Post-Closure Permit Renewal Application
Munitions Treatment Range
Unit 8 (Burial Pit)

Barry M. Goldwater Range
Luke Air Force Base, Arizona

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Environmental Element

5 January 2017

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Attachment 3	Post-Closure Inspection Form and Protocol
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Attachment 5	Part A Permit Application

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Acronyms and Abbreviations

A.A.C	Arizona Administrative Code
ADEQ	Arizona Department of Environmental Quality
AFB	Air Force Base
amsl	above mean sea level
bls	below land surface
CDM	CDM Federal Programs Corporation
CFR	Code of Federal Register
cm/sec	centimeters per second
DCG	Disaster Control Group
EOD	Explosive Ordnance Disposal
EPA	U.S. Environmental Protection Agency
°F	degrees Fahrenheit
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
ft/min	feet per minute
GBAFAF	Gila Bend Air Force Auxiliary Field
GPLs	Groundwater Protection Levels
IC	Incident Commander
MCAS Yuma	U.S. Marine Corps Air Station Yuma
mg/L	milligrams per liter
MTR	munitions treatment range
OSHA	Occupational Safety and Health Act
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facilities Assessment
RFI	RCRA Facility Investigaion
SWMU	Solid Waste Management Unit
TCLP	toxicity characteristic leaching procedure
USGS	United States Geological Survey
UXO	unexploded ordnance
%	percent

Section 1
Introduction

Luke Air Force Base (AFB) has prepared this Post-Closure Permit Renewal Application for the former Luke AFB Munitions Treatment Range (MTR) Unit 8 - Burial Pit on the Barry M. Goldwater Range. The purpose of this application is to renew the Post-Closure Permit issued by the Arizona Department of Environmental Quality (ADEQ) on 27 June 2006. This permit application meets the substantive requirements of post-closure as stated in 40 Code of Federal Regulations (CFR) 265, 40 CFR 270, and Arizona Administrative Code (A.A.C.) R18-8-265.A.

Partial closure for the former burial pit at the Barry M. Goldwater Range was completed on 20 June 2000 in accordance with the ADEQ-approved Final Partial Closure Plan (CDM 1999). The Final Partial Closure Report (CDM 2001) was submitted to ADEQ on 28 June 2001. The partial closure consisted of construction of a Resource Conservation and Recovery Act (RCRA) hazardous waste cap over the former burial pit. Details of the cap are included in Attachment 1.

This Post-Closure Permit Application is organized as follows:

Section 1	Introduction
Section 2	Facility Description
Section 3	Hydrogeologic Characterization and Monitoring Requirements
Section 4	Post-Closure Plans
Section 5	Personnel Training
Section 6	Procedures to Prevent Hazards
Section 7	Contingency Plan
Section 8	Other Federal Laws
Section 9	Financial Assurance
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Section 2
Facility Description

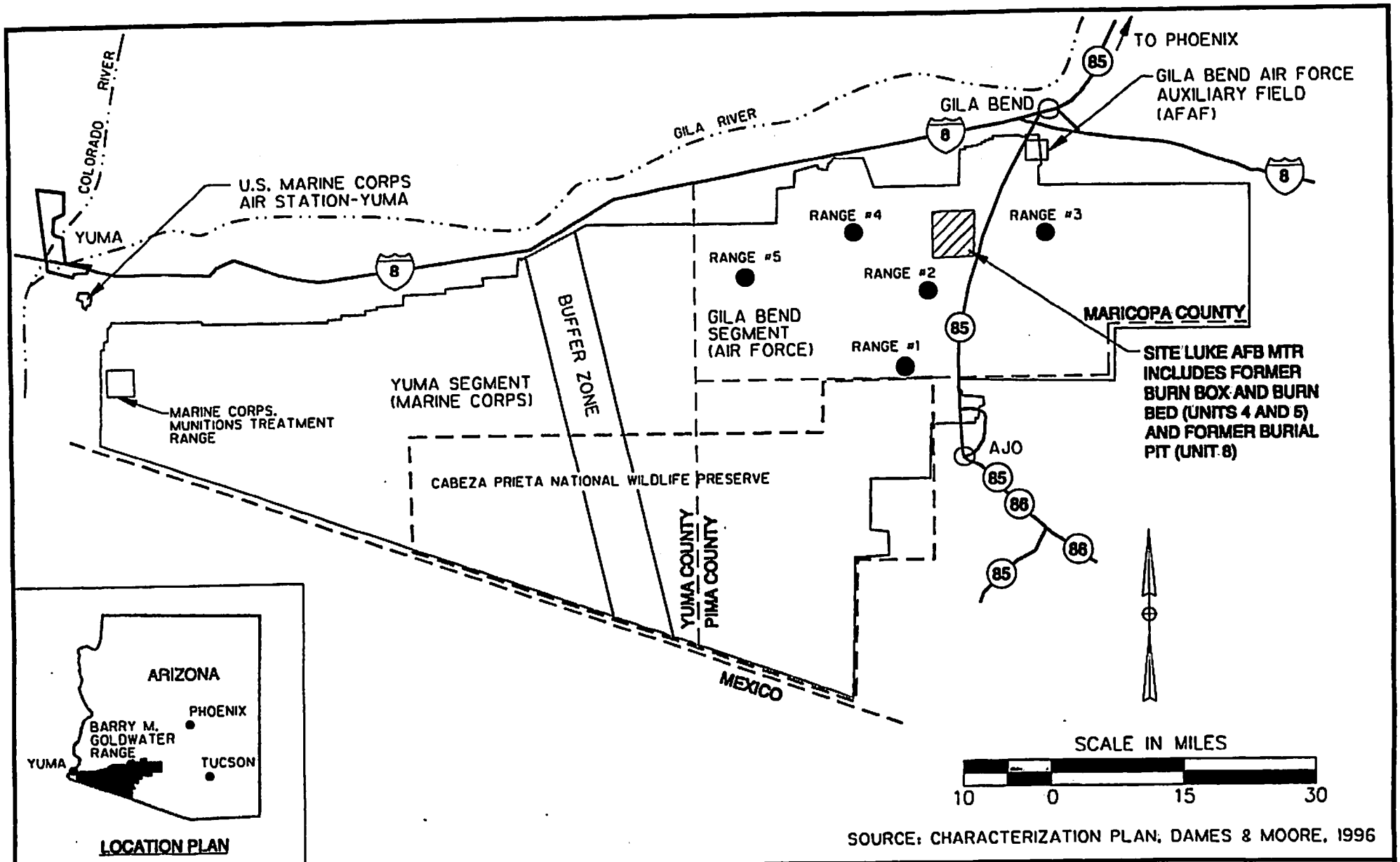
2.1 General Description

The Barry M. Goldwater Range is located in the extreme southwestern corner of Arizona along the United States/Mexico International Border (Figure 2-1) and has been an important facility for training pilots in air-to-ground combat since 1941. The Barry M. Goldwater Range is administered by the Air Education and Training Command of the U. S. Air Force through Luke AFB, and is jointly operated by the U.S. Air Force and U.S. Navy/U.S. Marine Corps under a joint-use agreement dated 1958 and amended in 1965. The Barry M. Goldwater Range extends from Yuma County on the west into Maricopa and Pima counties on the east (Figure 2-1). The Barry M. Goldwater Range is divided into two segments: the eastern two-thirds designated the Gila Bend Segment operated by the U.S. Air Force and the western one-third designated the Yuma Segment operated by the U.S. Navy/U.S. Marine Corps (i.e., U.S. Marine Corps Air Station Yuma [MCAS Yuma]). The Gila Bend Segment occupies over 1.6 million acres with approximately 400 miles of exterior perimeter. It is divided into nine subranges used for specific training purposes. The nine subranges include manned ranges 1 through 4, unmanned target range 5, three tactical ranges (north, east, and south), and an air-to-air tactical range on the western side of the Gila Bend Segment (Figure 2-1).

2.2 MTR Features

The MTR facilities are located on the northeastern portion of the Barry M. Goldwater Range, within Maricopa County, approximately 12 miles south-southwest of the Gila Bend Air Force Auxiliary Field (GBAFAF) and 15 miles southwest of Gila Bend, Arizona (Figure 2-1). The MTR occupies most of Sections 3, 4, and 9, Township 8 South, Range 6 West in the north-central portion of the Gila Bend Segment (Figure 2-2).

The MTR is located in a remote desert environment. It consists of a 5,000-foot radius exclusion zone (Figure 2-2). It is surrounded by undeveloped military range land for a minimum of three miles. The Range 4 access road, which intersects Highway 85 approximately 10 miles south of Gila Bend, Arizona, provides the only improved access to the site (Figures 2-1 and 2-2). A barbed wire fence fronts Highway 85. Signs are posted along this fence prohibiting access to the public. The signs read "WARNING, U.S. Air Force Installation, It is unlawful to enter this area without permission of the Installation Commander." Passage to the MTR from Highway 85 is gained through a locked gate at the intersection of Highway 85 and the Range 4 access road. Within the Barry M. Goldwater Range, a barbed wire fence and gate on the northeast side of the MTR provides limited security into the MTR.



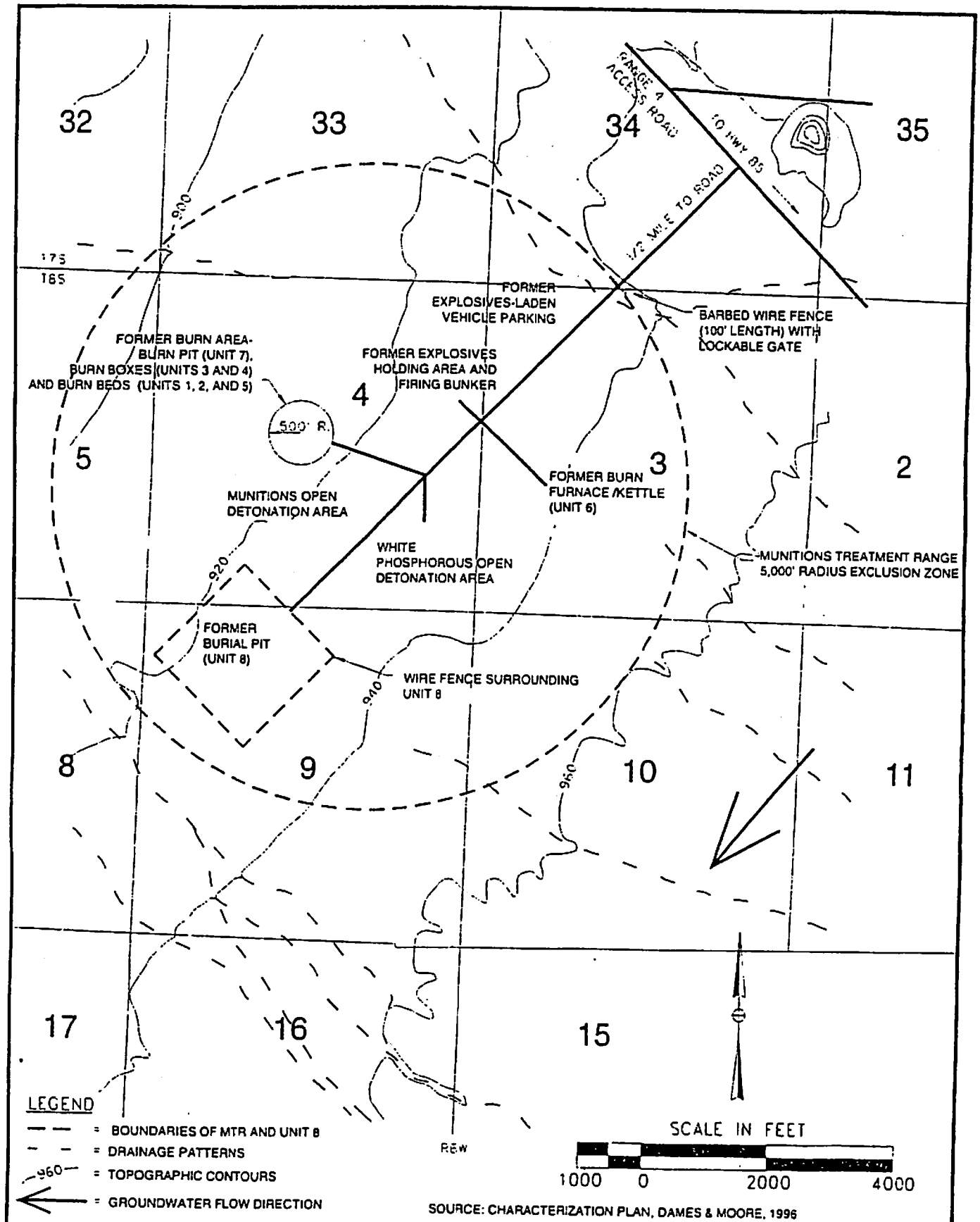
SOURCE: CHARACTERIZATION PLAN, DAMES & MOORE, 1996

AREA LOCATION MAP

CDM FEDERAL PROGRAMS CORPORATION

MUNITIONS BURIAL/TREATMENT RANGE
BARRY M. GOLDWATER RANGE
LUKE AFB, ARIZONA

Figure 2-1



SOURCE: CHARACTERIZATION PLAN, DAMES & MOORE, 1996

CDM FEDERAL PROGRAMS CORPORATION

LUKE AFB MTR FACILITY MAP

MUNITIONS BURIAL/TREATMENT RANGE
BARRY M. GOLDWATER RANGE
LUKE AFB, ARIZONA

Figure 2-2

The barbed wire fence extends 50 feet on both sides of the dirt-surfaced MTR access road.

The MTR consists of two detonation areas, eight former treatment units, and two former staging areas (Figure 2-2). Five of the eight treatment units were closed in 1995 (Dames and Moore, 1996) and the remaining three units were closed in 2000 (CDM 2001). The two former staging areas used for MTR mission support (explosives-laden vehicle parking area and explosives holding area and firing bunker) do not require closure under RCRA. The eight former MTR treatment units include:

- Unit 1, burn bed (closed in 1995 under ADEQ's Consent Order D-210-94);
- Unit 2, burn bed (closed in 1995 under ADEQ's Consent Order D-210-94);
- Unit 3, burn box (closed in 1995 under ADEQ's Consent Order D-210-94);
- Unit 4, burn box (partially closed in 2000 under ADEQ's Consent Order Z-87-98);
- Unit 5, burn bed (partially closed in 2000 under ADEQ's Consent Order Z-87-98);
- Unit 6, burn furnace/kettle (closed in 1995 under ADEQ's Consent Order D-210-94);
- Unit 7, open burn pit (closed in 1995 under ADEQ's Consent Order D-210-94); and
- Unit 8, burial pit (partially closed in 2000 under ADEQ's Consent Order Z-87-98).

A RCRA Facilities Assessment (RFA) is a required component of the RCRA Post-Closure Permit. ADEQ conducted the RFA and completed it in December 2004 (ADEQ 2004). Four Solid Waste Management Units (SWMUs) were identified in the RFA.

- SWMU 1 – Munitions Treatment Range (MTR). As discussed above, this SWMU consists of the eight Units described above, to include Unit 8 which is the subject of this permit.

- SWMU 2 – Auxiliary Air Field #6 (Aux 6). One open burn area and two open detonation areas.

- SWMU 3 – White Phosphorous Detonation Area. This was designated Unit 9 of the above SWMU 1.

- SWMU 4 – Open Detonation Area. This was designated Unit 10 of the above SWMU 1.

A RCRA Facility Investigation (RFI) of SWMUs 2 and 3 was performed by Luke Air Force Base in compliance with Condition VIII.C-3 of the Post-Closure Permit. SWMU 4 is currently used solely for emergency response activities exempt under 40 CFR

265.1(c)(11) and training exercises exempt under 40 CFR 266.202(a)(1)(i). This area will not be investigated until the Barry M. Goldwater Range closes.

During the RFI SWMU 2 was divided into three sub-areas. Sub-Area 1 (SWMU 2-1), Former Munitions Burning Furnace; Sub-Area 2 (SWMU 2-2), Southeast Open Burn/Open Detonation Area; and Sub-Area 3 (SWMU 2-3), Former Northwest Open Burn/Open Detonation Area.

ADEQ acknowledged closure of SWMU 2-2 in a letter dated 23 March 2012. ADEQ acknowledged closure of the white phosphorus detonation area (SWMU 3) in a letter dated December 15, 2009.

Investigation and corrective action for SWMUs 2-1 and 2-3 continue under Final Work Plan, RCRA Corrective Action Facility Investigation Auxiliary Field 6, Solid Waste Management Units 2-1 and 2-3, Luke Air Force Base, Barry M. Goldwater Range-East, ARIZONA (Weston, September 2015). ADEQ approved the work plan in a letter dated 28 September 2015. The final fieldwork effort will begin on 1 January 2017 and end 17 March 2017. Report preparation will take approximately nine months. Therefore, the estimated closure date for these SWMUs is December 2017. The work plan addresses the release of hazardous waste(s), hazardous waste constituents, and hazardous waste decomposition byproducts.

2.3 Former Burial Pit Description (Unit 8)

The former burial pit was located in the southwest portion of the 5,000-foot radius MTR exclusion zone (Figure 2-2). Former features included an open burial pit, approximately 140 feet long by 40 feet wide by 12 feet deep (the overall length included a 30-foot-long entrance ramp that sloped down to the south); a soil stockpile, approximately 70 feet wide by 100 feet long that varied from 4 to 10 feet in height (north to south); and an inferred covered portion of the burial pit (70 feet long by 40 feet wide that existed between the open pit and the stockpile. The former burial pit was operated between 1983 and 1989 (CDM 2001).

During the June 2000 closure activities, it was noted that most of the debris in the former burial pit were covered with soil; however, several inert bombs and numerous inert munitions and treated shell casings were noted in and around the burial pit. There were limited occurrences of live shells, as well as ash and burned soil on the northern wall of the burial pit. The stockpile appeared free of debris and stained soil.

The site soil at the former burial pit is fine-grained sand, and the area around the pit has been graded. Beyond the graded area, vegetation is sparse and consists of native grasses and creosote bushes. Regional topography slopes downward to the northwest according to the United States Geological Survey (USGS) 7.5-minute Black Gap and South of Theba quadrangle maps.

Figure 2-2 provides a topographic map showing Unit 8 and the surrounding MTR. The figure shows the following characteristics, as required by 40 CFR 270.14(19):

- A distance of greater than 1,000 feet is shown around Unit 8.
- The map scale is 1 inch equal to 2,000 feet (a smaller scale of 1 inch to 200 feet, as specified in the regulation, will not provide any additional data or detail to the map, it will only show the Unit 8 area which has no surrounding characteristics other than the burial pit itself and undeveloped open desert range land, restricted from public access and used exclusively for military activity).
- As shown on the figure, no surface waters exist in Unit 8 or within 1,000 feet of Unit 8.
- The land surrounding Unit 8 (within 1,000 feet) is used for the MTR; Unit 8 is fully encompassed within the MTR exclusion zone.
- The boundaries of Unit 8 and the MTR are shown on the map (see legend). In addition, during the closure activities, an as built survey was prepared of the post excavation topographic elevations and the northing and easting coordinates for sampling locations of the pit. This survey is included as Figure 2 in Attachment 1.
- Access control to Unit 8 is provided by a barbed wire fence and locked gate at the MTR entrance northeast of Unit 8 and a chain link fence around Unit 8 which is 72″ high (as shown in figure). In addition, four warning signs are posted around the perimeter stating (in English and Spanish): Danger, Unauthorized Personnel Keep Out. The signs are legible from 25 feet.
- There are no buildings or structures within 1,000 feet of Unit 8. The former MTR units surrounding Unit 8 are shown on the figure.
- Drainage patterns are shown on the map using dashed/dotted lines (see legend).
- An arrow indicating general groundwater flow direction is included on the figure (see legend).

A burrowing animal exclusion fence was added to the security fence in December 2005. This was done in response to a Notice of Violation issued by ADEQ for burrowing animal holes observed in the earthen cover during the 30 November 2004 facility hazardous waste inspection. The fence prevents animals from climbing over it or tunneling under it. Post-Closure care inspections indicate the exclusion fence is effective.

There are no vehicles around the facility.

The 100-year flood plain has not been mapped by the Federal Emergency Management Agency (FEMA) for Unit 8, the MTR, or much of the Barry M. Goldwater Range. Luke

AFB conducted a flood plain study for Unit 8 and determined that Unit 8 is outside the 100-year flood plain (CDM 2004). The flood plain study, certified by an Arizona Professional Engineer, is provided as Attachment 2; Figure 5 of Attachment 2 provides the 100-year flood plain map.

Storm-flow calculations for the EPA-specified 25-year 24-hour storm event indicated that the shoulder of the erosion layer would be overtopped at peak flow, but that the crown of the erosion layer would not be overtopped. As an additional safety factor a band of ungrouted rip-rap was installed along the base of the upstream (north and east) legs of the fence. The band was sloped downward away from the fence.

2.4 Former Munitions Burial/Treatment Range Operations

Munitions stockpiles at various U.S. Air Force installations, including Luke AFB, are subject to inventory turnover. Munitions may become obsolete, outdated, or unserviceable. When relegated to these categories, disposal at the MTR was required. In addition, explosive items from off-range sources were occasionally transported to the Luke AFB or the GBAFAF for treatment and disposal at the MTR. Munitions to be treated were considered solid wastes exhibiting the hazardous characteristic of reactivity (i.e., D003 according to 40 CFR 261.23).

Munitions scheduled for disposal were stored in an underground bunker located on the south end of Luke AFB. All items were carefully inspected and inventoried. Temporary storage could not exceed 10 days. The ordnance was transported from the storage area to the MTR by Explosive Ordnance Disposal (EOD) or Transportation Squadron personnel in a tractor-trailer, using proper placards. All items were manifested and transported to the MTR. Vehicles laden with explosives were temporarily staged in the parking area at the north end of the MTR, until allowed to proceed to one of the clear zones for unloading and treatment.

Treatment and/or disposal operations were not conducted in wet weather or in winds exceeding 15 miles per hour. Under Interim Status, the maximum amount of ordnance allowed to be burned or detonated during one operation was 2,000 pounds net explosive weight (CDM 1993).

The history and operation of the former burial pit is not well documented. However, scrap metal including munitions casings, inert rounds and bombs, and demilitarized ordnance were disposed in this burial pit. In addition, open burns were reportedly conducted inside the burial pit between 1983 and 1989. These burn events were reportedly conducted inside the burial pit without any type of containment vessel. They were sustained with dunnage and diesel fuel. Soil cover was then placed over the remaining ash and debris. Luke AFB and EOD personnel estimated the thickness of waste burial pit ranged from 5 to 15 feet (CDM 2001).

2.5 Summary of Closure Activities

In June 2000, the former burn box and burn bed (Units 4 and 5) were clean closed by removal and decontamination of the remaining metal structures and concrete pad. No residual contaminants exist. In-place closure activities were also completed at the former burial pit (Unit 8), which included the construction of a hazardous waste landfill cap.

The pre-closure investigation consisted of the collection of 97 multi-media samples from the three MTR units, which were analyzed for benzene, toluene, ethylbenzene, xylenes, polycyclic aromatic hydrocarbons, explosives, metals, mercury, nitrate, and cyanide. Selected samples were also analyzed for hazardous characteristics including toxicity characteristic leaching procedure (TCLP) metals and TCLP volatile organic compounds. Surface and subsurface samples were taken from fourteen locations within the burial pit. Surface soil samples were collected to a depth of two feet, while subsurface samples were collected as deep as 30 feet below the ground surface. Subsurface samples were used to evaluate the waste material within the former burial pit, as well as the natural soil underlying the former burial pit. Samples indicated that the ash and debris layer existed randomly throughout the pit at a thickness ranging from less than 2 inches to 10 feet, with an average thickness of 3 to 4 feet.

Based on the results of onsite visual inspection, pre-closure sampling and analysis, closure construction activities, and closure confirmation samples, the partial closure of the burn box, burn bed, and burial pit is considered complete. All pre-closure characterization and closure activities were completed in accordance with ADEQ's Consent Order No. Z 87-98, and Luke AFB's Partial Closure Plan (CDM 1999). All closure activities and confirmation samples demonstrate adequate closure.

The Final Partial Closure Report (CDM 2001) documents the completion of site characterization and closure. There are no uncontrolled threats to human health and the environment associated with the closed former burial pit. Due to the nature of the hazardous waste landfill cap installed at Unit 8, foreseeable potential releases and potential pathways for human exposure are extremely remote.

2.6 Chronological History of the MTR

The history of regulated munitions treatment by Luke AFB on the Barry M. Goldwater Range encompassed approximately 20 years. A summary of the significant historical events follows:

1980	Luke AFB and MCAS Yuma jointly filed for interim status hazardous waste treatment operations on the Barry M. Goldwater Range with the submittal of the RCRA Part A Permit Application. Current Part A Permit Application is included as Attachment 4.

1983	Initiated use of burial pit (Unit 8).
1986	Terminated use of burial pit (Unit 8).
1988	Submitted RCRA Part B Permit Application.
1993	Initiated thermal treatment using burn box and burn bed (Units 4 and 5). Submitted revised RCRA Part B Permit Application.
1995	Closed RCRA thermal treatment Units 1, 2, 3, 6, and 7 at the MTR under ADEQ's Consent Order No. D-210-94.
1996	Terminated thermal treatment using burn box and burn bed (Units 4 and 5).
Aug 1998	Signed ADEQ Consent Order No. Z-87-98 for the closure of burial pit (Unit 8). Submitted revised RCRA Part B Permit Application.
Aug 1999	Submitted Partial Closure Plan to close burn box, burn bed, and burial pit (Units 4, 5, and 8).
Nov 1999	Received ADEQ approval of the Partial Closure Plan.
Jun 2000	Implemented clean closure of burn box and burn bed (Units 4 and 5), and in-place closure of burial pit (Unit 8) in accordance with the Partial Closure Plan.
Aug 2000	Submitted Pre-Final Partial Closure Report documenting the partial closure activities.
Jun 2001	Submitted Final Partial Closure Report
Apr 2005	Submitted Part B Post-Closure Permit Application
Jun 2006	ADEQ issues Part B Post-Closure Permit

The MTR closure is considered "partial" because though RCRA operations are no longer performed, emergency response activities exempt under 40 CFR 265.1(c)(11) and training exercises exempt under 40 CFR 266.202(a)(1)(i) may be conducted at the site.

Section 3
Hydrogeologic Characterization and Monitoring Requirements

3.1 Environmental Setting

3.1.1 Climate

The local climate is arid, characterized by mild winters and hot summers. Mean monthly temperatures range from 56 degrees Fahrenheit (°F) in January to 95°F in July. Annual precipitation is three to four inches based on a 30-year average. Precipitation typically occurs from July to mid-September. Only traces of precipitation occur from December through March (CDM 2001).

Winds are typically out of the north and northwest during the fall, winter, and spring. Strong winds from the west are likely during the spring. Wind patterns change during the summer and typically occur from the south and southeast. Winds are normally light to moderate (0 to 16 miles per hour), and evapotranspiration rates in the area exceed 50 inches annually (CDM 2001). Wind roses for the Luke AFB are provided in Figures 3-1, 3-2, and 3-3, including one wind rose for each month, an annual wind rose, and a wind rose for each of the seasons (spring, summer, fall, and winter) (LAFB 1999).

3.1.2 Flora and Fauna

Much of the area surrounding the MTR units is relatively flat and undeveloped. The flora and fauna of this area are characteristic of valley floors throughout the desert regions of southwest Arizona. The flora native to this arid location consists of creosote brush, mesquite, various bursage, ironwood, paloverde, and cholla cactus. Animals native to the area, although not abundant, include desert cottontails, kangaroo rats, lizards, coyotes, rattlesnakes, scorpions, hawks, quail, and owls (CDM 2001).

3.1.3 Flood Plain Standard

A Flood Insurance Study for the Barry M. Goldwater Range has not been performed by the FEMA and consequently a Flood Insurance Rate Map (FIRM) panel for the precise location of the Luke AFB MTR was never developed or printed by FEMA. Luke AFB conducted a flood plain study for Unit 8 and determined that Unit 8 is outside the 100-year flood plain (CDM 2004). The flood plain study, certified by an Arizona Professional Engineer, is provided as Attachment 2; Figure 5 of Attachment 2 provides the 100-year flood plain map.

Figure 3-1
Wind Roses by Month (January to July)

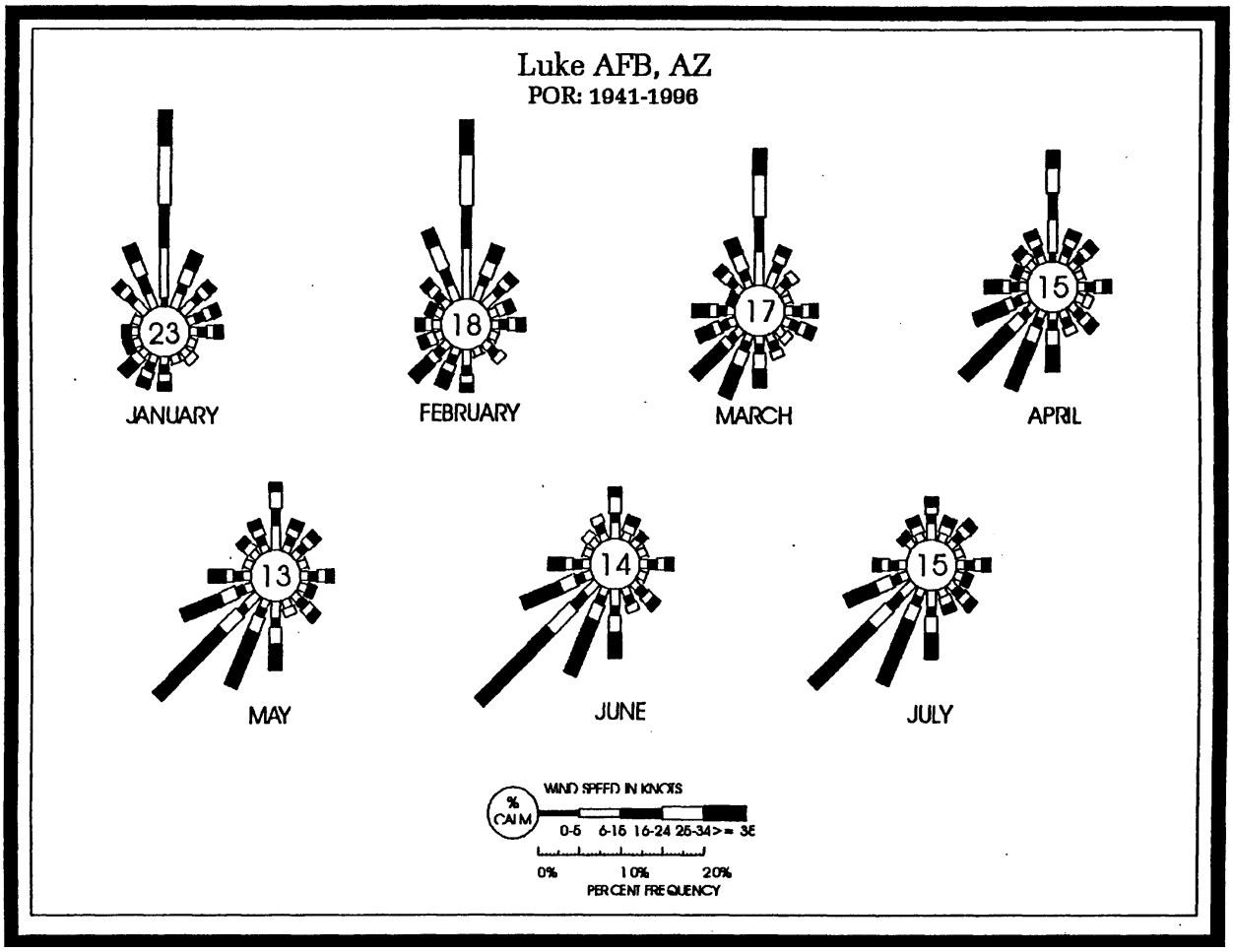


Figure 3-2
Wind Roses by Month (August to December and Annual Mean)

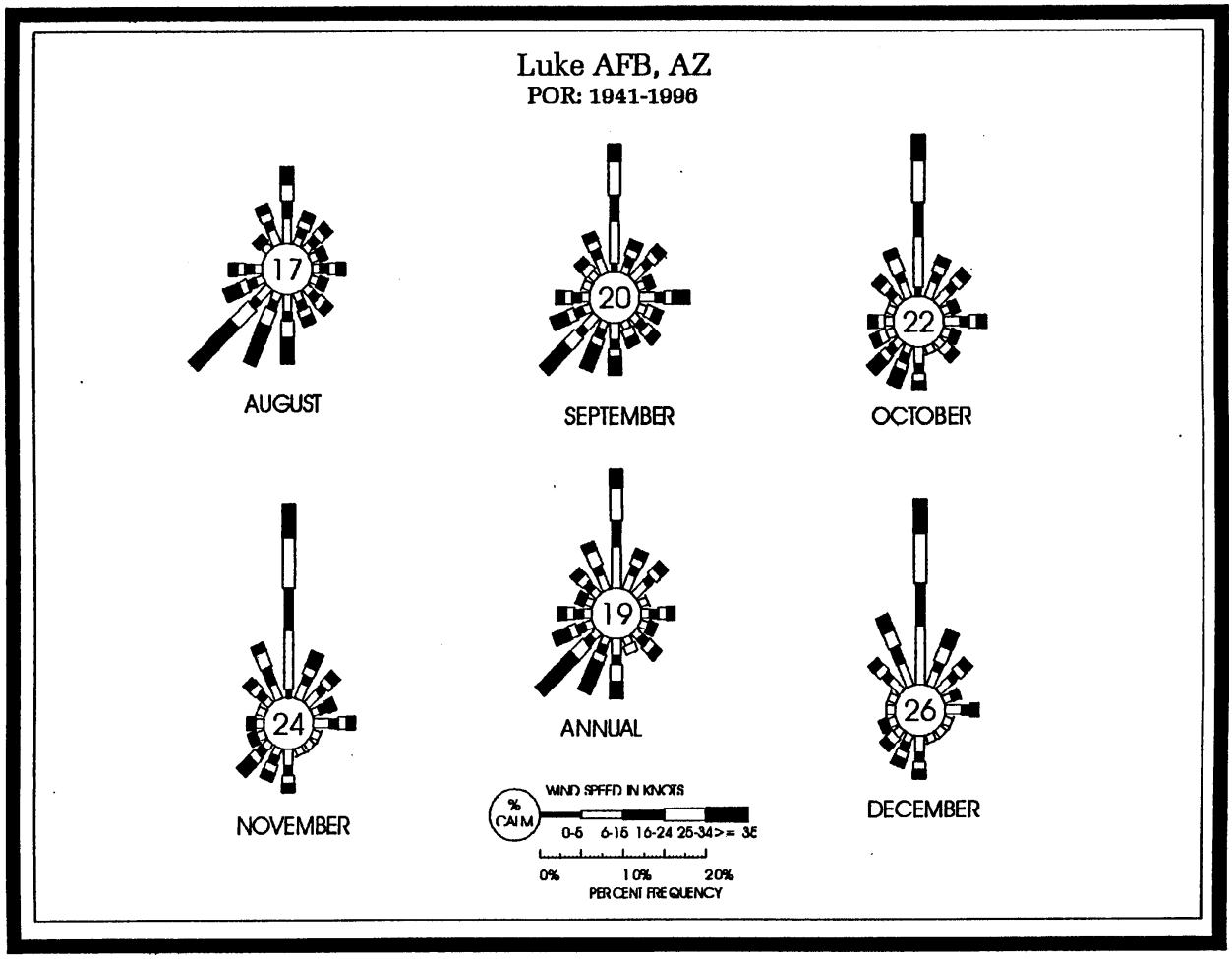
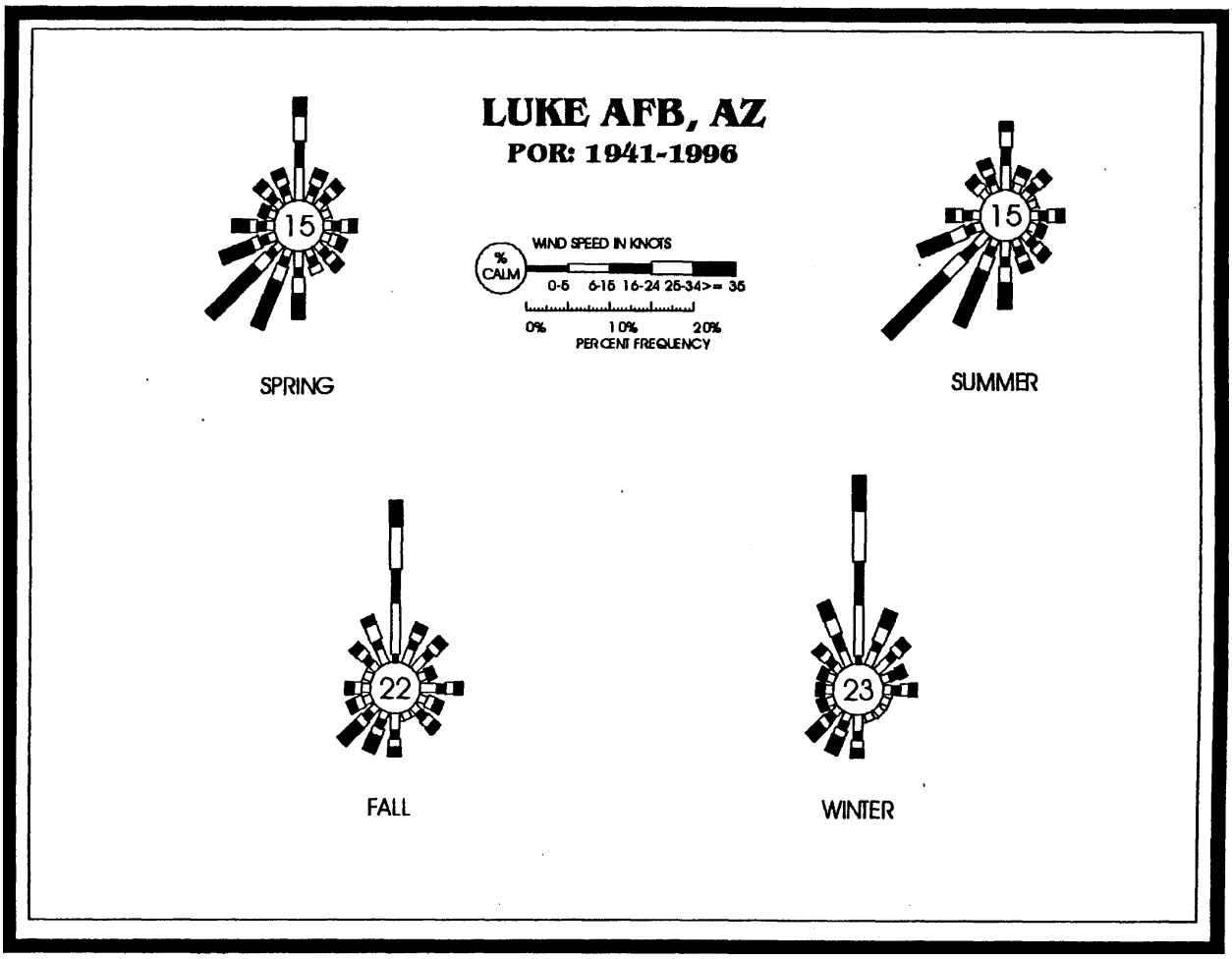


Figure 3-3
Wind Roses (Seasonal)



No arroyos or other surface-water channels were observed around the MTR. Surface water runoff flows to the northwest either as sheet flow or in ephemeral arroyos when sufficient precipitation is present (CDM 2001).

3.1.4 Geology

The Barry M. Goldwater Range is located within the Sonoran Desert section of the Basin and Range physiographic province. The area is characterized by north to northwest trending, basins, and isolated mountain ranges separated by desert plains. The land surface within the basins is relatively flat, with elevations ranging from approximately 200 feet to greater than 1,200 feet above mean sea level (amsl). The basins slope gently downward to the north and west toward the Gila and Colorado Rivers (CDM 1998).

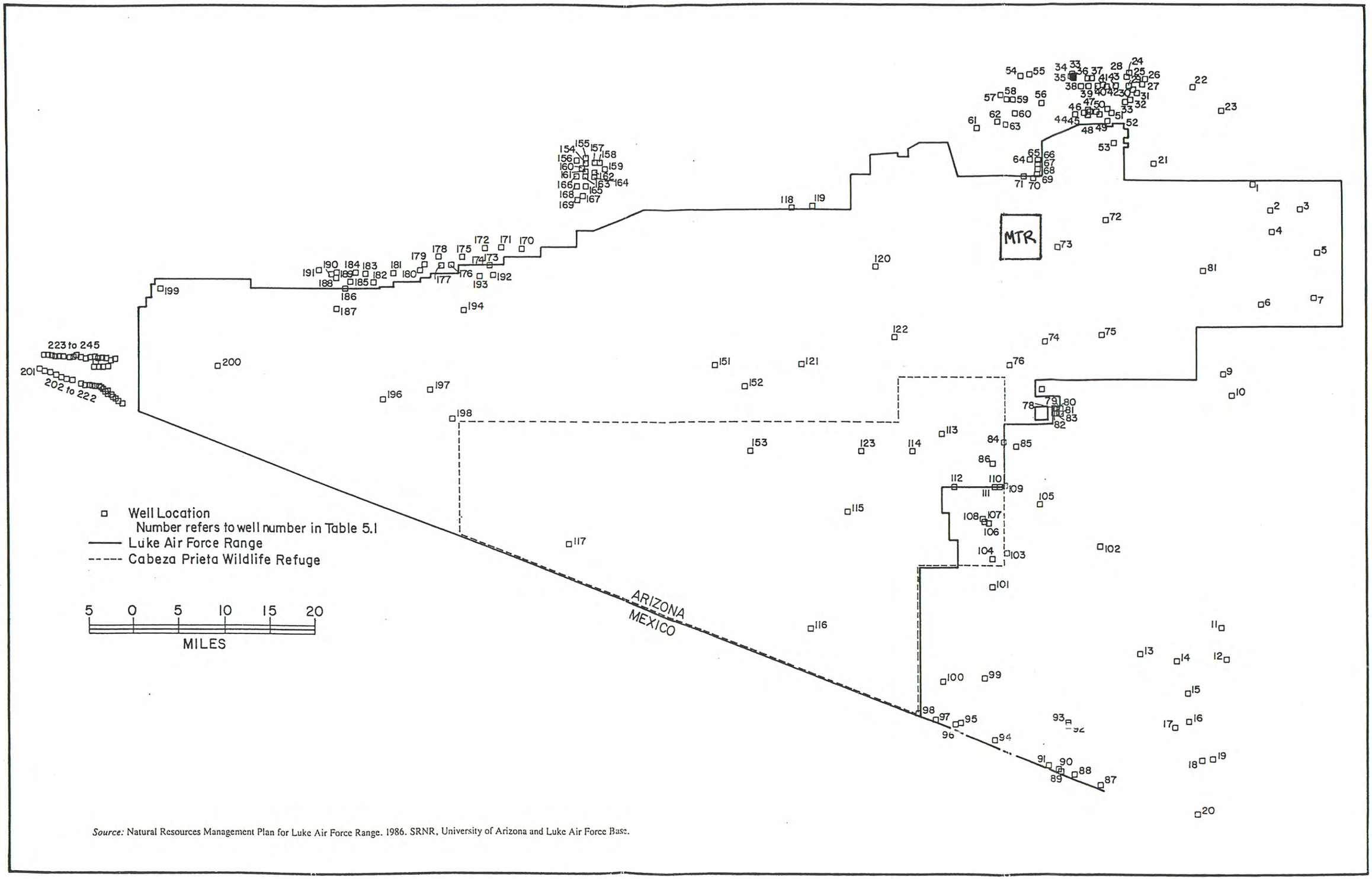
Two types of soils generally occur at the Barry M. Goldwater Range: coarse-grained and fine-grained soils. Coarse-grained soils, consisting of gravel, cobbles, boulders, and sand (primarily) with some silt and little clay, occur on 98 percent (%) of the range, and are typically associated with the basin-fill areas. The fine-grained soil deposits occur on only 2% of the Barry M. Goldwater Range, and consist of clay (primarily) with some silt (CDM 1998).

The Luke AFB MTR is situated in an area of basin fill at an elevation of 800 feet amsl. Eroded from the surrounding mountains, this fill has been reported to depths of several thousand feet. Soil at the site consists primarily of fine-grained silty sand, but gravel, cobbles and boulders are common. There is very little clay in the area. The soil was derived from the uplands that typically consist of granite, granite-gneiss, andesite, basalt, schist, and limestone. Some calcium-carbonate cemented layer occur locally, below the surface, and are evidenced in the side walls of the burial pit. Permeability of the sandy soils is relatively high (i.e., >0.01 centimeters per second [cm/sec] or 0.00002 foot per minute [ft/min]) (CDM 2001).

3.1.5 Regional Hydrogeology

Numerous well locations and natural water catchments are located elsewhere on and near the Barry M. Goldwater Range, which are shown on Figure 3-4 (U of A and LAFB, 1986).

Several groundwater studies have been conducted on surrounding perimeter areas of the Barry M. Goldwater Range, however, no studies include the MTR area. The major water-bearing units in the perimeter areas are found above and below thick lacustrine clay layers. The largest and deepest basins are Lechuguilla and Mohawk-Tule in the western portion of the Barry M. Goldwater Range, and San Cristobal in the central portion. Studies done of the Lechuguilla Desert and Mohawk-Tule Valley indicate a surficial, unconfined aquifer at depths ranging from 125 feet below land surface (bls) to 366 feet bls. The surficial, unconfined aquifer in the San Cristobal Valley extends from approximately 20 feet bls to approximately 120 feet bls (U of A and LAFB, 1986).



Source: Natural Resources Management Plan for Luke Air Force Range. 1986. SRNR, University of Arizona and Luke Air Force Base.

Figure 3-4
Water Well Locations

Figure 3-4
Water Well Locations

Near the northern boundary of the Barry M. Goldwater Range, water was found in a well near the Gila River at a depth of 184 feet bls. The well probably was drawing water from an aquifer in the upper stratigraphic unit hydrologically connected to the aquifer underlying the Gila River corridor. Along the northwestern flank of the Copper Mountains, water was found at a considerable deeper depth of 482 feet. This water may have come from the deeper gravelly portions of the lacustrine deposits (U of A and LAFB, 1986).

3.1.6 Local Hydrogeology

Groundwater data collected by the Department of Water Resources indicates that local groundwater is approximately 300 to 325 feet bls. Groundwater occurs in the unconsolidated alluvial sediment and flows southward (Figure 3-5), primarily under unconfined conditions. Groundwater recharge likely occurs through rivers and streams hydraulically connected with the underlying aquifer (e.g. Gila River 15 miles to the north). Limited, if any, recharge is believed to result from precipitation. The low recharge rate and the high discharge rate for southern Arizona yields a net recharge rate of approximately one percent. In general, the groundwater quality is poor, resulting from naturally high concentrations of chloride (500 milligrams per liter [mg/L]), fluoride (4 mg/L), arsenic (0.02 mg/L), and total dissolved solids (1,034 mg/L). The groundwater is not suitable as potable supply without treatment (CDM 2001).

There are no injection or extraction wells within one mile of the MTR; however, several extraction/irrigation wells are located within three miles of the site (CDM 2001).

3.2 Assessment of Potential Groundwater Impacts

Although no groundwater monitoring is currently in-place at the MTR, an intuitive evaluation of the current hydrogeologic conditions existing at the MTR indicate the potential for groundwater impacts to be extremely remote. Annual evapotranspiration exceeds precipitation by a factor of ten, and the depth to groundwater is greater than 300 feet.

Several thermal treatment units were closed by removal and decontamination of the remaining metal structures and concrete pad, and no residual contaminants exist. In-place closure activities were completed at the former burial pit, which included the construction of a hazardous waste landfill cap. The cap was designed with a surficial armor, a moisture barrier, and a drainage layer such that moisture infiltration is negligible and potential erosion of the cap materials is minimized. Further, the closure investigations documented that no minimum Groundwater Protection Levels (GPLs) or TCLP standards were exceeded by any of the waste, surface or subsurface samples taken from within, around, or below the former burial pit.

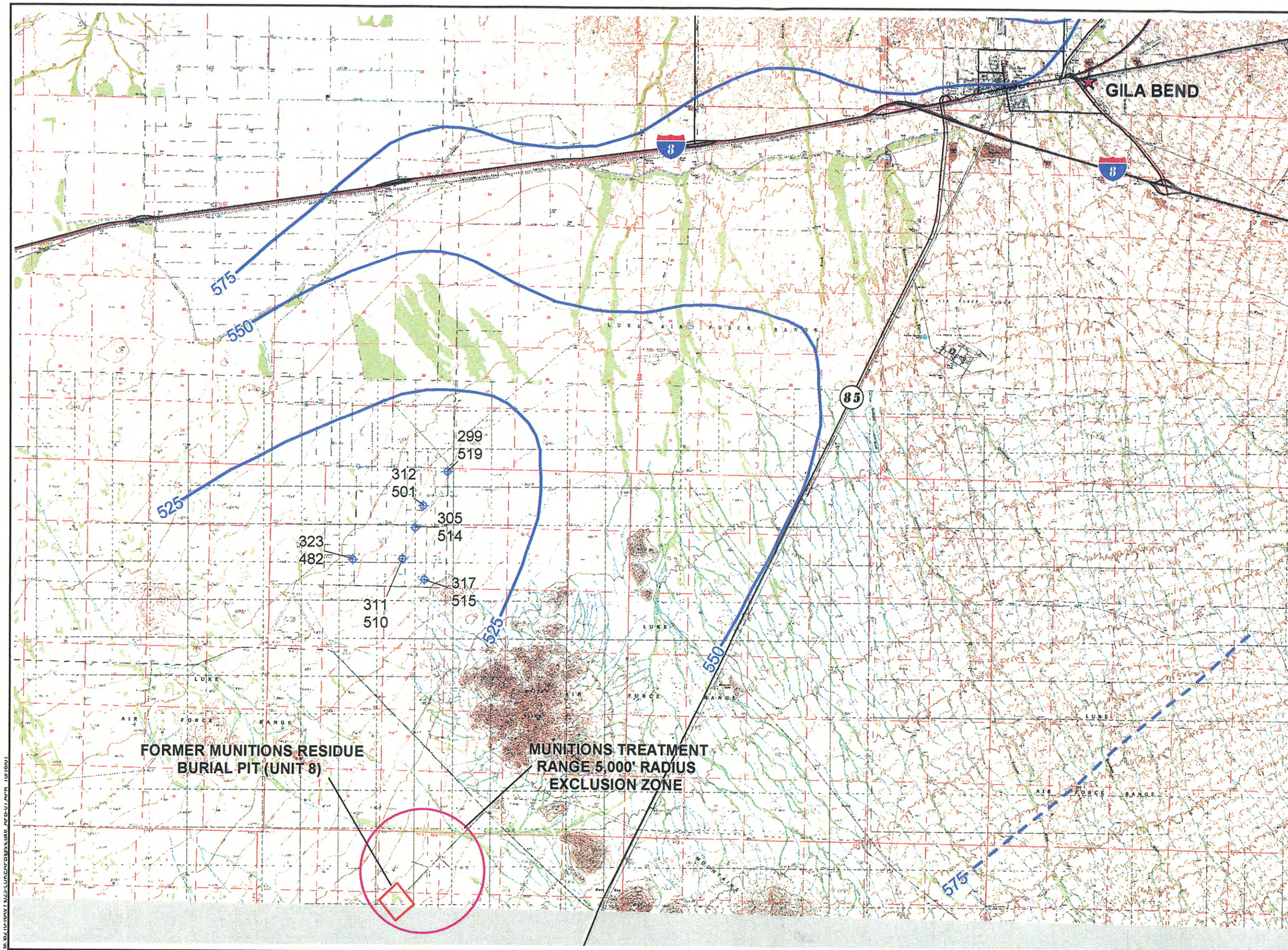
Figure 3-5 is a topographic map of the Luke AFB MTR area that shows upper aquifer groundwater elevation contour lines and indicates groundwater flow direction.

3.3 Groundwater Monitoring Requirements

The potential for groundwater impact is limited. Based on an intuitive demonstration, the migration pathway is considered incomplete and the requirement for groundwater monitoring is not applicable to the site. This is supported by the following:

- Depth to groundwater is greater than 300 feet.
- No minimum GPLs were exceeded during pre-closure investigations, down to 30 feet.
- Annual rainfall is less than 5 inches per year.
- Flood potential is low.
- Evapotranspiration is approximately 50 inches per year.
- The entire waste area has been capped with a RCRA hazardous waste cap (RCRA Subtitle C) consisting of two moisture barriers.

Based on these data, the existence of a complete pathway to groundwater is not likely; therefore, the requirements for groundwater monitoring are not applicable.



LEGEND

- Water Level Elevation Contour* (ft. msl)
- Inferred Water Level Contour*
- Water Level Data Point*
- Munitions Treatment Range Exclusion Zone
- Munitions Residue Burial Pit
- Road

Data Labels

The first line represents groundwater depth and the second line represents groundwater elevation. i.e.

323 = Depth to Groundwater (ft)
482 = Groundwater Elevation (ft. msl)

*Source: D.W.R Hydrologic Map Series Report NO. 29, Sheet 1 of 2, "Depth to Water and Altitude of the Water Level and Chemical Quality of Groundwater, July, 1996

N

4000 0 4000 Feet

Registered Professional Engineer (Civil)
CERTIFICATE NO. 30527
ALAN C. THOMAS
Date Signed 4/13/2016
ARIZONA, U.S.A.
expires 9/30/2017

Figure 3-5

Groundwater Elevation Map

Luke AFB MTR,
Maricopa County, AZ

CDM Federal Programs Corporation

Section 4
Post-Closure Plans

4.1 Length of Post-Closure Period

Post-closure care for the MTR Unit 8 began in January 2002 (certification of closure date) and will continue for 30 years, through the year 2032, per 40 CFR 265.117. Cap inspection will be carried out at the frequency specified in Section 4.2 for a minimum of twenty years, at which time a reevaluation of post-closure care will occur. Early termination of care must be approved in writing by ADEQ.

4.2 Inspection Schedule and Plan

Luke AFB will continue to monitor (visually inspect) the burial pit six times per year, once between January and March, once between April and June, once in July, once in August, once in September, and once between October and December.

A Post-Closure Inspection Form, specifying explicit procedures for monitoring is included as Attachment 3. Monitoring will be performed at the frequency specified above to determine if maintenance is needed. All monitoring events will be documented on the Post-Closure Inspection Form. Necessary actions will be identified on the same form, classified into one of three categories based on the severity of the problem, schedule for remediation, and tracked for progress by Luke AFB environmental personnel. The inspection will assess:

- Access roads for erosion and rutting.
- Perimeter fencing, gates and signage for damage, corrosion, integrity of the locks, digging around the fence base, presence and legibility of signs.
- Final cover for integrity, water and wind erosion, deterioration, burrowing animals in the vicinity of the cap, settlement, ponded water, deep rooting plants, vegetative cover density, and vandalism.
- Drainage structures for obstruction of flow, excessive siltation, erosion, debris and excessive vegetation.
- Debris from training and emergency disposal activity.

Inspection documentation will be maintained in a file at the primary environmental office at Luke AFB for at least ten years from the date of inspection. These records may be requested for review by ADEQ.

4.3 Cap Maintenance Requirements

In order to assure the integrity of the cap, periodic maintenance must be completed. This maintenance includes monitoring of the following:

- Roads and access control
- Security structures (fencing, signs)
- Water and wind erosion of the cap
- Burrowing animals in the vicinity of the cap
- Deep rooting plants in the vicinity of the cap
- Vandalism in the vicinity of the cap

A Post-Closure Inspection Checklist, specifying explicit procedures for monitoring is included in Attachment 3. Monitoring will be performed at the frequency specified in Section 4.2 to determine if maintenance is needed. Necessary actions will be identified on the Post-Closure Inspection Form (Attachment 3), scheduled for remediation, and tracked for progress by Luke AFB Environmental Personnel. Necessary minor maintenance will be carried out within three weeks of the monitoring event. If an imminent hazard (i.e., emergency) is identified or has already occurred, remedial action will be taken immediately.

4.4 Post-Closure Contact

Contact the following person regarding the facility during the post-closure care period:

Position:	Environmental Chief
Organization:	56 CES/CEIE Luke AFB
Address:	13970 Gillespie Drive Luke AFB, AZ 85309-1149
Phone:	(623) 856-3832

4.5 Certification of Completion of Post-Closure Care

No later than 60 days after completion of the established post-closure care period for the facility, Luke AFB will submit to ADEQ by registered mail a certification that the post-closure care period for the hazardous waste disposal unit was performed in accordance with the specifications in the Post-Closure Plan. The certification will be signed by the Permittee and an independent registered professional engineer registered in the State of Arizona. The certification will be submitted with documentation supporting the independent registered professional engineer's certification.

Section 5
Personnel Training

Luke Environmental staff personnel are in charge of the Unit 8 post-closure care and they are required to demonstrate successful completion of health and safety training prescribed by 29 CFR 1910.120. To conduct regular inspections of Unit 8, Luke Environmental personnel must notify EOD prior to all inspections. EOD personnel must accompany Luke Environmental personnel if any intrusive work (e.g., cap repairs) is to be conducted at Unit 8. The following sections describe the training requirements for Luke Environmental personnel.

5.1 Luke Environmental Personnel Training

5.1.1 Health and Safety Training - 29 CFR 1910.120

All Luke Environmental personnel who perform activities at hazardous or potentially hazardous waste sites must participate in health and safety training programs designed to comply with the initial and refresher training requirements of Occupational Safety and Health Act (OSHA) Standard 29 CFR 1910.120. All training will be directed by a person trained in hazardous waste management procedures.

5.1.1.1 Initial 40-Hour Health And Safety Training

OSHA requires that all employees involved with activities at hazardous or potentially hazardous waste sites receive a minimum of 40 hours of off-site instruction prior to assignment. In order to ensure the quality and consistency of this training, training programs are carefully scrutinized as to content and actual field experience of the trainers.

Minimum course requirements include the following:

- Overview - 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response;
- Overview - 29 CFR 1910.1200, Hazard Communication;
- Health Hazard Recognition;
- Physical Hazard Recognition;
- Respiratory Protection - Selection, Use, and Maintenance;
- Personal Protective Equipment - Use and Limitations;
- Temperature Extremes;
- Site Control;

- Medical Surveillance;
- Site-specific Health and Safety Plans - Developments and Uses;
- Air Monitoring Equipment - Uses and Limitations;
- Emergency Plans and Procedures;
- Available Reference Materials;
- Effective Decontamination Procedures;
- Container Handling; and
- Confined Space Entry.

Courses must require the attendees to successfully complete a written examination at course completion.

5.1.1.2 Refresher Training

To supplement the initial training, 8 hours of refresher training is required annually. These sessions are designed to expand on and clarify the initial training. Additional topics may include Accident Prevention, Seasonal Physical hazards, Trenching and Shoring, Lockout/Tagout, Block and Bleed, Hazardous Waste Transportation, and Hazardous Waste Manifests. These sessions are designed to concisely present materials relevant to work being performed. Documentation of these sessions includes the completion a quiz, which covers the materials that have been presented.

5.1.2 Annual RCRA Training

All Luke Environmental personnel who perform activities at the MTR are informed that these operations might generate RCRA hazardous waste and that proper management of any such wastes is required. Annual RCRA training for Luke Environmental personnel is provided at Luke AFB. Detailed training records are maintained at the primary environmental office until the post-closure care period is completed.

5.1.2.1 Training Content, Frequency, and Techniques

The RCRA training program for Luke Environmental personnel is presented by the environmental office at Luke AFB and is performed annually.

An outline of the RCRA training program conducted at Luke AFB follows:

A. Regulatory Overview

1. RCRA - Federal Act
2. 1984 RCRA Amendments
3. Legal Liability
4. Enforcement Program

B. What is Hazardous Waste?

1. Definitions
2. Identification of Hazardous Waste
3. Solid Wastes which are not Hazardous Wastes
4. Listed Waste
5. Characteristic Waste
6. Mixtures

C. Knowing When Hazardous Waste is Generated

1. Identification of Waste
2. Analysis of Hazardous Waste
3. Sampling for Analysis

D. Basic Waste Management

1. General Waste Management
2. Accumulation of Waste Onsite
3. Waste Disposal Options
4. Recordkeeping
5. Waste Analysis Reports
6. The Manifest
7. Waste Log Book

E. Onsite Management

1. General Obligations
2. Storage

F. Shipping Hazardous Waste

1. General Responsibility
2. DOT Hazardous Materials Table
3. Packaging
4. Marking
5. Labeling
6. Placarding
7. The Uniform Hazardous Waste Manifest
8. Generator Transportation

G. Personnel Safety and Protection

1. Hazard Recognition and Evaluation
2. Physical Hazards - Flammability
3. Chemical Hazards
4. Respiratory Protection

Section 6
Procedures to Prevent Hazards

6.1 Property Use Restrictions

Post-closure activities on the former burial pit site must not disturb the integrity of the cap or of monitoring systems unless the EPA Regional Administrator or ADEQ deems a disturbance necessary. Because the property surrounding the MTR consists of fenced, undeveloped military range land for a minimum of three miles, the property is not easily accessible to the public. Therefore, post-closure activities are not expected to impact the integrity of the cap or monitoring systems.

The Barry M. Goldwater Range Comprehensive Range Plan has been updated to provide the type, location, and quantity of hazardous waste disposed of within the MTR Unit 8. A survey plat indicating the location and dimensions of the MTR Unit 8 with respect to a permanently surveyed benchmark is also included. The survey plat is Attachment 1, Figure 2 of this renewal application.

6.2 Security Provisions

The MTR is located in a remote desert environment. Range 4 access road that intersects Highway 85, approximately 10 miles south of Gila Bend, Arizona provides the only improved access to the site. A barbed wire fence fronts Highway 85. Passage to the MTR from Highway 85 is gained through a locked gate at the intersection of Highway 85 and the Range 4 access road. Within the Barry M. Goldwater Range, a barbed wire fence and gate on the northeast side of the MTR provides limited security into the MTR. The barbed wire fence extends 50 feet on both sides of the dirt-surfaced MTR access road. Inside the MTR, a chain link fence surrounds Unit 8 and four warning signs are posted around the perimeter stating (in English and Spanish): Danger, Unauthorized Personnel Keep Out. The signs are legible from 25 feet. Barry M. Goldwater Range Management Personnel periodically patrol the site. These current security provisions are to remain in place.

6.3 Emergency Preparedness

A letter was sent to the GBAFAF Fire Department, Security Forces, Range Operations, Luke AFB EOD, and the Town of Gila Bend Fire Department which familiarized them with the layout of the MTR Unit 8, properties of hazardous waste entombed at the facility and associated hazards, places where the facility personnel would normally be working, entrances to and roads inside the facility, and the evacuation route. The West Valley Hospital was familiarized via letter with the possible types of injuries which could occur. These are support service agencies listed in section 7.6.1.

Section 7
Contingency Plan

7.1 Executive Summary

An area location map and a site facility map area provided in Figures 2-1 and 2-2, respectively.

Open burning and open detonation operations formerly occurred at the MTR operated by Luke AFB. All MTR units were clean-closed except Unit 8 (munitions burial pit) that was closed in-place with a hazardous waste landfill cap. The Closure Report determined that there are no uncontrolled threats to human health and the environment associated with the in-place closure of MTR Unit 8. However, per 40 CFR 265, a contingency plan must be in place for the owner and operators during the post-closure care period to minimize hazards to human health or the environment from fires, explosions, or any unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to air, soil, or surface water. This Contingency Plan does not replace or supersede the Luke AFB Installation Emergency Management Plan. This Contingency Plan supplements the Luke AFB Installation Emergency Management Plan for incidents occurring at or near the MTR Unit 8.

All Air Force installations adhere to the Air Force Incident Management System (AFIMS) concept of emergency response operations. The Installation Emergency Management Plan contains procedures and checklists that implement the AFIMS. The AFIMS uses an approach based on the National Incident Management System and integrates components from the National Planning Framework. The AFIMS ensures effective and efficient integration with local, state, and federal governments in order to respond to, recover from, and mitigate the effects of incidents/emergencies, regardless of cause, size, or complexity. The AFIMS establishes an installation Disaster Response Force (DRF). Elements of the DRF include the Crisis Action Team (CAT), directed by the installation commander, the Emergency Operations Center (EOC), directed by the mission support group commander, squadron Unit Control Centers, Incident Commander (IC), First Responders, and Specialized Teams. The Luke AFB Environmental Element, of which the Emergency Coordinators of this Contingency Plan are assigned, is an Office of Collateral Responsibility within the EOC. The AFIMS is scalable to react appropriately to any given incident. For example, the EOC contains 22 base agencies. For a medium size fuel spill on base the IC may determine that the only resources required are the Fire Department, Security Forces, and Environmental personnel and the IC would coordinate the response. Alternatively, for an aircraft mishap, the entire CAT and EOC would be activated.

This Contingency Plan is dynamic in that it requires maintenance updates as conditions change. It is important to keep this portion of the Post-Closure Permit Application updated. Revisions to the contingency plan are needed should any of the following occur: (1) the facility permit is revised; (2) the plan is inadequate in an emergency; (3) the procedures herein can be improved; (4) the facility operations change in a way that alters the plan; (5) the Emergency Coordinator changes; and/or (6) the emergency equipment list changes. Amendments to this plan can be initiated by any responsible party at Luke AFB and must be processed as Class 1, 2, or 3 permit modifications per 40 CFR 270.42. Changes are proposed to the Environmental Chief, 56 CES/CEIE (at Luke AFB), the office responsible for permit maintenance. Adopted changes will be provided to all record holders of this permit application.

Copies of this Contingency Plan are available at the primary Environmental office located on the Main Base and at the GBAFAF Fire Department. Important information is briefly summarized as follows:

Name:	MTR Unit 8, Barry M. Goldwater Range
Location:	Maricopa County
Owner:	U.S. Air Force
Operator:	56 Fighter Wing, Luke AFB, AZ 85309-1721
EPA ID No.:	AZ 4570024139

Emergency Coordinators - Duty Hours (0600-1630):
Primary: Charles Jefferson Rothrock
Job Title: Environmental Chief
Address: 56 CES/CEIE
13970 Gillespie Drive
Luke AFB, AZ 85309-1149
Work Phone: 623-856-3832
Cell Phone: 480-251-1716

Alternate: Jeffery Schone
Job Title: Air Program Manager
Address: 56 CES/CEIE
13970 Gillespie Drive
Luke AFB, AZ 85309-1149
Work Phone: 623-856-8486
Cell Phone: 623-451-9647

Emergency Coordinators - After Duty Hours (1630-0600):
Luke AFB Command Post (623) 856-5600

Facility Type:	Closed hazardous waste landfill containing munitions treatment debris with the potential for unexploded ordnance. Contains arsenic. Not a manned facility, no personnel onsite. No chemical storage.
Facility Site Plan:	See Figure 2-2
Description of Activities:	Formerly used for open burning and open detonation of waste explosive ordnance. Closed and not accepting waste.

7.2 Emergency Coordinators

The Emergency Coordinators for the MTR Unit 8 serve as technical advisors to the Incident Commander (IC) and/or the Emergency Operations Center (EOC) Director. The Emergency Coordinators will advise the IC/EOC Director on the organization, control, and cleanup efforts at the scene. The IC/EOC Director has full authority to engage any necessary support services for the emergency response. The Emergency Coordinators are thoroughly familiar with all aspects of the facility's Contingency Plan, all operations and activities at the facility, the location and characteristics of waste handled, the location of all records within the facility, and the facility layout.

The Unit 8 burial pit is approximately 75 miles from Luke AFB and approximately 12 miles from GBAFAF. Due to their proximity to the MTR, in the event of an emergency, initial response actions will be made by the GBAFAF Fire Department. The GBAFAF Fire Chief will serve as the IC unless relieved by an IC dispatched from Luke AFB. Luke AFB and GBAFAF maintain a sophisticated communications network that enables emergency response personnel to communicate internally as well as with outside support services. The Unit 8 Emergency Coordinator will be immediately available via voice communication to advise the IC. An Emergency Coordinator will be dispatched to the scene as soon as deemed practicable by the IC or EOC Director.

7.3 Implementation of the Contingency Plan

The Contingency Plan will be implemented in the event of an incident involving Unit 8 that may threaten human health or safety or the environment. A release of hazardous waste is not expected to be a problem from the MTR or Unit 8 because no hazardous waste operations are conducted in the MTR, there is no onsite storage of hazardous waste at the MTR, and Unit 8 (burial pit) is contained within a hazardous waste landfill cap.

Depending on the degree of severity, the following potential emergencies might require implementation of the Contingency Plan:

7.3.1 Wildland Fire

The only flammable material at the MTR Unit 8 is the vegetative cover. Additionally, there are not any ignition sources associated with the facility. Therefore, a wildland fire moving toward the facility is the only reasonable fire scenario. This scenario is further buffeted by the 500 foot radius of cleared vegetation surrounding the MTR Unit 8. The GBAFAF Fire Department would respond and extinguish the fire. If the IC determines the fire is beyond the capabilities of the GBAFAF Fire Department then the Town of Gila Bend Fire Department would respond, and potentially the Luke AFB Fire Department. The Emergency Coordinator would be dispatched from Luke AFB.

7.3.2 Aircraft Mishap

The Luke AFB EOC is activated for any aircraft mishap. The primary and alternate Emergency Coordinators for this plan are members of the EOC, and therefore would immediately recognize that this Contingency Plan would need to be implemented for an aircraft incident on or near the MTR Unit 8. The GBAFAF Fire Department would respond and extinguish any fire. The GBAFAF security forces would provide security for the area. The EOC Director, based on input from the IC and EOC, would dispatch select EOC follow-on functions such as Explosive Ordnance Disposal, Bioenvironmental, and Emergency Coordinator.

7.3.3 Explosion

The GBAFAF Fire Department would respond to extinguish any fire. Explosive Ordnance Disposal personnel would be dispatched to investigate and safe the area. The Emergency Coordinator would be dispatched from Luke AFB.

7.3.4 Material Spill

The GBAFAF Fire Department would respond and the Emergency Coordinator would be dispatched from Luke AFB.

In the event of a spill of solid wastes, the following procedures will be followed as closely as possible, depending on the situation:

- Safety precautions for handling potentially explosive waste
- Appropriate PPE will be worn.
- Non-sparking equipment will be used.
- Waste will be placed only in approved containers.
- Open flame and heat-producing devices will be kept away from explosive waste/scrap.

In the event of a fuel spill, the following procedures will be followed as closely as possible, depending on the situation:

- All unnecessary personnel will be removed from the area.
- All ignition sources will be removed from the affected area.
- Appropriate PPE will be worn.
- If possible, without compromising safety, personnel may attempt to stop the leak at its source.
- Leaking fuel will be contained by the best means available for the situation. On a hard surface, absorbent materials such as vermiculite will be used to contain and clean up a spill. On soil, shovels will be used to construct a dike around the spill to contain lateral movement.
- All containment and cleanup materials will be placed in drums for disposal.

7.3.5 Severe weather condition

Following a severe weather condition in the vicinity of MTR Unit 8 the Emergency Coordinator would perform an inspection of the facility. If immediate support was required to safe the facility the Emergency Coordinator would implement the Contingency Plan. Explosive Ordnance Disposal personnel would investigate and safe the facility.

7.3.6 Animal, snake, or insect bite

If someone is suspected of being bitten by a poisonous animal, snake, or insect 911 will be called to dispatch an ambulance from the GBAFAF Fire Department.

7.4 Emergency Response Procedures

7.4.1 Notification

Since the MTR Unit 8 is not a manned facility and is an isolated location, notification of an incident requiring implementation of the Contingency Plan would most likely come from an individual in one of the categories listed below that would call 911;

- Luke AFB or Barry M. Goldwater Range personnel working in the vicinity of the facility that would observe an incident
- An Air Force pilot flying overhead could observe an incident
- Border Patrol personnel that man a checkpoint on State Route 85 just south of the Range 4 road that would observe an incident

- A motorist travelling on State Route 85 in the vicinity of the facility that would observe an incident

In the event of an aircraft mishap, Luke AFB would know internally via aircraft operation channels.

All 911 or other emergency notifications route to the Luke AFB Fire Department Emergency Control Center. The Emergency Coordinators are notified by the automated "AtHoc" system (computer alert, desk phone, personal cell phone) or telephonically by the Emergency Control Center. The Environmental Coordinators respond to either the EOC (if it is activated) or on-scene IC as directed.

Any notification of an emergency incident will be directly received by or routed to the GBAFAF Fire Department. The Fire Chief will initiate response procedures in accordance with the Luke AFB Installation Emergency Management Plan and its support plan, Appendix 3, Hazardous Materials Emergency Planning and Response Plan. The Emergency Coordinator will notify the ADEQ via telephone immediately of activation of the Contingency Plan. This notification will include:

- The name and telephone number of the reporter;
- The name and address of the facility;
- The time and type of incident (for example, release, fire);
- The name and quantity of material(s) involved, to the extent known;
- Media in which release occurred;
- The extent of injuries, if any; and
- The possible hazards to human health, or the environment, outside the facility.

7.4.2 Evacuation Routes

The MTR Unit 8 is not a manned facility. The MTR is only accessible via the Range 4 access road off of AZ Route #85. Access to the Range 4 road is controlled via a locked gate at the intersection with AZ Route #85. Only authorized personnel are allowed past the gate. The MTR is accessed by a dirt road off the Range 4 road. This road is the only way in and out. The only people who have a need to be at the MTR are EOD personnel conducting emergency response detonations and Environmental personnel who regularly inspect the Unit 8 cap along with any contractors needed to perform cap maintenance.

In the event of an emergency situation requiring evacuation of the MTR, all personnel will immediately leave the area via the dirt road to the Range 4 access road. At the intersection of the MTR dirt road and the Range 4 access road, all personnel will be accounted for and complete evacuation will be accomplished by driving east on the Range 4 access road and then north on AZ Route #85 to GBAFAF.

7.4.3 Containment and Control

Containment and control will be accomplished in accordance with the Luke AFB Installation Emergency Management Plan and its Appendix 3, Hazardous Materials Emergency Planning and Response Plan. The GBAFAF Fire Chief will initially serve as the IC. The IC is responsible for the following measures:

- Recommend to the EOC Director whether the EOC should be activated or not.
- Coordinate response resources through the EOC or Luke AFB Fire Department Emergency Control Center if the EOC is not activated. Contact and confer with the MTR Unit 8 Emergency Coordinator.
- Extinguish any fire.
- Assess the identity of the hazardous materials released, the severity of the spill, the quantity released, the cause of the spill, and the source of the discharge.
- Establish and isolate perimeter and hazard control zones.
- Implement appropriate actions to stop the release, if the discharge continuous.
- Implement appropriate actions to contain the spill and prevent released materials from leaving the site.

7.4.4 Emergency Coordinator Measures

The Emergency Coordinator for the MTR Unit 8 serves as technical advisor to the IC and/or the EOC Director. The Emergency Coordinator will advise the IC/EOC Director on the organization, control, and cleanup efforts at the scene. Depending on the situation, the Emergency Coordinator will:

- Advise on of the contents of the hazardous waste landfill that comprises Unit 8.
- Advise on the unexploded ordnance (UXO) hazards inherent with the MTR (formerly used for open burning and open detonation of waste explosive ordnance) and advise if EOD personnel will be needed for the response. Brief responding EOD personnel on the UXO hazards inherent with Unit 8.
- Advise on the construction of the Unit 8 cap and how to mitigate disturbance to the cap during a response.
- Advise on any cleanup efforts relating to a release of hazardous waste from Unit 8.

- Direct initial and final cleanup actions in coordination with the Base Civil Engineer and Environmental office.

7.4.5 Follow-up Actions

Following containment and control of the emergency, the Emergency Coordinator, in conjunction with the Base Civil Engineer and Environmental, will coordinate and oversee all initial and final cleanup and remediation activities. An emergency response/remediation contractor may be called upon, as needed. ADEQ will be provided an opportunity to review and approve cleanup work plans. The specific activities are as follows:

- Start actions to collect, store, treat, and dispose of waste, contaminated soil, contaminated runoff, contaminated surface water, or any other contaminated materials, as appropriate. This will be a joint effort involving Explosive Ordnance Disposal, fire, safety, and environmental personnel.

- Ensure that Explosive Ordnance Disposal, fire, and safety personnel investigate the cause of the emergency and provide a technical report to the Installation Commander within 72 hours.

- Ensure that proper restoration actions are started as soon possible after appropriate explosive decontamination procedures have been completed. This will be a joint operation between safety and civil engineering personnel. All decontamination actions will be documented and the records maintained permanently at Luke AFB Explosive Ordnance, safety, and real estate offices. The appropriate decontamination procedures will remove any remaining residue in accordance with the cleanup requirements. This procedure will include sampling and analysis to demonstrate the adequacy of cleanup.

- Ensure that equipment repaired or replaced as a result of the incident is re-certified, as necessary, prior to being placed.

7.5 Emergency Equipment

The MTR Unit 8 is not a manned facility and no emergency equipment is available at the site. Initial responders will be dispatched from GBAFAF. The GBAFAF Fire Department maintains the following, regularly inspected, emergency equipment that would be used to respond to an incident at the MTR Unit 8.

- Command Vehicle – description: 2016 Dodge 1500 4x4 pick-up truck

  Capability - support vehicle for command and control

- Rapid Intervention Vehicle (RIV) – description: 2011 Pierce RIV P-34

Capability – this is the first response apparatus when an aircraft crashes. The unit features ultra-high pressure firefighting technology that uses two-thirds less water and foam than a traditional fire engine. The water droplets are smaller than normal and are delivered at a higher velocity, which has a greater effect on compartment-type fires. When combined with aqueous film forming foam, this technology provides quick extinguishment and offers greater foam covering when applied to hydrocarbon-type fires.

Delivers 90 gals/min @ 1350 psi

Stores 400 gallons of water

Stores 56 gallons of foam

Carries 2 personnel

- Fire Engine – description: 2016 Rosenbauer Engine P-22

  Capability – these are the workhorse of the fire service. Most are outfitted to be first or second apparatus to a structure fire. Fire engines, or pumpers, carry personnel, hoses, tools, and water. There are a variety of hoses for attack and supply. Hoses will put out different amounts of water depending on the hose length, diameter, and the amount of pressure in the pump. The deluge gun is a water cannon used to put a lot of water on a large fire.

  Delivers 1250 gals/min @150 psi

  Stores 500 gallons of water

  Stores 60 gallons of foam

  Carries 4 personnel

- Tender – description: 2013 KME Tender P-26

  Capability – The primary purpose of a tender (tanker) is to carry large amounts of water to the fire scene. It delivers its water rapidly, then refills to keep the water supply consistent. It can also supply the fire engine with water.

  Delivers 1250 gals/min @150 psi

  Stores 4000 gallons of water

  Carries 2 personnel

- Wildland Fire Engine – description: 2014 KME Engine 4x4 P-24

  Capability – similar to the fire engine but it is designed for fighting wildland fires so it has improved hill climbing and rough terrain capability.

  Delivers 1250 gals/min @150 psi

  Stores 500 gallons of water

  Stores 50 gallons of foam

Carries 4 personnel

- Ambulance – description: 2002 Ford F-350 4x4

  Capability – transports up to two. Meets Arizona Department of Health Services requirements. Manned with state certified EMT and Paramedics.

Additional emergency response equipment is available at Luke AFB and will be dispatched on orders from the OSC or EOC Director.

7.6 Coordination Agreements

Emergency support services may be received from the groups listed below. GBAFAF maintains a mutual aid agreement with the city of Gila Bend Fire Department. A copy of this Contingency Plan has been provided to each agency listed under Support Services.

7.6.1 Support Services

- Fire Department, GBAFAF.
- Fire Department, Gila Bend.
- Fire Department, Luke AFB.
- Hospital, West Valley Medical Center.
- Range Management, GBAFAF.
- EOD Control, Luke AFB.
- Security, GBAFAF.
- Arizona Department of Public Safety.
- Other agencies as deemed necessary by the Emergency Coordinator.

7.6.2 Method Of Contact

The IC or EOC Director will make the determination of what support services will be required to respond to an incident at the MTR Unit 8. The support service will be contacted by the IC via radio or telephone. If the EOC is activated, the IC will request the support service thru the EOC Director and the EOC Fire Department representative will contact the support service via radio or telephone. The GBAFAF Range Operations Office will broadcast a notification of an emergency at the MTR Unit 8 to all personnel on the Barry M. Goldwater Range via radio. All government personnel and contractors on the range are required to carry a radio and monitor transmissions.

7.7 Required Reports

The Emergency Coordinator will complete the Spill Reporting Log Sheet during the response as information is obtained. If there has been any release to the environment the ADEQ will be notified immediately by calling the ADEQ Spill Hotline at #602-771-2330. Additionally, the National Response Center will be immediately notified by calling #800-424-8802. Air Force channels are immediately notified via the Spill Incident Reporting Information System web application at:

https://www.my.af.mil/accgeoprod7/easi/ea/ea-default.aspx.

The completed Spill Reporting Log Sheet will be maintained at the Luke AFB Environmental office.

Any implementation of the Contingency Plan will be noted in the operating record with the time, date, and details. ADEQ's RCRA Permits Section will be immediately notified at (602) 771-4165. Within 15 days after the incident a written report will be submitted to the ADEQ Hazardous Waste Unit. The report will include those items noted in A.C.C. R18-8-264.A (40 CFR 264.56(i)).

Section 8
Other Federal Laws

The Luke AFB MTR former burial pit is not subject to the requirements of any other applicable Federal Laws.

Section 9
Financial Assurance

A certificate of financial assurance will be required upon decommissioning of the base. A cost estimate for post-closure care and financial assurance for post-closure care are not required because the former burial pit is located on a military base, per ADEQ's memo dated 30 March 1999.

Section 10
Part B Certification Sheet

I certify under penalty of law that this document and all attachments [or identified portions thereof] have been read and understood by persons working under my direction or supervision and that the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for knowingly submitting false information, including the possibility of fines and imprisonment for knowing violations.

22 JAN 16

SCOTT L. PLEUS
Brigadier General, USAF
Commander, 56th Fighter Wing

Date

Section 11
References

CDM Federal Programs Corporation. 1998. *Resource Conservation and Recovery Act (RCRA) Part B Permit Application 1998 Update for Barry M. Goldwater Air Force Range, Arizona*. August.

———. 1999. *Final Partial Closure Plan; Munitions Burial/Treatment Range Units 4 and 5 (Burn Box and Burn Bed) and Unit 8 (Burial Pit) Barry M. Goldwater Air Force Range, Luke Air Force Base, Arizona.* August.

———. 2001. *Final Partial Closure Report; Munitions Burial/Treatment Range Units 4 and 5 (Burn Box and Burn Bed) and Unit 8 (Burial Pit) Barry M. Goldwater Air Force Range, Luke Air Force Base, Arizona.* June.

———. 2004. *100-Year Flood Plain Mapping, Munitions Treatment Range Unit 8 (Burial Pit), Barry M. Goldwater Range, Luke Air Force Base, Arizona.* October.

Dames and Moore. 1996. *Partial Closure Report Burn Pit, Burn Beds, Burn Box, and Burn Kettle Closure Air Force Munitions Treatment Range Barry M. Goldwater Range.* November.

State of Arizona Department of Water Resources (Arizona DWR). 1996. *Hydrologic Map Series Report No. 29*. July.

United States Air Force. 1999. *Luke Air Force Base Terminal Forecast Reference Notebook & Local Area Forecast Plan*. <http://www.luke.af.mil/weather/Data/Papers/TFRN/index.asp> *Chapter Four: Statistical Climatology*. October.

United States Air Force. 2013. *Luke AFB Installation Emergency Response Plan*.

United States Air Force. 2006. *Stormwater Management Plan, Hazardous Waste Landfill Cap, Munitions Treatment Range(MTR), Unit 8, Barry M. Goldwater Range, Arizona.* March

United States General Services Administration (GSA). 1998. *Restrictive Covenants on Non-excess Property. Memorandum for Regional Directors.* From John Q. Martin, Director, Redeployment Services Division. 16 October.

University of Arizona and Luke Air Force Base (U of A and LAFB). 1986. *Natural Resources Management Plan for Luke Air Force Range.*

Weston Solutions. 2006. *Construction Completion Report, Construct Burrowing Animal Exclusion Fence, Munitions Treatment Range, Unit 8, Luke Air Force Base, Arizona.* January

Attachment 1

Details of the Unit 8 Cap

Details of the Unit 8 Cap

Information presented in this attachment was compiled from the following documents:

- CDM Federal Programs Corporation (CDM). 2001. *Final Partial Closure Report, Munitions Burial/Treatment Range Units 4 and 5 (Burn Box and Burn Bed) and Unit 8 (Burial Pit), Barry M. Goldwater Air Force Rand, Luke Air Force Base, Arizona*. 29 June.
- CDM Federal Programs Corporation (CDM). 1999. *Final Partial Closure Plan for Munitions Burial/Treatment Range Units 4 and 5 (Burn Box) and Unit 8 (Burial Pit), Barry M. Goldwater Air Force Range, Luke Air Force Base, Arizona.* 16 August.
- Geofon, Inc (Geofon). 2000. *Field Activities Report, RCRA Partial Closure Construction Activities at Units 4, 5, and 8, Barry M. Goldwater Range, Gila Bend, Luke Air Force Base, Arizona.* 4 August.
- United States Environmental Protection Agency (EPA). 1990. *Seminars - Design and Construction of RCRA/CERCLA Final Covers.* July-August.
- United States Environmental Protection Agency (EPA). 1989a. *Requirements for Hazardous Waste Landfill Design, Construction, and Closure.* August.
- United States Environmental Protection Agency (EPA). 1989b. *Final Covers on Hazardous Waste Landfills and Surface Impoundments.* July.

Unit 8 Cap Construction

A RCRA-compliant hazardous waste landfill cap was constructed at the 240 feet long by 40 feet wide MTR Unit 8 (burial pit), as required by ADEQ. A Final Partial Closure Plan (CDM 1999) and a schematic cap design were submitted to and approved by ADEQ prior to cap construction.

In lieu of a detailed design, the RCRA hazardous waste cap was constructed according to EPA guidance and an Arizona Professional Engineer certified the plan and construction. EPA's design requirements are such that moisture infiltration and wind erosion will be negligible. Luke AFB has provided certification that the Unit 8 cover meets EPA's stringent design requirements.

The cap consisted from top to bottom of:

- A top layer of two components:
    1) a gravel surface component (minimum thickness of 2 inches) with native vegetation to minimize erosion, and
    2) a compacted soil component with a minimum thickness of 2 feet, the surface of which slopes 3 percent;

- A geocomposite drainage layer; and
- A geosynthetic clay liner (GCL) with a 40-mil geomembrane backing to provide a long-term barrier to moisture infiltration into the underlying wastes.

The surface of the burial pit was graded smooth and compacted with a vibratory roller at a depth of 3 feet. To assure that the correct slope (3%) had been achieved, a registered land surveyor checked the elevations. The GCL, a GSE GundSeal® geosynthetic clay liner (provided by FML Liners, Inc. in Huntington Beach, California) was placed on the prepared soil/fill material. The GCL consists of a layer of high quality sodium bentonite adhered to a 40-mil geomembrane backing. The GCL was installed in 17.5-foot-wide sections over the compacted fill material. The seams of the GCL were overlapped a minimum of 12 inches and shingled down in the direction of the slope in accordance with the manufacturer's recommendations. The liner was keyed into the native soil along the edges of the pit by excavating an additional three feet of material along each sidewall prior to placement of the GCL.

Upon completion of the GCL installation, a FabriCap® geocomposite drainage layer provided by FML Liners, Inc., was installed on top of the GCL (at a depth of 3 feet). The FabriCap® geocomposite layer consists of a HyperNet® capping composite with interwoven polypropylene geotextile fabric heat-bonded to one side. The geotextile serves as a filter to prevent the geonet from clogging, while the geonet provides a path for any liquids that may migrate through two feet of compacted overburden to be transmitted to natural soil three feet away from burial pit wastes. The geocomposite layer was installed in the direction of the flow and positioned by hand to minimize wrinkles. The seams along the length of the geocomposite layer were overlapped two to three inches and the seams along the width were overlap a minimum of 12 inches in accordance with the manufacturer's recommendations. The geonet core along the seams were tied together with plastic fasteners spaced every 5 feet along the length and every 12 inches along the width. The geotextile layers of the sections were then joined by heat bonding.

Soil from the existing stockpile was then moisture conditioned, mixed and placed over the entire burial pit area in six- to eight-inch lifts until a thickness of 2 feet was achieved. The soil was compacted to a minimum of 95 percent of ASTM D 1557 maximum dry density.

The surface component of the hazardous waste landfill cap was graded to slope at least three percent away from the centerline. The total dimensions of the hazardous waste landfill cover were approximately 240 feet long by 44 feet wide (Figure 1). All extra soil remaining at the site after construction of the cap was graded so that water will flow away from the covered burial pit. Final grade elevations are provided in Figure 2.

Wind erosion was considered a critical factor in maintaining the soil cover system. To minimize the effects of wind erosion, a 2-inch thick layer of 1-inch diameter gravel was placed on the surface of the cover in accordance with the approved Final Partial Closure Plan (CDM 1999). Native vegetation seed was also spread over the graded area. The seed mix design was provided by the Gila Bend Range Management Office biologists. One initial watering event was performed in accordance with the seed supplier's recommendations prior to demobilization from the site.

EPA Cap Requirements

The table below compares the EPA guidance requirements for each layer to the construction details of the Unit 8 cap layers, demonstrating that the Unit 8 cap meets all EPA cap requirements.

EPA Guidance (EPA 1989a, 1989b)	**Unit 8 Cap (CDM 1999, 2001 and Geofon 2000)**
Vegetative Cover	
Thickness ≥ 2 feet	Thickness = 2 feet and 2 inches (gravel surface component with thickness of 2 inches and compacted soil component with thickness of 2 feet)
Minimal erosion and maintenance Vegetative growth not to extend below 2 feet	Gravel surface component included native (shallow-rooting) vegetation (including brittlebush and needle grama grass) to minimize erosion
Final top slope between 3 and 5% after settlement or subsidence.	The surface of the compacted soil component was graded to slope at least 3% away from the centerline (slope checked by registered land surveyor)
Surface drainage system capable of conducting run-off across cap without rills and gullies	All extra soil remaining on site after construction of the cap was graded so that water will flow away from the covered burial pit.

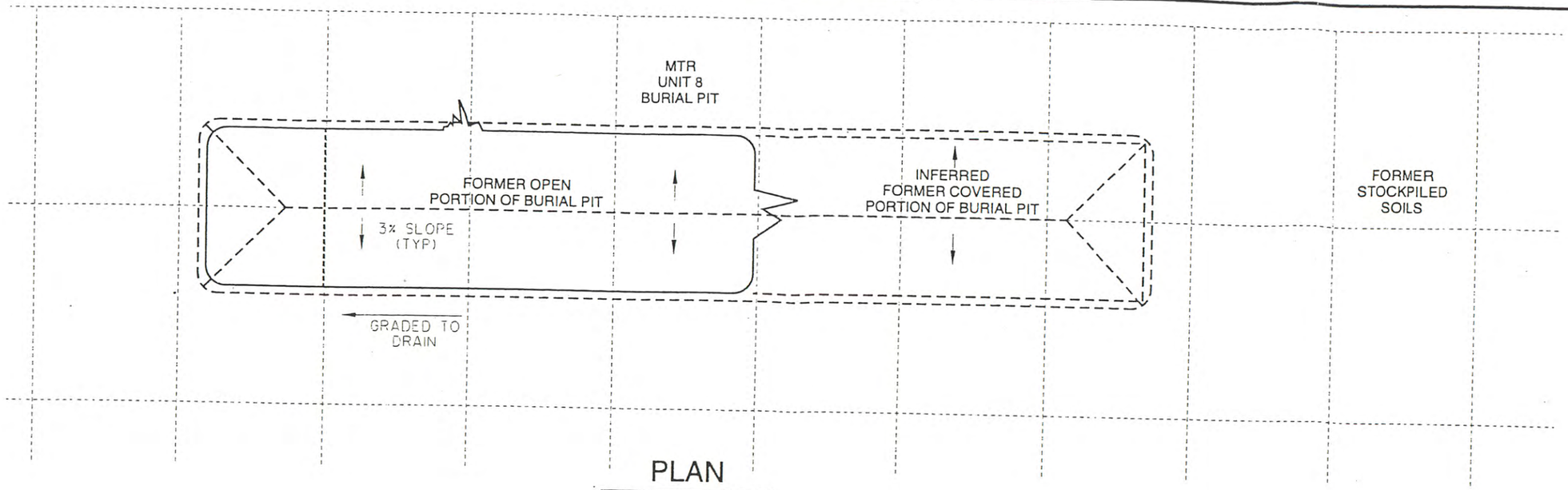
EPA Guidance (EPA 1989a, 1989b)	Unit 8 Cap (CDM 1999, 2001 and Geofon 2000)
Drainage Layer Design	
Thickness ≥ 1 foot	In lieu of 1 foot of natural drainage materials, a 200 mil FabriCap® geocomposite drainage layer (FML Liners, Inc.) was used
Minimum hydraulic transmissivity of 5×10^{-4} m^2/sec	Hydraulic transmissivity = 9.0×10^{-3} m^2/sec
Bottom slope ≥ 2% (after settlement/subsidence)	Bottom slope = 3% (place on top of GCL). Soil/fill material beneath GCL and drainage layer were moisture conditioned and compacted to minimize settlement.
Overlain by graded granular or synthetic filter to prevent clogging Allow lateral flow and discharge of liquids	The FabriCap® geocomposite drainage layer consists of a HyperNet® capping composite with interwoven polypropylene geotextile fabric heat-bonded to one side. The geotextile serves as a filter to prevent the geonet from clogging, while the geonet provides a path for the liquids. Further, the geonet (at a 3% slope) extended 3 feet away from the pit waste on all sides
Low Permeability Liner Design (FML Component)	
Thickness ≥ 20 mil	GSE GundSeal® geosynthetic clay liner (GCL) (from FML Liners, Inc., Huntington Beach, CA) consisting of a layer of high quality sodium bentonite adhered to a 40-mil geomembrane backing.
Final upper slope ≥ 2% (after settlement)	Final upper slope = 3% slope (checked by land surveyor after compaction). The underlying soil/fill was moisture conditioned and compacted, and further settlement is not anticipated.
Located wholly below the average depth of frost penetration in the area	Not applicable for Barry M. Goldwater Range, Arizona. Further, the GCL and geocomposite drainage layer are two feet below grade, which is adequate frost protection for many southern states.

Maintenance Needs for the Cap

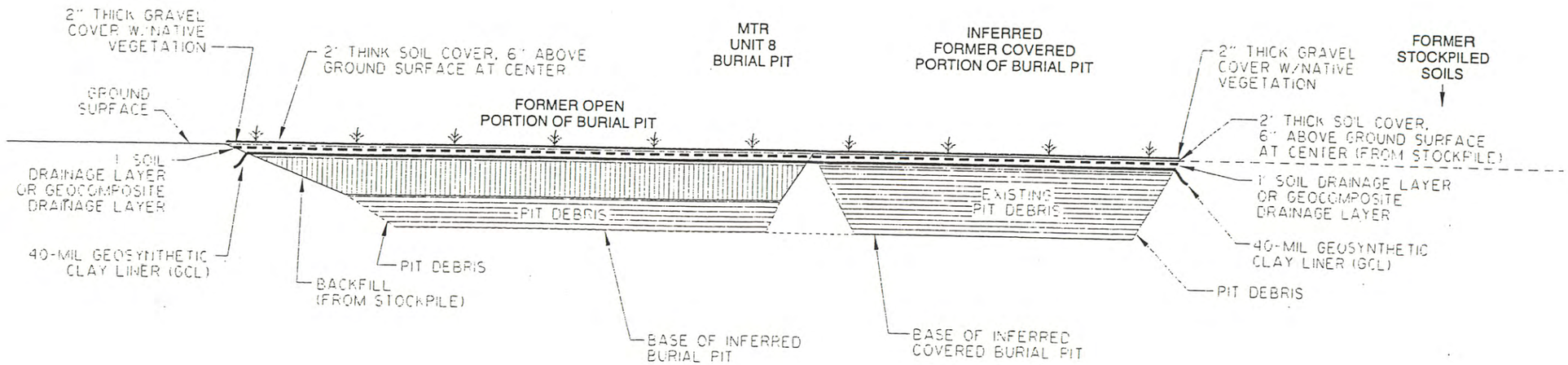
Maintenance needs for the cap will be identified as necessary with the findings of scheduled monitoring events. Inspection of the vegetative cover and integrity of the cap are components of the monitoring event. If a problem is identified during an inspection, e.g., the need for mowing, fertilization, removal of deep-rooting plants, replacement of cap soils, etc., corrective action must be taken. Please see the Post-Closure Inspection Checklist and Form included Attachment 3.

Settlement and Subsidence

No geotechnical testing was conducted to evaluate potential consolidation. However, the burial pit was open and exposed to rainfall prior to capping. Silty sand soils within the pit were typically medium moist (not saturated) and thin ash and debris layers were found between 3 and 15 feet. Debris throughout the pit was typically metal. Based on these subsurface conditions, measurable consolidation is not anticipated. Dewatering and biological decay of the material is also not anticipated. Further, the waste surface was compacted with a vibratory roller and nuclear density testing of the compaction was conducted in accordance with the ASTM standard. Proctor testing was conducted completed and documented during construction of the cap. Finally, long-term routine monitoring will be conducted and settlement, although not anticipated, will be monitored.



PLAN



CROSS-SECTION

NOT TO SCALE

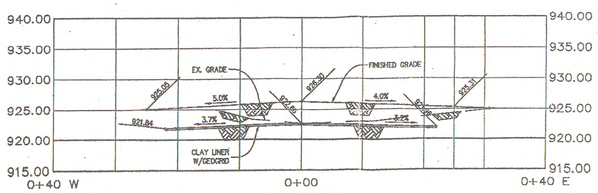
CDM
FEDERAL PROGRAMS CORPORATION

DATE JUNE 2002
FIG. 18
MODIFIED BY JSPOWN
PROJECT NO. 6219-018

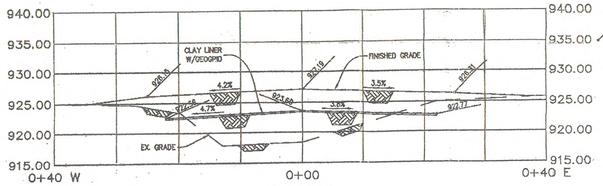
SCHEMATIC
RCRA CAP

Luke AFB MTR Unit 8
BARRY M. GOLDWATER RANGE, ARIZONA

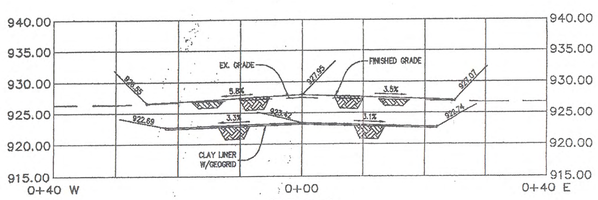
Figure 1



SECTION C–C
SCALE: 1"=10'



SECTION B–B
SCALE: 1"=10'



SECTION A–A
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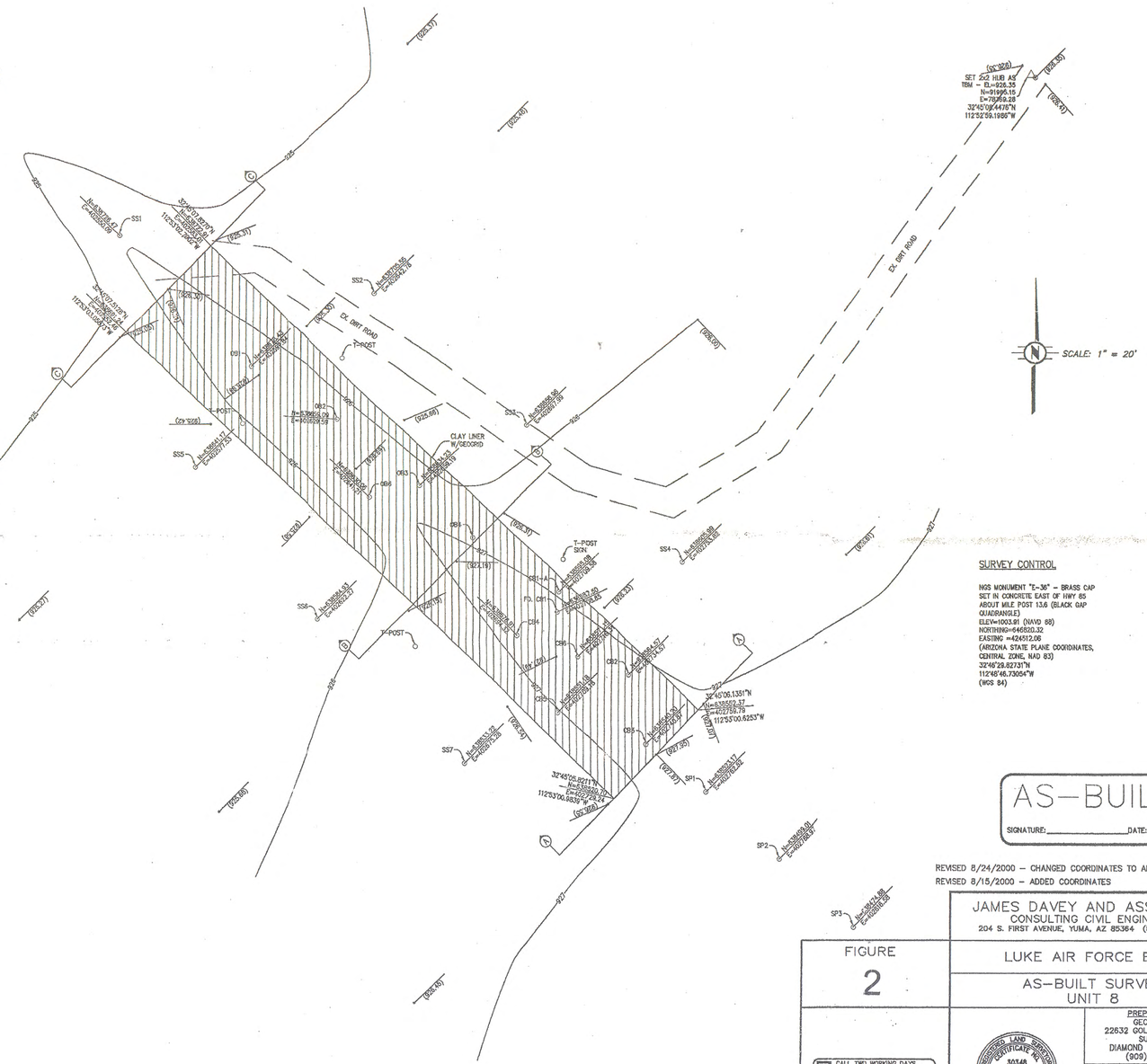

SURVEY CONTROL

NGS MONUMENT "E-36" – BRASS CAP
SET IN CONCRETE EAST OF HWY 85
ABOUT MILE POST 13.6 (BLACK GAP
QUADRANGLE)
ELEV=1003.81 (NAVD 88)
NORTHING=646820.32
EASTING =424512.06
(ARIZONA STATE PLANE COORDINATES,
CENTRAL ZONE, NAD 83)
32°46'29.82731"N
112°45'46.73054"W
(WGS 84)

AS–BUILT

SIGNATURE:_____ DATE:_____

REVISED 8/24/2000 – CHANGED COORDINATES TO ARIZONA STATE PLANE
REVISED 8/15/2000 – ADDED COORDINATES

JAMES DAVEY AND ASSOCIATES
CONSULTING CIVIL ENGINEERS
204 S. FIRST AVENUE, YUMA, AZ 85364 (520) 782-7926

FIGURE
2

LUKE AIR FORCE BASE

AS–BUILT SURVEY
UNIT 8

CALL TWO WORKING DAYS BEFORE YOU DIG
263-1100
1-800-STAKE-IT
(OUTSIDE MARICOPA COUNTY)

PROJECT: GEO–SV1

REGISTERED LAND SURVEYOR
CERTIFICATE NO.
30148
JAMES V. DAVEY
Date Signed
ARIZONA, U.S.A.

PREPARED FOR:
GEOFON, INC.
22632 GOLDEN SPRINGS DR
SUITE 270
DIAMOND BAR, CA 91765
(909) 396-7662

SURVEYED BY: JD/KH/BF
DRAWN BY: TINO/JVZ
APPROVED BY: JVD
SHEET 1
MAY 5, 2000

Memorandum

Prepared by: *Mohamed Abdel-Latif, P.E.*
Michael Oakland, P.E.

Date: *April 14, 2005*

Subject: *Slope Stability and HELP Model Assessment*
Unit 8 (Burial Pit) Landfill Closure Cap
Luke Air Force Base, Arizona

This memorandum summarizes an assessment of the slope stability and anticipated infiltration for the Resource Conservation and Recovery Act (RCRA) Subtitle C-compliant cap used to cover and permanently close Munitions Treatment Range (MTR) Unit 8 (Burial Pit). The purpose of this memorandum is to address the following omissions identified by the Arizona Department of Environmental Quality (ADEQ) in the August 2003 Draft Final Post-Closure Permit Application for the Unit 8 (Burial Pit) at Luke Air Force Base's munitions treatment range:

1. Slope stability analysis shall be submitted to ADEQ for review and approval. ADEQ shall approve an exemption from this requirement if an engineering evaluation showing that this analysis is not required is submitted.

2. Hydrologic Evaluation for Landfill Performance (HELP) Model calculations (or equivalent method) for determining leachate leakage through the cover shall be submitted to ADEQ.

Cap Description

The cap is approximately 240 feet (ft) by 40 ft in plan (approximately ¼ acre). The site was graded (raised on the north end and cut on the south end to a uniform dept of two ft below grade surface). The final two feet were completed as a RCRA Subtitle C-compliant cap using onsite stockpiled fine sandy soils and geotextiles (as described below) to a slight crown over the landfill to a slope of at least 3 percent but did not exceed 5 percent. The landfill was crowned in the middle with slopes of about 22 ft on each side. From ground surface downward, the cap consists of the following:

- 2 inches (in) of gravel to prevent wind and water erosion of the cap, seeded with native seed mix, and watered once to stimulate growth.

- 2 ft of cover soil consisting of the fine sand from the on-site stockpile placed in 6 to 8 in lifts and compacted to 95-100 percent of the maximum proctor density, as well as over-excavated three ft beyond the limits of the former burial pit to key the cap and liner into natural soil.

- A geocomposite drainage layer that consists of a prefabricated drainage net sandwiched between two layers of filter fabric.

- A geosynthetic clay liner which consists of a layer of synthetic bentonite clay bonded to a 40 mil HDPE also placed on a compacted base.

Slope Stability

The landfill cap is essentially at grade with nominal slopes ranging from only about 3 to 5 percent (1V:33H to 1V:20H) for a total raise-in-grade of only about 1 ft. Stability of such shallow slopes has very little potential for failure and is usually assessed based on observation rather than attempting to "force fit" slope stability analysis tools which are intended for more critical situations. The following engineering evaluation is submitted in lieu of a slope stability analysis.

Two components of potential failure are usually analyzed; deep seated failure through the waste material and veneer sliding along the layers which form the cap. The Unit 8 cap has no potential for deep seated sliding because the entire fill is essentially below grade. Only the cap itself is above grade. The components of the Unit 8 landfill cap are designed for much steeper grades and most of the interfaces have interface friction components of as much as 28 degrees. The critical interface is at the bottom of the smooth HDPE in the geosynthetic liner. Against the fine grain compacted fill, it would be expected that the interface friction angle would be at least 12 degrees. As a conservative check of stability, the tangent of the interface friction angle is divided by the tangent of the slope. This is the factor of safety for an infinite slope. In this case that would be tan 12/(1/20) or a factor of safety of 4.25 which is well above the 1.5 usually required for static analysis and does not include the effects of buttressing or allowable tension in the liner which would be substantial if mobilized.

Even under seismic loading, it is readily apparent that the landfill cap would be stable. Based on the USGS hazard maps, the ground acceleration related to having only a 10 percent chance of being exceeded in 250 years, which is typically used in landfill design, is about 0.105 g. For a horizontal layer, this adds a load of 10.5 percent to the slope or decreases the factor of safety by this amount which still results in a factor of safety of over 3.5 which is well above what is required even without considering other stabilizing factors.

These calculations confirm what is apparent by observation: the relatively flat, at grade, cap is stable against sliding.

Cap Infiltration

The HELP model was used to assess infiltration through the cap during representative annual rain events during an entire year. Two cases were run, one assuming an average permeability of soil and number of liner defects and a second case assuming conservative values of permeability and higher than normal number of defects.

indicated by the HELP model (model output is attached as a reference to this memorandum), under the average conditions, the average annual percolation through the liner over the entire landfill is about 4.5 cubic feet or about 34 gallons. Using conservative

assumptions, the percolation is only 11.2 cubic feet or 84 gallons. The evaluation indicates that the infiltration is between 0.07 and 0.18 percent of the total rainfall.

It should be noted that some infiltration may occur at the perimeter of the landfill from precipitation around the landfill and runoff from the cap. While it is anticipated that most of this precipitation will move vertically through the soil column, there is some potential that a portion could migrate laterally into the landfill. While it is difficult to assess this volume, it is expected to be relatively small.

Closure

These assessments have been prepared based on information included in the Partial Closure Report for the Munitions Burial/Treatment Range Units 4 and 5 (Burn Box and Burn Bed) and Unit 8 (Burial Pit), Barry M. Goldwater Range, Luke Air Force Base, Arizona (CDM 2001). No other warranty, express or implied, is made. If conditions differ from those assumed, the results of this evaluations should be re-evaluated and confirmed or modified in writing.

If you have any questions or require further information, please do not hesitate to contact us.

Attachment

Help Model Outputs

ATTACHMENT

HELP MODEL OUTPUT 1

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:     C:\HELP\luke\precip.D4
TEMPERATURE DATA FILE:       C:\HELP\luke\temp.D7
SOLAR RADIATION DATA FILE:   C:\HELp\luke\solar.D13
EVAPOTRANSPIRATION DATA:     C:\HELP\luke\evap.D11
SOIL AND DESIGN DATA FILE:   C:\HELP\luke\soil2.D10
OUTPUT DATA FILE:            C:\HELP\luke\out2.OUT


TIME:  18:55     DATE:   4/ 9/2005


******************************************************************************

     TITLE:  Luke Air Force Base, Arizona

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                       TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER  21
          THICKNESS                  =     24.00   INCHES
          POROSITY                   =      0.3970 VOL/VOL
          FIELD CAPACITY             =      0.0320 VOL/VOL
          WILTING POINT              =      0.0130 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.0328 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.300000012000     CM/SEC
```

ATTACHMENT

HELP MODEL OUTPUT 1 (continued)

```
                    LAYER  2
                    --------

            TYPE 2 - LATERAL DRAINAGE LAYER
              MATERIAL TEXTURE NUMBER  34
THICKNESS                    =      2.00    INCHES
POROSITY                     =      0.8500 VOL/VOL
FIELD CAPACITY               =      0.0100 VOL/VOL
WILTING POINT                =      0.0050 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0100 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =   33.0000000000      CM/SEC
SLOPE                        =      3.00    PERCENT
DRAINAGE LENGTH              =     22.0     FEET


                    LAYER  3
                    --------

            TYPE 4 - FLEXIBLE MEMBRANE LINER
              MATERIAL TEXTURE NUMBER  35
THICKNESS                    =      1.00    INCHES
POROSITY                     =      0.0000 VOL/VOL
FIELD CAPACITY               =      0.0000 VOL/VOL
WILTING POINT                =      0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT   =      0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.    =  0.199999996000E-12 CM/SEC
FML PINHOLE DENSITY          =      0.50    HOLES/ACRE
FML INSTALLATION DEFECTS     =      1.00    HOLES/ACRE
FML PLACEMENT QUALITY        =  3 - GOOD


          GENERAL DESIGN AND EVAPORATIVE ZONE DATA
          ----------------------------------------

NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
         SOIL DATA BASE USING SOIL TEXTURE #21 WITH A
         POOR STAND OF GRASS, A SURFACE SLOPE OF  3.%
         AND A SLOPE LENGTH OF   22. FEET.

SCS RUNOFF CURVE NUMBER              =     66.90
FRACTION OF AREA ALLOWING RUNOFF     =    100.0     PERCENT
AREA PROJECTED ON HORIZONTAL PLANE   =      0.223   ACRES
EVAPORATIVE ZONE DEPTH               =     18.0     INCHES
INITIAL WATER IN EVAPORATIVE ZONE    =      0.463   INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE   =      7.146   INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE   =      0.234   INCHES
INITIAL SNOW WATER                   =      0.000   INCHES
INITIAL WATER IN LAYER MATERIALS     =      0.806   INCHES
TOTAL INITIAL WATER                  =      0.806   INCHES
TOTAL SUBSURFACE INFLOW              =      0.00    INCHES/YEAR
```

ATTACHMENT

HELP MODEL OUTPUT 1 (continued)

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
PHOENIX ARIZONA

STATION LATITUDE	=	33.26	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	21	
END OF GROWING SEASON (JULIAN DATE)	=	359	
EVAPORATIVE ZONE DEPTH	=	18.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	6.30	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	45.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	24.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	35.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	44.00	%

NOTE: PRECIPITATION DATA FOR PHOENIX ARIZONA
WAS ENTERED FROM THE DEFAULT DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR PHOENIX ARIZONA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
52.30	56.10	60.60	68.00	77.00	86.50
92.30	89.90	84.60	73.40	60.60	53.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR PHOENIX ARIZONA
AND STATION LATITUDE = 33.26 DEGREES

****

ANNUAL TOTALS FOR YEAR 1974

	INCHES	CU. FEET	PERCENT
PRECIPITATION	8.18	6621.628	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	5.447	4409.044	66.59

ATTACHMENT

HELP MODEL OUTPUT 1 (continued)

DRAINAGE COLLECTED FROM LAYER 2	2.7221	2203.478	33.28
PERC./LEAKAGE THROUGH LAYER 3	0.013772	11.149	0.17
AVG. HEAD ON TOP OF LAYER 3	0.0002		
CHANGE IN WATER STORAGE	-0.003	-2.043	-0.03
SOIL WATER AT START OF YEAR	0.826	669.004	
SOIL WATER AT END OF YEAR	0.824	666.961	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.000	0.00

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ANNUAL TOTALS FOR YEAR 1975

	INCHES	CU. FEET	PERCENT
PRECIPITATION	4.51	3650.800	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	2.934	2374.681	65.05
DRAINAGE COLLECTED FROM LAYER 2	1.4016	1134.597	31.08
PERC./LEAKAGE THROUGH LAYER 3	0.011624	9.410	0.26
AVG. HEAD ON TOP OF LAYER 3	0.0001		
CHANGE IN WATER STORAGE	0.163	132.113	3.62
SOIL WATER AT START OF YEAR	0.824	666.961	
SOIL WATER AT END OF YEAR	0.987	799.074	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.000	0.00

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ATTACHMENT

HELP MODEL OUTPUT 1 (continued)

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ANNUAL TOTALS FOR YEAR 1976

	INCHES	CU. FEET	PERCENT
PRECIPITATION	7.16	5795.950	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	5.045	4083.957	70.46
DRAINAGE COLLECTED FROM LAYER 2	2.3989	1941.915	33.50
PERC./LEAKAGE THROUGH LAYER 3	0.014018	11.348	0.20
AVG. HEAD ON TOP OF LAYER 3	0.0002		
CHANGE IN WATER STORAGE	-0.298	-241.271	-4.16
SOIL WATER AT START OF YEAR	0.987	799.074	
SOIL WATER AT END OF YEAR	0.689	557.803	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.002	0.00

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ANNUAL TOTALS FOR YEAR 1977

	INCHES	CU. FEET	PERCENT
PRECIPITATION	3.96	3205.580	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	1.942	1571.707	49.03
DRAINAGE COLLECTED FROM LAYER 2	1.3914	1126.286	35.14
PERC./LEAKAGE THROUGH LAYER 3	0.011807	9.558	0.30
AVG. HEAD ON TOP OF LAYER 3	0.0001		
CHANGE IN WATER STORAGE	0.615	498.029	15.54

ATTACHMENT

HELP MODEL OUTPUT 1 (continued)

SOIL WATER AT START OF YEAR	0.689	557.803	
SOIL WATER AT END OF YEAR	1.304	1055.832	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.001	0.00

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ANNUAL TOTALS FOR YEAR 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	15.23	12328.535	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	10.442	8452.779	68.56
DRAINAGE COLLECTED FROM LAYER 2	5.0402	4080.025	33.09
PERC./LEAKAGE THROUGH LAYER 3	0.018027	14.592	0.12
AVG. HEAD ON TOP OF LAYER 3	0.0004		
CHANGE IN WATER STORAGE	-0.270	-218.867	-1.78
SOIL WATER AT START OF YEAR	1.304	1055.832	
SOIL WATER AT END OF YEAR	1.034	836.966	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.004	0.00

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ATTACHMENT

HELP MODEL OUTPUT 1 (continued)

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1974 THROUGH 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.79	0.56	1.04	0.27	0.24	0.04
	0.89	0.65	0.82	0.80	0.74	0.95
STD. DEVIATIONS	0.93	0.79	0.93	0.27	0.46	0.05
	0.56	0.79	0.63	0.76	0.89	0.92
RUNOFF						
TOTALS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
STD. DEVIATIONS	0.000	0.000	0.000	0.000	0.000	0.000
	0.000	0.000	0.000	0.000	0.000	0.000
EVAPOTRANSPIRATION						
TOTALS	0.761	0.353	0.732	0.230	0.238	0.026
	0.285	0.544	0.465	0.374	0.654	0.500
STD. DEVIATIONS	0.842	0.555	0.934	0.239	0.437	0.030
	0.285	0.590	0.550	0.566	0.695	0.395
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	0.2741	0.1946	0.2263	0.1151	0.1293	0.0359
	0.0890	0.4585	0.1655	0.1991	0.3629	0.3406
STD. DEVIATIONS	0.1831	0.2587	0.1823	0.0432	0.1903	0.0217
	0.0185	0.4604	0.1381	0.1512	0.2930	0.4464
PERCOLATION/LEAKAGE THROUGH LAYER 3						
TOTALS	0.0015	0.0011	0.0012	0.0010	0.0009	0.0006
	0.0007	0.0017	0.0010	0.0012	0.0016	0.0014
STD. DEVIATIONS	0.0004	0.0006	0.0006	0.0002	0.0006	0.0002
	0.0001	0.0009	0.0003	0.0005	0.0005	0.0008

ATTACHMENT

HELP MODEL OUTPUT 1 (continued)

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	0.0002	0.0002	0.0002	0.0001	0.0001	0.0000
	0.0001	0.0004	0.0002	0.0002	0.0003	0.0003
STD. DEVIATIONS	0.0002	0.0003	0.0002	0.0000	0.0002	0.0000
	0.0000	0.0004	0.0001	0.0001	0.0003	0.0004

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1974 THROUGH 1978

	INCHES		CU. FEET	PERCENT
PRECIPITATION	7.81	(4.509)	6320.5	100.00
RUNOFF	0.000	(0.0000)	0.00	0.000
EVAPOTRANSPIRATION	5.162	(3.2906)	4178.43	66.109
LATERAL DRAINAGE COLLECTED FROM LAYER 2	2.59084	(1.49220)	2097.260	33.18188
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.01385	(0.00258)	11.211	0.17738
AVERAGE HEAD ON TOP OF LAYER 3	0.000	(0.000)		
CHANGE IN WATER STORAGE	0.041	(0.3737)	33.59	0.531

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ATTACHMENT

HELP MODEL OUTPUT 1 (continued)

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                PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978
                ----------------------------------------------------------------
                                                   (INCHES)      (CU. FT.)
                                                   ----------    -------------
      PRECIPITATION                                 1.24          1003.768

      RUNOFF                                        0.000            0.0000

      DRAINAGE COLLECTED FROM LAYER  2              0.42573        344.62097

      PERCOLATION/LEAKAGE THROUGH LAYER  3          0.000401         0.32495

      AVERAGE HEAD ON TOP OF LAYER  3               0.010

      MAXIMUM HEAD ON TOP OF LAYER  3               0.003

      LOCATION OF MAXIMUM HEAD IN LAYER  2
            (DISTANCE FROM DRAIN)                   0.0 FEET

      SNOW WATER                                    0.00             0.0000


      MAXIMUM VEG. SOIL WATER (VOL/VOL)                    0.1063

      MINIMUM VEG. SOIL WATER (VOL/VOL)                    0.0130

         ***  Maximum heads are computed using McEnroe's equations.  ***

              Reference:  Maximum Saturated Depth over Landfill Liner
                          by Bruce M. McEnroe, University of Kansas
                          ASCE Journal of Environmental Engineering
                          Vol. 119, No. 2, March 1993, pp. 262-270.

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ATTACHMENT

HELP MODEL OUTPUT 1 (continued)

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                 FINAL WATER STORAGE AT END OF YEAR 1978
   ---------------------------------------------------------------------
                  LAYER        (INCHES)       (VOL/VOL)
                  -----        --------       ---------
                    1            0.9939         0.0414

                    2            0.0200         0.0100

                    3            0.0000         0.0000

                SNOW WATER       0.000

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ATTACHMENT

HELP MODEL OUTPUT 2

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**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
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PRECIPITATION DATA FILE:     C:\HELP\luke\precip.D4
TEMPERATURE DATA FILE:       C:\HELP\luke\temp.D7
SOLAR RADIATION DATA FILE:   C:\HELp\luke\solar.D13
EVAPOTRANSPIRATION DATA:     C:\HELP\luke\evap.D11
SOIL AND DESIGN DATA FILE:   C:\HELP\luke\soil.D10
OUTPUT DATA FILE:            C:\HELP\luke\out2.OUT


TIME:  18:35     DATE:   4/ 9/2005


******************************************************************************

     TITLE:  Luke Air Force Base, Arizona

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     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                  LAYER  1
                                  --------

                       TYPE 2 - LATERAL DRAINAGE LAYER
                         MATERIAL TEXTURE NUMBER   2
          THICKNESS                  =     24.00   INCHES
          POROSITY                   =      0.4370 VOL/VOL
          FIELD CAPACITY             =      0.0620 VOL/VOL
          WILTING POINT              =      0.0240 VOL/VOL
          INITIAL SOIL WATER CONTENT =      0.0674 VOL/VOL
          EFFECTIVE SAT. HYD. COND.  =  0.579999993000E-02 CM/SEC
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ATTACHMENT

HELP MODEL OUTPUT 2 (continued)

LAYER 2

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 34

THICKNESS	=	8.00	INCHES
POROSITY	=	0.8500	VOL/VOL
FIELD CAPACITY	=	0.0100	VOL/VOL
WILTING POINT	=	0.0050	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0101	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	33.0000000000	CM/SEC
SLOPE	=	3.00	PERCENT
DRAINAGE LENGTH	=	22.0	FEET

LAYER 3

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 35

THICKNESS	=	1.60	INCHES
POROSITY	=	0.0000	VOL/VOL
FIELD CAPACITY	=	0.0000	VOL/VOL
WILTING POINT	=	0.0000	VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000	VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.199999996000E-12	CM/SEC
FML PINHOLE DENSITY	=	0.10	HOLES/ACRE
FML INSTALLATION DEFECTS	=	1.00	HOLES/ACRE
FML PLACEMENT QUALITY	=	3 - GOOD	

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 2 WITH A POOR STAND OF GRASS, A SURFACE SLOPE OF 3.% AND A SLOPE LENGTH OF 22. FEET.

SCS RUNOFF CURVE NUMBER	=	76.60	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	0.223	ACRES
EVAPORATIVE ZONE DEPTH	=	18.0	INCHES
INITIAL WATER IN EVAPORATIVE ZONE	=	0.935	INCHES
UPPER LIMIT OF EVAPORATIVE STORAGE	=	7.866	INCHES
LOWER LIMIT OF EVAPORATIVE STORAGE	=	0.432	INCHES
INITIAL SNOW WATER	=	0.000	INCHES
INITIAL WATER IN LAYER MATERIALS	=	1.697	INCHES
TOTAL INITIAL WATER	=	1.697	INCHES
TOTAL SUBSURFACE INFLOW	=	0.00	INCHES/YEAR

ATTACHMENT

HELP MODEL OUTPUT 2 (continued)

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
PHOENIX ARIZONA

STATION LATITUDE	=	33.26	DEGREES
MAXIMUM LEAF AREA INDEX	=	0.00	
START OF GROWING SEASON (JULIAN DATE)	=	21	
END OF GROWING SEASON (JULIAN DATE)	=	359	
EVAPORATIVE ZONE DEPTH	=	18.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	6.30	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	45.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	24.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	35.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	44.00	%

NOTE: PRECIPITATION DATA FOR PHOENIX ARIZONA
WAS ENTERED FROM THE DEFAULT DATA FILE.

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR PHOENIX ARIZONA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
52.30	56.10	60.60	68.00	77.00	86.50
92.30	89.90	84.60	73.40	60.60	53.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR PHOENIX ARIZONA
AND STATION LATITUDE = 33.26 DEGREES

****

ANNUAL TOTALS FOR YEAR 1974

	INCHES	CU. FEET	PERCENT
PRECIPITATION	8.18	6621.628	100.00
UNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	6.956	5631.105	85.04

ATTACHMENT

HELP MODEL OUTPUT 2 (continued)

DRAINAGE COLLECTED FROM LAYER 2	1.2009	972.093	14.68
PERC./LEAKAGE THROUGH LAYER 3	0.005674	4.593	0.07
AVG. HEAD ON TOP OF LAYER 3	0.0003		
CHANGE IN WATER STORAGE	0.017	13.837	0.21
SOIL WATER AT START OF YEAR	1.777	1438.506	
SOIL WATER AT END OF YEAR	1.794	1452.343	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.000	0.00

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ANNUAL TOTALS FOR YEAR 1975

	INCHES	CU. FEET	PERCENT
PRECIPITATION	4.51	3650.800	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	3.379	2735.327	74.92
DRAINAGE COLLECTED FROM LAYER 2	0.8008	648.222	17.76
PERC./LEAKAGE THROUGH LAYER 3	0.005014	4.059	0.11
AVG. HEAD ON TOP OF LAYER 3	0.0002		
CHANGE IN WATER STORAGE	0.325	263.192	7.21
SOIL WATER AT START OF YEAR	1.794	1452.343	
SOIL WATER AT END OF YEAR	2.119	1715.535	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.001	0.00

ATTACHMENT

HELP MODEL OUTPUT 2 (continued)

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ANNUAL TOTALS FOR YEAR 1976

	INCHES	CU. FEET	PERCENT
PRECIPITATION	7.16	5795.950	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	6.828	5527.365	95.37
DRAINAGE COLLECTED FROM LAYER 2	1.1331	917.226	15.83
PERC./LEAKAGE THROUGH LAYER 3	0.005400	4.371	0.08
AVG. HEAD ON TOP OF LAYER 3	0.0003		
CHANGE IN WATER STORAGE	-0.807	-653.012	-11.27
SOIL WATER AT START OF YEAR	2.119	1715.535	
SOIL WATER AT END OF YEAR	1.313	1062.524	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.000	0.00

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ANNUAL TOTALS FOR YEAR 1977

	INCHES	CU. FEET	PERCENT
PRECIPITATION	3.96	3205.580	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	2.796	2263.527	70.61
DRAINAGE COLLECTED FROM LAYER 2	0.7674	621.195	19.38
PERC./LEAKAGE THROUGH LAYER 3	0.004641	3.757	0.12

ATTACHMENT

HELP MODEL OUTPUT 2 (continued)

AVG. HEAD ON TOP OF LAYER 3	0.0002		
CHANGE IN WATER STORAGE	0.392	317.102	9.89
SOIL WATER AT START OF YEAR	1.313	1062.524	
SOIL WATER AT END OF YEAR	1.704	1379.625	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.000	0.00

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ANNUAL TOTALS FOR YEAR 1978

	INCHES	CU. FEET	PERCENT
PRECIPITATION	15.23	12328.535	100.00
RUNOFF	0.000	0.000	0.00
EVAPOTRANSPIRATION	11.729	9494.867	77.02
DRAINAGE COLLECTED FROM LAYER 2	2.1061	1704.882	13.83
PERC./LEAKAGE THROUGH LAYER 3	0.007317	5.923	0.05
AVG. HEAD ON TOP OF LAYER 3	0.0006		
CHANGE IN WATER STORAGE	1.387	1122.863	9.11
SOIL WATER AT START OF YEAR	1.704	1379.625	
SOIL WATER AT END OF YEAR	3.091	2502.489	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.001	0.00

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ATTACHMENT

HELP MODEL OUTPUT 2 (continued)

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1974 THROUGH 1978

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	0.79 0.89	0.56 0.65	1.04 0.82	0.27 0.80	0.24 0.74	0.04 0.95
STD. DEVIATIONS	0.93 0.56	0.79 0.79	0.93 0.63	0.27 0.76	0.46 0.89	0.05 0.92
RUNOFF						
TOTALS	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
STD. DEVIATIONS	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.000
EVAPOTRANSPIRATION						
TOTALS	0.561 0.234	0.439 0.633	0.816 0.708	0.429 0.601	0.416 0.822	0.120 0.560
STD. DEVIATIONS	0.543 0.160	0.562 0.689	0.975 0.516	0.179 0.502	0.562 0.637	0.078 0.477
LATERAL DRAINAGE COLLECTED FROM LAYER 2						
TOTALS	0.0737 0.0477	0.0741 0.0508	0.1392 0.1543	0.0710 0.1319	0.0753 0.1319	0.0944 0.1573
STD. DEVIATIONS	0.0309 0.0217	0.0421 0.0213	0.1858 0.1334	0.0638 0.0405	0.0326 0.0527	0.1009 0.1152
PERCOLATION/LEAKAGE THROUGH LAYER 3						
TOTALS	0.0004 0.0004	0.0004 0.0003	0.0005 0.0006	0.0004 0.0005	0.0004 0.0006	0.0004 0.0006
STD. DEVIATIONS	0.0001 0.0001	0.0001 0.0001	0.0003 0.0003	0.0002 0.0001	0.0001 0.0001	0.0002 0.0002

ATTACHMENT

HELP MODEL OUTPUT 2 (continued)

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	0.0003	0.0003	0.0005	0.0002	0.0003	0.0003
	0.0002	0.0002	0.0005	0.0004	0.0005	0.0005
STD. DEVIATIONS	0.0001	0.0002	0.0006	0.0002	0.0001	0.0004
	0.0001	0.0001	0.0004	0.0001	0.0002	0.0004

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1974 THROUGH 1978

	INCHES		CU. FEET	PERCENT
PRECIPITATION	7.81	(4.509)	6320.5	100.00
RUNOFF	0.000	(0.0000)	0.00	0.000
EVAPOTRANSPIRATION	6.338	(3.5704)	5130.44	81.171
LATERAL DRAINAGE COLLECTED FROM LAYER 2	1.20165	(0.54131)	972.724	15.38998
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.00561	(0.00103)	4.540	0.07184
AVERAGE HEAD ON TOP OF LAYER 3	0.000	(0.000)		
CHANGE IN WATER STORAGE	0.263	(0.7888)	212.80	3.367

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ATTACHMENT

HELP MODEL OUTPUT 2 (continued)

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PEAK DAILY VALUES FOR YEARS 1974 THROUGH 1978

	(INCHES)	(CU. FT.)
PRECIPITATION	1.24	1003.768
RUNOFF	0.000	0.0000
DRAINAGE COLLECTED FROM LAYER 2	0.04570	36.99435
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.000068	0.05502
AVERAGE HEAD ON TOP OF LAYER 3	0.005	
MAXIMUM HEAD ON TOP OF LAYER 3	0.000	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	0.0 FEET	
SNOW WATER	0.00	0.0000

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.1676
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0240

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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ATTACHMENT

HELP MODEL OUTPUT 2 (continued)

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                 FINAL WATER STORAGE AT END OF YEAR 1978
   ---------------------------------------------------------------------
                  LAYER        (INCHES)       (VOL/VOL)
                  -----        --------       ---------
                    1            2.9314         0.1221

                    2            0.0800         0.0100

                    3            0.0000         0.0000

                SNOW WATER       0.000

******************************************************************************
******************************************************************************
```

Attachment 2

100-Year Flood Plain Mapping

100-Year Flood Plain Mapping
Munitions Treatment Range
Unit 8 (Burial Pit)

Barry M. Goldwater Range
Luke Air Force Base, Arizona

U.S. Navy Contract Number: N68711-00-D-0004
Delivery Order: 018

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22 October 2004

Executive Summary

CDM Federal Programs Corporation (CDM) has prepared this flood plain mapping project for Luke Air Force Base's (AFB) former Munitions Treatment Range (MTR) Unit 8 – Burial Pit on the Barry M. Goldwater Range. The purpose of this project is to determine the discharge of the 100-year storm event, delineate this 100-year flood plain, and estimate the water depth at the MTR Unit 8 during this 100-year event.

From the field investigation and topography maps, it was determined that surface water flows towards the northwest. There were no significant drainage channels but several ephemeral arroyos or "washes" were noted in the watershed. No arroyos were observed flowing through the MTR Unit 8.

The United States Geological Survey (USGS) topographic maps (www.gisdatadepot.com) shows the MTR Unit 8 located in the Tenmile Wash watershed. This watershed is approximately 1,211 square miles. The MTR was sub-divided into a smaller watershed of approximately 17 square miles. The sub-division was performed following the natural contours and streams shown on the topography maps. Using the 1,211 square miles in the Tenmile Wash would over estimate the flow through the MTR Unit 8.

The Arizona Department of Water Resources Level 2 methodology (State of Arizona 1996) was used to calculate the 100-year discharge. The MTR Unit 8 is located in Flood Region 13 based on figures provided by the Arizona Department of Water Resources. For a recurrence interval of 100 years or the 100-year storm event, the Arizona Department of Water Resources recommends using the following equation:

$Q = 10^{(5.52-2.42*A^{(-0.12)})}$
Where Q = discharge, cubic feet per second (cfs)
A = drainage area, square miles

The only variable for the Region 13 equation is the drainage area.

Additional hydraulic modeling was performed to evaluate the depth of flood waters and the extent of the 100-year flood plain.

The 100-year discharge for the MTR sub-basin was approximately 6,270 cubic feet per second (cfs).

The flood plain mapping indicates that the MTR Unit 8 is outside of the 100-year flood plain. The depth of water during the 100-year storm event over the MTR Unit 8 would therefore be zero. Unit 8 is located approximately 1,500 feet from the flood plain. The flood plain mapping was ended at the edge of the MTR sub-basin. The flood plain does extend towards the west but is not shown on the mapping.

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Acronyms and Abbreviations

A	drainage area, square miles
ADEQ	Arizona Department of Environmental Quality
AFB	Air Force Base
CDM	CDM Federal Programs Corporation
cfs	cubic feet per second
DEM	Digital Elevation Model
EPA	United States Environmental Protection Agency
ESRI	Environmental Systems Research Institute
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
HEC-RAS	Hydrologic Engineering Center – River Analysis System
HUC	Hydrologic Unit Code
MTR	Munitions Treatment Range
NAD 27	1927 North American Datum
NGVD 29	National Geodetic Vertical Datum 1929
Q	discharge, cubic feet per second
Quad	Quadrangle
USGS	United States Geological Survey

Section 1
Introduction

1.1 Purpose of Study

CDM Federal Programs Corporation (CDM) has prepared this flood plain mapping project for Luke Air Force Base's (AFB) former Munitions Treatment Range (MTR) Unit 8 – Burial Pit on the Barry M. Goldwater Range. The purpose of this project is to determine the discharge of the 100-year storm event, delineate this 100-year flood plain, and estimate the water depth at the MTR Unit 8 during this 100-year event.

A Flood Insurance Rate Map (FIRM) for the Luke AFB MTR Unit 8 (panel #04013C3950D) has not currently been developed by the Federal Emergency Management Agency (FEMA).

1.2 Background

The Barry M. Goldwater Range is located in the southwestern corner of Arizona along the United States and Mexico border; see Figure 1, Area Location Map. The MTR is located in the northeastern portion of the Barry M. Goldwater Range in Township 8 South, Range 6 West, approximately 10 miles south of Gila Bend along Highway 85. The former MTR consisted of several open burn units, open detonation units, and staging areas, see Figure 2, Luke AFB MTR Facility Map. Five of the eight treatment units were closed in 1995 and the remaining three units (including Unit 8) were closed in 2000 (CDM 2003). MTR Unit 8, the former burial pit, was closed in place with a hazardous waste landfill cap. The former MTR is accessed via the Range 4 Access Road, which is gated and secured.

The climate is arid, characterized by mild winters and hot summers. Mean monthly temperatures range from 56 degrees Fahrenheit in January to 95 degrees Fahrenheit in July. Annual precipitation is three to four inches based on a thirty year average. Precipitation generally occurs from July to September (CDM 2001). Evapotranspiration rates for this area exceed 50 inches annually (CDM 2001).

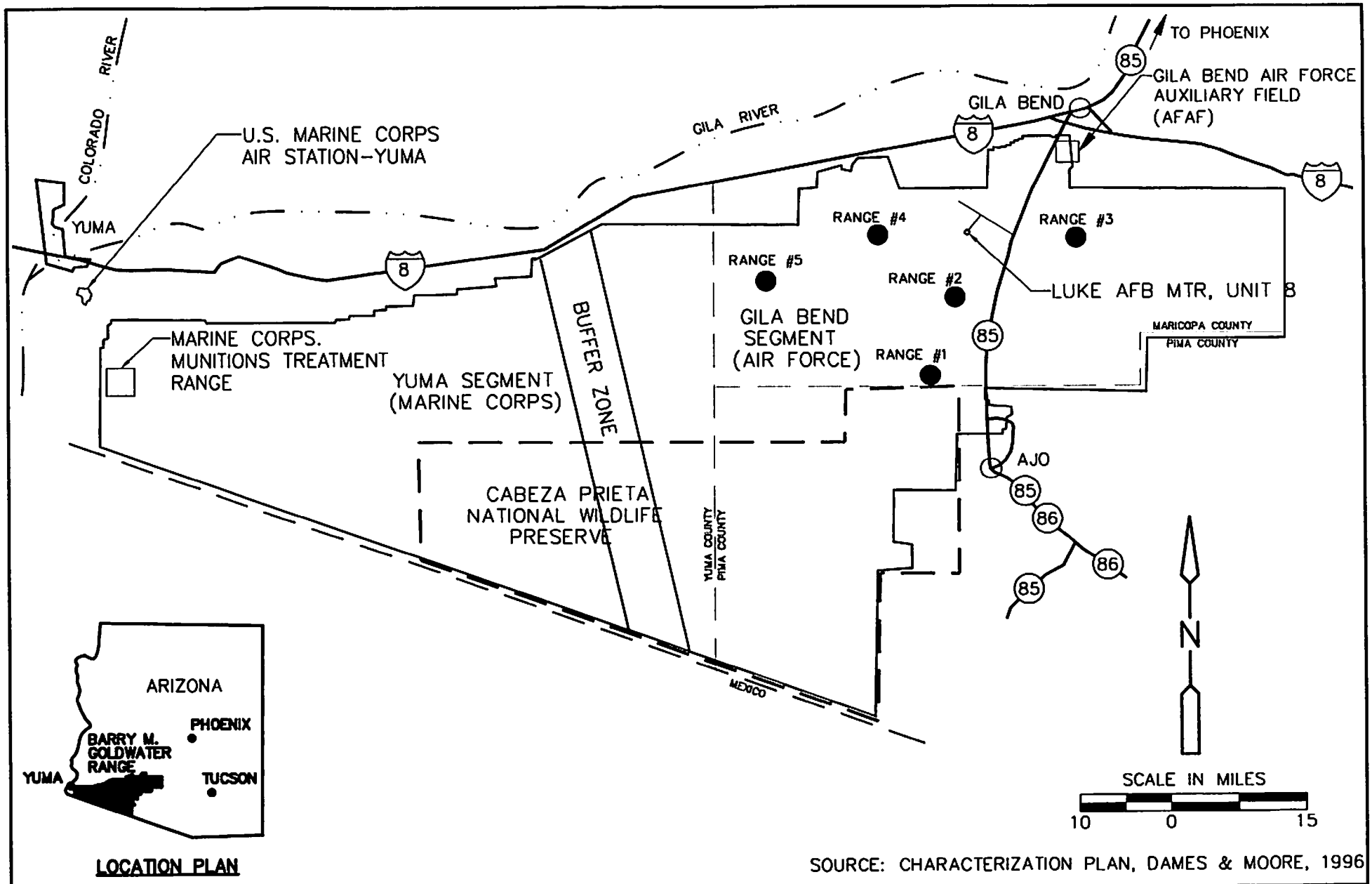
The vegetation native to this area includes creosote brush, mesquite, various bursage, ironwood, paloverde, and cholla cactus (CDM 2003).

The soils in this watershed consist of two types; course-grained and fine-grained soils. The majority of the soils are coarse-grained, consisting of gravel, cobbles, boulders, and sand. The permeability of the sandy soils is relatively high at 0.00002 feet per minute (CDM 2001).

The MTR Unit 8 site is located in the Sonoran Desert section of the Basin and Range physiographic province. The area is characterized by north to northwest trending, basins, and isolated mountain ranges separated by desert plains. The topography is relatively flat with elevations ranging from 200 feet to more than 1,200 feet above mean sea level (CDM 2003).

As part of this flood plain study, a field investigation was conducted on July 14, 2004. Much of the drainage area was observed from the local highway. The MTR Unit 8 engineered cap was observed, and the area around the site was clear of vegetation. Photos of the site are included in Appendix A.

From the field investigation and topography maps, it was determined that surface water flows towards the northwest. There were no significant drainage channels but several ephemeral arroyos or "washes" were noted in the watershed. No arroyos were observed flowing through the MTR Unit 8.



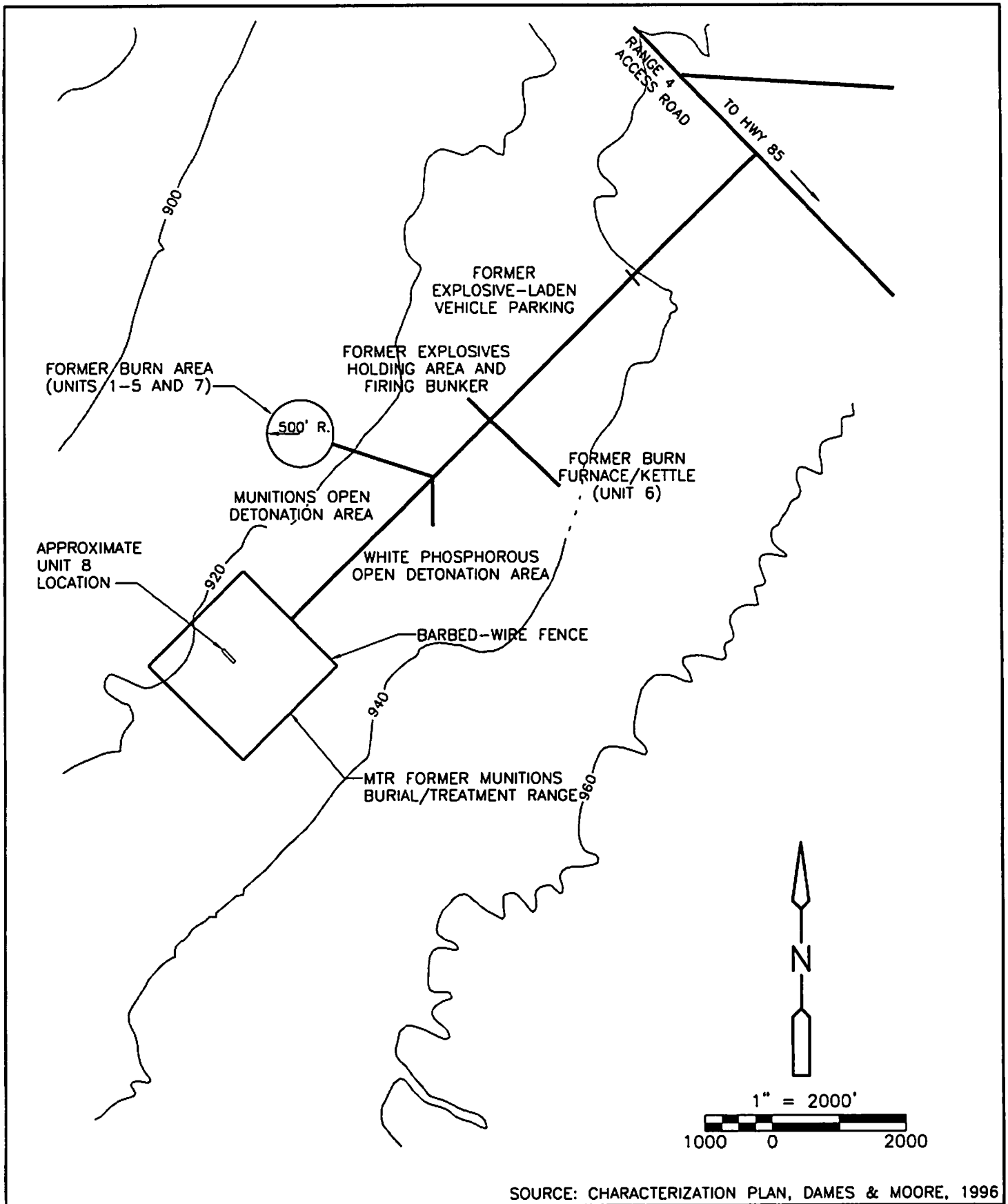
LOCATION PLAN

SOURCE: CHARACTERIZATION PLAN, DAMES & MOORE, 1996

CDM

Figure 1
AREA LOCATION MAP

MUNITIONS BURIAL/TREATMENT RANGE
BARRY M. GOLDWATER RANGE
LUKE AFB, ARIZONA



SOURCE: CHARACTERIZATION PLAN, DAMES & MOORE, 1996

CDM

Figure 2
LUKE AFB MTR FACILITY MAP

MUNITIONS BURIAL/TREATMENT RANGE
BARRY M. GOLDWATER RANGE
LUKE AFB, ARIZONA

Section 2
Mapping

A FIRM for the Luke AFB MTR Unit 8 (panel #04013C3950D) has not been currently developed by FEMA.

The mapping used for the project was the United States Geological Survey (USGS) quadrangle (quad) maps (www.gisdatadepot.com). No current topography mapping, with the exception of an As-Built drawing for the engineered cap (CDM 2003), has been developed at the MTR Unit 8 site. The site falls within the South of Theba, Arizona quad map. The entire watershed of 1,211 square miles falls within 36 quad maps including:

South of Theba, Arizona
Midway, Arizona
Midway NW, Arizona
Black Gap, Arizona

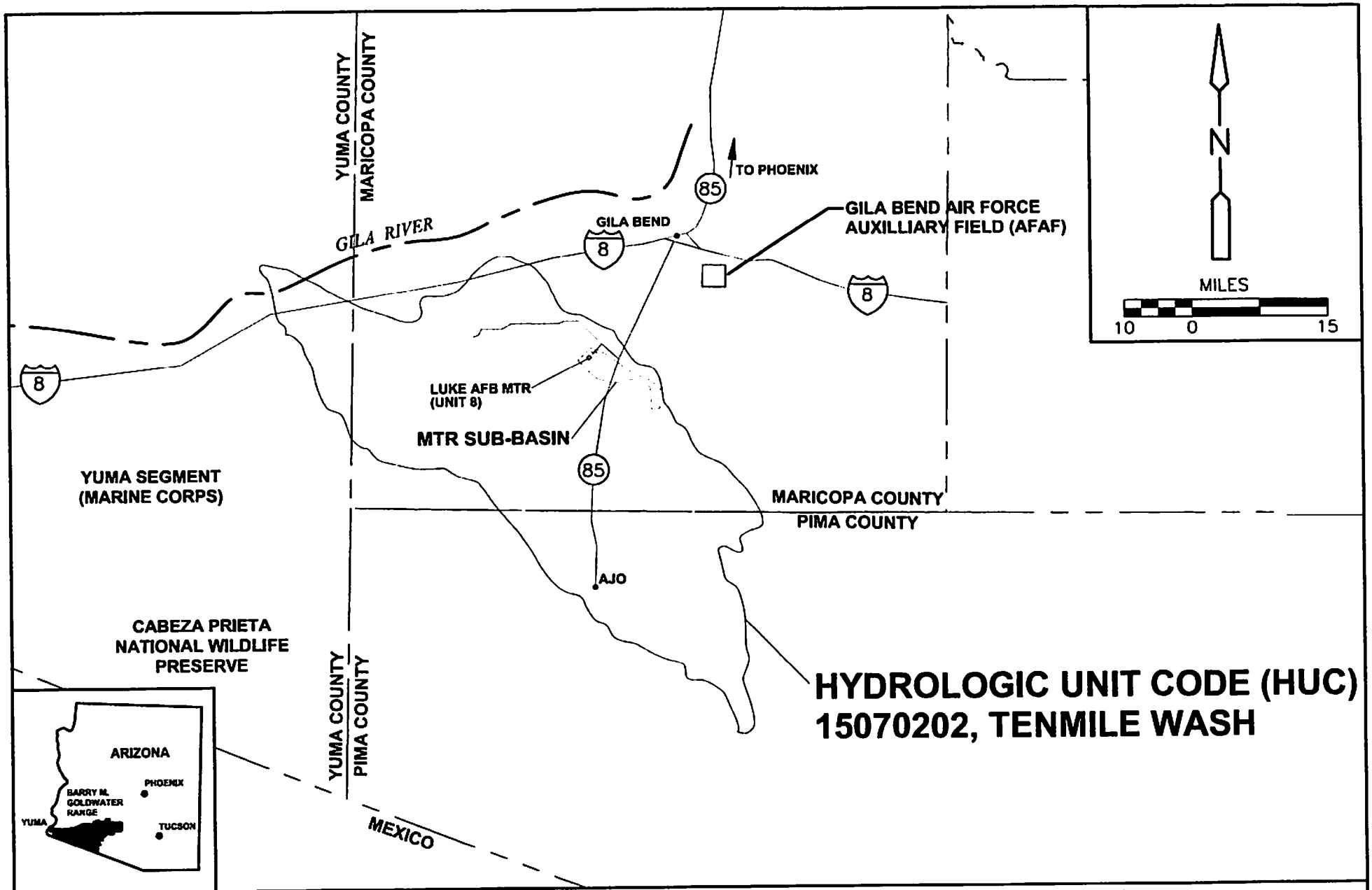
These four quad maps make up the 17 square mile sub-basin used for the hydrology/hydraulic analysis. The watershed was sub-divided using the flow paths or water course shown on the quad maps.

The horizontal datum of these maps is based on 1927 North American Datum (NAD 27). The vertical datum is based on the National Geodetic Vertical Datum of 1929 (NGVD 29).

All quad maps are dated "Provisional Edition 1986".

Digital elevation models (DEMs) were obtained from the USGS. The DEMs were opened in Environmental Systems Research Institute (ESRI) Arcview and converted to Autocad files. From the Autocad files, cross sections were created and imported into the Hydraulic Engineering Center - River Analysis System (HEC-RAS) model. This procedure is described in more detail in Section 4 Hydraulics.

The hydrologic unit code (HUC) for this area is the Tenmile Wash. The USGS cataloging unit for the Tenmile Wash is 15070202. This information was obtained from USGS and the United States Environmental Protection Agency (EPA). The USGS has categorized each river in the United States by developing a numbered system that divides and sub-divides hydrologic units. Figure 3, Tenmile Wash Boundary, shows the location of the watershed in relation to the MTR.



CDM

Figure 3
TENMILE WASH BOUNDARY

MUNITIONS BURIAL/TREATMENT RANGE
BARRY M. GOLDWATER RANGE
LUKE AFB, ARIZONA

Section 3
Hydrology

The methodology for the hydrologic analysis was provided by the Arizona Department of Water Resources (State of Arizona 1996).

The Arizona Department of Water Resources categorizes these methodologies in 3 levels. The Level 1 procedure allows for estimating flood depth and floodway width without a detailed topography map. This procedure uses a curve developed by the USGS based on stream gage data in the Southwest. The Level 2 methodology consists of estimating the 100-year peak discharge and the 100-year floodplain. Equations for solving the peak discharge were developed by USGS using stream gage data, regression analyses, and a statistical procedure for arid regions. The Level 2 methodology is slightly more sophisticated than the Level 1 procedure. The Level 3 methodology entails the estimation of the 100-year discharge and floodplain using more sophisticated methods than both Level 1 and Level 2. The Level 3 procedure may be required where structures could be encroached upon during the 100-year storm event.

For this project, the Level 2 methodology and additional hydraulic modeling were chosen to develop the 100-year flood plain. The Level 1 method is a simplistic calculation that may over estimate the discharge. The Level 3 methodology might be required if existing structures (buildings, bridges, etc.) were located on the site. No structures are located on or near the MTR Unit 8 sub-basin. The procedure for Level 2 is included in Appendix B. In addition, the Level 2 methodology was chosen based on the acceptance of this method for a previous project (Chang 2002) located on the United States Marine Corps Air Station - Yuma, Barry M. Goldwater Range, Yuma, Arizona. These projects are similar in the sense that they are located in remote and rural areas with large flood plains.

The MTR Unit 8 is located in Flood Region 13 based on figures provided by the Arizona Department of Water Resources. For a recurrence interval of 100 years or the 100-year storm event, the Arizona Department of Water Resources recommends using the following equation:

$Q = 10^{(5.52-2.42*A^{(-0.12)})}$

Where Q = discharge, cubic feet per second (cfs)
A = drainage area, square miles

The only variable for the Region 13 equation is the drainage area.

The HUC established for this drainage area is the Tenmile Wash. The USGS cataloging unit for the Tenmile Wash is 15070202. The HUC contains the major watershed boundaries as published by the USGS. The HUC shows boundaries at 4 levels of detail ranging from local to regional drainage areas. The area of Tenmile Wash is approximately 1,211 square miles. The discharge point for the Tenmile Wash

watershed is the Gila River. The MTR Unit 8 is located approximately 35 miles from this discharge point. Figure 3, Tenmile Wash Boundary, shows the approximate location of the Tenmile Wash and the discharge location with the Gila River.

The Tenmile Wash watershed was sub-divided to create the MTR sub-basin. The drainage area for this sub-basin is 17 square miles. The purpose for sub-dividing the watershed was to identify the arroyos or drainage courses that affect the MTR Unit 8. Using the entire watershed of 1,211 square miles would over estimate the flow the MTR Unit 8 encounters. From the quad maps, the MTR sub-basin was determined by following water courses surrounding the MTR Unit 8 and traveling upstream to a termination point (a high point or a change in flow direction).

Using the above equation, the 100-year discharge was calculated:

MTR Sub-basin:

Area = 17 square miles

$Q = 10^{(5.52-2.42*17^{\wedge}(-0.12))}$

Q = 6,270 cfs

For comparisons, the entire Tenmile Wash was calculated for the 100-year discharge:

For the Tenmile Wash watershed:

Area = 1,211 square miles

$Q = 10^{(5.52-2.42*1211^{\wedge}(-0.12))}$

Q = 30,735 cfs

The MTR sub-basin flow of Q = 6,270 cfs was used to determine flood plain and flood depths at the MTR Unit 8 site.

Section 4
Hydraulics

The computer program HEC-RAS 3.1 "River Analysis System" was used to compute the project water-surface profile. The HEC-RAS model was developed to simulate existing conditions during a 100-year storm event. The data used in the HEC-RAS model was compiled from the USGS quad maps and the DEMs. Existing hydraulic modeling data was not found or available to calibrate or verify the model.

The Tenmile Wash watershed or the sub-basin does not have any truly defined channels. There are many ephemeral arroyos or washes throughout the watershed. Based on field observations and the USGS maps, the washes typically flow from the southeast to the northwest. Constraints were not placed on the HEC-RAS model to confine the flows to a single channel. Divided flows were allowed in the model to simulate these many washes.

Cross sections for the model were developed using the DEMs obtained from the USGS. The DEMs were opened in ESRI Arcview and converted to Autocad files. From these Autocad files, cross sections were created and imported into HEC-RAS. Seven cross sections were generated for the model. The sections varied from 10,000 feet to 14,000 feet long from the left bank to the right bank. This was done so that the many washes shown on the quad sheets were used in the model. Figure 4, Cross-Sections, shows the locations of the cross sections, the sub-basin, and the MTR Unit 8.

The cross sections were checked by hand to verify the DEM's were adequate for modeling.

The results of the HEC-RAS model can be found in Appendix C – HEC – RAS Model Results.

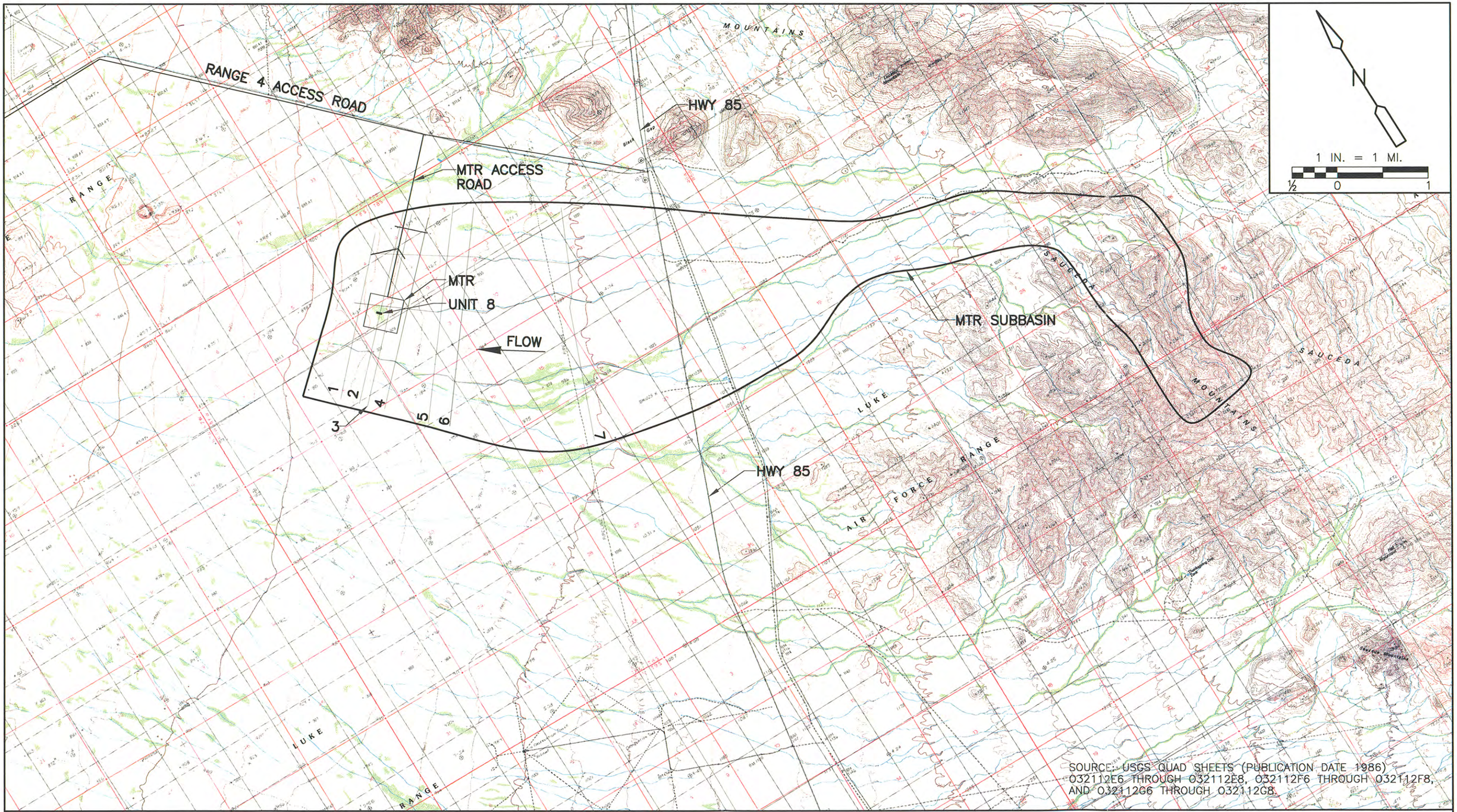
The following information was used for the HEC-RAS model:

- Manning's "n" values or roughness coefficient were estimated by using the method provided by the USGS. The photos in Appendix A show a small portion of the overall watershed. Native vegetation was more abundant than what are shown in these photos. Due to the nature of the MTR site, the vegetation throughout the site was estimated. The Manning's "n" value that was used in the model was 0.035.

- Contraction and expansion loss coefficients for gradual transitions were taken as 0.1 and 0.3, respectively.

- A steady state flow analysis was performed for the MTR sub-basin using a flow of 6,270 cfs.

- Normal depth and critical depth were selected for the boundary condition of the steady state flow analysis. Then normal depth analysis is shown in the results. The results were similar between the two boundary conditions.



SOURCE: USGS QUAD SHEETS (PUBLICATION DATE 1986) 032112E6 THROUGH 032112E8, 032112F6 THROUGH 032112F8, AND 032112G6 THROUGH 032112G8.

CDM

Figure 4
CROSS-SECTIONS

MUNITIONS BURIAL/TREATMENT RANGE
BARRY M. GOLDWATER RANGE
LUKE AFB, ARIZONA

Section 5
Results

Based on the results of the HEC-RAS model for the sub-basin area of 17 square miles, the MTR Unit 8 is above the 100-year flood waters. The MTR Unit 8 is located on cross section 2 approximately 5,600 feet from the left bank of this cross section at an approximate elevation of 927.2 feet. The location can be seen on Figure 4, Cross-Sections and Figure 5, Approximate 100-Year Flood Plain.

Table 1, HEC-RAS Result, 6,270 cfs, represents at each cross section, the minimum channel elevation, the water surface elevation, the channel velocity, and the Froude number. The minimum channel elevation is the lowest point on that particular cross section. The water surface elevation indicates the elevation of water throughout the entire cross section for the 100-year storm event. The channel velocity is the velocity of water through the flow path of the cross section. The Froude number indicates whether the flow is supercritical, critical, or subcritical. If the Froude number is greater than one, the flow is supercritical. If the Froude number is less than one, the flow is subcritical. For the value one, the flow is considered critical.

The results of the modeling for cross section 2 show the minimum channel elevation as 921.0 feet. The water surface elevation is shown as 923.2 feet. From these results, the maximum depth of water for this cross section is 923.2 feet minus 921.0 feet which equals 2.2 feet. This low point is approximately 3,100 feet along cross section 2 from the left bank.

The quad maps and the DEM show that the MTR Unit 8 is located at an elevation of approximately 925 feet. This elevation can be seen on Figure 2, Luke AFB MTR Facility Map.

The As-Builts for the MTR Unit 8 show the elevation of the engineered cap at approximately 927.2 feet (CDM 2003). Based on the field visit and the As-Builts, this is a valid assumption. The cap was built up approximately 2.2 feet above existing grade (925 feet).

Table 1. HEC-RAS Results, 6,270 cfs

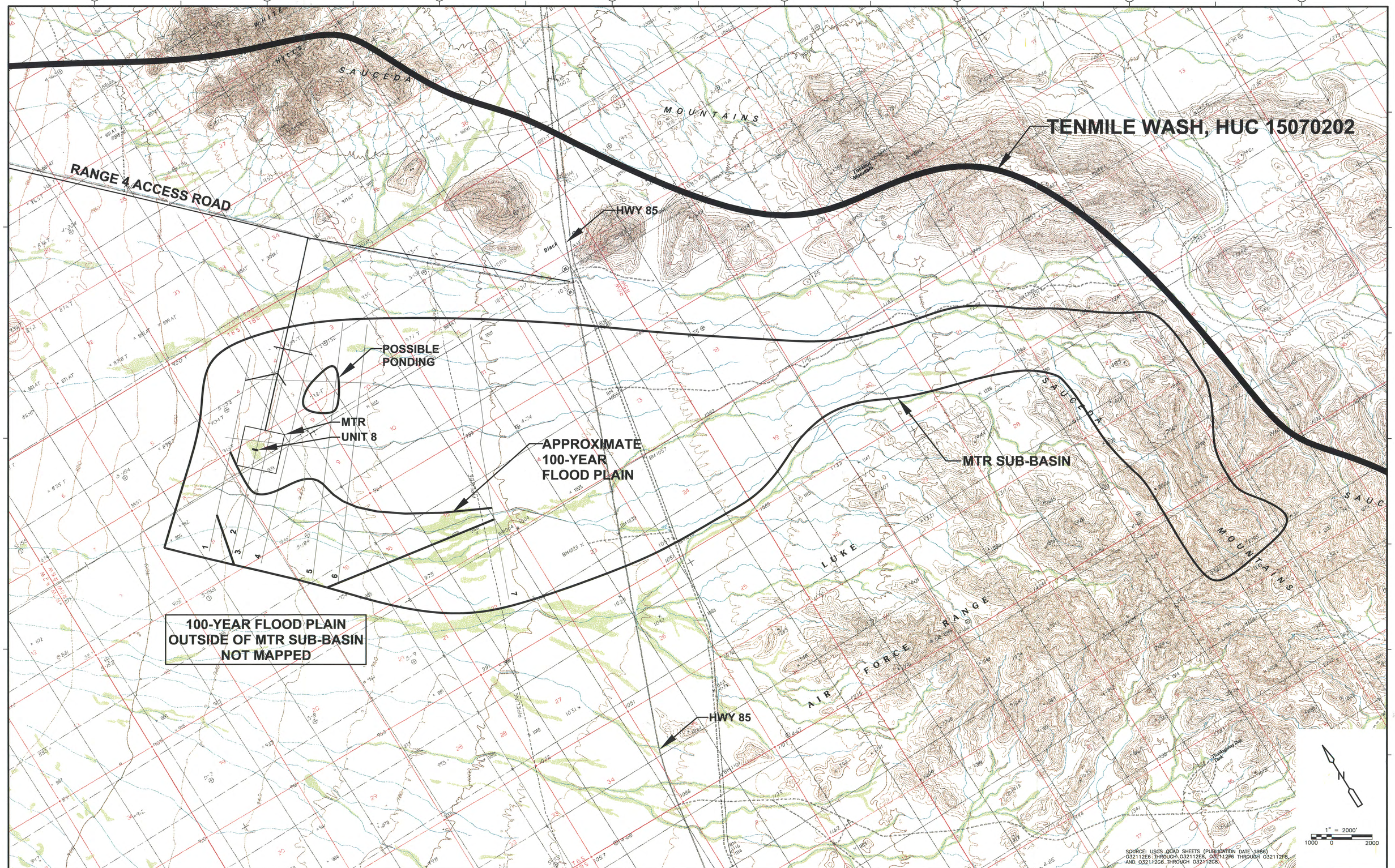
River Station	Discharge Q (cfs)	Minimum Channel Elevation (ft)	Water Surface Elevation (ft)	Channel Velocity (ft/s)	Froude #
7	6270	986.9	989.6	5.4	0.7
6	6270	949.2	951.7	3.5	0.6
5	6270	942.4	945.1	2.1	0.5
4	6270	930.0	933.0	2.5	0.4
3	6270	924.8	925.8	4.4	1.0
2	6270	921.0	923.2	2.4	0.4
1	6270	915.1	916.4	5.3	1.0

The results from the sub-basin (Q = 6,270 cfs) were mapped to identify an approximate 100-year flood plain for the MTR Unit 8. The results are shown on Figure 5. The model did identify some of the flow paths or washes shown on the quad maps in the area. Others were not identified primarily due to the elevation difference in the flow paths of these washes.

Instead of confining the flow path within a single channel or two, the model was allowed to divide or split the flow. This is to show the flow within the various arroyos throughout the flood plain. Allowing the flow to divide results in a conservative water surface elevation, typically a certain percentage of the total flow would enter one channel and the remaining percentage of the total flow would enter the second channel.

The flood plain mapping shown in Figure 5 depicts the extent of the 100-year water surface within the MTR sub-basin. The mapping does not take into account ground of higher elevation that might appear as islands within the flood plain.

This project did not study sediment generation, transport, and deposition within the floodplain. The location of sediment deposition could affect the water surface elevation within this floodplain.



REV. NO.	DATE	DRWN	CHKD	REMARKS

DESIGNED BY: B. JOHNSON
DRAWN BY: A. SMITH
SHEET CHK'D BY:
CROSS CHK'D BY:
APPROVED BY:
DATE: 10/22/2004

CDM

MUNITIONS BURIAL/TREATMENT RANGE
BARRY M. GOLDWATER RANGE
LUKE AFB, ARIZONA

APPROXIMATE 100-YEAR FLOOD PLAIN

PROJECT NO. CAD
FILE NAME: project_area.dwg

SHEET NO.
Figure 5

Section 6
References

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www.gisdatadepot.com. USGS Quadrangle Maps.

Appendices

Appendix A	Photos
Appendix B	Arizona Department of Water Resources Flood Mitigation Section
Appendix C	HEC-RAS Model Results

Appendix A

Photos

MTR Unit 8 Cap

MTR Unit 8 – looking towards the southeast. Site has been cleared of vegetation.

MTR Unit 8 Cap – looking towards the east.

MTR Unit 8 – looking south. Near the western edge of Unit 8. Native vegetation.

Appendix B

Arizona Department of Water Resources Flood Mitigation Section

Excerpts from "Delineation of Riverine Floodplains and Floodways in Arizona". State Standard Attachment SSA 2-96. July, 1996.

CDM

ARIZONA DEPARTMENT OF WATER RESOURCES
FLOOD MITIGATION SECTION

Delineation of

Riverine Floodplains and Floodways

in Arizona

500 North Third Street
Phoenix, Arizona 85004

(602) 417-2445

STATE STANDARD ATTACHMENT

JULY, 1996

SSA 2-96

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Appendix G. Level 2 - Estimating Peak Discharges on Ungaged Rural Watersheds

Overview of Methodology

Equations for estimating peak discharges for ungaged watersheds in Arizona and the Southwest were developed by the US Geological Survey using stream gage records and regression analyses and a newly developed statistical procedure for arid regions, the hybrid method. Unique equations were developed for each of seven regions within Arizona, including a region for watersheds at high elevation (> 7,500 feet). Required information includes the watershed area and up to one of the following: (1) mean annual precipitation, (2) mean elevation, or (3) mean annual evaporation. Figures G-2 to G-3 show some of these required data for the entire State of Arizona. A detailed description of the procedures and numerous examples are provided by the USGS in Thomas et. al., 1994.

Step-by-Step Procedures

Step 1 Locate watershed on region map (Figure G-1)

Step 2 Select appropriate regional equations (Tables G-1 to G-7)

Step 3 Determine required input parameters for region (Tables G-1 to G-7)

a. Determine watershed area (A, square miles)
b. Estimate mean annual precipitation (P, inches) Region 1, Figure G-2
c. Estimate mean annual evaporation (EV, inches) Region 11, Figure G-3
d. Estimate mean elevation of watershed (EL, feet) Regions 8,14,12,

Step 4 Check if watershed is within "Cloud of Common Values[1]" (Figures G-4 to G-8)

Step 5 Apply equations to obtain discharge estimates

a. Watershed in one region (See Example #G1)
b. Watershed elevation above 6,750 feet? (See Example #G2)
c. Watershed located within two adjacent regions? (See Example #G3)

Limitations:

1. Methodology generates discharge *estimates*, NOTE error range given (Tables G1-G7).

2. Watersheds characteristics analyzed should fall within the range of data used to develop the equations. Watersheds with values outside these data ranges may have higher standard

[1] There is no cloud of common values for Regions 10 and 13 because only drainage area is required for the recommended procedure.

error than indicated in Tables G-1 to G-7.

3. The equations may not be appropriate for the following watershed types:

   - Urban Areas[2]
   - Alluvial Fan/Distributary Flow/Sheet Flow Areas[3]
   - Agricultural Areas with flood irrigation structures[3]
   - Areas with highly permeable bedrock or cinders[3]
   - Areas with large dams or diversions[3]

   For the watershed types above use the Level 1 or 3 discharge methodology.

Table G-1. Region 1 Equations

Recurrence Interval	Equation	Average Standard Error (%)
2	$Q = 0.124\ A^{0.845}\ P^{1.44}$	59
5	$Q = 0.629\ A^{0.807}\ P^{1.12}$	52
10	$Q = 1.43\ A^{0.786}\ P^{0.958}$	48
25	$Q = 3.08\ A^{0.768}\ P^{0.811}$	46
50	$Q = 4.75\ A^{0.758}\ P^{0.732}$	46
100	$Q = 6.78\ A^{0.750}\ P^{0.668}$	46

Q = discharge, cfs
A = drainage area, sq. miles
P = mean annual precipitation, inches

Table G-2. Region 8 Equations

Recurrence Interval	Equation	Average Standard Error (%)
2	$Q = 598\ A^{0.501}\ EL^{-1.02}$	72
5	$Q = 2620\ A^{0.449}\ EL^{-1.28}$	62
10	$Q = 5310\ A^{0.425}\ EL^{-1.40}$	57
25	$Q = 10500\ A^{0.403}\ EL^{-1.49}$	54
50	$Q = 16000\ A^{0.390}\ EL^{-1.54}$	53
100	$Q = 23300\ A^{0.377}\ EL^{-1.59}$	53

NOTE: EL = mean elevation in watershed/1000. See Thomas et. al., 1994 for procedure for estimating elevation.

[2] The recommended equations will tend to *underestimate* peak discharges.

[3] The recommended equations will tend to *overestimate* peak discharges.

Table G-6. Region 13 Equations		
Recurrence Interval	**Equation**	**Average Standard Error (%)**
2	$Q = 10^{(6.38-4.29 A^{(-0.06)})}$	57
5	$Q = 10^{(5.78-3.31 A^{(-0.08)})}$	40
10	$Q = 10^{(5.68-3.02 A^{(-0.09)})}$	37
25	$Q = 10^{(5.64-2.78 A^{(-0.10)})}$	39
50	$Q = 10^{(5.57-2.59 A^{(-0.11)})}$	43
100	$Q = 10^{(5.52-2.42 A^{(-0.12)})}$	48
Q = discharge, cfs A = drainage area, sq. miles		

Table G-7. Region 14 Equations		
Recurrence Interval	**Equation**	**Average Standard Error (%)**
2	$Q = 583 A^{0.588} EL^{-1.3}$	74
5	$Q = 618 A^{0.524} EL^{-0.70}$	63
10	$Q = 361 A^{0.464}$	65
25	$Q = 581 A^{0.462}$	63
50	$Q = 779 A^{0.462}$	64
100	$Q = 1010 A^{0.463}$	66
Q = discharge, cfs A = drainage area, sq. miles NOTE: EL = mean elevation in watershed/1000. See Thomas et. al., 1994 for procedure for estimating elevation.		

Figure G-1

FLOOD REGIONS IN ARIZONA

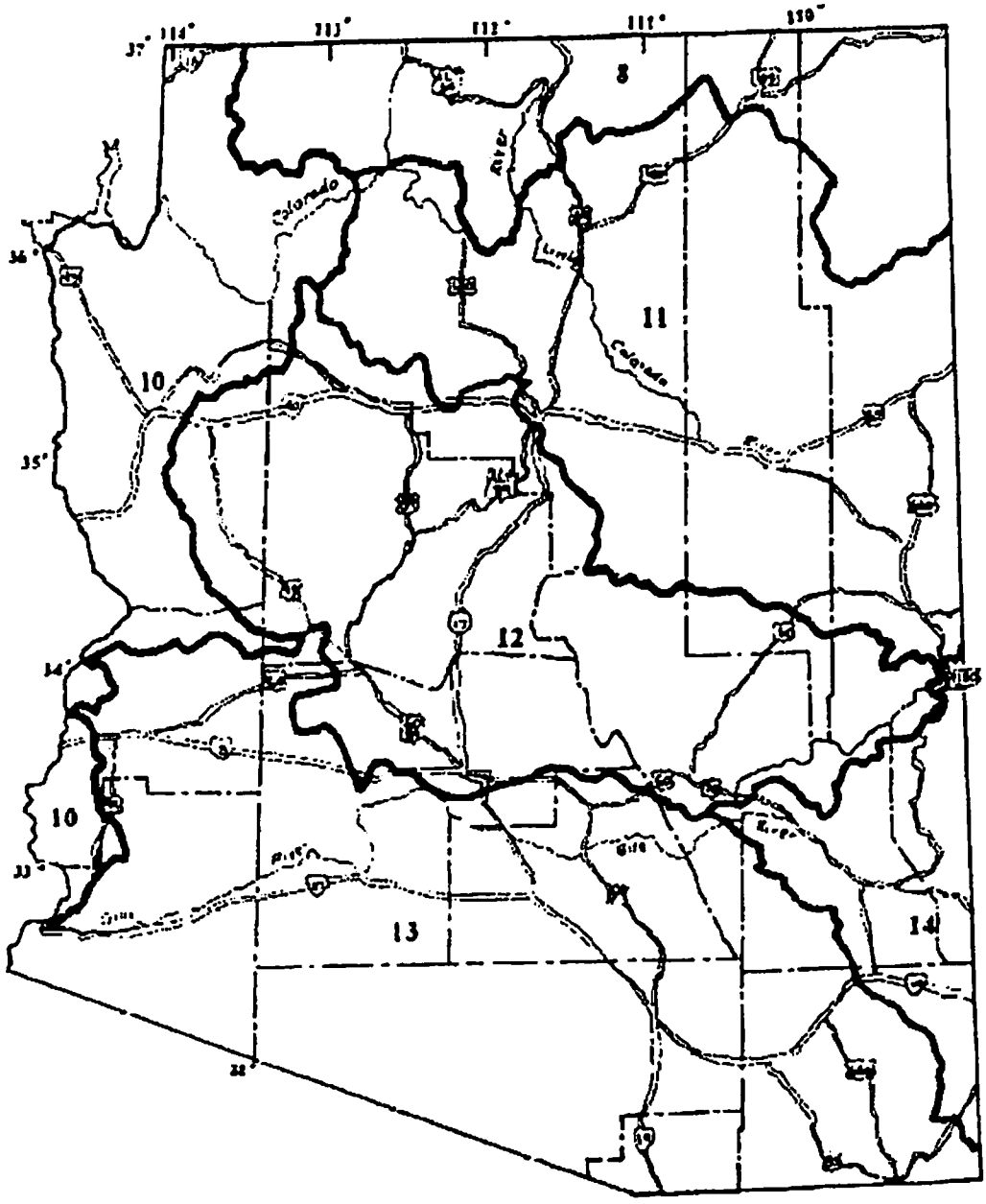
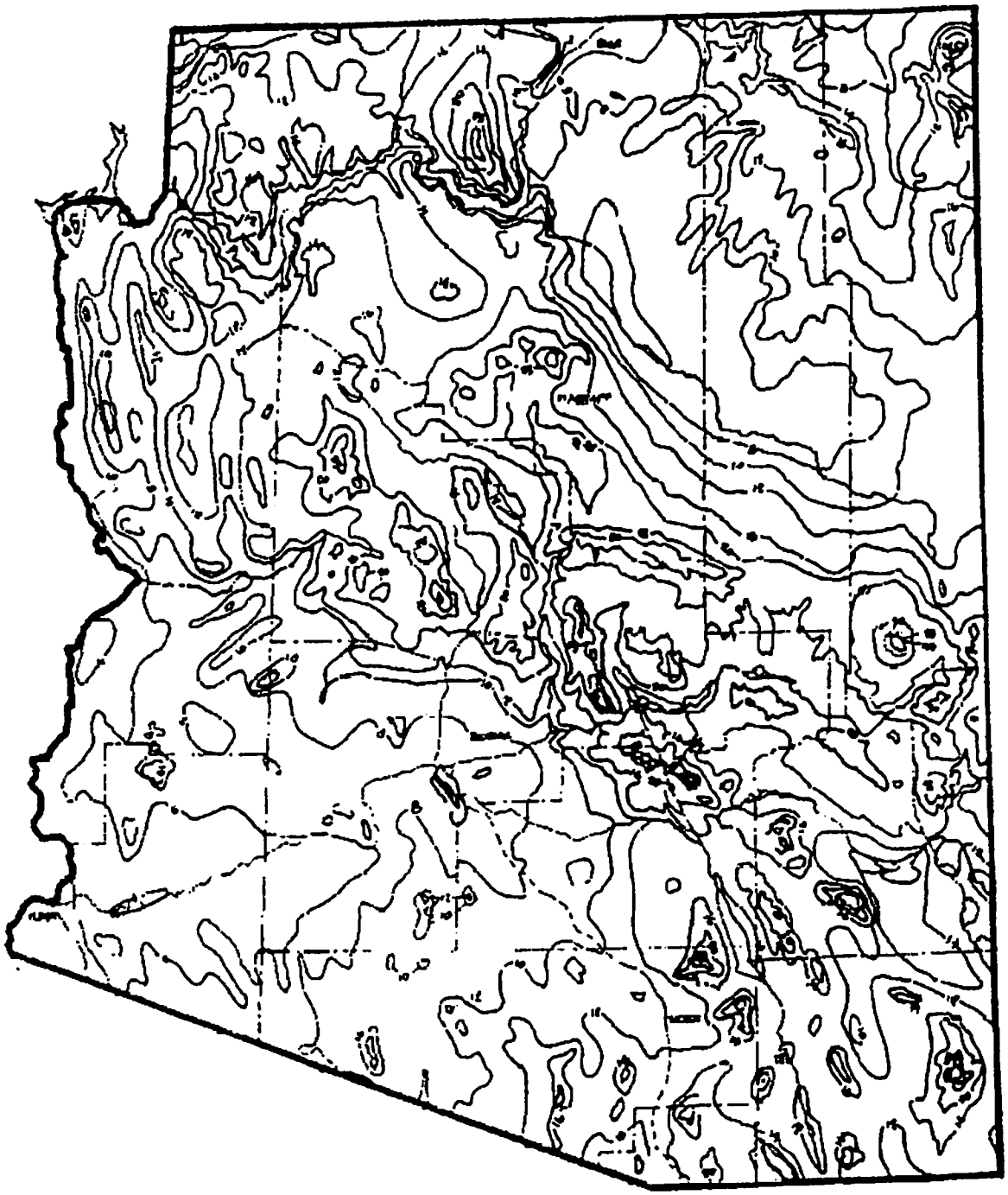


Figure modified from Thomas, B.E. and others, 1994, Methods for Estimating Magnitude & Frequency of Floods in the Southwestern United States, USGS Open File Report 93-419. Figure # 7.

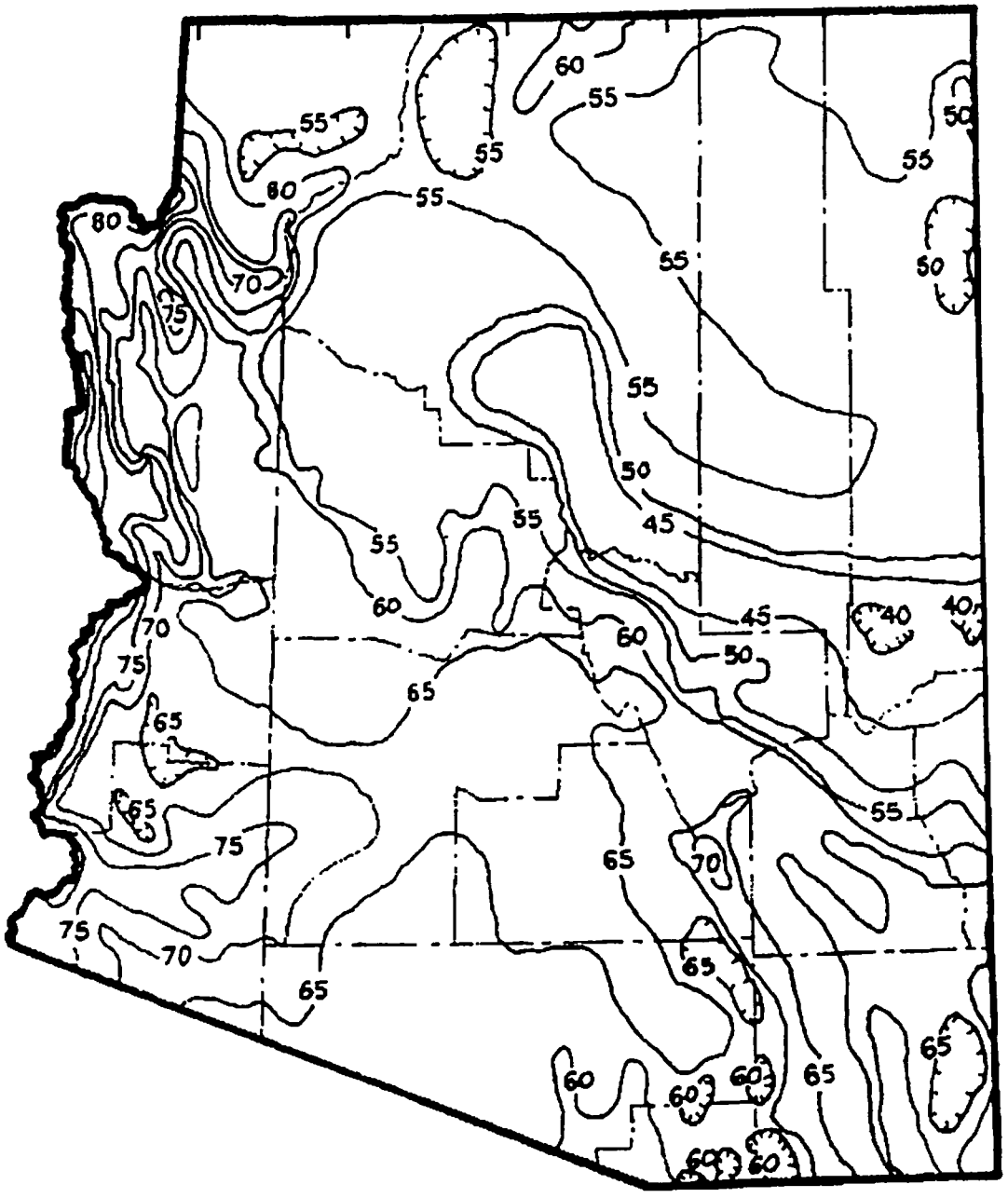
Figure G-2 **MEAN ANNUAL PRECIPITATION (PREC.), 1931-1960**



— 65 — **Mean Annual Precipitation, in inches**

Figure modified from ADOT, 1993, Highway Drainage Design Manual--Hydrology. Figure #10-10.

Figure G-3 **MEAN ANNUAL EVAPORATION (EVAP)**



— 65 — **Mean Annual Evaporation, in inches**

Figure modified from ADOT, 1993, Highway Drainage Design Manual--Hydrology. Figure #10-11.

Example #G1. Rural Watershed Within One Flood Region.

Estimate peak discharges for recurrence intervals of 50 and 100 years (Q_{50} and Q_{100}) for an ungaged site in Central Arizona Region 12 (Figures G-1 and G-7, Table G-5). The required basin characteristics are drainage area (A), in square miles, and mean basin elevation (EL), in feet. The drainage area was planimetered from a USGS topographic map, and measures 110 mi^2, and the mean basin elevation is 5,900 ft. The drainage area and mean elevation are within the cloud of common values for the region (Figure G-7).

The characteristics are inserted into the appropriate equations as follows:

$$Q_{50} = 10^{(7.36-4.17\,A^{(-0.08)})}\,(EL)^{-0.440}$$

$$Q_{50} = 10^{(7.36-4.17\,(110)^{(-0.08)})}\,(5.90)^{-0.440}$$

$$Q_{50} = 14{,}381 \text{ cfs} = 14{,}400 \text{ cfs}$$

and

$$Q_{100} = 10^{(6.55-3.17\,A^{(-0.11)})}\,(EL)^{-0.454}$$

$$Q_{100} = 10^{(6.55-3.17\,(110)^{(-0.11)})}\,(5.90)^{-0.454}$$

$$Q_{100} = 20{,}410 \text{ cfs} = 20{,}400 \text{ cfs}$$

For Additional Information and Examples[5]:

Thomas, B.E., Hjalmarson, H.W., Waltemeyer, S.D., 1994, *Methods for Estimating Magnitude and Frequency of Floods in the Southwestern United States*. USGS Open File Report 93-419.

Transition Zones (weighting equations) ..... p. 21
Limitations ..... p. 22, 66
Examples ..... p. 67-71
Measuring Variables, including Mean Elevation ..... p. 17-18
Drainage Area Size ..... p. 19
Explanation of Methodology ..... p. 77-115

See Also:

"A Study to Evaluate Existing Methods for Determining Peak Discharges for Ungaged Watersheds in Arizona, Phase II & III Report, Report prepared for the State Standards Work Group, May 1995. Prepared by Benchmark Consulting Services, Ltd.

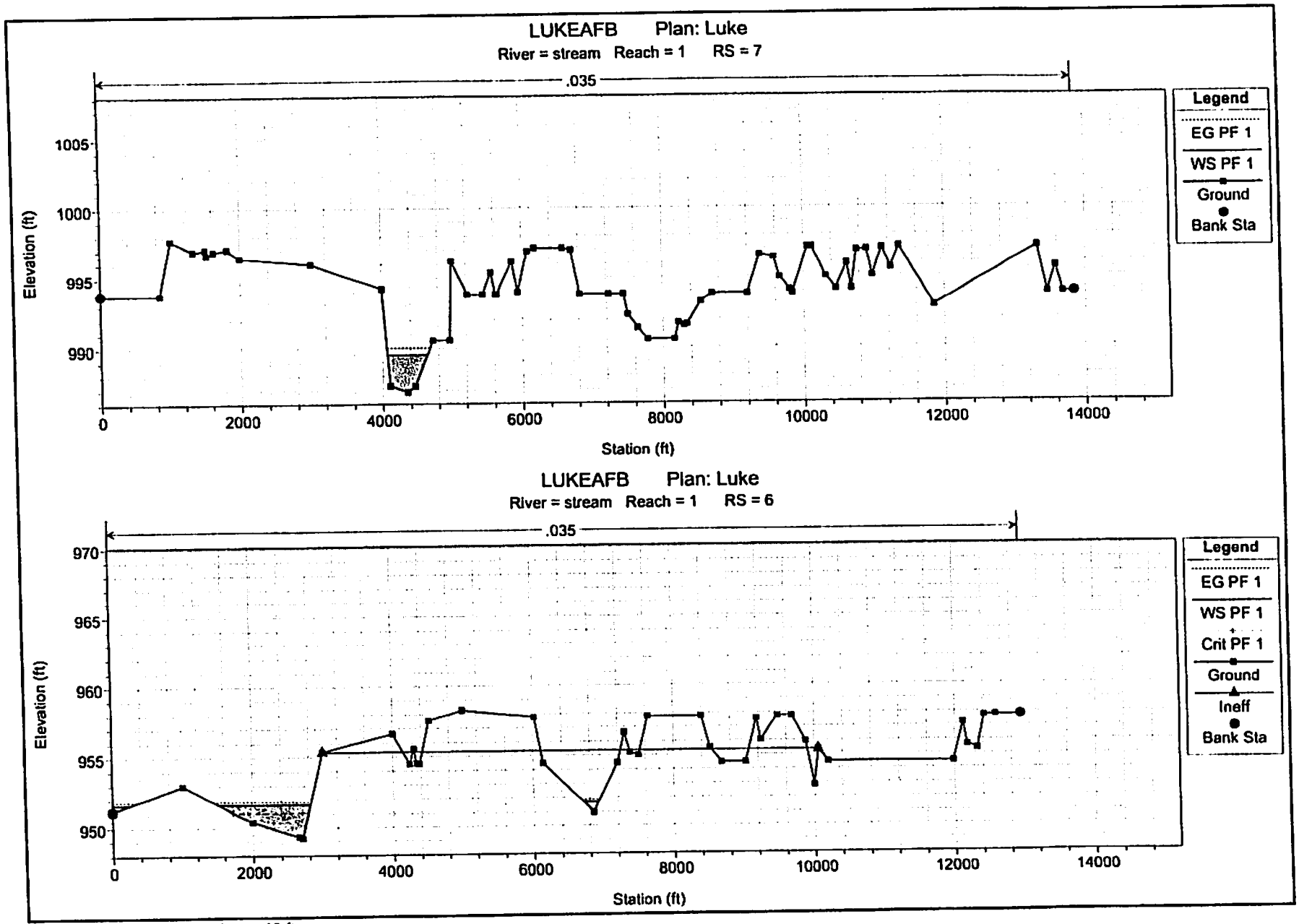
Notice: *A spreadsheet software program described in Appendix J is available from ADWR. This program is set up to perform the Level 2 discharge calculations for Arizona. Contact ADWR for more information.*

[5] The procedures and examples described above are based on, or taken directly from the references cited. These references should be consulted in the event of errors, omissions or other discrepancies.

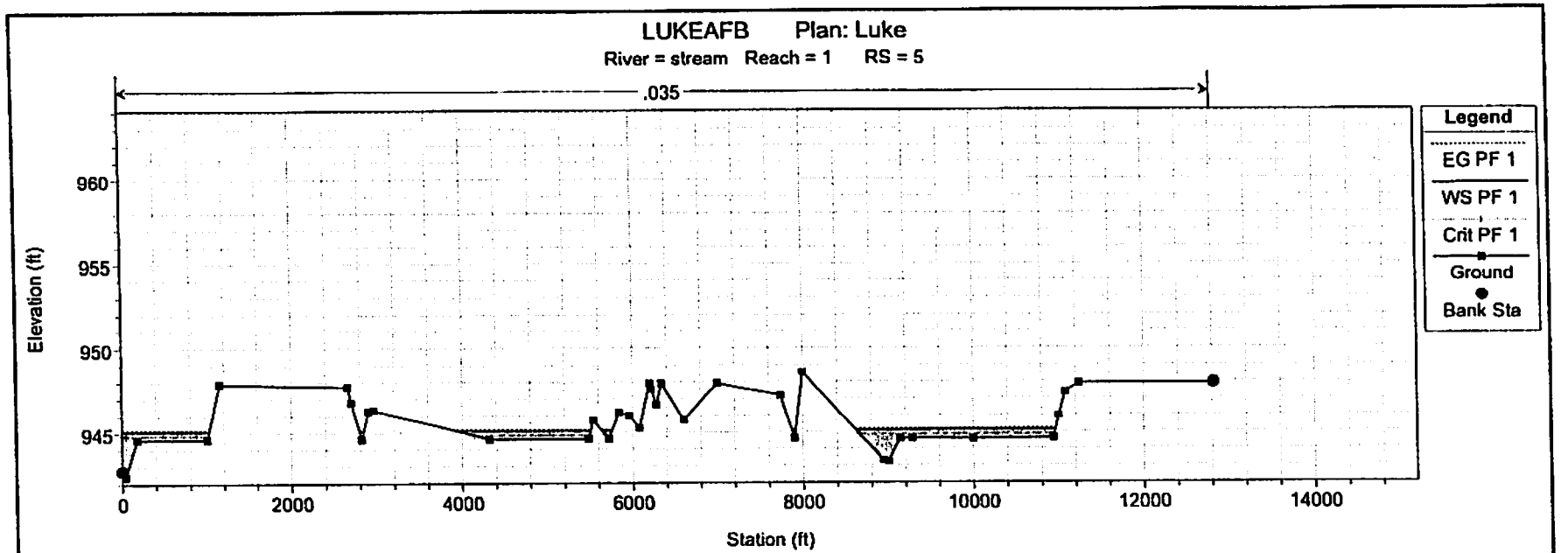
Appendix C

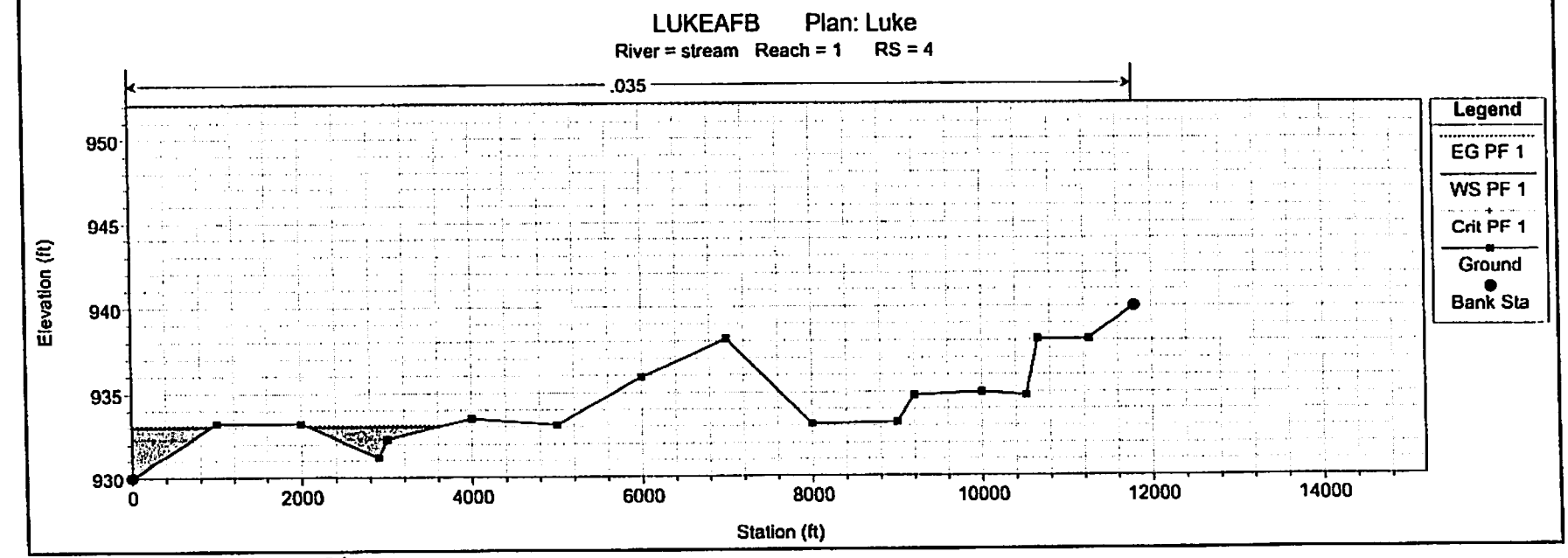
HEC-RAS Model Results

CDM

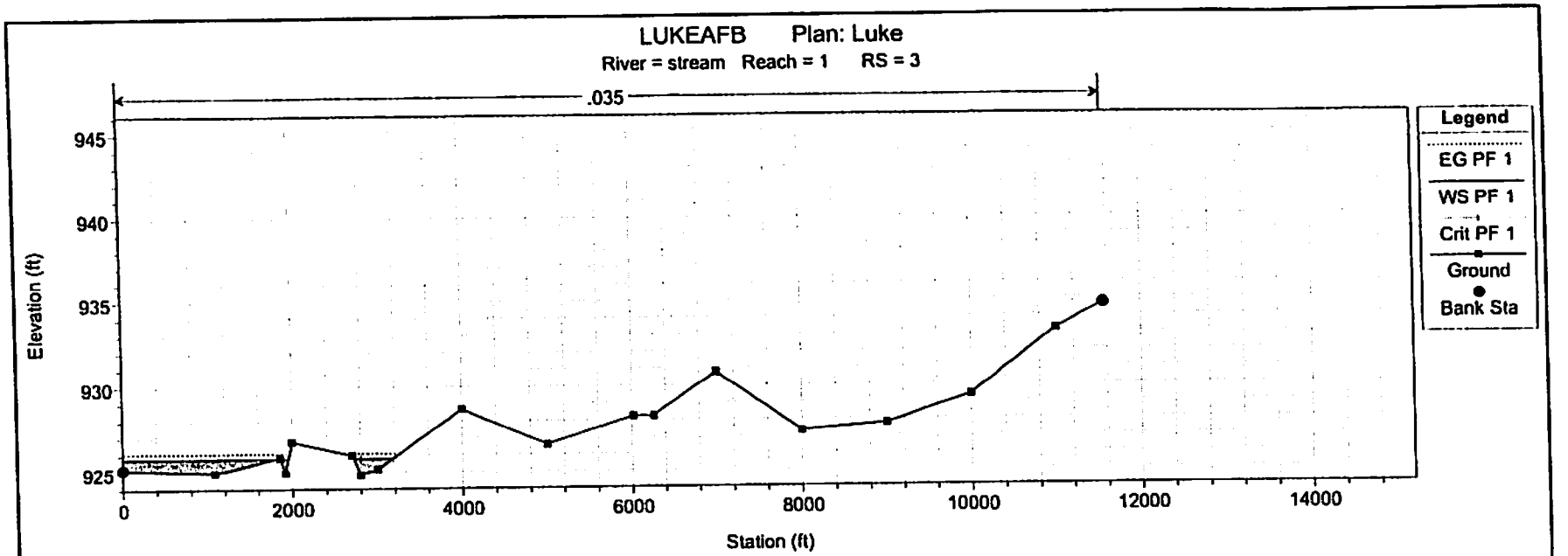


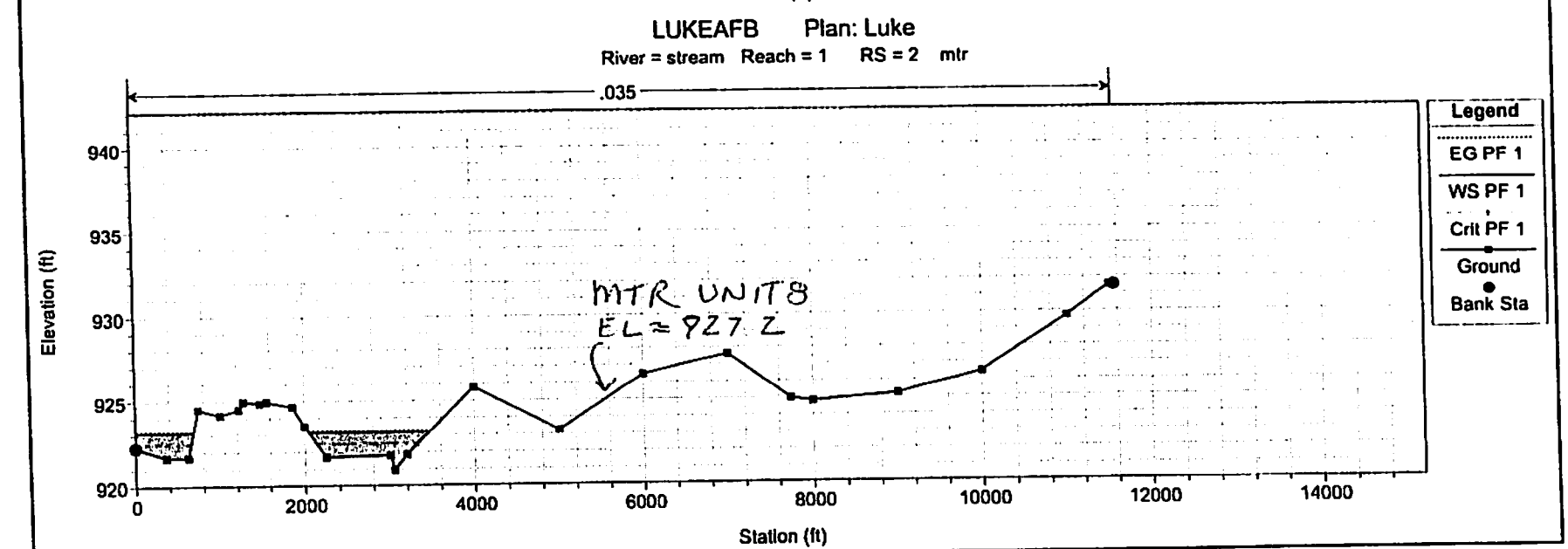
1 in Horiz. = 2000 ft 1 in Vert. = 10 ft



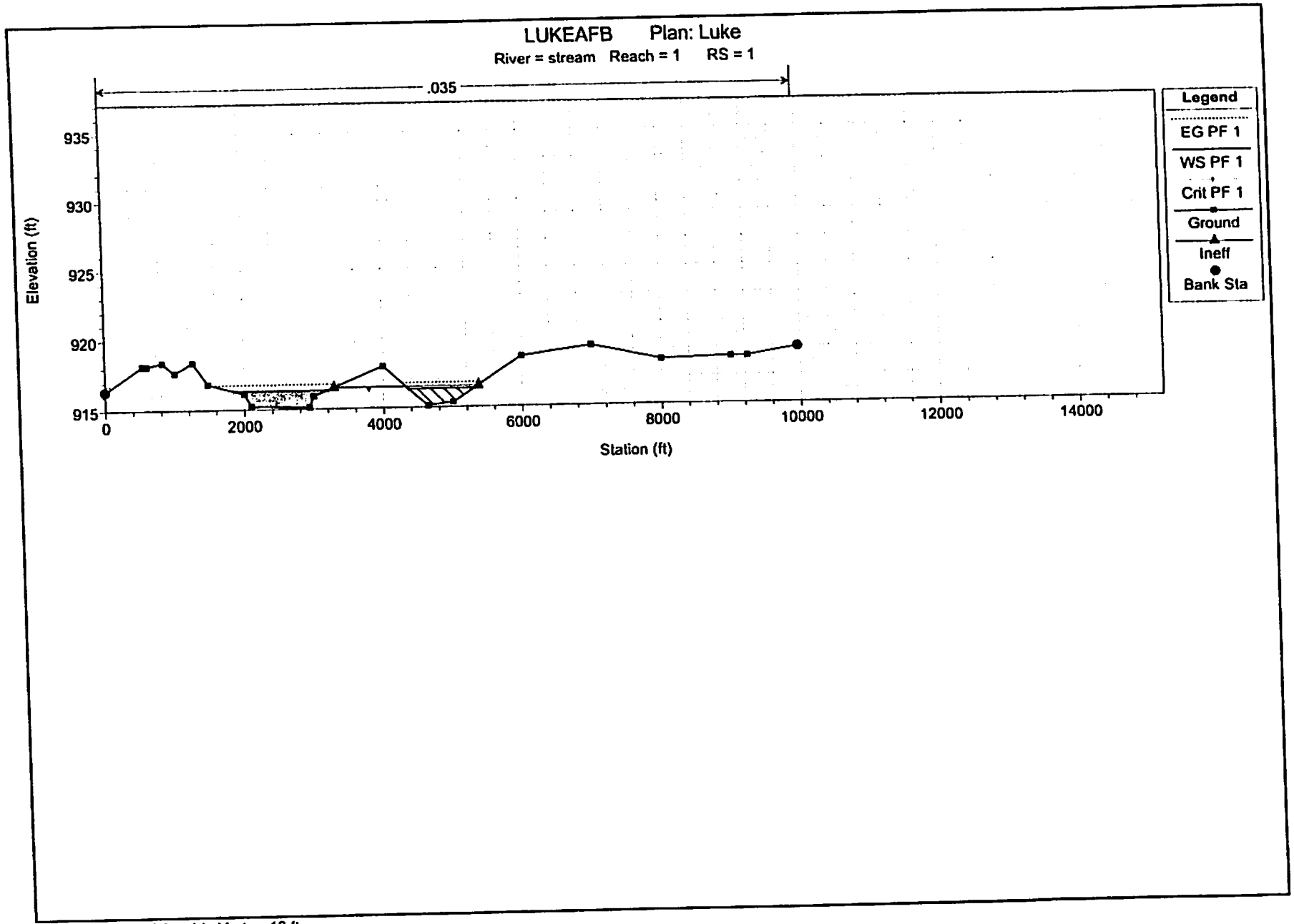


1 in Horiz. = 2000 ft 1 in Vert. = 10 ft





1 in Horiz. = 2000 ft 1 in Vert. = 10 ft



1 in Horiz. = 2000 ft 1 in Vert. = 10 ft

Errors Warnings and Notes for Plan : Luke

Location: River: stream Reach: 1 RS: 7 Profile: PF 1
Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section.
This may indicate the need for additional cross sections.

Location: River: stream Reach: 1 RS: 6 Profile: PF 1
Warning: Divided flow computed for this cross-section.
Warning: The cross-section end points had to be extended vertically for the computed water surface.
Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section.
This may indicate the need for additional cross sections.
Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

Location: River: stream Reach: 1 RS: 5 Profile: PF 1
Warning: Divided flow computed for this cross-section.
Warning: The cross-section end points had to be extended vertically for the computed water surface.
Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section. This may indicate the need for additional cross sections.

Location: River: stream Reach: 1 RS: 4 Profile: PF 1
Warning: Divided flow computed for this cross-section.
Warning: The cross-section end points had to be extended vertically for the computed water surface.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section. This may indicate the need for additional cross sections.

Location: River: stream Reach: 1 RS: 3 Profile: PF 1
Warning: The energy equation could not be balanced within the specified number of iterations. The program selected the water surface that had the least amount of error between computed and assumed values.
Warning: Divided flow computed for this cross-section.
Warning: The cross-section end points had to be extended vertically for the computed water surface.
Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.
Warning: The energy loss was greater than 1.0 ft (0.3 m) between the current and previous cross section. This may indicate the need for additional cross sections.
Warning: During the standard step iterations, when the assumed water surface was set equal to critical depth, the calculated water surface came back below critical depth. This indicates that there is not a valid subcritical answer. The program defaulted to critical depth.

Location: River: stream Reach: 1 RS: 2 Profile: PF 1
Warning: Divided flow computed for this cross-section.

Warning: The cross-section end points had to be extended vertically for the computed water surface.

Warning: The conveyance ratio (upstream conveyance divided by downstream conveyance) is less than 0.7 or greater than 1.4. This may indicate the need for additional cross sections.

Warning: The energy loss was greater than 1.0 ft (0.3 m). between the current and previous cross section. This may indicate the need for additional cross sections.

Location: River: stream Reach: 1 RS: 1 Profile: PF 1

Warning: Slope-Area method could not converge on a starting water surface elevation within the specified number of trials. The program used critical depth as the starting water surface.

Warning: Divided flow computed for this cross-section.

Note: Multiple critical depths were found at this location. The critical depth with the lowest, valid, water surface was used.

Attachment 3

Post-Closure Inspection Form and Protocol

Post Closure Inspection Form
Barry M. Goldwater Range MTR Unit 8

Category I – Immediate action reqd.
Category II – Corrective action req'd w/in 60 days.
Category III – Continued monitoring/eval req'd. No action req'd unless situation worsens. If condition persists for 180 days, corrective action will be implemented w/in 60 days after 180 days of monitoring has been completed.

Date/Time:
Inspector's Name and Title:
Signature:

Component	Yes/ No	Description of Problem	Finding Category
Is the MTR access road navigable?			
Is the fence at the entrance of the MTR intact?			
Is the Unit 8 gate locked, closed upon arrival?			
Are the Unit 8 gate and lock functioning properly?			
Is the fence surrounding Unit 8 intact?			
Are the MTR and Unit 8 signs upright, visible, and legible?			
Is there evidence of vandalism of the fencing, gate or signs?			
Is there evidence of erosion (caused by wind or water) on or near the cap? Does the soil on the cap need replacing?			
Is there evidence of burrowing animals on the cap?			
Is there evidence of burrowing animals near the cap?			
Is there vegetation on the cap? Does it appear to need fertilization or mowing? Does it appear to consist of shallow-rooted plants (not impacting the deeper layers of the cap)?			
Is there evidence of vandalism of the cap?			
Are there any signs of drainage structure integrity problems?			
Are drainage structures clear of any blockage debris and/or excessive vegetation?			

Other observation notes:

Attach photographic log.

Repairs/corrective action needed:
Schedule for repairs/corrective action:

Description and date of completed repair/corrective action:

Maintain completed inspection forms and photographs in MTR Unit 8 monitoring files for a minimum of 10 years after inspection date.

LUKE AFB MTR UNIT 8

PROTOCOL FOR INSPECTION AND MAINTENANCE COMPLIANCE

This document is written to provide more details on how Luke AFB will perform inspection and maintenance of Unit 8.

The Post-Closure Inspection Form is designed to require a "Yes" or "No" indication on the form for each item. Findings of concern for any inspection item are described on the form, along with documentation concerning action taken. For purposes of this protocol, any finding of concern will be classified into one of the three categories for subsequent follow-up:

CATEGORY 1 – Immediate action required.
CATEGORY 2 – Corrective action required within 60 days.
CATEGORY 3 – Continued monitoring and evaluation required. No action required unless the situation worsens. If the condition persists for 180 days, then corrective action will be implemented within 60 days after 180 days of monitoring has been completed.

Category 1 – This type of inspection finding requires immediate action. The most common example would be a significant security deficiency that affects the ability to secure the facility, such as a missing or broken padlock, or a downed fence. Temporary corrective action will be implemented the same day as the finding if possible, and permanent corrective action (if different) will be implemented within 10 days.

Category 2 – This category will apply to findings of significant erosion, settling or subsidence. For purposes of this protocol, significant erosion will be defined as an erosion cut that is at least six inches wide, 36 inches in length, and at least twice as deep as it is wide. This definition would encompass the typical erosion conditions that have been observed at the site since closure construction, particularly following heavy rainfall events. Significant settling or subsidence will be defined by a depression more than four inches deep that is also at least four square feet in size. Category 2 will also apply to findings of debris blockage in drainage structures, excessive vegetation at gates, and missing or damaged signage. Corrective action to address Category 2 inspection findings will be implemented within 60 days of the original finding.

Category 3 – This category will apply to minor findings during inspections that do not warrant corrective action right away, but need to be monitored and evaluated for any change or deterioration. Examples include minor surface cracks, minor depressions, and minor erosion. Category 3 findings will be re-evaluated at each subsequent inspection for changes or deteriorations that warrant corrective action. If the situation

deteriorates to meet the definition of a Category 2 deficiency as described above, then the finding will be re-categorized, and corrective action will be implemented within 60 days of that determination.

Certain Category 3 findings such as small surface desiccation cracks will self-repair or heal, following rainfall and re-hydration of the cap material. If such improvement is observed during a subsequent inspection, it will be noted at that time, and no further action or monitoring of that item will be required. If a Category 3 finding remains unchanged after 180 days, then corrective action will be implemented within 60 days of that determination. The intent of this protocol is to avoid having documented inspection findings that are not addressed within a reasonable period of time.

When completing the Inspection Form, all findings of concern will be designated on the form as Category 1, 2, or 3 as defined above. The timelines defined for each category will begin on the day of the initial finding of concern. Corrective actions taken will be recorded on the most recent Inspection Form that documents the finding of concern.

Other observations noted during the inspection will be recorded in the "Other observations notes" section of the Inspection Form. Observations that are not findings of concern (part of Yes/No section) are for historical information and future reference, and are not intended to trigger corrective action or timeline.

Attachment 4

Hospital Route Map

Figure 1 Route to Hosipital

Figure 2: Zoomed in Directions from 303 to Abrazo West Campus

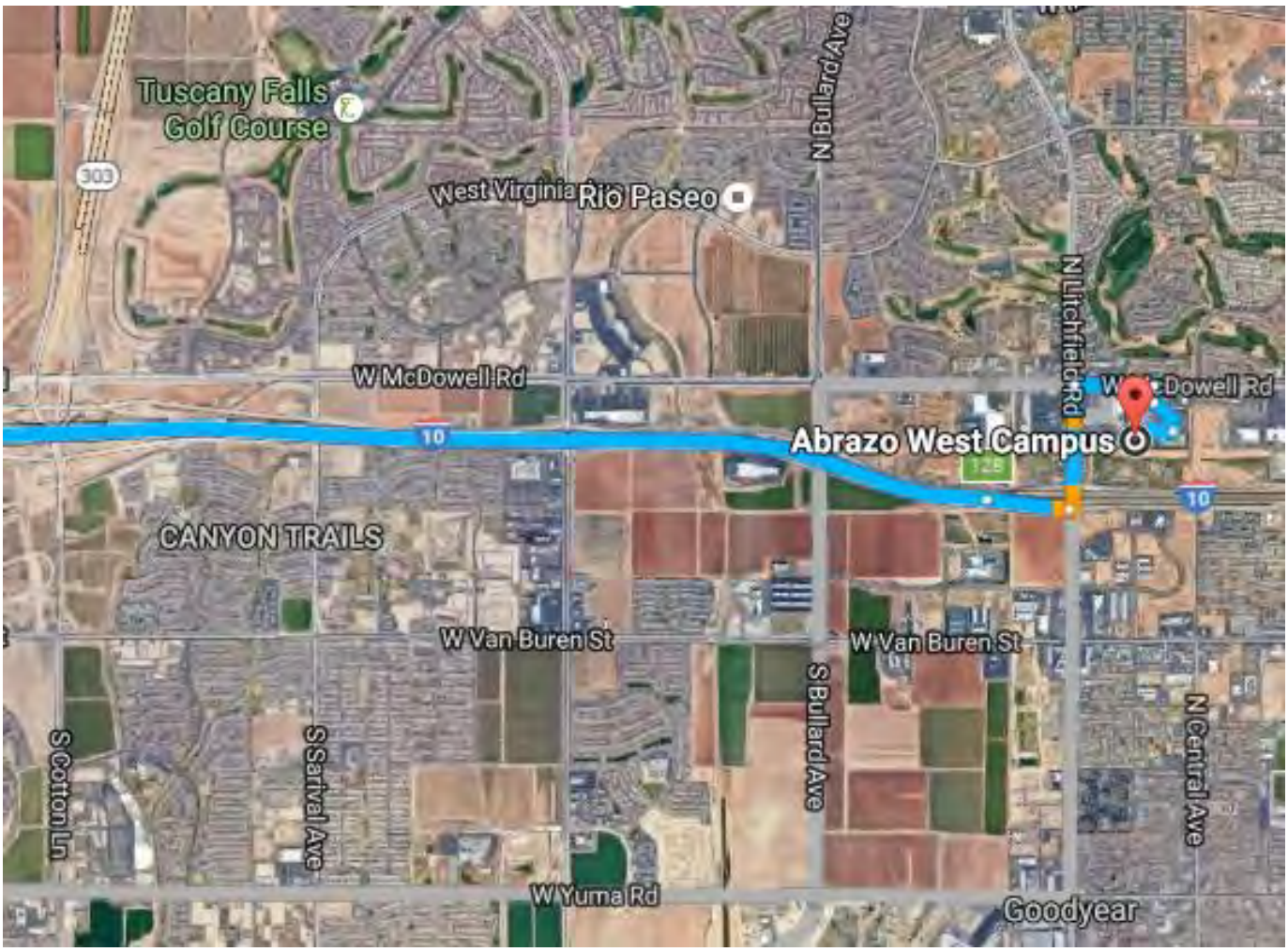


Figure 3 Zoomed in Directions from Unit 8 to Highway 85

Attachment 5

Part A Permit Application

OMB# 2050-0024; Expires 01/31/2017

SEND COMPLETED FORM TO: The Appropriate State or Regional Office.	United States Environmental Protection Agency **RCRA SUBTITLE C SITE IDENTIFICATION FORM**

1. Reason for Submittal

MARK ALL BOX(ES) THAT APPLY

Reason for Submittal:

- ☐ To provide an Initial Notification (first time submitting site identification information / to obtain an EPA ID number for this location)
- ☐ To provide a Subsequent Notification (to update site identification information for this location)
- ☐ As a component of a First RCRA Hazardous Waste Part A Permit Application
- ☒ As a component of a Revised RCRA Hazardous Waste Part A Permit Application (Amendment #_____)
- ☐ As a component of the Hazardous Waste Report (If marked, see sub-bullet below)
  - ☐ Site was a TSD facility and/or generator of >1,000 kg of hazardous waste, >1 kg of acute hazardous waste, or >100 kg of acute hazardous waste spill cleanup in one or more months of the report year (or State equivalent LQG regulations)

2. Site EPA ID Number

EPA ID Number A Z 4 5 7 0 0 2 4 1 3 9

3. Site Name

Name: Munitions Treatment Range, Unit 8, Barry M. Goldwater Range, Eastern Segment

4. Site Location Information

Street Address: South of Route 8 at Gila Bend and West of Range 4 Road

City, Town, or Village: Gila Bend | **County:** Maricopa

State: AZ | **Country:** USA | **Zip Code:** 85337

5. Site Land Type

☐ Private ☐ County ☐ District ☑ Federal ☐ Tribal ☐ Municipal ☐ State ☐ Other

6. NAICS Code(s) for the Site (at least 5-digit codes)

A. 9 2 8 1 1 | C.

B. | D.

7. Site Mailing Address

Street or P.O. Box: 13970 Gilespie Drive

City, Town, or Village: Luke Air Force Base

State: AZ | **Country:** USA | **Zip Code:** 85309

8. Site Contact Person

First Name: Jeff | **MI:** | **Last:** Rothrock

Title: Environmental Chief

Street or P.O. Box: 13970 Gillespie Drive

City, Town or Village: Luke Air Force Base

State: AZ | **Country:** USA | **Zip Code:** 85309

Email: charles.rothrock@us.af.mil

Phone: 623-856-3832 | **Ext.:** | **Fax:**

9. Legal Owner and Operator of the Site

A. Name of Site's Legal Owner: United States Air Force | **Date Became Owner:** 09/05/1941

Owner Type: ☐ Private ☐ County ☐ District ☑ Federal ☐ Tribal ☐ Municipal ☐ State ☐ Other

Street or P.O. Box:

City, Town, or Village: | **Phone:**

State: | **Country:** | **Zip Code:**

B. Name of Site's Operator: Luke Air Force Base | **Date Became Operator:** 09/05/1941

Operator Type: ☐ Private ☐ County ☐ District ☑ Federal ☐ Tribal ☐ Municipal ☐ State ☐ Other

10. Type of Regulated Waste Activity (at your site)
Mark "Yes" or "No" for all current activities (as of the date submitting the form); complete any additional boxes as instructed.

A. Hazardous Waste Activities; Complete all parts 1-10.

Y☐ N☐ **1. Generator of Hazardous Waste**
If "Yes," mark only one of the following – a, b, or c.

☐ a. LQG: Generates, in any calendar month, 1,000 kg/mo (2,200 lbs/mo.) or more of hazardous waste; **or** Generates, in any calendar month, or accumulates at any time, more than 1 kg/mo (2.2 lbs/mo) of acute hazardous waste; **or** Generates, in any calendar month, **or** accumulates at any time, more than 100 kg/mo (220 lbs/mo) of acute hazardous spill cleanup material.

☐ b. SQG: 100 to 1,000 kg/mo (220 – 2,200 lbs/mo) of non-acute hazardous waste.

☐ c. CESQG: Less than 100 kg/mo (220 lbs/mo) of non-acute hazardous waste.

If "Yes" above, indicate other generator activities in 2-10.

Y☐ N☐ **2. Short-Term Generator** (generate from a short-term or one-time event and not from on-going processes). If "Yes," provide an explanation in the Comments section.

Y☐ N☐ **3. United States Importer of Hazardous Waste**

Y☐ N☐ **4. Mixed Waste (hazardous and radioactive) Generator**

Y☐ N☐ **5. Transporter of Hazardous Waste**
If "Yes," mark all that apply.

☐ a. Transporter

☐ b. Transfer Facility (at your site)

Y☑ N☐ **6. Treater, Storer, or Disposer of Hazardous Waste** Note: A hazardous waste Part B permit is required for these activities.

Y☐ N☐ **7. Recycler of Hazardous Waste**

Y☐ N☐ **8. Exempt Boiler and/or Industrial Furnace**
If "Yes," mark all that apply.

☐ a. Small Quantity On-site Burner Exemption

☐ b. Smelting, Melting, and Refining Furnace Exemption

Y☐ N☐ **9. Underground Injection Control**

Y☐ N☐ **10. Receives Hazardous Waste from Off-site**

B. Universal Waste Activities; Complete all parts 1-2.

Y☐ N☑ **1. Large Quantity Handler of Universal Waste (you accumulate 5,000 kg or more) [refer to your State regulations to determine what is regulated]. Indicate types of universal waste managed at your site. If "Yes," mark all that apply.**

a. Batteries ☐
b. Pesticides ☐
c. Mercury containing equipment ☐
d. Lamps ☐
e. Other (specify) _____ ☐
f. Other (specify) _____ ☐
g. Other (specify) _____ ☐

Y☐ N☑ **2. Destination Facility for Universal Waste**
Note: A hazardous waste permit may be required for this activity.

C. Used Oil Activities; Complete all parts 1-4.

Y☐ N☑ **1. Used Oil Transporter**
If "Yes," mark all that apply.

☐ a. Transporter

☐ b. Transfer Facility (at your site)

Y☐ N☑ **2. Used Oil Processor and/or Re-refiner**
If "Yes," mark all that apply.

☐ a. Processor

☐ b. Re-refiner

Y☐ N☑ **3. Off-Specification Used Oil Burner**

Y☐ N☑ **4. Used Oil Fuel Marketer**
If "Yes," mark all that apply.

☐ a. Marketer Who Directs Shipment of Off-Specification Used Oil to Off-Specification Used Oil Burner

☐ b. Marketer Who First Claims the Used Oil Meets the Specifications

D. Eligible Academic Entities with Laboratories—Notification for opting into or withdrawing from managing laboratory hazardous wastes pursuant to 40 CFR Part 262 Subpart K

❖ You can ONLY Opt into Subpart K if:

- you are at least one of the following: a college or university; a teaching hospital that is owned by or has a formal affiliation agreement with a college or university; or a non-profit research institute that is owned by or has a formal affiliation agreement with a college or university; AND
- you have checked with your State to determine if 40 CFR Part 262 Subpart K is effective in your state

Y☐ N☐ 1. Opting into or currently operating under 40 CFR Part 262 Subpart K for the management of hazardous wastes in laboratories **See the item-by-item instructions for definitions of types of eligible academic entities. Mark all that apply:**

☐ **a. College or University**

☐ **b. Teaching Hospital that is owned by or has a formal written affiliation agreement with a college or university**

☐ **c. Non-profit Institute that is owned by or has a formal written affiliation agreement with a college or university**

Y☐ N☐ 2. Withdrawing from 40 CFR Part 262 Subpart K for the management of hazardous wastes in laboratories

11. Description of Hazardous Waste

A. Waste Codes for Federally Regulated Hazardous Wastes. Please list the waste codes of the Federal hazardous wastes handled at your site. List them in the order they are presented in the regulations (e.g., D001, D003, F007, U112). Use an additional page if more spaces are needed.

D003						

B. Waste Codes for State-Regulated (i.e., non-Federal) Hazardous Wastes. Please list the waste codes of the State-Regulated hazardous wastes handled at your site. List them in the order they are presented in the regulations. Use an additional page if more spaces are needed.

12. Notification of Hazardous Secondary Material (HSM) Activity

Y ☐ N ☐ Are you notifying under 40 CFR 260.42 that you will begin managing, are managing, or will stop managing hazardous secondary material under 40 CFR 261.2(a)(2)(ii), 40 CFR 261.4(a)(23), (24), or (25)?

If "Yes," you must fill out the Addendum to the Site Identification Form: Notification for Managing Hazardous Secondary Material.

13. Comments

This Part A Permit Application is being submitted concurrently with a RCRA Part B Post-Closure Application to renew the Barry M. Goldwater Range Munitions Treatment Range Unit 8 Post-Closure Permit. Unit 8 is a former munitions treatment burial pit that has been closed with a hazardous waste cap.

14. Certification. I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations. For the RCRA Hazardous Waste Part A Permit Application, all owner(s) and operator(s) must sign (see 40 CFR 270.10(b) and 270.11).

Signature of legal owner, operator, or an authorized representative	Name and Official Title (type or print)	Date Signed (mm/dd/yyyy)
	SCOTT L. PLEUS	01/22/2016
	Brigadier General, USAF	
	Commander, 56th Fighter Wing	

EPA ID Number | A | Z | 4 | 5 | 7 | 0 | 0 | 2 | 4 | 1 | 3 | 9 |

OMB#: 2050-0024; Expires 01/31/2017

United States Environmental Protection Agency

HAZARDOUS WASTE PERMIT INFORMATION FORM

1. Facility Permit Contact	**First Name:** Jeff	**MI:**	**Last Name:** Rothrock
	Contact Title: Environmental Chief		
	Phone: 623-856-3832	**Ext.:**	**Email:** charles.rothrock@us.af.mil
2. Facility Permit Contact Mailing Address	**Street or P.O. Box:** 13970 Gillespie Drive		
	City, Town, or Village: Luke Air Force Base		
	State: AZ		
	Country: USA	**Zip Code:** 85309	
3. Operator Mailing Address and Telephone Number	**Street or P.O. Box:** 13970 Gillespie Drive		
	City, Town, or Village: Luke Air Force Base		
	State: AZ	**Phone:** 623-856-3832	
	Country: USA	**Zip Code:** 85309	
4. Facility Existence Date	**Facility Existence Date (mm/dd/yyyy):** Mid 1970's - the history of the burial pit is not well documented.		

5. Other Environmental Permits

A. Facility Type *(Enter code)*	B. Permit Number	C. Description

6. Nature of Business: The mission of Luke AFB is to train the world's greatest F-35 and F-16 fighter pilots. The mission of the Barry M. Goldwater Range is to provide management of the air-to-air and air-to-ground tactical aviation range complexes and airspace while incorporating environment stewardship of the natural and cultural resources.

7. Process Codes and Design Capacities – Enter information in the Section on Form Page 3

A. PROCESS CODE – Enter the code from the list of process codes below that best describes each process to be used at the facility. If more lines are needed, attach a separate sheet of paper with the additional information. For "other" processes (i.e., D99, S99, T04 and X99), describe the process (including its design capacity) in the space provided in Item 8.

B. PROCESS DESIGN CAPACITY – For each code entered in Item 7.A; enter the capacity of the process.

1. **AMOUNT – Enter the amount. In a case where design capacity is not applicable (such as in a closure/post-closure or enforcement action) enter the total amount of waste for that process.**
2. **UNIT OF MEASURE – For each amount entered in Item 7.B(1), enter the code in Item 7.B(2) from the list of unit of measure codes below that describes the unit of measure used. Select only from the units of measure in this list.**

C. PROCESS TOTAL NUMBER OF UNITS – Enter the total number of units for each corresponding process code.

Process Code	Process	Appropriate Unit of Measure for Process Design Capacity
	Disposal	
D79	Underground Injection Well Disposal	Gallons; Liters; Gallons Per Day; or Liters Per Day
D80	Landfill	Acre-feet; Hectares-meter; Acres; Cubic Meters; Hectares; Cubic Yards
D81	Land Treatment	Acres or Hectares
D82	Ocean Disposal	Gallons Per Day or Liters Per Day
D83	Surface Impoundment Disposal	Gallons; Liters; Cubic Meters; or Cubic Yards
D99	Other Disposal	Any Unit of Measure Listed Below
	Storage	
S01	Container	Gallons; Liters; Cubic Meters; or Cubic Yards
S02	Tank Storage	Gallons; Liters; Cubic Meters; or Cubic Yards
S03	Waste Pile	Cubic Yards or Cubic Meters
S04	Surface Impoundment	Gallons; Liters; Cubic Meters; or Cubic Yards
S05	Drip Pad	Gallons; Liters; Cubic Meters; Hectares; or Cubic Yards
S06	Containment Building Storage	Cubic Yards or Cubic Meters
S99	Other Storage	Any Unit of Measure Listed Below
	Treatment	
T01	Tank Treatment	Gallons Per Day; Liters Per Day
T02	Surface Impoundment	Gallons Per Day; Liters Per Day
T03	Incinerator	Short Tons Per Hour; Metric Tons Per Hour; Gallons Per Hour; Liters Per Hour; BTUs Per Hour; Pounds Per Hour; Short Tons Per Day; Kilograms Per Hour; Gallons Per Day; Metric Tons Per Hour; or Million BTU Per Hour
T04	Other Treatment	Gallons Per Day; Liters Per Day; Pounds Per Hour; Short Tons Per Hour; Kilograms Per Hour; Metric Tons Per Day; Short Tons Per Day; BTUs Per Hour; Gallons Per Day; Liters Per Hour; or Million BTU Per Hour
T80	Boiler	Gallons; Liters; Gallons Per Hour; Liters Per Hour; BTUs Per Hour; or Million BTU Per Hour

Process Code	Process	Appropriate Unit of Measure for Process Design Capacity
	Treatment (Continued)	**(for T81 – T94)**
T81	Cement Kiln	Gallons Per Day; Liters Per Day; Pounds Per Hour; Short Tons Per Hour; Kilograms Per Hour; Metric Tons Per Day; Metric Tons Per Hour; Short Tons Per Day; BTU Per Hour; Liters Per Hour; Kilograms Per Hour; or Million BTU Per Hour
T82	Lime Kiln	
T83	Aggregate Kiln	
T84	Phosphate Kiln	
T85	Coke Oven	
T86	Blast Furnace	
T87	Smelting, Melting, or Refining Furnace	
T88	Titanium Dioxide Chloride Oxidation Reactor	
T89	Methane Reforming Furnace	
T90	Pulping Liquor Recovery Furnace	
T91	Combustion Device Used in the Recovery of Sulfur Values from Spent Sulfuric Acid	
T92	Halogen Acid Furnaces	
T93	Other Industrial Furnaces Listed in 40 CFR 260.10	
T94	Containment Building Treatment	Cubic Yards; Cubic Meters; Short Tons Per Hour; Gallons Per Hour; Liters Per Hour; BTU Per Hour; Pounds Per Hour; Short Tons Per Day; Kilograms Per Hour; Metric Tons Per Day; Gallons Per Day; Liters Per Day; Metric Tons Per Hour; or Million BTU Per Hour
	Miscellaneous (Subpart X)	
X01	Open Burning/Open Detonation	Any Unit of Measure Listed Below
X02	Mechanical Processing	Short Tons Per Hour; Metric Tons Per Hour; Short Tons Per Day; Metric Tons Per Day; Pounds Per Hour; Kilograms Per Hour; Gallons Per Hour; Liters Per Hour; or Gallons Per Day
X03	Thermal Unit	Gallons Per Day; Liters Per Day; Pounds Per Hour; Short Tons Per Hour; Kilograms Per Hour; Metric Tons Per Day; Metric Tons Per Hour; Short Tons Per Day; BTU Per Hour; or Million BTU Per Hour
X04	Geologic Repository	Cubic Yards; Cubic Meters; Acre-feet; Hectare-meter; Gallons; or Liters
X99	Other Subpart X	Any Unit of Measure Listed Below

Unit of Measure	Unit of Measure Code
Gallons	**G**
Gallons Per Hour	**E**
Gallons Per Day	**U**
Liters	**L**
Liters Per Hour	**H**
Liters Per Day	**V**

Unit of Measure	Unit of Measure Code
Short Tons Per Hour	**D**
Short Tons Per Day	**N**
Metric Tons Per Hour	**W**
Metric Tons Per Day	**S**
Pounds Per Hour	**J**
Kilograms Per Hour	**X**
Million BTU Per Hour	**X**

Unit of Measure	Unit of Measure Code
Cubic Yards	**Y**
Cubic Meters	**C**
Acres	**B**
Acre-feet	**A**
Hectares	**Q**
Hectare-meter	**F**
BTU Per Hour	**I**

7. Process Codes and Design Capacities (Continued)

EXAMPLE FOR COMPLETING Item 7 (shown in line number X-1 below): A facility has a storage tank, which can hold 533.788 gallons.

Line Number		A. Process Code (From list above)			B. PROCESS DESIGN CAPACITY (1) Amount (Specify)	(2) Unit of Measure	C. Process Total Number of Units	For Official Use Only
X	1	S	0	2	533.788	G	001	
	1	D	8	0	5136	S	001	
	2							
	3							
	4							
	5							
	6							
	7							
	8							
	9							
1	0							
1	1							
1	2							
1	3							

ote: If you need to list more than 13 process codes, attach an additional sheet(s) with the information in the same format as above. Number the line sequentially, taking into account any lines that will be used for "other" process (i.e., D99, S99, T04, and X99) in Item 8.

8. Other Processes (Follow instructions from Item 7 for D99, S99, T04, and X99 process codes)

Line Number (Enter #s in sequence with Item 7)		A. Process Code (From list above)			B. PROCESS DESIGN CAPACITY (1) Amount (Specify)	(2) Unit of Measure	C. Process Total Number of Units	For Official Use Only
X	2	T	0	4	100.00	U	001	

9. Description of Hazardous Wastes - Enter Information in the Sections on Form Page 5

A. EPA HAZARDOUS WASTE NUMBER – Enter the four-digit number from 40 CFR, Part 261 Subpart D of each listed hazardous waste you will handle. For hazardous wastes which are not listed in 40 CFR, Part 261 Subpart D, enter the four-digit number(s) from 40 CFR Part 261, Subpart C that describes the characteristics and/or the toxic contaminants of those hazardous wastes.

B. ESTIMATED ANNUAL QUANTITY – For each listed waste entered in Item 9.A, estimate the quantity of that waste that will be handled on an annual basis. For each characteristic or toxic contaminant entered in Item 9.A, estimate the total annual quantity of all the non-listed waste(s) that will be handled which possess that characteristic or contaminant.

C. UNIT OF MEASURE – For each quantity entered in Item 9.B, enter the unit of measure code. Units of measure which must be used and the appropriate codes are:

ENGLISH UNIT OF MEASURE	CODE	METRIC UNIT OF MEASURE	CODE
POUNDS	P	KILOGRAMS	K
TONS	T	METRIC TONS	M

If facility records use any other unit of measure for quantity, the units of measure must be converted into one of the required units of measure, taking into account the appropriate density or specific gravity of the waste.

D. PROCESSES

1. PROCESS CODES:

For listed hazardous waste: For each listed hazardous waste entered in Item 9.A, select the code(s) from the list of process codes contained in Items 7.A and 8.A on page 3 to indicate all the processes that will be used to store, treat, and/or dispose of all listed hazardous wastes.

For non-listed waste: For each characteristic or toxic contaminant entered in Item 9.A, select the code(s) from the list of process codes contained in Items 7.A and 8.A on page 3 to indicate all the processes that will be used to store, treat, and/or dispose of all the non-listed hazardous wastes that possess that characteristic or toxic contaminant.

NOTE: THREE SPACES ARE PROVIDED FOR ENTERING PROCESS CODES. IF MORE ARE NEEDED:

1. **Enter the first two as described above.**
2. **Enter "000" in the extreme right box of Item 9.D(1).**
3. **Use additional sheet, enter line number from previous sheet, and enter additional code(s) in Item 9.E.**

2. PROCESS DESCRIPTION: If code is not listed for a process that will be used, describe the process in Item 9.D(2) or in Item 9.E(2).

NOTE: HAZARDOUS WASTES DESCRIBED BY MORE THAN ONE EPA HAZARDOUS WASTE NUMBER – Hazardous wastes that can be described by more than one EPA Hazardous Waste Number shall be described on the form as follows:

1. **Select one of the EPA Hazardous Waste Numbers and enter it in Item 9.A. On the same line complete Items 9.B, 9.C, and 9.D by estimating the total annual quantity of the waste and describing all the processes to be used to store, treat, and/or dispose of the waste.**
2. **In Item 9.A of the next line enter the other EPA Hazardous Waste Number that can be used to describe the waste. In Item 9.D.2 on that line enter "included with above" and make no other entries on that line.**
3. **Repeat step 2 for each EPA Hazardous Waste Number that can be used to describe the hazardous waste.**

EXAMPLE FOR COMPLETING Item 9 (shown in line numbers X-1, X-2, X-3, and X-4 below) – A facility will treat and dispose of an estimated 900 pounds per year of chrome shavings from leather tanning and finishing operations. In addition, the facility will treat and dispose of three non-listed wastes. Two wastes are corrosive only and there will be an estimated 200 pounds per year of each waste. The other waste is corrosive and ignitable and there will be an estimated 100 pounds per year of that waste. Treatment will be in an incinerator and disposal will be in a landfill.

Line Number		A. EPA Hazardous Waste No. (Enter code)				B. Estimated Annual Qty of Waste	C. Unit of Measure (Enter code)	D. PROCESSES									
								(1) PROCESS CODES (Enter Code)									(2) PROCESS DESCRIPTION (If code is not entered in 9.D(1))
X	1	K	0	5	4	900	P	T	0	3	D	8	0				
X	2	D	0	0	2	400	P	T	0	3	D	8	0				
X	3	D	0	0	1	100	P	T	0	3	D	8	0				
X	4	D	0	0	2												Included With Above

9. Description of Hazardous Wastes ***(Continued. Use additional sheet(s) as necessary; number pages as 5a, etc.)***

Line Number		A. EPA Hazardous Waste No. (Enter code)				B. Estimated Annual Qty of Waste	C. Unit of Measure (Enter code)	D. PROCESSES									
								(1) PROCESS CODES (Enter Code)									(2) PROCESS DESCRIPTION (If code is not entered in 9.D(1))
	1	D	0	0	3	5136	M	D	8	0							Capped Landfill
	2																
	3																
	4																
	5																
	6																
	7																
	8																
	9																
1	0																
1	1																
1	2																
1	3																
1	4																
1	5																
1	6																
1	7																
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1	9																
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2	7																
2	8																
2	9																
3	0																
3	1																
3	2																
3	3																
3	4																
3	5																
3	6																

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9. Description of Hazardous Wastes *(Continued. Use additional sheet(s) as necessary; number pages as 5a, etc.)*

Line Number		A. EPA Hazardous Waste No. (Enter code)				B. Estimated Annual Qty of Waste	C. Unit of Measure (Enter code)	D. PROCESSES									
								(1) PROCESS CODES (Enter Code)									(2) PROCESS DESCRIPTION (If code is not entered in 9.D.1)

10. Map

Attach to this application a topographical map, or other equivalent map, of the area extending to at least one mile beyond property boundaries. The map must show the outline of the facility, the location of each of its existing intake and discharge structures, each of its hazardous waste treatment, storage, or disposal facilities, and each well where it injects fluids underground. Include all spring, rivers, and other surface water bodies in this map area. See instructions for precise requirements.

11. Facility Drawing

All existing facilities must include a scale drawing of the facility (see instructions for more detail).

12. Photographs

All existing facilities must include photographs (aerial or ground-level) that clearly delineate all existing structures; existing storage, treatment, and disposal areas; and sites of future storage, treatment, or disposal areas (see instructions for more detail).

13. Comments

This Part A Permit Application is being submitted concurrently with a RCRA Part B Post-Closure Application to renew the Barry M. Goldwater Range Munitions Treatment Range Unit 8 Post-Closure Permit. Unit 8 is a former munitions treatment burial pit that has been closed with a hazardous waste cap.