDITIONAL DETAILS.

NOTES BY SYMBOL '⬡':

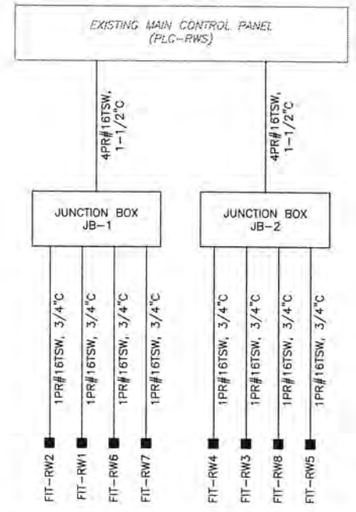
1. MOUNT HEAT TRACE THERMOSTAT TO PIPE PER MANUFACTURER'S RECOMMENDATIONS. THERMOSTAT SHALL BE SIMILAR TO BRISKHEAT MODEL TD101.
2. HEAT TRACE THERMOSTAT NO.1 SHALL CONTROL ALL HEAT TRACING FROM THE PIPING MANIFOLD TO THE EXISTING PACKAGED COLUMN AIR STRIPPER.
3. HEAT TRACE THERMOSTAT NO.2 SHALL CONTROL ALL HEAT TRACING FROM THE EXISTING COLUMN AIR STRIPPER PAST THE EXISTING EFFLUENT FILTER PACKAGE, AS WELL AS THE EXISTING SUMP PUMP PIPING.



ELECTRICAL EQUIPMENT MOUNTING DETAIL

DETAIL A

NTS



TREATMENT ROOM INSTRUMENTATION RISER

DIAGRAM 1

VINCENT J. PLANSKY JR. E-8075 — 9/30/11

EPA U.S. Environmental Protection Agency Region 7 Kansas City, Kansas

MARK	DESCRIPTION	DATE	APPR.

DESIGNED BY: CDM — DATE: 9/30/11
DWN BY: CAD — CKD BY: JSP — SOLICITATION NO.: W912P6-07-R-0044
SUBMITTED BY: CDM — CONTRACT NO.: -
PLOT SCALE: NTS — PLOT DATE: 9/29/2011 — FILE NUMBER: 11447.205
SIZE: ANSI D — FILE NAME: E-04DGN.dwg

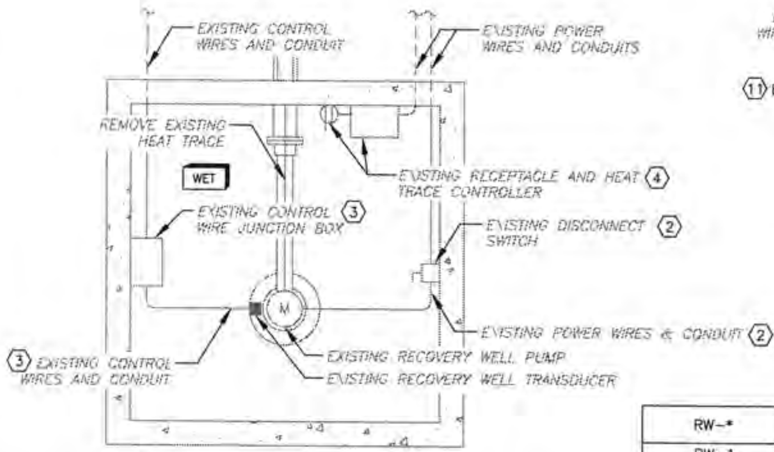
HGL — CDM Federal Programs Corporation

GARVEY ELEVATOR SUPERFUND SITE
OPERABLE UNIT 1 - INTERIM REMEDIAL DESIGN
HASTINGS, NEBRASKA

TREATMENT BUILDING ELECTRICAL PLAN, DETAILS, AND RISER DIAGRAMS

SHEET IDENTIFICATION
E-04

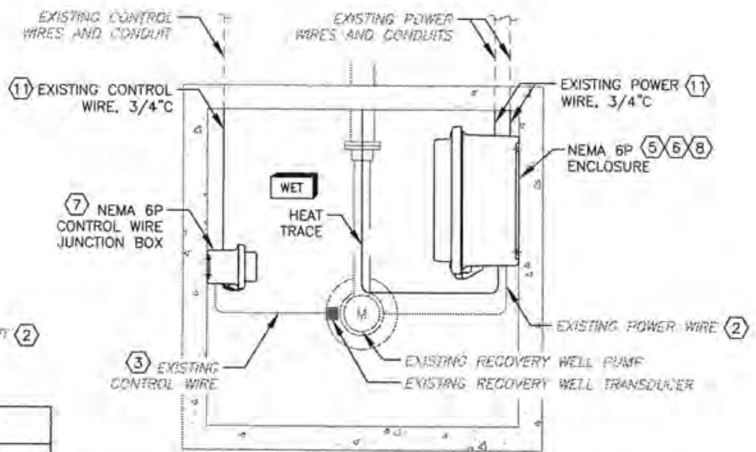
1 2 3 4 5



RECOVERY WELL SITE ELECTRICAL EXISTING (RW-*)

PLAN
N.T.S. (1)

RW-*
RW-1
RW-2
RW-3
RW-4
RW-7
RW-8



RECOVERY WELL SITE ELECTRICAL MODIFICATION (RW-*)

PLAN
N.T.S. (1)

GENERAL NOTES:

1. EACH BIDDER OR THEIR AUTHORIZED REPRESENTATIVES SHALL, BEFORE PREPARING THEIR PROPOSAL, VISIT ALL AREAS OF THE EXISTING BUILDINGS AND STRUCTURES IN WHICH WORK UNDER THIS CONTRACT IS TO BE PERFORMED AND INSPECT CAREFULLY THE PRESENT INSTALLATION.
2. THE OWNER RETAINS THE RIGHT TO KEEP ANY ELECTRICAL EQUIPMENT, CONDUIT, AND WIRES REMOVED FROM THE EXISTING INSTALLATION. MOVE EQUIPMENT TO DESIGNATED STORAGE LOCATION ONSITE. CONTRACTOR IS RESPONSIBLE FOR OFFSITE DISPOSAL OF UNWANTED MATERIAL.
3. CONTRACTOR SHALL OBTAIN APPROVAL FROM OWNER BEFORE STARTING WORK. THE CONTRACTOR SHALL COORDINATE THE WORK WITH THE OWNER.
4. IN ALL AREAS INVOLVING DEMOLITION, ALL EQUIPMENT, UNUSED WIRING, UNUSED CONDUIT, PULLBOXES, AND SUPPORT MATERIAL MARKED FOR DEMOLITION SHALL BE COMPLETELY REMOVED. THE AREAS SHALL BE CLEANED OF DEMOLITION DEBRIS. REPAIR AND PATCH ANY SUPPORT STRUCTURES EFFECTED BY THE DEMOLITION.
5. REFERENCE OTHER DISCIPLINE DRAWINGS FOR HEAT TRACING EXTENTS.
6. THE EXISTING PANELBOARD SCHEDULE SHOWN REPRESENTS THE LATEST DOCUMENTED INFORMATION AVAILABLE. HOWEVER UNDOCUMENTED CHANGES MAY HAVE BEEN MADE. THE CONTRACTOR SHALL PROVIDE THE NECESSARY CHANGES TO THE EXISTING PANELBOARD AS REQUIRED TO PROVIDE A COMPLETE AND OPERABLE SYSTEM ACCORDING TO THE INTENT OF THIS AND ALL DRAWINGS.

NOTES BY SYMBOL '⬡':

(1) RECOVERY WELL SITE PLANS ARE GENERAL DEPICTION OF THE WELLS NOTED IN THE TABLE. ALL RECOVERY WELL SITES ARE NOT TYPICAL OF EACH OTHER IN REGARDS TO LAYOUT OF THE EQUIPMENT AND PIPING.

(2) REMOVE EXISTING DISCONNECT SWITCH AND ALL ASSOCIATED SUPPORT MATERIAL. REMOVE EXISTING CONDUIT FROM DISCONNECT SWITCH TO PUMP AND RECONNECT SUBMERSIBLE CABLE TO NEW MANUAL MOTOR STARTER.

(3) REMOVE EXISTING CONTROL WIRE JUNCTION BOX AND ALL ASSOCIATED SUPPORT MATERIAL. REMOVE EXISTING CONDUIT FROM EXISTING CONTROL WIRE JUNCTION BOX TO TRANSDUCER AND RECONNECT TRANSDUCER CABLE TO NEW CONTROL WIRE JUNCTION BOX.

(4) REMOVE EXISTING RECEPTACLE, HEAT TRACE CONTROLLER AND ALL ASSOCIATED SUPPORT MATERIAL.

(5) PROVIDE A NEW NEMA 6P FIBERGLASS ENCLOSURE SIMILAR TO STAHLIN J SERIES – TYPE FHLL. ENCLOSURE SHALL BE SIZED TO HOUSE EQUIPMENT AS CALLED FOR BY KEYNOTES. PROVIDE A THERMOSTATICALLY CONTROLLED STRIP HEATER INSIDE OF THE ENCLOSURE TO BE POWERED FROM THE RECEPTACLE.

(6) INSIDE OF THE NEMA 6P ENCLOSURE MOUNT A NEW 600V, 3P, 30A NEMA 4X STAINLESS STEEL MANUAL MOTOR STARTER TO REPLACE THE EXISTING DISCONNECT SWITCH. RECONNECT EXISTING CIRCUIT AND INSTALL NEW EQUIPMENT IN SIMILAR LOCATION AS EXISTING SO THAT EXISTING WIRE LENGTHS ARE SUFFICIENT.

(7) PROVIDE A NEW NEMA 6P FIBERGLASS CONTROL WIRE JUNCTION BOX IN APPROXIMATELY THE SAME LOCATION AS EXISTING JUNCTION BOX SO THAT EXISTING WIRE LENGTHS ARE SUFFICIENT FOR PROPER INSTALLATION. PROVIDE SPLICES AND TERMINALS AS NECESSARY TO MATCH EXISTING INSTALLATION.

(8) INSIDE OF THE NEMA 6P ENCLOSURE MOUNT A NEW 20A GFI/WPIU DUPLEX RECEPTACLE AND A NEW HEAT TRACE CONTROLLER SIMILAR TO "BRISK HEAT" CATALOG NUMBER TB261N-110. PROVIDE AND INSTALL A 3/C#12 "SOW" CABLE WITH A 5-20P OUTDOOR RATED CORD CAP FOR THE HEAT TRACE CONTROLLER POWER.

(9) VERIFY INDIVIDUAL LOADS AND PROVIDE A NEW TYPED DIRECTORY.

(10) PROVIDE AND INSTALL NEW CIRCUIT BREAKER IN EXISTING PANELBOARD AS SHOWN. NEW COMPONENT(S) SHALL MEET OR EXCEED THE SHORT CIRCUIT RATING OF THE EXISTING PANELBOARD.

(11) REMOVE EXISTING CONDUIT AND REPLACE WITH 3/4" PVC SCHEDULE 80 CONDUIT. SEAL ALL CONDUITS WITH APPROPRIATE WATERTIGHT CONNECTORS TO MAINTAIN PROTECTIVE RATING OF ALL EQUIPMENT.

EXISTING PANELBOARD 'LP1' (9)

LOCATION ELECTRICAL ROOM

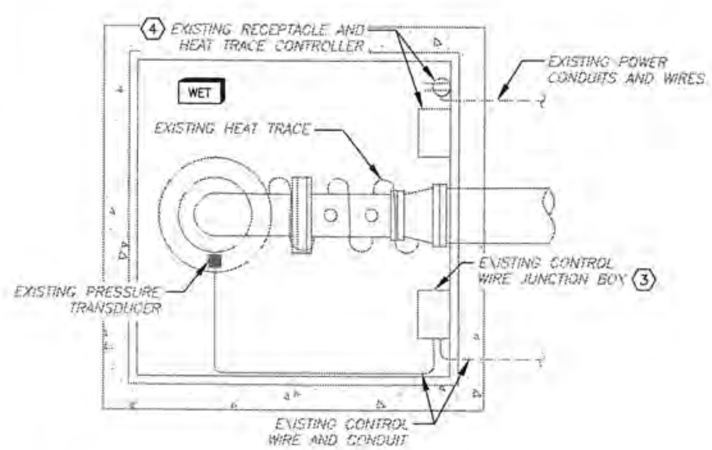
225 AMP BUS RATING 200 AMP MAIN C/B 22 KA SHORT CIRCUIT RATING 42 POLES

208Y/120 VOLTS 3 PH. 4 WIRE 60 HZ. ☐ ELECTRONIC GRADE (OPTIONAL) SURFACE MOUNTED

DESCRIPTION	NOTES	LOAD KVA A	LOAD KVA B	LOAD KVA C	C/B AMP/POLES	CKT	CKT	C/B AMP/POLES	LOAD KVA A	LOAD KVA B	LOAD KVA C	DESCRIPTION	NOTES
SVE PANEL		7.7			80 / 3	1	2	30 / 3	4.8			CATOX	
—			7.7		—	3	4	—		4.8		—	
—				7.7	—	5	6	—			4.8	—	
SCRUBBER		1.44			15 / 3	7	8	15 / 3	1.44			MAIN CONTROL PANEL (MCP)	
—			1.44		—	9	10	—		1.44		—	
—				1.44	—	11	12	—			1.44	—	
HEAT TRACE 1AB, 2AB, 6C		1.92			20 / 1	13	14	20 / 1	1.92			CONTROL POWER MCP	
HEAT TRACE 3AB, 4AB, 8C			1.92		20 / 1	15	16	20 / 1		1.92		RECEPTACLES IN 1-1 & 1-2	
HEAT TRACE 7C, SVE D-11				1.92	20 / 1	17	18	20 / 1			1.92	FILTER PANEL	
HEAT TRACE SVE-1 SVE D-9		1.92			20 / 1	19	20	20 / 1	1.92			SCRUBBER HEAT TRACE	
HEAT TRACE SVE-3, SVE-4, EW-5			1.92		20 / 1	21	22	20 / 2		—		SPARE	
NORTH WALL WEST HEAT TRACE				1.92	20 / 1	23	24	—			—	—	
NORTH WALL EAST HEAT TRACE		1.92			20 / 1	25	26	15 / 1	1.92			OUTSIDE TANK HEAT TRACE	
SPACE			—		20 / 1	27	28	30 / 2		—		SPARE	
				—	30 / 1	29	30	—			—	SPARE	
		—			30 / 1	31	32	20 / 1	.5			FIT-RW3, RW4, RW5, RW8	
FIT-RW1,RW2, RW6, RW7			.5		20 / 1	33	34	30 / 2		—		SPARE	
(10) HEAT TRACE THRMST NO.1	3			1.92	30/1	35	36	—			—	—	
(10) HEAT TRACE THRMST NO.2	3	1.92			30/1	37	38	—	—			SPACE	
			—			39	40	—		—		SPACE	
—				—		41	42	—			—	SPACE	
TOTAL KVA		16.8	13.5	14.9					12.5	8.2	8.2	TOTAL KVA	
									29.3	21.7	23.1	TOTAL CONNECTED KVA	

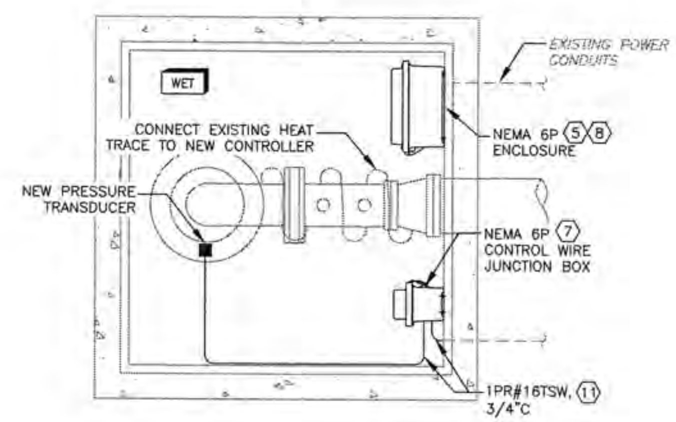
GENERAL NOTES:

1.	PROVIDE LOCKING HARDWARE
2.	2#12, #12G, 3/4"C
3.	30mA GROUND FAULT CIRUCIT BREAKER FOR EQUIP PROTECTION



INJECTION WELL SITE NO.2 ELECTRICAL EXISTING

PLAN
N.T.S.



INJECTION WELL SITE NO.2 ELECTRICAL MODIFICATION

PLAN
N.T.S.

EPA
U.S. Environmental Protection Agency
Region 7
Kansas City, Kansas

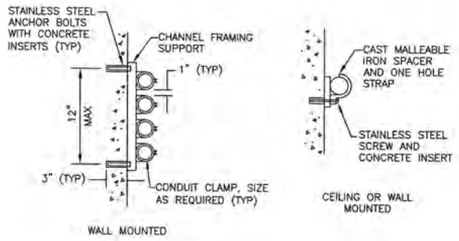
MARK | DESCRIPTION | DATE | APPR | MARK | DESCRIPTION | DATE | APPR

HGL
CDM
CDM Federal Programs Corporation

GARVEY ELEVATOR SUPERFUND SITE
OPERABLE UNIT 1 - INTERIM REMEDIAL DESIGN
HASTINGS, NEBRASKA

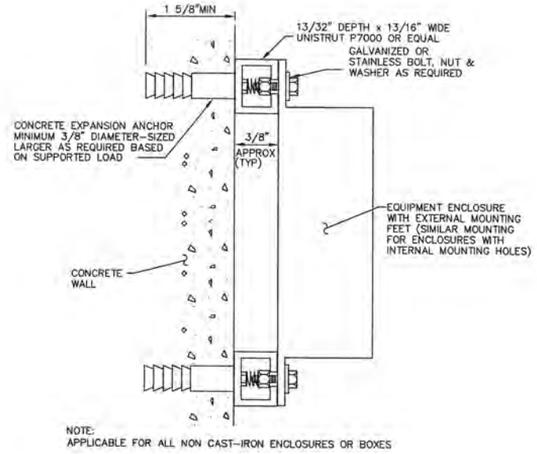
INJECTION AND RECOVERY WELL SITE ELECTRICAL EXISTING AND MODIFICATION PLANS

SHEET IDENTIFICATION
E-05



TYPICAL CONDUIT SUPPORT METHODS

DETAIL A
NTS

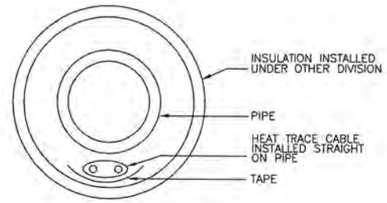


EQUIPMENT ENCLOSURE MOUNTING ON CONCRETE WALL

DETAIL B
N.T.S.

NOTES:

1. THE FINAL SYSTEM LAYOUT AND DESIGN OF EACH HEAT TRACE SYSTEM SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR AND THE HEAT TRACE MANUFACTURER. THE CONTRACTOR SHALL REVIEW ALL PIPE LENGTHS AND SIZES, PIPE MATERIALS AND HEAT LOSS CALCULATIONS WITH THE MANUFACTURER. THE MANUFACTURER SHALL THEN RECOMMEND THE QUANTITIES, WATTAGES AND CABLE PRODUCT REQUIRED FOR EACH APPLICATION.
2. REFER TO THE MECHANICAL DRAWINGS FOR PIPE LOCATIONS, NUMBER OF VALVES, AND LENGTHS. ALL FITTINGS AND INSTRUMENTS SHALL BE INCLUDED IN THE SCOPE OF THE WORK.
3. PROVIDE NEMA 4X CONNECTION BOXES, THERMOSTATS, AND ALL ACCESSORIES REQUIRED TO PREVENT ANY EXPOSED PIPING FROM FREEZING.



HEAT TRACING DETAIL

DETAIL C
NTS

VINCENT J PLANSKY JR E-9075 PROFESSIONAL ELECTRICAL ENGINEER STATE OF NEBRASKA

11

EPA
U.S. Environmental Protection Agency
Region 7
Kansas City, Kansas

MARK	DESCRIPTION	DATE	APPR.
MARK	DESCRIPTION	DATE	APPR.

HGL

CDM
CDM Federal Programs Corporation

DESIGNED BY: CMD
DATE: 09/07/11
DWN BY: CMD
CKD BY: ISP
SOLICITATION NO.: W912P9-07-R-0044
SUBMITTED BY: CDM
CONTRACT NO.: -
PLOT SCALE: NTS
PLOT DATE: 9/29/2011
FILE NUMBER: 10-44-208
SIZE: ANSI D
FILE NAME: EZ-1.DWG

GARVEY ELEVATOR SUPERFUND SITE
OPERABLE UNIT 1 - INTERIM REMEDIAL DESIGN
HASTINGS, NEBRASKA

ELECTRICAL DETAILS

SHEET IDENTIFICATION
EZ-1

GENERAL INSTRUMENT OR FUNCTION SYMBOLS

SHARED DISPLAY/ SHARED CONTROL				
PRIMARY CHOICE	SECONDARY CHOICE	COMPUTER SOFTWARE	DISCRETE	LOCATION AND ACCESSIBILITY
◯	◇	⬡	◯	FIELD MOUNTED AND NORMALLY OPERATOR ACCESSIBLE
◯	◇	⬡	◯	PRIMARY CONTROL PANEL MOUNTED AND NORMALLY OPERATOR ACCESSIBLE
◯	◇	⬡	◯	PRIMARY CONTROL PANEL MOUNTED AND NOT NORMALLY OPERATOR ACCESSIBLE
◯	◇	⬡	◯	SECONDARY CONTROL PANEL MOUNTED AND NORMALLY OPERATOR ACCESSIBLE
◯	◇	⬡	◯	SECONDARY CONTROL PANEL MOUNTED AND NOT NORMALLY OPERATOR ACCESSIBLE

◯◯ INSTRUMENTS SHARING COMMON HOUSING

◯ PILOT LIGHT

MISCELLANEOUS SYMBOLS

MOTOR

MCC — INDICATES INTERLOCK OR LOGIC IN A MOTOR CONTROL CENTER

I — INDICATES GENERAL OR MISCELLANEOUS HARDWIRED INTERLOCK

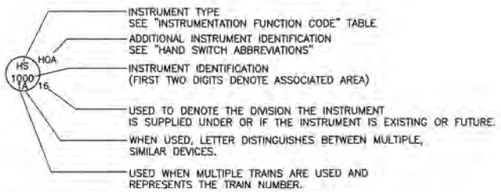
MS — MOTOR STARTER

SCR — SILICONE CONTROL RECTIFIER

VFD — VARIABLE FREQUENCY DRIVE

P — PURGE OR FLUSHING DEVICE

TYPICAL TAG NUMBERS & DESIGNATION



HAND SWITCH ABBREVIATIONS

AO = AUTO/OFF
AM = AUTO/MANUAL
CM = COMPUTER/MANUAL
CL = COMPUTER/LOCAL
E-STOP = EMERGENCY STOP
FR = FORWARD/REVERSE
FOR = FORWARD/OFF/REVERSE
FS = FAST SLOW
FOS = FAST/OFF/SLOW
HOA = HAND/OFF/AUTO
LLS = LEAD/LAG/STANDBY
LOC = LOCAL/OFF/COMPUTER
LOR = LOCAL/OFF/REMOTE
LOS = LOCKOUT/STOP
LA = LOCAL/AUTO
LR = LOCAL/REMOTE
OC = OPEN/CLOSE
OCA = OPEN/CLOSE/AUTO
OO = ON/OFF
OOA = ON/OFF/AUTO
OSC = OPEN/STOP/CLOSE
RSL = RAISE/STOP/LOWER
SS = START/STOP
SOR = START/OFF/RESET

INSTRUMENTATION FUNCTION CODE

	FIRST LETTERS		SUCCEEDING LETTERS		
	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5
	MEASURED/INITIATING VARIABLE	VARIABLE MODIFIER	READOUT/PASSIVE FUNCTION	OUTPUT/ACTIVE FUNCTION	FUNCTION MODIFIER
A	ANALYSIS		ALARM		
B	BURNER, COMBUSTION		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
C	USER'S CHOICE			CONTROL	CLOSED
D	USER'S CHOICE	DIFFERENCE, DIFFERENTIAL			DEVIATION
E	VOLTAGE		SENSOR, PRIMARY ELEMENT		
F	FLOW, FLOW RATE	RATIO			
G	USER'S CHOICE		GLASS, GAUGE, VIEWING DEVICE		
H	HAND				HIGH
I	CURRENT		INDICATE		
J	POWER		SCAN		
K	TIME, SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT		LOW
M	MOISTURE				MIDDLE, INTERMEDIATE
N	USER'S CHOICE		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
O	USER'S CHOICE		ORIFICE, RESTRICTION		OPEN
P	PRESSURE		POINT (TEST CONNECTION)		
Q	QUANTITY	INTEGRATE, TOTALIZE	INTEGRATE, TOTALIZE		
R	RADIATION		RECORD		RUN
S	SPEED, FREQUENCY	SAFETY		SWITCH	STOP
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	
V	VIBRATION, MECHANICAL, ANALYSIS			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL, PROBE		
X	UNCLASSIFIED (1)	X-AXIS	ACCESSORY DEVICES, UNCLASSIFIED (1)	UNCLASSIFIED (1)	UNCLASSIFIED (1)
Y	EVENT, STATE, PRESENCE	Y-AXIS		AUXILIARY DEVICES	
Z	POSITION, DIMENSION	Z-AXIS, SAFETY INSTRUMENT SYSTEM		DRIVER, ACTUATOR, UNCLASSIFIED, FINAL CONTROL ELEMENT	

TABLE NOTES:
(1) WHEN USED SYMBOL OR SIGNAL LINE IS ANNOTATED.

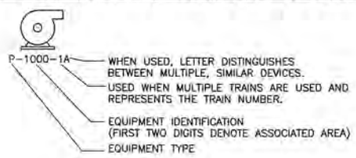
INSTRUMENT LINE SYMBOLS

- ELECTRICAL SIGNAL
- TELEPHONE SIGNAL
- ELECTROMAGNETIC OR SONIC SIGNAL (GUIDED)
- ELECTROMAGNETIC OR SONIC SIGNAL (UNGUIDED)
- PNEUMATIC SIGNAL
- CAPILLARY TUBE
- HYDRAULIC SUPPLY
- VENDOR SUPPLIED CABLE
- COMMUNICATION LINK – COPPER (HARDWIRED)
- COMMUNICATION LINK – FIBER OPTICS

ELECTRICAL / AIR SOURCES

UPS — UPS POWERED ELECTRICAL SOURCE
ES — ELECTRICAL SOURCE
IA — INSTRUMENT AIR SOURCE

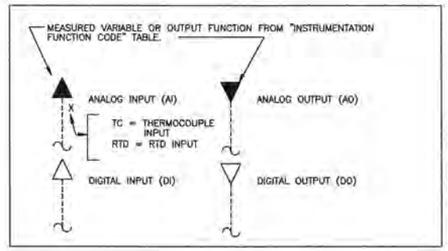
TYPICAL EQUIPMENT TAG NUMBERS & DESIGNATION



PROCESS EQUIPMENT

WELL PUMP

I/O SIGNALS



PRIMARY ELEMENTS

- FE / M — MAGNETIC FLOW METER
- FE — TURBINE OR PROPELLER FLOW METER
- FE — AVERAGING PITOT TUBE
- FE — ULTRASONIC FLOW METER
- FE — ROTAMETER
- FE — WEIR
- FE — ORIFICE PLATE
- FE — VENTURI TUBE
- FE — FLUME
- FE / X — GENERAL INSERTION FLOW METER (IM=INSERT MAG)
- FE — THERMAL MASS FLOW METER
- LE — FLOAT SWITCH
- LE — ULTRASONIC LEVEL SENSOR
- LE — RADAR LEVEL SENSOR
- LE — CAPACITANCE LEVEL SENSOR
- PI — PRESSURE GAUGE
- PDI — DIFFERENTIAL PRESSURE GAUGE
- TI — TEMPERATURE GAUGE
- AE / X — GENERAL ANALYZER (pH=pH; DO=DISSOLVED OXYGEN; H2S=HYDROGEN SULFIDE; LEL=% LOWER EXPLOSIVE LIMIT; O2=OXYGEN; O3=OZONE; NH3=NITRATE; TURB=TURBIDITY; FL=FLUORIDE)

GENERAL NOTES

1. THIS LEGEND APPLIES TO P&IDS ONLY AND MAY DIFFER FROM LEGENDS FOR OTHER SHEETS.

2. IN GENERAL THIS LEGEND SHEET AND THE P&IDS ARE BASED ON THE INTERNATIONAL SOCIETY OF AUTOMATION (ISA) STANDARDS FOR PRACTICES FOR INSTRUMENTATION. SOME MODIFICATIONS, ADDITIONS AND ALTERATIONS HAVE BEEN MADE AS REQUIRED TO ACCOMODATE PROJECT REQUIREMENTS.

3. SOME PROCESS ITEMS SUCH AS EQUIPMENT ISOLATION VALVES, BYPASS LINES, ETC., WHICH ARE NOT CRITICAL FOR AN UNDERSTANDING OF THE INSTRUMENTATION FUNCTIONS ARE NOT SHOWN ON THE P&IDS.

4. SEE ELECTRICAL AND MECHANICAL SHEETS AND SPECIFICATIONS FOR ADDITIONAL CONTROL AND INTERLOCK REQUIREMENTS.

5. LIGHTER WEIGHT LINES, SHOWN AS ——— , INDICATE EQUIPMENT, INSTRUMENTS OR PIPING THAT ARE EXISTING. WEIGHTED LINES, SHOWN AS ——— OR HEAVIER ——— , INDICATE EQUIPMENT, INSTRUMENTS OR PIPING THAT ARE NEW. DASHED WEIGHTED LINES, SHOWN AS — — — , INDICATED EQUIPMENT, INSTRUMENTS OR PIPING THAT ARE GROUPED AS A PACKAGE.

GENERAL ABBREVIATIONS

AI	ANALOG IN
AO	ANALOG OUT
CPU	CENTRAL PROCESSOR UNIT
DI	DIGITAL OR DISCRETE INPUT
DO	DIGITAL OUTPUT
FC	FAIL CLOSED
FO	FAIL OPEN OR FIBER OPTIC
HMI	HUMAN MACHINE INTERFACE
MCC	MOTOR CONTROL CENTER
NC	NORMALLY CLOSED
NPW	NON-POTABLE WATER
NO	NORMALLY OPEN
PLC	PROGRAMMABLE LOGIC CONTROLLER
PW	PLANT WATER
RIO	REMOTE INPUT/OUTPUT
UPS	UNINTERRUPTIBLE POWER SUPPLY
VFD	VARIABLE FREQUENCY DRIVE

U.S. Environmental Protection Agency
Region 7
Kansas City, Kansas

MARK	DESCRIPTION	DATE	APPR.

MARK	DESCRIPTION	DATE	APPR.

DESIGNED BY: S. LINDELL
DWN BY: L. HUGHES
SUBMITTED BY: CM
PLOT SCALE: 1"=20'
SIZE: ANSI D
DATE: 08/2011
CKD BY: J. ROBINSON
PLOT DATE: 9/26/2011
FILE NAME: 001GNLG.dwg
SOLICITATION NO.: W912PR-07-R-0044
CONTRACT NO.:
FILE NUMBER: 1H4-7208

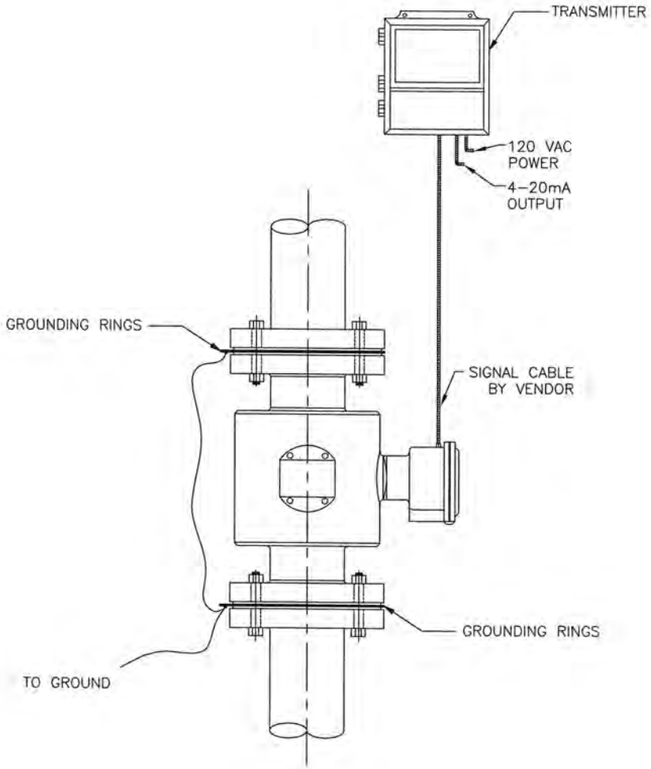
HGL
CDM
CDM Federal Programs Corporation

GARVEY ELEVATOR SUPERFUND SITE
OPERABLE UNIT 1 - INTERIM REMEDIAL DESIGN
HASTINGS, NEBRASKA

GENERAL NOTES AND LEGEND

SHEET IDENTIFICATION
I-01

REGISTERED PROFESSIONAL ENGINEER
SCOTT M. MOLL
STATE OF NEBRASKA
9-30-11



NOTES:

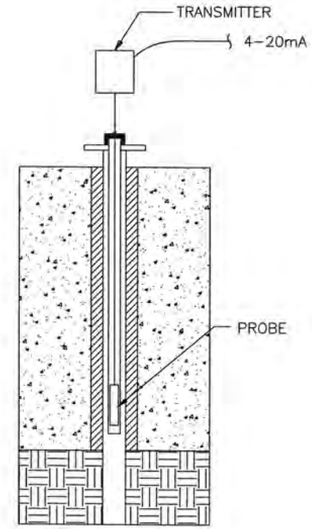
1) FLOW TUBE TO BE 10 STRAIGHT PIPE DIAMETERS UPSTREAM AND 5 PIPE DIAMETERS DOWNSTREAM OF ANY OBSTRUCTIONS.

2) PROVIDE GROUNDING RINGS.

3) 120 VAC POWER TO TRANSMITTER AND 4–20 mA OUTPUT SIGNAL SHALL BE ROUTED THROUGH SEPARATE JUNCTION BOXES.

MAGNETIC FLOW METER AND TRANSMITTER INSTALLATION

DETAIL A
NTS –



WELL LEVEL TRANSMITTER INSTALLATION

DETAIL B
NTS –

EPA
U.S. Environmental Protection Agency
Region 7
Kansas City, Kansas

MARK	DESCRIPTION	DATE	APPR.

MARK	DESCRIPTION	DATE	APPR.

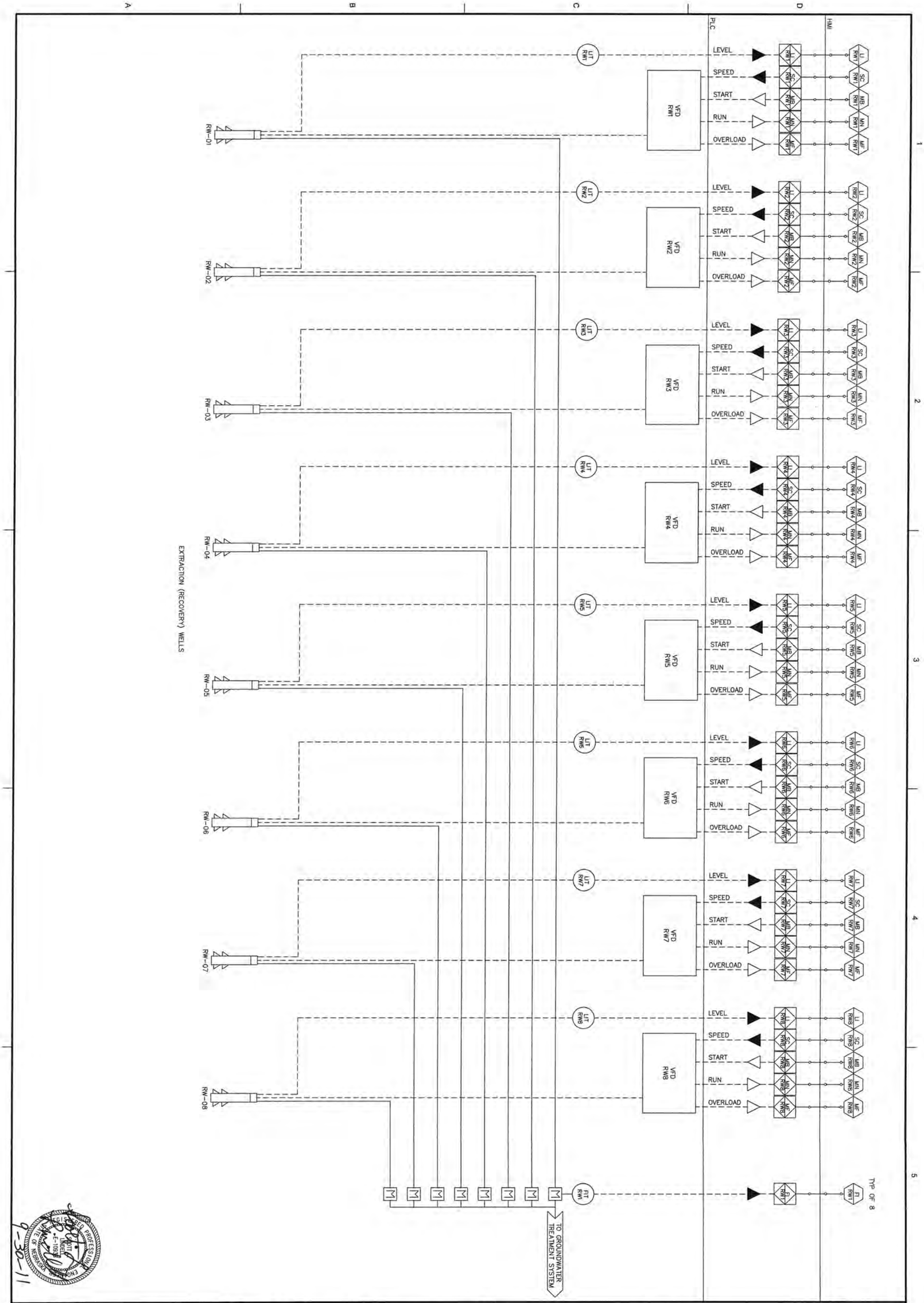
HGL
CDM Federal Programs Corporation

DESIGNED BY: S. LINDELL	CHD BY: J. ROBINSON	DATE: 09/2011	SOLICITATION NO.: W912P9-07-R-0044
DWN BY: L. HUGHES	SUBMITTED BY: DSM	CONTRACT NO.:	
PLOT SCALE: 1"=20'	PLOT DATE: 9/29/2011	FILE NUMBER: HI-417208	
SIZE: ANSI D	FILE NAME: 0002P07.dwg		

GARVEY ELEVATOR SUPERFUND SITE
OPERABLE UNIT 1 - INTERIM REMEDIAL DESIGN
HASTINGS, NEBRASKA

INSTRUMENT MOUNTING DETAILS

SHEET IDENTIFICATION
I-02



9-30-11

GARVEY ELEVATOR SUPERFUND SITE
OPERABLE UNIT 1 - INTERIM REMEDIAL DESIGN
HASTINGS, NEBRASKA

GROUNDWATER RECOVERY WELLS

SHEET IDENTIFICATION: I-03

HGL HydroGeologic, Inc.
CDM Federal Programs Corporation

DESIGNED BY: S. LINDELL		DATE: 09/2011
DWN BY: L. HUGHES	CKD BY: J. ROBINSON	SOLICITATION NO.: W912P6-07-R-0044
SUBMITTED BY: CDM		CONTRACT NO.: -
PLOT SCALE: 1"=20'	PLOT DATE: 9/29/2011	FILE NUMBER: H-4-47208
SIZE: ANSI D	FILE NAME: I003PIDI.dwg	

MARK	DESCRIPTION	DATE	APPR.	MARK	DESCRIPTION	DATE	APPR.

U.S. Environmental Protection Agency Region 7 Kansas City, Kansas