DRAFT

ENVIRONMENTAL ASSESSMENT FOR WILDLIFE CONTROL ACTIONS AT WILLIAMS LAKE BUCKLEY AIR FORCE BASE

DEPARTMENT OF THE AIR FORCE
BUCKLEY AIR FORCE BASE, COLORADO

AIR FORCE CENTER FOR
ENGINEERING AND THE ENVIRONMENT

APRIL 2012

ACRONYMS

°F	degrees Fahrenheit
140 WG/SE	140th Wing Safety Office
460 SW	460th Space Wing
AASF	Army Aviation Support Facility
ACHP	Advisory Council on Historic Preservation
AFB	Air Force Base
AFI	Air Force Instruction
AICUZ	Air Installation Compatible Use Zone
AIRFA	American Indian Religious Freedom Act
ANG	Air National Guard
ANGB	Air National Guard Base
APZ	Accident Potential Zone
AQCR	Air Quality Control Region
AT/FP	Antiterrorism Force Protection
BASH	Bird-Aircraft Strike Hazard
BMP	best management practice
CAA	Clean Air Act
CDOW	Colorado Division of Wildlife
CDPHE	Colorado Department of Public Health and Environment
CDWR	Colorado Department of Water Resources
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CGP	construction general permit
CNHP	Colorado Natural Heritage Program
CO	carbon monoxide
COANG	Colorado Air National Guard
CWA	Clean Water Act
CZ	Clear Zone
DoD	Department of Defense
E-	Expressway
EA	Environmental Assessment
EIAP	Environmental Impact Analysis Process
EO	Executive Order
ERP	Environmental Restoration Program
ESA	Endangered Species Act
ETL	Engineering Technical Letter
FONPA	Finding of No Practicable Alternative
FONSI	Finding of No Significant Impact
FTA	Federal Transit Authority
FY	Fiscal Year
HAP	hazardous air pollutant
I-	Interstate
IICEP	Interagency and Intergovernmental Coordination for Environmental Planning
JFHQ-CO	Joint Force Headquarters – Colorado
MBTA	Migratory Bird Treaty Act
MGY	million gallons per year
mph	miles per hour
MS4	Municipal Separate Storm Sewer System
msl	mean sea level
mya	million years ago
N/A	not applicable
NAAQS	National Ambient Air Quality Standards
NAGPRA	Native American Graves Protection and Repatriation Act
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NIOC	Naval Information Operations Command
NO_2	nitrogen dioxide
NOI	Notice of Intent
NOSC	Navy Operational Support Center
NO_x	nitrogen oxides
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NSR	New Source Review
O_3	ozone
ODS	Ozone Depleting Substances
Pb	lead
PM_{10}	particulate matter equal to or less than ten microns in diameter
$PM_{2.5}$	particulate matter equal to or less than 2.5 microns in diameter
PSD	Prevention of Significant Deterioration
QD	quantity-distance
ROI	region of influence
RTD	Regional Transportation District
sf	square foot/feet
SIP	State Implementation Plan
SO_2	sulfur dioxide
SO_x	sulfur oxide
SWPPP	Storm Water Pollution Prevention Plan
sy	square yard
tpy	tons per year
UFC	Unified Facilities Criteria
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
USC	U.S. Code
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
WRCC	Western Regional Climate Center

DRAFT
FINDING OF NO SIGNIFICANT IMPACT & FINDING OF NO PRACTICABLE ALTERNATIVE

WILDLIFE CONTROL ACTIONS AT WILLIAMS LAKE BUCKLEY AIR FORCE BASE, COLORADO

Pursuant to provisions of the National Environmental Policy Act (NEPA), 42 U.S. Code 4321 *et seq.*, implementing Council on Environmental Quality (CEQ) Regulations, 40 Code of Federal Regulations (CFR) 1500-1508, and 32 CFR Part 989, *Environmental Impact Analysis Process* (EIAP), the U.S. Air Force (Air Force) conducted an assessment of the potential environmental consequences of implementing wildlife control actions at Williams Lake, located at Buckley Air Force Base (AFB), Colorado. This Environmental Assessment (EA), *EA for Wildlife Control Actions at Williams Lake*, incorporated by reference in this finding, considers the potential impacts of the Proposed Action on the natural and human environments.

Proposed Action and Alternatives

The Proposed Action comprises development and implementation of a Wildlife Management Control Program for Williams Lake that incorporates specific recommendations from Buckley AFB's Bird/Wildlife Aircraft Strike Hazard (BASH) Plan required to minimize or prevent wildlife interference with aircraft operations on the base. Alternative 1, the Preferred Alternative, would include relocation of existing fish, draining water from the lake, removal of Williams Lake dam, and regrading the Williams Lake drainage basin to predevelopment drainage conditions. Alternative 2 is similar to the Preferred Alternative; however, under Alternative 2, Williams Lake dam would not be removed and regrading of the drainage basin would not occur. The No-Action Alternative would include continued implementation of wildlife deterrence measures Williams Lake; however, no wildlife habitat modifications or improvements would be conducted.

Summary of Findings

The analyses of the affected environment and environmental consequences of implementing the Proposed Action presented in the EA concluded that no significant adverse effects would result. In addition, no cumulative adverse impacts would result from activities associated with the project when considered in conjunction with recent, past, and future projects within the project area. As there would be no significant adverse environmental impacts associated with implementation of the Proposed Action, no mitigation measures are necessary.

The proposed management practices identified in the EA are standard construction management practices that would be implemented by the contractor to comply with permit requirements.

Seven areas of environmental consequences evaluated in detail in the EA were determined to have the potential to result in less than significant impacts that are described below.

- **Biological Resources.** Construction activities would result in localized minor impacts to vegetation and wildlife due to excavation, trenching, and other site preparation activities. However, these impacts would be short-term and last only for the duration of construction activities and revegetation of disturbed sites would be accomplished using appropriate and proven reseeding techniques. The Proposed Action is expected to have negligible impacts on special-status species, and best management practices (BMPs) and appropriate avoidance and management procedures would be incorporated as applicable. Non-jurisdictional wetlands associated with an unnamed tributary of Sand Creek and adjacent to Williams Lake would be impacted under the Proposed Action. Minor to moderate short-term impacts to these non-jurisdictional wetlands are anticipated under the Preferred Alternative and Alternative 2. However, the wetland areas that would be potentially impacted are not considered high-value from an ecosystem function standpoint and are not known to support any sensitive plant and wildlife species or critical habitat for threatened or endangered species and they are currently actively managed to discourage wildlife access, due to BASH concerns. Similar wetland and riparian habitat also exist in and around nearby (approximately 1700 feet) Sand Creek and any species potentially displaced could relocate there and easily find a place to forage, nest, and roost. In addition, these non-jurisdictional wetlands are man-made resulting from construction of Williams Lake Dam and the Preferred Alternative would include habitat improvements that would mirror pre-development hydrologic and vegetative conditions to the maximum extent feasible and would help to restore pre-development ecosystem functions. Because the existing wetlands do not support critical habitat or sensitive species, are considered low value from an ecosystem standpoint, are currently managed to discourage wildlife access, because the Preferred Alternative will restore pre-development ecosystem functions, and there is similar habitat in abundance nearby any potential impacts to the existing non-jurisdictional wetlands are expected to be less than significant and if no replacement of these wetlands is conducted the impacts are also expected to be less than significant. Therefore, no further mitigation is required.

- **Water Resources.** Construction activities under the Proposed Action would incorporate BMPs to minimize erosion, runoff, and sedimentation, and a Storm Water Pollution Prevention Plan (SWPPP) containing additional BMPs and other procedures would be implemented to prevent adverse impacts to surface water. No impacts to regional surface water systems, including the South Platte River, are anticipated under either the Preferred Alternative or Alternative 2. With regard to the impacts to floodplains, the Preferred Alternative would incorporate proposed drainage improvements that would be designed to provide adequate capacity to convey water from a 100-year storm event. The resulting footprint of the non-regulated Williams Lake drainage area specific 100-year floodplain associated with the Preferred Alternative would experience an overall reduction in size, including a reduction in the total coverage of the existing 100-year floodplain, which is located on off-base property. Under Alternative 2, the existing dam structure would remain in place and act as a retention barrier to any upstream surface flows; therefore, Alternative 2 would not result in any impacts to floodplains.

- **Geological Resources.** Potential impacts to geological resources associated with the Proposed Action would be limited to ground-disturbing activities (i.e., excavation/trenching) during construction or operational maintenance activities. BMPs would be implemented to minimize potential occurrences of erosion, siltation, and soil compaction, and any impacts would be minor and would last only for the duration of ground-disturbing activities. Once proposed activities under either the Preferred Alternative or Alternative 2 would be complete, potential impacts to soils would be negligible. Therefore, implementation of the Proposed Action would result in less than significant impacts to geological resources.

- **Air Quality.** Fugitive dust would be generated from construction activities, including excavation, trenching, and other ground-disturbing activities. Implementation of standard BMPs for dust control (e.g., regularly watering exposed soils, soil stockpiling, soil stabilization, etc.) would reduce potential impacts to negligible levels. Combustion emissions resulting from construction activities under both the Preferred Alternative and Alternative 2 would be below *de minimis* thresholds for a General Conformity determination, and would not exceed 10 percent of the regional emissions inventory. Therefore, implementation of the Proposed Action would result in less than significant air quality impacts.

- **Safety.** Implementation of either the Preferred Alternative or Alternative 2 would measurably reduce the mishap potential related to BASH at Williams Lake by entirely eliminating the lake and its potential food source as a wildlife attractant. Therefore, with regard to mishaps and BASH, major positive short- and long-term impacts would result from implementation of the Proposed Action. In addition, the Proposed Action would result in less than significant impacts to airfield safety zones and no impact to explosives safety.

- **Land Use.** Implementation of the Proposed Action would not result in any changes to existing land use patterns on-base and would be consistent with existing land use designations. Either the Preferred Alternative or Alternative 2 would adversely affect existing recreational uses at Williams Lake (i.e., fishing); however, other recreational uses at Williams Lake (e.g., camping, trails, and picnic areas) and the rest of Buckley AFB would not be impacted. Further, regrading and revegetation of the area under the Preferred Alternative would maintain the open space character of the area and support its primary purpose as an attractive recreational area. Therefore, impacts to land use compatibility and recreation would be considered less than significant.

- **Visual Resources.** Implementation of the Proposed Action would result in a landscape aesthetically consistent with the surrounding visual character of the area. Therefore, long-term impacts to visual resources are anticipated to be less than significant under either the Preferred Alternative or Alternative 2.

Finding of No Significant Impact & Finding of No Practicable Alternative

Based upon my review of the facts and analyses contained in the attached EA, conducted in accordance with the provisions of NEPA, the CEQ Regulations, and 32 CFR Part 989, I conclude that the Proposed Action will not have a significant environmental impact, either by itself or cumulatively with other ongoing projects at Buckley AFB, will not involve an element of high risk or uncertainty on the human environment, and its effects on the quality of the human environment are not highly controversial. Pursuant to Executive Order (EO) 11988, *Floodplain Management* and the authority delegated by the Secretary of the Air Force Order 791.1, I find there is no practicable alternative to conducting the Proposed Action within a floodplain. Also, pursuant to EO 11990, *Protection of Wetlands,* I find there is no practicable alternative for implementing the Preferred Alternative without the further risk to public health or safety. The Air Force further finds all practicable measures have been taken to minimize harm to the floodplain and wetlands, and proposed measures to minimize impacts are documented in the EA. This finding fulfills both the requirements of the

referenced EOs and 32 CFR 989.14 requirements for a Finding of No Practicable Alternative. Accordingly, an Environmental Impact Statement is not required. The signing of this Finding of No Significant Impact & Finding of No Practicable Alternative completes the environmental impact analysis process.

Approved by:

JEFFREY C. ALLEN	DATE
SES, DAF	
Director of Logistics, Installations and Mission Support	

ENVIRONMENTAL ASSESSMENT
FOR WILDLIFE CONTROL ACTIONS AT WILLIAMS LAKE
FOR BUCKLEY AFB

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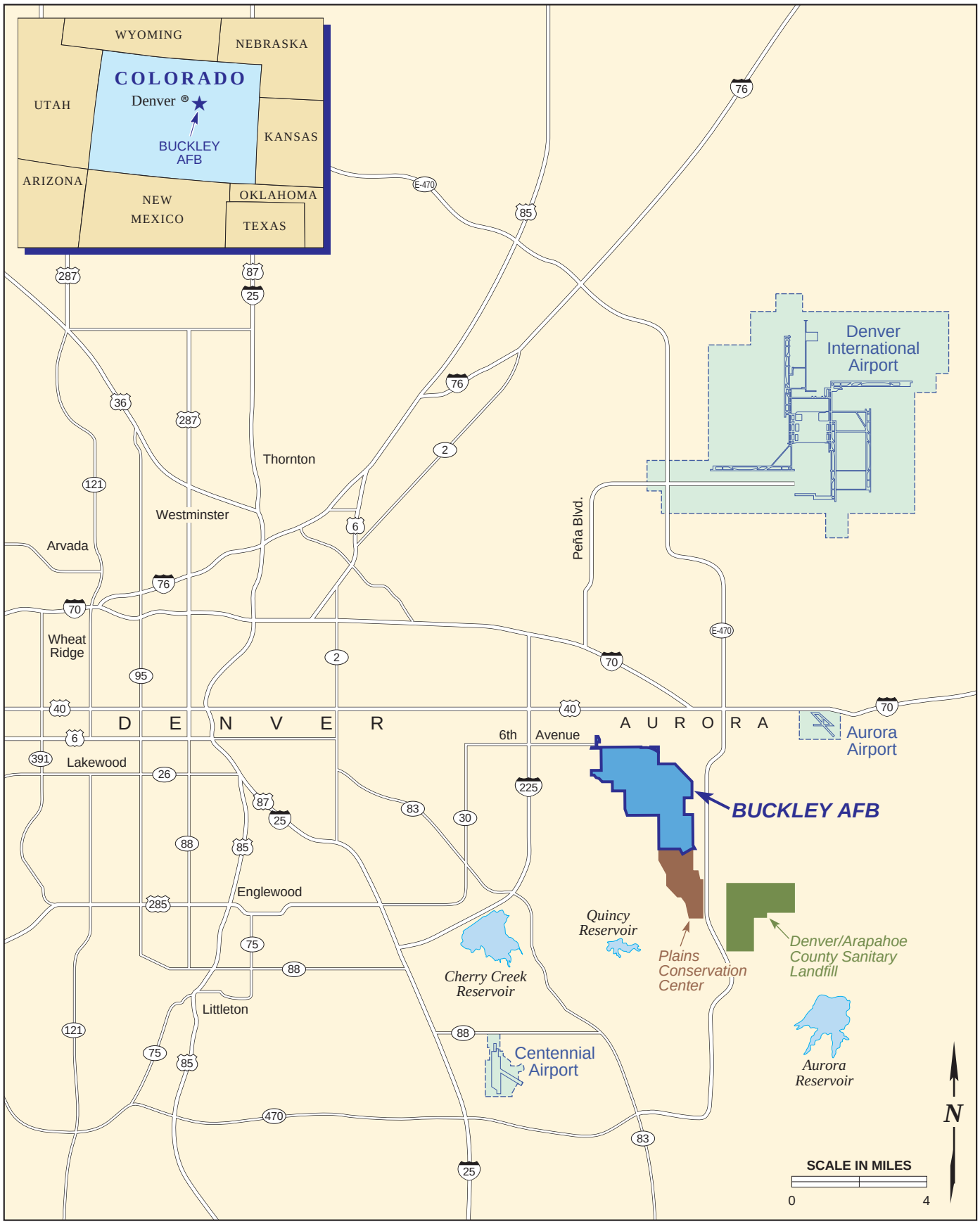
SECTION 1
OVERVIEW

1.1 INTRODUCTION

This Environmental Assessment (EA) has been prepared in accordance with the U.S. Air Force (USAF) Environmental Impact Analysis Process (EIAP) (32 Code of Federal Regulations [CFR] Part 989) to assess potential environmental impacts associated with implementing wildlife control actions at Williams Lake, located at Buckley Air Force Base (AFB), Colorado. The Proposed Action to be addressed in this EA comprises development and implementation of a Wildlife Management Control Program at Williams Lake and incorporation of specific recommendations from Buckley AFB's Bird/Wildlife Aircraft Strike Hazard (BASH) Plan required to minimize or prevent wildlife interference with aircraft operations on the base. The Proposed Action may make some of the actions specified in the Buckley AFB BASH Plan unnecessary or may require less frequent implementation. Williams Lake is located approximately 2,083 feet from the base's primary runway and is in close proximity to the normal overhead aircraft traffic pattern; the attraction and presence of birds at the lake poses a threat to aircraft safety. Specific action alternatives considered in this EA include removal of the Williams Lake dam and drainage of the lake.

1.2 LOCATION AND BACKGROUND

Buckley AFB, abutting the eastern limits of the City of Aurora, is located in Arapahoe County, approximately 5 miles east of Denver and approximately 10 miles southwest of Denver International Airport (Figure 1-1). Regional access to the base is provided by toll highway Expressway 470 (E-470), from which the base can be reached by Jewell Avenue, as well as by Interstate 25 (I-25), I-225, I-70, and I-76. Access to the base from the City of Aurora is via East Mississippi Avenue and 6th Avenue. Predominant land use activities in the area comprise high-density residential, commercial, and light industrial to the north and west of the base. East of the base are several large undeveloped parcels, a small municipal airport (Aurora Airport), the Denver/Arapahoe County Sanitary Landfill, and smaller areas under various phases of residential expansion. The base comprises about 3,283 acres, virtually all of which have been disturbed or developed to support USAF missions (Figure 1-2).

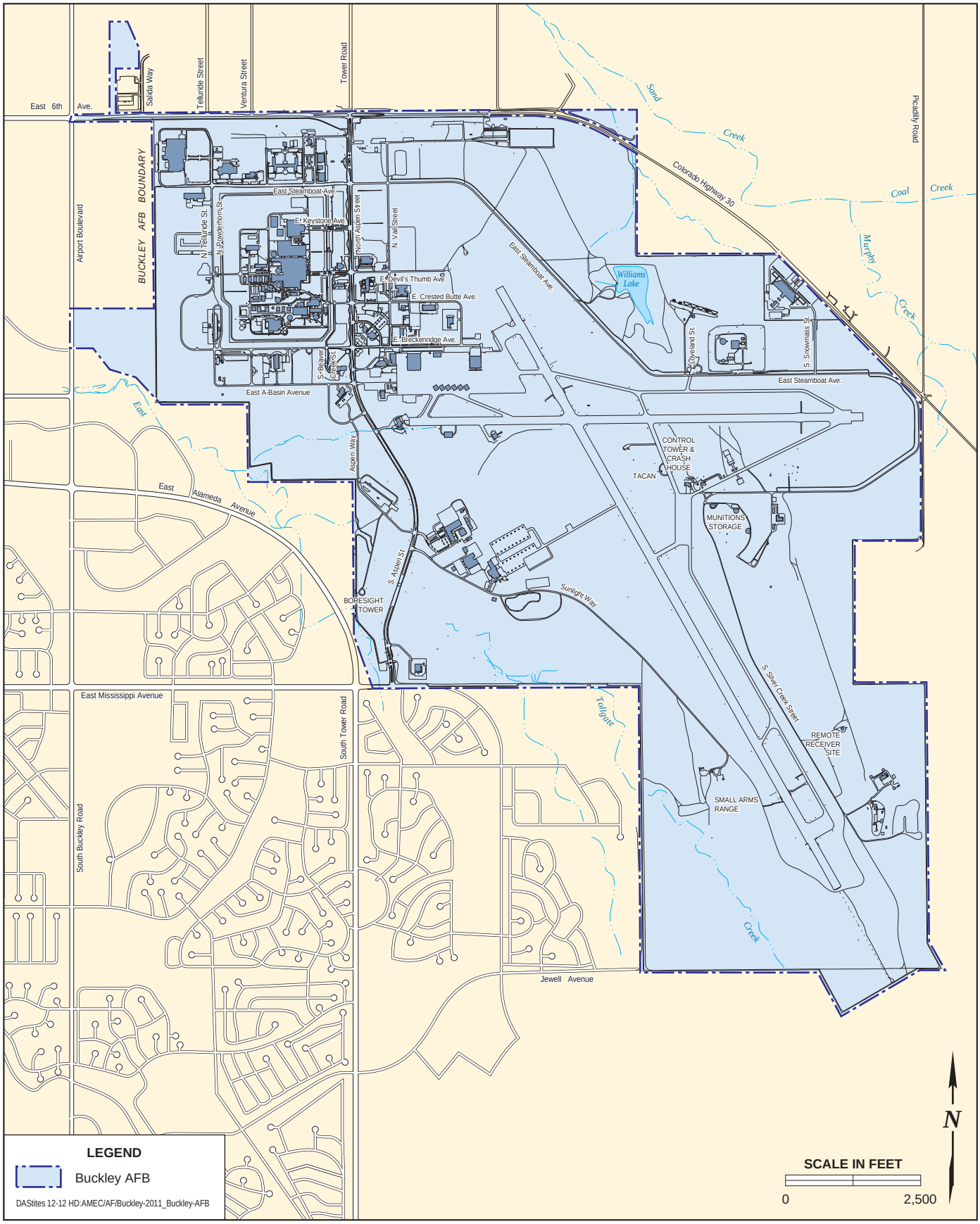


EA

Location of Buckley AFB
Aurora, Colorado

FIGURE 1-1

No warranty is made by the State/Territory as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document," in that it is intended to change as new data become available and are incorporated into the GIS database.



EA

Buckley AFB

FIGURE 1-2

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The 460th Space Wing (460 SW) is a unit of the USAF and is the current host unit at Buckley AFB. The unit's mission statement is "We are ready forces providing space-based warning and awareness – protecting the homeland and global warfighters." In addition to the 460 SW, several major tenant organizations are located at Buckley AFB.

1.3 PURPOSE AND NEED

The *purpose* of the Proposed Action is to reduce wildlife strike hazards and satisfy aircraft operation needs, improve safety conditions (for pilots, personnel on the installation, and in the surrounding community), reduce substantial costs associated with aircraft damage or loss (which can be as high as several million dollars per incident), satisfy base mission objectives, satisfy elements of the base's Integrated Natural Resources Management Plan, and support objectives of the National Security Strategy.

The *need* for the Proposed Action is driven by safety concerns related to wildlife interference with aircraft operations at Buckley AFB. Due to the location of Williams Lake and its close proximity to Buckley AFB's runway with direct overhead operation of Buckley AFB aircraft and transient (visiting) aircraft and the lake's tendency to attract birds – especially waterfowl – and other wildlife species, the lake poses a potential threat to flight safety related to Bird/Wildlife-Aircraft Strike Hazard (BASH). The Proposed Action would include implementation of accepted wildlife control techniques to modify habitat for targeted species and achieve a balance between management of natural resources and flight safety.

1.3.1 Project History and Planning Process

Williams Lake, located in the northeastern part of Buckley AFB, is a man-made reservoir approximately 10 acres in size that was originally developed for recreational purposes. It was created in 1961 by damming a minor tributary of Sand Creek. The water level within the lake was historically maintained by a well and supplemented by rainwater runoff from Buckley AFB; however, the well was shut off in 2011 and is no longer supplying water to maintain the water level at Williams Lake. Instead, water supplies in the lake are augmented by upstream surface runoff only. For much of its history, Williams Lake served as a recreational fishery, including a bass and bluegill stocking program started by

the Air National Guard (ANG) (when the facility was an ANG base) and the U.S. Fish and Wildlife Service (USFWS) in the mid-1990s. However, recreational fishing has decreased over the years and the fishing program at Williams Lake was suspended in 2011.

Buckley AFB's Bird Hazard Working Group identified a total of three bird strikes in 2009, costing $715,098 in damage (Buckley AFB 2010b; 2011a). Additionally, past wildlife hazards have included two coyote strikes by F-16s at the base. Many of the recent strikes have been recorded in the airfield environment where the situation can be addressed through habitat management, bird watch condition warnings, control of wildlife populations, and bird dispersal techniques.

Bird strikes have occurred throughout the year and at varying times of day. Migrant birds cause potential problems during both spring and autumn migration periods and breeding grassland birds cause problems during summer months. These safety conditions are the target of the BASH Plan at Buckley AFB. The U.S. Department of Agriculture (USDA) Wildlife Services currently has a two-year full-time contract to assist base personnel with wildlife management and control.

In 2003-2004, USDA conducted a 14-month Wildlife Hazard Assessment for the purpose of identifying wildlife attractants at Buckley AFB, specific hazardous species observed in surveys conducted throughout this period, and quantification of the threat that these species represented. The assessment concluded that the best method to control waterfowl is the removal or exclusion of attractive wetland/pond habitats (USDA 2004).

The 140th Wing Safety Office (140 WG/SE) has documented a position that actions should be taken to address the use of Williams Lake by waterfowl species. The increase in pelican population is of particular concern because from 1985 to 2006 the average cost to the USAF for each pelican strike was over $12.2 million. By comparison, the Canada goose average cost per strike was more than $1.2 million per strike (USAF 2007).

In a memo dated 21 June 2006 to Bruce James (Chief, Environmental Flight), USDA recommended that Williams Lake be drained because of its risk to aviation and advised against "practices which have the potential to attract

additional birds to Williams Lake. Such practices would include stocking with fish, installing water aerators/fountains, and pumping water to maintain the lake" (USDA 2006).

An independent BASH consultant that contributed to preparation of the Buckley AFB BASH Plan said of Williams Lake in that document, "Due to its close proximity to the approach end of Runway 14 a long term solution needs to be explored to detract larger species of birds from approaching the runway" (USAF 2006). Additionally, in November 2006, Buckley AFB received an Environmental, Safety Occupational Health Compliance Assessment and Management Program evaluation, in which the flight safety inspector identified the hazard Williams Lake posed as a major finding and determined this hazard posed a high risk that needs to be addressed (Buckley AFB 2006).

Buckley AFB previously prepared an EA and Finding of No Significant Impact (FONSI) in 2010 (Buckley AFB 2010a) that included three alternatives which included implementing the Buckley AFB BASH Plan (No Action Alternative, Alternative A), implementing a wire grid system to prevent birds from landing on the lake (Alternative B), and draining and removing the dam (Alternative C). The wire grid system has since been an deemed an insufficient alternative to control the BASH risk posed by the lake because it would not eliminate the attractiveness to birds to the area even though it would help prevent birds from landing on the lake.

Buckley AFB has also recently completed habitat modification by removing trees along East Tollgate Creek that were also near the Buckley AFB airfield that provided perching, roosting, nesting, and foraging habitat for large birds that were mostly raptor (hawks, eagles, and owls) species. As with the Proposed Action in this EA, the intent for the habitat modification along East Tollgate Creek was intended to help prevent a collision with aircraft that could result in catastrophic engine failure. An EA and FONSI was also prepared before that action (Buckley AFB 2011d)

1.4 SUMMARY OF ENVIRONMENTAL STUDY REQUIREMENTS

The EIAP is the process by which Federal agencies facilitate consideration of environmental regulations and through which the public and agencies have an opportunity to make known their concerns about federally proposed or funded

activities. The primary legislation affecting these agencies' decision-making process is the National Environmental Policy Act (NEPA). This act and other facets of the EIAP are briefly summarized below. Expanded summaries of the regulations pertaining to the EIAP are provided in Appendix A.

National Environmental Policy Act. The intent of NEPA is to protect, restore, or enhance the environment through well-informed Federal decisions. The Council on Environmental Quality (CEQ) was established under NEPA and subsequently issued *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act* (40 CFR § 1500-1508, 32 CFR part 989).

Endangered Species Act of 1973. Established measures for the protection of plant and animal species that are federally listed as threatened and endangered, and for the conservation of habitats that are critical to the continued existence of those species.

Clean Air Act and Conformity Requirements. Provided the authority for the U.S. Environmental Protection Agency (USEPA) to establish nationwide air quality standards to protect public health and welfare (i.e., National Ambient Air Quality Standards [NAAQS]). The USEPA requires the proponent of a proposed action to perform an analysis to determine if its implementation would conform to the State Implementation Plan (SIP).

Water Resources Regulatory Requirements. The Clean Water Act (CWA) of 1977 (33 U.S. Code [USC] §§ 1251 *et seq.*) regulates pollutant discharges that could affect aquatic life forms or human health and safety. Section 404 of the CWA, and Executive Order (EO) 11990, *Protection of Wetlands*, regulate development activities in or near streams or wetlands. EO 11988, *Floodplain Management*, requires Federal agencies to take action to reduce the risk of flood damage. Federal agencies are directed to consider the proximity of their actions to or within floodplains.

Cultural Resources Regulatory Requirements. The National Historic Preservation Act of 1966 (NHPA) established the National Register of Historic Places (NRHP) and the Advisory Council on Historic Preservation (ACHP) which outlined procedures for the management of cultural resources on Federal property. EO 13007, *Indian Sacred Sites*, directs Federal agencies to accommodate access to, and ceremonial use of, sacred Indian sites. The American Indian

Religious Freedom Act (AIRFA) established Federal policy to protect and preserve the rights of Native Americans to believe, express, and exercise their traditional religions, including providing access to sacred sites. The Native American Graves Protection and Repatriation Act (NAGPRA) requires consultation with Native American tribes prior to excavation or removal of human remains and certain objects of cultural importance.

Antiterrorism Force Protection (AT/FP). The DoD has developed AT/FP standards that are designed to reduce the likelihood of physical damage and mass casualties from potential terrorist attacks. Unified Facilities Criteria (UFC) 4-010-01, *DoD Minimum Anti-terrorism Standards for Buildings,* outlines various planning, construction, and operational standards to address potential terrorist threats.

Sustainability and Greening. EO 13514, *Federal Leadership in Environmental, Energy, and Economic Performance,* strives to improve efficiency and environmental performance in Federal agencies by setting goals in the areas of energy efficiency, greenhouse gas emission mitigation, water conservation, waste management and recycling, green procurement, pollution prevention, and livable communities, among others.

Environmental Justice and Protection of Children. EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, ensures that citizens in either of these categories are not disproportionately affected. Potential health and safety impacts that could disproportionately affect children are considered under the guidelines established by EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks*.

Interagency and Intergovernmental Coordination for Environmental Planning (IICEP). IICEP is a federally mandated process for informing and coordinating with other governmental agencies regarding proposed actions. Through the IICEP process, the USAF will notify relevant Federal, state, and local agencies regarding the proposed action and incorporate comments in the EA (refer to Appendix B).

1.5 SCOPE OF THE ENVIRONMENTAL ASSESSMENT

1.5.1 Issues Studied in Detail

This EA provides detailed analyses of potential environmental impacts to the following resources that would likely be affected by implementation of the Proposed Action:

- Biological Resources
- Water Resources
- Geological Resources
- Air Quality
- Safety (including BASH)
- Land Use (including Recreation)
- Visual Resources

1.5.2 Issues Eliminated from Further Study

Per NEPA and CEQ regulations, environmental resource areas that are anticipated to experience either no or negligible environmental impact under implementation of the Proposed Action are not examined in detail in this EA. These environmental resources include:

- Noise
- Cultural Resources
- Transportation and Circulation
- Utilities
- Hazardous Materials and Wastes
- Socioeconomics
- Environmental Justice
- Airspace Management

A brief summary of the reasons for not undergoing detailed analyses of these resources is provided below.

Noise. Under the Proposed Action, construction activities would generate temporary, localized minor noise increases in the vicinity of the project footprint. Further, no sensitive receptors are currently located within the vicinity of Williams Lake and it is anticipated that the planned Family Camp Area adjacent to Williams Lake would be closed during construction activities. Once

completed, no operational noise sources would be established and no increases in traffic would occur. In addition, all noise-generating activities would occur in an environment dominated heavily by aircraft noise.

Cultural Resources. The Proposed Action would not occur in an area of potential effect to previously identified historic properties, which are cultural properties that are eligible for inclusion on the National Registry of Historic Places (NRHP). In the unlikely event that cultural resources are encountered within the project area or in the unlikely event that human remains, funerary objects, or Native American sacred objects are discovered, all work in the area will be stopped and the discoveries will be evaluated in accordance with the NHPA and NAGPRA and further coordination will be completed with the Colorado State Historic Preservation Office (SHPO) and the Buckley AFB Tribal Stakeholders.

Transportation and Circulation. Activities under the Proposed Action would result in negligible increases in traffic on base. Additionally, any increases would be short-term and would cease upon the completion of construction activities. Construction activities would occur on active roadways and would result in localized, minor impacts over the short term and no impacts over the long term.

Utilities. Activities under the Proposed Action would be subject to standard design review requirements in order to avoid inadvertent interruption of existing subsurface utilities on base. In addition, the Proposed Action is not expected to result in any measurable increases in utility demands over existing conditions.

Hazardous Materials and Wastes. The Proposed Action would result in a short-term increase in the storage of construction-related hazardous materials and waste; however, the increase would be temporary and would constitute a negligible impact. In addition, although Environmental Restoration Program (ERP) Site 5 is located to the southeast of Williams Lake, the site would not be disturbed by implementation of the Proposed Action and current ERP investigations indicate that the site has negligible contamination levels (Buckley AFB 2010a). In the long-term, implementation of Proposed Action would not result in the increased use of hazardous materials or generation of hazardous wastes.

Socioeconomics. Implementation of the Proposed Action would provide short-term socioeconomic benefits to the local economy, including construction

employment and materials purchases. However, such short-term beneficial impacts from temporary employment gains would be negligible on a regional scale and the Proposed Action would result in no long-term changes in employment levels or economic activity at Buckley AFB.

Environmental Justice. With regard to environmental justice issues, no major, adverse environmental impacts associated with the Proposed Action are anticipated to affect on- or off-base communities and any short-term impacts are expected to be minor. Therefore, no populations (minority, low-income, or otherwise) would be disproportionately adversely impacted and no adverse impact with regard to environmental justice would result. In general, implementation of the Proposed Action would not result in increased exposure of children to environmental health risks or safety risks such as the generation, use, or storage of hazardous materials. Standard site safety precautions (e.g., fencing) would reduce potential risks to minimal levels and any potential impacts to children would be negligible and short-term.

Airspace Management. Implementation of the Proposed Action would not result in any changes to aircraft operations at Buckley AFB and would have no impact on airspace management or aircraft operations. An evaluation of impacts to flight safety including BASH conditions is included within the analysis for *Safety*.

SECTION 2
DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

2.1 INTRODUCTION

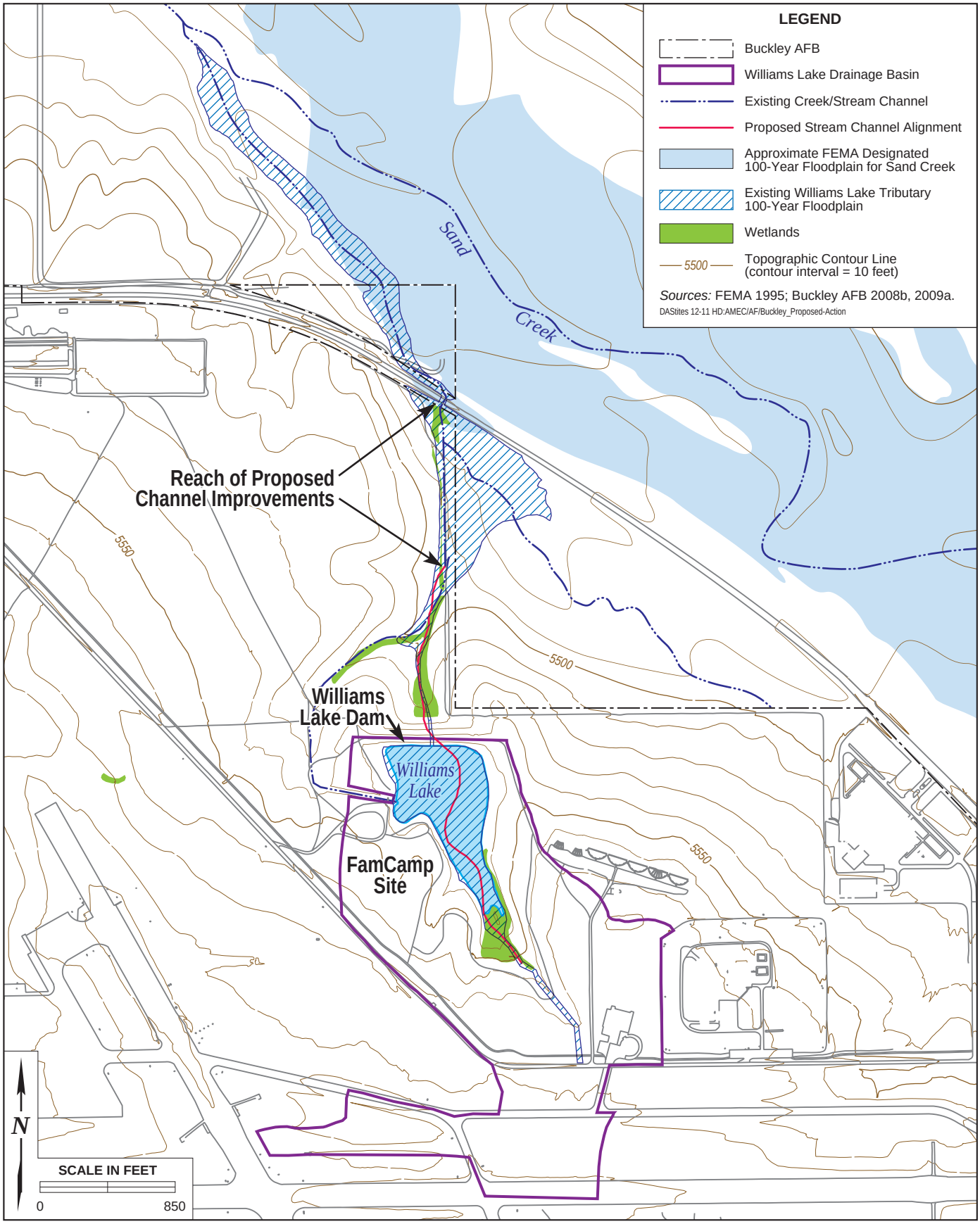
To minimize or prevent wildlife interference with aircraft operations at Buckley Air Force Base (AFB), the U.S. Air Force (USAF) proposes to implement accepted wildlife control techniques at Williams Lake, which serves as an attractant to wildlife species, specifically waterfowl (e.g., pelican and Canada goose), and poses a threat to flight safety. This section describes details related to the Proposed Action and alternatives considered.

2.2 PROPOSED ACTION AND ALTERNATIVES

The Proposed Action to be addressed in this Environmental Assessment (EA) comprises development and implementation of a Wildlife Management Control Program for Williams Lake that incorporates specific recommendations from Buckley AFB's Bird-Aircraft Strike Hazard (BASH) Plan required to minimize or prevent wildlife interference with aircraft operations on the base. The Proposed Action would include implementation of accepted wildlife control techniques to modify habitat for targeted species and achieve a balance between management of natural resources and flight safety. Specific action alternatives considered for implementation of the Proposed Action include removal of the Williams Lake dam and drainage of the lake (Figure 2-1).

2.2.1 Alternatives Eliminated From Further Consideration

A previous EA was prepared in 2010 to assess the potential environmental impacts associated with two specific alternatives at Williams Lake including installing a wire-grid system over the lake surface to exclude wildlife access and removing Williams Lake dam (Buckley AFB 2010a). The previous EA's associated Finding of No Significant Impacts (FONSI) was signed in 2010; however, a Finding of No Practicable Alternatives (FONPA) required for activities proposed within or adjacent to wetlands and floodplains was never developed. In addition, it was determined that the analysis of potential downstream impacts under the dam removal alternative did not adequately



EA

Proposed Project Location
Buckley AFB

FIGURE 2-1

No warranty is made by the State/Territory as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document," in that it is intended to change as new data become available and are incorporated into the GIS database.

include consideration of related to downstream flooding and required supplemental environmental analysis. Therefore, this alternative has been included for analysis in this document. Further, installation of wire-grid system is no longer considered to be the most effective alternative to implement the Proposed Action. Although a wire-gird system would prevent wildlife from accessing the lake would meet the purpose and need of the Proposed Action, the lake would not be eliminated as a visual attractant to overheard birds migrating though the area. Since this action has previously been sufficiently analyzed in the 2010 EA and resulting FONSI it has not been included as a specific alternative in this environmental analysis.

National Environmental Policy Act (NEPA) guidelines require that an assessment of potentially effective and reasonably feasible alternatives to implementation of the Proposed Action be provided. Alternatives that were dismissed early in the planning process as unreasonable are not addressed in this EA or in the EA prepared in 2010. For instance, potential alternatives to modify, relocate, or reduce aircraft operation activities were eliminated from consideration in this EA as they would conflict with the flying missions of major tenant organizations located at Buckley AFB. In addition, potential alternatives to relocate Williams Lake to another location within Buckley AFB or to implement a hunting program to reduce wildlife were eliminated from future consideration due to potential conflicts with future development and runway expansion at the base and because of potential safety concerns. Details for three alternatives for the Proposed Action, including a No-Action Alternative, are described below.

2.2.2 Preferred Alternative – Remove Williams Lake Dam

Major components under Alternative 1, the Preferred Alternative, would include relocation of existing fish, draining water from the lake, removal of Williams Lake dam, and habitat improvements and design measures within the Williams Lake drainage basin to mirror predevelopment drainage conditions. Removal of Williams Lake as an attractant to waterfowl and other bird species would help to reduce wildlife strike hazards and would effectively meet the purpose and need for the Proposed Action. In addition, habitat improvements and design

measures under the Preferred Alternative would include the construction of an intermittent drainage channel that would typically be dry during the year and would not create an additional attractant to waterfowl and other bird species. Specific details of the major components of the Preferred Alternative are described below.

2.2.2.1 Relocation of Game Fish

Prior to lake drainage and dam removal, all game fish (bass and bluegill) would be relocated to the maximum extent feasible to nearby water bodies through netting and/or electro-fishing techniques. Electro-fishing is a common scientific survey and fisheries management method that uses electricity to stun fish for capture and allows them to return to their natural state in as little as two minutes after being stunned. Once game fish have been removed, an approved piscicide (rotenone) would be applied to the lake to eradicate remaining fish, which would then be gathered and buried. Rotenone persistence in natural waters varies from a few days to several weeks depending on the season and if needed, can be rapidly detoxified by the addition of a strong oxidizing agent such as potassium permanganate (Ling 2003). Prior to draining the lake, water quality testing would be performed to ensure sufficient detoxification of the remaining water to meet appropriate standards for discharge.

2.2.2.2 Draining Williams Lake

Following relocation of game fish, impounded water would be pumped over the dam or into the existing overflow channel, discharging into the small seasonal tributary that drains the Williams Lake basin and flows into Sand Creek, just north of Buckley AFB's boundary. The water would be pumped out slowly or the area surrounding the pipe's discharge point would be protected against the force of the pumped water in an effort to minimize excessive erosion at the point of discharge. Recently conducted sampling and analysis indicates that water quality and sediment conditions at Williams Lake do not exceed water quality standards established by the Colorado Department of Public Health and Environment for the South Platte River Basin (Buckley AFB 2011b; refer to Appendix C).

2.2.2.3 Dam Removal

Once drained, the man-made earthen dam that forms Williams Lake would be excavated and removed, non short-grass prairie and riparian vegetation including trees would be removed, and the Williams Lake drainage basin would be regraded to mirror predevelopment topography to the maximum extent feasible. Runoff from the Williams Lake drainage basin would then flow unimpeded in its natural drainage pattern. Buckley AFB would comply with all guidelines for removal of dams established by the State Engineer with the Colorado Department of Water Resources (CDWR 2007).

Procedures followed would be dependent upon the hazard classification of the dam and the jurisdictional height of the dam from the crest of the emergency spillway to the invert of the former natural channel at the centerline of the dam. A precise characterization of the Williams Lake dam structure with regard to these parameters is not known, so an assumption has been made for purposes of this assessment that the more stringent requirements taken from the CDWR's *Rules and Regulations for Dam Safety and Dam Construction* would apply as follows (CDWR 2007):

- The dam shall be excavated down to the level of the natural ground, or as necessary in accordance with Rule 7.1.2.3, at the maximum section; and shall be of sufficient width to pass the 24-hour, 100-year flood with a maximum increase in reservoir depth of five feet. However, the maximum excavation width shall not exceed the width of the original natural channel before the dam was constructed, regardless of the 100-year flood magnitude unless approved by the State Engineer for improved public safety.
- The sides of the dam shall be excavated to a slope that is stable, but not steeper than 2:1 (two horizontal to one vertical). Slope stability analysis that provides an adequate factor of safety for steeper slopes may be accepted by the State Engineer, but in no case shall the slopes be steeper than 1:1.
- The excavation shall be designed to prevent silt previously deposited in the reservoir and material excavated from washing downstream.

- Water impounded in the reservoir area shall be released in a controlled manner that will not endanger lives or damage downstream properties.
- The drawing(s) of the plan for the excavation of the dam shall include the location, dimensions and lowest elevation.
- The removal of the dam shall be performed under the supervision of an engineer.
- The engineer shall submit written notice of the completion of the removal of the dam along with as-constructed plans.

2.2.2.4 Habitat Improvement and Drainage Channel Design

The Preferred Alternative would incorporate specific habitat improvement and drainage channel design measures that would minimize or eliminate potentially negative downstream impacts associated with removing the Williams Lake dam including minimizing the resulting floodplain width and size, reducing flood risk to properties, and increasing the stability of the drainage channel overall. A Hydrologic and Hydraulic Assessment (Buckley AFB 2011c) has been prepared to develop a model of existing conditions for the Williams Lake and associated minor tributary drainage basin as well as to evaluate hydrologic and hydraulic conditions after proposed channel design and potential downstream impacts (refer to Appendix D).

Habitat and channel design measures would include engineering and construction of a new, approximately 2,200-foot drainage channel which would run from upstream of the current Williams Lake area and would to approximately 700 feet downstream of the dam (refer to Figure 2-1). The new drainage channel would be routed to replicate a natural sinuous stream channel and would be designed with adequate capacity to convey water from a 100-year storm event. The new channel would be grass-lined and would have a bottom width of 20 feet, a depth of 3 feet, a longitudinal slope of 1 percent, and side slopes constructed at a 4:1 ratio. Five sloping boulder drop structures would be constructed to provide grade control for the new drainage channel (Buckley AFB 2011c). The channel would function as an intermittent drainage, and would typically be dry during the year except during precipitation events.

In addition, habitat and channel design measures also include rehabilitation of approximately 1,500 linear feet of the existing drainage channel which flows from downstream of the Williams Lake dam to the culvert at East 6th Avenue (refer to Figure 2-1). The existing channel would be restructured and rehabilitated to provide adequate capacity to convey water from a 100-year storm event. The rehabilitated and improved drainage channel would be grass-lined and would have a bottom width of 10 feet, a depth of 3 feet, a longitudinal slope of 1 percent, and side slopes constructed at a 4:1 ratio. As with the proposed new drainage channel, the rehabilitated portion of the existing channel would include two sloping boulder drop structures to provide grade control (Buckley AFB 2011c).

Freshly exposed sediments in the lake bottom will most likely not be able to support vegetation growth and would likely need to be removed or mixed with natural soils. Exposed areas on the former lake bed would be subject to erosion until a vegetative cover can be established. For this reason, the exposed former lake bed would be revegetated as soon as possible following drainage and regrading of the lake. A similar protection strategy is required for the areas excavated beneath the existing dam structure. Some form of stabilization such as hydromulching or a biodegradable erosion blanket would minimize sediment movement until the protective vegetation becomes established.

Protection measures, similar to or as described above, would be implemented to help reduce impacts to soil and water resources from the forceful discharge of pumped lake water required in this alternative. A construction stormwater permit in accordance with the U.S. Environmental Protection Agency's (USEPA) construction general permit (CGP) would be required and requirements of the USAF Engineering Technical Letter 03–1: *Storm Water Construction Standards* (AF ETL 03–1) and Buckley AFB's Municipal Separate Storm Sewer Systems (MS4) permit would also be applicable. Both the CGP and AF ETL 03–1 include specific requirements for control of stormwater runoff during construction and stabilization of the disturbed areas to mitigate impacts from construction, along with monitoring to document compliance. Further, applicable stormwater permits would be revised as necessary.

2.2.3 Alternative 2 – Drain Williams Lake

Major components under Alternative 2 (*Drain Williams Lake*) would be similar to the Preferred Alternative; however, under Alternative 2, Williams Lake dam would not be removed and regrading of the drainage basin would not occur. Draining of the lake would also help to reduce wildlife strike hazards and would meet the purpose and need for the Proposed Action. However, this alternative is less desirable than the Preferred Alternative as it would require ongoing maintenance activities to periodically pump out impounded water after precipitation to eliminate surface water as a wildlife attractant as well as landscaping activities to prevent the reestablishment of wetland plant species. Major components under Alternative 2 would include relocation of existing fish, draining water from the lake, and revegetation of the former lake area. Details of the major components of the Alternative 2 are described below.

2.2.3.1 Relocation of Game Fish

Relocation of game fish would be conducted as described under the Preferred Alternative. Prior to lake drainage and dam removal, all game fish would be relocated to the maximum extent feasible to nearby water bodies through netting and/or electro-fishing technique and an approved piscicide (rotenone) would be applied to the lake to eradicate remaining fish, which would then be gathered and buried.

2.2.3.2 Draining Williams Lake

As with the Preferred Alternative, following relocation of game fish the feed pipeline from Well #3 would be deactivated, and impounded water would be pumped over the dam or into the existing overflow channel, discharging into the small seasonal tributary that drains the Williams Lake basin and flows into Sand Creek. Prior to draining the lake, water quality testing would be performed to ensure sufficient detoxification of the remaining water to meet appropriate standards for discharge. When required and as conditions warrant (i.e., ponding after precipitation), surface water runoff impounded by the Williams Lake dam would be pumped out periodically to ensure that standing water is not present as an attractant to wildlife.

2.2.3.3 Revegetation

Once drained, non short-grass prairie vegetation in the drainage basin would be removed and disturbed areas in the Williams Lake drainage basin would be revegetated with a native short-grass prairie seed mix. As with the Preferred Alternative, freshly exposed sediments in the lake bottom would likely need to be removed or mixed with natural soils to support revegetation. Given the potential for sporadic ponding after precipitation, periodic landscape maintenance (i.e., mowing) of the exposed lake bed area would be conducted to prevent the reestablishment of wetland plant species.

2.2.3.4 Habitat Improvements and Design

Habitat improvement design measures would be similar to those described under the Preferred Alternative; however, drainage channel construction would not be implemented. The exposed former lake bed would be revegetated as soon as possible following drainage of and regrading of the lake and mitigation responses intended to reduce impacts to soil and water resources from the forceful discharge of pumped lake water would be incorporated. In addition, a construction stormwater permit in accordance with the USEPA's CGP would be required and requirements of AF ETL 03–1 and Buckley AFB's MS4 permit would also be applicable. Further, applicable stormwater permits would be revised as necessary.

2.2.4 Alternative 3: No-Action Alternative

The No-Action Alternative would include continued implementation of recommendations from the current BASH Plan that are specific to Williams Lake or are of a general nature that is inclusive of the wildlife control needs at Williams Lake (USAF 2006). The existing BASH Plan establishes procedures to minimize hazards to all assigned and transient aircraft at the base, including those posed at Williams Lake, and a variety of techniques and organizations are involved in the control program. A variety of dispersal and control measures are employed on an as-needed basis. These measures include active harassment such as pyrotechnic devices and bioacoustics (i.e., recorded distress and alarm calls of species to be dispersed) and depredation activities that are conducted

with appropriate annual USFWS permits by USAF, Air National Guard, USDA, or private contracted personnel.

Although this alternative is the least desirable because it would not remove the primary wildlife attractant to the Williams Lake area, the No-Action Alternative will be carried forward for further analysis in the EA in accordance with NEPA guidelines and CEQ requirements.

SECTION 3
AFFECTED ENVIRONMENT

This section describes relevant existing environmental conditions for resources potentially affected by the Proposed Action and project alternatives. In compliance with guidelines contained in the National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) regulations, and 32 Code of Federal Regulations (CFR) § 989, the description of the affected environment focuses on only those resources potentially subject to impacts.

Resource descriptions focus on the following areas: biological resources, water resources, geology and soils, air quality, safety, land use, and visual resources. Per Section 1.5.2, environmental resources eliminated from further study include noise, cultural resources, transportation and circulation, utilities, hazardous materials and wastes, socioeconomics, environmental justice, and airspace management.

3.1 BIOLOGICAL RESOURCES

3.1.1 Definition of Resource

Biological resources include native or naturalized plants and animals and the habitats in which they occur. Sensitive biological resources are defined as those plant and animal species listed as threatened or endangered, or proposed as such, by the U.S. Fish and Wildlife Service (USFWS), Colorado Division of Wildlife (CDOW), or Colorado Natural Heritage Program (CNHP). The Federal Endangered Species Act (ESA) of 1973 and the Colorado ESA protect listed species against killing, harming, harassment, or any action that may damage their habitat. Species of concern are not protected by law, but could become listed and protected at any time.

Sensitive habitats include those areas designated by the USFWS as critical habitat protected by the ESA and sensitive ecological areas as designated by state or federal rulings. Sensitive habitats also include wetlands, plant communities that are unusual or of limited distribution, and important seasonal use areas for

wildlife (e.g., spring and autumn migration routes, breeding areas, crucial summer/winter habitats).

Migratory birds, as listed in 50 CFR § 10.13, are ecologically and economically important to the U.S. and enable various recreational activities such as feeding, bird watching, behavioral studying, and photography collections. The *Migratory Bird Treaty Act* (MBTA), as amended, was enacted to protect migratory birds from capture, pursuit, hunting, or removal from natural habitat. Over 800 avian species are currently protected under the MBTA. In 2001, Executive Order (EO) 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*, was issued to ensure that Federal agencies consider environmental effects on migratory bird species and, where feasible, implement policies and programs, which support the conservation and protection of migratory birds.

Jurisdictional wetlands are those subject to regulatory authority under Section 404 of the Clean Water Act (CWA) and EO 11990, *Protection of Wetlands*. Wetlands are defined by the U.S. Army Corps of Engineers (USACE) and the USEPA as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions" (33 CFR § 328.3[b]). The USACE has authority to regulate jurisdictional wetlands as *Waters of the U.S.* under Section 404 of the CWA; however, EO 11990, *Protection of Wetlands* and the related Department of Defense Instruction 4715.3*, Natural Resources Conservation Program* provides guidance concerning how to mitigate or minimize any net loss of both jurisdictional and non-jurisdictional wetlands.

3.1.2 Existing Conditions

The Region of Influence (ROI) for biological resources is limited to the Williams Lake study area, which includes Williams Lake and its associated drainage area and tributary, as well as the drainage channel to its confluence with Sand Creek.

3.1.2.1 Vegetation

Two types of grassland communities occur at Buckley AFB. The crested wheatgrass (*Agropyron cristatum*) complex is the most common while a native mid-grass prairie occurs only in the southern portions of the base and is dominated by western wheatgrass (*Agropyron smithii*). Other vegetation types include landscaped areas and riparian bottomlands (Buckley AFB 2008a).

Existing vegetation community conditions within the Williams Lake study area can be described as a mosaic of grassland prairie, exotic weed infestations, riparian, and riparian bottomlands. Typical grassland vegetation includes blue grama (*Bouteloua gracilis*), crested wheatgrass, western wheatgrass, yucca (*Yucca glauca*), plains pricklypear cactus (*Opuntia polyacantha*), needlegrass (*Stipa* spp.), buffalograss (*Buchloe dactyloides*), Russian thistle (*Salsola iberica*), kochia (*Kochia scoparia*), various mustards, crested pricklypoppy (*Argemone polyanthemos*), and sunflowers (*Helianthus* spp.). The shrubby component within the Williams Lake study area includes rubber rabbitbrush (*Chrysothamnus nauseosus*), and broom snakeweed (*Gutierrezia sarothrae*) (Buckley AFB 2008a).

3.1.2.2 Wildlife

The open grasslands and riparian corridors at Buckley AFB and within the Williams Lake study area provide habitat for a variety of wildlife species. Numerous reptiles and amphibians have the potential to occur within the study area including the western hognose snake (*Heterodon nasicus*), bullsnake (*Pituophis catenifer*), prairie rattlesnake (*Crotalus viridis viridis*), many-lined skink (*Eumeces multivirgatus*), plains spadefoot (*Spea bombifrons*), and tiger salamander (*Ambystoma tigrinum*) (Buckley AFB 2008a; 2010a).

Common songbirds found at Buckley AFB and within the Williams Lake study area include the horned lark (*Eremophila alpestris*), western meadowlark (*Sturnella neglecta*), house finch (*Carpodacus mexicanus*), black-billed magpie (*Pica pica*), American robin (*Turdus migratorius*), and lark bunting (*Calamospiza melanocorys*). Birds of prey occurring and/or foraging within the Williams Lake study area include the burrowing owl (*Athene cunicularia*), red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*Buteo swainsoni*), American kestrel (*Falco*

sparverius), and prairie falcon (*Falco mexicanus*). The mallard (*Anas platyrhynchos*), Canada goose (*Branta canadensis*), northern shoveler (*Anas clypeata*), great blue heron (*Ardea herodias*), and killdeer (*Charadrius vociferus*) are bird species associated with the surface water at Williams Lake. All of these birds referenced in this section, their eggs, and their nests are protected by the MBTA (Buckley AFB 2000) and may not be disturbed during construction activities.

The grassland complex within the Williams Lake study area supports a variety of small mammals. Rodents include the thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), black-tailed prairie dog (*Cynomys ludovicianus),* eastern fox squirrel (*Sciurus niger*), and western harvest mouse (*Reithrodontomys megalotis*). Black tailed jackrabbits (*Lepus californicus*) and desert cottontails (*Sylvilagus audubonii*) also utilize these grasslands. Large herbivores on base are generally absent due to perimeter fencing and lack of suitable habitat but an occasional mule deer (*Odocoileus hemionus*) or white-tailed deer (*Odocoileus virginianus*) may be found. Predators include the red fox (*Vulpes vulpes*), coyote (*Canis latrans*), American Badger (*Taxidea taxus*), and striped skunk (*Mephitis mephitis*) (Buckley AFB 2008a; 2010a).

3.1.2.3 Sensitive Species

According to information obtained from the USFWS, CDOW, and Buckley AFB, a total of 13 special-status species potentially occur on-base (Table 3-1).

Northern Leopard Frog. The northern leopard frog can be found along the riparian margins of ponds, marshes, streams, lakes, and reservoirs. It also occurs in wet meadows and along irrigation ditches. Surveys have not been conducted for this species at Buckley AFB, but suitable habitat may exist along the bottomlands and stream margins associated with Williams Lake and unnamed tributaries of Sand Creek.

Bald Eagle. The bald eagle is a species of special concern in Colorado and is associated with large rivers, lakes, and reservoirs. They usually feed on fish but on the eastern plains of Colorado are known to feed on small mammals such as black-tailed prairie dogs, especially during the winter (Buckley AFB 2000). Bald

eagles occur as winter transients at Buckley AFB, where they may occasionally forage in prairie dog towns.

Ferruginous Hawk. Ferruginous hawks were known to occur as a resident at the property managed by the Plains Conservation Center adjacent to Buckley AFB (Buckley AFB 2000). This species forages for small mammals including black-tailed prairie dogs in open vegetation areas. Due to the large numbers of prairie dogs on base and extensive habitat occupied by these and other prey species, these hawks can be found on base as a transient or while foraging.

Table 3-1. Sensitive Species Potentially Occurring on Buckley AFB

Common Name	Scientific Name	Status
Amphibians		
Northern leopard frog	*Rana pipiens*	SSC
Birds		
Bald eagle	*Haliaeetus leucocephalus*	SSC
Ferruginous hawk	*Buteo regalis*	SSC
Mountain plover	*Charadrius montanus*	SSC
Western burrowing owl	*Athene cunicularia*	ST
Whooping crane	*Grus americana*	FE, SE
Mammals		
Black-footed ferret	*Mustele nigripes*	FE, SE
Black-tailed prairie dog	*Cynomys ludovicianus*	SSC
Preble's Meadow jumping mouse	*Zapus hudsonius preblei*	FT, ST
Swift fox	*Vulpes velox*	SSC
Plants		
Colorado butterfly plant	*Gaura neomexicana* ssp. *coloradensis*	FT
Ute Ladies'-tresses orchid	*Spiranthes diluvialis*	FT
Reptiles		
Common garter snake	*Thamnophis sirtalis*	SSC

FC - Federal candidate
FT - Federally threatened
FE - Federally endangered
SSC - State special concern
ST - State threatened
SE - State endangered
Note: Table 3-1 includes only the State and Federally listed species, which either occur or potentially occur at Buckley AFB.
Sources: Buckley AFB 2008a, Buckley AFB 2010a, CDOW 2010a, 2010b; USFWS 2011a.

Mountain Plover. The mountain plover is listed as a State special concern species. This species prefers shortgrass prairies dominated by buffalograss and

blue grama with areas of bare ground. They also inhabit prairie dog towns. The breeding range of the mountain plover does not include the western portion of Arapahoe County. The mountain plover is only likely to be found on base as a rare migratory transient.

Western Burrowing Owl. The State threatened western burrowing owl is a migratory resident that occurs on base from March through October. They inhabit the grassland community and use abandoned prairie dog burrows or other excavated sites as nesting locations. In 2011, eight burrowing owl nests were observed on the eastern side of the base (USFWS 2012).

Whooping Crane. The whooping crane is a Federally and State endangered species that has been recorded in mudflats around reservoirs and in agricultural areas. In Colorado, it is uncommon in spring and fall and a rare migrant in the western valleys. Whooping cranes are mostly recorded in Mesa, Delta, and Gunnison counties and are casual migrants on the eastern plains. Habitat on Buckley AFB would potentially include nesting areas in wetlands adjacent to Williams Lake.

Black-Footed Ferret. The black-footed ferret is a Federally and State endangered species. It is closely associated with prairie dog habitat, as it depends upon prairie dogs for food and uses prairie dog burrows for nesting. Although black-footed ferrets have historically occupied areas ranging from the shortgrass and midgrass prairie to semidesert shrublands, they are presently known to exist only in a remnant restored population in the Shirley Basin of Wyoming and in captive breeding populations across the country. Although no live ferrets have been found in Colorado, evidence suggests that they inhabit Colorado.

Black-Tailed Prairie Dog. Another state special concern species, the black-tailed prairie dog, is a common and numerous resident at Buckley AFB. It inhabits short and mid-grass prairies where it forms colonies known as towns. Prairie dogs provide a food source and/or valuable habitat for many species including some of the sensitive species mentioned in this section. Prairie dogs are managed in accordance with Buckley AFB's Integrated Natural Resource Management Plan (INRMP) and wildlife management plan.

Preble's Meadow Jumping Mouse. The Preble's Meadow jumping mouse is a State- and Federally threatened species. Meadow jumping mice have very long tails and very large feet. Their habitat consists of grassy or weedy fields, where they use runways made by other rodents. Although Buckley AFB contains habitat suitable for the Preble's Meadow jumping mouse, the USFWS has determined that there are no longer any wild free-ranging Preble's Meadow jumping mice in the Denver metropolitan area and has designated it as a block clearance zone (Buckley AFB 2008a).

Swift Fox. The swift fox, a State special concern species, is found across the eastern plains of Colorado. Typical habitat includes short and mid-grass prairies with relatively flat or gently rolling topography. This species preys largely on rabbits and hares but also takes smaller rodents such as black-tailed prairie dogs. This species has not been observed at Buckley AFB (Buckley AFB 2008a); however, it may go unnoticed due to its nocturnal behavior.

Colorado Butterfly Plant. A Federally threatened species, the Colorado butterfly plant also occurs in short and mid-grass prairies with relatively flat or gently rolling topography. Potential habitat for the Colorado butterfly plant occurs along the bottomlands and stream margins associated with Williams Lake and unnamed tributaries of Sand Creek.

Ute Ladies'-tresses Orchid. The Ute ladies'-tresses orchid is a Federally threatened species. It occurs in wet meadows, along streams, lakes, and associated floodplains. Although suitable habitat for the Ute ladies'-tresses orchid has been identified in low-lying areas near Williams Lake, a survey conducted in 2001 did not find any specimens (Buckley AFB 2003). However, this species generally reproduces exclusively by seed which are microscopic and easily dispersed by wind or water (USFWS 2011b); therefore, the potential exists for the Ute ladies'-tresses to have been introduced to areas of suitable habitat at Williams Lake following the 2001 species surveys.

Common Garter Snake. The common garter snake is a State special concern species that inhabits marshes, ponds, and the edges of streams. For the most part, it is restricted to aquatic, wetland, and riparian habitats along the floodplains of streams. Likely habitat at Buckley AFB includes wetlands and

riparian areas along tributaries of Sand Creek and in the wetlands adjacent to Williams Lake.

3.1.2.4 Wetlands

National Wetland Inventory (NWI) maps identify wetland areas in the northeast part of Buckley AFB that are associated with the unnamed tributary of Sand Creek, as well as wetland areas adjacent to Williams Lake (Buckley AFB 2003, 2010a). Refer to Figure 3-1 in Section 3.2, *Water Resources*, for a map of wetland areas within the project study area.

Williams Lake has been classified by the USACE as a *palustrine open water wetland* (Buckley AFB 2010a). USACE determined that Williams Lake and associated drainage areas, including downstream wetlands are not jurisdictional wetlands and are therefore not regulated by USACE (USACE 2001, 2003).

3.2 WATER RESOURCES

3.2.1 Definition of Resource

Water resources analyzed in this study include *surface water*, *groundwater*, and *water management*. Surface water resources include lakes, rivers, and streams that collect and distribute water from precipitation and natural or human-created water collection systems. Groundwater comprises subsurface water resources that are interlaid in layers of rock and soil and recharged by surface water seepage. Water management—including the management of storm water and other runoff—is pertinent to the quality and availability of surface water and groundwater resources. Other issues relevant to water resources include watershed areas affected by existing and potential hazards related to *floodplains*.

3.2.2 Existing Conditions

The ROI for water resources includes surface waters within the Williams Lake study area and associated drainage basins, as well as groundwater underlying the study area and Buckley AFB. Discussions of water management and floodplains are generally limited to the Williams Lake study area.

3.2.2.1 Regional Setting

The primary surface water drainage system comprising the Denver Metropolitan Region is the South Platte River, located approximately 15 miles northwest of Buckley AFB. Smaller drainages located in the vicinity of the Williams Lake study area include the Sand, East Toll Gate, Coal, and Murphy creeks, as well as two smaller, unnamed creeks. Regional surface drainage trends flow from the southeast to the northwest.

The Denver Metropolitan Region is underlain by four principal bedrock aquifers that comprise the Denver Basin: the Laramie-Fox Hills, Arapahoe, Denver, and Dawson aquifers. These aquifers are separated by beds of shale with low permeability and are located within zones of sandstone and siltstone (Buckley AFB 2008a). The Denver Aquifer is the uppermost aquifer and is up to 1,000 feet

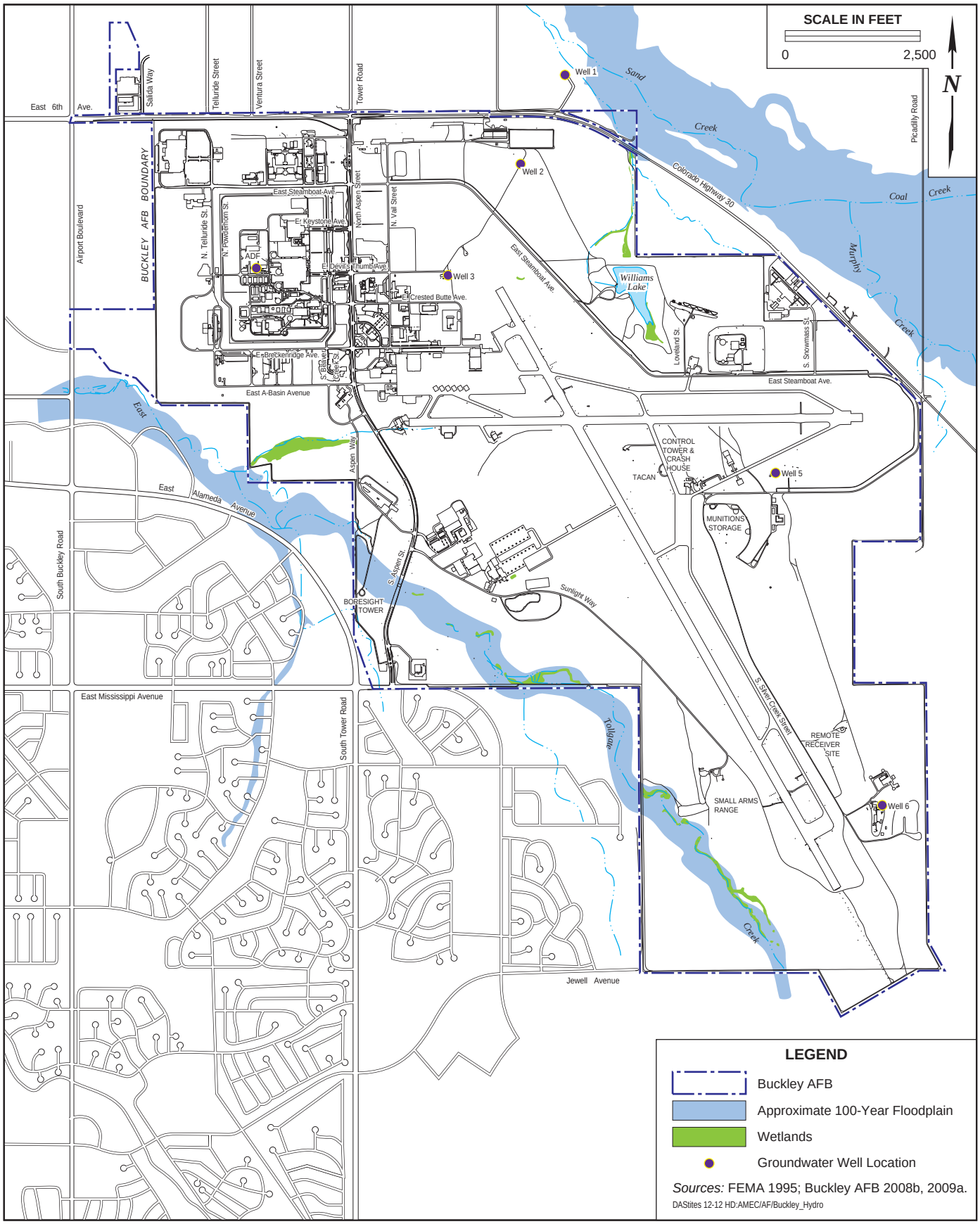
thick. It is classified as a tributary in some locations because it comes in contact with surrounding surface water systems and their alluvium. The deepest of the aquifers is the Laramie Fox-Hills and is underlain by the Pierre shale formation, a layer of great thickness and low water permeability (Buckley AFB 2003). The Arapahoe and Denver aquifers meet USEPA drinking water standards (Buckley AFB 2003, 2008b). The Denver Basin aquifer system is a source of drinking water for the Denver Metropolitan Region and nearby rural communities (Buckley AFB 2008a).

3.2.2.2 Buckley AFB

Surface Water

The principal surface water body at Buckley AFB and within the evaluated study area is Williams Lake, located in the northeast part of the base (Figure 3-1). Williams Lake is a man-made reservoir that was constructed in 1961 and was predominantly used primarily for recreational purposes (e.g., fishing); however, the fishing program was recently discontinued at the lake (Buckley AFB 2009b). Hydrological evaluations of Williams Lake have determined that the lake and associated drainage areas may not be hydrologically connected to nearby surface waters (Buckley AFB 2010a).

The lake provides a maximum surface area of approximately 30 acres and storage capacity of up to 85 acre-feet; however, the present surface area of the lake is only about 8.7 acres (Buckley AFB 2003, 2009a, 2010a). The evaporative loss rate for Williams Lake has been estimated between 8.5 and 11.4 million gallons per year (MGY), and generally requires about 15 MGY to be pumped into the lake from Well #3 to maintain the lake's water level. In 2011, the pump from Well #3 was shut off and is no longer supplying water to maintain the water level at Williams Lake. Instead, water supplies in the lake are augmented by local runoff, but the amount of runoff is generally not great enough to maintain water levels and the lake's water retention capability is further diminished by seepage through the dam structure (Buckley AFB 2003, 2009a).



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Surface Water Resources, Floodplains, Groundwater Wells, and Wetlands at Buckley AFB

FIGURE 3-1

No warranty is made by the State/Territory as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document," in that it is intended to change as new data become available and are incorporated into the GIS database.

Recently conducted sampling and analysis indicate that water quality and sediment conditions at Williams Lake do not exceed water quality standards established by the CDPHE for the South Platte River Basin (Buckley AFB 2011b). Testing has occurred to verify that fish in the lake are safe for consumption.

Specifically, fish were sampled from the lake in 2004 for heavy metals, and the levels did not violate established state health standards (Buckley AFB 2010a). The lake has been maintained to serve as a backup source of water for firefighting purposes on Buckley AFB in case supplies from the City of Aurora are unavailable (Buckley AFB 2010a). Subsequently, the lake has also been evaluated as a possible storage reservoir for irrigation and emergency potable water supplies (Buckley AFB 2009a).

Floodplains

The Federal Emergency Management Agency (FEMA) has designated 100-year floodplains associated with the East Toll Gate Creek and its smaller tributaries that cross the southwest part of Buckley AFB; small sections of the FEMA 100-year floodplains associated with Sand Creek cross the northeast corner of the base (Buckley AFB 2008a) (refer to Figure 3-3). EO 11988, *Floodplain Management* and Department of Defense Instruction 4715.3, *Natural Resource Conservation Program* require Federal agencies to avoid to the extent possible adverse impacts to 100-year floodplains. FEMA-designated 100-year floodplains are not associated with Williams Lake but are located nearby within the Sand Creek drainage.

A Hydrologic and Hydraulic Assessment (Buckley AFB 2011c, see Appendix C) was conducted for the Williams Lake study area that identified the existing non-regulated 100-year floodplain along the downstream drainage and connecting tributary to Sand Creek (refer to Figure 2-1). The non-regulated floodplain identified within the Williams Lake study area has not been reviewed by FEMA for federal designation. This non-regulated floodplain represents flows from surface water runoff of minor watersheds on Buckley AFB when soil evaporation rates and infiltration capacities are exceeded by the volume of surface runoff

water. This may occur during periods of heavy rainfall events or rapid snowmelt.

3.3 GEOLOGICAL RESOURCES

3.3.1 Definition of Resources

Geological resources analyzed in this study include *topography*, *geology*, and *soils*. Topography is the general shape and arrangement of a land surface, including its height and the position of its natural and human-created features. Geology describes the structure and configuration of the earth's surface and subsurface materials and their inherent properties. Soils are the unconsolidated surface materials overlying bedrock or other subsurface material, and they are typically described in terms of their composition materials, elasticity, slope, permeability, water-holding capacity, and erosion potential.

3.3.2 Existing Conditions

3.3.2.1 Regional Setting

Buckley AFB is located within the Denver Basin in the western portion of Colorado's central high plains, approximately 50 miles east of the Continental Divide. The Denver Basin is a structural depression that is 300 miles long and 200 miles wide and was formed about 67 million years ago (mya) during a mountain-building event called the Laramide Orogeny (Buckley AFB 2003). Geologic layers within the basin are comprised of zones of sandstone and siltstone in excess of 5,000 feet thick overlaying the 8,000-foot thick, relatively impermeable Pierre shale formation that forms the bottom of the basin (Buckley AFB 2003, 2008b). The Denver Basin is surrounded on three sides by higher terrain, including the Palmer Lake Divide to the south, the Rampart Range and Rocky Mountains to the west, and Cheyenne Ridge to the north. The relatively level Great Plains lie to the east. Most of the basin is characterized by broadly rolling topography with major streams in wide valleys (Buckley AFB 2008a).

3.3.2.2 Buckley AFB

Topography

The topography of Buckley AFB comprises relatively flat land and rolling upland. Elevations range from approximately 5,500 feet above mean sea level (msl) in the northwestern corner of the base to approximately 5,650 feet above msl in the southeastern corner of the base (Buckley AFB 2008a).

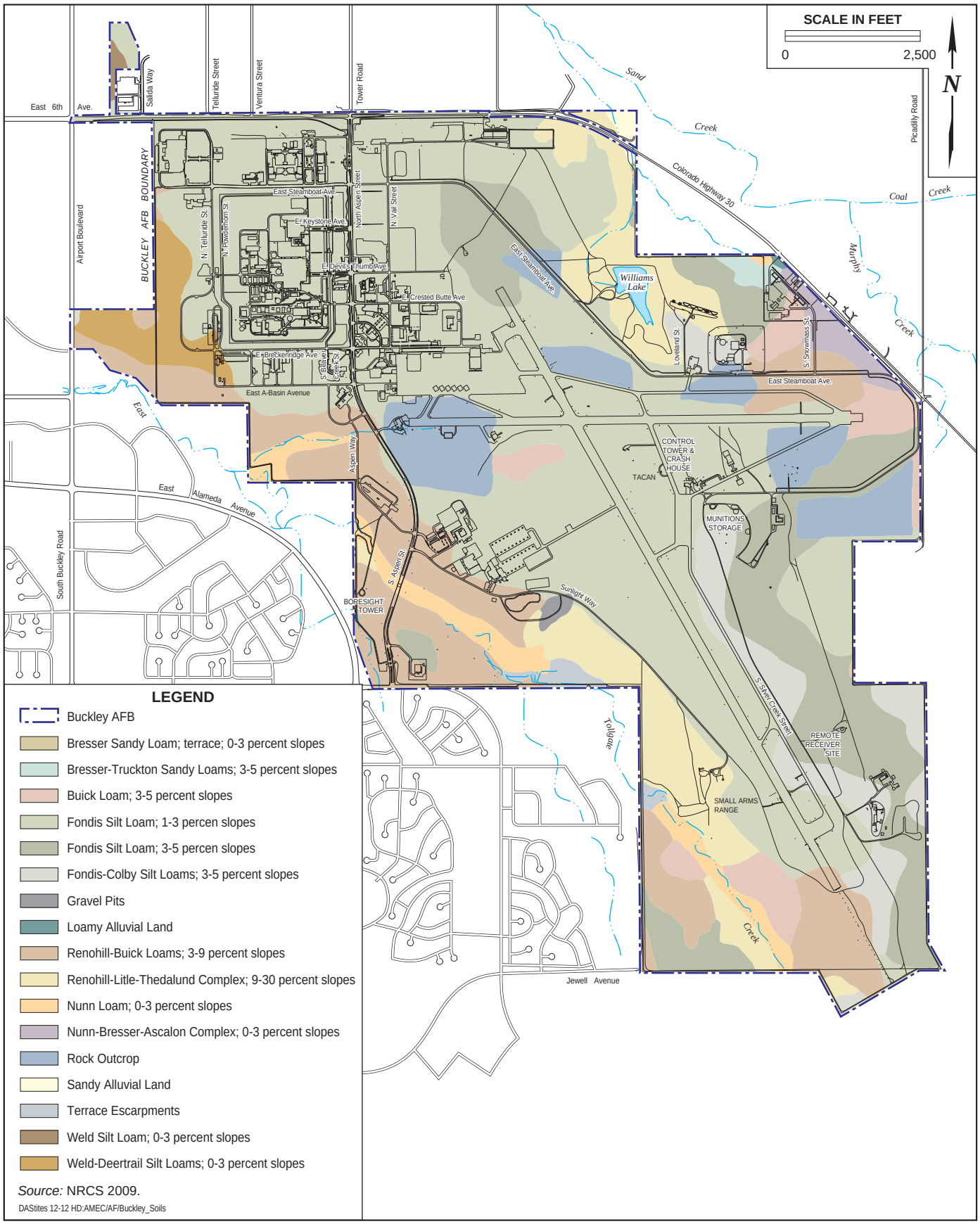
Geology

Buckley AFB is located in the lowlands of the South Platte River, in the western part of the Denver Basin. Surficial deposits in the base vicinity are comprised of unconsolidated, wind-blown (*eolian*), and/or water-deposited (*alluvial*) sediments that can reach a thickness of 30 feet. Deposition of these sediments began about 2.6 mya and continues today. These deposits overlay the layers of sandstone and siltstone and the shale floor that comprise the Denver Basin (Buckley AFB 2003).

Soils

U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) maps identify three primary soil associations on Buckley AFB: the *Alluvial Land-Nunn Association*, *Renohill-Buick-Little Association*, and *Fondis-Weld Association* (Figure 3-2). Other on-base areas have been mapped as containing *Rock Outcrop* complexes (NRCS 2009).

Most of the surficial soils present on Buckley AFB have been classified as moderately to highly erodible; however, engineering modifications to surface construction (e.g., foundation design) and incorporation of site-specific drainage plans can compensate for expansive soil conditions (Buckley AFB 2003). Detailed information about soil associations present at Buckley AFB is presented below. Since the Alluvial Land-Nunn Association and Rock Outcrops would not be located in the footprint of the Proposed Action and project alternatives, they have been excluded from further discussion below.



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Soil Associations at Buckley AFB

FIGURE 3-2

No warranty is made by the State/Territory as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document," in that it is intended to change as new data become available and are incorporated into the GIS database.

Fondis-Weld Association. This soil association consists of deep, nearly level, loamy soils formed mainly in silty eolian material. Fondis soils are well-drained and gently sloping (1 to 5 percent), with moderately slow permeability and high water-holding capacity. They are also susceptible to wind and water erosion (NRCS 2009). Soils from the Fondis-Weld Association have been mapped on the majority of the Buckley AFB surface area (refer to Figure 3-2).

Renohill-Buick-Little Association. This soil association consists of moderately deep, well-drained, loamy to clayey soils. Within this association, the dominant Renohill soils have moderate internal drainage, varying slopes (3 to 30 percent), moderately slow to slow permeability, and moderate available water-holding capacity. They are susceptible to soil blowing and water erosion (NRCS 2009). The most common Renohill-Buick-Little Association soils found on Buckley AFB are the Renohill-Buick loam and the Renohill-Little complexes. These soils have been mostly mapped on the East Toll Gate Creek uplands and south of Coal and Sand Creeks (refer to Figure 3-2).

3.4 AIR QUALITY

3.4.1 Definition of Resource

This section describes air quality considerations and conditions in the area around Buckley AFB. The discussion addresses air quality standards and describes current air quality conditions in the region. Air quality is affected by stationary sources (e.g., industrial development) and mobile sources (e.g., motor vehicles). Air quality at a given location is a function of several factors including the quantity and type of pollutants emitted locally and regionally, and the dispersion rates of pollutants in the region. The primary factors affecting pollutant dispersion are wind speed and direction, atmospheric stability, temperature, the presence or absence of inversions, and topography.

3.4.1.1 Criteria Pollutants

Air quality in a given location is determined by the concentration of various pollutants in the atmosphere. National Ambient Air Quality Standards (NAAQS) are established by USEPA for criteria pollutants, including: ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter equal to or less than ten microns in diameter (PM_{10}) and 2.5 microns in diameter ($PM_{2.5}$), and lead (Pb). NAAQS represent maximum levels of background pollution that are considered safe, with an adequate margin of safety, to protect public health and welfare.

3.4.2 Existing Conditions

3.4.2.1 Local Air Quality

Buckley AFB is located within the Metropolitan Denver Intrastate Air Quality Control Region (AQCR). The ROI for this resource is the entire Denver AQCR. A geographic area with air quality that is cleaner than the primary standard is called an "attainment" area; areas that do not meet the primary standard are called "nonattainment" areas and areas that were formerly nonattainment areas that have since achieved attainment status are called “maintenance” areas.

Table 3-2 summarizes the attainment status for Arapahoe County within the Denver AQCR.

Table 3-2. Arapahoe County Designation for Criteria Pollutants

National Ambient Air Quality Standard Criteria Pollutant	Designation
Carbon monoxide (CO)	Attainment/Maintenance
Nitrogen dioxide (NO_2)	Attainment
8-hour ozone (O_3) (as measured by precursors nitrogen oxides (NO_x) and volatile organic compounds (VOCs)	Non-attainment
Particulate matter with aerodynamic diameter of 10 micrometers or less (PM_{10})	Attainment/Maintenance
Particulate matter with aerodynamic diameter of 2.5 micrometers or less ($PM_{2.5}$)	Attainment
Sulfur (measured as sulfur dioxide, SO_2)	Attainment
Lead (Pb)	Attainment

Source: USEPA 2011.

3.4.2.2 Emissions at Buckley AFB

Buckley AFB operates under a Title V Operating Permit that regulates air emissions. Buckley AFB is a major source of criteria pollutants under the Title V program because it has the potential to emit more than 100 tons of the criteria pollutant NO_x under New Source Review (NSR) and Prevention of Significant Deterioration (PSD) provisions. Buckley AFB is a minor source of CO, SO_2, VOCs, and PM_{10} under the PSD provisions, with a potential to emit of less than 250 tons per year (tpy) of these pollutants. Buckley AFB is a PSD synthetic minor source of NO_x because the base accepted permit limits that establish the potential to emit for this pollutant at less than 250 tons per year (Jensen 2002).

Mobile sources are not regulated under the Clean Air Act (CAA), Title V operating permit, or the Colorado operating permit program, but are considerable components of total base air emissions. These emissions, therefore, are periodically inventoried as part of Buckley AFB's air quality management program. Emissions from mobile sources include CO, NO_x, Pb, sulfur oxides (SO_x), PM_{10}, and VOCs. Motorized Air Force vehicles and portable equipment are also considered mobile sources, including equipment operated and refueled under vehicle inspection and maintenance provisions.

Buckley AFB currently emits hazardous air pollutants (HAPs) during the course of base activities such as storing fuel, using paints, and running generators. However, Buckley AFB is not a major source of HAPs. These emissions are estimated annually in the *Buckley AFB Air Emissions Inventory*. The most recent air emissions summary for mobile and stationary sources at Buckley AFB is presented in Table 3-3.

Buckley AFB also uses Class I and Class II Ozone-Depleting Substances (ODS). Class I ODS are currently used for fire suppression. Class II ODS are used as a refrigerant in air conditioners. The current policy at Buckley AFB is to prohibit the use of Class I or Class II ODS for new construction projects.

Table 3-3. Stationary and Mobile Source Emissions at Buckley AFB

Category	Annual Emissions (tons per year)				
	CO	NO_x	PM_{10}	SO_x	VOCs
2009 Stationary Source Emissions at Buckley AFB	19.87	58.62	4.28	0.99	18.78
2007 Mobile Source Emissions at Buckley AFB	290.20	7.58	2.1	56.87	8.02
Total Emissions at Buckley AFB	309.33	47.40	7.81	57.55	30.09

Notes: VOCs and NO_X contribute to the formation of ground-level O_3. Pb and $PM_{2.5}$ were not included in this table because they were not included in the 2007 Denver Metropolitan AQCR emissions inventory, the 2007 stationary source emission inventory, or the 2003 mobile source emissions inventory.

Sources: Buckley AFB 2010c, 2009c.

3.5 SAFETY

3.5.1 Definition of Resource

The primary safety concern at facilities with aircraft operations is the potential for aircraft mishaps (i.e., crashes), which may be caused by mid-air collisions with other aircraft or objects, weather difficulties, pilot error, equipment malfunction, or bird-aircraft strikes. The USAF has defined aircraft mishap classifications based upon personal injury and property damage. These mishap classifications range from Class A (i.e., total cost in excess of $1 million for injury, occupational illness, and property damage; or destruction or damage beyond repair to military aircraft) to Class D (i.e., total damages between $1,000 and $10,000). Bird-aircraft strike hazard (BASH) is defined as the threat of aircraft collision with birds and other wildlife during aircraft operations.

Accident Potential Zones (APZs)—rectangular zones extending outward from the ends of active runways at military bases—delineate those areas recognized as having the greatest risk of aircraft mishaps, most of which occur during takeoff or landing. Clear Zones (CZs) are the areas closest to the end of the runway, which are considered the most hazardous areas. APZs and noise zones together form the Air Installation Compatible Use Zone (AICUZ) for an air installation. The AICUZ program serves to protect USAF airfields from encroachment and incompatible land development.

Air Force Manual 91-201, *Explosives Safety Standards*, requires that defined quantity-distance (QD) arcs be maintained between explosive materials storage (e.g., munitions) and handling facilities and a variety of other types of facilities. QD arcs are determined by the type and quantity of explosive materials stored; within QD arcs, development is either restricted or altogether prohibited in order to maintain personnel safety and minimize the potential for damage in the event of an accident.

3.5.2 Existing Conditions

The ROI for safety is limited to the Williams Lake Study Area and adjacent areas located within Buckley AFB's designated airfield safety zones.

3.5.2.1 BASH and Other Wildlife Hazards

Most birds fly close to ground level; correspondingly, more than 90 percent of all reported BASH incidents occur below 3,000 feet above ground level (AGL) and/or in the immediate vicinity of the airfield (Federal Aviation Administration [FAA] 2007). At most military bases, about half of reported bird-strikes occur in the immediate vicinity of the airfield and another 25 percent occur during low-altitude local training exercises. Waterfowl present the greatest BASH potential due to their congregational flight patterns and because, when migrating, they can be encountered at altitudes of up to 20,000 feet AGL. Raptors also present a substantial hazard due to their size and soaring flight patterns. In general, the threat of bird-aircraft strikes increases during March and April and from August through November due to migratory activity.

Bird-aircraft strikes present a substantial threat to Buckley AFB aircraft and aircrew safety due to the base's proximity to resident and migratory bird species. The base developed a BASH Plan in order to minimize the threat and occurrence of bird strike and wildlife hazards at Buckley AFB. There were 35 bird strikes reported between 1999 and 2009 at Buckley AFB (City-Data.com 2009). Buckley AFB's Bird Hazard Working Group recently identified a total of three bird strikes in 2009 alone, costing $715,098 in damage (Buckley AFB 2010b; 2011a). Additionally, two coyotes have been struck by F-16s at the base (Buckley AFB 2002).

Buckley AFB currently implements a variety of BASH control measures along for in the area of Williams Lake and the adjacent airfield. BASH Control measures include active harassment of birds and wildlife using frightening devices such as starter pistols, standard 12-guage shotguns, or modified flare pistols. These devices deploy pyrotechnics over flocks and individual birds and can disperse birds away from areas for which bird activity is undesirable due to aircraft operations. Williams Lake and the airfield also have a system of fixed remotely-

triggered propane cannons triggered by the Buckley AFB Air Traffic Control Tower when birds are in the vicinity is used in conjunction with personnel-deployed pyrotechnics (BAFB 2010a).

Depredation, which is the lethal removal of nuisance birds and other wildlife may also be used at times control BASH at Williams Lake and the airfield and conducted in accordance with permits from the USFWS. Depredation is a last resort measure used to reinforce harassment measures and habitat modification.

3.5.2.2 Aircraft Mishaps

There have been no recent notable aircraft mishaps reported at Buckley AFB. In 2005, an F-16C fighter aircraft assigned to Buckley AFB was destroyed upon making an emergency landing at Lamar Airport, located approximately 150 miles southeast of the base in Lamar, Colorado. There were no fatalities and only minor damage to private property (Buckley AFB 2005).

3.5.2.3 Accident Potential Zones

At Buckley AFB, CZs and APZs extend 15,000 feet from both ends of the runway (refer to Figure 3-3 in Section 3.6, *Land Use*). Most of the CZs are within base boundaries, but the majority of the APZs fall outside of the base (Buckley AFB 2003). Present land use to the north of the base is comprised by a mix of light industrial, undeveloped space, and recreational facilities, while agricultural and undeveloped uses predominate south of Buckley AFB (City of Aurora 2009a). Refer to Section 3.6, *Land Use*, for a detailed discussion of present and future land use around the base.

3.5.2.4 Explosives Safety

QD arcs have been established around various facilities adjacent to the airfield, including a munitions hold area, hot cargo pad, and the munitions storage area. The development footprints associated with the Proposed Action and project alternatives would be located outside of all established QD arcs at Buckley AFB. Accordingly, explosives safety would not be impacted by the Proposed Action or project alternatives, and an analysis of potential impacts has been eliminated from Section 4, *Environmental Consequences*.

3.6 LAND USE

3.6.1 Definition of Resource

Land use comprises the natural conditions or human-modified activities occurring at a particular location. Human-modified land use categories may include residential, commercial, industrial, transportation, communications and utilities, agricultural, institutional, recreational, and other developed uses. Management plans and zoning regulations determine the type and extent of land use allowable in specific areas and are often intended to protect specially designated or environmentally sensitive areas.

3.6.2 Existing Conditions

The ROI for land use is limited to Buckley AFB and, where applicable, land use policies pertaining to the City of Aurora.

3.6.2.1 Regional Setting

Buckley AFB is located in the northeast part of the City of Aurora, along the eastern fringe of the city's developed core. Present land use in the vicinity of the base is comprised of light industrial to the northwest; a mix of light industrial, undeveloped space, and park and sports facilities to the north; newly-constructed residential neighborhoods to the southwest; and, agricultural and undeveloped space to the east and south (City of Aurora 2009a). The Plains Conservation Center manages an approximately 1,100-acre state-designated preservation area located southeast of Buckley AFB (Plains Conservation Center 2011).

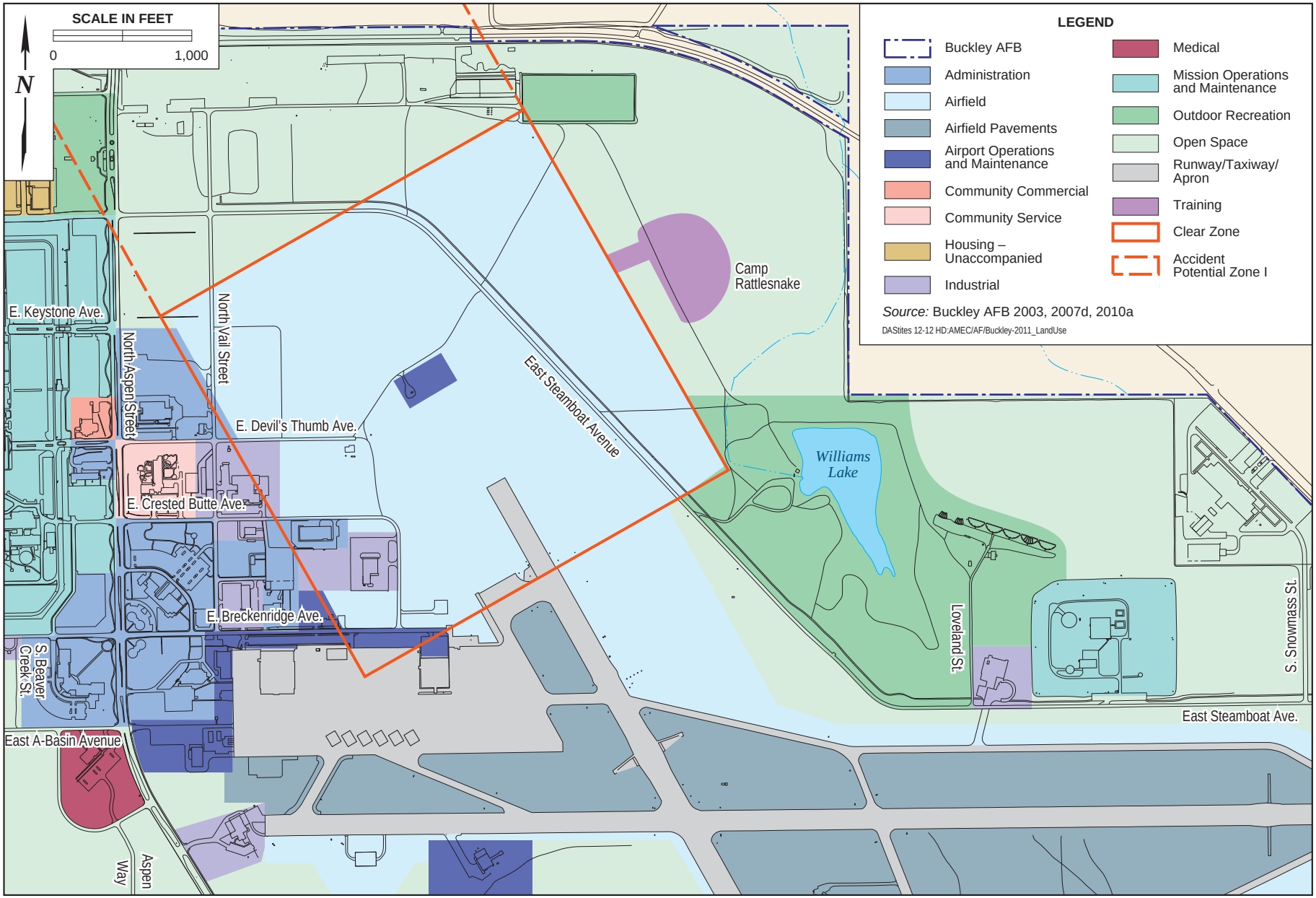
Noise and airfield safety contours have been delineated around Buckley AFB and adjacent areas to restrict building heights, as well as the establishment of noise-sensitive receptors (e.g., schools, hospitals, etc.) and otherwise incompatible uses (City of Aurora 2009b). Refer to Section 3.5, *Safety*, for a discussion of designated airfield safety zones round Buckley AFB.

Areas to the east of the base are part of the *E-470 Corridor*, a 25-mile planned future growth corridor established along E-470 in the City of Aurora *2009 Comprehensive Plan* (City of Aurora 2009c). The E-470 Corridor is presently mostly undeveloped, but planned development includes large areas of regional and commercial activity, over 40,000 residential dwelling units, and park and open space areas (City of Aurora 2007, 2009d, 2009e). Corridor areas east of Buckley AFB would be developed as *Research and Development* facilities that would be constructed as a campus-oriented development intermixed with open space (Buckley AFB 2003). Corridor areas southeast of the base would remain as open space (City of Aurora 2009d, 2009e).

3.6.2.2 Buckley AFB

Land use within Buckley AFB has been classified into 14 categories based on the types of activities and associated uses that occur (refer to Figure 3-3). Undeveloped areas along the perimeter of Buckley AFB have been classified as *Open Space*. *Outdoor Recreation* areas are located among *Open Space*, including a large recreation area surrounding Williams Lake (Buckley AFB 2007c). *Outdoor Recreation* and O*pen Space* are the predominant land uses in the eastern part of the base surrounding Williams Lake. A recently developed Family Camp facility lies along the western shore of the lake and a paintball obstacle course lies to the northwest. In addition to camping and paintball activities, picnic facilities, hiking/walking trails, and playgrounds are located in the vicinity Williams Lake.

The *Airfield* and associated *Airfield Pavements* and *Airfield Operations and Maintenance* are the predominant land use in the central part of the base. Two *Mission Operations and Maintenance* areas are located on-base: a large area in the northwest part of the base and an additional area in the east near Williams Lake (Buckley AFB 2007c). *Administrative* and *Industrial* uses are mostly concentrated in the northwest part of Buckley AFB, with additional minor concentrations in the vicinity of the airfield (Buckley AFB 2007c, 2010a). Two *Training* areas are also located on-base: one southwest of the airfield and one immediately northwest of Williams Lake (Buckley AFB 2010a). Various uses are located only in the northwest part of the base, including *Community Commercial*, *Community Service*, *Housing–Accompanied*, *Housing–Unaccompanied*, and *Medical* (Buckley AFB 2007c).



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Current Land Use at Buckley AFB

FIGURE 3-3

No warranty is made by the State/Territory as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document," in that it is intended to change as new data become available and are incorporated into the GIS database.

3.7 VISUAL RESOURCES

3.7.1 Definition of Resource

Visual resources are defined as the natural and manufactured features that comprise the aesthetic qualities of an area. These features form the overall impressions that an observer receives of an area or its landscape character. Landforms, water surfaces, vegetation, and manufactured features are considered characteristic of an area if they are inherent to the structure and function of a landscape.

3.7.2 Existing Conditions

The ROI for visual resources is limited to Williams Lake facilities and surrounding open space.

3.7.2.1 Regional Visual Character

Topography surrounding Buckley AFB ranges from generally level to gently rolling and is dominated by suburban development to the southwest and northwest. Some commercial, industrial, and recreational development exists to the north. Areas south and east of the base are mostly undeveloped (the state-designated preservation area managed by the Plains Conservation Center, located southeast of the base, comprises approximately 1,100 acres of undeveloped grassland). The man-made reservoir *Williams Lake* is the result of the damming of a minor tributary of Sand Creek. There are no wild and scenic rivers, designated scenic roads or vistas, or other sensitive visual resources near Buckley AFB. State parks and federal wildlife refuges located near the base include: Cherry Creek State Park, 6 miles to the southwest; Barr Lake State Park, 18 miles to the north; Chatfield State Park, 20 miles to the southwest; Roxborough State Park, 24 miles to the southwest; Golden Gate Canyon State Park, 36 miles to the northwest; and Rocky Mountain Arsenal National Wildlife Refuge, 10 miles to the north.

3.7.2.2 Buckley AFB

Buckley AFB is located on the eastern side of the City of Aurora with a visual environment characteristic of a large military facility. Most structures are one-story in height and have been constructed using a variety of materials and in a variety of architectural styles. Renewable energy systems (e.g., solar photovoltaic arrays) have been developed on the southern side of the base near the Mississippi Gate. The East Toll Gate Creek drainage at the southwest border of the base serves as a physical and visual break between the base and surrounding residential areas. Seedlings were planted along the north, west, and southwest borders of the base to create a greenbelt buffer.

SECTION 4
ENVIRONMENTAL CONSEQUENCES

Environmental impacts which would result from implementation of the Proposed Action at Buckley Air Force Base (AFB) by the U.S. Air Force (USAF) are evaluated in this section. Issues studied in detail are listed in Section 1.5.1 and are presented by resource area, as described in Section 3, *Affected Environment*. Examination of potential environmental impacts is intended to reduce redundancy where similar impacts are expected for each alternative to the Proposed Action. Per the National Environmental Policy Act (NEPA) and Council on Environmental Quality regulations, environmental resource areas that are anticipated to experience either no or negligible environmental impact under implementation of the Proposed Action are not examined in detail in this document. Section 1.5.2, *Issues Eliminated from Further Study*, provides a list and summary of resource areas eliminated from detailed analysis.

The definitions for impact intensity thresholds used in this document are as follows:

- ***Negligible***. Impacts on the resource, although anticipated, would be difficult to observe and are not measurable.
- ***Minor***. Impacts on the resources would be detectible upon close scrutiny or would result in small but measurable changes to the resource.
- ***Moderate***. Impacts on the resource would be easily observed and measurable, but would be localized or short-term (equal to or less than two years).
- ***Major***. Impacts on the resource would be easily observed and measurable, widespread, and long-term (more than two years).

4.1 BIOLOGICAL RESOURCES

4.1.1 Approach to Analysis

Determining the magnitude of potential impacts to biological resources is based on 1) the importance (i.e., legal, commercial, recreational, ecological, or scientific) of the resource; 2) the proportion of the resource affected relative to its occurrence in the region; 3) the sensitivity of the resource to proposed activities; and 4) the duration of ecological ramifications. Impacts to biological resources are significant if species or habitats of concern are adversely affected over relatively large areas or disturbance causes reductions in population size or distribution.

When necessary, representatives of the U.S. Fish and Wildlife Service (USFWS), Colorado Division of Wildlife (CDOW), and Colorado Natural Heritage Program (CNHP) are contacted to determine the presence or potential occurrence of sensitive species and habitats in the study area. Potential physical impacts such as habitat loss, noise, and impacts to surface water were evaluated to assess potential impacts to biological resources resulting from implementation of the Preferred Alternative and identified alternatives.

4.1.2 Impacts

4.1.2.1 Alternative 1 (Preferred Alternative): Remove Williams Lake Dam

<u>Vegetation</u>

The Williams Lake site consists of a mosaic of grassland prairie, exotic weed infestations, riparian, and riparian bottomlands. The existing dam is primarily vegetated with crested wheatgrass complex and invasive, weedy species. Non-jurisdictional wetland vegetation is present within the lake drainage basin, including large riparian trees. Direct impacts to vegetation would be primarily related to the excavation and removal of the dam, slope grading to return the site to its natural topography, and construction staging areas associated with the proposed dam removal activities. Additionally, the large riparian trees existing near the lake would also be removed.

The drained lake bed would be reseeded with a native short-grass prairie seed mix as soon as possible following drainage and regrading of the lake to prevent potential soil erosion. Additionally, all other exposed soils resulting from excavation and removal of the dam structure would be reseeded with a native grassland prairie seed mix and protected with hydromulching or a biodegradable erosion blanket until vegetation is established. Soil erosion protection would be extended along the downstream channel to prevent excessive erosion. All revegetation of disturbed sites would be accomplished using appropriate and proven reseeding techniques.

Impacts to the vegetation communities resulting from implementation of the Preferred Alternative are expected to be localized, minor, and short-term due to revegetation efforts. No anticipated long-term habitat loss would be associated with the Preferred Alternative. Therefore, long-term impacts to vegetation are expected to be less than significant.

Wildlife

Impacts to wildlife are expected to be minimal since much of the construction activities consist of the drainage of William Lake and the excavation and removal of the dam structure. Game fish (bass and bluegill) would be relocated to nearby water bodies to the maximum extent feasible prior to draining Williams Lake. Therefore, impacts to game fish would be negligible. In areas where sensitive species (as discussed in the following section) exist or are nesting, excavation and construction activities may need to be delayed during the nesting season or until clearance surveys are conducted. Overall, implementation of the proposed project would result in a negligible impact to wildlife at Buckley AFB assuming that appropriate precautions and avoidance measures for identified sensitive species are implemented during any required activities that would involve earth-moving activity. Therefore, implementation of the Preferred Alternative would constitute a minor impact to wildlife over the short and long term that would be less than significant.

Sensitive Species

According to information from the USFWS, CDOW, and Buckley AFB, a total of 13 special-status species potentially occur on base. This includes one amphibian species, five bird species, four mammalian species, one reptile species, and two plant species.

Although they have not been noted within the project area, suitable habitat for the northern leopard frog and the common garter snake may exist along the bottomlands and stream margins below Williams Lake and unnamed tributaries of Sand Creek. Surveying would be required to identify if either species is present within the proposed project site. Coordination with the CDOW and/or USFWS may be required if individual northern leopard frogs or common garter snakes exist within the project area and construction activities may need to be delayed until clearance surveys are conducted.

Potential habitat for the Colorado butterfly plant and Ute ladies'-tresses orchid also occurs along the bottomlands and stream margins below Williams Lake and unnamed tributaries of Sand Creek. Surveying conducted in 2001 did not find any Ute Ladies'-tresses orchid specimens within the Williams Lake area (Buckley AFB 2003). Although they have not been noted within the project area, surveying would be required to identify if either the Colorado butterfly plant or the Ute ladies'-tresses orchid species is present within the proposed project site. Coordination with the USFWS may be required if either species exist within the project area and construction activities may need to be delayed until identified healthy specimens can be salvaged and relocated.

Five sensitive bird species have been identified as potentially occurring within Buckley AFB. Three of these sensitive bird species are known to occur at Buckley AFB: bald eagle, ferruginous hawk, and burrowing owl. Both the bald eagle and ferruginous hawk forage at and around Buckley AFB. Implementation of the Preferred Alternative could potentially result in minor impacts to these two species due to the loss of a limited number of trees for perching and nesting. The burrowing owl is known to nest mainly in the northeastern portion of the base and along the airfield flight lines and there is a potential for burrowing owls to be present within the project area. If construction activities are proposed

between March 1 and October 31 (known nesting periods), pre-construction surveying would be required and performed by onsite USFWS personnel before the Preferred Alternative is implemented to identify if burrowing owls or their burrows are present within the proposed project site. The CDOW recommends a 150-foot buffer to be established around occupied burrows during the nesting season (March 1 through October 31). If occupied burrows are located within the area of proposed construction, construction activities in those areas would be delayed until the owl migrated out of the area (November 1 through February 28). If construction could not be delayed, Buckley AFB personnel would consult with the CDOW and USFWS prior to conducting any earth-moving activities. According to the CDOW, another option is to encourage the owl out of the area, once fledged. Care should be taken to observe the owls to be sure they have relocated away from the proposed construction site (CDOW 2010a). Therefore, with implementation of appropriate avoidance and management procedures, the Preferred Alternative could have temporary minor impacts on burrowing owls.

Black-tailed prairie dogs inhabit many areas throughout the base, but are most common in the cantonment and flight line areas. Existing prairie dog towns are not present within the Williams Lake area; however, some individuals may be present. Limited mortality or displacement of prairie dogs is expected and disturbed areas following completion of the Preferred Alternative may soon be re-colonized by displaced individuals. Therefore, impacts to the current population of black-tailed prairie dogs at Buckley AFB are expected to be minor and short-term.

The mountain plover, whooping crane, and swift fox have the potential for occurring on base as rare transients; however, impacts to these species are not expected, because more suitable habitat for these transient species is located outside of the areas affected by the Preferred Alternative.

There is no record of occurrences for black-footed ferrets within Buckley AFB; therefore, no impacts are anticipated by the Preferred Alternative for this species. Although Buckley AFB contains habitat suitable for the Preble's Meadow jumping mouse, the USFWS has determined that there are no longer any wild free-ranging Preble's Meadow jumping mice in the Denver metropolitan area and has designated it as a block clearance zone (Buckley AFB 2008b). Therefore,

no impacts are anticipated by the Preferred Alternative for this species and impacts to sensitive species overall would be less than significant. Buckley AFB would ultimately seek concurrence by the USFWS on the impact to sensitive species and formal consultation, in accordance with Section 7 of the Endangered Species Act (ESA), may be required. If formal consultation is required, a Biological Assessment and Biological Opinion may also be required and would be completed prior to the implementation of the Preferred Alternative.

Wetlands

There are two wetlands associated with an unnamed tributary of Sand Creek in the northeast part of Buckley AFB, as well as wetland areas adjacent to Williams Lake. The USACE determined that Williams Lake and associated drainage areas—including downstream wetlands—are not jurisdictional wetlands and are not regulated by USACE (USACE 2001, 2003). Therefore, since wetland areas within the project area that would be potentially impacted by the Preferred Alternative are not jurisdictional *Waters of the U.S.*, implementation of the Preferred Alternative is not anticipated to impact jurisdictional wetland resources and would be less than significant. Executive Order 11990, *Protection of Wetlands* and Department of Defense Instruction (DoDI) 4715.3, *Environmental Conservation Program* provide guidance against net loss of both jurisdictional and non-jurisdictional wetlands (USAF 2008).

Impacts to non-jurisdictional wetlands are anticipated under the Preferred Alternative as the proposed habitat improvements would result in the removal of these wetlands. However, wetland areas that would be impacted by the Preferred Alternative are not considered high-value from an ecosystem function standpoint. They are not known to support any sensitive plant and wildlife species or critical habitat for threatened and endangered species and are actively managed to discourage wildlife access due to BASH concerns. Similar wetland and riparian habitat also exist in and around Sand Creek (approximately 1700 feet north of Williams Lake) and any species potentially displaced could relocate there and easily find a place to forage, nest, and roost. In addition, non-jurisdictional wetlands in the project area are man-made resulting from construction of Williams Lake Dam and the Preferred Alternative would include habitat improvements that would mirror pre-development hydrologic and

vegetative conditions to the maximum extent feasible and would help to restore pre-development ecosystem functions. Because the existing wetlands do not support critical habitat or sensitive species, are considered low value from an ecosystem standpoint, are currently managed to discourage wildlife access, because the Preferred Alternative will restore pre-development ecosystem functions, and there is similar habitat in abundance nearby any potential impacts to the existing non-jurisdictional wetlands are expected to be less than significant and if no replacement of these wetlands is conducted the impacts are also expected to be less than significant. Therefore, no further mitigation is required.

4.1.2.2 Alternative 2: Drain Williams Lake

Under Alternative 2, potential short- and long-term impacts to biological resources would be similar to those described under the Preferred Alternative. However, under this alternative, only the lake would be drained and the existing Williams Lake dam structure would not be removed nor would downstream improvements would be implemented. Non-native vegetation and large riparian trees within the Williams Lake drainage basin would be removed and the area would be revegetated, using appropriate and proven reseeding techniques, with native short-grass prairie species. Impacts to the existing vegetation are expected to be localized and short-term. Therefore, impacts to biological resources under Alternative 2 are expected to remain the same as those described under the Preferred Alternative and less than significant.

4.1.2.3 Alternative 3: No-Action Alternative

Implementation of the No-Action Alternative would result in no changes to the existing vegetation, wildlife, wetlands, or sensitive species occurring around Williams Lake at Buckley AFB. Conditions would remain as described in Section 3.1, *Biological Resources*.

currently managed to discourage wildlife access, and because the Preferred Alternative will restore pre-development ecosystem functions, any potential impacts to the existing non-jurisdictional wetlands are expected to be less than significant and if replacement of these wetlands is not conducted the impacts are also expected to be less than significant. Therefore, no mitigation would be required.

4.1.2.2 Alternative 2: Drain Williams Lake

Under Alternative 2, potential short- and long-term impacts to biological resources would be similar to those described under the Preferred Alternative. However, under this alternative, only the lake would be drained and the existing Williams Lake dam structure would not be removed nor would downstream improvements would be implemented. Non-native vegetation and large riparian trees within the Williams Lake drainage basin would be removed and the area would be revegetated, using appropriate and proven reseeding techniques, with native short-grass prairie species. Impacts to the existing vegetation are expected to be localized and short-term. Therefore, impacts to biological resources under Alternative 2 are expected to remain the same as those described under the Preferred Alternative and less than significant.

4.1.2.3 Alternative 3: No-Action Alternative

Implementation of the No-Action Alternative would result in no changes to the existing vegetation, wildlife, wetlands, or sensitive species occurring around Williams Lake at Buckley AFB. Conditions would remain as described in Section 3.1, *Biological Resources*.

4.2 WATER RESOURCES

4.2.1 Approach to Analysis

An impact to water resources would be significant if implementation of a project alternative would: 1) reduce water availability to or interfere with the supply of existing users; 2) create or contribute to the overdraft of groundwater basins or exceed decreed annual yields of water supply sources; 3) adversely affect surface or groundwater quality; 4) threaten or damage unique hydrologic characteristics; or, 5) violate established laws or regulations that have been adopted to protect or manage water resources, including management plans adopted by Buckley AFB. Since the Proposed Action and alternatives would not extract groundwater to supplement water levels at Williams Lake (refer to Section 3.2, *Water Resources*), further analysis of groundwater impacts has been eliminated.

4.2.2 Impacts

4.2.2.1 Alternative 1 (Preferred Alternative): Remove Williams Lake Dam

<u>Surface Water and Groundwater</u>

Water quality sampling has been performed at Williams Lake to establish existing water quality conditions; the lake's water quality meets the appropriate standards for discharge set by the Colorado Department of Public Health and Environment for the South Platte River Basin (refer to Appendix C). Following removal of game fish from the lake and the subsequent proposed application of the approved piscicide (rotenone), water quality testing would be performed to ensure the applied rotenone will have been sufficiently detoxified and that the resultant lake water quality continues to meet the appropriate standards for discharge set by the Colorado Department of Public Health and Environment for the South Platte River Basin. Impounded water would then be pumped over the dam or into the existing overflow channel, and then discharged into the small seasonal tributary that flows north into Sand Creek located approximately 1 mile downstream of Williams Lake.

Water impounded in the Williams Lake reservoir area would be released in a controlled manner that would not endanger lives or damage downstream properties. The water from the reservoir would be pumped out slowly and the area surrounding the pipe's discharge point would be protected in an effort to minimize excessive erosion at the point of discharge.

The removal of the dam will include preventative design measures that will reduce the potential for silt deposits within the reservoir, along with material excavated from the dam, from washing downstream. During construction, best management practices (BMPs) (e.g., silt fencing, erosion stabilization measures, etc.) would also be implemented to minimize erosion, runoff, and sedimentation. Further, because cumulative soil disturbance associated with the Proposed Action would be greater than 1 acre, a construction storm water permit, comprised of a stormwater pollution prevention plan (SWPPP) and a Notice of Intent (NOI), would be prepared and implemented. The BMPs and monitoring reporting procedures would be developed and implemented for the Preferred Alternative. Following construction activities, all temporarily disturbed areas would be restored to pre-development conditions at the site to the maximum extent practicable, including re-contouring to previous surface hydrological conditions and revegetating to prevent potential increases in soil erosion. Therefore, construction-related impacts to surface water would be minor and short term.

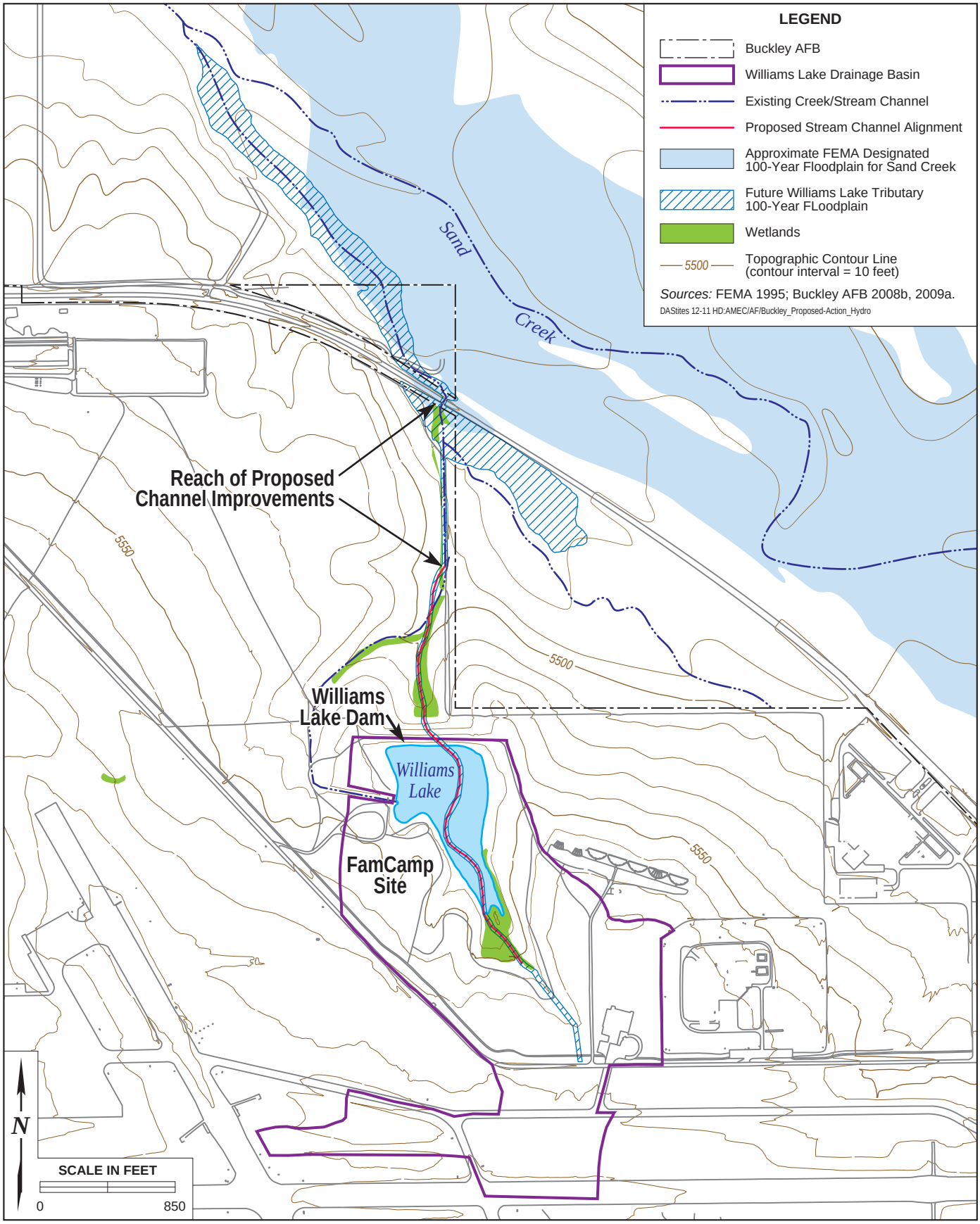
Implementation of the Preferred Alternative would not result in any increases of impermeable surfaces present at Buckley AFB and the proposed habitat improvements would include a grass-lined drainage channel. Consequently, the Preferred Alternative would not result in any changes to groundwater recharge in the project area. The quality of on-base and nearby surface water features (e.g., East Toll Gate and Sand creeks, etc.) are not anticipated to be adversely affected by the Preferred Alternative. Additionally, no impacts to regional surface water systems including the South Platte River are anticipated. Therefore, impacts to surface water and groundwater overall would be less than significant under the Preferred Alternative.

Floodplains

EO 11988, *Floodplain Management* and DoDI 4715.3, *Natural Resource Conservation Program* requires Federal agencies to avoid to the extent possible adverse impacts to 100-year floodplains. The Preferred Alternative would incorporate design measures to address potentially negative downstream flood impacts associated with removal of the Williams Lake dam. These measures include specific designs for construction of a drainage channel and associated rehabilitation which would provide adequate capacity to convey water from a 100-year storm event while minimizing the resulting 100-year floodplain width and size, reducing flood risk to properties, and increasing the stability of the drainage channel overall (Buckley AFB 2011c; refer to Appendix C).

The Preferred Alternative would include engineering and construction of a new, approximately 2,200-linear foot drainage channel, which would start upstream of the current Williams Lake and would run to approximately 700 feet downstream of Williams Lake dam (Figure 4-1). The new drainage channel would be routed to replicate a natural sinuous stream channel and would be designed with adequate capacity to convey water from a 100-year storm event. The new channel would be grass-lined and would have a bottom width of 20 feet, a depth of 3 feet, a longitudinal slope of 1 percent, and side slopes constructed at a 4:1 ratio. Five sloping boulder drop structures would constructed to provide grade control for the new drainage channel.

In addition, the Preferred Alternative would also include rehabilitation of approximately 1,500 linear feet of the existing drainage channel which flows from downstream of the Williams Lake dam to the culvert at East 6th Avenue (refer to Figure 2-1). The existing channel would be restructured and rehabilitated to provide adequate capacity to convey water from a 100-year storm event. The rehabilitated and improved drainage channel would be grass-lined and would have a bottom width of 10 feet, a depth of 3 feet, a longitudinal slope of 1 percent, and side slopes constructed at a 4:1 ratio. As with the proposed new drainage channel, the rehabilitated portion of the existing channel would include two sloping boulder drop structures to provide grade control (Buckley AFB 2011c).



EA

Proposed Project Location and Future Williams Lake Tributary 100-Year Floodplain

FIGURE 4-1

No warranty is made by the State/Territory as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data. This map is a "living document," in that it is intended to change as new data become available and are incorporated into the GIS database.

Table 4-1. Existing and Future Williams Lake Tributary 100-Year Floodplain

Segment	Existing Conditions Floodplain (off-base amount)	Future Conditions Floodplain under Preferred Alternative (off-base amount)
Upstream of Williams Lake Dam	10.17 total acres (0 acres)	1.56 total acres (0 acres)
Dam to East 6th Avenue Culvert	12.28 total acres (8.17 acres)	9.14 total acres (6.59 acres)
East 6th Avenue Culvert to Sand Creek	9.67 total acres (7.72 acres)	10.63 total acres (8.38 acres)
Total	**32.12 total acres (15.89 acres)**	**21.33 total acres (14.97 acres)**

Source: Buckley AFB 2011c.

The resulting footprint of the non-regulated Williams Lake drainage area specific 100-year floodplain associated with the Preferred Alternative is presented in Figure 4-1. Table 4-1 provides a comparison of area for the existing and future non-regulated Williams Lake drainage area 100-year floodplain associated with the Preferred Alternative. Implementation of the Preferred Alternative, including channel design and improvement measures, would reduce the overall size of the existing non-regulated 100-year floodplain by approximately 10.79 acres (33.6 percent reduction). Specifically, the area of the existing non-regulated 100-year floodplain located immediately upstream of the East 6th Avenue culvert would be reduced by approximately 3.14 acres (32.5 percent reduction). Ponding on the south side of East 6th Avenue from a potential 100-year flood event would not overtop the existing road surface elevation and the 100-year floodplain elevation would be greater than one foot below the existing road surface elevation (see Appendix C; Buckley AFB 2011c).

Under existing conditions, the Williams Lake dam serves as a reservoir for surface water runoff from minor watersheds on Buckley AFB. As such, floodwaters are retained at Williams Lake and are subject to natural seepage through the dam structure. Implementation of the Preferred Alternative would eliminate the existing retention of floodwaters by Williams Lake dam. With the removal of the dam structure, floodwaters would be discharged off-base at the time of occurrence instead of being temporarily stored at Williams Lake. As such, under the Preferred Alternative, modeled flow volumes for proposed

future flood discharge conditions would increase downstream of the existing dam structure leaving Buckley AFB and flowing to Sand Creek. Existing and future conditions peak flows are presented in Table 4-2 by storm event scenario. Although implementation of the Preferred Alternative would increase 100-year event peak flow discharges from the Williams Lake tributary into Sand Creek by approximately 90 cubic feet per second (a 42-percent increase), this additional flow during a 100-year event would be considered a minor contribution to the overall capacity of Sand Creek. In addition, implementation of the Preferred Alternative would result in an overall reduction of the coverage of the existing Williams Lake tributary 100-year floodplain, including a reduction in the total coverage of the existing 100-year floodplain, which is located on off-base property. Finally, since the Preferred Alternative does not include development of impermeable surfaces of any kind and would not result in the inclusion of any facilities or structures in the anticipated 100-year floodplain, adverse impacts to floodplains would be minor over the short- and long-term and would be considered less than significant.

Table 4-2. Existing and Future Conditions Peak Event Discharge from Williams Lake Tributary into Sand Creek

Scenario	Existing Peak Event Discharge	Future Conditions Peak Event Discharge
2-Year Event	25 cfs	37 cfs
10-Year Event	47 cfs	78 cfs
100-Year Event	214 cfs	304 cfs

cfs- cubic feet per second
Source: Buckley AFB 2011c.

4.2.2.2 Alternative 2: Drain Williams Lake

Under Alternative 2, potential short- and long-term impacts to surface water would be similar to those described under the Preferred Alternative. As with the Preferred Alternative, water impounded in Williams Lake would be released in a controlled manner that would not endanger lives or damage downstream properties. The water from the lake would be periodically pumped out slowly and the area surrounding the pipe's discharge point would be protected in an effort to minimize excessive erosion at the point of discharge. The Williams Lake dam would not be removed under this alternative. Instead, the existing dam

structure would remain in place and act as a retention barrier to any upstream surface flows, thus continuing to eliminate the potential for flooding along the downstream drainage. Therefore, Alternative 2 would not result in any impacts to floodplains and would have less than significant impacts to water resources overall.

4.2.2.3 Alternative 3: No-Action Alternative

Under the No-Action Alternative, surface water, groundwater, and water management would remain unchanged from baseline conditions as described in Section 3.2, *Water Resources*, and no impacts would occur.

4.3 GEOLOGICAL RESOURCES

4.3.1 Approach to Analysis

An impact to geological resources would be significant if implementation of the Proposed Action or a project alternative would: 1) increase potential occurrences of erosion, siltation, or geological hazards (e.g., landslides, etc.); 2) incorporate engineering or construction techniques that do not adequately address potential geologic hazards; or, 3) expose people or structures to major geological hazards. Generally, impacts with regard to geological resources can be avoided or minimized if proper construction techniques, erosion and siltation control measures, and structural engineering designs are incorporated into project development. Since no unique geological resources would be located in the footprints of the Proposed Action and project alternatives (refer to Section 3.3, *Geological Resources*), further analysis of unique geological resources has been eliminated. In addition, since potential impacts to geological resources would be limited to the project vicinity on Buckley AFB, there would be no impacts to regional geology and further analysis has been eliminated.

4.3.2 Impacts

4.3.2.1 Alternative 1 (Preferred Alternative): Remove Williams Lake Dam

Implementation of the Preferred Alternative would result in the excavation and removal of the man-made earthen dam that forms Williams Lake. The Williams Lake drainage basin would then be regraded to replicate predevelopment topography to the maximum extent feasible. The Preferred Alternative would also include drainage channel construction and improvement activities. Freshly exposed sediments on the former lake bed would be subject to erosion until a vegetative cover can be established. For this reason, the exposed former lake bed would be revegetated as soon as possible following drainage and regrading of the lake. A similar protection strategy is required for the areas excavated beneath the existing dam structure and disturbed during drainage channel improvement activities. Some form of stabilization such as hydromulching or a biodegradable erosion blanket would minimize sediment movement until the protective vegetation becomes established. The dam would be excavated to the

natural ground level (or as necessary, in accordance with Rule 7.1.2.3 of CDWR's *Rules and Regulations for Dam Safety and Dam Construction* [CDWR 2007]). The sides of the breach would be excavated to a slope that is stable, but not steeper than a 2:1 horizontal to vertical ratio. The breach would also be designed to prevent silt from the reservoir and excavated material from washing downstream. Refer to Section 2.2.1.3 for further detail about dam removal activities and Section 4.2 for analysis of the environmental consequences related to water resources.

The majority of the excavation, regrading, and channel improvement activities would occur in areas identified as containing *Renohill-Litle-Thedalund* soils. These soils comprise loamy to clayey material with moderate internal drainage and loamy and silty eolian (i.e., wind-blown) material, respectively, that can become compacted by heavy equipment during construction. This soil type is also susceptible to wind and water erosion (Natural Resources Conservation Service [NRCS] 2009).

In order to minimize potential erosion, sedimentation, siltation, and soil compaction during excavation, regrading, and other construction activities, BMPs would be incorporated as part of the Preferred Alternative, including:

- Covering stockpiled soils and excavated and trenched areas during rains;
- Incorporating erosion and siltation prevention measures (e.g., minimal watering for dust suppression, use of netting and silt fencing, etc.);
- Channeling surface water flow away from excavated and trenched areas;
- Backfilling all excavated soils to their original location where feasible;
- Re-contouring to previous surface hydrological conditions;
- Revegetating surface areas as soon as soils are backfilled into excavated and trenched areas; and,
- Limiting the use of heavy equipment to the maximum extent practicable.

With implementation of the BMPs described above, construction-related impacts to soils would be reduced and localized to the project footprint. In addition, because total soil disturbance associated with implementation of the Preferred Alternative would be greater than 1 acre, a SWPPP and NOI for construction activities would be developed and implemented. Therefore, implementation of

the Preferred Alternative would result in negligible, site-specific impacts to soils over the short term.

Once proposed activities under the Preferred Alternative are completed, potential impacts to soils would be minimal. Freshly exposed sediments in the lake bottom will most likely not be able to support vegetation growth and would likely need to be removed or mixed with natural soils. Exposed areas on the former lake bed would be subject to erosion and would be revegetated as soon as possible and all excavation and other soil disturbance activities would also incorporate BMPs listed above, as appropriate. Further, all project components would be engineered to ensure potential impacts from erosion, siltation, and geological hazards (e.g., landslides, slumping, etc.) would be minimized. All construction activities proposed within the installation would occur on previously disturbed land used to form the man-made lake and within the associated drainage basin and the Williams Lake drainage basin would be regraded to replicate predevelopment topography to the maximum extent feasible. Therefore, implementation of the Preferred Alternative would result in negligible short-term impacts to geological resources and would be less than significant.

4.3.2.2 Alternative 2: Drain Williams Lake

Potential short- and long-term impacts to soils and other geological resources would be similar to those described under the Preferred Alternative; however, Williams Lake dam would not be removed and regrading of the drainage basin would not occur. Alternative 2 would incorporate the same BMPs identified previously in Section 4.3.2.1 for lake-draining activities to minimize potential occurrences of erosion, siltation, and soil compaction, and implementation of Alternative 2 would also result in minor, site-specific impacts to soils over the short term. In addition, all activities would occur on previously disturbed land (i.e., the lakebed itself). Therefore, implementation of Alternative 2 would result in negligible long-term impacts to geological resources and would be less than significant.

4.3.2.3 Alternative 3: No-Action Alternative

Under the No-Action Alternative, the proposed wildlife control actions would not occur. Therefore, no impacts to geological resources would be anticipated under the No-Action Alternative.

4.4 AIR QUALITY

4.4.1 Approach to Analysis

Air Force Instruction (AFI) 32-7040, *Air Quality Compliance and Resource Management*, provides a framework for ensuring that USAF actions conform to appropriate implementation plans. Section 2.4 of AFI 32-7040, *Conformity Planning*, ensures that such actions would conform to the applicable implementation plan through the U.S. Environmental Protection Agency (USEPA) General Conformity Rule. In the case of the Proposed Action, conformity with the Colorado State Implementation Plan (SIP) would be required. Section 2.5 of AFI 32-7040, *National Environmental Policy Act (NEPA) and Environmental Impact Analysis Process Planning*, outlines the requirements under NEPA for analysis of air quality impacts with respect to the Prevention of Significant Deterioration (PSD)/New Source Review (NSR) (40 Code of Federal Regulations [CFR] Part 51), hazardous air pollutants (HAP) emissions, and emissions of any other regulated pollutants under the Clean Air Act (CAA) such as Ozone Depleting Substances (ODSs) that will result from implementation of the Proposed Action. Direct and indirect emissions of criteria pollutants or their precursors associated with the Proposed Action must be calculated for all non-exempt emission sources, including mobile and stationary, as well as construction-phase emissions.

With respect to the General Conformity Rule, effects on air quality would be considered significant if the Proposed Action would exceed *de minimis* threshold levels established in 40 CFR 93.153(b) for individual nonattainment or maintenance pollutants – 100 tons per year (TPY) ozone (O_3), carbon monoxide (CO), nitrogen oxides (NO_x), and particulate matter equal to or less than ten microns in diameter (PM_{10}).

4.4.2 Impacts

4.4.2.1 Alternative 1 (Preferred Alternative): Remove Williams Lake Dam

Fugitive Dust Emissions

Under the Preferred Alternative, fugitive dust would be generated from excavating, trenching, clearing, and grading activities, as well as combustion emissions from construction-related vehicles and equipment. Dust emissions generated from such activity can vary substantially depending on levels of activity, specific operations, and prevailing meteorological conditions. Using conservatively high estimates (based on moderate activity levels, moderate silt content in affected soils, and a temperate climate), the standard dust emission factor for construction activity is estimated at 1.2 tons of dust generated per acre per month of activity (USEPA 1995). This factor is referenced to total suspended particulates, instead of specifically PM_{10} or $PM_{2.5}$ (particulate matter equal or less than 2.5 microns in diameter), and, consequently, results in conservatively high estimates. Based on the conservatively high estimate that all project acreage would be disturbed at any one time (13.86 acres or 603,625 square feet [sf]), a projected total of about 16.63 tons per month of dust would be generated if all construction activities were implemented simultaneously. Refer to Appendix B for a full list of air emission factors, calculations, and assumptions.

Increased fugitive dust (i.e., PM_{10}) resulting from activities under the Preferred Alternative would involve short-term adverse impacts that could be reduced through standard dust minimization practices (e.g., watering soils to depth of trenching, regularly watering exposed soils, soil stockpiling, and soil stabilization). These standard dust minimization measures can reduce dust generation by 75 percent (USEPA 1995); thereby reducing dust emissions to approximately 4.16 tons per month (refer to Appendix B). Although any substantial increase in PM_{10} emissions is inherently adverse, implementation of these dust minimization measures would limit the total quantity generated during project implementation. Increased PM_{10} emissions associated with the Preferred Alternative would be short-term and temporary, and would be minimized using dust suppression techniques; therefore, impacts to air quality would be minor and less than significant.

Combustion Emissions

Mobile source combustion emissions associated with construction-related vehicles and equipment would be minimal because most vehicles would be driven to and kept at work sites for the duration of construction activities. Further, as is the case with PM_{10} emissions associated with trenching and site preparation activities, emissions generated by construction equipment would be temporary and short-term; therefore, no major impact to air quality would occur as a result of use and maintenance of construction-related vehicles or equipment.

Projected combustion emissions from mobile construction equipment under implementation of the Preferred Alternative are listed in Table 4-3; they are based on the scenario of 8-hour workdays, five days per week, for simultaneous construction activity over the course of 9 months (180 work days or 1,140 hours). Because a specific equipment list and horsepower rating for the equipment is not yet determined, emission factors were representative of a fleet-wide average, and a standard equipment list for construction was used. Refer to Appendix B for a full list of assumptions and emission factors used in this analysis.

Table 4-3. Projected Fugitive Dust and Combustion Emissions for Construction and Operational Activities

Equipment	Emissions (TPY)				
	CO	NO_x	PM_{10}	SO_x	VOCs
Grader	0.40824	1.16856	0.06048	0.19872	0.10656
Loader	0.30528	0.61776	0.06192	0.0828	0.09504
Bobcat	0.19296	0.36576	0.03888	0	0.0648
Dozer	0.87048	2.18664	0.08856	0.32616	0.16704
Paving equipment	0.30168	0.69192	0.04968	0.10368	0.08424
Paver	0.32328	0.64368	0.04824	0.1188	0.0864
Excavator	0.936	3.312	0.2304	0.5328	0.2448
Combustion Emissions	**3.34**	**8.99**	**0.58**	**1.36**	**0.85**
Fugitive Dust Emissions	**N/A**	**N/A**	**49.92**	**N/A**	**N/A**
TOTAL EMISSIONS	**3.34**	**8.99**	**50.50**	**1.36**	**0.85**
De minimis threshold value	100	100	100	N/A	100

Notes: Refer to Appendix B for a full list of assumptions and emission factors used in this analysis. N/A = not applicable.
Sources: Buckley AFB 2009a and 2009d.

Operational Emissions

Implementation of the Preferred Alternative would not include operation of any facility or result in the generation of any stationary emissions. Further, long-term maintenance of the altered land area associated with the Preferred Alternative is expected to generate negligible additional vehicle traffic and related operational emissions. Therefore, operational emissions associated with the Preferred Alternative are expected to be negligible and less than significant.

General Conformity

Emissions from construction and operational related activities associated with the Proposed Action would be well below *de minimis* thresholds values for O_3, CO, NO_X, and PM_{10}; therefore a General Conformity determination would not be required (refer to Table 4-3). Therefore, implementation of the Preferred Alternative would result in minor impacts and impacts to air quality overall would be less than significant.

4.4.2.2 Alternative 2: Drain Williams Lake

Air quality impacts under this alternative would be similar to those identified under the Preferred Alternative but would exclude emissions associated with dam removal and stream improvement activities; thus, total fugitive dust emissions under Alternative 2 are estimated to be 10.32 tons per month (refer to Appendix B). Under implementation of this alternative, standard dust minimization practices would be implemented, reducing these emissions by 75 percent to a total of approximately 2.58 tons per month and 23.22 TPY. Combustion and operational emissions would be less than those calculated for the Preferred Alternative and remain well below the *de minimis* threshold values (refer to Table 4-3 and Appendix B). Therefore, local and regional air quality impacts would remain minor and less than significant.

4.4.2.3 Alternative 3: No-Action Alternative

If the No-Action Alternative were selected, short-term temporary air quality impacts anticipated to occur during implementation of the Proposed Action

would not occur and air quality conditions and emissions associated with ongoing operations at Buckley AFB would remain as described in Section 3.4, *Air Quality*.

4.5 SAFETY

4.5.1 Approach to Analysis

If implementation of the Proposed Action would substantially increase risks associated with aircraft mishap potential or flight safety relevant to the public or the environment, it would represent a major impact. For example, if an action involved an increase in aircraft operations such that mishap potential would increase substantially, air safety would be compromised.

Further, if implementation of the Proposed Action would result in incompatible land use with regard to safety criteria such as Accident Potential Zones (APZs), Clear Zones (CZs), or quantity-distance (QD) arcs, impacts would be considered major.

4.5.2 Impacts

4.5.2.1 Alternative 1 (Preferred Alternative): Remove Williams Lake Dam

<u>Mishap Potential and Bird-Aircraft Strike Hazard</u>

Under implementation of the Preferred Alternative, Williams Lake and its associated dam would be removed and the landscape surrounding the lake restored to pre-development conditions. As such, no retained water – in the form of a lake or pond – would result; further, no habitat for fish would remain at the site. Implementation of the Preferred Alternative would significantly reduce the mishap potential related to bird/wildlife aircraft strike hazards (BASH) at Williams Lake by entirely eliminating the lake and its attributes as a wildlife-attractant (especially waterfowl bird species) for food, habitat, and resting. Implementing the Preferred Alternative would also significantly reduce the requirement to implement BASH control measures such as active harassments and depredation around the lake which is not possible at all times during aircraft operations due to the limited number of personnel available to perform these actions. BMPs to reduce fugitive dust emissions described previously in Section 4.4, *Air Quality*, would also address potential visual hazards for aircraft operations from construction activities performed in the

vicinity of the runway. Therefore, with regard to mishaps and BASH, major positive short- and long-term impacts would result from implementation of the Preferred Alternative.

Buckley AFB recently completed construction of Family Camp, currently scheduled to open in May 2012, directly adjacent to Williams Lake that is intended to provide short-term parking for recreational vehicles (RV) and camper trailers and will also provide water and electricity for the RVs and campers. The Family Camp has the potential to attract wildlife to the area by having household trash containers in the camp as well as the potential for camp visitors to leave food around campsites. All trash containers in the Family Camp will be inspected daily to ensure they are closed and they are not overfilled exposing waste food items that may attract wildlife. Signage will be placed throughout the camp to remind campers that they are to keep trash containers closed at all times. Signage will also be placed throughout the camp prohibiting the camp visitors from feeding birds and other wildlife. If these measures are implemented, the potential of the camp to attract wildlife to the area would be minimal and would not negate the overall effectiveness of implementing the Preferred Alternative.

Accident Potential Zones

The Preferred Alternative would not result in a change in shape or shift in location of established APZs and no habitable structures are proposed for development in the CZs or APZs associated with the airfield. Construction activity would be short-term and the presence of construction equipment and personnel at Williams Lake would not impede flight operations. Although unlikely, if needed, coordination with Air Traffic Control would occur before construction or maintenance activities were conducted in any CZ or APZ area. Therefore, the Preferred Alternative would result in negligible impacts to airfield safety and would be less than significant.

Explosives Safety

Implementation of the Proposed Action would not involve the storage or use of explosives and would not conflict with established QD arcs. Accordingly, no

impact to explosives safety would occur under the Proposed Action and impacts to safety overall would be less than significant.

4.5.2.2 Alternative 2: Drain Williams Lake

Implementation of Alternative 2 would result in similar impacts as described under the Preferred Alternative. Alternative 2 would also result in the elimination of the lake as a wildlife attractant and bird-strike hazard; however, continual maintenance activities would be required to keep Williams Lake drained over the long-term. Activities associated with this alternative would similarly be sited outside of CZs and APZs and would not impede the airfield's imaginary surfaces. Coordination with Air Traffic Control would occur before construction or maintenance activities were conducted in any CZ or APZ area. Therefore, no impacts with regard to airfield safety zones and explosives safety are anticipated and impacts to BASH and mishap potential are expected to include major positive short- and long-term effects.

4.5.2.3 Alternative 3: No-Action Alternative

If the No-Action Alternative were selected, the proposed wildlife control actions at Williams Lake would not be implemented and the mishap potential and BASH, as described in Section 3.5, would remain the same.

4.6 LAND USE

4.6.1 Approach to Analysis

The severity of potential land use impacts is based on the level of land use sensitivity in areas affected by a Proposed Action. In general, the Proposed Action would result in major land use impacts if it would: 1) be inconsistent or in noncompliance with applicable land use plans or policies; 2) preclude the viability of existing land use; 3) preclude continued use or occupation of an area; 4) be incompatible with adjacent or vicinity land use to the extent that public health or safety is threatened; or 5) conflict with airfield planning criteria established to ensure the safety and protection of human life and property.

4.6.2 Impacts

4.6.2.1 Alternative 1 (Preferred Alternative): Remove Williams Lake Dam

Under the Preferred Alternative, the Williams Lake dam would be removed and the lake would be drained, affecting surrounding recreational land uses such as the adjacent Family Camp and the nearby paintball obstacle course in the short-term and the presence of the lake as a passive recreational amenity over the long term. However, regrading and revegetation of the area would maintain the open space character of the area and support its primary purpose as an attractive recreational area. Users of existing recreational amenities including camping, picnicking, hiking/walking trails, and playgrounds would experience negligible impacts over the long term (refer to Section 4.7 for a discussion of consequences related to visual resources). Therefore, impacts to recreation would be considered minor over the long-term and would be less than significant.

The site's *Outdoor Recreation* and *Open Space* land use designations would be maintained and no changes in zoning would be required to implement the Preferred Alternative. Further, the Proposed Action as a whole would be consistent with the base's *General Plan*. Finally, as discussed in Section 4.5, because activities associated with the Preferred Alternative are outside the designated airfield APZs and CZs, they would not conflict with airfield planning

criteria. Therefore, impacts to land use compatibility would be considered minor over the long term and less than significant.

4.6.2.2 Alternative 2: Drain Williams Lake

Impacts to recreation under Alternative 2 would be similar to those described under the Preferred Alternative, including long-term impacts to fishing as a recreational amenity. In addition, regrading of the basin to predevelopment conditions would not occur and the drained lake may thus become less attractive to recreational users (refer to Section 4.7 for impacts related to visual resources). Therefore, impacts to recreation over the long term would be considered minor to moderate. Similar to the Preferred Alternative, impacts to land use and compatibility would also be considered minor over the long term under Alternative 2 and would be less than significant.

4.6.2.3 Alternative 3: No-Action Alternative

Under this alternative, no impacts to land use at Buckley AFB or its vicinity would occur. Williams Lake and the associated recreational and open spaces would be maintained in their current state. There would be no encroachment onto land currently designated as *Outdoor Recreation* or *Open Space*, as none of the proposed construction would proceed. Consequently, land use would remain unchanged from current conditions, as described in Section 3.5, and no impacts to land use would be anticipated under implementation of the No-Action Alternative.

4.7 VISUAL RESOURCES

4.7.1 Approach to Analysis

Determination of the severity of impacts to visual resources is based on the level of visual sensitivity in the area. Visual sensitivity is defined as the degree of public interest in a visual resource and concern over adverse changes in the quality of that resource. In general, an impact to a visual resource is considered major if implementation of the Proposed Action would result in substantial alteration to an existing sensitive visual setting.

4.7.2 Impacts

4.7.2.1 Alternative 1 (Preferred Alternative): Remove Williams Lake Dam

Implementation of the Preferred Alternative would require the removal of the Williams Lake dam, draining of the lake water, and regrading and revegetation of the drainage basin to predevelopment conditions. All of these elements would potentially impact the visual resources of the Williams Lake area during the short-term; however, visual resources in the vicinity of the Preferred Alternative are considered sensitive only to short-term recreational users of the site (refer to Section 4.6). Therefore, excavation and habitat improvement activities would comprise a minor impact to visual resources over the short term. The Preferred Alternative is intended to restore the Williams Lake drainage area to its more natural predevelopment appearance and the proposed habitat improvements and modifications would result in a landscape aesthetically consistent with the surrounding visual character of the area. Therefore, long-term impacts to visual resources are anticipated to be negligible and less than significant.

4.7.2.2 Alternative 2: Drain Williams Lake

Implementation of this alternative would result in similar short-term impacts to visual resources as with implementation of the Preferred Alternative. However, without the removal of the dam and regrading and revegetation, implementation of Alternative 2 may actually be less visually appealing than the Preferred Alternative. Therefore, implementation of this alternative could potentially

comprise a moderate impact to visual resources over the long term but would remain less than significant.

4.7.2.3 Alternative 3: No-Action Alternative

No changes to existing visual resources, as described in Section 3.7, *Visual Resources*, would occur under implementation of the No-Action Alternative. Therefore, selection of this alternative would have no foreseeable impacts to visual resources in the vicinity of Williams Lake at Buckley AFB.

SECTION 5
CUMULATIVE IMPACTS

Cumulative impacts on environmental resources result from incremental impacts of the Proposed Action which, when combined with other past, present, and reasonably foreseeable future projects in an affected area, may collectively cause more substantial adverse impacts. Cumulative impacts can result from minor but collectively substantial actions undertaken over a period of time by various agencies (federal, state, or local) or persons. In accordance with the National Environmental Policy Act (NEPA), a discussion of cumulative impacts resulting from projects, which are proposed, under construction, recently completed, or anticipated to be implemented in the near future is required.

The cumulative projects list included in this analysis includes both on- and off-base projects that have been identified through a review of public documents and information provided by Buckley Air Force Base (AFB) (Buckley AFB 2009f).

5.1 OFF-BASE ACTIVITIES

Buckley AFB is located in the northeast part of the City of Aurora, along the eastern fringe of the City's developed core. Present land use in the vicinity of the base is comprised of light industrial and residential uses to the northwest, west, and southwest, and agricultural, undeveloped space, and grassland conservation areas to the northeast, east, and southeast (City of Aurora 2009b). The City of Aurora's *Comprehensive Plan* (2009) identifies three planning areas in the vicinity of Buckley AFB: Colfax Corridor East of Interstate (I-) 225/Northeast Colfax Area; I-225 Corridor and City Center Strategic Area; and, Expressway 470 (E-470) Corridor Strategic Area. In addition, the City of Aurora Parks and Open Space Department has identified future planning objectives as well as recreational development opportunities within the vicinity of the base. These vicinity development plans are further described below.

<u>Colfax Corridor East of I-225/Northeast Colfax Area</u>—The Colfax Corridor is located along East Colfax Avenue, approximately 1 mile north of Buckley AFB. The properties along East Colfax Avenue, many of which are vacant, are primarily zoned for commercial uses. The Northeast Colfax Area comprises

established residential neighborhoods and industrial areas located to the north and south of the Colfax Corridor. Presently, there are no major development projects proposed in these areas (City of Aurora 2009f).

I-225 Corridor and City Center Strategic Area—The I-225 Corridor and the City Center of Aurora are located approximately 3 miles west of Buckley AFB. The I-225 Corridor is lined with regional office and retail centers, as well as older and newly-established residential areas. The City Center comprises regional office, retail, and government administration facilities, including the recently-completed City of Aurora Municipal Center, the Arapahoe County Administrative Annex, and the Aurora Mall. Several additional projects have been proposed for the City Center, including multiple residential dwellings, corporate office buildings, a regional bus transfer facility, and a light rail transit corridor. As a part of FasTracks, a multi-billion dollar comprehensive transit expansion plan, a 10.5-mile light rail transit extension is proposed through the I-225 Corridor. It would connect the existing Nine Mile Station with the planned East Corridor's Peoria/Smith Station (Denver Regional Transportation District [RTD] 2011). In September 2011, the Federal Transit Authority (FTA) issued a Finding of No Significant Impact (FONSI) on the Environmental Assessment (EA) for the segment of light rail joining Nine Mile Station to Iliff Station, the first of eight segments comprising the proposed light rail transit extension. Ensuing steps for the project include the development of a construction procurement package for the segment (Denver RTD 2011).

Expressway 470 (E-470) Corridor Strategic Area—The E-470 Corridor is a 25-mile planned future growth corridor established along the toll highway E-470, to the east of Buckley AFB. The area is primarily undeveloped; however, planned development includes large areas of regional and commercial activity, over 40,000 residential dwelling units, and park and open space areas. Corridor areas adjacent to the east of Buckley AFB would be developed as campus-oriented research and development facilities, while areas southeast of the installation would remain as open space. The development timeframe for the E-470 Corridor extends well into the future, as a majority of the corridor has not yet been annexed into the City (City of Aurora 2009a). However, development has occurred and is ongoing in some portions of the corridor, including areas located in the immediate vicinity of Buckley AFB (City of Aurora 2009f).

Recreational Development in the City of Aurora—The City of Aurora currently contains over 9,000 acres of parks and open space (City of Aurora 2007). Recent construction activities overseen by the Parks and Open Spaces Department include improvements at Carson Park, the extension of the Unnamed Creek Trail from its current terminus at Flanders Park to Hampden Avenue, and facility enhancement at Beck Recreation Center & Springhill Park. As is outlined in the 2007 *Parks and Open Space Framework Master Plan* the Parks and Open Space Department intends to continue to expand parks and open spaces, providing the community with recreational amenities and opportunities wherever possible.

5.2 ON-BASE ACTIVITIES

Buckley AFB has implemented a *General Plan* to guide current and future development at the installation. The *General Plan* establishes long-range land use planning goals and is intended to guide infill development on currently vacant land, as well as functional consolidation and redesignation of land uses to accommodate the anticipated doubling of the base's current staffing levels (Buckley AFB 2009f).b Both on- and off-base factors are considered in planning the most appropriate layout of land uses, as well as transportation corridors to support functional effectiveness, efficiency, and compatibility at the installation.

There are a number of recently completed, in progress, and planned Capital Improvement Projects to support Buckley AFB's continuing transition from an Air National Guard Base (ANGB) to an AFB, and to facilitate future growth at the installation. Table 5-1 represents the current schedule of construction and demolition projects available at the time of this EA. However, the prioritization, initiation, and completion of proposed projects are dynamic, and the scope, priority, and schedule of individual projects may potentially change. The information in Table 5-1 is provided as a reference to compare the Proposed Action in the context of other planned projects at the base.

For the purposes of this EA, recently completed, in progress, and planned cumulative construction and demolition projects at Buckley AFB through Fiscal Year (FY) 2011 have been evaluated. Proposed projects include administration buildings, infrastructure upgrades, and training and support facilities.

Table 5-1. Projects Planned at Buckley AFB

Project Title	Land Use	Size		Status
		Building Area (sf)	Parking Area (sy)	
Construction Projects				
Consolidated Fuels Storage	Factory/Industrial	10,000	5,000	Recently completed
VQ/TLF	Residential	109,002	25,000	Recently completed
Air Reserve Personnel Center	Business	105,336	25,000	Recently completed
Family Camp (NAF)	Residential	1,044	522,720	Recently completed
AFR Training Facility (BRAC)	Business	28,500	5,000	Recently completed
Weapons Release (COANG)	Factory/Industrial	17,500	1,000	Recently completed
Freight Transfer Facility	Factory/Industrial	12,000	5,000	Currently under construction
Alert Crew Quarters - East Ramp (COANG)	Business	5,000	500	Fiscal Year 2012/13
ADF-C Project Mountainview	Business	201,000	14,000	Fiscal Year 2012/13
Fire Trainer	Utility/ Miscellaneous	8,000	500	Fiscal Year 2012/13
Cold Storage	Factory/Industrial	5,000	300	Fiscal Year 2012/13
Tactical Unmanned Aerial System (TUAS)	Factory/Industrial	1,100	250	Fiscal Year 2012/13
Replace AGE/ASE (COANG)	Business	5,000	500	Fiscal Year 2012/13
Alert Crew Quarters - East Ramp (COANG)	Business	5,000	500	Fiscal Year 2012/13
Small Arms Range Complex	Utility/ Miscellaneous	10,000	400	Fiscal Year 2014
Logistics Readiness Facility	Factory/Industrial	20,000	1,000	Fiscal Year 2014
Weapons Live Load/ Hot Cargo (COANG)	N/A	N/A	50,000	Fiscal Year 2014
Taxiway Arm/Disarm Pads (COANG)	N/A	N/A	50,000	Fiscal Year 2014
CATM Small Arms Indoor Range	Utility/ Miscellaneous	23,735	500	Fiscal Year 2014
Main Entry Control Facility	Business	5,800	2,000	Fiscal Year 2014
Military Service Station	Factory/Industrial	319	2,000	Fiscal Year 2014
RV Storage Lot (NAF)	N/A	N/A	5,000	Fiscal Year 2015

Table 5-1. Projects Planned at Buckley AFB (Continued)

Project Title	Land Use	Size		Status
		Building Area (sf)	Parking Area (sy)	
Relocate East Parking Apron (COANG)	N/A	N/A	40,300	Fiscal Year 2017
North Runway Extension (COANG)	N/A	N/A	59,856	Fiscal Year 2018
Demolition Projects				
Consolidated Fuels Storage Area	Factory/Industrial	10,000	555	Recently completed
Former Wastewater Treatment Facility	Factory/Industrial	243,778	N/A	Fiscal Year 2015+
Building 940	Factory/Industrial	14,758	N/A	Fiscal Year 2017+
Building 1606 (control tower) construction of fire station building	Utility/ Miscellaneous	8,783	N/A	Fiscal Year 2017+

N/A - Not available
sf - square feet
sy – square yard
Source: Buckley AFB 2012

Biological Resources

Overall cumulative impacts to biological resources are moderately adverse over the long-term at Buckley AFB as a substantial amount of development is planned on previously undeveloped areas at the base. Cumulative adverse impacts to biological resources would be partially minimized through continued implementation of the base's Integrated Natural Resources Management Plan (INRMP), which is intended to manage and enhance the quality of natural resources located on Buckley AFB. Under implementation of either the Preferred Alternative or Alternative 2, no major direct impacts to vegetation, wildlife, sensitive species, or wetlands are expected. Further, implementation of the Preferred Alternative would result in re-establishment of pre-development conditions in the Williams Lake area, thereby resulting in ecological restoration that would be considered beneficial with respect to natural resources. Therefore, the Proposed Action would result in an overall minor contribution to the long-term adverse cumulative impacts on biological resources, which would be less than significant.

Water Resources

With regard to water resources, the potential exists for moderate cumulative adverse impacts to occur, as long-term increases in impermeable surfaces are anticipated with future cumulative on-base development. However, implementation of the Proposed Action would not contribute to these cumulative increases in impermeable surface. Impacts to surface water resulting from the Proposed Action are minor and short-term, as best management practices (BMPs) would be put into place to ensure that sedimentation in both the tributary as well as Sand Creek would be minimized during construction activities and neither action alternative would result in any facility development or creation of impermeable surfaces. In addition, the Preferred Alternative would result in an overall reduction of the non-regulated Williams Lake drainage area 100-year floodplain. Therefore, the overall contribution of the Proposed Action to cumulative impacts on water resources would be minor and less than significant.

Geological Resources

With regard to geological resources, on-base cumulative project development would locally impact soils at Buckley AFB. Soils at Buckley AFB have been modified by past developments and are generally capable of supporting such activities. The Proposed Action would implement BMPs, including watering and/or soil stockpiling, to limit impacts to soils. In addition, there are no unique geological resources of geologic hazards in the vicinity of the Proposed Action. Consequently, the Proposed Action's contribution to minor adverse cumulative impacts on geological resources would be negligible and less than significant.

Air Quality

Although the scope, priority, and schedule of individual projects may change, the potential exists for cumulative impacts to occur with regard to air quality as future growth at Buckley AFB and the City of Aurora is anticipated to result in increased traffic and construction emissions. Cumulative air quality impacts are expected to result in moderate adverse impacts related to construction activities and increased use- and personnel-related emissions. The Proposed Action would

implement BMPs for the purpose of reducing fugitive dust and combustion emissions during construction activities to acceptable levels. Further, no operational impacts to air quality would occur as a result of the Proposed Action. Given its small scale and temporary nature, the Proposed Action would constitute a minor, short-term adverse contribution to the cumulative impacts associated with air quality and would be less than significant.

Safety

As proposed, cumulative development on-base would generally result in long-term moderate beneficial cumulative impacts to safety, as individual projects would be designed to comply with regulations and/or improve conditions of Antiterrorism Force Protection (AT/FP) standards. The Proposed Action would have a negligible impact on AT/FP, airfield safety zones, and explosives safety and would constitute a long-term beneficial impact to mishap potential and BASH by reducing these risks. Proposed off-base cumulative activities are generally located at such a distance from Buckley AFB that they do not pose a threat to safety conditions on-base. In addition, recent or reasonably foreseeable future off-base projects such as golf courses or other projects with ponds or other water features that could attract wildlife and potentially contribute to BASH would be located at such a distance from the active runway at Buckley that they would not be of concern. Under the Preferred Alternative, proposed habitat improvements and channel design would result in an intermittent drainage that would not create an additional attractant to waterfowl and other bird species at Buckley AFB or otherwise. Under Alternative 2, ongoing maintenance activities would prevent the reestablishment of the lake as a wildlife attractant. Therefore, the Proposed Action would constitute a positive contribution to overall beneficial cumulative safety impacts.

Land Use

With regard to land use, the Proposed Action would not result in any changes to existing land use patterns on-base and would be consistent with existing land use designations. Both the Preferred Alternative and Alternative 2 would adversely affect existing recreational uses at Williams Lake (i.e., fishing); however, other recreational uses at Williams Lake (e.g., camping, trails, and

picnic areas) and the rest of Buckley AFB would not be impacted. Further, regrading and revegetation of the area under the Preferred Alternative would maintain the open space character of the area and support its primary purpose as an attractive recreational area. In addition, cumulative projects for construction and improvement of off-base recreational areas and amenities throughout the region would result in a cumulatively beneficial impact to recreation. Therefore, the Proposed Action's adverse contribution to this cumulatively beneficial impact would be minor.

Visual Resources

Cumulative impacts to visual resources at Buckley AFB are expected to be moderate and adverse as future growth would generally result in a change to the rural and semi-rural aesthetic. However, alternatives under the Proposed Action would not result in any changes from this rural and semi-rural aesthetic. Further, the Preferred Alternative is intended to restore the Williams Lake drainage area to its more natural predevelopment appearance, while implementation of Alternative 2 may actually be less visually appealing than the Preferred Alternative as it would not include proposed habitat improvements and modifications. Therefore, the Preferred Alternative's contribution to cumulative impacts to visual resources would be considered negligible while Alternative 2's contribution to cumulative impacts would be considered minor.

SECTION 6
SUMMARY OF FINDINGS

Summaries of environmental impacts anticipated to result from implementation of the Proposed Action at Buckley Air Force Base (AFB) are provided in this section for resource areas as evaluated in Section 4, *Environmental Consequences*.

Biological Resources. Construction activities would result in localized minor impacts to vegetation and wildlife due to excavation, trenching, and other site preparation activities. However, these impacts would be short-term and last only for the duration of construction activities and revegetation of disturbed sites would be accomplished using appropriate and proven reseeding techniques. The Proposed Action is expected to have negligible impacts on special-status species, and best management practices (BMPs) and appropriate avoidance and management procedures (e.g., conducting species surveys, scheduling construction outside of migratory bird nesting season, etc.) would be incorporated as applicable and where recommended by applicable agencies (e.g., U.S. Fish and Wildlife Service, Colorado Division of Wildlife [CDOW], etc.).

There are isolated wetland areas directly adjacent, to the north and to the south, of Williams Lake that would be adversely impacted under the Proposed Action. However, these wetland areas are not considered jurisdictional wetlands and are not regulated by U.S. Army Corps of Engineers (USACE) under Section 404 of the Clean Water Act. Therefore, there would be no impact to jurisdictional wetland resources. Minor to moderate short-term impacts to these non-jurisdictional wetlands are anticipated under the Preferred Alternative and Alternative 2. Impacts to non-jurisdictional wetlands are anticipated under the Preferred Alternative as the proposed habitat improvements would result in the removal of these wetlands. However, wetland areas that would be potentially impacted are not considered high-value from an ecosystem function standpoint. They are not known to support and sensitive plant or wildlife species or critical habitat and are actively managed to discourage wildlife access. In addition, non-jurisdictional wetlands in the project area are man-made resulting from construction of Williams Lake Dam and the Preferred Alternative would include habitat improvements that would mirror pre-development hydrologic and vegetative conditions to the maximum extent feasible and would help to restore

pre-development ecosystem functions. Therefore, anticipated impacts to non-jurisdictional wetlands are expected to be less than significant.

Water Resources. Construction activities under the Proposed Action would incorporate BMPs to minimize erosion, runoff, and sedimentation, and a Storm Water Pollution Prevention Plan (SWPPP) containing additional BMPs and other procedures would be implemented to prevent adverse impacts to surface water. The Proposed Action would not increase impermeable surfaces present at Buckley AFB and the quality of on-base and nearby surface water features (e.g., East Toll Gate and Sand Creeks, etc.) are not anticipated to be adversely affected by the Proposed Action. Additionally, no impacts to regional surface water systems including the South Platte River are anticipated under either the Preferred Alternative or Alternative 2.

With regard to the impacts to floodplains, the Preferred Alternative would incorporate proposed drainage improvements that would be designed to provide adequate capacity to convey water from a 100-year storm event. The resulting footprint of the non-regulated Williams Lake drainage area specific 100-year floodplain associated with the Preferred Alternative would experience an overall reduction in size, including a reduction in the total coverage of the existing 100-year floodplain, which is located on off-base property. Further, modeled future peak flow during a 100-year event would be a minor contribution to the overall capacity of Sand Creek. Therefore, the Preferred Alternative would result in minor adverse impacts to floodplains over the long-term. Under Alternative 2, the existing dam structure would remain in place and act as a retention barrier to any upstream surface flows, thus reducing the potential for flooding along the downstream drainage and connecting tributary to Sand Creek. Therefore, Alternative 2 would not result in any impacts to floodplains.

Geological Resources. Potential impacts to geological resources associated with the Proposed Action would be limited to ground-disturbing activities (i.e., excavation/trenching) during construction or operational maintenance activities. BMPs would be implemented to minimize potential occurrences of erosion, siltation, and soil compaction, and any impacts would be minor and would last only for the duration of ground-disturbing activities. Once proposed activities under both the Preferred Alternative and Alternative 2 are completed, potential

impacts to soils would be negligible. Therefore, implementation of the Proposed Action would result in negligible long-term impacts to geological resources.

Air Quality. Under implementation of the Proposed Action, fugitive dust would be generated from construction activities, including excavation, trenching, and other ground-disturbing activities. Implementation of standard BMPs for dust control (e.g., regularly watering exposed soils, soil stockpiling, soil stabilization, etc.) would reduce potential impacts to negligible levels. Combustion emissions resulting from construction activities under both the Preferred Alternative and Alternative 2 would be below *de minimis* thresholds for a General Conformity determination. Any emissions resulting from maintenance activities under the Proposed Action would be negligible. Therefore, implementation of the Proposed Action does not require a conformity analysis and would result in minor air quality impacts.

Safety. Implementation of the Preferred Alternative and Alternative 2 would measurably reduce the mishap potential related to bird-aircraft strike hazards (BASH) at Williams Lake by entirely eliminating the lake and its potential food source as a wildlife attractant. Therefore, with regard to mishaps and BASH, major positive short- and long-term impacts would result from implementation of the Proposed Action. In addition, the Proposed Action would result in negligible impacts to airfield safety zones and no impact to explosives safety.

Land Use. Both the Preferred Alternative and Alternative 2 would adversely affect surrounding recreational land uses such as the adjacent Family Camp and the nearby paintball obstacle course in the short-term and the presence of the lake as a passive recreational amenity over the long term. However, other recreational uses at Williams Lake (e.g., camping, trails, and picnic areas) and the rest of Buckley AFB would not be impacted. Further, regrading and revegetation of the area under the Preferred Alternative would maintain the open space character of the area and support its primary purpose as an attractive recreational area. Implementation of the Proposed Action would not result in any changes to existing land use patterns on-base and would be consistent with existing land use designations. Therefore, impacts to land use compatibility and recreation would be considered minor over the long term.

Visual Resources. Under the Preferred Alternative, removal of the dam and habitat improvement activities would comprise a minor impact to visual resources over the short term. The Preferred Alternative is intended to restore the Williams Lake drainage area to its more natural predevelopment appearance and the proposed habitat improvements and modifications would result in a landscape aesthetically consistent with the surrounding visual character of the area. Therefore, long-term impacts to visual resources are anticipated to be negligible under the Preferred Alternative. Implementation of Alternative 2 would result in similar short-term impacts to visual resources; however, without the removal of the dam and regrading and revegetation, implementation of Alternative 2 may actually be less visually appealing than the Preferred Alternative. Therefore, implementation of this alternative could potentially comprise a moderate impact to visual resources over the long term.

SECTION 7
SPECIAL PROCEDURES

Impact evaluations conducted during preparation of this Environmental Assessment (EA) have determined that no major environmental impacts would result from implementation of the Proposed Action at Buckley Air Force Base (AFB). This determination is based on a thorough review and analysis of existing resource information, the application of accepted modeling methodologies, and coordination with knowledgeable, responsible personnel from the U.S. Air Force (USAF) and relevant local, state, and federal agencies.

Special procedures required prior to implementation of the Proposed Action include biological surveys for the northern leopard frog and the common garter snake, both of which are state species of special concern. Although they have not been noted within the project area, coordination with the Colorado Department of Wildlife (CDOW) and U.S. Fish and Wildlife Service (USFWS) may be required if northern leopard frogs or common garter snakes are identified within the project area. Further, the Proposed Action may need to be delayed until clearance surveys are conducted. The burrowing owl is known to nest mainly in the northwestern portion of the base and along the airfield flight lines; however, there is a potential for burrowing owls to be present within the project area. Additionally, required special procedures regarding burrowing owls include mandatory buffers around known owl burrows. If construction activities are proposed between March 1 and October 31 (known nesting periods), pre-construction surveying would be required and performed onsite by USFWS personnel before the Proposed Action is implemented to identify if burrowing owls or their burrows are present within the proposed project site. Surveys are required for the species if earth moving activities occur during the nesting season, and the Proposed Action would be delayed if nesting owls would be potentially impacted. If delays in the Proposed Action are infeasible, consultation and coordination with the CDOW and USFWS would occur prior to any earth-moving activities.

Special procedures for federally listed plant species include biological surveys for the Ute ladies'-tresses Orchid as well as the Colorado butterfly plant. Although previous surveys have failed to confirm specimens within the Williams

Lake area (Buckley AFB 2003), additional efforts would be necessary to ensure that both of these federally listed plant species are not currently present within or in the vicinity of the project area. Although they have not been noted within the project area, coordination with the USFWS would be required if either species is identified. Further, if identified, the Proposed Action would potentially need to be delayed until identified healthy specimens can be salvaged and relocated.

Prior to draining Williams Lake, water quality testing would be performed to ensure the applied rotenone (an approved piscicide) has been sufficiently detoxified and that the remaining lake water meets the appropriate standards for discharge set by the Colorado Department of Public Health and Environment for the South Platte River Basin. If rotenone is detected, an oxidizing agent such as potassium permanganate may be required to detoxify the water body.

In addition to standard best management practices (BMPs), such as ensuring public safety through the construction of fencing around the project area; implementation of control measures for reducing fugitive dust emissions; construction of silt fencing and suspension of activity during rainy periods as well as the use of soil stockpiling and replacement for the purpose of reducing erosion; the use of all appropriate avoidance and management procedures to protect and conserve threatened and endangered species; and adherence to all federal, state, and local requirements relating to storm water pollution prevention, including development of a Notice of Intent and Storm Water Pollution Prevention Plan under the General Permit for Storm Water Discharges from Construction Activities Program, no other special procedures are required prior to implementation of the Proposed Action.

In the unlikely event that cultural resources are encountered within the project area or in the unlikely event that human remains, funerary objects, or Native American sacred objects are discovered, all work in the area will be stopped and the discoveries will be evaluated in accordance with the National Historic Preservation Act and Native American Graves Protection and Repatriation Act and further coordination will be completed with the Colorado State Historic Preservation Office and the Buckley AFB Tribal Stakeholders.

SECTION 8
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APPENDIX B

AIR EMISSION FACTORS AND ASSUMPTIONS

APPENDIX B
AIR EMISSION FACTORS AND ASSUMPTIONS

B.1 FUGITIVE DUST EMISSIONS ASSOCIATED WITH CONSTRUCTION ACTIVITIES

Table B-1. Disturbed Land Area from Construction-Related Activities

Construction Operation	Alternative 1 (Preferred Alternative)		Alternative 2		No-Action Alternative	
	Linear Feet	**Area***	**Linear Feet**	**Area***	**Linear Feet**	**Area***
Lake bed grading	N/A	374,633 sf	N/A	374,633 sf	N/A	N/A
Dam removal	N/A	105,827 sf	N/A	N/A	N/A	N/A
New/improved stream	2,415	123,165 sf	N/A	N/A	N/A	N/A
Total area	**603,625 sf**		**374,633 sf**		**N/A**	
Total area	**13.8573 acres**		**8.6004 acres**		**N/A**	

Note: N/A = not applicable

Assumptions: The area of the new/improved stream (123,165 sf) excludes the lake and dam, as this area has already been accounted for in the lake bed grading area (374,633 sf). The new/improved stream will be 34 feet wide; however, 50 feet accounts for the total area disturbed, including preparation, staging, construction, etc. Therefore, 2,415 linear feet x 50-foot-wide disturbance = 123,165 sf area.

Table B-2. Fugitive Dust Emissions from Construction-Related Activities

Fugitive Dust Calculation	Alternative 1 (Preferred Alternative)	Alternative 2	No-Action Alternative
Emissions Per Month (tons/month)	16.63	10.32	N/A
Total Emissions (tons/year)	149.66	92.88	N/A
Emissions Per Month With 75% Reduction Due to BMPs (tons/month)	4.16	2.58	N/A
Total Emissions With 75% Reduction Due to BMPs (tons/year)	37.41	23.22	N/A

Assumptions: Using the standard dust emission factor for construction activity of 1.2 tons of dust per acre per month of activity, emissions were calculated by multiplying this factor by the acreage listed in Table B-1 (e.g., for the Preferred Alternative, 13.8573 acres x 1.2 tons per acre per month = 16.63 tons per month). To calculate total emissions, the emissions per month were multiplied by the construction period of 9 months (e.g., 16.63 tons per month x 9 months = 149.66 tons). Standard dust minimization measures (i.e., BMPs) can reduce dust up to 75%; thus, to calculate the emissions per month including implementation of BMPs, the emissions per month without BMPs were multiplied by 0.25 (e.g., 16.63 tons/month x 0.25 = 4.16 tons/month). To calculate the total emissions including implementation of BMPs, the emissions per month with BMPs were multiplied by the construction period of 9 months (e.g., 4.16 tons/month x 9 months = 37.41 tons).

B.2 COMBUSTION EMISSIONS ASSOCIATED WITH CONSTRUCTION ACTIVITIES

Table B-3. Construction-Related Combustion Emission Factors Used to Calculate Total Project Emissions in Table 4-3

Equipment	Days	Hours of Operation	Emission Factors (lbs/hr)					
			CO	NO_x	PM_{10}	$PM_{2.5}$	SO_x	ROG
grader	270	1,440	0.567	1.623	0.084	0.077	0.276	0.148
loader	270	1,440	0.424	0.858	0.086	0.079	0.115	0.132
bobcat	270	1,440	0.268	0.508	0.054	0.050	0.0	0.09
dozer	270	1,440	1.209	3.037	0.123	0.113	0.453	0.232
paving equipment	270	1,440	0.419	0.961	0.069	0.063	0.144	0.117
paver	270	1,440	0.449	0.894	0.067	0.062	0.165	0.12
excavator	270	1,440	1.300	4.600	0.320	0.310	0.740	0.340

Note: ROG = reactive organic gasses
Source: Santa Barbara County Air Pollution Control District (APCD) Form 24 -Table 2, 1997 (for all emission factors except for $PM_{2.5}$) South Coast Air Quality Management District, California Environmental Quality Act (CEQA) Air Quality Handbook, 1993 (for $PM_{2.5}$ emissions fraction of PM_{10} for off-road diesel equipment), USEPA 2006 (for emission factors for excavator)

Assumptions: Construction period equal to 9 months, with 4 weeks per month, 5 work days per week, 8 hours per work day, and therefore, 270 days or 1,440 hours of operation total. The construction period was multiplied by the emission factor above and divided by 2000 lbs/ton to calculate the combustion emissions in tons presented in Table 4-1. For example, for the CO from a grader, (1,140 hrs x 0.567 lbs/hr) / 2000 lbs/ton = 0.40824 tons.

APPENDIX C

BUCKLEY AFB SAMPLING ANALYSIS RESULTS
LAKE WILLIAMS

1 February 2011

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Subject: Buckley AFB Sampling Analysis Results, Lake Williams

With this letter, Tetra Tech, Inc. (Tetra Tech) is submitting the analytical sampling results, QA/QC data, and Chain of Custody for the above referenced sampling event. Attachment 1 summarizes the results, Attachment 2 contains a diagram of the sampling locations, and Attachment 3 contains the analytical report.

For any questions, please contact Mr. Joe Patrick at (719) 556-4400 or via e-mail at joseph.patrick.ctr@peterson.af.mil or the undersigned at (719) 685-6585 or via e-mail at benjamin.recker@tetratech.com.

Sincerely,

TETRA TECH, INC.

Benjamin C. Recker, P.E., LEED AP
Environmental Engineer

Attachment: as stated

Tetra Tech, Inc.
7222 Commerce Center Drive, Suite 185 | Colorado Springs, CO 80919
Tel 719.685.6585 Fax 719.260.1710 www.tetratech.com

Attachment 1
Summary of Analytical Results

Location/ Sample	Matrix	Parameter	Method	Sample Number	Sample Date	Result	Result Qualifier (Flag)
Lake Williams Sampling Point #1 Water Depth = 13 Feet	Water At surface	Temp pH Conductivity Turbidity Dissolved Oxygen			23 Nov 2010	2°C 9.3 s.u. 2.3 mS/cm 11 ntu 11.8 ppm	
	Water 5 Ft Depth	Temp pH Conductivity Turbidity Dissolved Oxygen			23 Nov 2010	3°C 9.3 s.u. 2.3 mS/cm 11 ntu 11.8 ppm	
	Sediment	**Total Metals:** Aluminum Arsenic Barium Cadmium Chromium Copper Lead Molybdenum Selenium Silver Mercury PCB	SW6010B SW7471A SW8082	GN10300BA GN10301BA	23 Nov 2010	 13,000 mg/kg 2.2 mg/kg 330 mg/kg 0.36 mg/kg 12 mg/kg 33 mg/kg 20 mg/kg ND ND ND 0.022 mg/kg All ND	 B B U U U B U

Attachment 1 (Cont)
Summary of Analytical Results

Location/ Sample	Matrix	Parameter	Method	Sample Number	Sample Date	Result	Result Qualifier (Flag)
Lake Williams Sampling Point #2 Water Depth = 3 feet	Water At surface	Temp pH Conductivity Turbidity Dissolved Oxygen			23 Nov 2010	3°C 9.3 s.u. 2.3 mS/cm 13 ntu 11.5 ppm	
	Water 3 Ft Depth	Temp pH Conductivity Turbidity Dissolved Oxygen			23 Nov 2010	3°C 9.3 s.u. 2.3 mS/cm 13 ntu 11.5 ppm	
	Sediment	**Total Metals:** Aluminum Arsenic Barium Cadmium Chromium Copper Lead Molybdenum Selenium Silver Mercury PCB	SW6010B SW7471A SW8082	GN10298BA GN10299BA	23 Nov 2010	 13,000 mg/kg 2.4 mg/kg 690 mg/kg 0.27 mg/kg 12 mg/kg 22 mg/kg 12 mg/kg 0.31 mg/kg ND ND ND All ND	 B B U U U U

Attachment 1 (Cont)
Summary of Analytical Results

Location/ Sample	Matrix	Parameter	Method	Sample Number	Sample Date	Result	Result Qualifier (Flag)
Lake Williams Sampling Point #3 Water Depth = 12 feet	Water At surface	Temp pH Conductivity Turbidity Dissolved Oxygen			23 Nov 2010	2°C 9.3 s.u. 2.3 mS/cm 10 ntu 12.1 ppm	
	Water 5 Ft Depth	Temp pH Conductivity Turbidity Dissolved Oxygen			23 Nov 2010	3°C 9.3 s.u. 2.3 mS/cm 11 ntu 12.0 ppm	
	Water 5 Ft Depth	Total Phosphorous Total Nitrogen	365.2 353.2	GN10297BA GN10297BA	23 Nov 2010	0.072 mg/l 0.0081 mg/l	N J
		Total Coliform Fecal Coliform BOD TSS TDS Oils & Grease pH Nitrite Nitrates Turbidity	 A5210B 160.2 160.1 1664 150.1 300.0 300.0 A2130B	GN10290BA GN10291BA GN10292BA GN10293BA GN10293BA GN10294BA GN10295BA GN10295BA GN10295BA GN10296BA	23 Nov 2010	23.1 tc /100 ml <1 fc/100 ml 4 mg/l 39 mg/l 1200 mg/l ND 9.31 ND 0.17 mg/l 83 ntu	 U U J

Attachment 1
Summary of Analytical Results

Location/ Sample	Matrix	Parameter	Method	Sample Number	Sample Date	Result	Result Qualifier (Flag)
Lake Williams Sampling Point #4 Water Depth = 6 fee	Water At surface	Temp pH Conductivity Turbidity Dissolved Oxygen			23 Nov 2010	3°C 9.3 s.u. 2.3 mS/cm 11 ntu 12.2 ppm	
	Water 5 Ft Depth	Temp pH Conductivity Turbidity Dissolved Oxygen			23 Nov 2010	3°C 9.3 s.u. 2.3 mS/cm 12 ntu 11.9 ppm	
	Sediment	**Total Metals:** Aluminum Arsenic Barium Cadmium Chromium Copper Lead Molybdenum Selenium Silver Mercury	SW6010B SW7471A	GN10302BA	23 Nov 2010	 14,000 mg/kg 2.3 mg/kg 290 mg/kg 0.45 mg/kg 12 mg/kg 31 mg/kg 20 mg/kg ND 1.8 mg/kg ND 0.014 mg/kg	 B B U B U B
Lake Williams Sampling Point #5	Water At surface	Temp pH Conductivity Turbidity Dissolved Oxygen			23 Nov 2010	1°C 9.4 s.u. 2.2 mS/cm 9 ntu 11.7 ppm	

Notes:
mg/kg indicates milligrams per kilogram
mS/cm indicates milliSiemens per centimeter
n.t.u indicates Nephelometric Turbidity Units
tc/100 ml indicates total coliforms per 100 milliters
fc/100 ml indicates fecal coliforms per 100 milliliters

Result Qualifiers (Flag):

Metals: Result qualifier -- A “B” is entered if the reported value was obtained from a reading that was less than the Practical Quantitation Limit but greater than or equal to the Method Detection Limit (MDL). If the analyte was analyzed for but not detected a “U” is entered. For samples, negative values are reported as non-detects (“U” flagged). For blanks, if the absolute value of the negative value is above the MDL and below the practical quantitation limit, then the result is “B” flagged.

U or ND: This flag indicates that the compound was analyzed for but not detected.

B: This flag is used when the analyte is detected in the associated method blank as well as in the sample. It indicates probable blank contamination and warns the data user. This flag shall be used for a tentatively identified compound (TIC) as well as for a positively identified target compound.

Inorganics: Concentration qualifier -- A “J” is entered if the reported value was obtained from a reading that was less than the Reporting Limit but greater than or equal to ALS’s Method detection Limit. If the analyte was analyzed for but not detected a “U” is entered.

N: Spiked sample recovery not within control limits.

Attachment 2
Diagram of Sampling Locations

Attachment 3
Analytical Report

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division
Fort Collins, Colorado

Oil and Grease

Case Narrative

Tetra Tech, Inc.

293-295, 297-302

Work Order Number: 1011292

1. This report consists of 1 water sample. The sample was received cool and intact by ALS on 11/24/2010.

2. The water sample did not have a pH less than 2 upon receipt.

3. The sample was prepared and analyzed according to EPA Method 1664A procedures utilizing SOP 671 Rev. 7.

4. The sample was prepared and analyzed within the established hold time.

5. The method blank associated with this project was below the reporting limit for oil and grease.

6. All laboratory control sample and laboratory control sample duplicate recoveries and RPDs were within the acceptance criteria.

7. A matrix spike and matrix spike duplicate could not be performed because of insufficient sample. A laboratory control sample and laboratory control sample duplicate were performed instead.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Mindy Norton
Mindy Norton
Organics Primary Data Reviewer

10.9.10
Date

Organics Final Data Reviewer

12/8/10
Date

ALS
Data Qualifier Flags
Chromatography and Mass Spectrometry

U or ND:	**This flag indicates that the compound was analyzed for but not detected.**
J:	**This flag indicates an estimated value. This flag is used as follows : (1) when estimating a concentration for tentatively identified compounds (TICs) where a 1:1 response is assumed; (2) when the mass spectral and retention time data indicate the presence of a compound that meets the volatile and semivolatile GC/MS identification criteria, and the result is less than the reporting limit (RL) but greater than the method detection limit (MDL); (3) when the data indicate the presence of a compound that meets the identification criteria, and the result is less than the RL but greater than the MDL; and (4) the reported value is estimated.**
B:	**This flag is used when the analyte is detected in the associated method blank as well as in the sample. It indicates probable blank contamination and warns the data user. This flag shall be used for a tentatively identified compound (TIC) as well as for a positively identified target compound.**
E:	**This flag identifies compounds whose concentration exceeds the upper level of the calibration range.**
A:	**This flag indicates that a tentatively identified compound is a suspected aldol-condensation product.**
X:	**This flag indicates that the analyte was diluted below an accurate quantitation level.**
***:**	**This flag indicates that a spike recovery is outside the control criteria.**
+:	**This flag indicates that the relative percent difference (RPD) exceeds the control criteria.**

ALS Environmental -- FC

Sample Number(s) Cross-Reference Table

Paragon OrderNum: 1011292
Client Name: Tetra Tech, Inc.
Client Project Name:
Client Project Number: 293-295, 297-302
Client PO Number: 1061585

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
GN10293BA	1011292-1		WATER	23-Nov-10	11:02
GN10294BA	1011292-2		WATER	23-Nov-10	11:02
GN10295BA	1011292-3		WATER	23-Nov-10	11:02
GN10297BA	1011292-4		WATER	23-Nov-10	11:02
GN10298BA	1011292-5		SEDIMEN	23-Nov-10	11:02
GN10299BA	1011292-6		SEDIMEN	23-Nov-10	11:02
GN10300BA	1011292-7		SEDIMEN	23-Nov-10	10:40
GN10301BA	1011292-8		SEDIMEN	23-Nov-10	10:40
GN10302BA	1011292-9		SEDIMEN	23-Nov-10	11:14

PARAGON ANALYTICS

ALS Paragon

225 Commerce Drive, Fort Collins, CO 80524
TF: 800-443-1511 PH: 970-490-1511 FX: 970-490-1522

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

ALS

Chain-of-Custody

Lab ID	1011292
Date	11/23/2010
Page	1 of 1

Project Name/No.	N/A	Sampler(s)	Joe Patrick	Turnaround	Standard or (Due Standard)
REPORT TO:	Joe Patrick			Disposal	By Lab or eturn to Clie
PHONE:	719-556-4400				
FAX:	719-556-5201				
E-MAIL:	joe.patrick@tetratech.com				
COMPANY:	Tetra Tech				
ADDRESS:	580 Goodfellow St				
	Peterson AFB, CO 80914-2370				

Provide additional information as needed in comments section.

Circle Analytical Method Above: 8082, 8020, 8260, 8260, 8270, 365.2, 353.2, SW8260B SW8270D SW8081A SW815, 300, 150.1, SW6010B 7470A/7471A E200.7 E245.1, 1010, SW6020A E200.8, SW7196A Alkaline Digestion? Y / N, 200.7, 160.2, 160.1, 1311, 664

Circle Analytical Method Above: 8015, 8015, 353.2 & 365.2, 300, E903.1, SW9320 E904.0, D5811, E906.0, Zinc (200.7), ~~200.7~~ 6010

Sample ID	Date	Time *	Lab ID	Matrix	No. of Containers	PCB	TCLP Metals (8 RCRA)	BTEX	Total Halogens	VOCs	TCLP SVOCs	Tot Phosphorous	Tot. Nitrogen	TCLP Organics SW1311	Total Nitrates	pH	Dissolved Metals (ICP) or Hg	Flashpoint	Dissolved Metals (ICP-MS)	Hexavalent Chromium	Molybdenum	TSS	TDS	TCLP Metals (RCRA 8)	O & G	TEPH-GRO	TEPH-DRO	Tot. Nitrogen & Tot. Phosphor	Nitrates	Radium 226	Radium 228	Strontium 90 (Total RadioSr)	Tritium	Total Metals	Total Metals & Cu, Al, Mb
GN10293BA	11/23/10	11:02	1	W	1																	X	X												
GN10294BA	11/23/10	11:02	2	W	1																				X										
GN10295BA	11/23/10	11:02	3	W	1										X	X																			
GN10297BA	11/23/10	11:02	4	W	1							X	X																						
GN10298BA	11/23/10	11:02	5	Se	1																														X
GN10299BA	11/23/10	11:02	6	Se	1	X																													
GN10300BA	11/23/10	10:40	7	Se	1																														X
GN10301BA	11/23/10	10:40	8	Se	1	X																													
GN10302BA	11/23/10	11:14	9	Se	1																														X
Last ITEM																																			

* Time Zone: EST CST MST PST **Matrix Key:** O = oil, S = soil, NS = non-soil solid, W = water, L = liquid, E = extract, F = f Se=sediment

Comments:

** Samples above are From Lake Williams **

Originator: Retain a photocopy after transfer!

Relinquished By (1)	
Signature	[signature]
Printed Name	Joe Patrick
Date	11/23/10
Time	4:30 pm
Company	Tetra Tech

Relinquished By	
Signature	
Printed Name	
Date	
Time	
Company	

Received By (1)	
Signature	C Trimble
Printed Name	C Trimble
Date	11-24-10
Time	1020
Company	ALS

Received By	
Signature	
Printed Name	
Date	
Time	
Company	

CONDITION OF SAMPLE UPON RECEIPT FORM

Client: TETRA TECH Workorder No: 1011292

Project Manager: AW Initials: CDT Date: 11-24-10

1. Does this project require any **special handling** in addition to standard Paragon procedures?		YES	(NO)
2. Are custody **seals** on **shipping containers** intact?	NONE	(YES)	NO
3. Are Custody seals on **sample containers** intact?	(NONE)	YES	NO
4. Is there a **COC (Chain-of-Custody) present** or other representative documents?		(YES)	NO
5. Are the **COC and bottle labels complete and legible**?		(YES)	NO
6. Is the **COC in agreement** with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.)		(YES)	NO
7. Were **airbills / shipping documents** present and/or removable?	DROP OFF	(YES)	NO
8. Are all aqueous **samples requiring preservation preserved correctly?** (excluding volatiles)	N/A	(YES)	NO
9. Are all aqueous **non-preserved samples pH 4-9**?	N/A	(YES)	NO
10. Is there **sufficient sample** for the requested analyses?		(YES)	NO
11. Were all samples placed in the **proper containers** for the requested analyses?		(YES)	NO
12. Are all samples within **holding times** for the requested analyses?		(YES)	NO
13. Were all sample containers received **intact**? (not broken or leaking, etc.)		(YES)	NO
14. Are all samples requiring **no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon)** headspace free? **Size of bubble:** ____ < green pea ____ > green pea	(N/A)	YES	NO
15. Do perchlorate LCMS-MS samples **have** headspace? (at least 1/3 of container required)	(N/A)	YES	NO
16. Were samples checked for and free from the presence of **residual chlorine?** (Applicable when PM has indicated samples are from a chlorinated water source; note if field preservation with sodium thiosulfate was not observed.)	(N/A)	YES	NO
17. Were the samples **shipped on ice**?		(YES)	NO
18. Were cooler temperatures measured at 0.1-6.0°C? **IR gun used*:** #2 (#4)	RAD ONLY	(YES)	NO

Cooler #: 1

Temperature (°C): 1.8°

No. of custody seals on cooler: 1

DOT Survey/ Acceptance Information

External µR/hr reading: 12

Background µR/hr reading: 10

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? (YES) / NO / NA (If no, see Form 008.)

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16

If applicable, was the client contacted? YES / NO / (NA) Contact: _____ Date/Time: _____

Project Manager Signature / Date: [signature] 11/24/10

*IR Gun #2: Oakton, SN 29922500201-0066 *IR Gun #4: Oakton, SN 2372220101-0002

Form 201r22.xls (6/1/09)

Hexane Extractable Material--Gravimetric

Method EPA1664 Revision A

Method Blank

Lab Name: **ALS Environmental -- FC**
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Lab ID: EX101129-2MB

Sample Matrix: WATER
% Moisture: N/A
Date Collected: N/A
Date Extracted: 29-Nov-10
Date Analyzed: 29-Nov-10
Prep Method: METHOD

Prep Batch: EX101129-2
QCBatchID: EX101129-2-1
Run ID: EX101129-2A
Cleanup: NONE
Basis: N/A
File Name:

Sample Aliquot: 1000 ml
Final Volume: 1 sample
Result Units: MG/L
Clean DF: 1

CASNO	Target Analyte	DF	Result	Reporting Limit	Result Qualifier	EPA Qualifier
10-30-0	OIL AND GREASE	1	5	5	U	

Data Package ID: *EX1011292-1*

Hexane Extractable Material--Gravimetric

Method EPA1664 Revision A

Sample Results

Lab Name: **ALS Environmental -- FC**
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Field ID: GN10294BA
Lab ID: 1011292-2

Sample Matrix: WATER
% Moisture: N/A
Date Collected: 23-Nov-10
Date Extracted: 29-Nov-10
Date Analyzed: 29-Nov-10
Prep Method: METHOD

Prep Batch: EX101129-2
QCBatchID: EX101129-2-1
Run ID: EX101129-2A
Cleanup: NONE
Basis: As Received
File Name:

Sample Aliquot: 950 ml
Final Volume: 1 sample
Result Units: MG/L
Clean DF: 1

CASNO	Target Analyte	Dilution Factor	Result	Reporting Limit	Result Qualifier	EPA Qualifier
10-30-0	OIL AND GREASE	1	5.3	5.3	U	

Data Package ID: *EX1011292-1*

Hexane Extractable Material--Gravimetric

Method EPA1664 Revision A

Laboratory Control Sample and Laboratory Control Sample Duplicate

Lab Name: ALS Environmental -- FC
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Lab ID: EX101129-2LCS

Sample Matrix: WATER
% Moisture: N/A
Date Collected: N/A
Date Extracted: 11/29/2010
Date Analyzed: 11/29/2010
Prep Method: METHOD

Prep Batch: EX101129-2
QCBatchID: EX101129-2-1
Run ID: EX101129-2A
Cleanup: NONE
Basis: N/A
File Name:

Sample Aliquot: 1000 ml
Final Volume: 1 sample
Result Units: MG/L
Clean DF: 1

CASNO	Target Analyte	Spike Added	LCS Result	Reporting Limit	Result Qualifier	LCS % Rec.	Control Limits
10-30-0	OIL AND GREASE	39.9	39.2	5		98	78 - 114%

Lab ID: EX101129-2LCSD

Sample Matrix: WATER
% Moisture: N/A
Date Collected: N/A
Date Extracted: 11/29/2010
Date Analyzed: 11/29/2010
Prep Method: METHOD

Prep Batch: EX101129-2
QCBatchID: EX101129-2-1
Run ID: EX101129-2A
Cleanup: NONE
Basis: N/A
File Name:

Sample Aliquot: 1000 ml
Final Volume: 1 sample
Result Units: MG/L
Clean DF: 1

CASNO	Target Analyte	Spike Added	LCSD Result	Reporting Limit	Result Qualifier	LCSD % Rec.	RPD Limit	RPD
10-30-0	OIL AND GREASE	39.9	38	5		95	18	3

Data Package ID: *EX1011292-1*

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division
Fort Collins, Colorado

Metals
Case Narrative

Tetra Tech, Inc.

293-295, 297-302

Work Order Number: 1011292

1. This report consists of 3 sediment samples.

2. The samples were received cool and intact by ALS on 11/24/10.

3. The samples were prepared for analysis based on SW-846, 3rd Edition procedures.

   For analysis by Trace ICP, the samples were digested following method 3050B and SOP 806 Rev. 14.

   For analysis by Cold Vapor AA (CVAA), the samples were digested following method 7471A and SOP 812 Rev. 14.

4. The samples were analyzed following SW-846, 3rd Edition procedures.

   Analysis by Trace ICP followed method 6010B and SOP 834 Rev. 7.

   The relationship between intensity and concentration for each element is established using at least four standards, one of which is a blank solution.

   During sample analysis concentrations are computed by the software and the results are printed in mg/L. The instrument software does not provide a printout which gives both intensity and concentration. The validity of the calibration equation is tested by analyzing the following solutions: a blank, a low level check solution with concentrations near the reporting limit, an Initial Calibration Verification (ICV) standard from a 2nd source standard solution with concentrations near the middle of the analytical range, a Continuing Calibration Verification (CCV) standard with concentrations at two times those in the ICV, and a readback of the highest calibration standard.

   These solutions provide verification that the calibration equations are functioning properly throughout the analytical range of the instrument. During sample analysis

dilutions are made for analytes found at concentrations above the highest calibration standard. No results are taken from extrapolations beyond the highest standard.

Analysis by CVAA followed method 7471A and SOP 812 Rev. 14.

The relationship between intensity and concentration is determined daily, prior to sample analysis. At least five standards and a blank solution are analyzed to establish the calibration curve. The instrument software performs a linear regression to fit the calibration data to a curve of the form:

$$conc. = B * I + C$$

where:
conc. = concentration
B = slope coefficient
I = intensity
C = intercept coefficient

A printout summarizing the calibration data supplies the calibration curve and correlation coefficient. During sample analysis both intensity and concentration values are printed. Dilutions are made for concentrations above the highest calibration standard. No results are taken from extrapolations above the highest standard.

5. All standards and solutions are NIST traceable and were used within their recommended shelf life.

6. The samples were prepared and analyzed within the established hold times.

All in house quality control procedures were followed, as described below.

7. General quality control procedures.
   - A preparation (method) blank and laboratory control sample were digested and analyzed with the samples in each digestion batch. There were not more than 20 samples in each digestion batch.
   - The preparation (method) blank associated with each digestion batch was below the practical quantitation limit for the requested analytes.
   - The laboratory control sample associated with each digestion batch was within the acceptance limits. This indicates complete digestion according to the method.
   - All initial and continuing calibration blanks associated with each analytical batch were below the practical quantitation limits for the requested analytes.
   - All initial and continuing calibration verifications associated with each analytical batch were within the acceptance criteria for the requested analytes. This indicates a valid calibration and stable instrument conditions.
   - The interference check samples and high standard readbacks associated with Method 6010B were within acceptance criteria.
8. Matrix specific quality control procedures.

Sample 1011292-9 was designated as the quality control sample for the mercury analysis. Per method requirements, matrix QC was performed for the Trace ICP analysis. Since a sample from this order number was not the selected quality control (QC) sample, matrix specific QC results are not included in this report.

Similarity of matrix and therefore relevance of the QC results should not be automatically inferred for any sample other than the native sample selected for QC.

- A matrix spike and matrix spike duplicate were digested and analyzed with the mercury batch. All acceptance criteria for accuracy were met.
- A sample duplicate and matrix spike duplicate were digested and analyzed with the mercury batch. All acceptance criteria for precision were met.

9. Sample 1011292-5 required a dilution to bring iron into the analytical range of the Trace ICP. Accurate quantitation of iron is necessary to correct for spectral interferences on lead and selenium. The lead and selenium results were determined from the diluted sample.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Emily Knodel
Inorganics Primary Data Reviewer

12-08-10
Date

Inorganics Final Data Reviewer

12/9/10
Date

Inorganic Data Reporting Qualifiers

The following qualifiers are used by the laboratory when reporting results of inorganic analyses.

- Result qualifier -- A “B” is entered if the reported value was obtained from a reading that was less than the Practical Quantitation Limit but greater than or equal to the Method Detection Limit (MDL). If the analyte was analyzed for but not detected a “U” is entered. For samples, negative values are reported as non-detects (“U” flagged). For blanks, if the absolute value of the negative value is above the MDL and below the practical quantitation limit, then the result is “B” flagged.

- QC qualifier -- Specified entries and their meanings are as follows:

  E - The reported value is estimated because of the presence of interference. An explanatory note may be included in the narrative.

  M - Duplicate injection precision was not met.

  N - Spiked sample recovery not within control limits. A post spike is analyzed for all ICP analyses when the matrix spike and or spike duplicate fail and the native sample concentration is less than four times the spike added concentration.

  Z - Spiked recovery not within control limits. An explanatory note may be included in the narrative.

  * - Duplicate analysis (relative percent difference) not within control limits.

  S - SAR value is estimated as one or more analytes used in the calculation were not detected above the detection limit.

ALS Environmental -- FC

Sample Number(s) Cross-Reference Table

Paragon OrderNum: 1011292
Client Name: Tetra Tech, Inc.
Client Project Name:
Client Project Number: 293-295, 297-302
Client PO Number: 1061585

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
GN10293BA	1011292-1		WATER	23-Nov-10	11:02
GN10294BA	1011292-2		WATER	23-Nov-10	11:02
GN10295BA	1011292-3		WATER	23-Nov-10	11:02
GN10297BA	1011292-4		WATER	23-Nov-10	11:02
GN10298BA	1011292-5		SEDIMEN	23-Nov-10	11:02
GN10299BA	1011292-6		SEDIMEN	23-Nov-10	11:02
GN10300BA	1011292-7		SEDIMEN	23-Nov-10	10:40
GN10301BA	1011292-8		SEDIMEN	23-Nov-10	10:40
GN10302BA	1011292-9		SEDIMEN	23-Nov-10	11:14

PARAGON ANALYTICS

ALS Paragon

225 Commerce Drive, Fort Collins, CO 80524
TF: 800-443-1511 PH: 970-490-1511 FX: 970-490-1522

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

ALS

Chain-of-Custody

Lab ID	1011292
Date	11/23/2010
Page	1 of 1

Project Name/No.	N/A	Sampler(s)	Joe Patrick	Turnaround	Standard or (Due Standard)
REPORT TO:	Joe Patrick			Disposal	By Lab or eturn to Clie
PHONE:	719-556-4400				
FAX:	719-556-5201				
E-MAIL:	joe.patrick@tetratech.com				
COMPANY:	Tetra Tech				
ADDRESS:	580 Goodfellow St				
	Peterson AFB, CO 80914-2370				

Provide additional information as needed in comments section.

Circle Analytical Method Above: 8082, 8020, 8260, 8260, 8270, 365.2, 353.2, SW8260B SW8270D SW8081A SW815, 300, 150.1, SW6010B 7470A/7471A E200.7 E245.1, 1010, SW6020A E200.8, SW7196A Alkaline Digestion? Y / N, 200.7, 160.2, 160.1, 1311, 664

Circle Analytical Method Above: 8015, 8015, 353.2 & 365.2, 300, E903.1, SW9320 E904.0, D5811, E906.0, Zinc (200.7), ~~200.7~~ 6010

Sample ID	Date	Time *	Lab ID	Matrix	No. of Containers	PCB	TCLP Metals (8 RCRA)	BTEX	Total Halogens	VOCs	TCLP SVOCs	Tot Phosphorous	Tot. Nitrogen	TCLP Organics SW1311	Total Nitrates	pH	Dissolved Metals (ICP) or Hg	Flashpoint	Dissolved Metals (ICP-MS)	Hexavalent Chromium	Molybdenum	TSS	TDS	TCLP Metals (RCRA 8)	O & G	TEPH-GRO	TEPH-DRO	Tot. Nitrogen & Tot. Phosphor	Nitrates	Radium 226	Radium 228	Strontium 90 (Total RadioSr)	Tritium	Total Metals	Total Metals & Cu, Al, Mb
GN10293BA	11/23/10	11:02	1	W	1																	X	X												
GN10294BA	11/23/10	11:02	2	W	1																				X										
GN10295BA	11/23/10	11:02	3	W	1										X	X																			
GN10297BA	11/23/10	11:02	4	W	1							X	X																						
GN10298BA	11/23/10	11:02	5	Se	1																														X
GN10299BA	11/23/10	11:02	6	Se	1	X																													
GN10300BA	11/23/10	10:40	7	Se	1																														X
GN10301BA	11/23/10	10:40	8	Se	1	X																													
GN10302BA	11/23/10	11:14	9	Se	1																														X
Last ITEM																																			

* Time Zone: EST CST MST PST **Matrix Key:** O = oil, S = soil, NS = non-soil solid, W = water, L = liquid, E = extract, F = f Se=sediment

Comments:

** Samples above are From Lake Williams **

Originator: Retain a photocopy after transfer!

Relinquished By (1)		Relinquished By	
Signature	[signature]	Signature	
Printed Name	Joe Patrick	Printed Name	
Date	11/23/10	Date	
Time	4:30 pm	Time	
Company	Tetra Tech	Company	

Received By (1)		Received By	
Signature	C Trimble	Signature	
Printed Name	C Trimble	Printed Name	
Date	11-24-10	Date	
Time	1020	Time	
Company	ALS	Company	

CONDITION OF SAMPLE UPON RECEIPT FORM

Client: TETRA TECH Workorder No: 1011292

Project Manager: AW Initials: CDT Date: 11-24-10

1. Does this project require any **special handling** in addition to standard Paragon procedures?		YES	(NO)
2. Are custody **seals** on **shipping containers** intact?	NONE	(YES)	NO
3. Are Custody seals on **sample containers** intact?	(NONE)	YES	NO
4. Is there a **COC (Chain-of-Custody) present** or other representative documents?		(YES)	NO
5. Are the **COC and bottle labels complete and legible**?		(YES)	NO
6. Is the **COC in agreement** with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.)		(YES)	NO
7. Were **airbills / shipping documents** present and/or removable?	DROP OFF	(YES)	NO
8. Are all aqueous **samples requiring preservation preserved correctly?** (excluding volatiles)	N/A	(YES)	NO
9. Are all aqueous **non-preserved samples pH 4-9**?	N/A	(YES)	NO
10. Is there **sufficient sample** for the requested analyses?		(YES)	NO
11. Were all samples placed in the **proper containers** for the requested analyses?		(YES)	NO
12. Are all samples within **holding times** for the requested analyses?		(YES)	NO
13. Were all sample containers received **intact**? (not broken or leaking, etc.)		(YES)	NO
14. Are all samples requiring **no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon)** headspace free? **Size of bubble:** ____ < green pea ____ > green pea	(N/A)	YES	NO
15. Do perchlorate LCMS-MS samples **have** headspace? (at least 1/3 of container required)	(N/A)	YES	NO
16. Were samples checked for and free from the presence of **residual chlorine?** (Applicable when PM has indicated samples are from a chlorinated water source; note if field preservation with sodium thiosulfate was not observed.)	(N/A)	YES	NO
17. Were the samples **shipped on ice**?		(YES)	NO
18. Were cooler temperatures measured at 0.1-6.0°C? **IR gun used*:** #2 (#4)	RAD ONLY	(YES)	NO

Cooler #: 1

Temperature (°C): 1.8°

No. of custody seals on cooler: 1

DOT Survey/ Acceptance Information

External µR/hr reading: 12

Background µR/hr reading: 10

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? (YES) / NO / NA (If no, see Form 008.)

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16

If applicable, was the client contacted? YES / NO / (NA) Contact: _____ Date/Time: _____

Project Manager Signature / Date: [signature] 11/24/10

*IR Gun #2: Oakton, SN 29922500201-0066 *IR Gun #4: Oakton, SN 2372220101-0002

Form 201r22.xls (6/1/09)

Total ICP Metals

Method SW6010B

Sample Results

Lab Name: **ALS Environmental -- FC**
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Field ID: GN10298BA
Lab ID: 1011292-5

Sample Matrix: SEDIMENT
% Moisture: 45.6
Date Collected: 23-Nov-10
Date Extracted: 03-Dec-10
Date Analyzed: 06-Dec-10
Prep Method: SW3050 Rev B

Prep Batch: IP101203-2
QCBatchID: IP101203-2-4
Run ID: IT101206-2A2
Cleanup: NONE
Basis: Dry Weight
File Name: 101206A.

Sample Aliquot: 1.001 g
Final Volume: 100 ml
Result Units: MG/KG
Clean DF: 1

CASNO	Target Analyte	Dilution Factor	Result	Reporting Limit	MDL	Result Qualifier	EPA Qualifier
7429-90-5	ALUMINUM	1	13000	37	9.9		
7440-38-2	ARSENIC	1	2.4	1.8	0.68		
7440-39-3	BARIUM	1	690	18	0.14		
7440-43-9	CADMIUM	1	0.27	0.92	0.11	B	
7440-47-3	CHROMIUM	1	12	1.8	0.36		
7440-50-8	COPPER	1	22	1.8	0.45		
7439-92-1	LEAD	2	12	1.1	0.69		
7439-98-7	MOLYBDENUM	1	0.31	1.8	0.29	B	
7782-49-2	SELENIUM	2	0.99	1.8	0.99	U	
7440-22-4	SILVER	1	0.25	1.8	0.25	U	

Data Package ID: *IT1011292-1*

Total ICP Metals

Method SW6010B

Sample Results

Lab Name: **ALS Environmental -- FC**
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Field ID: GN10300BA
Lab ID: 1011292-7

Sample Matrix: SEDIMENT
% Moisture: 75.9
Date Collected: 23-Nov-10
Date Extracted: 03-Dec-10
Date Analyzed: 06-Dec-10
Prep Method: SW3050 Rev B

Prep Batch: IP101203-2
QCBatchID: IP101203-2-4
Run ID: IT101206-2A2
Cleanup: NONE
Basis: Dry Weight
File Name: 101206A.

Sample Aliquot: 1.045 g
Final Volume: 100 ml
Result Units: MG/KG
Clean DF: 1

CASNO	Target Analyte	Dilution Factor	Result	Reporting Limit	MDL	Result Qualifier	EPA Qualifier
7429-90-5	ALUMINUM	1	13000	79	21		
7440-38-2	ARSENIC	1	2.2	4	1.5	B	
7440-39-3	BARIUM	1	330	40	0.31		
7440-43-9	CADMIUM	1	0.36	2	0.23	B	
7440-47-3	CHROMIUM	1	12	4	0.78		
7440-50-8	COPPER	1	33	4	0.97		
7439-92-1	LEAD	1	20	1.2	0.75		
7439-98-7	MOLYBDENUM	1	0.63	4	0.63	U	
7782-49-2	SELENIUM	1	1.1	2	1.1	U	
7440-22-4	SILVER	1	0.53	4	0.53	U	

Data Package ID: *IT1011292-1*

Total ICP Metals

Method SW6010B

Sample Results

Lab Name: **ALS Environmental -- FC**
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Field ID: GN10302BA
Lab ID: 1011292-9

Sample Matrix: SEDIMENT
% Moisture: 75.2
Date Collected: 23-Nov-10
Date Extracted: 03-Dec-10
Date Analyzed: 06-Dec-10
Prep Method: SW3050 Rev B

Prep Batch: IP101203-2
QCBatchID: IP101203-2-4
Run ID: IT101206-2A2
Cleanup: NONE
Basis: Dry Weight
File Name: 101206A.

Sample Aliquot: 1.039 g
Final Volume: 100 ml
Result Units: MG/KG
Clean DF: 1

CASNO	Target Analyte	Dilution Factor	Result	Reporting Limit	MDL	Result Qualifier	EPA Qualifier
7429-90-5	ALUMINUM	1	14000	78	21		
7440-38-2	ARSENIC	1	2.3	3.9	1.4	B	
7440-39-3	BARIUM	1	290	39	0.3		
7440-43-9	CADMIUM	1	0.45	1.9	0.23	B	
7440-47-3	CHROMIUM	1	12	3.9	0.76		
7440-50-8	COPPER	1	31	3.9	0.95		
7439-92-1	LEAD	1	20	1.2	0.73		
7439-98-7	MOLYBDENUM	1	0.62	3.9	0.62	U	
7782-49-2	SELENIUM	1	1.8	1.9	1	B	
7440-22-4	SILVER	1	0.52	3.9	0.52	U	

Data Package ID: *IT1011292-1*

Total MERCURY

Method SW7471A

Sample Results

Lab Name: **ALS Environmental -- FC**
Client Name: Tetra Tech, Inc.
Client Project ID: 293-295, 297-302
Work Order Number: 1011292
Reporting Basis: Dry Weight

Final Volume: 100 g
Matrix: SEDIMENT
Result Units: MG/KG

Client Sample ID	Lab ID	Date Collected	Date Prepared	Date Analyzed	Percent Moisture	Dilution Factor	Result	Reporting Limit	MDL	Flag	Sample Aliquot
GN10298BA	1011292-5	11/23/2010	12/6/2010	12/07/2010	45.59	1	0.0058	0.06	0.0058	U	0.612 g
GN10300BA	1011292-7	11/23/2010	12/6/2010	12/07/2010	75.90	1	0.022	0.14	0.013	B	0.602 g
GN10302BA	1011292-9	11/23/2010	12/6/2010	12/07/2010	75.21	1	0.014	0.13	0.013	B	0.609 g

Comments:

1. ND or U = Not Detected at or above the client requested detection limit.

Data Package ID: *HG1011292-1*

ICP Metals

Method SW6010B

Method Blank

Lab Name: **ALS Environmental -- FC**
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Lab ID: IP101203-2MB

Sample Matrix: SOIL
% Moisture: N/A
Date Collected: N/A
Date Extracted: 03-Dec-10
Date Analyzed: 06-Dec-10

Prep Batch: IP101203-2
QCBatchID: IP101203-2-4
Run ID: IT101206-2A2
Cleanup: NONE
Basis: N/A
File Name: 101206A.

Sample Aliquot: 1 g
Final Volume: 100 ml
Result Units: MG/KG
Clean DF: 1

CASNO	Target Analyte	DF	Result	Reporting Limit	MDL	Result Qualifier	EPA Qualifier
7429-90-5	ALUMINUM	1	5.4	20	5.4	U	
7440-38-2	ARSENIC	1	0.37	1	0.37	U	
7440-39-3	BARIUM	1	0.11	10	0.078	B	
7440-43-9	CADMIUM	1	0.059	0.5	0.059	U	
7440-47-3	CHROMIUM	1	0.2	1	0.2	U	
7440-50-8	COPPER	1	0.25	1	0.25	U	
7439-92-1	LEAD	1	0.19	0.3	0.19	U	
7439-98-7	MOLYBDENUM	1	0.16	1	0.16	U	
7782-49-2	SELENIUM	1	0.27	0.5	0.27	U	
7440-22-4	SILVER	1	0.13	1	0.13	U	

Data Package ID: *IT1011292-1*

ICP Metals

Method SW6010B

Laboratory Control Sample

Lab Name: **ALS Environmental -- FC**
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Lab ID: IP101203-2LCS

Sample Matrix: SOIL
% Moisture: N/A
Date Collected: N/A
Date Extracted: 12/03/2010
Date Analyzed: 12/06/2010
Prep Method: SW3050B

Prep Batch: IP101203-2
QCBatchID: IP101203-2-4
Run ID: IT101206-2A2
Cleanup: NONE
Basis: N/A
File Name: 101206A.

Sample Aliquot: 1 g
Final Volume: 100 ml
Result Units: MG/KG
Clean DF: 1

CASNO	Target Analyte	Spike Added	LCS Result	Reporting Limit	Result Qualifier	LCS % Rec.	Control Limits
7429-90-5	ALUMINUM	200	193	20		97	80 - 120%
7440-38-2	ARSENIC	200	183	1		92	80 - 120%
7440-39-3	BARIUM	200	193	10		97	80 - 120%
7440-43-9	CADMIUM	5	4.66	0.5		93	80 - 120%
7440-47-3	CHROMIUM	20	18.7	1		94	80 - 120%
7440-50-8	COPPER	25	24.6	1		98	80 - 120%
7439-92-1	LEAD	50	46.7	0.3		93	80 - 120%
7439-98-7	MOLYBDENUM	100	95.5	1		96	80 - 120%
7782-49-2	SELENIUM	200	173	0.5		86	80 - 120%
7440-22-4	SILVER	10	8.96	1		90	80 - 120%

Data Package ID: *IT1011292-1*

Mercury

Method SW7471A

Method Blank

Lab Name: **ALS Environmental -- FC**
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Lab ID: HG101206-1MB

Sample Matrix: SEDIMENT
% Moisture: N/A
Date Collected: N/A
Date Extracted: 06-Dec-10
Date Analyzed: 07-Dec-10

Prep Batch: HG101206-1
QCBatchID: HG101206-1-3
Run ID: HG101207-1A3
Cleanup: NONE
Basis: N/A
File Name: 10120700

Sample Aliquot: 0.6 g
Final Volume: 100 g
Result Units: MG/KG
Clean DF: 1

CASNO	Target Analyte	DF	Result	Reporting Limit	MDL	Result Qualifier	EPA Qualifier
7439-97-6	MERCURY	1	-0.0042	0.033	0.0032	B	

Data Package ID: *HG1011292-1*

Mercury

Method SW7471A

Laboratory Control Sample

Lab Name: **ALS Environmental -- FC**
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Lab ID: HG101206-1LCS

Sample Matrix: SEDIMENT
% Moisture: N/A
Date Collected: N/A
Date Extracted: 12/06/2010
Date Analyzed: 12/07/2010
Prep Method: METHOD

Prep Batch: HG101206-1
QCBatchID: HG101206-1-3
Run ID: HG101207-1A3
Cleanup: NONE
Basis: N/A
File Name: 10120700

Sample Aliquot: 0.6 g
Final Volume: 100 g
Result Units: MG/KG
Clean DF: 1

CASNO	Target Analyte	Spike Added	LCS Result	Reporting Limit	Result Qualifier	LCS % Rec.	Control Limits
7439-97-6	MERCURY	0.167	0.166	0.0333		99	80 - 120%

Data Package ID: *HG1011292-1*

Mercury

Method SW7471A

Matrix Spike And Matrix Spike Duplicate

Lab Name: ALS Environmental -- FC
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Field ID: GN10302BA
LabID: 1011292-9MS

Sample Matrix: SEDIMENT
% Moisture: 75.2
Date Collected: 23-Nov-10
Date Extracted: 06-Dec-10
Date Analyzed: 07-Dec-10
Prep Method: METHOD

Prep Batch: HG101206-1
QCBatchID: HG101206-1-3
Run ID: HG101207-1A3
Cleanup: NONE
Basis: Dry Weight

Sample Aliquot: 0.604 g
Final Volume: 100 g
Result Units: MG/KG
File Name: 10120700

CASNO	Target Analyte	Sample Result	Samp Qual	MS Result	MS Qual	Reporting Limit	Spike Added	MS % Rec.	Control Limits
7439-97-6	MERCURY	0.014	B	1.31		0.134	1.34	97	80 - 120%

Field ID: GN10302BA
LabID: 1011292-9MSD

Sample Matrix: SEDIMENT
% Moisture: 75.2
Date Collected: 23-Nov-10
Date Extracted: 06-Dec-10
Date Analyzed: 07-Dec-10
Prep Method: METHOD

Prep Batch: HG101206-1
QCBatchID: HG101206-1-3
Run ID: HG101207-1A3
Cleanup: NONE
Basis: Dry Weight

Sample Aliquot: 0.605 g
Final Volume: 100 g
Result Units: MG/KG
File Name: 10120700

CASNO	Target Analyte	MSD Result	MSD Qual	Spike Added	MSD % Rec.	Reporting Limit	RPD Limit	RPD
7439-97-6	MERCURY	1.29		1.33	95	0.133	20	2

Data Package ID: *HG1011292-1*

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division
Fort Collins, Colorado

Inorganics

Case Narrative

Tetra Tech, Inc.

293-295, 297-302

Work Order Number: 1011292

1. This report consists of 3 water samples.

2. The samples were received cool and intact by ALS on 11/24/10.

3. The samples had been correctly preserved for the requested analyses.

4. The samples were prepared for analysis based on Methods for the Chemical Analysis of Waters and Wastes (MCAWW), May 1994 procedures and Environmental Monitoring Systems Laboratory (EMSL) Rev 2.1 procedures.

5. The samples were analyzed following MCAWW and EMSL procedures for the following methods:

Analyte	Method	SOP #
Nitrate/nitrite as N	353.2 Revision 2.0	1127 Rev 7
pH	150.1	1126 Rev 17
Total phosphorus	365.2	1119 Rev 6
TDS	160.1	1101 Rev 10
TSS	160.2	1100 Rev 10
Nitrate as N	300.0 Revision 2.1	1113 Rev 11
Nitrite as N	300.0 Revision 2.1	1113 Rev 11

6. All standards and solutions were used within their recommended shelf life.

7. The samples were prepared and analyzed within the established hold time for each analysis.

All in house quality control procedures were followed, as described below.

8. General quality control procedures.

- A preparation (method) blank and laboratory control sample (LCS) were prepared and analyzed with the samples in each applicable preparation batch. There were not more than 20 samples in each preparation batch.
- The method blank associated with each applicable batch was below the reporting limit for the requested analytes. This indicates that no contaminants were introduced to the samples during preparation and analysis.
- The LCS was within the acceptance limits for each applicable analysis.
- All initial and continuing calibration blanks (ICB/CCB) associated with each applicable analytical batch were below the reporting limit for the requested analytes.
- All initial and continuing calibration verifications (ICV/CCV) associated with each applicable analytical batch were within the acceptance criteria for the requested analytes. This indicates a valid calibration and stable instrument conditions.

9. Matrix specific quality control procedures.

   Sample 1011292-4 was designated as the quality control sample for the total phosphorus analysis. Sample 1011292-1 was designated as the quality control sample for the TSS analysis. Sample 1011292-3 was designated as the quality control sample for the nitrate as N and nitrite as N analysis. Per method requirements, matrix QC was performed for the remaining analyses. Since a sample from this order number was not the selected quality control (QC) sample, matrix specific QC results are not included in this report.

   Similarity of matrix and therefore relevance of the QC results should not be automatically inferred for any sample other than the native sample selected for QC.

   - A matrix spike (MS) and matrix spike duplicate (MSD) were prepared and analyzed with the total phosphorus, nitrate as N, and nitrite as N batches. All guidance criteria for precision and accuracy were met with the following exceptions:

Analyte	Sample ID
Total Phosphorus	1011292-4MS & MSD

     The native sample result is flagged for total phosphorus. The laboratory control sample indicates that the procedure was in control.
   - A sample duplicate was prepared and analyzed with the TSS batch. All guidance criteria for precision were met with the following exception:

Analyte	Sample ID
TSS	1011292-1D

     The native sample result is flagged for duplicate failure.

10. Electrical conductivity screening indicated that the concentration of dissolved salts was high in sample 1011292-3. Therefore, it was necessary to dilute the sample prior to injection into the ion chromatograph in order to minimize the amount of salts loaded into the analytical column.

11. Manual integrations are performed when needed to provide consistent and defensible data following the guidelines in SOP 939 Revision 3.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Megan Johnson

Megan Johnson
Inorganics Primary Data Reviewer

12/9/10
Date

Inorganics Final Data Reviewer

12/9/10
Date

Inorganic Data Reporting Qualifiers

The following qualifiers are used by the laboratory when reporting results of inorganic analyses.

- Concentration qualifier -- A “J” is entered if the reported value was obtained from a reading that was less than the Reporting Limit but greater than or equal to ALS’s Method Detection Limit. If the analyte was analyzed for but not detected a “U” is entered.

- QC qualifier -- Specified entries and their meanings are as follows:

  N - Spiked sample recovery not within control limits.

  * - Duplicate analysis (relative percent difference) not within control limits.

  Z - Calibration spike recovery not within control limits.

ALS Environmental -- FC

Sample Number(s) Cross-Reference Table

Paragon OrderNum: 1011292
Client Name: Tetra Tech, Inc.
Client Project Name:
Client Project Number: 293-295, 297-302
Client PO Number: 1061585

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
GN10293BA	1011292-1		WATER	23-Nov-10	11:02
GN10294BA	1011292-2		WATER	23-Nov-10	11:02
GN10295BA	1011292-3		WATER	23-Nov-10	11:02
GN10297BA	1011292-4		WATER	23-Nov-10	11:02
GN10298BA	1011292-5		SEDIMEN	23-Nov-10	11:02
GN10299BA	1011292-6		SEDIMEN	23-Nov-10	11:02
GN10300BA	1011292-7		SEDIMEN	23-Nov-10	10:40
GN10301BA	1011292-8		SEDIMEN	23-Nov-10	10:40
GN10302BA	1011292-9		SEDIMEN	23-Nov-10	11:14

PARAGON ANALYTICS

ALS Paragon
ALS Laboratory Group
225 Commerce Drive, Fort Collins, CO 80524
TF: 800-443-1511 PH: 970-490-1511 FX: 970-490-1522

Chain-of-Custody

Lab ID 1011292

Date 11/23/2010 **Page** 1 of 1

Project Name/No.	N/A	Sampler(s)	Joe Patrick	Turnaround	Standard or (Due *Standard*)	Disposal	*By Lab* or eturn to Clie

REPORT TO:	Joe Patrick
PHONE:	719-556-4400
FAX:	719-556-5201
E-MAIL:	joe.patrick@tetratech.com
COMPANY:	Tetra Tech
ADDRESS:	580 Goodfellow St
	Peterson AFB, CO 80914-2370

Provide additional information as needed in comments section.

Sample ID	Date	Time *	Lab ID	Matrix	No. of Containers
GN10293BA	11/23/10	11:02	1	W	1
GN10294BA	11/23/10	11:02	2	W	1
GN10295BA	11/23/10	11:02	3	W	1
GN10297BA	11/23/10	11:02	4	W	1
GN10298BA	11/23/10	11:02	5	Se	1
GN10299BA	11/23/10	11:02	6	Se	1
GN10300BA	11/23/10	10:40	7	Se	1
GN10301BA	11/23/10	10:40	8	Se	1
GN10302BA	11/23/10	11:14	9	Se	1
Last ITEM					

Circle Analytical Method Above

Sample ID	PCB (8082, circled)	TCLP Metals (8 RCRA)	BTEX (8020)	Total Halogens (8260)	VOCs (8260)	TCLP SVOCs (8270)	Tot Phosphorous (365.2, circled)	Tot. Nitrogen (353.2, circled)	TCLP Organics SW1311 (SW8260B SW8270D SW8081A SW815)	Total Nitrates (300, circled)	pH (150.1, circled)	Dissolved Metals (ICP) or Hg (SW6010B 7470A/7471A E200.7 E245.1)	Flashpoint (1010)	Dissolved Metals (ICP-MS) (SW6020A E200.8)	Hexavalent Chromium (SW7196A Alkaline Digestion? Y / N)	Molybdenum (200.7)	TSS (160.2, circled)	TDS (160.1, circled)	TCLP Metals (RCRA 8) (1311)	O & G (1664, circled)
GN10293BA																	X	X		
GN10294BA																				X
GN10295BA										X	X									
GN10297BA							X	X												
GN10298BA																				
GN10299BA	X																			
GN10300BA																				
GN10301BA	X																			
GN10302BA																				

Circle Analytical Method Above

Sample ID	TEPH-GRO (8015)	TEPH-DRO (8015)	Tot Nitrogen & Tot. Phosphoro (353.2 & 365.2)	Nitrates (300)	Radium 226 (E903.1)	Radium 228 (SW9320 E904.0)	Strontium 90 (Total RadioSr) (D5811)	Tritium (E906.0)	Total Metals (Zinc (200.7))	Total Metals & Cu, Al, Mb (~~200.7~~ 6020, circled)
GN10293BA										
GN10294BA										
GN10295BA										
GN10297BA										
GN10298BA										X
GN10299BA										
GN10300BA										X
GN10301BA										
GN10302BA										X

* Time Zone: EST CST MST PST Matrix Key: O = oil, S = soil, NS = non-soil solid, W = water, L = liquid, E = extract, F = f Se=sediment

Comments:
** Samples above are From Lake Williams **

Relinquished By: (1)	Relinquished By:
Signature [signature]	Signature
Printed Name Joe Patrick	Printed Name
Date 11/23/10 Time 4:30 pm	Date Time
Company Tetra Tech	Company

Received By: (1)	Received By:
Signature C Trimble	Signature
Printed Name C Trimble	Printed Name
Date 11-24-10 Time 1020	Date Time
Company ALS	Company

Originator: Retain a photocopy after transfer!

CONDITION OF SAMPLE UPON RECEIPT FORM

Client: TETRA TECH Workorder No: 1011292

Project Manager: AW Initials: CDT Date: 11-24-10

1. Does this project require any **special handling** in addition to standard Paragon procedures?		YES	(NO)
2. Are custody **seals** on **shipping containers** intact?	NONE	(YES)	NO
3. Are Custody seals on **sample containers** intact?	(NONE)	YES	NO
4. Is there a **COC (Chain-of-Custody) present** or other representative documents?		(YES)	NO
5. Are the **COC and bottle labels complete and legible**?		(YES)	NO
6. Is the **COC in agreement** with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.)		(YES)	NO
7. Were **airbills / shipping documents** present and/or removable?	DROP OFF	(YES)	NO
8. Are all aqueous **samples requiring preservation preserved correctly?** (excluding volatiles)	N/A	(YES)	NO
9. Are all aqueous **non-preserved samples pH 4-9**?	N/A	(YES)	NO
10. Is there **sufficient sample** for the requested analyses?		(YES)	NO
11. Were all samples placed in the **proper containers** for the requested analyses?		(YES)	NO
12. Are all samples within **holding times** for the requested analyses?		(YES)	NO
13. Were all sample containers received **intact**? (not broken or leaking, etc.)		(YES)	NO
14. Are all samples requiring **no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon)** headspace free? **Size of bubble:** ____ < green pea ____ > green pea	(N/A)	YES	NO
15. Do perchlorate LCMS-MS samples **have** headspace? (at least 1/3 of container required)	(N/A)	YES	NO
16. Were samples checked for and free from the presence of **residual chlorine?** (Applicable when PM has indicated samples are from a chlorinated water source; note if field preservation with sodium thiosulfate was not observed.)	(N/A)	YES	NO
17. Were the samples **shipped on ice**?		(YES)	NO
18. Were cooler temperatures measured at 0.1-6.0°C? **IR gun used*:** #2 (#4)	RAD ONLY	(YES)	NO

Cooler #: 1

Temperature (°C): 1.8°

No. of custody seals on cooler: 1

DOT Survey/ Acceptance Information

External µR/hr reading: 12

Background µR/hr reading: 10

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? (YES) / NO / NA (If no, see Form 008.)

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16

If applicable, was the client contacted? YES / NO / (NA) Contact: _____ Date/Time: _____

Project Manager Signature / Date: [signature] 11/24/10

*IR Gun #2: Oakton, SN 29922500201-0066 *IR Gun #4: Oakton, SN 2372220101-0002

Form 201r22.xls (6/1/09)

Nitrate/Nitrite as N

Method EPA353.2 Revision 2.0

Sample Results

Lab Name: **ALS Environmental -- FC**
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Field ID:	GN10297BA
Lab ID:	1011292-4

Sample Matrix: WATER
% Moisture: N/A
Date Collected: 23-Nov-10
Date Extracted: 01-Dec-10
Date Analyzed: 01-Dec-10
Prep Method: NONE

Prep Batch: NN101201-3
QCBatchID: NN101201-3-1
Run ID: NN101201-3A
Cleanup: NONE
Basis: As Received
File Name: 1201ANOX.FDT

Sample Aliquot: 5 ml
Final Volume: 5 ml
Result Units: MG/L
Clean DF: 1

CASNO	Target Analyte	Dilution Factor	Result	Reporting Limit	MDL	Result Qualifier	EPA Qualifier
1-005	NITRATE/NITRITE AS N	1	0.0081	0.01	0.0036	J	

Data Package ID: *nn1011292-1*

pH

Method EPA150.1

Sample Results

Lab Name: **ALS Environmental -- FC**
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Field ID: GN10295BA
Lab ID: 1011292-3

Sample Matrix: WATER
% Moisture: N/A
Date Collected: 23-Nov-10
Date Extracted: 24-Nov-10
Date Analyzed: 24-Nov-10
Prep Method: NONE

Prep Batch: PH101124-1
QCBatchID: PH101124-1-1
Run ID: ph101124-1a
Cleanup: NONE
Basis: As Received
File Name:

Sample Aliquot: 20 ml
Final Volume: 20 ml
Result Units: pH
Clean DF: 1

CASNO	Target Analyte	Dilution Factor	Result	Reporting Limit	Result Qualifier	EPA Qualifier
10-29-7	PH AnalysisTime: 13:30	1	9.31	0.1		

Data Package ID: *ph1011292-1*

Total Phosphorus as P

Method EPA365.2

Sample Results

Lab Name: **ALS Environmental -- FC**
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Field ID: GN10297BA
Lab ID: 1011292-4

Sample Matrix: WATER
% Moisture: N/A
Date Collected: 23-Nov-10
Date Extracted: 03-Dec-10
Date Analyzed: 03-Dec-10
Prep Method: METHOD

Prep Batch: PO101203-1
QCBatchID: PO101203-1-1
Run ID: po101203-2a
Cleanup: NONE
Basis: As Received
File Name: Manual Entry

Sample Aliquot: 50 ml
Final Volume: 50 ml
Result Units: MG/L
Clean DF: 1

CASNO	Target Analyte	Dilution Factor	Result	Reporting Limit	MDL	Result Qualifier	EPA Qualifier
7723-14-0	TOTAL PHOSPHORUS	1	0.072	0.05	0.04		N

Data Package ID: *po1011292-1*

Total Dissolved Solids

Method EPA160.1

Sample Results

Lab Name: **ALS Environmental -- FC**
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Field ID: GN10293BA
Lab ID: 1011292-1

Sample Matrix: WATER
% Moisture: N/A
Date Collected: 23-Nov-10
Date Extracted: 24-Nov-10
Date Analyzed: 29-Nov-10
Prep Method: METHOD

Prep Batch: TD101124-1
QCBatchID: TD101124-1-1
Run ID: td101129-1a
Cleanup: NONE
Basis: As Received
File Name: Manual Entry

Sample Aliquot: 50 ml
Final Volume: 50 ml
Result Units: MG/L
Clean DF: 1

CASNO	Target Analyte	Dilution Factor	Result	Reporting Limit	Result Qualifier	EPA Qualifier
10-33-3	TOTAL DISSOLVED SOLIDS	1	1200	40		

Data Package ID: *td1011292-1*

Total Suspended Solids

Method EPA160.2

Sample Results

Lab Name: **ALS Environmental -- FC**
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Field ID: GN10293BA
Lab ID: 1011292-1

Sample Matrix: WATER
% Moisture: N/A
Date Collected: 23-Nov-10
Date Extracted: 23-Nov-10
Date Analyzed: 29-Nov-10
Prep Method: METHOD

Prep Batch: TS101124-1
QCBatchID: TS101124-1-1
Run ID: ts101129-1a
Cleanup: NONE
Basis: As Received
File Name: Manual Entry

Sample Aliquot: 100 ml
Final Volume: 100 ml
Result Units: MG/L
Clean DF: 1

CASNO	Target Analyte	Dilution Factor	Result	Reporting Limit	Result Qualifier	EPA Qualifier
10-32-2	TOTAL SUSPENDED SOLIDS	1	39	20		*

Data Package ID: *ts1011292-1*

Ion Chromatography

Method EPA300.0 Revision 2.1

Sample Results

Lab Name: **ALS Environmental -- FC**
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Field ID: GN10295BA
Lab ID: 1011292-3

Sample Matrix: WATER
% Moisture: N/A
Date Collected: 23-Nov-10
Date Extracted: 24-Nov-10
Date Analyzed: 24-Nov-10
Prep Method: NONE

Prep Batch: IC101124-1
QCBatchID: IC101124-1-1
Run ID: IC101124-2A
Cleanup: NONE
Basis: As Received
File Name: 01124_013.DXD

Sample Aliquot: 5 ml
Final Volume: 5 ml
Result Units: MG/L
Clean DF: 1

CASNO	Target Analyte	Dilution Factor	Result	Reporting Limit	MDL	Result Qualifier	EPA Qualifier
14797-65-0	NITRITE AS N	2	0.2	0.2	0.0096	U	
14797-55-8	NITRATE AS N	2	0.17	0.4	0.031	J	

Data Package ID: *ic1011292-1*

Nitrate/Nitrite as N

Method EPA353.2 Revision 2.0

Method Blank

Lab Name: **ALS Environmental -- FC**
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Lab ID: NN101201-3MB

Sample Matrix: WATER
% Moisture: N/A
Date Collected: N/A
Date Extracted: 01-Dec-10
Date Analyzed: 01-Dec-10

Prep Batch: NN101201-3
QCBatchID: NN101201-3-1
Run ID: NN101201-3A
Cleanup: NONE
Basis: N/A
File Name: 1201ANOX.FDT

Sample Aliquot: 5 ml
Final Volume: 5 ml
Result Units: MG/L
Clean DF: 1

CASNO	Target Analyte	DF	Result	Reporting Limit	MDL	Result Qualifier	EPA Qualifier
1-005	NITRATE/NITRITE AS N	1	0.01	0.01	0.0036	U	

Data Package ID: *nn1011292-1*

Nitrate/Nitrite as N

Method EPA353.2 Revision 2.0

Laboratory Control Sample

Lab Name: ALS Environmental -- FC
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Lab ID: NN101201-3LCS

Sample Matrix: WATER
% Moisture: N/A
Date Collected: N/A
Date Extracted: 12/01/2010
Date Analyzed: 12/01/2010
Prep Method: NONE

Prep Batch: NN101201-3
QCBatchID: NN101201-3-1
Run ID: NN101201-3A
Cleanup: NONE
Basis: N/A
File Name: 1201ANOX.FDT

Sample Aliquot: 5 ml
Final Volume: 5 ml
Result Units: MG/L
Clean DF: 1

CASNO	Target Analyte	Spike Added	LCS Result	Reporting Limit	Result Qualifier	LCS % Rec.	Control Limits
1-005	NITRATE/NITRITE AS N	0.5	0.509	0.01		102	90 - 110%

Data Package ID: *nn1011292-1*

Total Phosphorus as P

Method EPA365.2

Method Blank

Lab Name: **ALS Environmental -- FC**
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Lab ID: PO101203-1MB

Sample Matrix: WATER
% Moisture: N/A
Date Collected: N/A
Date Extracted: 03-Dec-10
Date Analyzed: 03-Dec-10

Prep Batch: PO101203-1
QCBatchID: PO101203-1-1
Run ID: po101203-2a
Cleanup: NONE
Basis: N/A
File Name: Manual Entry

Sample Aliquot: 50 ml
Final Volume: 50 ml
Result Units: MG/L
Clean DF: 1

CASNO	Target Analyte	DF	Result	Reporting Limit	MDL	Result Qualifier	EPA Qualifier
7723-14-0	TOTAL PHOSPHORUS	1	0.05	0.05	0.04	U	

Data Package ID: *po1011292-1*

Total Phosphorus as P

Method EPA365.2

Laboratory Control Sample

Lab Name: **ALS Environmental -- FC**
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Lab ID: PO101203-1LCS

Sample Matrix: WATER
% Moisture: N/A
Date Collected: N/A
Date Extracted: 12/03/2010
Date Analyzed: 12/03/2010
Prep Method: METHOD

Prep Batch: PO101203-1
QCBatchID: PO101203-1-1
Run ID: po101203-2a
Cleanup: NONE
Basis: N/A
File Name: Manual Entry

Sample Aliquot: 50 ml
Final Volume: 50 ml
Result Units: MG/L
Clean DF: 1

CASNO	Target Analyte	Spike Added	LCS Result	Reporting Limit	Result Qualifier	LCS % Rec.	Control Limits
7723-14-0	TOTAL PHOSPHORUS	0.5	0.519	0.05		104	80 - 120%

Data Package ID: *po1011292-1*

Total Phosphorus as P

Method EPA365.2

Matrix Spike And Matrix Spike Duplicate

Lab Name: ALS Environmental -- FC
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Field ID: GN10297BA
LabID: 1011292-4MS

Sample Matrix: WATER
% Moisture: N/A
Date Collected: 23-Nov-10
Date Extracted: 03-Dec-10
Date Analyzed: 03-Dec-10
Prep Method: METHOD

Prep Batch: PO101203-1
QCBatchID: PO101203-1-1
Run ID: po101203-2a
Cleanup: NONE
Basis: As Received

Sample Aliquot: 50 ml
Final Volume: 50 ml
Result Units: MG/L
File Name: Manual Entry

CASNO	Target Analyte	Sample Result	Samp Qual	MS Result	MS Qual	Reporting Limit	Spike Added	MS % Rec.	Control Limits
7723-14-0	TOTAL PHOSPHORUS	0.072		0.179	N	0.05	0.25	43	80 - 120%

Field ID: GN10297BA
LabID: 1011292-4MSD

Sample Matrix: WATER
% Moisture: N/A
Date Collected: 23-Nov-10
Date Extracted: 03-Dec-10
Date Analyzed: 03-Dec-10
Prep Method: METHOD

Prep Batch: PO101203-1
QCBatchID: PO101203-1-1
Run ID: po101203-2a
Cleanup: NONE
Basis: As Received

Sample Aliquot: 50 ml
Final Volume: 50 ml
Result Units: MG/L
File Name: Manual Entry

CASNO	Target Analyte	MSD Result	MSD Qual	Spike Added	MSD % Rec.	Reporting Limit	RPD Limit	RPD
7723-14-0	TOTAL PHOSPHORUS	0.177	N	0.25	42	0.05	20	1

Data Package ID: *po1011292-1*

Total Dissolved Solids

Method EPA160.1

Method Blank

Lab Name: **ALS Environmental -- FC**
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Lab ID: TD101124-1MB

Sample Matrix: WATER
% Moisture: N/A
Date Collected: N/A
Date Extracted: 24-Nov-10
Date Analyzed: 29-Nov-10
Prep Method: METHOD

Prep Batch: TD101124-1
QCBatchID: TD101124-1-1
Run ID: td101129-1a
Cleanup: NONE
Basis: N/A
File Name: Manual Entry

Sample Aliquot: 100 ml
Final Volume: 100 ml
Result Units: MG/L
Clean DF: 1

CASNO	Target Analyte	DF	Result	Reporting Limit	Result Qualifier	EPA Qualifier
10-33-3	TOTAL DISSOLVED SOLIDS	1	20	20	U	

Data Package ID: *td1011292-1*

Total Dissolved Solids

Method EPA160.1

Laboratory Control Sample

Lab Name: **ALS Environmental -- FC**
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Lab ID: TD101124-1LCS

Sample Matrix: WATER
% Moisture: N/A
Date Collected: N/A
Date Extracted: 11/24/2010
Date Analyzed: 11/29/2010
Prep Method: METHOD

Prep Batch: TD101124-1
QCBatchID: TD101124-1-1
Run ID: td101129-1a
Cleanup: NONE
Basis: N/A
File Name: Manual Entry

Sample Aliquot: 100 ml
Final Volume: 100 ml
Result Units: MG/L
Clean DF: 1

CASNO	Target Analyte	Spike Added	LCS Result	Reporting Limit	Result Qualifier	LCS % Rec.	Control Limits
10-33-3	TOTAL DISSOLVED SOLIDS	400	395	20		99	85 - 115%

Data Package ID: *td1011292-1*

Total Suspended Solids

Method EPA160.2

Method Blank

Lab Name: **ALS Environmental -- FC**
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Lab ID: TS101124-1MB

Sample Matrix: WATER
% Moisture: N/A
Date Collected: N/A
Date Extracted: 23-Nov-10
Date Analyzed: 29-Nov-10
Prep Method: METHOD

Prep Batch: TS101124-1
QCBatchID: TS101124-1-1
Run ID: ts101129-1a
Cleanup: NONE
Basis: N/A
File Name: Manual Entry

Sample Aliquot: 100 ml
Final Volume: 100 ml
Result Units: MG/L
Clean DF: 1

CASNO	Target Analyte	DF	Result	Reporting Limit	Result Qualifier	EPA Qualifier
10-32-2	TOTAL SUSPENDED SOLIDS	1	20	20	U	

Data Package ID: *ts1011292-1*

Total Suspended Solids

Method EPA160.2

Laboratory Control Sample

Lab Name: ALS Environmental -- FC
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Lab ID: TS101124-1LCS

Sample Matrix: WATER
% Moisture: N/A
Date Collected: N/A
Date Extracted: 11/23/2010
Date Analyzed: 11/29/2010
Prep Method: METHOD

Prep Batch: TS101124-1
QCBatchID: TS101124-1-1
Run ID: ts101129-1a
Cleanup: NONE
Basis: N/A
File Name: Manual Entry

Sample Aliquot: 100 ml
Final Volume: 100 ml
Result Units: MG/L
Clean DF: 1

CASNO	Target Analyte	Spike Added	LCS Result	Reporting Limit	Result Qualifier	LCS % Rec.	Control Limits
10-32-2	TOTAL SUSPENDED SOLIDS	580	557	20		96	85 - 115%

Data Package ID: *ts1011292-1*

Total Suspended Solids

Method EPA160.2

Duplicate Sample Results

Lab Name: **ALS Environmental -- FC**
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Field ID: GN10293BA
Lab ID: 1011292-1D

Sample Matrix: WATER
% Moisture: N/A
Date Collected: 11/23/2010
Date Extracted: 11/23/2010
Date Analyzed: 11/29/2010

Prep Batch: TS101124-1
QCBatchID: TS101124-1-1
Run ID: ts101129-1a
Cleanup: NONE
Basis: As Received
File Name: Manual Entry

Sample Aliquot: 100 ml
Final Volume: 100 ml
Result Units: MG/L
Clean DF: 1

CASNO	Target Analyte	Sample Result	Samp Qual	Duplicate Result	Dup Qual	Reporting Limit	Dilution Factor	RPD	RPD Limit
10-32-2	TOTAL SUSPENDED SOLI	39		52	*	20	1	29	5

Data Package ID: *ts1011292-1*

Ion Chromatography

Method EPA300.0 Revision 2.1

Method Blank

Lab Name: **ALS Environmental -- FC**
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Lab ID: IC101124-1MB

Sample Matrix: WATER
% Moisture: N/A
Date Collected: N/A
Date Extracted: 24-Nov-10
Date Analyzed: 24-Nov-10

Prep Batch: IC101124-1
QCBatchID: IC101124-1-1
Run ID: IC101124-2A
Cleanup: NONE
Basis: N/A
File Name: 01124_011.DXD

Sample Aliquot: 5 ml
Final Volume: 5 ml
Result Units: MG/L
Clean DF: 1

CASNO	Target Analyte	DF	Result	Reporting Limit	MDL	Result Qualifier	EPA Qualifier
14797-65-0	NITRITE AS N	1	0.1	0.1	0.0048	U	
14797-55-8	NITRATE AS N	1	0.1	0.2	0.016	J	

Data Package ID: *ic1011292-1*

Ion Chromatography

Method EPA300.0 Revision 2.1

Laboratory Control Sample

Lab Name: **ALS Environmental -- FC**
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Lab ID: IC101124-1LCS

Sample Matrix: WATER
% Moisture: N/A
Date Collected: N/A
Date Extracted: 11/24/2010
Date Analyzed: 11/24/2010
Prep Method: NONE

Prep Batch: IC101124-1
QCBatchID: IC101124-1-1
Run ID: IC101124-2A
Cleanup: NONE
Basis: N/A
File Name: 01124_012.DXD

Sample Aliquot: 5 ml
Final Volume: 5 ml
Result Units: MG/L
Clean DF: 1

CASNO	Target Analyte	Spike Added	LCS Result	Reporting Limit	Result Qualifier	LCS % Rec.	Control Limits
14797-65-0	NITRITE AS N	2	1.94	0.1		97	90 - 110%
14797-55-8	NITRATE AS N	5	5	0.2		100	90 - 110%

Data Package ID: *ic1011292-1*

Ion Chromatography

Method EPA300.0 Revision 2.1

Matrix Spike And Matrix Spike Duplicate

Lab Name: ALS Environmental -- FC
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Field ID: GN10295BA
LabID: 1011292-3MS

Sample Matrix: WATER
% Moisture: N/A
Date Collected: 23-Nov-10
Date Extracted: 24-Nov-10
Date Analyzed: 24-Nov-10
Prep Method: NONE

Prep Batch: IC101124-1
QCBatchID: IC101124-1-1
Run ID: IC101124-2A
Cleanup: NONE
Basis: As Received

Sample Aliquot: 5 ml
Final Volume: 5 ml
Result Units: MG/L
File Name: 01124_014.DXD

CASNO	Target Analyte	Sample Result	Samp Qual	MS Result	MS Qual	Reporting Limit	Spike Added	MS % Rec.	Control Limits
14797-65-0	NITRITE AS N	0.2	U	3.72		0.2	4	93	85 - 115%
14797-55-8	NITRATE AS N	0.17	J	10.3		0.4	10	101	85 - 115%

Field ID: GN10295BA
LabID: 1011292-3MSD

Sample Matrix: WATER
% Moisture: N/A
Date Collected: 23-Nov-10
Date Extracted: 24-Nov-10
Date Analyzed: 24-Nov-10
Prep Method: NONE

Prep Batch: IC101124-1
QCBatchID: IC101124-1-1
Run ID: IC101124-2A
Cleanup: NONE
Basis: As Received

Sample Aliquot: 5 ml
Final Volume: 5 ml
Result Units: MG/L
File Name: 01124_015.DXD

CASNO	Target Analyte	MSD Result	MSD Qual	Spike Added	MSD % Rec.	Reporting Limit	RPD Limit	RPD
14797-65-0	NITRITE AS N	3.69		4	92	0.2	15	1
14797-55-8	NITRATE AS N	10.3		10	101	0.4	15	0

Data Package ID: *ic1011292-1*

December 10, 2010

Mr. Ben Recker
Tetra Tech, Inc.
7222 Commerce Drive, Ste. 185
Colorado Springs, CO 80919

Re:	ALS Workorder:	10-11-292
	Project Name:	None Submitted
	Project Number:	293-295, 297-302

Dear Mr. Recker:

Four water and five sediment samples were received from Tetra Tech, Inc. on November 24, 2010. The samples were scheduled for the following analyses:

PCBs	pages 1-11
Metals	pages 1-16
Inorganics	pages 1-26
Oil and Grease	pages 1-9

The results for these analyses are contained in the enclosed reports.

Thank you for your confidence in ALS Environmental. Should you have any questions, please call.

Sincerely,

ALS Environmental
Amy Wolf
Project Manager

ARW/km
Enclosure (s): Report

ALS is accredited by the following accreditation bodies for various testing scopes in accordance with requirements of each accreditation body. All testing is performed under the laboratory management system, which is maintained to meet these requirement and regulations. Please contact the laboratory or accreditation body for the current scope testing parameters.

Accreditation Body	License or Certification Number
Washington	C1280
Utah	CO00078
Arizona	AZ0742
Alaska	UST-086
Alaska	CO00078
Florida	E87914
Missouri	175
North Dakota	R-057
New Jersey	CO003
Nevada	CO000782008A
California	06251CA
Kansas	E-10381
Maryland	285
Pennsylvania	68-03116
Texas	T104704241-09-1
Colorado	CO00078
Connecticut	PH-0232
Idaho	CO00078
Tennessee	2976
Kentucky	90137
L-A-B (DoD ELAP/ISO 17025)	L2257

ALS Environmental -- FC

Sample Number(s) Cross-Reference Table

Paragon OrderNum: 1011292
Client Name: Tetra Tech, Inc.
Client Project Name:
Client Project Number: 293-295, 297-302
Client PO Number: 1061585

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
GN10293BA	1011292-1		WATER	23-Nov-10	11:02
GN10294BA	1011292-2		WATER	23-Nov-10	11:02
GN10295BA	1011292-3		WATER	23-Nov-10	11:02
GN10297BA	1011292-4		WATER	23-Nov-10	11:02
GN10298BA	1011292-5		SEDIMEN	23-Nov-10	11:02
GN10299BA	1011292-6		SEDIMEN	23-Nov-10	11:02
GN10300BA	1011292-7		SEDIMEN	23-Nov-10	10:40
GN10301BA	1011292-8		SEDIMEN	23-Nov-10	10:40
GN10302BA	1011292-9		SEDIMEN	23-Nov-10	11:14

PARAGON ANALYTICS

ALS Paragon

225 Commerce Drive, Fort Collins, CO 80524
TF: 800-443-1511 PH: 970-490-1511 FX: 970-490-1522

ALS Laboratory Group

Chain-of-Custody

Lab ID	1011292
Date	11/23/2010
Page	1 of 1

Project Name/No.	N/A	Sampler(s)	Joe Patrick
Turnaround	Standard or (Due Standard)	Disposal	By Lab or return to Client
REPORT TO:	Joe Patrick		
PHONE:	719-556-4400		
FAX:	719-556-5201		
E-MAIL:	joe.patrick@tetratech.com		
COMPANY:	Tetra Tech		
ADDRESS:	580 Goodfellow St		
	Peterson AFB, CO 80914-2370		

Provide additional information as needed in comments section.

Circle Analytical Method Above

Sample ID	Date	Time *	Lab ID	Matrix	No. of Containers	PCB 8082	TCLP Metals (8 RCRA)	BTEX 8020	Total Halogens 8260	VOCs 8260	TCLP SVOCs 8270	Tot Phosphorous 365.2	Tot. Nitrogen 353.2	TCLP Organics SW1311	Total Nitrates 300	pH 150.1	Dissolved Metals (ICP) or Hg SW6010B 7470A/7471A E200.7 E245.1	Flashpoint 1010	Dissolved Metals (ICP-MS) SW6020A E200.8	Hexavalent Chromium SW7196A Alkaline Digestion? Y / N	Molybdenum 200.7	TSS 160.2	TDS 160.1	TCLP Metals (RCRA 8) 1311	O & G 664
GN10293BA	11/23/10	11:02	1	W	1																	X	X		
GN10294BA	11/23/10	11:02	2	W	1																				X
GN10295BA	11/23/10	11:02	3	W	1										X	X									
GN10297BA	11/23/10	11:02	4	W	1							X	X												
GN10298BA	11/23/10	11:02	5	Se	1																				
GN10299BA	11/23/10	11:02	6	Se	1	X																			
GN10300BA	11/23/10	10:40	7	Se	1																				
GN10301BA	11/23/10	10:40	8	Se	1	X																			
GN10302BA	11/23/10	11:14	9	Se	1																				
Last ITEM																									

Sample ID	TEPH-GRO 8015	TEPH-DRO 8015	Tot Nitrogen & Tot Phosphorus 353.2 & 365.2	Nitrates 300	Radium 226 E903.1	Radium 228 SW9320 E904.0	Strontium 90 (Total RadioSr) D5811	Tritium E906.0	Total Metals Zinc (200.7)	Total Metals & Cu, Al, Mb ~~200.7~~ 6010
GN10293BA										
GN10294BA										
GN10295BA										
GN10297BA										
GN10298BA										X
GN10299BA										
GN10300BA										X
GN10301BA										
GN10302BA										X
Last ITEM										

Circle Analytical Method Above

* Time Zone: EST CST MST PST **Matrix Key:** O = oil, S = soil, NS = non-soil solid, W = water, L = liquid E = extract, F = f Se=sediment

Comments:

** Samples above are From Lake Williams **

Originator: Retain a photocopy after transfer!

Relinquished By: (1)	
Signature	[illegible]
Printed Name	Joe Patrick
Date	11/23/10
Time	4:30 pm
Company	Tetra Tech

Relinquished By:	
Signature	
Printed Name	
Date	
Time	
Company	

Received By: (1)	
Signature	C Trimble
Printed Name	C Trimble
Date	11-24-10
Time	1020
Company	ALS

Received By:	
Signature	
Printed Name	
Date	
Time	
Company	

CONDITION OF SAMPLE UPON RECEIPT FORM

Client: Tetra Tech Workorder No: 1011292

Project Manager: AW Initials: CDT Date: 11-24-10

1. Does this project require any **special handling** in addition to standard Paragon procedures?		YES	(NO)
2. Are custody **seals** on **shipping containers** intact?	NONE	(YES)	NO
3. Are Custody seals on **sample containers** intact?	(NONE)	YES	NO
4. Is there a **COC (Chain-of-Custody) present** or other representative documents?		(YES)	NO
5. Are the **COC and bottle labels complete and legible**?		(YES)	NO
6. Is the **COC in agreement** with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.)		(YES)	NO
7. Were **airbills / shipping documents** present and/or removable?	DROP OFF	(YES)	NO
8. Are all aqueous **samples requiring preservation preserved correctly?** (excluding volatiles)	N/A	(YES)	NO
9. Are all aqueous **non-preserved samples pH 4-9**?	N/A	(YES)	NO
10. Is there **sufficient sample** for the requested analyses?		(YES)	NO
11. Were all samples placed in the **proper containers** for the requested analyses?		(YES)	NO
12. Are all samples within **holding times** for the requested analyses?		(YES)	NO
13. Were all sample containers received **intact**? (not broken or leaking, etc.)		(YES)	NO
14. Are all samples requiring **no** headspace (**VOC, GRO, RSK/MEE, Rx CN/S, radon**) headspace free? **Size of bubble:** ____ < green pea ____ > green pea	(N/A)	YES	NO
15. Do perchlorate LCMS-MS samples **have** headspace? (at least 1/3 of container required)	(N/A)	YES	NO
16. Were samples checked for and free from the presence of **residual chlorine?** (Applicable when PM has indicated samples are from a chlorinated water source; note if field preservation with sodium thiosulfate was not observed.)	(N/A)	YES	NO
17. Were the samples **shipped on ice**?		(YES)	NO
18. Were cooler temperatures measured at 0.1-6.0°C? **IR gun used*:** #2 (#4)	RAD ONLY	(YES)	NO

Cooler #: 1

Temperature (°C): 1.8°

No. of custody seals on cooler: 1

DOT Survey/ Acceptance Information

External µR/hr reading: 12

Background µR/hr reading: 10

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? (YES) / NO / NA (If no, see Form 008.)

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16

If applicable, was the client contacted? YES / NO / (NA) Contact: _____ Date/Time: _____

Project Manager Signature / Date: [signature] 11/24/10

*IR Gun #2: Oakton, SN 29922500201-0066 *IR Gun #4: Oakton, SN 2372220101-0002

DO NOT LIFT USING THIS TAG

DO NOT LIFT USING THIS TAG

ALIGN FEDEX AIRBILL ROUGH HERE

FedEx US Airbill Express

FedEx Tracking Number 8715 2976 3148

RECIPIENT: PEEL HERE

1 From This portion can be removed for Recipient's records.

Date 11/23/10 FedEx Tracking Number 871529763148

Sender's Name Joe Patrick Phone 719 314-5512

Company Tetra Tech

Address 580 Goodfellow St Dept./Floor/Suite/Room

City Peterson AFB State CO ZIP 80914

2 Your Internal Billing Reference 6710-ENV-FC-LB-000

3 To

Recipient's Name Phone 970 490-1611

Company ALS LABORATORY GRO

HOLD Weekday — Print FedEx location address below. NOT available for FedEx Priority Overnight.

HOLD Saturday — Print FedEx location address below. Available ONLY for FedEx Priority Overnight and FedEx 2Day to select locations.

Address 225 COMMERCE DR Dept./Floor/Suite/Room

We cannot deliver to P.O. boxes or P.O. ZIP codes.

Address

Print FedEx location address here if HOLD option is selected.

City FORT COLLINS State CO ZIP 80524-2762

0415412430

8715 2976 3148

Recipient's Copy

4a Express Package Service * To most locations. *Packages up to 150 lbs.*

- [X] FedEx Priority Overnight — Next business morning.* Friday shipments will be delivered on Monday unless SATURDAY Delivery is selected.
- [ ] FedEx Standard Overnight — Next business afternoon.* Saturday Delivery NOT available.
- [ ] FedEx First Overnight — Earliest next business morning delivery to select locations.* Saturday Delivery NOT available.
- [ ] FedEx 2Day — Second business day.* Thursday shipments will be delivered on Monday unless SATURDAY Delivery is selected.
- [ ] FedEx Express Saver — Third business day.* Saturday Delivery NOT available.

4b Express Freight Service ** To most locations. *Packages over 150 lbs.*

- [ ] FedEx 1Day Freight — Next business day.** Friday shipments will be delivered on Monday unless SATURDAY Delivery is selected.
- [ ] FedEx 2Day Freight — Second business day.** Thursday shipments will be delivered on Monday unless SATURDAY Delivery is selected.

FedEx 1Day Freight Bookin

ight — Saturday Delivery NOT available.

5 Packaging

- [ ] FedEx Envelope*
- dEx Tube
- [X] Other

6 Special Handling

- [ ] SATURDAY Delivery — NOT available for FedEx Standard Overnight, FedEx Express Saver, or FedEx 3Day Freight.
- [ ] No Signature Required — Package may be left without obtaining a signature for delivery.
- [ ] Direct Signature — Someone at recipient's address may sign for delivery. *Fee applies.*
- [ ] Indirect Signature — If no one is available at recipient's address, someone at a neighboring address may sign for delivery. For residential deliveries only. *Fee applies.*

Does this shipment contain dangerous goods? One box must be checked.

- [ ] No
- [ ] Yes — As per attached Shipper's Declaration.
- [ ] Yes — Shipper's Declaration not required.
- [ ] Dry Ice — Dry Ice, 9, UN 1845 ____ x ____ kg
- [ ] Cargo Aircraft Only

Dangerous goods (including dry ice) cannot be shipped in FedEx packaging or placed in a FedEx Express Drop Box.

7 Payment *Bill to:* Enter FedEx Acct. No. or Credit Card No. below. Obtain Recip. Acct. No. [ ]

- [ ] Sender — Acct. No. in Section 1 will be billed.
- [ ] Recipient
- [X] Third Party
- [ ] Credit Card
- [ ] Cash/Check

[redacted] 1578 [redacted]

Total Packages 1 Total Weight ____ lbs. Credit Card Auth.

†Our liability is limited to $100 unless you declare a higher value. See the current FedEx Service Guide for details.

553

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FZ

12-1

ALS Laboratory Group
ANALYTICAL CHEMISTRY & TESTING SERVICES

Environmental Division
Fort Collins, Colorado

PCBs

Case Narrative

Tetra Tech, Inc.

293-295, 297-302

Work Order Number: 1011292

1. This report consists of 2 sediment samples. The samples were received cool and intact by ALS on 11/24/2010.

2. These samples were extracted and analyzed according to SW-846, 3rd Edition procedures. Specifically, the sediment samples were extracted using soxhlet procedures according to SOP 625 Revision 11 based on Method 3540C.

   The extracts were then processed using sulfuric acid cleanup according to SOP 651 Revision 9 based on Method 3665A in an attempt to remove potential interferences.

3. The extracts were then analyzed using GC/ECD (electron capture detectors) with an RTX-5 capillary column according to SOP 409 Revision 6 based on SW-846 Method 8082. All positive results were then confirmed on an RTX-CLPesticidesII column. Unless interferences were present, the quantitation of each analyte is the higher of the concentrations obtained from each column that met initial and continuing calibration criteria. Note that analyst raw data annotation may provide further clarification.

4. All initial and continuing calibration criteria were met.

5. The method blank associated with this project was below the MDL for all analytes.

6. All laboratory control sample recoveries were within the acceptance criteria.

7. All matrix spike and matrix spike duplicate recoveries and RPDs were within acceptance criteria.

8. All samples were extracted and analyzed within the established holding times.

9. All surrogate recoveries were within acceptance criteria.

10. Manual integrations are performed when needed to provide consistent and defensible data following the guidelines in SOP 939 Revision 3.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

Mindy Norton — 12.9.10

Mindy Norton
Organics Primary Data Reviewer

Date

Dan Shenerman — 12-09-10

Organics Final Data Reviewer

Date

ALS
Data Qualifier Flags
Chromatography and Mass Spectrometry

U or ND:	**This flag indicates that the compound was analyzed for but not detected.**
J:	**This flag indicates an estimated value. This flag is used as follows : (1) when estimating a concentration for tentatively identified compounds (TICs) where a 1:1 response is assumed; (2) when the mass spectral and retention time data indicate the presence of a compound that meets the volatile and semivolatile GC/MS identification criteria, and the result is less than the reporting limit (RL) but greater than the method detection limit (MDL); (3) when the data indicate the presence of a compound that meets the identification criteria, and the result is less than the RL but greater than the MDL; and (4) the reported value is estimated.**
B:	**This flag is used when the analyte is detected in the associated method blank as well as in the sample. It indicates probable blank contamination and warns the data user. This flag shall be used for a tentatively identified compound (TIC) as well as for a positively identified target compound.**
E:	**This flag identifies compounds whose concentration exceeds the upper level of the calibration range.**
A:	**This flag indicates that a tentatively identified compound is a suspected aldol-condensation product.**
X:	**This flag indicates that the analyte was diluted below an accurate quantitation level.**
***:**	**This flag indicates that a spike recovery is outside the control criteria.**
+:	**This flag indicates that the relative percent difference (RPD) exceeds the control criteria.**

ALS Environmental -- FC

Sample Number(s) Cross-Reference Table

Paragon OrderNum: 1011292
Client Name: Tetra Tech, Inc.
Client Project Name:
Client Project Number: 293-295, 297-302
Client PO Number: 1061585

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
GN10293BA	1011292-1		WATER	23-Nov-10	11:02
GN10294BA	1011292-2		WATER	23-Nov-10	11:02
GN10295BA	1011292-3		WATER	23-Nov-10	11:02
GN10297BA	1011292-4		WATER	23-Nov-10	11:02
GN10298BA	1011292-5		SEDIMEN	23-Nov-10	11:02
GN10299BA	1011292-6		SEDIMEN	23-Nov-10	11:02
GN10300BA	1011292-7		SEDIMEN	23-Nov-10	10:40
GN10301BA	1011292-8		SEDIMEN	23-Nov-10	10:40
GN10302BA	1011292-9		SEDIMEN	23-Nov-10	11:14

PARAGON ANALYTICS

ALS Paragon

ALS Laboratory Group

225 Commerce Drive, Fort Collins, CO 80524
TF: 800-443-1511 PH: 970-490-1511 FX: 970-490-1522

Chain-of-Custody

Lab ID 1011292

Date 11/23/2010 **Page** 1 of 1

Project Name/No. N/A **Sampler(s)** Joe Patrick **Turnaround** Standard or (Due *Standard*) **Disposal** *By Lab* or eturn to Clie

REPORT TO:	Joe Patrick
PHONE:	719-556-4400
FAX:	719-556-5201
E-MAIL:	joe.patrick@tetratech.com
COMPANY:	Tetra Tech
ADDRESS:	580 Goodfellow St
	Peterson AFB, CO 80914-2370

Provide additional information as needed in comments section.

Circle Analytical Method Above

Sample ID	Date	Time *	Lab ID	Matrix	No. of Containers	PCB (8082)	TCLP Metals (8 RCRA)	BTEX (8020)	Total Halogens (8260)	VOCs (8260)	TCLP SVOCs (8270)	Tot Phosphorous (365.2)	Tot. Nitrogen (353.2)	TCLP Organics SW1311 (SW8260B SW8270D SW8081A SW815)	Total Nitrates (300)	pH (150.1)	Dissolved Metals (ICP) or Hg (SW6010B 7470A/7471A E200.7 E245.1)	Flashpoint (1010)	Dissolved Metals (ICP-MS) (SW6020A E200.8)	Hexavalent Chromium (SW7196A Alkaline Digestion? Y / N)	Molybdenum (200.7)	TSS (160.2)	TDS (160.1)	TCLP Metals (RCRA 8) (1311)	O & G (664)	TEPH-GRO (8015)	TEPH-DRO (8015)	Tot Nitrogen & Tot. Phosphoro (353.2 & 365.2)	Nitrates (300)	Radium 226 (E903.1)	Radium 228 (SW9320 E904.0)	Strontium 90 (Total RadioSr) (D5811)	Tritium (E906.0)	Total Metals (Zinc (200.7))	Total Metals & Cu, Al, Mb (~~200.7~~ 6020)
GN10293BA	11/23/10	11:02	1	W	1																	X	X												
GN10294BA	11/23/10	11:02	2	W	1																				X										
GN10295BA	11/23/10	11:02	3	W	1										X	X																			
GN10297BA	11/23/10	11:02	4	W	1							X	X																						
GN10298BA	11/23/10	11:02	5	Se	1																														X
GN10299BA	11/23/10	11:02	6	Se	1	X																													
GN10300BA	11/23/10	10:40	7	Se	1																														X
GN10301BA	11/23/10	10:40	8	Se	1	X																													
GN10302BA	11/23/10	11:14	9	Se	1																														X
Last ITEM																																			

* Time Zone: EST CST MST PST **Matrix Key:** O = oil, S = soil, NS = non-soil solid, W = water, L = liquid, E = extract, F = f Se=sediment

Comments:

** Samples above are From Lake Williams **

Relinquished By: (1)	Relinquished By:
Signature [signature]	Signature
Printed Name Joe Patrick	Printed Name
Date 11/23/10 Time 4:30 pm	Date Time
Company Tetra Tech	Company

Received By: (1)	Received By:
Signature C Trimble	Signature
Printed Name C Trimble	Printed Name
Date 11-24-10 Time 1020	Date Time
Company ALS	Company

Originator: Retain a photocopy after transfer!

CONDITION OF SAMPLE UPON RECEIPT FORM

Client: TETRA TECH Workorder No: 1011292

Project Manager: AW Initials: CDT Date: 11-24-10

1. Does this project require any **special handling** in addition to standard Paragon procedures?		YES	(NO)
2. Are custody **seals** on **shipping containers** intact?	NONE	(YES)	NO
3. Are Custody seals on **sample containers** intact?	(NONE)	YES	NO
4. Is there a **COC (Chain-of-Custody) present** or other representative documents?		(YES)	NO
5. Are the **COC and bottle labels complete and legible**?		(YES)	NO
6. Is the **COC in agreement** with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.)		(YES)	NO
7. Were **airbills / shipping documents** present and/or removable?	DROP OFF	(YES)	NO
8. Are all aqueous **samples requiring preservation preserved correctly?** (excluding volatiles)	N/A	(YES)	NO
9. Are all aqueous **non-preserved samples pH 4-9**?	N/A	(YES)	NO
10. Is there **sufficient sample** for the requested analyses?		(YES)	NO
11. Were all samples placed in the **proper containers** for the requested analyses?		(YES)	NO
12. Are all samples within **holding times** for the requested analyses?		(YES)	NO
13. Were all sample containers received **intact**? (not broken or leaking, etc.)		(YES)	NO
14. Are all samples requiring **no headspace (VOC, GRO, RSK/MEE, Rx CN/S, radon)** headspace free? **Size of bubble:** ____ < green pea ____ > green pea	(N/A)	YES	NO
15. Do perchlorate LCMS-MS samples **have** headspace? (at least 1/3 of container required)	(N/A)	YES	NO
16. Were samples checked for and free from the presence of **residual chlorine?** (Applicable when PM has indicated samples are from a chlorinated water source; note if field preservation with sodium thiosulfate was not observed.)	(N/A)	YES	NO
17. Were the samples **shipped on ice**?		(YES)	NO
18. Were cooler temperatures measured at 0.1-6.0°C? **IR gun used*:** #2 (#4)	RAD ONLY	(YES)	NO

Cooler #: 1

Temperature (°C): 1.8°

No. of custody seals on cooler: 1

DOT Survey/ Acceptance Information

External µR/hr reading: 12

Background µR/hr reading: 10

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? (YES) / NO / NA (If no, see Form 008.)

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16

If applicable, was the client contacted? YES / NO / (NA) Contact: _____ Date/Time: _____

Project Manager Signature / Date: [signature] 11/24/10

*IR Gun #2: Oakton, SN 29922500201-0066 *IR Gun #4: Oakton, SN 2372220101-0002

PCBs

Method SW8082
Method Blank

Lab Name: ALS Environmental -- FC
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Lab ID: EX101130-1MB

Sample Matrix: SEDIMENT
% Moisture: N/A
Date Collected: N/A
Date Extracted: 30-Nov-10
Date Analyzed: 02-Dec-10

Prep Batch: EX101130-1
QCBatchID: EX101130-1-1
Run ID: PT101202-1
Cleanup: SW3665
Basis: N/A
File Name: 16439.dat

Sample Aliquot: 30 g
Final Volume: 10 g
Result Units: UG/KG
Clean DF: 1

CASNO	Target Analyte	DF	Result	Reporting Limit	MDL	Result Qualifier	EPA Qualifier
12674-11-2	AROCLOR-1016	1	33	33	5.6	U	
11104-28-2	AROCLOR-1221	1	67	67	5.6	U	
11141-16-5	AROCLOR-1232	1	33	33	5.6	U	
53469-21-9	AROCLOR-1242	1	33	33	5.6	U	
12672-29-6	AROCLOR-1248	1	33	33	5.6	U	
11097-69-1	AROCLOR-1254	1	33	33	5.6	U	
11096-82-5	AROCLOR-1260	1	33	33	5.6	U	

Surrogate Recovery

CASNO	Surrogate Analyte	Result	Flag	Spike Amount	Percent Recovery	Control Limits
2051-24-3	DECACHLOROBIPHENYL	12.4		16.7	74	60 - 125
877-09-8	TETRACHLORO-M-XYLENE	14.7		16.7	88	70 - 125

Data Package ID: *PT1011292-1*

PCBs

Method SW8082
Sample Results

Lab Name: **ALS Environmental -- FC**
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Field ID:	GN10299BA
Lab ID:	1011292-6

Sample Matrix: SEDIMENT
% Moisture: 47.8
Date Collected: 23-Nov-10
Date Extracted: 30-Nov-10
Date Analyzed: 02-Dec-10
Prep Method: SW3540 Rev C

Prep Batch: EX101130-1
QCBatchID: EX101130-1-1
Run ID: PT101202-1
Cleanup: SW3665
Basis: Dry Weight
File Name: 16441.dat

Sample Aliquot: 31.63 g
Final Volume: 10 g
Result Units: UG/KG
Clean DF: 1

CASNO	Target Analyte	Dilution Factor	Result	Reporting Limit	MDL	Result Qualifier	EPA Qualifier
12674-11-2	AROCLOR-1016	1	61	61	10	U	
11104-28-2	AROCLOR-1221	1	120	120	10	U	
11141-16-5	AROCLOR-1232	1	61	61	10	U	
53469-21-9	AROCLOR-1242	1	61	61	10	U	
12672-29-6	AROCLOR-1248	1	61	61	10	U	
11097-69-1	AROCLOR-1254	1	61	61	10	U	
11096-82-5	AROCLOR-1260	1	61	61	10	U	

Surrogate Recovery

CASNO	Surrogate Analyte	Result	Flag	Spike Amount	Percent Recovery	Control Limits
2051-24-3	DECACHLOROBIPHENYL	20.3		30.3	67	60 - 125
877-09-8	TETRACHLORO-M-XYLENE	25		30.3	83	70 - 125

Data Package ID: *PT1011292-1*

PCBs

Method SW8082
Sample Results

Lab Name: **ALS Environmental -- FC**
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Field ID: GN10301BA
Lab ID: 1011292-8

Sample Matrix: SEDIMENT
% Moisture: 87.0
Date Collected: 23-Nov-10
Date Extracted: 30-Nov-10
Date Analyzed: 02-Dec-10
Prep Method: SW3540 Rev C

Prep Batch: EX101130-1
QCBatchID: EX101130-1-1
Run ID: PT101202-1
Cleanup: SW3665
Basis: Dry Weight
File Name: 16444.dat

Sample Aliquot: 30.86 g
Final Volume: 10 g
Result Units: UG/KG
Clean DF: 1

CASNO	Target Analyte	Dilution Factor	Result	Reporting Limit	MDL	Result Qualifier	EPA Qualifier
12674-11-2	AROCLOR-1016	1	250	250	42	U	
11104-28-2	AROCLOR-1221	1	500	500	42	U	
11141-16-5	AROCLOR-1232	1	250	250	42	U	
53469-21-9	AROCLOR-1242	1	250	250	42	U	
12672-29-6	AROCLOR-1248	1	250	250	42	U	
11097-69-1	AROCLOR-1254	1	250	250	42	U	
11096-82-5	AROCLOR-1260	1	250	250	42	U	

Surrogate Recovery

CASNO	Surrogate Analyte	Result	Flag	Spike Amount	Percent Recovery	Control Limits
2051-24-3	DECACHLOROBIPHENYL	83.1		125	66	60 - 125
877-09-8	TETRACHLORO-M-XYLENE	96.5		125	77	70 - 125

Data Package ID: *PT1011292-1*

PCBs

Method SW8082

Laboratory Control Sample

Lab Name: ALS Environmental -- FC
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Lab ID: EX101130-1LCS

Sample Matrix: SEDIMENT
% Moisture: N/A
Date Collected: N/A
Date Extracted: 11/30/2010
Date Analyzed: 12/02/2010
Prep Method: SW3540C

Prep Batch: EX101130-1
QCBatchID: EX101130-1-1
Run ID: PT101202-1
Cleanup: SW3665
Basis: N/A
File Name: 16440.dat

Sample Aliquot: 30 g
Final Volume: 10 g
Result Units: UG/KG
Clean DF: 1

CASNO	Target Analyte	Spike Added	LCS Result	Reporting Limit	Result Qualifier	LCS % Rec.	Control Limits
12674-11-2	AROCLOR-1016	133	128	33.3		96	40 - 140%
11096-82-5	AROCLOR-1260	133	117	33.3		88	60 - 130%

Surrogate Recovery

CASNO	Surrogate Analyte	Result	Flag	Spike Amount	Percent Recovery	Control Limits
2051-24-3	DECACHLOROBIPHENYL	12.8		16.7	77	60 - 125
877-09-8	TETRACHLORO-M-XYLENE	15.2		16.7	91	70 - 125

Data Package ID: *PT1011292-1*

PCBs

Method SW8082
Matrix Spike And Matrix Spike Duplicate

Lab Name: ALS Environmental -- FC
Work Order Number: 1011292
Client Name: Tetra Tech, Inc.
ClientProject ID: 293-295, 297-302

Field ID: GN10299BA
LabID: 1011292-6MS

Sample Matrix: SEDIMENT
% Moisture: 47.8
Date Collected: 23-Nov-10
Date Extracted: 30-Nov-10
Date Analyzed: 02-Dec-10
Prep Method: SW3540 Rev C

Prep Batch: EX101130-1
QCBatchID: EX101130-1-1
Run ID: PT101202-1
Cleanup: SW3665
Basis: Dry Weight

Sample Aliquot: 31.64 g
Final Volume: 10 g
Result Units: UG/KG
File Name: 16442.dat

CASNO	Target Analyte	Sample Result	Samp Qual	MS Result	MS Qual	Reporting Limit	Spike Added	MS % Rec.	Control Limits
12674-11-2	AROCLOR-1016	61	U	217		60.6	242	89	40 - 140%
11096-82-5	AROCLOR-1260	61	U	182		60.6	242	75	60 - 130%

Field ID: GN10299BA
LabID: 1011292-6MSD

Sample Matrix: SEDIMENT
% Moisture: 47.8
Date Collected: 23-Nov-10
Date Extracted: 30-Nov-10
Date Analyzed: 02-Dec-10
Prep Method: SW3540 Rev C

Prep Batch: EX101130-1
QCBatchID: EX101130-1-1
Run ID: PT101202-1
Cleanup: SW3665
Basis: Dry Weight

Sample Aliquot: 30.86 g
Final Volume: 10 g
Result Units: UG/KG
File Name: 16443.dat

CASNO	Target Analyte	MSD Result	MSD Qual	Spike Added	MSD % Rec.	Reporting Limit	RPD Limit	RPD
12674-11-2	AROCLOR-1016	202		248	81	62.1	50	7
11096-82-5	AROCLOR-1260	193		248	78	62.1	50	6

Surrogate Recovery MS/MSD

CASNO	Target Analyte	Spike Added	MS % Rec.	MS Flag	MSD % Rec.	MSD Flag	Control Limits
2051-24-3	DECACHLOROBIPHENYL	30.3	72		73		60 - 125
877-09-8	TETRACHLORO-M-XYLENE	30.3	78		77		70 - 125

Data Package ID: *PT1011292-1*

Drinking Water Bacteriological Analysis Results

Pueblo City-County Health Department Laboratory
101 W. 9th St.
Pueblo, CO 81003
(719) 583-4318
www.pueblohealthdept.org

If you have not pre-paid your sample(s) please consider this your INVOICE and results.

Tetra Tech (Joe Patrick)

580 Goodfellow St.

Peterson AFB CO 80914

Sample: 10-6318

Collector: Joe Patrick 11/23/2010 11:02:00 AM

Address: BAFB Lake Williams (x2) GN10290BA **County:** El Paso

Analysis Method: Quanti-tray **Fee for Sample:** $20.00

Received By: Nelson 11/23/2010 2:00:00 PM

Results: **Total Coliform:** Presence **Fecal Coliform:**

Ecoli Result: Presence **Comments:** 23.1 total col/100 ml, 1.0 E. coli per 100

Date: 11/24/2010 2:30:00 PM **Analyst:** Nelson

Absence means compliance with federal EPA drinking water standards for coliform bacteria. Pueblo City-County Health Department Laboratory is certified by the Colorado Department of Public Health and Environment under primary agreement with the US Environmental Protection Agency to analyze water for coliform bacteria.

Total coliform presence with absence of fecal coliform/E. coli indicates contamination from a non-warm blooded source such as soil, tree roots, leaves, etc. This does not indicate contamination from fecal material of warm-blooded animals. Treatment of water supply is recommended. Instructions are included for your information.

Total coliform presence with fecal coliform/E. coli presence indicates contamination from fecal material of warm-blooded animals. Treatment of water supply is recommended. Instructions are included for your information.

Results Information:

This analysis is for coliform bacteria only; no chemical analysis was performed. For further testing please contact a laboratory certified by the Colorado Department of Public Health and Environment for water chemistries. For a current list of certified drinking water laboratories in the state please go to www.cdphe.state.co.us. Click on "Divisions and Programs". Then click on "Laboratory Services Division". Near the bottom of the page click on "Water Testing Laboratories". This website also has the complete list of analyses performed by CDPHE laboratory and their pricing.

For further information regarding this analysis, please contact the laboratory at the number above.

Drinking Water Bacteriological Analysis Results

Pueblo City-County Health Department Laboratory
101 W. 9th St.
Pueblo, CO 81003
(719) 583-4318
www.pueblohealthdept.org

If you have not pre-paid your sample(s) please consider this your INVOICE and results.

Tetra Tech (Joe Patrick)

580 Goodfellow St.

Peterson AFB CO 80914

Sample: 10-6319

Collector: Joe Patrick 11/23/2010 11:02:00 AM

Address: BAFB Lake Williams (x2) GN10291BA **County:** El Paso

Analysis Method: MF-fecal coliform **Fee for Sample:** $18.00

Received By: Nelson 11/23/2010 2:00:00 PM

Results: **Total Coliform:** **Fecal Coliform:** Absence

Ecoli Result: **Comments:** <1 fecal coliform per 100 ml

Date: 11/24/2010 2:30:00 PM **Analyst:** Nelson

Absence means compliance with federal EPA drinking water standards for coliform bacteria. Pueblo City-County Health Department Laboratory is certified by the Colorado Department of Public Health and Environment under primary agreement with the US Environmental Protection Agency to analyze water for coliform bacteria.

Total coliform presence with absence of fecal coliform/E. coli indicates contamination from a non-warm blooded source such as soil, tree roots, leaves, etc. This does not indicate contamination from fecal material of warm-blooded animals. Treatment of water supply is recommended. Instructions are included for your information.

Total coliform presence with fecal coliform/E. coli presence indicates contamination from fecal material of warm-blooded animals. Treatment of water supply is recommended. Instructions are included for your information.

Results Information:

This analysis is for coliform bacteria only; no chemical analysis was performed. For further testing please contact a laboratory certified by the Colorado Department of Public Health and Environment for water chemistries. For a current list of certified drinking water laboratories in the state please go to www.cdphe.state.co.us. Click on "Divisions and Programs". Then click on "Laboratory Services Division". Near the bottom of the page click on "Water Testing Laboratories". This website also has the complete list of analyses performed by CDPHE laboratory and their pricing.

For further information regarding this analysis, please contact the laboratory at the number above.

APPENDIX D

LAKE WILLIAMS HYDROLOGICAL AND HYDRAULIC ASSESSMENT

LAKE WILLIAMS HYDROLIGIC AND HYDRAULIC ASSESSMENT REPORT BUCKLEY AIR FORCE BASE, COLORADO

FINAL REPORT

Submitted to:

HDR Environmental, Operations and Construction, Inc.
9563 S Kingston Ct Suite 200
Englewood, CO 80112

Buckley Air Force Base
660 South Aspen Street Stop 86
Buckley AFB, Colorado 80011

Submitted by:

AMEC Environment and Infrastructure
2000 S. Colorado Blvd, Suite 2-1000
Denver, Colorado 80222

February 29, 2012
AMEC Project No. 32710095

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1 INTRODUCTION

1.1 Purpose and Scope

Buckley Air Force Base (BAFB) is located adjacent to the City of Aurora, Colorado and is bounded by East 6th Avenue to the north, E-470 to the east, East Jewell Avenue and Mississippi Road to the south, and Buckley Road to the west (See Figure 1). BAFB is approximately 5 square miles of mostly open, dry land fields. An airfield runs northwest-southeast through the middle of the installation and is generally the basin boundary line between the East Toll Gate Creek and Sand Creek watersheds. The Lake Williams study area lies within the Sand Creek watershed.

The purpose of the Lake Williams Hydrologic and Hydraulic Assessment is evaluate the potential drainage and flood control impacts of the Lake Williams removal, identify cost effective means of mitigating the potential impacts and to supplement the Environmental Assessment For Wildlife Control Actions at Williams Lake, at Buckley AFB Report.

Tasks completed to develop the Lake Williams Hydrologic and Hydraulic Assessment of Buckley Air Force Base Report include:

- A kickoff meeting was held to review project objectives, goals and performed a site visit to visually inspect and document existing conditions of Lake Williams and the downstream conveyance that is a tributary to the Sand Creek Watershed.
- Collected and reviewed all available documentation and previous relevant reports.
- Developed a computer model of existing and future hydrologic and hydraulic conditions of Lake Williams and downstream watershed.
- Analyzed the potential drainage and flood control impacts of the Lake Williams removal.
- Evaluated strategies, developed alternative analysis and recommendations for correcting any potentially negative drainage and flood control impacts downstream associated with the removal of Lake Williams.
- Developed a technical report documenting the findings and recommendations.

1.2 Mapping

Aerial imagery was taken on 22 February 2008 by Aerial Surveys International of Watkins, Colorado. The 6-inch resolution imagery was used to develop 2-foot topography mapping for the Buckley AFB. The mapping was used to develop existing, future and proposed conditions in the Lake Williams Hydrologic and Hydraulic Assessment.

1.3 Data Collection

The Lake Williams Hydrologic and Hydraulic Assessment Report is based on the previously published Environmental Assessments and other drainage studies in the project area along with additional information provided by Buckley Air Force Base staff. Field visits were conducted to supplement the information.

The following reports were used in preparation of this report.

- Final Environmental Assessment Williams Lake Wildlife Control, Buckley Air Force Base, 460 CES/CEV, January 2010
- Conceptual Base-Wide Hydrologic Study and Drainage Infrastructure Assessment Report, AMEC Earth & Environmental, May 2010
- Sand Creek Major Drainageway Planning Phase A, UDFCD, City of Commerce City, City and County of Denver, City of Aurora, Simons, Li and Associates, March 1983
- Sand Creek Channel Improvements, Buckley Road to Colfax Avenue, Aurora, CO. Prepared for UDFCD by Greenhorne and O'Mara, May 1995
- Urban Storm Drainage Criteria Manual, UDFCD, 2008
- Soil Survey for Arapahoe County, Colorado, USDA, SCS, 1971

A concurrent study titled Sand Creek (Colfax to Yale) Major Drainageway Plan and Flood Hazard Area Delineation is being performed by Matrix Design Group. This MDP will provide future conditions analysis of Sand Creek which is downstream of the project area. The preliminary Final Hydrology Report (November 2011) does not show the project area having any retention from Lake Williams in its existing and future conditions analysis.

2 STUDY AREA DESCRIPTION

2.1 Project Area

Lake Williams is a man-made reservoir with a surface area of approximately 10 acres. The reservoir was originally developed for recreational use. For much of its history, Lake Williams has served as a recreational fishery for BAFB. The reservoir was created in 1961 by constructing an embankment on a minor tributary to Sand Creek. The reservoir level is maintained by a well and supplemented by runoff from the Lake Williams watershed. An emergency spillway for the lake is located on the western portion of the lake and is designed for rainfall events greater than the 100-year. The project area map is shown on Figure 2.

The Lake Williams watershed is located in the northeast portion of the Buckley AFB property and drains to the north. The watershed has no discharge as Lake Williams acts as a surface water retaining structure during all storm events up to and including the 100-year event. The Lake Williams watershed is located within the DB-13 watershed. Lake Williams is located on the main drainageway withing DB-13. Runoff in the basin is surface flow from its headwaters to where it discharges off BAFB property, crossing 6th Avenue through a 6'x7' RCB.

2.2 Land Use

The DB13 watershed is approximately 1.5 miles long, 0.75 miles wide and generally slopes to the north at slopes ranging from 0 to 5 percent. The elevation range across DB13 is from 5590' at its headwaters to 5452' at the confluence with the Sand Creek. The soils within the watershed consist of hydrologic soils groups C, and A as defined by the Natural Resources Conservation Service (NRCS). The DB13 watershed has an approximate existing imperviousness conditions value of 8%. No future conditions land use was used in the Lake Williams Hydrologic and Hydraulic Assessment Report because of the uncertainty of future construction projects within the DB13 watershed.

2.3 Reach Description

For the purpose of this study, the DB13 drainageway has been subdivided into 3 representative reaches. The study reaches are shown on Figure 3. The reach designations were chosen based on conveyance types, major flow changes, and other physical changes along the BD13 drainageway. Figure 3 also includes representative photographs of each reach.

Reach 1: Confluence with Sand Creek to 6'x7' RCB at East 6th Avenue

DB13 drainageway is conveyed to Sand Creek from 6th Avenue by a natural, open channel that has 100-year conveyance capacity for for the entire reach length of approximately 2800'. Additional flow from the east combines with flows from Buckley AFB just downstream of the 6'x7' RCB at 6th Avenue. The channel immediately downstream of the 6th Avenue crossing has a very mild slope and in some areas significant ponding occurs. Minor flow events may not reach Sand Creek due to the potential ponding and high infiltration rates of the soils within Reach 1.

Reach 2: 6'x7' RCB at East 6th Avenue to ~700' Downstream of Lake Williams Embankment

DB13 drainageway is conveyed downstream of Lake Williams through an open channel system that has 100-year conveyance at the upper most portion of the reach. Channel capacity is limited further downstream in the reach. The portion of Reach 2 that parallels the Buckley AFB perimeter fence located within subwatershed DB13- 23 does not have adequate capacity to convey the 2-year event without overtopping the perimeter road. The existing channel is undersized from this section to the 6'x7' RCB at 6th Avenue.

Reach 3: ~700' Downstream of Lake Williams to upstream of Lake Williams

Runoff conveys as sheet flow from the headwaters of the Lake Williams drainage basin convey to Lake Williams. Lake Williams acts as a retention structure for all surface water runoff within the Lake Williams drainage basin and has no discharge for design events analyzed in this study (100-year and less).

3 HYDROLOGIC ANALYSIS

3.1 Overview

A hydrologic analysis of the DB13 watershed was performed to establish existing and future hydrologic conditions as defined by existing land use with Lake Williams and existing land use without Lake Williams, respectively.

Design rainfall, physical runoff characteristics, and runoff hydrographs for the existing and future hydrologic models were developed and derived in accordance to the UDFCD Drainage Criteria Manual. The following physical characteristics were determined for each subwatershed and used in the input file in the EPA SWMM hydrologic analysis:

- Basin contributing drainage area
- Width of the subwatershed
- Subwatershed slope
- Percent Imperviousness
- Depression storage
- Soil infiltration rates

3.2 Design Rainfall

One-and six-hour point precipitation values were developed from NOAA Atlas rainfall depth-frequency maps for the Denver region. Rainfall hyetographs were developed using design storm distributions for the 100-, 10-, and 2-year rainfall events. The one- and six-hour rainfall depths for the DB13 watershed are presented in Table 3.2-1.

Table 3.2-1 Point Rainfall Depth (Inches)

Return Period	1-Hour Rainfall	6-Hour Rainfall
2-Year	1.00	1.40
10-Year	1.60	2.22
100-Year	2.65	3.40

Two hour point rainfall depths were determined using UDFCD criteria by transferring the one-hour precipitation values into a two-hour design storm by multiplying the one-hour depths by the associated percentages for each five-minute time increment. No area reduction factor was applied to the incremental rainfall depths for the DB13 subwatersheds. All DB13 subwatersheds have a 1.0 correction factor due to all subwatershed contributing areas being less than 10 square miles.

3.3 Subwatershed Characteristics

3.3.1 Subwatershed Delineation

The DB13 watershed consists of 23 subwatersheds that range in size from 4 acre to 53 acres with an average size of 23 acres. Subwatershed delineations for the DB13 watershed are shown on Figure 4. Delineations of the subbasins for future conditions in the DB13 watershed did not change from existing conditions. The subwatersheds within Buckley AFB property were delineated using two-foot mapping while all other basin were delineated using contours developed from USGS 10-meter digital elevation models.

3.3.2 Watershed Imperviousness

The subwatershed basins were overlaid on the impervious area map (derived from the 6-inch resolution imagery) and area-weighted imperviousness values were determined for each individual subwatershed using GIS spatial analysis. Due the uncertainty of future construction projects within the DB13 watershed, future conditions impervious values did not change from existing conditions. Table 3.3.2-1 was used as the recommended percentage imperviousness values for paved streets, driveways, walks and roofs. Subwatershed conditions are shown in Figure 4.

Table 3.3.2-1 Recommended Percentage Imperviousness Values

Land Use or Surface Characteristics	Percentage Imperviousness
Paved Street	100
Drive and Walks	90
Roofs	90

3.3.3 Soils Information

Several NRCS soil types are present within the DB13 watershed. The significant majority of NRCS soils within the DB13 watershed are classified as hydrologic soil classification A and C. Table 3.3.3-1 shows the UDFCD recommended Horton infiltration parameters with their associated hydrologic soil classification (USDCM, 2008). The hydrologic soil distribution within DB13 watershed is shown on Figure 5.

Table 3.3.3-1 Horton Infiltration Parameters

NRCS Hydrologic Soil Group	Infiltration (in/hour)		Decay Coefficient
	Initial	Final	
A	5.0	1.0	0.0007
B	4.5	0.6	0.0018
C	3.0	0.5	0.0018
D	3.0	0.5	0.0018

3.4 Hydrograph Routing

EPA SWMM5 was used to route the hydrographs throughout the DB13 watershed. EPA SWMM5 routes the hydrographs through a series of junctions, dividers, conduits, storage units,

storage outlets and outfalls. Figures 6-1 and 6-2 show the EPA SWMM5 routing schematics, illustrating the relative location and connectivity of the EPA SWMM5 network. Figures 7-1 through 7-4 show the EPA SWMM5 routing schematics spatially relative to the DB13 watershed. The routing elements used to convey the flow are open channel flow.

3.5 Analysis and Results

Peak flows were estimated from rainfall and the physical attributes of the DB13 watershed. Table 3.7-1 provides existing condition peak flow information at five critical design points along the DB13 drainageway for the 100-, 10-, and 2-year events. Table 3.7-2 provides future conditions peak flow information at the same five critical design points along the DB13 drainageway for the 100-, 10-, and 2-year events. Future conditions hydrology is defined as the removal of Lake Williams with no land use changes and the resulting hydrologic response.

Table 3.5-1 Summary of Discharges for Existing Conditions

Location	Design Point	Existing Conditions		
		2-Year (cfs)	10-Year (cfs)	100-Year (cfs)
Lake Williams	**DB-Lake**	27	52	111
700' downstream of Lake Williams	**J-13-24**	13	27	76
1200' downstream of Lake Williams	**J-13-22**	13	27	103
6th Avenue	**#13**	14	30	132
Confluence with Sand Creek	**J-SC-10**	25	47	214

Table 3.5-2 Summary of Discharges for Future Conditions

Location	Design Point	Future Conditions		
		2-Year (cfs)	10-Year (cfs)	100-Year (cfs)
Lake Williams	**DB-Lake**	27	52	111
700' downstream of Lake Williams	**J-13-24**	40	52	185
1200' downstream of Lake Williams	**J-13-22**	40	78	209
6th Avenue	**#13**	41	81	236
Confluence with Sand Creek	**J-SC-10**	37	78	304

4 HYDRAULIC ANALYSIS

4.1 Evaluation of Existing Facilities

Hydraulic analysis was performed on the DB13 drainageway to evaluate capacity of existing road crossings and conveyance channels. The drainageway analysis was performed using EPA SWMM 5, Flowmaster and UD-Culvert. 2-foot mapping was used as the surface geometry for the hydraulic modeling. Both existing and future hydrologic conditions were hydraulically modeled. Existing and future conditions 100-year floodplain inundation maps are shown on Figures 8-1 and 8-2.

Existing drainage facilities within the DB13 watershed along the DB13 drainageway consist of: retention structure at Lake Williams; a low flow culvert crossing ~250' upstream of 6th Avenue; a 6'x7' RCB crossing at 6th Avenue; and a low flow culvert crossing ~900' downstream of 6th Avenue. A stage storage discharge curve was developed for Lake Williams using a normal pool elevation and the 2-foot mapping. No discharge up to the 100-year event for Lake Williams as the spillway crest in not overtopped. The 6'x7' RCB has adequate conveyance to pass the 100-year event for both existing and future conditions without overtopping 6th Avenue and having a 0.9 HW/D ratio. Significant ponding currently occurs upstream of the 6th Avenue crossing during the 100-year event. Similar ponding (depth and extents) will occur upstream of the 6th Avenue crossing in the future conditions.

Table 4.1-1 Existing Facilities Table

Facility Location	Crossing Type	Structure Type	Structure Size	Flow Capacity (cfs)	Existing Conditions 100-year Flow (cfs)	Future Conditions 100-year Flow (cfs)
6th Avenue	Roadway Crossing	RCB	6'x7'	283	132	237

Existing conveyance channels within Reach 1 have 100-year conveyance capacity. Field observations and topographic mapping suggest that ponding occurs within Reach 1 and low frequency storms may not convey to Sand Creek due to ponding and type A soils. Reach 2 has portions which do not convey the 2-year event without overtopping the maintenance road to the east and spilling into the adjacent property. Any flows that do overtop the maintenance road and reach the adjacent property would ultimately be conveyed to the 6'x7' RCB at 6th Avenue.

5 ALTERNATIVE ANALYSIS

5.1 Alternative Development Process

The purpose of the alternative analysis is to identify feasible alternatives in a comprehensive manner that would assure that a variety of possible solutions were considered. Several alternatives including no improvements, engineered channel improvements, and conveyance structure improvements were evaluated.

The approach was to minimize the analysis of proposed facilities such that only the "best" alternatives were chosen for alternative development. An initial screening matrix was developed to determine which alternatives would be looked at in greater detail. The "best" alternatives were then examined further to identify the benefits, quantifying and estimating cost of construction, operation and maintenance considerations, and right of way/easement requirements associated with the alternatives.

100-year detention just upstream of 6th Avenue was identified as a possible alternative to attenuate flows leaving the Buckley AFB property. The required detention volume for this alternative would be 5.75 acre-ft. The required surface area for this alternative would require acquisition of adjacent properties for the detention pond footprint. This alternative would not address upstream erosion control and flooding issues brought about from removal of Lake Williams. Nor would the alternative meet the goal of wildlife control techniques at Buckley AFB since the detention pond would provide an open water surface for a period of time. This detention alternative would potentially serve as an attractant to wildlife species, specifically waterfowl (e.g., pelicans and Canada goose), and poses a threat to flight safety. Water quality only detention was another alternative that initially screened out of the alternative development process due to the 48 hour drain time that is required, thus not meeting the Buckley AFB goal of preventing wildlife interference with aircraft operations on base.

5.2 Alternative Categories

Three alternative groups were defined as viable for further development within the DB13 watershed. Costs were estimated for the alternative groups selected for a specific reach that included the construction cost of the improvement, land acquisition, dewatering, mobilization, traffic control, utility coordination/relocation, stormwater management/erosion control, engineering, legal/administrative, construction management, and contingency.

General descriptions of the alternative groups are as follows:

Alternative 1: No Improvements

This alternative would maintain the existing storm sewer system, culverts, open channels and crossing structures. This is the "Do Nothing" alternative and will be considered if no improvements are necessary because of physical constraints, low damages due to flooding, adequate conveyance for the major storm event, or no structures are located within the 100-year floodplain.

Alternative 2: Engineered Channel for Major Event

The engineered channel alternative is a trapezoidal channel, with low flow channel, designed to convey the 100-year event. The objective of the engineered channel is to reduce the floodplain width, reduce flood risk to properties, and increase the stability of the channel. Channel types include grass lined and wetland bottom channels. Grade control structures are implemented to establish and maintain a stable channel slope.

Alternative 3: Storm Sewer Conveyance for Major Event

The storm sewer conveyance for the major event includes area inlets and RCP storm sewer to convey future conditions 100-year flow. The storm sewer system will be designed to carry major storm flows and the area inlets capturing the storms flows shall be designed accordingly.

5.3 Alternative Costs

Cost estimates were developed for all alternatives within the DB13 watershed. The unit costs were estimated with UD-MP COST Version 1.1 with 2009 UDFCD unit cost index data.

A summary of construction costs of the drainageway improvements, land acquisition, dewatering, mobilization, traffic control, utility coordination/relocation, stormwater management/erosion control, engineering, legal/administrative, construction management, and contingencies can be found in Appendix B.

5.4 Alternative Plans

The locations of the alternative improvements are illustrated in Figure 9.

5.4.1 Reach 1

Alternative 1: No Improvements

The existing channel conveyance is sufficient for the future conditions flows from the DB13 drainageway. The future conditions floodplain within Reach 1 is 1'-3' wider than the existing conditions floodplain. There is currently is no flooding damages within Reach 1 resulting from the DB13 drainageway. Reach 1 is also located completely within the 100-year regulatory Sand Creek floodplain.

Alternative 2: Engineered Channel for Major Event

An engineered channel improvement would be of no significant benefit to the DB13 drainageway within Reach 1. The DB13 drainageway within Reach1 is stable and conveys 100-year flows to Sand Creek without inundating any habitable structures.

5.4.2 Reach 2

Alternative 1: No Improvements

This alternative will not eliminate the overtopping of the maintenance road to the east of the channel. Split flow from this overtopping will continue to spill over the adjacent property to the east. Future conditions flows will continue to erode and can eventually cause degradation of the existing channel side slopes.

Alternative 2: Engineered Channel for Major Event

The objective of this alternative is to convey future conditions 100-year flows within Reach 2 by constructing a 100-year capacity engineered channel. This channel would be a ~1500 LF grass lined channel with a bottom width of 10', depth of 3', longitudinal slope of 1% and side slopes of 4H:1V. Two sloping grouted boulder drop structures would be needed as grade control within Reach 2. Extensive grading and excavation, bank protection, and a low-flow channel will be incorporated into this alternative. This alternative is estimated to cost **$685,814**.

Alternative 3: Storm Sewer Conveyance for Major Event

The objective of this alternative is to convey future conditions 100-year flows within Reach 2 by constructing subsurface storm sewer with 100-year capacity. Approximately 1500 LF of storm sewer system consisting of 66" RCP buried at a minimum of 1' below the surface, area inlets to collect surface flow, manholes at a maximum of 300' spacing and outfall protection. This alternative is estimated to cost **$855,219**.

5.4.3 Reach 3

Alternative 2: Engineered Channel for Major Event

The objective of this alternative is to convey future conditions 100-year flows within Reach 3 by constructing a 100-year capacity engineered channel. This channel would be a ~2200 LF grass lined channel with a bottom width of 20', depth of 3', longitudinal slope of 1% and side slopes of 4H:1V. Five sloping grouted boulder drop structures would be needed as grade control within Reach 3. Extensive grading and excavation, bank protection, and a low-flow channel will be incorporated into this alternative. This alternative is estimated to cost **$871,769**.

Alternative 3: Storm Sewer Conveyance for Major Event

The objective of this alternative is to convey future conditions 100-year flows within Reach 2 by constructing subsurface storm sewer with 100-year capacity. Approximately2200 LF of storm sewer system would consist of 54" RCP buried at a minimum of 1' below the surface, area inlets to collect surface flow, manholes at a maximum of 300' spacing and outfall protection. This alternative is estimated to cost **$1,034,979.**

6 Recommended Alternative

6.1 Alternative Description

The purpose of this alternatives analysis was to provide a recommended alternative. The recommended alternative addresses the most appropriate modifications which are necessary within the DB13 watershed to minimize hydraulic concerns that result from the removal of Lake Williams.

The recommended plan includes:

Reach 1 – Alternative 1 No Improvements: The existing channel conveyance is sufficient for the future conditions flows from the DB13 drainageway. The future conditions floodplain within Reach 1 is 1'-3' wider than the existing conditions floodplain. There is currently is no flooding damages within Reach 1 resulting from the DB13 drainageway.

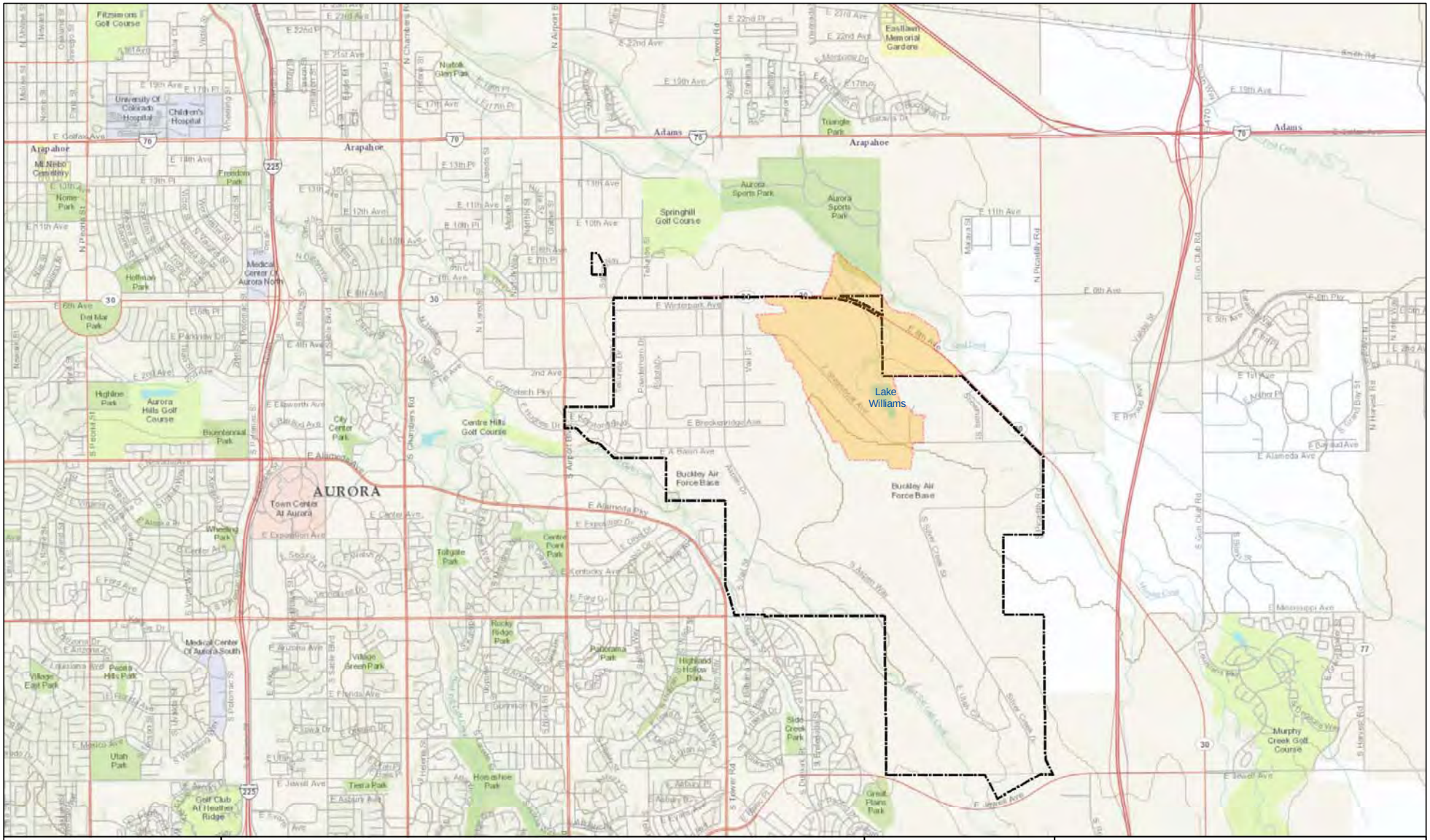
Reach 2 – Alternative 2 Engineered Channel for Major Event: Provide engineered channel improvements with capacity to convey the 100-year event within Reach 2. Increased channel capacity in this area reduces the 100-year floodplain through this reach and prevents split flow from leaving the Buckley AFB to the adjacent property to the east. This alternative provides future conditions 100-year conveyance capacity for flows introduced to the reach by the removal of Lake Williams. This alternative also provides stable conveyance for more frequent flows, up to the 100-year peak.

Reach 3 – Alternative 2 Engineered Channel for Major Event: Provide engineered channel improvements with capacity to convey the 100-year event within Reach 3. Providing an engineering channel with 100-year capacity in this area will reduce the degradation and erosion to the DB13 drainageway that the proposed removal of Lake Williams will introduce.

The recommended alternative for each reach was chosen based on a combination of quantitative and qualitative measurements. The locations of the recommended improvements are illustrated in Figure 10.

APPENDIX A

Figures



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LEGEND:

BUCKLEY AFB BOUNDARY

PROJECT AREA

Unclassified and FOUO

N

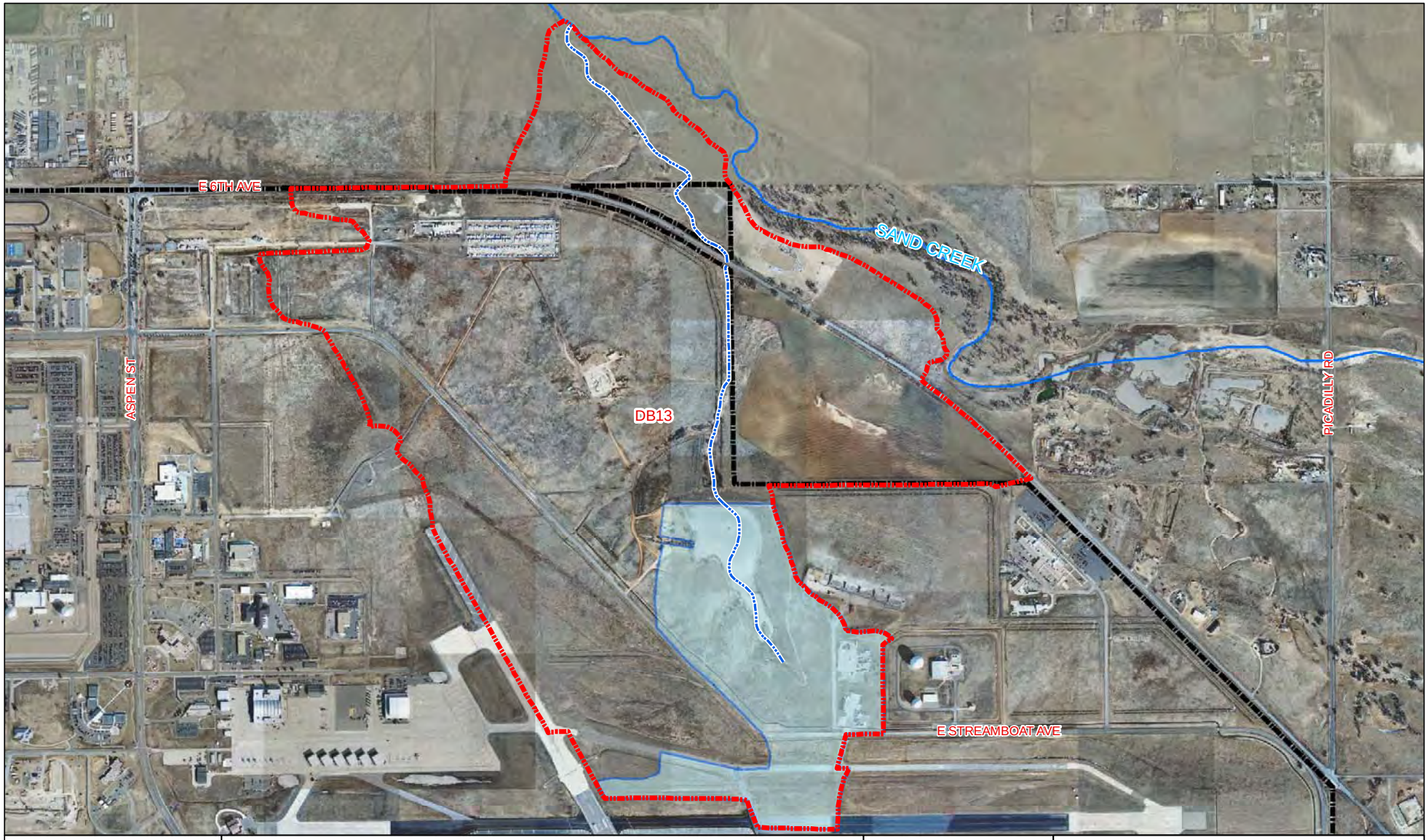
3,000

Feet

DATE: DECEMBER 2011

LAKE WILLIAMS HYDROLOGIC AND HYDRAULIC ASSESSMENT
BUCKLEY AFB, CO

FIGURE 1
GENERAL SITE MAP



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LEGEND:

- BUCKLEY AFB BOUNDARY
- DB13 Watershed
- Lake Williams Watershed
- DB13 Drainageway

Unclassified and FOUO

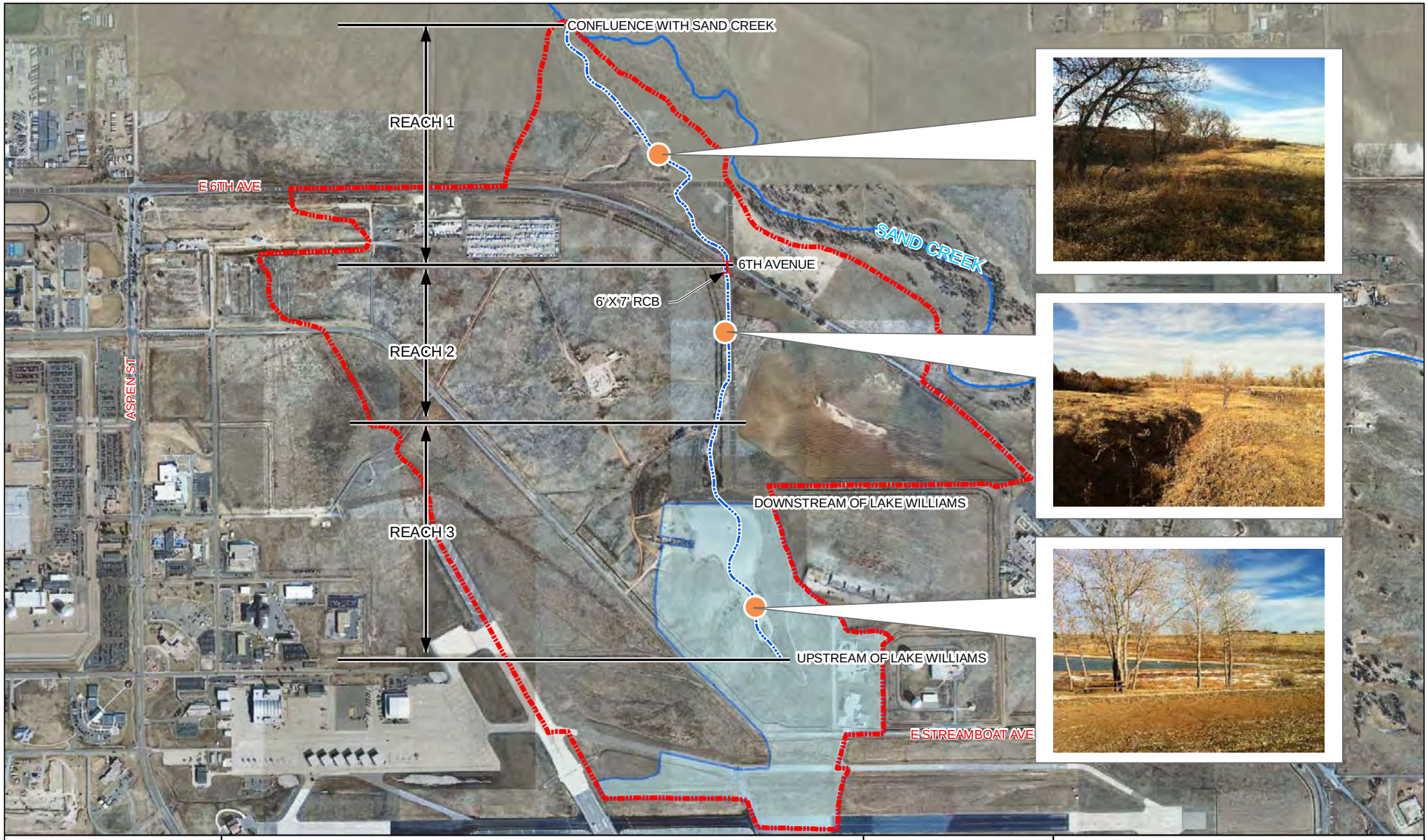
N

800 Feet

DATE: DECEMBER 2011

LAKE WILLIAMS HYDROLOGIC AND HYDRAULIC ASSESSMENT
BUCKLEY AFB, CO

FIGURE 2
PROJECT AREA MAP



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LEGEND:

- BUCKLEY AFB BOUNDARY
- DB13 Watershed
- DBLake Watershed
- DB13 Drainageway

Unclassified and FOUO

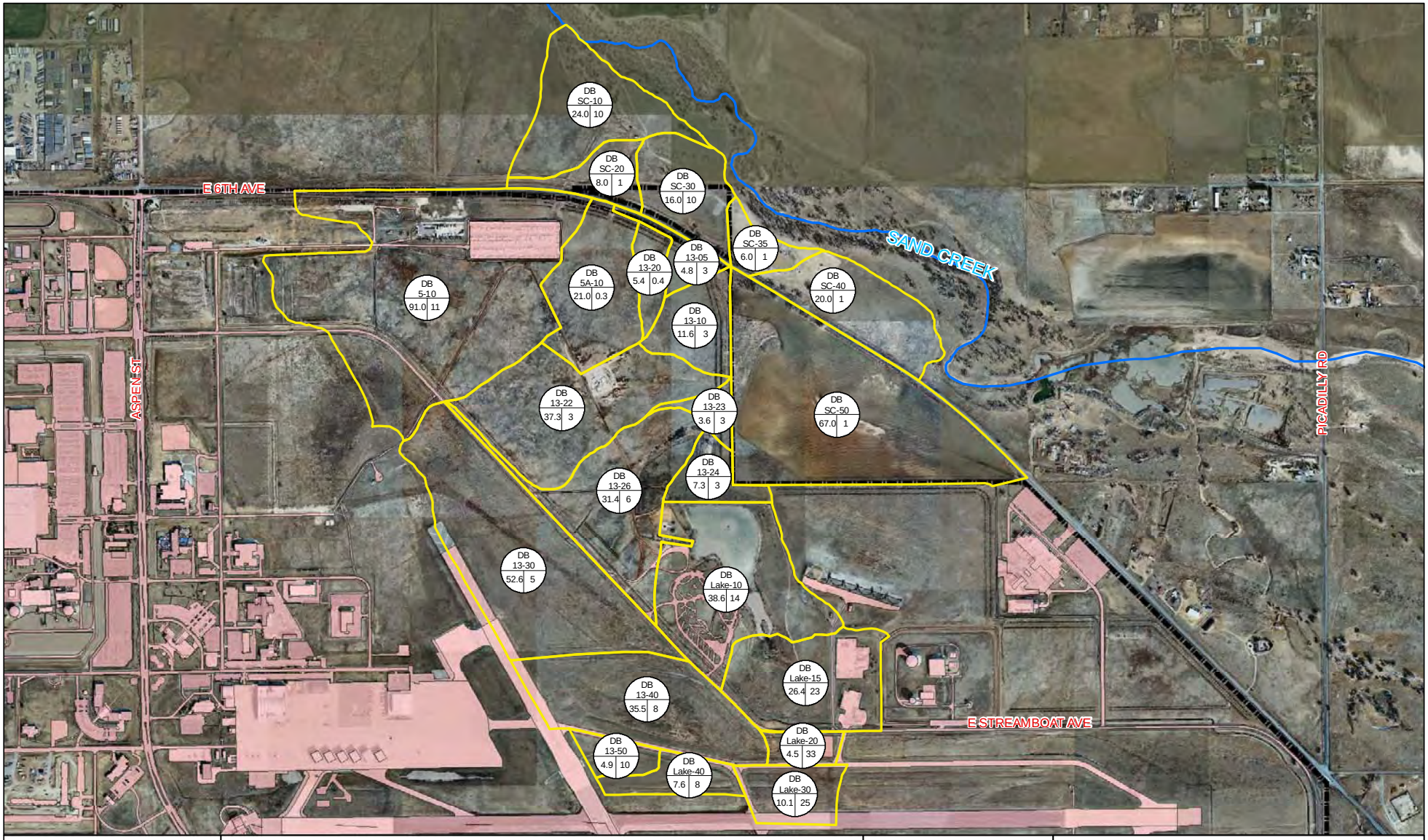
N

800 Feet

DATE: DECEMBER 2011

LAKE WILLIAMS HYDROLOGIC AND HYDRAULIC ASSESSMENT
BUCKLEY AFB, CO

FIGURE 3
REACH DESCRIPTIONS



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LEGEND:

- BUCKLEY AFB BOUNDARY
- SUBWATERSHEDS
- IMPERVIOUS AREA

DB XX | XX XX — DRAINAGE BASIN; AREA; % IMPERVIOUS

Unclassified and FOUO

N

800 Feet

DATE: DECEMBER 2011

LAKE WILLIAMS HYDROLOGIC & HYDRAULIC ASSESSMENT
BUCKLEY AFB, CO

FIGURE 4
EXISTING / FUTURE
SUBWATERSHED CONDITIONS

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LEGEND:

Unclassified and FOUO

BUCKLEY AFB BOUNDARY

SUBWATERSHEDS

HYDROLOGIC SOIL GROUPS

A (HIGH SOIL TRANSMISSION RATE)

C (LOW SOIL TRANSMISSION RATE)

N

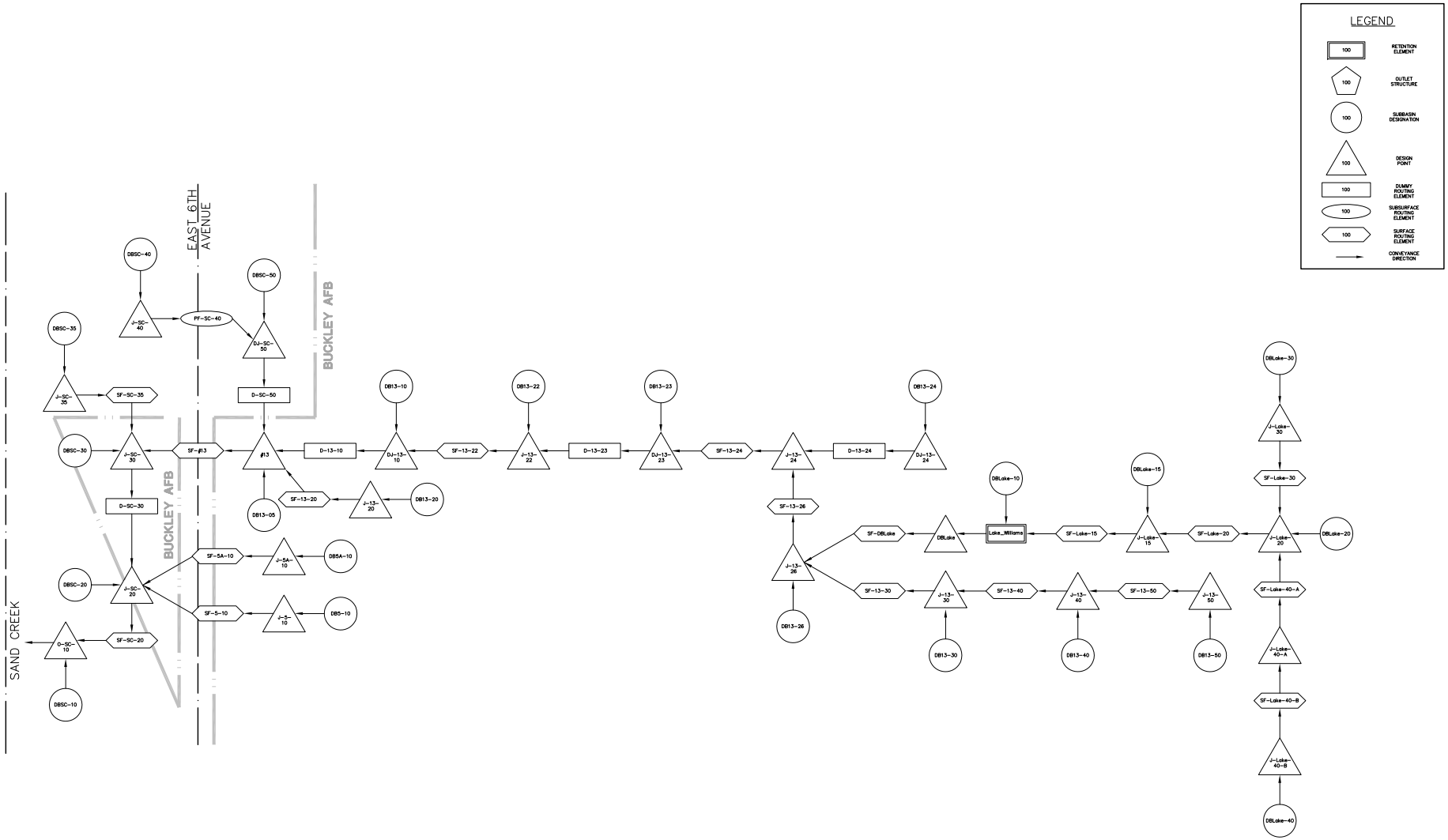
800

Feet

DATE: DECEMBER 2011

LAKE WILLIAMS HYDROLOGIC AND HYDRAULIC ASSESSMENT
BUCKLEY AFB, CO

FIGURE 5
SUBWATERSHEDS AND SOILS MAP



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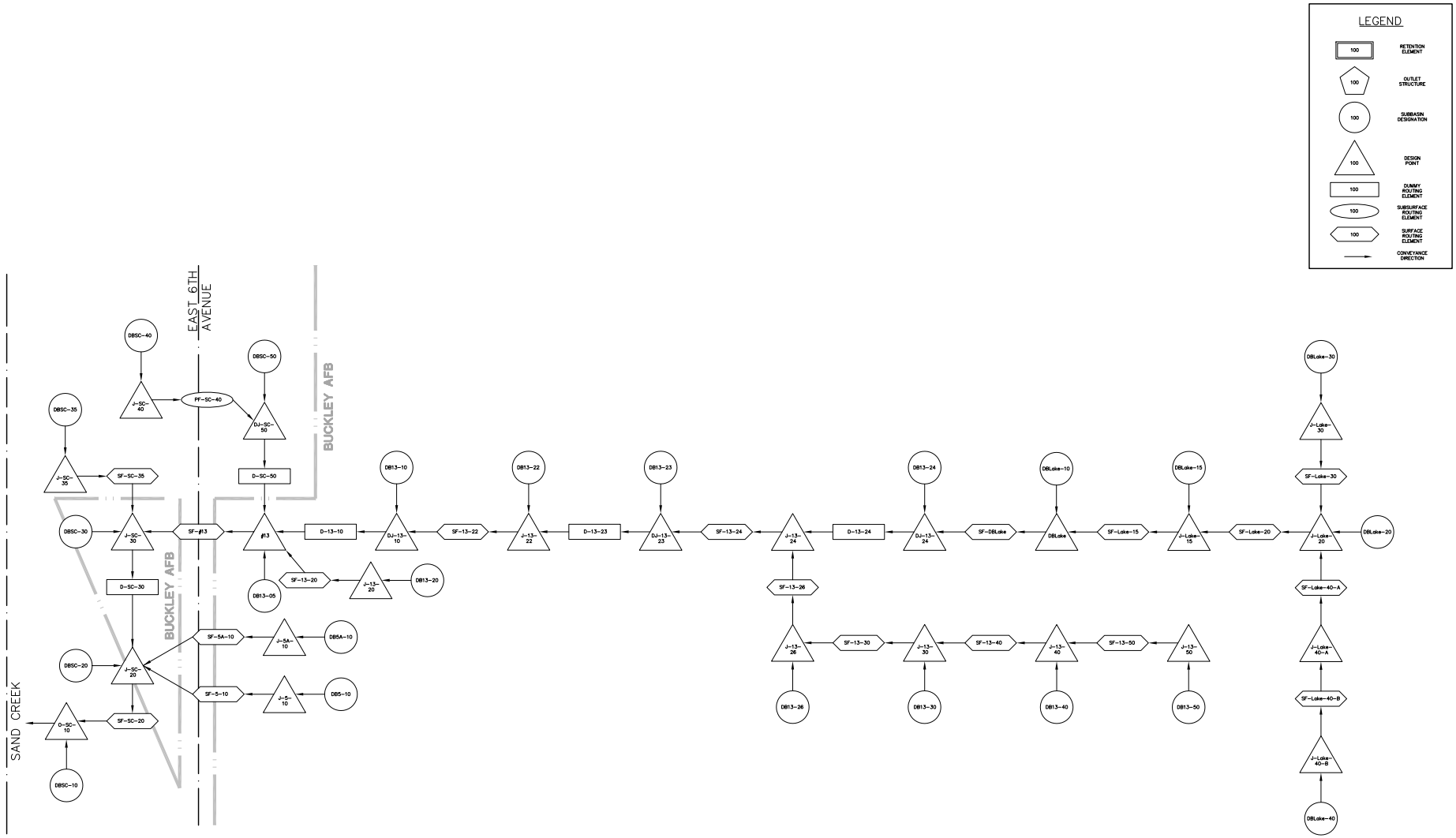
REVISIONS			
NO.	DESCRIPTION	DATE	BY

CITY AURORA
COUNTY ARAPHOE
STATE COLORADO

DATE: 12/2011
PROJECT NO.:
DESIGNED BY: SMY
CHECKED: E.J.

LAKE WILLIAMS HYDROLOGIC AND HYDRAULIC ASSESSMENT
EXISTING CONDITIONS
EPA SWMM SCHEMATIC

FIGURE
6-1



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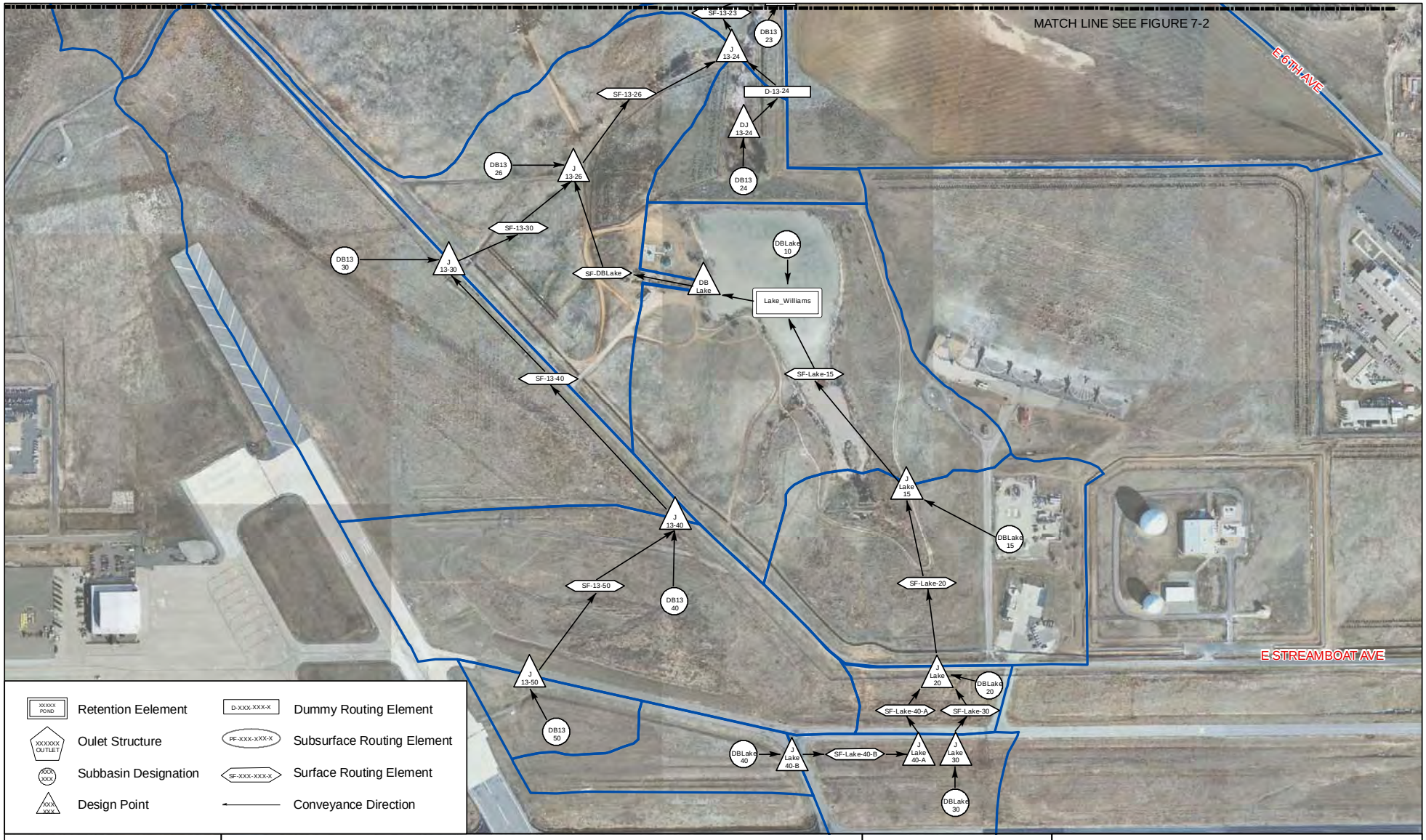
REVISIONS			
NO.	DESCRIPTION	DATE	BY

CITY AURORA
COUNTY ARAPHOE
STATE COLORADO

DATE: 12/2011
PROJECT NO.:
DESIGNED BY: SMY
CHECKED: E.J.

LAKE WILLIAMS HYDROLOGIC AND HYDRAULIC ASSESSMENT
FUTURE CONDITIONS
EPA SWMM SCHEMATIC

FIGURE
6-2



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LEGEND:

BUCKLEY AFB BOUNDARY

DRAINAGE BASINS

Unclassified and FOUO

N

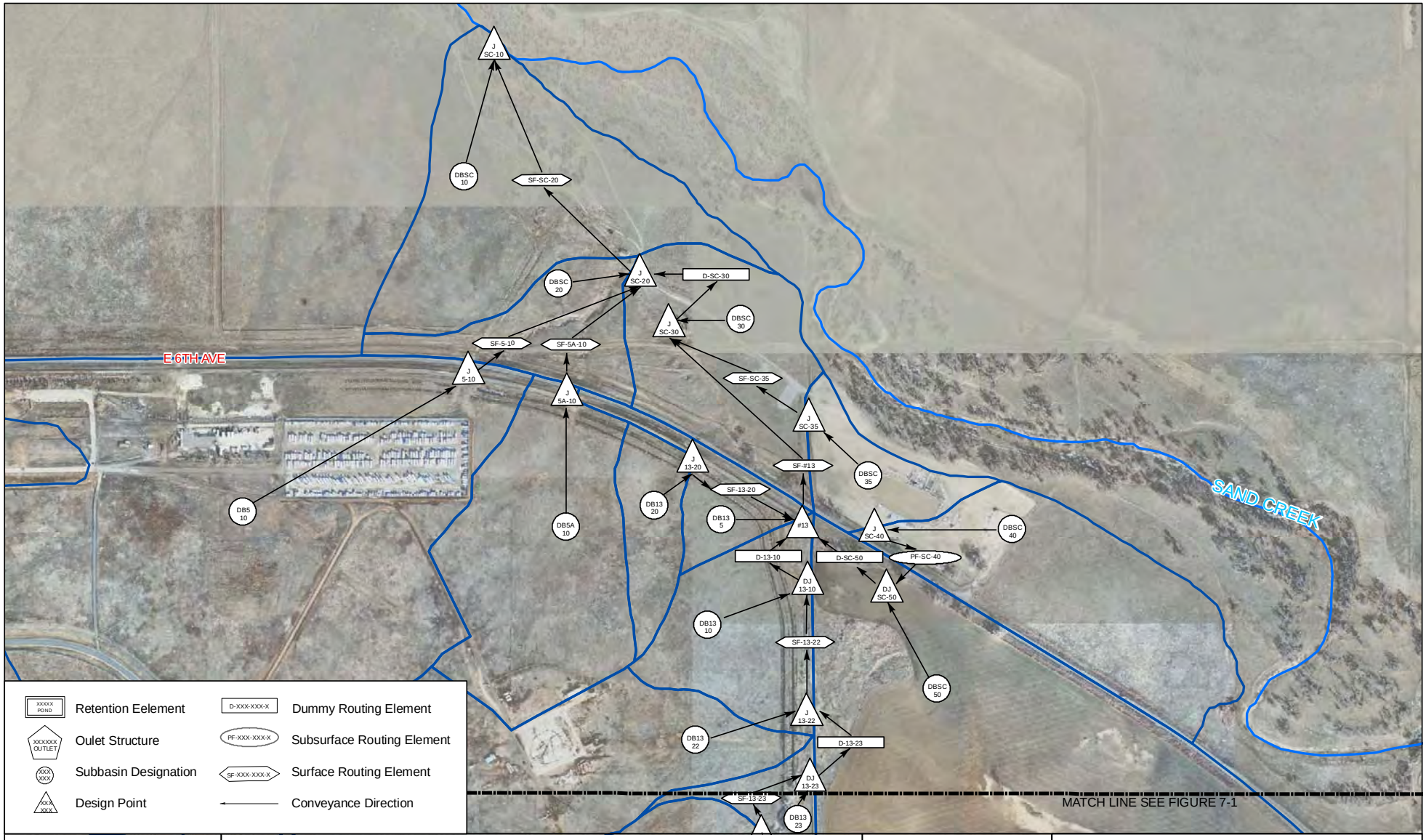
400

Feet

DATE: DECEMBER 2011

LAKE WILLIAMS HYDROLOGIC AND HYDRAULIC ASSESSMENT
BUCKLEY AFB, CO

FIGURE 7-1
EXISTING CONDITIONS
EPA SWMM ROUTING MAP



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LEGEND:

BUCKLEY AFB BOUNDARY

DRAINAGE BASINS

Unclassified and FOUO

N

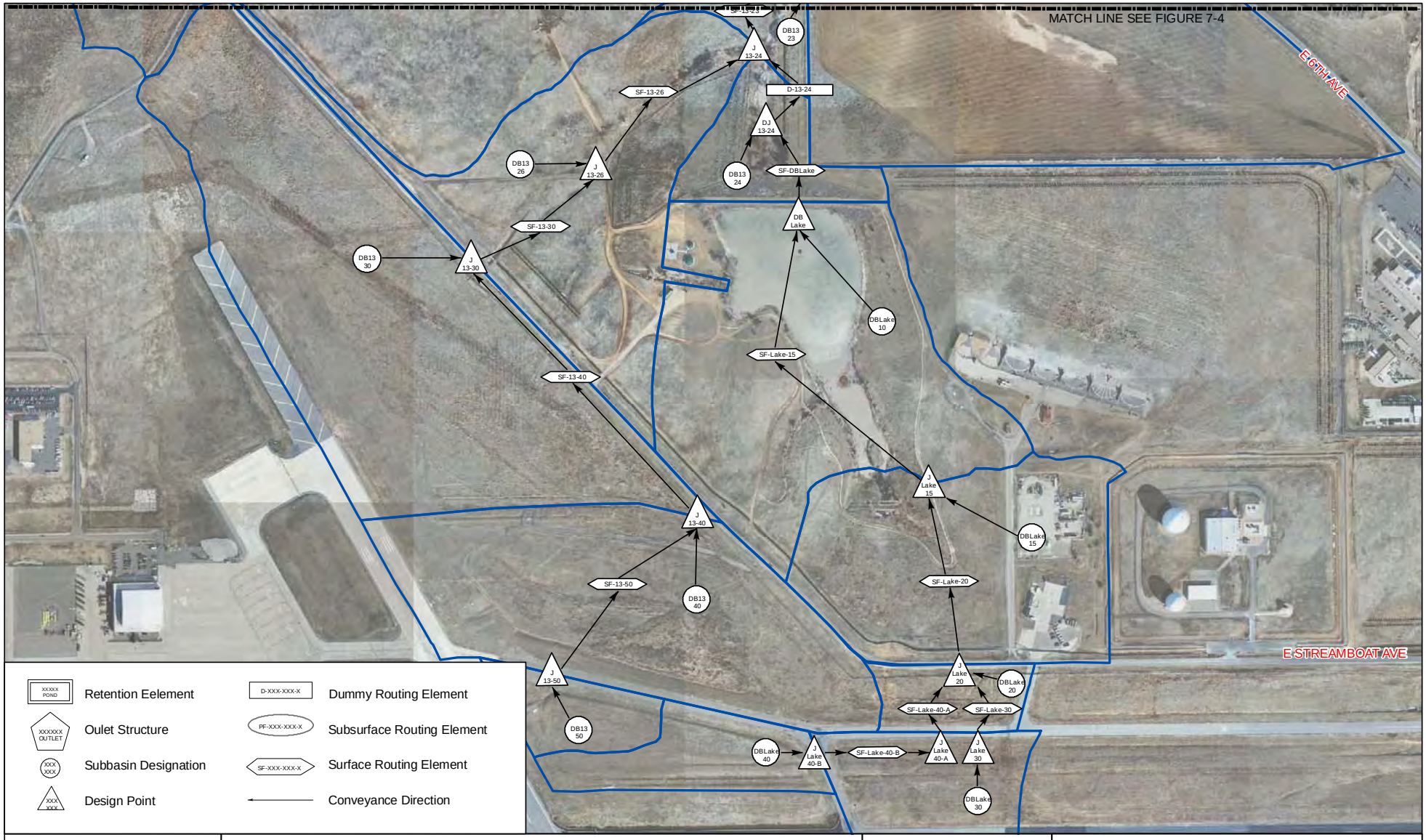
400

Feet

DATE: DECEMBER 2011

LAKE WILLIAMS HYDROLOGIC AND HYDRAULIC ASSESSMENT
BUCKLEY AFB, CO

FIGURE 7-2
EXISTING CONDITIONS
EPA SWMM ROUTING MAP



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LEGEND:

BUCKLEY AFB BOUNDARY

DRAINAGE BASINS

Unclassified and FOUO

N

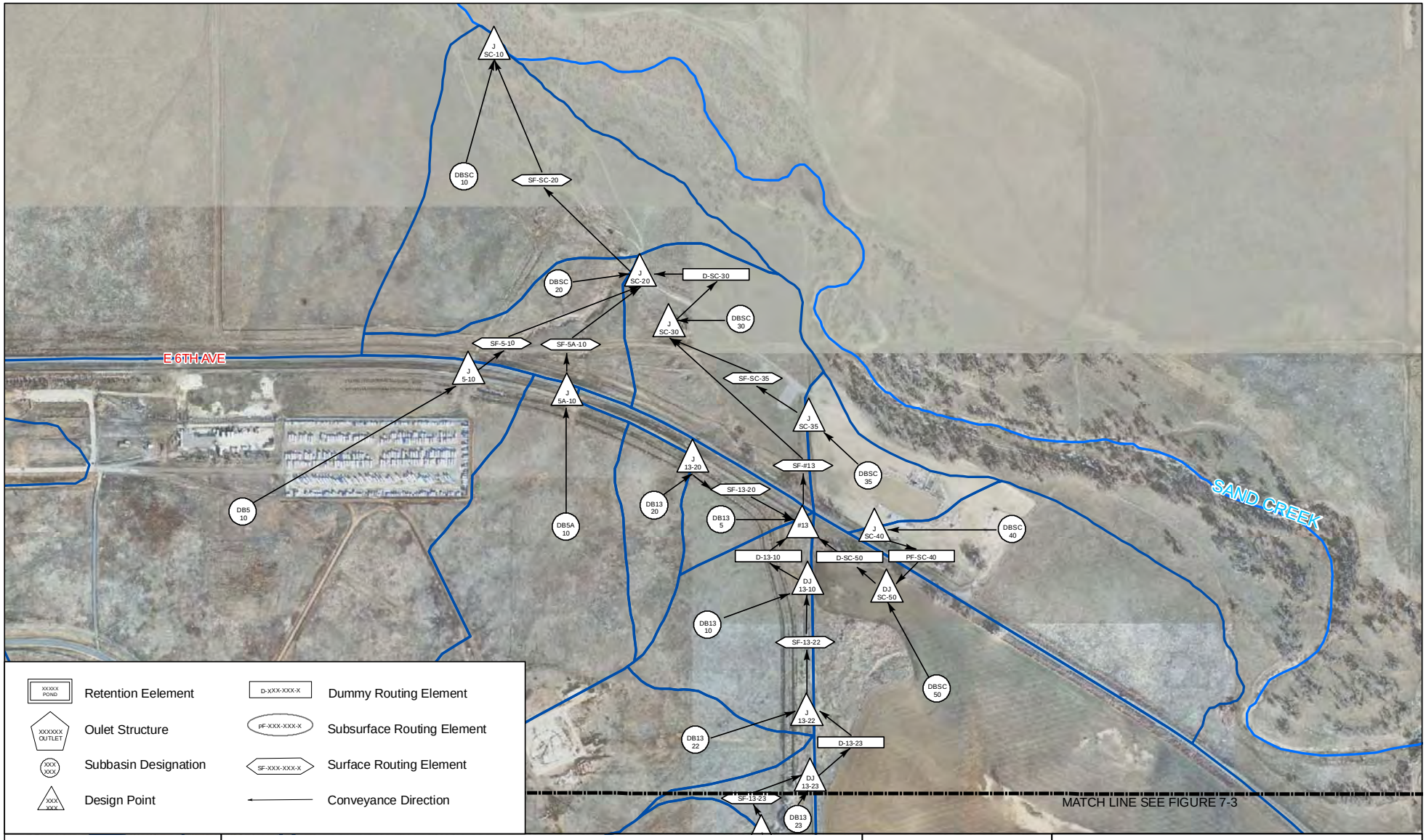
400

Feet

DATE: DECEMBER 2011

LAKE WILLIAMS HYDROLOGIC AND HYDRAULIC ASSESSMENT
BUCKLEY AFB, CO

FIGURE 7-3
FUTURE CONDITIONS
EPA SWMM ROUTING MAP



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LEGEND:

BUCKLEY AFB BOUNDARY

DRAINAGE BASINS

Unclassified and FOUO

N

400

Feet

DATE: DECEMBER 2011

LAKE WILLIAMS HYDROLOGIC AND HYDRAULIC ASSESSMENT
BUCKLEY AFB, CO

FIGURE 7-4
FUTURE CONDITIONS
EPA SWMM ROUTING MAP

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LEGEND:

- BUCKLEY AFB BOUNDARY
- PROJECT AREA
- EXISTING CONDITIONS 100-YR FLOODPLAIN

Unclassified and FOUO

N

800 Feet

DATE: DECEMBER 2011

LAKE WILLIAMS HYDROLOGIC AND HYDRAULIC ASSESSMENT
BUCKLEY AFB, CO

FIGURE 8-1
EXISTING CONDITIONS
100 YEAR FLOODPLAIN

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LEGEND:

Unclassified and FOUO

- BUCKLEY AFB BOUNDARY
- PROJECT AREA
- FUTURE CONDITIONS 100-YR FLOODPLAIN (No channel improvements)

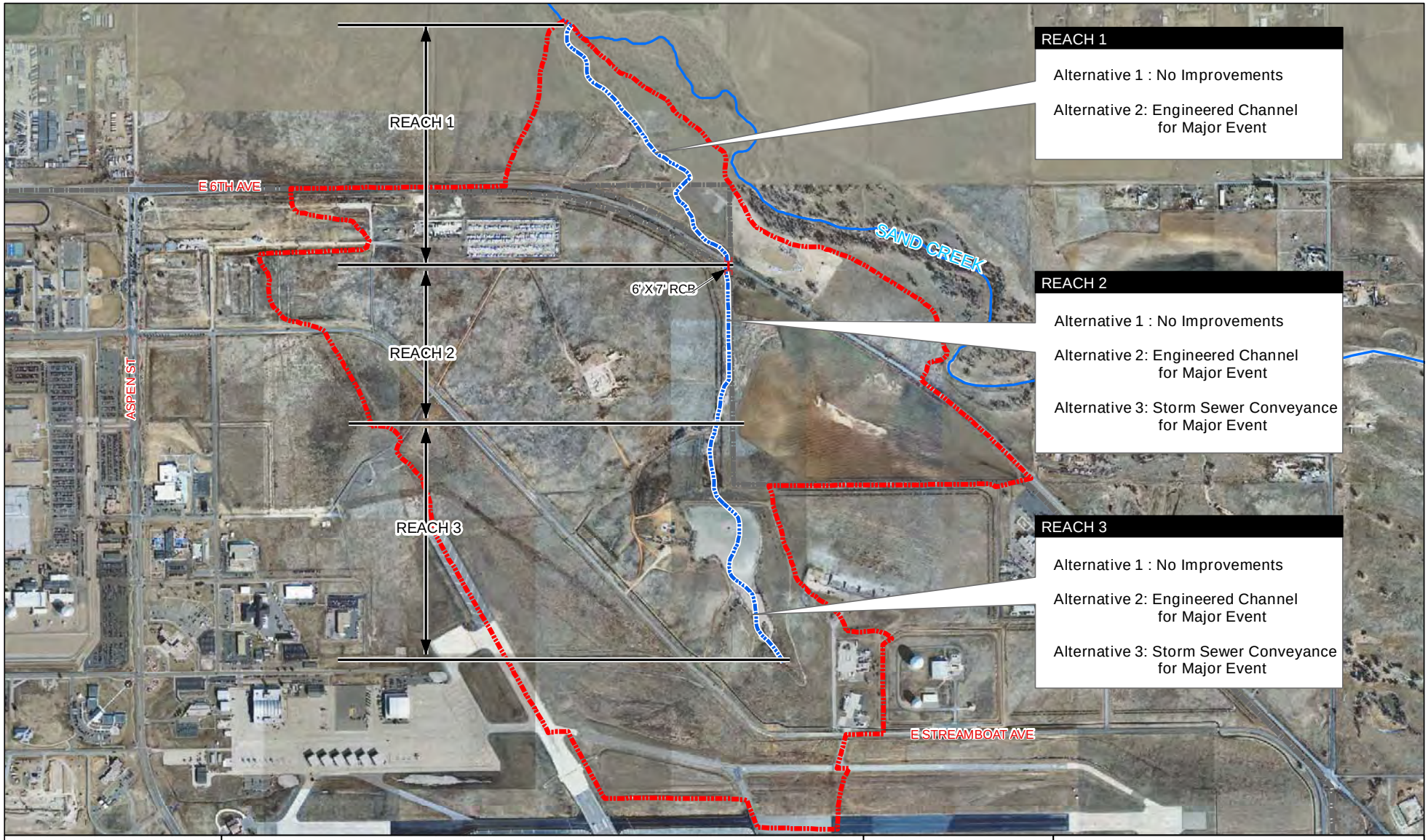
N

800 Feet

DATE: DECEMBER 2011

LAKE WILLIAMS HYDROLOGIC AND HYDRAULIC ASSESSMENT
BUCKLEY AFB, CO

FIGURE 8-2
FUTURE CONDITIONS
100 YEAR FLOODPLAIN



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LEGEND: Note: All alternatives include removal of Lake Williams embankment.

Unclassified and FOUO

- BUCKLEY AFB BOUNDARY
- DB13 Watershed
- DB13 Drainageway

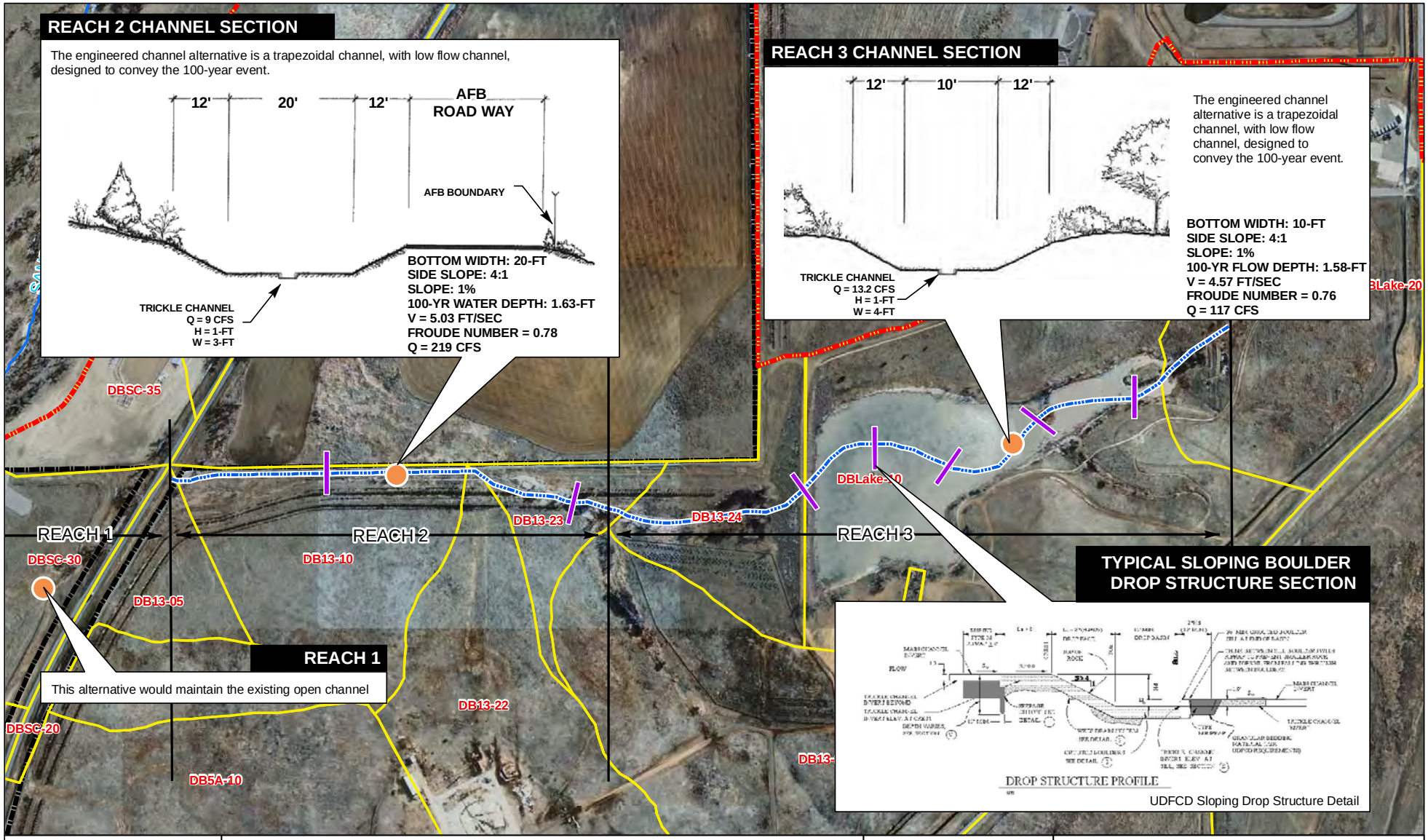
N

800 Feet

DATE: DECEMBER 2011

LAKE WILLIAMS HYDROLOGIC AND HYDRAULIC ASSESSMENT
BUCKLEY AFB, CO

FIGURE 9
PROPOSED ALTERNATIVES



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LEGEND:

Unclassified and FOUO

- BUCKLEY AFB BOUNDARY
- PROJECT AREA
- SUBWATERSHEDS
- PROPOSED CHANNEL
- SLOPING BOULDER DROP STRUCTURE

300 Feet

N

DATE: DECEMBER 2011

LAKE WILLIAMS HYDROLOGIC & HYDRAULIC ASSESSMENT
BUCKLEY AFB, CO

FIGURE 10
RECOMMENDED ALTERNATIVE

APPENDIX B

Alternative Cost Estimates

Table B.1 Cost Estiamte - Reach 2 Alternative 2 Channel for Major Event Cost Estiamte

MASTER PLAN COST ESTIMATOR - LITE

PROJECT :	32710095 - Lake Williams
DRAINAGEWAY :	DB13 (Channel)
REACH :	Reach 2
JURISDICTION :	Buckley AFB
	ESTIMATED BY : TJB DATE : 10/22/2011

DESCRIPTION	SUPPORTING DATA (USER DEFINED AND CALCULATED)						QUANTITY	UNIT	UNIT COST	TOTAL COST
Hydraulic Structures										
Sloping Drop Structures										
Height (ft)	**Bottom Width (ft)**	**Yn (ft)**		**La (ft)**	**Hard Basin Length (ft)**	**Total Width (ft)**				
6	20	1.5		5.00	60.00	32.00	2	EA	$64,382.06	$128,764.12
Check Structures										
Check Structure, Concrete							80	L.F.	$340.00	$27,200.00
Channel Improvements										
Boulder Edging, 12" High							1500	L.F.	$75.00	$112,500.00
Detention/Water Quality Facilities										
Detention (Complete-in-Place)										
Detention Facility 1 (Complete-in-Place)								AC-FT	$45,600.00	$0.00
Detention Facility 2 (Complete-in-Place)								AC-FT	$45,600.00	$0.00
Detention Facility 3 (Complete-in-Place)								AC-FT	$45,600.00	$0.00
Detention (User Entered Quantities)										
Excavation, Low Range								C.Y.	$12.00	$0.00
Excavation, Mid Range							8300	C.Y.	$15.00	$124,500.00
Excavation, High Range								C.Y.	$25.00	$0.00
Outlet Works								EA		$0.00
Water Quality Appurtenances								EA		$0.00
Removals										
Removal of culvert pipe (D<48")								LF	$30.00	$0.00
Removal of culvert pipe (48"<D<84")								LF	$50.00	$0.00
Removal of culvert pipe (D>84")								LF	$75.00	$0.00
Concrete Box Culvert								LF/CELL	$100.00	$0.00
Landscaping and Maintenance Improvements										
Wetlands Plantings								ACRE	$25,000.00	$0.00
Reclamation & seeding (native grasses)							2	ACRE	$1,000.00	$2,000.00
Trail/Path, Concrete (10' Width)								L.F.	$40.00	$0.00
Trail/Path, Crusher Fines (10' Width)								L.F.	$10.00	$0.00
Land Acquisition										
Temporary Easements								EA		$0.00
Easement/ROW Acquisition								ACRE		$0.00

Master Plan Improvement Cost Summary

Capital Improvement Costs			
Pipe Culverts and Storm Drains			$0.00
Concrete Box Culverts			$0.00
Hydraulic Structures			$155,964.12
Channel Improvements			$112,500.00
Detention/Water Quality Facilities			$124,500.00
Removals			$0.00
Landscaping and Maintenance Improvements			$2,000.00
Special Items (User Defined)			$0.00
Subtotal Capital Improvement Costs			**$394,964.12**
Additional Capital Construction Costs			
Dewatering	$4,000	L.S.	$4,000.00
Mobilization	5%		$19,748.21
Traffic Control		L.S.	$0.00
Utility Coordination/Relocation	$4,000	L.S.	$4,000.00
Stormwater Management/Erosion Control	5%		$19,748.21
Subtotal Additional Capital Improvement Costs			**$47,496.41**
Land Acquisition			
ROW/Easements			$0.00
Subtotal Land Acquistion			**$0.00**
Other Costs (percentage of Capital Improvement Costs)			
Engineering	15%		$66,369.08
Legal/Administrative	5%		$22,123.03
Contract Admin/Construction Management	10%		$44,246.05
Contingency	25%		$110,615.13
Subtotal Other Costs			**$243,353.29**
Totals			**$685,813.82**

Table B.2 Cost Estiamte - Reach 2 Storm Sewer Conveyance for Major Event

MASTER PLAN COST ESTIMATOR - LITE

PROJECT :	32710095 - Lake Williams				
DRAINAGEWAY :	DB13 (RCP)				
REACH :	Reach 2				
JURISDICTION :	Buckley AFB				
		ESTIMATED BY :	TJB	DATE :	10/22/2011

DESCRIPTION	SUPPORTING DATA (USER DEFINED AND CALCULATED)						QUANTITY	UNIT	UNIT COST	TOTAL COST
Pipe Culverts and Storm Drains										
Circular Pipes										
Diameter (in)	**Length (ft)**	**No. of Barrels**								
66-inch	1500	1					1500	L.F.	$231.00	$346,500.00
Headwalls										
Diameter (in)	**Applicable**	**No. of Barrels**	**U/S Headwall**	**D/S Headwall**	**Concrete (C.Y.)**	**Steel (lbs)**				
66-inch	Yes	1		Yes	2.60	249.00	1	EA	$2,019.20	$2,019.20
Wingwalls (includes concrete apron)										
Diameter (in)		**No. of Barrels**	**Interior Span (ft)**	**Length (ft)**	**Concrete (C.Y.)**	**Steel (lbs)**				
66-inch		1	10.25	18	16.27	748.32	1	EA	$11,984.33	$11,984.33
Manholes and Inlets										
Manhole, 4' Dia. (Pipe Dia. < 36")								EA	$3,000.00	$0.00
Manhole, 5' Dia. (Pipe Dia. 36" - 42")								EA	$4,500.00	$0.00
Manhole, 6' Dia. (Pipe Dia. = 48")								EA	$5,250.00	$0.00
Type B Manhole (Pipe Dia. 48" and larger, deflection < 10 degrees)							6	EA	$10,000.00	$60,000.00
Type P Manhole (Pipe Dia. 48" and larger, deflection > 10 degrees)								EA	$15,000.00	$0.00
Storm Inlet, Type R/Type 14, 5-foot							20	EA	$3,500.00	$70,000.00
Landscaping and Maintenance Improvements										
Wetlands Plantings								ACRE	$25,000.00	$0.00
Reclamation & seeding (native grasses)							2	ACRE	$1,000.00	$2,000.00
Trail/Path, Concrete (10' Width)								L.F.	$40.00	$0.00
Trail/Path, Crusher Fines (10' Width)								L.F.	$10.00	$0.00
Land Acquisition										
Temporary Easements								EA		$0.00
Easement/ROW Acquisition								ACRE		$0.00

Master Plan Improvement Cost Summary

Capital Improvement Costs			
Pipe Culverts and Storm Drains			$490,503.53
Concrete Box Culverts			$0.00
Hydraulic Structures			$0.00
Channel Improvements			$0.00
Detention/Water Quality Facilities			$0.00
Removals			$0.00
Landscaping and Maintenance Improvements			$2,000.00
Special Items (User Defined)			$0.00
Subtotal Capital Improvement Costs			**$492,503.53**
Additional Capital Construction Costs			
Dewatering	$5,000	L.S.	$5,000.00
Mobilization	5%		$24,625.18
Traffic Control		L.S.	$0.00
Utility Coordination/Relocation	$5,000	L.S.	$5,000.00
Stormwater Management/Erosion Control	5%		$24,625.18
Subtotal Additional Capital Improvement Costs			**$59,250.35**
Land Acquisition			
ROW/Easements			$0.00
Subtotal Land Acquistion			**$0.00**
Other Costs (percentage of Capital Improvement Costs)			
Engineering	15%		$82,763.08
Legal/Administrative	5%		$27,587.69
Contract Admin/Construction Management	10%		$55,175.39
Contingency	25%		$137,938.47
Subtotal Other Costs			**$303,464.63**
Totals			**$855,218.51**

Table B.3 Cost Estiamte - Reach 3 Alternative 2 Channel for Major Event Cost Estiamte

MASTER PLAN COST ESTIMATOR - LITE

PROJECT :	32710095 - Lake Williams
DRAINAGEWAY :	DB13 (Channel)
REACH :	Reach 3
JURISDICTION :	Buckley AFB
ESTIMATED BY :	TJB
DATE :	10/22/2011

DESCRIPTION	SUPPORTING DATA (USER DEFINED AND CALCULATED)						QUANTITY	UNIT	UNIT COST	TOTAL COST
Hydraulic Structures										
Sloping Drop Structures										
Height (ft)	**Bottom Width (ft)**	**Yn (ft)**		**La (ft)**	**Hard Basin Length (ft)**	**Total Width (ft)**				
6	10	1.55		5.00	60.00	22.40	5	EA	$44,998.44	$224,992.20
Check Structures										
Check Structure, Concrete							100	L.F.	$340.00	$34,000.00
Channel Improvements										
Boulder Edging, 12" High							2200	L.F.	$75.00	$165,000.00
Detention/Water Quality Facilities										
Detention (Complete-in-Place)										
Detention Facility 1 (Complete-in-Place)								AC-FT	$45,600.00	$0.00
Detention Facility 2 (Complete-in-Place)								AC-FT	$45,600.00	$0.00
Detention Facility 3 (Complete-in-Place)								AC-FT	$45,600.00	$0.00
Detention (User Entered Quantities)										
Excavation, Low Range							6200	C.Y.	$12.00	$74,400.00
Excavation, Mid Range								C.Y.	$15.00	$0.00
Excavation, High Range								C.Y.	$25.00	$0.00
Outlet Works								EA		$0.00
Water Quality Appurtenances								EA		$0.00
Removals										
Removal of culvert pipe (D<48")								LF	$30.00	$0.00
Removal of culvert pipe (48"<D<84")								LF	$50.00	$0.00
Removal of culvert pipe (D>84")								LF	$75.00	$0.00
Concrete Box Culvert								LF/CELL	$100.00	$0.00
Landscaping and Maintenance Improvements										
Wetlands Plantings								ACRE	$25,000.00	$0.00
Reclamation & seeding (native grasses)							2	ACRE	$1,000.00	$2,000.00
Trail/Path, Concrete (10' Width)								L.F.	$40.00	$0.00
Trail/Path, Crusher Fines (10' Width)								L.F.	$10.00	$0.00
Land Acquisition										
Temporary Easements								EA		$0.00
Easement/ROW Acquisition								ACRE		$0.00

Master Plan Improvement Cost Summary

Capital Improvement Costs			
Pipe Culverts and Storm Drains			$0.00
Concrete Box Culverts			$0.00
Hydraulic Structures			$258,992.20
Channel Improvements			$165,000.00
Detention/Water Quality Facilities			$74,400.00
Removals			$0.00
Landscaping and Maintenance Improvements			$2,000.00
Special Items (User Defined)			$0.00
Subtotal Capital Improvement Costs			**$500,392.20**
Additional Capital Construction Costs			
Dewatering	$6,000	L.S.	$6,000.00
Mobilization	5%		$25,019.61
Traffic Control	$0.00	L.S.	$0.00
Utility Coordination/Relocation	$6,000	L.S.	$6,000.00
Stormwater Management/Erosion Control	5%		$25,019.61
Subtotal Additional Capital Improvement Costs			**$62,039.22**
Land Acquisition			
ROW/Easements			$0.00
Subtotal Land Acquistion			**$0.00**
Other Costs (percentage of Capital Improvement Costs)			
Engineering	15%		$84,364.71
Legal/Administrative	5%		$28,121.57
Contract Admin/Construction Management	10%		$56,243.14
Contingency	25%		$140,607.86
Subtotal Other Costs			**$309,337.28**
Totals			**$871,768.70**

Table B.4 Cost Estiamte - Reach 3 Storm Sewer Conveyance for Major Event

MASTER PLAN COST ESTIMATOR - LITE

PROJECT :	32710095 - Lake Williams
DRAINAGEWAY :	DB13 (RCP)
REACH :	Reach 3
JURISDICTION :	Buckley AFB
ESTIMATED BY :	TJB
DATE :	10/22/2011

DESCRIPTION	SUPPORTING DATA (USER DEFINED AND CALCULATED)						QUANTITY	UNIT	UNIT COST	TOTAL COST
Pipe Culverts and Storm Drains										
Circular Pipes										
Diameter (in)	**Length (ft)**	**No. of Barrels**								
54-inch	2200	1					2200	L.F.	$189.00	$415,800.00
Headwalls										
Diameter (in)	**Applicable**	**No. of Barrels**	**U/S Headwall**	**D/S Headwall**	**Concrete (C.Y.)**	**Steel (lbs)**				
54-inch	Yes	1		Yes	2.12	209.00	1	EA	$1,651.20	$1,651.20
Wingwalls (includes concrete apron)										
Diameter (in)		**No. of Barrels**	**Interior Span (ft)**	**Length (ft)**	**Concrete (C.Y.)**	**Steel (lbs)**				
54-inch		1	8.75	16	13.80	633.11	1	EA	$10,165.65	$10,165.65
Manholes and Inlets										
Manhole, 4' Dia. (Pipe Dia. < 36")								EA	$3,000.00	$0.00
Manhole, 5' Dia. (Pipe Dia. 36" - 42")								EA	$4,500.00	$0.00
Manhole, 6' Dia. (Pipe Dia. = 48")								EA	$5,250.00	$0.00
Type B Manhole (Pipe Dia. 48" and larger, deflection < 10 degrees)							8	EA	$10,000.00	$80,000.00
Type P Manhole (Pipe Dia. 48" and larger, deflection > 10 degrees)								EA	$15,000.00	$0.00
Storm Inlet, Type R/Type 14, 5-foot							25	EA	$3,500.00	$87,500.00
Landscaping and Maintenance Improvements										
Wetlands Plantings								ACRE	$25,000.00	$0.00
Reclamation & seeding (native grasses)							1	ACRE	$1,000.00	$1,000.00
Trail/Path, Concrete (10' Width)								L.F.	$40.00	$0.00
Trail/Path, Crusher Fines (10' Width)								L.F.	$10.00	$0.00
Land Acquisition										
Temporary Easements								EA		$0.00
Easement/ROW Acquisition								ACRE		$0.00

Master Plan Improvement Cost Summary

Capital Improvement Costs			
Pipe Culverts and Storm Drains			$595,116.85
Concrete Box Culverts			$0.00
Hydraulic Structures			$0.00
Channel Improvements			$0.00
Detention/Water Quality Facilities			$0.00
Removals			$0.00
Landscaping and Maintenance Improvements			$1,000.00
Special Items (User Defined)			$0.00
Subtotal Capital Improvement Costs			**$596,116.85**
Additional Capital Construction Costs			
Dewatering	$6,000	L.S.	$6,000.00
Mobilization	5%		$29,805.84
Traffic Control	$0.00	L.S.	$0.00
Utility Coordination/Relocation	$6,000	L.S.	$6,000.00
Stormwater Management/Erosion Control	5%		$29,805.84
Subtotal Additional Capital Improvement Costs			**$71,611.69**
Land Acquisition			
ROW/Easements			$0.00
Subtotal Land Acquistion			**$0.00**
Other Costs (percentage of Capital Improvement Costs)			
Engineering	15%		$100,159.28
Legal/Administrative	5%		$33,386.43
Contract Admin/Construction Managemen	10%		$66,772.85
Contingency	25%		$166,932.13
Subtotal Other Costs			**$367,250.70**
Totals			**$1,034,979.23**