



DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 377TH AIR BASE WING (AFMC)

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MAR 20 2015

Mr. John Kieling, Chief
Hazardous Waste Bureau (HWB)
New Mexico Environment Department (NMED)
2905 Rodeo Park Road
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RECEIVED

MAR 24 2015

NMED
Hazardous Waste Bureau

Dear Mr. Kieling

Kirtland Air Force Base (AFB) is pleased to submit, "*Final Basis of Design – Mid-Plume Pump and Treat System*", for the Bulk Fuels Facility Spill, Solid Waste Management Units ST-106 and SS-111, Kirtland AFB, NM. This Basis of Design describes the technical approach and the design parameters that will be used in development of the pump and treat system.

Please contact Mr. L. Wayne Bitner at (505) 853-3484 or at ludie.bitner@us.af.mil or Mr. Scott Clark at (505) 846-9017 or at scott.clark@us.af.mil, if you have further questions.

Sincerely

TOM D. MILLER, Colonel, USAF
Commander

cc:
NMED-HWB (Roberts, Kieling, Cobrain, McDonald)
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KAFB4230




**40 CFR 270.11
DOCUMENT CERTIFICATION
MARCH 2015**

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TOM D. MILLER, Colonel, USAF
Commander, 377th Air Base Wing

This document has been approved for public release.



20 MARCH 2015

KIRTLAND AIR FORCE BASE
377th Air Base Wing Public Affairs



March 20, 2015

Subject: Kirtland Air Force Base – Final Basis of Design – Mid-Plume Pump and Treat System

1. INTRODUCTION

As part of an Interim Measure for remediation of the off-base portion of the dissolved phase ethylene dibromide (EDB; a fuel additive) groundwater plume, CB&I Federal Services LLC (CB&I) has been tasked to complete a detailed design for a groundwater extraction well, pipeline, treatment, and discharge system to be constructed on or near Kirtland Air Force Base (AFB), Albuquerque, New Mexico. This Basis of Design (BOD) describes the technical approach planned for the project and the design parameters that will be used. The full system is ultimately expected to be designed to extract and treat 800 gallons per minute (gpm) of groundwater, which will require installation of several new groundwater extraction wells in the dissolved EDB plume. Groundwater will be pumped from wells located to the west of the base to a treatment facility located on base, treated to remove EDB and any other volatile organic compounds (VOCs) by carbon adsorption, and then discharged to an infiltration gallery located on base. The initial steps in this Interim Measure that are described in this BOD are the installation and operation of the first extraction well designed to pump 100 gpm, an influent pipeline, site improvements and infrastructure (including a building) sized for the eventual capacity of 800 gpm, a groundwater treatment system sized for 400 gpm, a discharge pipeline sized for full capacity, and the first cell(s) of an infiltration gallery sized for at least 200 gpm per cell. Final system design will be detailed in As-Built reports submitted to NMED.

Additionally, a temporary groundwater treatment system is to be installed in accordance with the NMED approved Groundwater Extraction Pilot Implementation and Additional Plume Characterization Letter Work Plan Addendum #2 (USACE, 2015). This temporary system will incorporate portions of the full pump and treat system outlined in this Basis of Design document, and is anticipated to begin operation by June 30, 2015. Additional details regarding the design of the temporary treatment system will be included in a work plan to be submitted at a later date.

2. DESIGN CRITERIA

A groundwater extraction well (Kirtland AFB [KAFB]-106228), well vault, and influent pipeline will be installed on City of Albuquerque (COA) or Christ United Methodist Church (CUMC) property. A portion of the influent pipeline, the groundwater treatment system (GWTS) and building, effluent pipeline, and infiltration gallery will be installed on Kirtland AFB. Off-base design and construction will be coordinated with COA. This design basis has been divided into five phases. The phases are as follows:

- Phase 1 – Groundwater extraction well KAFB-106228
- Phase 2 – Wellhead vault and influent pipeline
- Phase 3 – GWTS equipment
- Phase 4 – GWTS process building and infrastructure
- Phase 5 – Effluent pipeline and infiltration gallery for treated water

CB&I will procure subcontractors to construct and supply the requirements of each phase. CB&I will coordinate and provide oversight of each phase from design through construction. The phases are described in the following sections.

2.1 Phase 1 – Groundwater Extraction Well KAFB-106228

An extraction well will be installed on CUMC property at 6200 Gibson Boulevard SE. At this location, the groundwater level is approximately 460 feet below ground surface. The extraction well will be 8 inches in diameter and screened from 15 feet above the water table to approximately 60 feet below the water table to capture the dissolved-phase EDB plume. The actual screen depths will be set after installation and sampling of additional monitoring wells. The well will be fitted with a submersible well pump (480-volt, three-phase) capable of pumping a nominal flow rate of 100 gpm. A motor actuated control valve will be installed in the well vault (Phase 2) to regulate the groundwater extraction rate. The groundwater extraction rate will be controlled based on water level in the well or to deliver a set flowrate. Continuous feedback of well water level from a level transducer will be recorded into the programmable logic controller (PLC) at the groundwater treatment plant (Phase 4). A secondary system will be implemented to shut down the pump during low-water level conditions. An overall site plan is included as Figure 1 to detail the well location. This extraction well will become part of the permanent pump & treat system, but will be installed in the spring of 2015 to meet the June 30, 2015 scheduled date for startup of the temporary system.

2.2 Phase 2 – Wellhead Vault and Influent Pipeline

The well vault will be installed to house and protect the wellhead (KAFB-106228), plumbing, fittings, and remote instrumentation necessary for extraction well operation and monitoring. The low profile, lockable well vault will be concrete constructed with H-20 traffic-rated cover, and flush-mounted with the existing grade. After completion, the installation will allow unimpeded truck and automobile traffic through the church parking lot. The well vault will be constructed with a concrete collar for protection. This wellhead vault will become part of the permanent pump & treat system, but will be installed in the spring of 2015 to meet the June 30, 2015 scheduled date for startup of the temporary system.

Instruments and controls within the well vault include pump controls, flow and well level instrumentation, and leak-monitoring devices. These components will be connected to the GWTS control panel on Kirtland AFB by a control cable buried in the trench with the groundwater pipeline. Additionally, pressure and temperature indication will be present at the well vault, as well as a sample port for pre-treatment groundwater sample collection. An automated control valve at the wellhead will be used to regulate groundwater flow rate and pressure, as described above.

Electrical power will be sourced from nearby Power New Mexico (PNM) overhead lines. The required power for the well pump operation will be provided from overhead lines in the vicinity of the well vault following COA and PNM standard specifications. The existing single-phased overhead line in the alley will be upgraded to three-phase power, and will be extended to one pole west of the wellhead vault by using the existing overhead system (upgrading poles as needed). The nearest pole to the wellhead will be equipped with a poletop three-phase transformer that feeds 480-volt, three-phase power routed a short distance underground to an above-grade rack. The rack will be located on CUMC property and will be protected by bollards and/or fencing. The rack will secure a 200-ampere line disconnect switch, service meter (provided by PNM), and service entrance disconnect. The panels will be lockable. Power from the service disconnect breaker will be routed underground to the wellhead vault to power the well pump motor starter and a small power center for 120-volt devices. Control wiring for the well pump and other well instrumentation will be installed in conduit alongside the pipeline from the wellhead to the treatment plant. All controls will be fed to the main control panel in the GWTS building. An electrical splice box will be located at the on-base valve vault in order to provide control connections to the temporary treatment system.

The influent pipelines from the wellhead onto base property will be installed by horizontal directional drilling (HDD) under the unnamed COA owned alley, and under Louisiana Boulevard to a manhole on Kirtland AFB. Once on Kirtland AFB property, the pipeline will be placed in a trench along the Kirtland AFB fence line to the treatment plant. The manhole will serve as a transition between the HDD and trenched installations, and a below grade point for leak monitoring and low point drains. Pits will be excavated at each boring point for HDD equipment. The number of pits will be determined based on location of underground and above ground utilities, aboveground facilities, and maximum pipe pull allowances. The overall capacity of the influent pipelines will be sized for 800 gpm.

Only one extraction well and influent pipeline will be installed initially. The first pipeline to be installed will be sized for approximately 200 gpm to prevent solid settlement and service the first groundwater extraction well. A second pipeline, to be installed at a later date, parallel to the first pipeline or in a different location depending on the locations of future groundwater extraction wells, will provide capacity for additional groundwater extraction, approximately 600 gpm. Approximately 1,600 linear feet (LF) of pipe will be located under the alley on COA property and 1,600 LF inside the Kirtland AFB fence line. The on-base trench will be located as close as practical to the base fenceline allowing for access in a bladed service road next to the fence. The trench will follow the fence line south to the GWTS located at the southeast quadrant of the intersection of Perimeter Circle and Ridgecrest Avenue. Figure 1, the Overall Site Plan, shows the well vault and pipeline locations. Final pipe routing will be coordinated with Kirtland AFB Civil Engineering.

Influent pipelines will be constructed using a double-wall high-density polyethylene (HDPE) piping system for containment of the contaminated groundwater. Pipe lengths will be joined by heat fusion. The first pipeline will be sized for a minimum flow rate of 100 gpm and maximum flow rate of 200 gpm, and will service the proposed extraction well (KAFB-106228). This proposed pipeline will be fitted with automated leak monitoring of the pipeline annular space at a low point drain located in the well vault, and at an inspection port and manhole where the proposed pipelines will enter Kirtland AFB. Future wells and connecting pipelines are to be located at a later date and not included in this BOD. Additional piping will be required to transport groundwater from the northern half of the EDB plume to the treatment plant, but are not included in this BOD.

Trenching, backfilling, and compaction will be completed according to COA standard specification. The top of pipe will be buried 36 inches below finished grade. The plastic pipe will be bedded in sand, and the trench will be backfilled with native soil. All buried piping and conduit will maintain COA minimum separation requirements.

HDD will be used at two road crossings for the first pipeline. The first road crossing involves drilling under Louisiana Boulevard from COA property to Kirtland AFB. The road crossing will be constructed near the end of the unnamed alley to a proposed manhole located on Kirtland AFB. The precast, shallow valve vault will be set approximately 5 feet below grade (base and flat top) and will be flush mounted with ground surface. The first road crossing is estimated to be 150 LF for the dual-containment piping (4-inch carrier, 8-inch containment), and a conduit for the control cable. The second road crossing will be on base, under the intersection of Perimeter Circle and Ridgecrest Avenue and is estimated at 200 LF. High-point air relief valves will be located in the well vault and on-base valve vault.

The subcontractor for the wellhead vault and pipeline (Phase 2 work) will terminate the influent pipelines and control wiring approximately 75 feet north of the GWTS building (Phase 4) located south of Ridgecrest Avenue. The piping will be capped, buried, and marked. A temporary flush-mounted handhole will be installed adjacent to the capped pipe. The control wiring from the well to the GWTS will include additional lengths coiled in the handhole for future extension and termination at the building electrical/control panel during Phase 4. Final pipe and wire connections will be made by the GWTS building contractor during Phase 4 of this work.

2.3 Phase 3 – Groundwater Treatment System Equipment

A permanent GWTS will be installed on Kirtland AFB near the southeast corner of Ridgecrest Avenue and Perimeter Circle, west of Walker Street in the former Zia Park neighborhood. The Phase 3 task details the groundwater treatment equipment that will be purchased for installation during Phase 4 (GWTS building). Ultimately, after installation of additional groundwater extraction wells, the full GWTS will consist of two parallel trains that will be sized to each treat 400 gpm of groundwater (800 gpm total). The system will use carbon adsorption to decrease concentrations of EDB in the groundwater from an expected influent concentration of 0.5 to 1.5 micrograms per liter ($\mu\text{g/L}$) to below the U.S. Environmental Protection Agency (EPA) drinking water maximum contaminant level of 0.050 $\mu\text{g/L}$. Based on recent sampling of the nearby groundwater monitoring well cluster (KAFB-106035, -106036, and -106037), the groundwater from the extraction well will not contain any other contaminants above their respective maximum contaminant levels or other regulatory criteria. All VOCs, other than EDB, are below detection limits, as are total petroleum hydrocarbons and dissolved metals. The GWTS will be designed and instrumented to efficiently operate 24 hours per day with minimal operator attention needed. The GWTS will be monitored and controlled by a PLC-based system (part of Phase 4) that will include telemetry and web access to alert operators to off-hour upset conditions, and to allow them to monitor the system. The GWTS building will be designed with a curbed floor that provides secondary containment for the treatment system equipment.

Major components in each 400-gpm system include the following:

- Influent 6,000-gallon feed tank
- Carbon feed pumps
- Pre-treatment bag filters
- Activated carbon treatment vessels (2 in lead/lag configuration, 20,000 pounds each)
- Post-treatment bag filters
- 6,000-gallon treated water storage tank
- Discharge pump
- Air compressor for slurry carbon fill/exchange

The design will include the two parallel treatment trains, but only one will be installed as part of this scope of work. The second train will be purchased and installed at a later date after installation of additional groundwater extraction wells. A Process Flow Diagram for the GWTS is attached as Figure 2.

The GWTS feed tank is a 6,000-gallon storage tank that will receive untreated water from the well pump. It will be a flat-bottomed tank constructed of fiberglass-reinforced plastic or epoxy-coated carbon steel and will be 10 feet in diameter. The treated water storage tank will be similar to the feed tank. Both tanks will be fitted with level switches and level-indication devices.

The feed pumps for the pre-filters and carbon beds are two identical centrifugal pumps sized for 200 gpm each. Having two smaller pumps will provide better turndown for the system while it is operating with just the first groundwater extraction well. They will be horizontal, American National Standards Institute- (ANSI-) style pumps with stainless steel wetted parts and mechanical seals. The pumps will run at 1,750 revolutions per minute (rpm) so that compared to 3,600-rpm pumps, maintenance costs will be reduced. The feed pumps and the pre-filters will be purchased as a pre-piped, skid-mounted system that will include flow meters and other instruments. The flow from the pumps will be controlled by either a motor actuated control valve at the discharge of the pumps or a variable frequency drive (VFD) controlling the speed of the pumps.

The pre-filters for the carbon beds will be two bag-filter housings piped in parallel. Each housing will hold six, 30-inch by 6-inch diameter filter bags rated at nominal 10-micron filtration. The post filters will be the same. The filter housings will be epoxy-coated carbon steel with stainless steel baskets. A davit support for the filter housing lid will be provided. The post-filters will be identical.

The two carbon adsorbers will be 10 feet in diameter and each can be loaded with 20,000 pounds of activated carbon. They will be constructed of epoxy-lined carbon steel and fitted with a common manifold that allows either bed to operate in the lead/lag position. Since the GWTS will initially be operated at 100 gpm, the groundwater flow distributors on the carbon beds will be designed to minimize channeling at low flow rates. Flow distributors and other internals in the carbon adsorbers will be constructed of stainless steel, not polyvinyl chloride.

The discharge pump is a single pump rated for 400 gpm. It will also be a horizontal ANSI -style centrifugal pump with a rated speed of 1,750 rpm and have stainless steel wetted parts. The discharge pump skid will have similar instrumentation as the feed pump skid. The flow from the discharge pump will be controlled by either a motor actuated control valve at the discharge of the pump or a VFD controlling the speed of the pump.

Additional details of equipment layout within the GWTS building are detailed in Figure 3, Equipment Layout.

2.4 Phase 4 – Groundwater Treatment System Process Building and Infrastructure

The GWTS building will be a new single-story, free-standing 4,160-square foot (52 feet by 80 feet), non-sprinkled structure that will house the GWTS equipment identified in Phase 3. The structure will have a covered (16 feet by 80 feet) truck loading/unloading bay with a sloped concrete pad and secondary concrete containment sump pit with a traffic-rated metal grate spanning the entire length. The concrete containment sump is sized to contain the release of untreated water from a tanker truck. The building will have a control room attached to the main structure. Figures 4 and 5 depict architectural renderings of the building.

The building will be constructed of conventional reinforced concrete masonry block walls supporting an open-web, parallel chord steel bar joist roof framing with a metal roof deck, which will serve as a horizontal diaphragm to transfer lateral loading to the exterior bearing/shear walls. The floor slab will be constructed as a reinforced concrete slab-on-grade with isolated spread footings provided as necessary to support the carbon beds and water tanks. The slab will be designed to accommodate American Association of State Highway and Transportation Officials vehicle and/or fork-truck traffic/loading as well as loading from miscellaneous totes and equipment. The building structure will be designed for containment as required by the governing building code provisions. The roof structure will be flat with positive drainage achieved by the use of built-up insulation creating a mono-slope condition to one side of the building, and drainage achieved using roof scuppers with downspouts. The eave height of the building (i.e., maximum joist-bearing elevation) is assumed not to exceed 23 feet, 4 inches above the finished floor, based on the height of the selected GWTS (Phase 3) and clearances required. A parapet will extend above the roof bearing such that the top of masonry is 28 feet, 8 inches above the finish floor elevation around the entire perimeter of the structure. Stormwater runoff from the building, and surrounding drive and parking will be diverted to the existing Kirtland AFB storm water collection system. Figure 6 shows the building orientation and improvements around the building.

The building will require tanker unloading of granular activated carbon that is used in the carbon beds. The carbon will be transferred from the delivery tankers and the carbon beds as water slurry. Fill and discharge hoses will be connected from the tanker to the carbon vessels through penetrations or doorways in the wall. A covered area outside the building will be used to park the tanker during loading operations.

The attached open-air truck-loading/unloading area will be covered with a roof structure comprised of open-web, steel bar joists with a structural metal roof deck bearing on the outside wall of the building, and structural steel beams supported by steel columns on the opposite end. This area will include a concrete apron that will slope to a containment trench designed to capture approximately 5,000 gallons of liquid in the event of a spill during loading/unloading activities.

The foundation system will include shallow, continuous and isolated spread footings bearing on suitable native soil or engineered fill as determined by geotechnical analysis. The slab-on-grade construction will bear on a compacted gravel sub-base as determined by geotechnical analysis. Intermediate or deep foundation systems such as a raft or mat foundation is not included as part of the scope for this building. A curb inside the building or integral to the wall will be poured and sealed to act as secondary containment. The containment will be able to hold the liquid volume of the largest vessel in the facility if a pipe/tank should rupture.

Kirtland AFB personnel have stated that existing piping at the former Zia Park housing area may contain asbestos. The influent pipeline, treatment building foundation, and effluent pipeline may encounter this piping during construction. A competent person will be on-site during construction activities to provide oversight and ensure that activities are halted if asbestos is encountered. A certified asbestos removal subcontractor will then be used to remove the friable or non-friable pipeline as needed and dispose of it properly.

The groundwater treatment system equipment, purchased in Phase 3, will be installed during Phase 4. Only one treatment train sized for 400 gpm will be installed at this time. The floor plan of the building (Figure 3) allows the current and future tanks and equipment to be transported into the building and lifted into their respective place. All interconnecting piping, pipe supports, valves, sample ports, and instrumentation for one 400-gpm system will be installed during this phase. Where applicable, piping blind flanges/caps, floor space, and electrical capacity will be installed to reduce redundant efforts when the second 400-gpm system is installed at a later date.

A PLC will be housed in the GWTS building as part of Phase 4. The PLC will integrate all control and feedback systems from the well to the infiltration gallery. These systems include, but are not limited to, GWTS equipment instrumentation, leak detection, well vault, and infiltration gallery instrumentation. Additional safety interlocks will be installed at the building and programmed in the PLC, including a high-high level switch in the building sump, and controls described in Phases 2 and 5. When high-high level, leak detection, or other safety interlocks are activated, a signal will shut down the extraction well pump at KAFB-106228 and GWTS equipment.

The building will be heated to 50 degrees Fahrenheit (°F) and ventilated with exhaust fans. The heating system will prevent freezing of pipelines, and the location of control/electrical equipment will be acceptable for proper electrical component operation. Additional cooling/heating equipment will be implemented for the control room as those requirements develop during design. Power required for the building will be a 480-volt, three-phase service. Subject to final KAFB and USACE direction, electrical service will be supplied by demolishing an existing handhole east of Pennsylvania Street and installing a PMH-9 pad-mounted sectionalizer and tapping into the existing 12470 volt service line. Two lengths of 5-inch HDPE conduit will be directionally drilled under Pennsylvania Street to the west. Once beyond Pennsylvania Street, two runs of 5-inch schedule 40, Polyvinyl Chloride (PVC) conduit will be begin and extend underground to Walker Street in Zia Park by means of open-cut excavation. One other road crossing across San Pablo Street will include directional drilling underneath with 5-inch HDPE conduit. Five (5) additional PMH-9 sectionalizers will be installed at increments of approximately 500 feet along the conduit path. A # 4/0 American Wire Gauge (AWG) copper service line will be installed in one run of conduit making terminations at each sectionalizer. An underground service line from the sectionalizer at Walker Street will be installed to feed a 500 kVA transformer located east of treatment building. This line will be directionally drilled utilizing 5-inch HDPE conduit, and #1/0 AWG copper line. Underground

cable will connect the transformer to the main disconnect panel in the GWTS building utilizing directly buried schedule 40 PVC conduit and cable runs sized per the load requirements of the building. The electrical service panel in the building will contain breakers and motor starters or VFDs for the first 400-gpm train of the treatment system, and will have room for the second treatment train. Final electrical design and specifications will be documented in the as-built reports.

Additional utilities include a non-potable water connection from the Kirtland AFB water distribution for general wash-down and carbon slurry fill operations. One hose bibb (hydrant style connector) should be available outside the facility for personnel to fill water trucks with treated water for dust control. A new fire water line and fire hydrant are to be installed from the nearest, assumed location (south of electrical substation 10 on Randolph Ave). The new fire water line is to be installed by trenching through Zia Park and across all existing roadways. The trenching will be backfilled and seeded to match existing conditions, while the roads will be re-paved to match existing conditions at the locations of the trenching. The fire hydrant will be installed within the site parameters of the building location and will meet all Kirtland AFB standards/ requirements. A communication line will be buried from nearby splice box (location to be determined by Kirtland AFB) to the treatment building. The communication line will be used to transmit a fire alarm signal in the building to the base-specified terminal. Trenching, backfilling, and compaction will be completed according to COA standard specification. The top of pipe will be buried 36 inches below finished grade. The plastic pipe will be bedded in sand, and the trench will be backfilled with native soil.

The influent and effluent piping described in Phases 2 and 5 will terminate approximately 75 feet north and south of the building, respectively. The work described in Phase 4 includes making final connections of piping and electrical/control wiring at the described transition locations. The coiled control/electrical wiring will terminate at the appropriate panels and final fusing of influent and effluent HDPE pipelines in order to integrate the GWTS from the well (KAFB-106228) and the effluent pipeline leading to the infiltration gallery. The Utility Routing Plan included as Figure 7 details locations of connection integration.

2.5 Phase 5 – Effluent Pipeline and Infiltration Gallery for Treated Water

The current plan for discharge of the treated water is to use an infiltration gallery, subject to confirmation that the planned infiltration area has sufficient permeability to accept 800 gpm in a reasonable-sized gallery. A buried HDPE pipe will be sized to allow discharge of 800 gpm from the GWTS to the infiltration gallery. The treated groundwater will discharge to a below-grade infiltration gallery designed to infiltrate 800 gpm. The gallery will be divided into four cells sized that can infiltrate 200 gpm each. This setup allows shutdown of one cell while continuing to discharge to the other cells. For example, while one cell is isolated for maintenance, the other three cells are available for discharge. This BOD addresses the design of four cells and the construction of one cell during Phase 5. The three remaining cells will be constructed at a later date.

This phase begins approximately 75 feet south of the GWTS building. The discharge pipeline will be capped, buried, and marked at this location. A temporary flush-mounted handhole will be installed adjacent to the capped pipe. The control wiring from the infiltration gallery to the GWTS will include additional lengths coiled in the handhole for future extension, and termination at the building electrical/control panel during Phase 4. Final pipe and wire connections will be made during Phase 4 of this work.

The discharge pipeline will be a single-wall HDPE pipe buried 36 inches below finished grade. The route of the pipeline is shown on Figure 1. The discharge pipeline will include open-cut trenching and HDD methods. High-traffic road crossings and sensitive utility crossings will implement HDD as the method of installation, as shown on Figure 1. Trenching, backfilling, and compaction will be performed according to

COA and Kirtland AFB standard specifications. Buried pipe will be bedded in sand, and the trench will be backfilled with native soil.

Infiltration gallery design is based on the design flow rate of 800 gpm. An initial infiltration test was performed at 4 boreholes spread across the proposed site at a depth of approximately 5 feet bgs. Testing developed varied infiltration rates ranging from 0.72 gallon per day per square foot (gpd/sf) to 4.10 gpd/sf (AMEC, 2014). The lower rates appear to be the result of underlying caliche layers inhibiting vertical infiltration, and the higher rates appear to be the result of testing in sandy backfill that does not represent the native lithology. In order to obtain more accurate infiltration rates and correctly design the infiltration galleries, 26 additional boreholes will be drilled to approximately 40 feet bgs to fully understand site geology, and up to 12 additional infiltration tests will be conducted below caliche present in the upper 10 feet of the area.

In addition to the initial infiltration test results, a literature search was conducted that found infiltration rates ranging from 0.7 gpd/sf in the New Mexico Administrative Code (NMED, 2013) to 1.8 gpd/sf (EPA, 2002). A local vendor suggested a maximum of 4 gpd/sf with an applied safety factor of 2.0, which equates to 2.0 gpd/sf. The following table summarizes the dimensions required per cell for a wide range of infiltration rates:

Infiltration Rate (gallons per day per square foot)	Length by Width Required for Each Cell (feet by feet)
6.0	217 by 217
4.0	266 by 266
2.0	377 by 377
1.8	398 by 398
1.0	534 by 534
0.7	639 by 639
0.36 (Based on initial infiltration testing)	894 by 894

Each infiltration gallery cell will have a manhole that is capable of handling 200 gpm and capable of transferring discharge to a manifold that directs water into the infiltration gallery. The infiltration gallery will be comprised of rows of chamber sections snapped together. The chamber setup provides for maximum infiltration area and storage capacity. An example of a chamber is the Infiltrator System High Capacity Chamber H-20. Each chamber section is 76 inches long, 34 inches wide, and 16 inches tall. A row may be comprised of 500 chamber sections pieced together. The infiltration gallery will have a number of features designed to provide drainage of the treated water into the subsurface. First, the excavation bottom will be lined with separation geotextile and topped with 1 foot of drain stone (½- to 1½-inch diameter). Then the chambers will be placed on the stone and enveloped in 2 feet of additional drain stone. The stone layer will be covered with separation geotextile. Backfill will be placed on the geotextile to grade. Additional backfill will be mounded 18 inches above-grade to promote positive drainage and to accommodate differential settlement. Approximately 6 inches of topsoil will be placed to promote vegetation. The infiltration galleries will be either temporarily or permanently seeded depending upon the time of year. Permanent seeding will be in accordance with Kirtland AFB requirements as provided in the following table.

Permanent seed species and mixtures will be proportioned by weight as follows:

Common Name	Species Name	Rate PLS pounds/acre
Side Oats Grama	<i>Bouteloua curtipendulum</i>	6
Blue Grama	<i>Bouteloua gracilis</i>	3
Indian Ricegrass	<i>Oryzopsis hymenoides</i>	12
Sand Dropseed	<i>Sporobolus cryptandrus</i>	2
Alkali Sacaton		2
Galleta Grass, Viva	<i>Pleuraphic jamesii</i>	6
TOTAL		31 PLS pounds/acre

PLS Pure Live Seed

Figure 1 details pipe routing and the infiltration gallery location. Additional infiltration testing will take place in mid-February 2015. When the test data and the report on this work are available, they will be included as an addendum to this BOD and incorporated into design documents.

During staking and utility locate activities for the initial infiltration test, and during the testing field work, CB&I personnel encountered three items of munitions debris. A trained UXO technician will be present during drilling and excavation activities to observe for additional munitions items. It is assumed that no additional munitions items will be discovered during the second infiltration test or construction activities. If additional items are discovered during drilling or construction activities, construction will be stopped until the items are addressed by Kirtland AFB Explosives Ordnance Disposal.

2.6 References

AMEC. 2014. *Kirtland Air Force Base Seepage Testing, Geotechnical Memo*, AMEC Environment & Infrastructure, November, 2014.

EPA. 2002. *Onsite Wastewater Treatment Systems Manual*, Table 4-3.

NMED. 2013. *20.7.3 New Mexico Administrative Code, Liquid Environmental Protection, Wastewater and Water Supply Facilities, Waste Disposal and Treatment*, September.

USACE. 2015. *Groundwater Extraction Pilot Implementation and Additional Plume Characterization Letter Work Plan Addendum #2*, January.

3. CODES AND STANDARDS

Specific building and design requirements are listed in this section.

- Jurisdictional Authority for off-base construction will be COA planning/permits division.
- Jurisdictional Authority for on-base construction will be Kirtland AFB.
- Transition to and under base fence line will be approved through COA and Kirtland AFB.

Building requirements for structures on Kirtland AFB are as follows:

- Architectural Compatibility Plan, Kirtland AFB
- U.S. Air Force, 377th Civil Engineer Division, 2014, General Design Standards, Civil Engineer Services
- Unified Facilities Criteria UFC 1-200-01, 2013, "General Building Requirements"
- International Code Council, International Building Code IBC 2012
- Leadership in Energy and Environmental Design (LEED) Standards: Engineering Technical Letter ETL 08-13 – Utility Structure (7 Credit Points to be met for structure)
- Energy Independence and Security Act, Section 438

Additional guidance will be referenced from the following:

- New Mexico Administrative Code, Title 20, *Environmental Protection*, Chapter 7, “Wastewater and Water Supply Facilities,” Part 3, “Liquid Waste Disposal and Treatment”
- New Mexico Administrative Code, Title 20, *Environmental Protection*, Chapter 6, “Water Quality,” Part 2, “Ground and Surface Water Protection”
- High Performance and Sustainable Buildings
- City of Albuquerque, 2011, “Standard Specifications for Public Works Construction”
- Endangered Species Act (burrowing owl)
- National Historic Preservation Act, Cultural Resources Section 106

4. SITE-SPECIFIC DESIGN ASSUMPTIONS

4.1 Equipment and Component Requirements

- The electrical area classification is “unclassified.”
- Aboveground piping materials of construction – ASTM International 53 Carbon Steel (at treatment building).
- Belowground piping materials of construction – PE4710 HDPE.
- Installation of piping along the unnamed alley and directional-drilling under Louisiana Boulevard will not encounter significant utility obstructions.
- An infiltration test will be performed at the infiltration gallery site. These data will be used in the design of the infiltration gallery.
- A Geotechnical Report will be produced by a third party, so that the treatment facility building foundation design can be completed.
- Equipment dimensions, and weights and anchorage, specifications will be required from equipment providers for proper slab/foundation design.

4.2 Ambient Conditions

The following information will be used in the system design:

- Maximum outdoor design temperature: 100°F
- Minimum outdoor design temperature: 10°F
- Plant ambient pressure: 5,385 feet above mean sea level

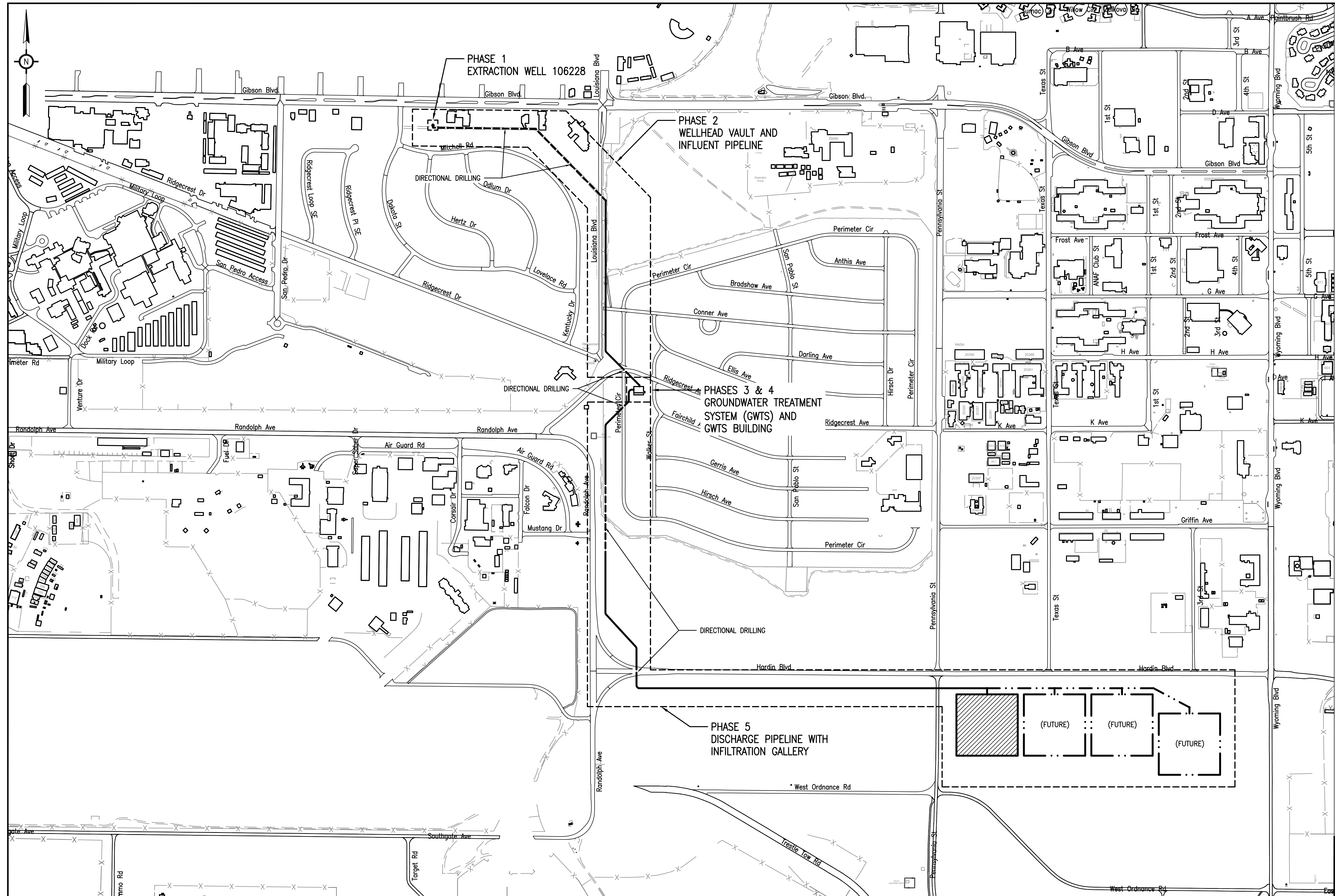
- Slab-On-Grade/Pavement design = American Association of State Highway and Transportation Officials HS20-44 or 3,000-pound load acting on a 4.5-inch by 4.5-inch area or 125 pounds per square foot or Mitsubishi model FD55N, pneumatic tire forklift truck with a maximum lift capacity of 12,000 pounds
- Environmental Loading as per Unified Facilities Criteria UFC 3-301-01, “Structural Engineering,” May 2014
 - a. Ground Snow = 10 pounds per square foot
 - b. Frost Penetration Depth = 18 inches minimum, pending more stringent geotechnical requirements
 - c. Wind Speed = 115 miles per hour (Risk Category II)
 - d. Seismic Design Criteria: $S_s = 47$ percent of gravity (0.47g), $S_1 = 14$ percent of gravity (0.14g)

4.3 Utility Sourcing

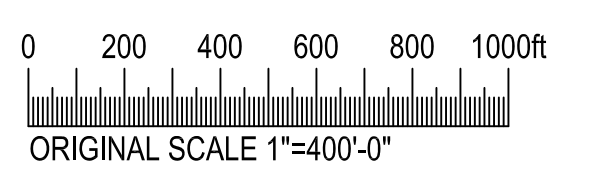
The off base well vault will source power from a local three-phase electrical pole nearby in the unnamed alley.

Power for the GWTS building will be sourced from an underground 12470 volt, three-phase line near the corner of Pennsylvania Street and K Avenue, pending final direction from USACE and KAFB (Figure 7). Water supply for the building and fire hydrant line will be a non-looped, single tap at a main line on the intersection of Ridgecrest Avenue and Randolph Avenue. A communication line will be installed from the treatment building to a nearby splice box (location to be determined by Kirtland AFB). Figure 7 shows the proposed locations of utility drops/connections.

FIGURES



- LEGEND:**
- BUILDING (SIZE AND SHAPE VARIES)
 - ROAD
 - FENCE
 - BURIED PIPE (OPEN-CUT EXCAVATION)
 - BURIED PIPE (HORIZONTAL DIRECTIONAL DRILLING)
 - PHASE DELINEATION
 - FUTURE CONSTRUCTION
 - INFILTRATION GALLERY



U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ALBUQUERQUE, NEW MEXICO

CLIENT DWG NO:

FIGURE 1 – OVERALL SITE PLAN
BASIS OF DESIGN
MID-PLUME PUMP & TREAT SYSTEM

FOR: BULK FUELS FACILITY, KIRTLAND AFB, NM

PROJECT NO: 140705 DWG NO: 140705-001-CV-03-BOD001 REV:

File: 140705-001-CV-03-BOD001.DWG
Date: 12/17/14
Plotted By: charlesbenfey

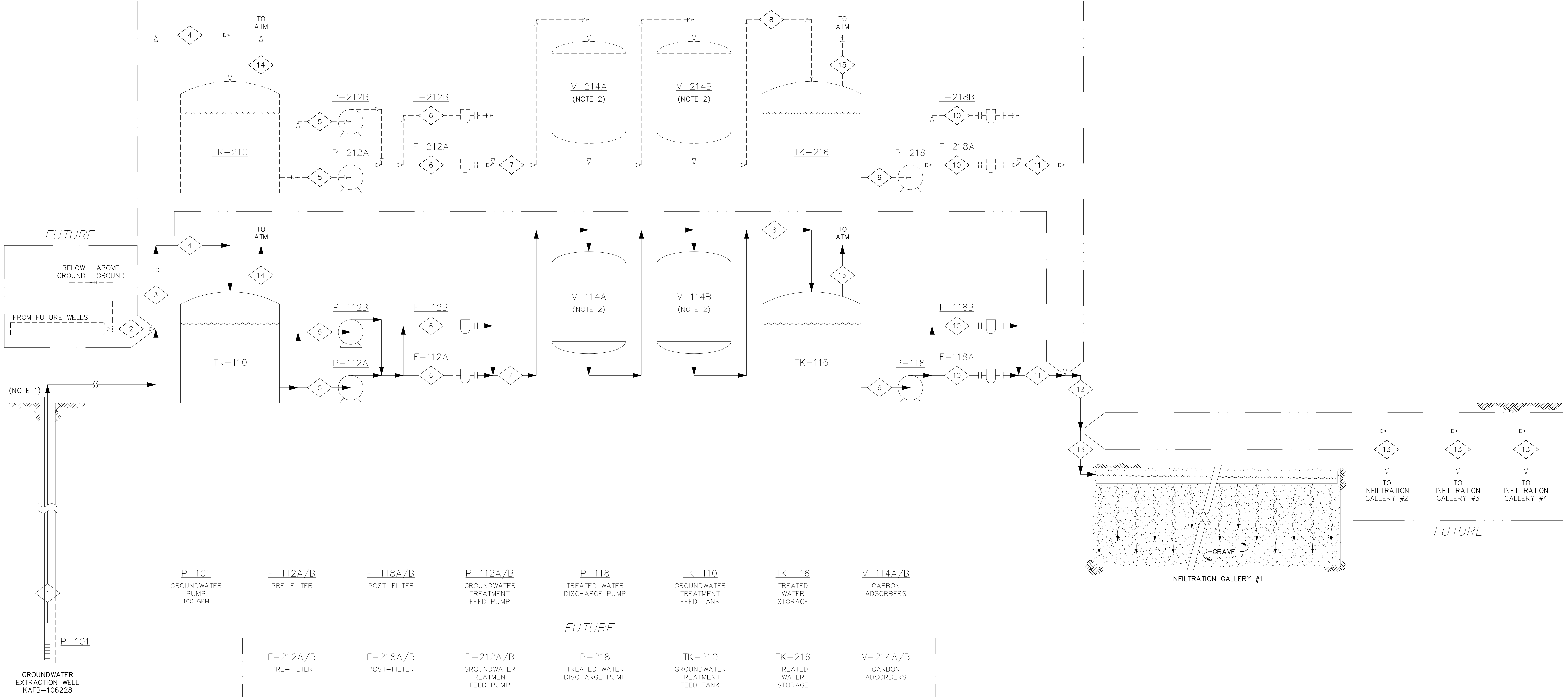
NOTES

REFERENCE DRAWINGS	NO.	REVISION	DRAWN	CK'D	APPD	DATE	DRAWN: CFB	CK'D:	APPD:	DATE: 12/17/14	SCALE: 1" = 400'



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FUTURE



- P-101 GROUNDWATER PUMP 100 GPM
- F-112A/B PRE-FILTER
- F-118A/B POST-FILTER
- P-112A/B GROUNDWATER TREATMENT FEED PUMP
- P-118 TREATED WATER DISCHARGE PUMP
- TK-110 GROUNDWATER TREATMENT FEED TANK
- TK-116 TREATED WATER STORAGE
- V-114A/B CARBON ADSORBERS
- F-212A/B PRE-FILTER
- F-218A/B POST-FILTER
- P-212A/B GROUNDWATER TREATMENT FEED PUMP
- P-218 TREATED WATER DISCHARGE PUMP
- TK-210 GROUNDWATER TREATMENT FEED TANK
- TK-216 TREATED WATER STORAGE
- V-214A/B CARBON ADSORBERS

COMPONENT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
STREAM NO.	KAFB-106228 TO GWTS	FUTURE WELLS TO GWTS	WELL FIELD TO GWTS	INFLUENT TO FEED TANK	GWTS FEED PUMPS	PRE-FILTER	CARBON ABSORPTION INLET	TREATED WATER	DISCHARGE PUMP	POST-FILTER	TREATED DISCHARGE	TREATED DISCHARGE	INFILTRATION GALLERY	TREATED WATER STORAGE TANK VENT	TREATED WATER STORAGE TANK VENT			
LIQUID FLOW (maximum)	gpm	700	800	400	200	400	400	400	400	400	400	800	200					
LIQUID FLOW (average)	gpm	100																
AIR FLOW (maximum)	acfm (scfm)													75	75			
INFILTRATION RATE	gal/day/ft ²												TBD		ATM			
ETHYLENE DIBROMIDE (EDB)	ug/L	2	2	2	2	2	2	0.03	0.03	0.03	0.03	0.03	0.03					
PRESSURE	PSIA	273.05		47.5	17.05	13.4	56.9	22.05	18	13.4	91.7	76.7	25	13.05	12.05			
TEMPERATURE	°F	58	58	58	58	58	58	58	58	58	58	58	58	58	68	68		
DENSITY (AT 70°F)	lb/ft ³	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	62.4	0.061	0.061			

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CORPS OF ENGINEERS
ALBUQUERQUE, NEW MEXICO

- NOTES
- PIPELINE FROM GROUNDWATER WELL KAFB-106228 IS DOUBLE-WALLED HDPE PIPE.
 - CARBON VESSELS ARE RUN IN SERIES WITH OPTIONAL VALVING FOR PARALLEL AND LEAD/LAG CONFIGURATION.
 - ATMOSPHERIC PRESSURE AT ELEVATION IN ALBUQUERQUE IS 12.05 PSIA.



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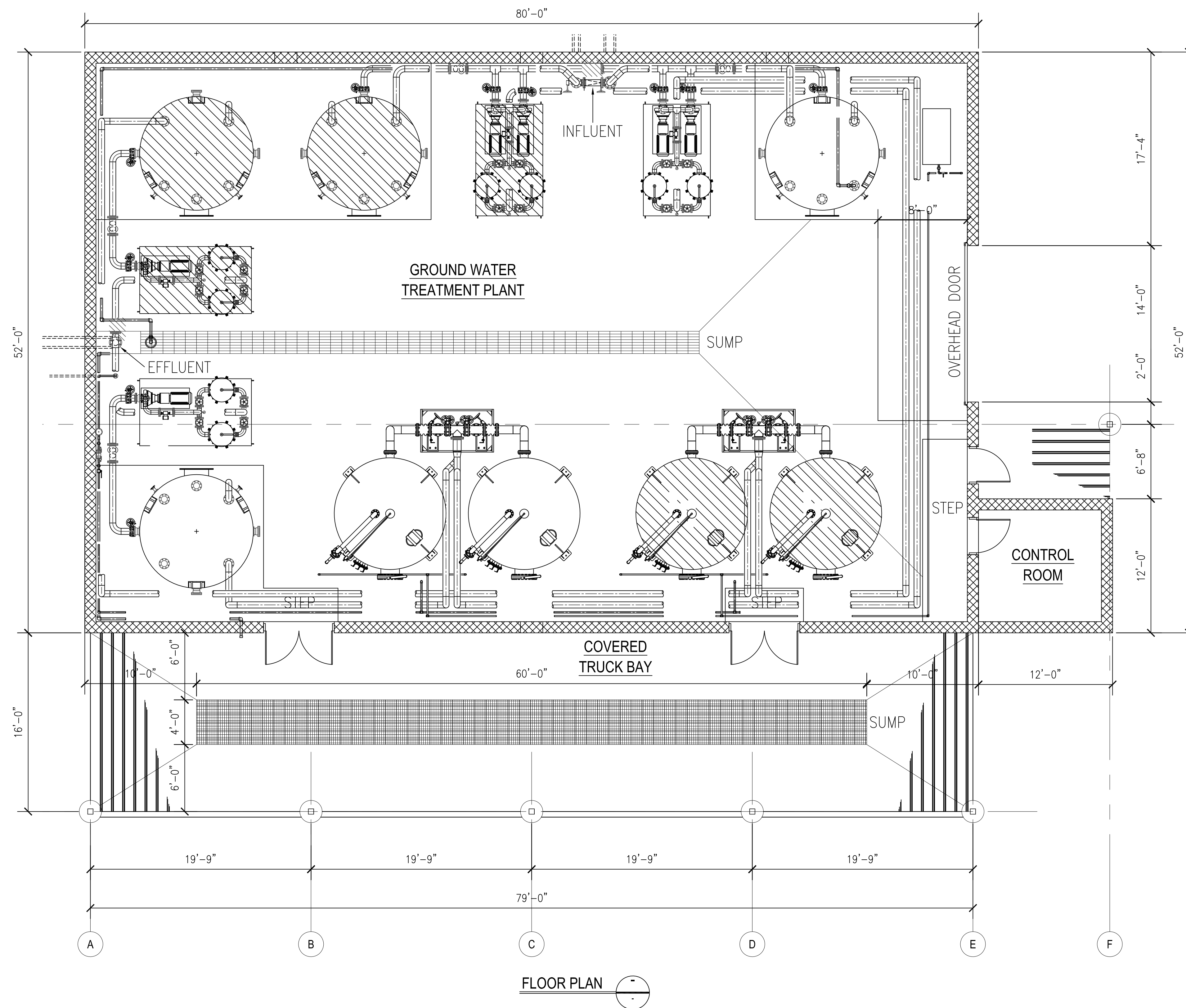
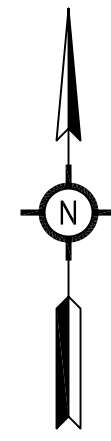
FIGURE 2 - PROCESS FLOW DIAGRAM
BASIS OF DESIGN
MID-PLUME PUMP & TREAT SYSTEM

FOR: BULK FUELS FACILITY, KIRTLAND AFB, NM

REFERENCE DRAWINGS	NO.	REVISION	DRAWN	CK'D	APPD	DATE	DRAWN: JWH	CK'D: ACS	APPD: SES	DATE: 12/17/14	SCALE: NONE
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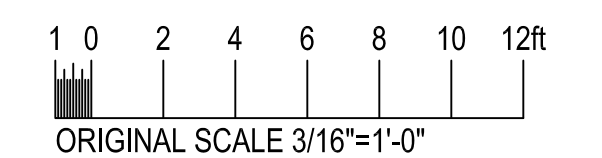
PROJECT NO: 140705 DWG NO: 140705-001-PR-01-BOD002 REV:

File: 140705-001-PR-01-BOD002.dwg Date: 12/17/14 11:10am Plotted By: charlesberry



LEGEND:

- 12" REINFORCED CMU
- FUTURE EQUIPMENT



FLOOR PLAN

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ALBUQUERQUE, NEW MEXICO

CLIENT DWG NO:

**FIGURE 3 – EQUIPMENT LAYOUT
BASIS OF DESIGN
MID-PLUME PUMP & TREAT SYSTEM**

FOR: BULK FUELS FACILITY, KIRTLAND AFB, NM



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DATE: 12/17/14

SCALE: 3/16" = 1'

PROJECT NO: 140705

DWG NO: 140705-001-CA-02-BOD003

REV:



PROPOSED RENDERING: SOUTH-EAST CORNER



PROPOSED RENDERING: NORTH-EAST CORNER

U.S. ARMY ENGINEER DISTRICT
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ALBUQUERQUE, NEW MEXICO

CLIENT DWG NO:

FIGURE 4 – ARCHITECTURAL RENDERING
BASIS OF DESIGN
MID-PLUME PUMP & TREAT SYSTEM

FOR: BULK FUELS FACILITY, KIRTLAND AFB, NM

PROJECT NO: 140705 DWG NO: 140705-001-CA-02-BOD004 REV:



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DRAWN:

CK'D:

APPD:

DATE: 12/17/14

SCALE:



PROPOSED RENDERING: NORTH-WEST CORNER



PROPOSED RENDERING: SOUTH-WEST CORNER

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ALBUQUERQUE, NEW MEXICO

CLIENT DWG NO:

FIGURE 5 – ARCHITECTURAL RENDERING
BASIS OF DESIGN
MID-PLUME PUMP & TREAT SYSTEM

FOR: BULK FUELS FACILITY, KIRTLAND AFB, NM

PROJECT NO: 140705

DWG NO: 140705-001-CA-02-BOD005

REV:



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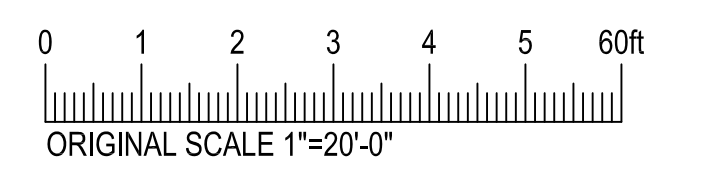
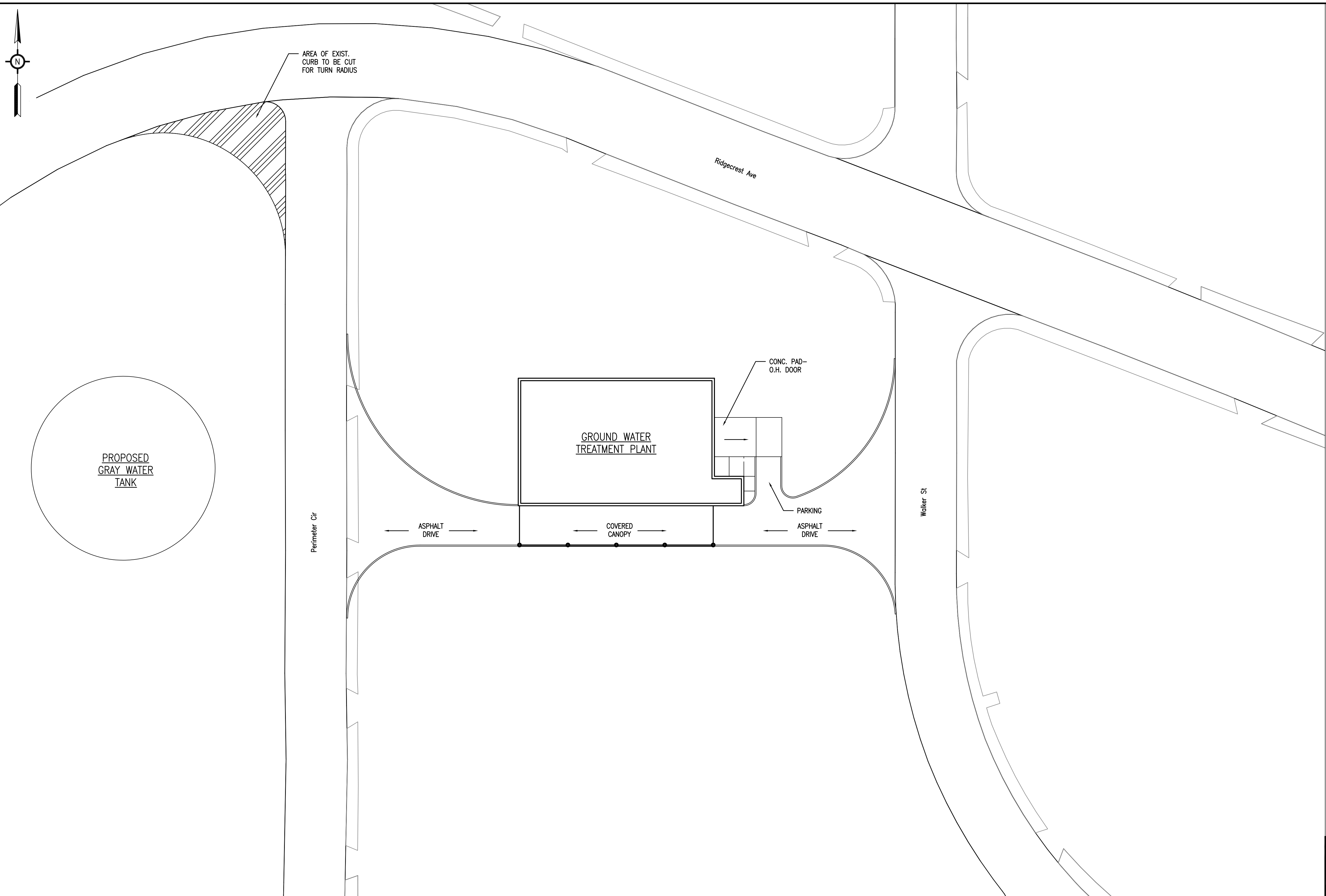
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CORPS OF ENGINEERS
ALBUQUERQUE, NEW MEXICO

CLIENT DWG NO:

FIGURE 6 – ARCHITECTURAL SITE PLAN
BASIS OF DESIGN
MID-PLUME PUMP & TREAT SYSTEM

FOR: BULK FUELS FACILITY, KIRTLAND AFB, NM

PROJECT NO: 140705 DWG NO: 140705-001-CA-02-BOD006 REV:

File: 140705-001-CA-02-BOD006.DWG
Date: 12/17/14 11:40am
Plotted By: charlesberney

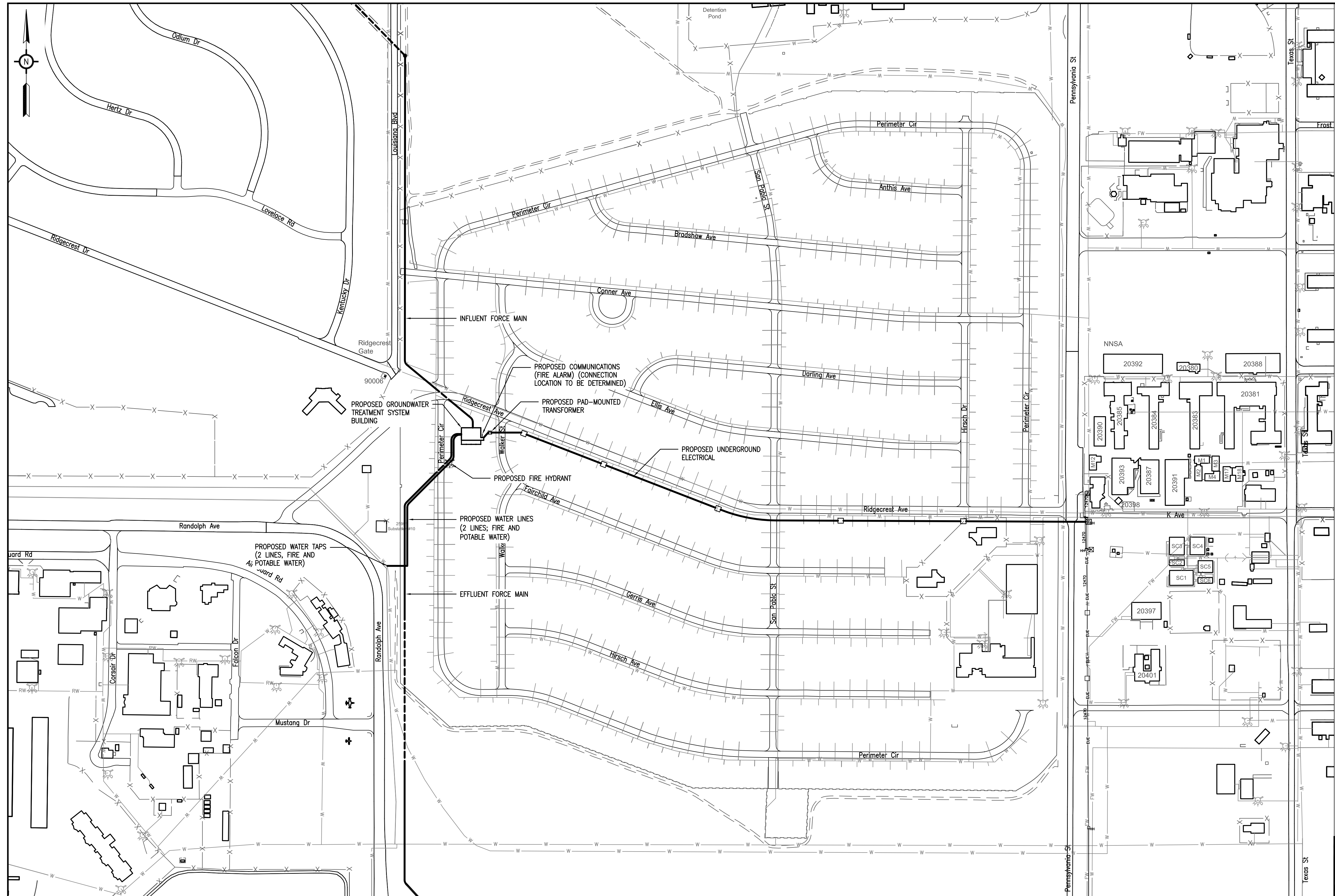
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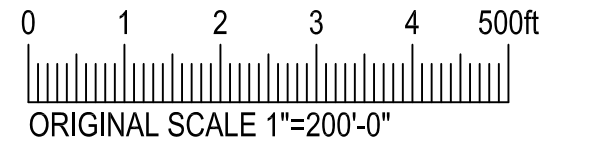


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- LEGEND:**
- BUILDING (SIZE AND SHAPE VARIES)
 - ROAD
 - FENCE
 - BURIED PIPE (OPEN-CUT EXCAVATION)
 - BURIED PIPE (HORIZONTAL DIRECTIONAL DRILLING)



U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
ALBUQUERQUE, NEW MEXICO

CLIENT DWG NO:

FIGURE 7 – UTILITY ROUTING PLAN
BASIS OF DESIGN
MID-PLUME PUMP & TREAT SYSTEM

FOR: BULK FUELS FACILITY, KIRTLAND AFB, NM

PROJECT NO: 140705 DWG NO: 140705-001-CV-03-BOD007 REV:

File: 140705-001-CV-03-BOD007.DWG
 Plot Date: 12/17/14 - 1:03pm
 Plotted By: charles.bentley

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