US Army Corps of Engineers ®
Omaha District

GOOSE CREEK
BOULDER, COLORADO

SECTION 206
ECOSYSTEM RESTORATION REPORT

APPENDIX A -
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JUNE 2011

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US Army Corps of Engineers ®
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GOOSE CREEK
BOULDER, COLORADO

SECTION 206
ECOSYSTEM RESTORATION REPORT

APPENDIX A-1
Finding of No Significant Impact (FONSI)

JUNE 2011

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Finding of No Significant Impact

For the Goose Creek Section 206 Aquatic Ecosystem Restoration Project, Boulder, Colorado, Detailed Project Report (DPR) With Integrated Environmental Assessment (EA)
June 2011

In accordance with the National Environmental Policy Act (NEPA) and implementing regulations, a Detailed Project Report (DPR) with incorporated Environmental Assessment (EA), has been prepared for the proposed aquatic ecosystem restoration project on Goose Creek at Boulder, Colorado. The proposed project is located within the city of Boulder, extending from immediately upstream of Foothills parkway to the confluence with Boulder Creek. The project involves restoring approximately 4,000 feet of South Goose Creek as well as Cottonwood Pond. The study reach is heavily urbanized, resulting in loss of aquatic and riparian habitat quantity and quality. The proposed project entails removal of invasive species, reestablishment of native riparian vegetation throughout the project site, excavation of channel meanders and a floodplain terrace in a short reach of the project, and the filling and re-excavation of a gravel pit known as Cottonwood Pond to restore the area to a wooded wetland resembling historic conditions.

The No Action alternative was eliminated from further consideration because it would not fulfill the purpose and need of the proposed project.

The DPR/EA and comments received from agencies and the public have been used to determine whether the proposed action requires the preparation of an Environmental Impact Statement (EIS). All environmental, social and economic factors relevant to the proposal were considered in this assessment. These include, but are not limited to, water quality, air quality, noise, wetlands, wildlife, threatened and endangered species and cultural resources. The primary benefit of the proposed project would be the removal of invasive vegetation and restoration of a riparian corridor important to the Boulder Creek watershed and complimentary to the Boulder Greenways master plan, the re-creation of a more natural, meandering channel within a portion of the project, and restoration of approximately 3 acres of wetland in Reaches 1 and 2, and approximately 7 – 10 acres of wooded wetland in the Cottonwood Pond area. These potential actions could create habitat for aquatic and riparian species dependent on the riparian corridor, including the endangered Prebles jumping mouse. Adverse effects could include temporary noise, dust, and water quality impacts; however, these effects were not deemed to be significant. Adverse impacts could also include the elimination of a small prairie dog community that currently inhabits one reach of the project and the identified disposal area. The project is being coordinated closely with OSMP and will follow the city of Boulder's prairie dog management plan; therefore no significant impacts are anticipated. No adverse impacts to threatened or endangered species or cultural resources are expected to occur as a result of the proposed project. The proposed actions would be in compliance with applicable environmental statutes.

It is my finding, based on the environmental assessment, that the proposed Federal activity will not have any significant adverse impacts on the environment and that the proposed project will not constitute a major Federal action significantly affecting the quality of the human environment. Therefore, an Environment Impact Statement will not be prepared.

9 Jun 11
Date

Robert J. Ruch
Colonel, Corps of Engineers
District Commander

US Army Corps of Engineers ®
Omaha District

GOOSE CREEK
BOULDER, COLORADO

SECTION 206
ECOSYSTEM RESTORATION REPORT

APPENDIX A-2
PREVIOUS BIOLOGICAL REPORTS & LITERATURE

JUNE 2011

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Introduction

Ecosystem restoration is one of the primary missions of the Corps Civil Works Program. The purpose of these ecosystem restoration activities is to restore significant ecosystem function, structure, and dynamic processes that have been degraded. The intent of restoration is to partially or fully reestablish the attributes of a naturalistic, functioning, and self-regulating system.

The characteristics and distribution of plant communities in a watershed influence the movement of water, sediment, nutrients, and wildlife. Plant communities within a stream corridor ecosystem are a valuable source of energy for the biological communities. In addition, they provide physical habitat and moderate solar energy fluxes to and from the surrounding aquatic and terrestrial ecosystems. Plant communities that cover a large area and that are diverse in vertical and horizontal structure can support far more diverse faunal communities than relatively homogenous communities. The quality of this vegetation can directly affect stream channel characteristics. Root systems in the stream bank can bind sediments and moderate erosion. Woody debris that falls into the stream can deflect flows and change deposition and erosion patterns. Woody debris accumulation influences the formation of microhabitats important to fish and invertebrate aquatic communities. The structure formed by large woody debris in a stream improves aquatic habitat for most aquatic species.

Stream corridors provide links with other features of the landscape, involving continuous corridors between the headwater and valley flood ecosystems and periodic interactions between terrestrial systems. Corridors are used by wildlife to disperse juveniles, to migrate, and to move between portions of their home range. Stream corridors are used by wildlife more than any other type of habitat and are a major source of water to wildlife. Stream corridors provide eight habitat features: presence of permanent sources of water; high primary productivity and biomass; dramatic contrasts in cover types and food availability; critical microclimates that provide water shade, evapotranspiration and cover; horizontal and vertical habitat diversity; maximized edge effect; effective seasonal migration routes, and high connectivity between vegetated patches. The linear arrangement of stream corridors provide a maximized edge effect, allowing a species to simultaneously access more than one cover or habitat type and exploit the resources of both. A continuous corridor is most desirable, and the next ideal is minimal fragmentation. Increasing patch size of a streamside vegetation type, increasing the number of woody riparian tree size classes, and increasing the number of species and growth forms (her, shrub, tree) of native riparian vegetation will increase the number of niches and forage, with associated increased species richness and biomass.

Features of riparian habitats that are important to mammals include woody and herbaceous strata, diversity of food and cover plants, structural diversity (stumps, snags, fallen logs, and vines), leaf littler, available surface water invertebrates and other prey items, and thermal cover. Several characteristics of riparian areas are important to large mammals, including terrestrial forage production, aquatic foods (plant and animal),

animal prey production, hiding and thermal cover, terrestrial and aquatic carrion, aquatic habitat and burrow or denning sites.

A stream corridor with a high degree of connectivity (how spatially continuous a corridor is) promotes valuable functions such as nutrient and material transport and movement of flora and fauna. The value is increased when the corridors often connect many small habitat patches and create larger, more complex habitats, with resulting larger wildlife populations and higher biodiversity. Greater connectivity and increased width of the riparian corridor increases its habitat value. More species find suitable habitat conditions in a wide, contiguous, and diverse assortment of native plant communities than in a narrow, homogeneous or highly fragmented corridor.

Corridors serve as habitat and migratory conduit for migratory and other highly mobile wildlife. Corridors must be wide enough and sufficiently connected to provide required habitat in order to function effectively.

Nearly all amphibians depend on aquatic habitats for reproduction and over-wintering. Many reptiles are also found primarily in riparian habitats. Birds are the most commonly observed terrestrial wildlife in riparian corridors. Riparian areas are desirable habitat for large mammals such as deer and elk. Others, like the mink, beaver, raccoon and muskrat, depend upon riparian areas in some or all of their range.

Naturally functioning, stable stream systems promote the diversity and availability of habitats. And wetlands are highly productive habitats for threatened and endangered fish and wildlife species. Wetlands provide habitat for up to 70 percent of the endangered and threatened species.

The numbers and species composition of fishes and invertebrates in a stream depends on factors such as current, depth, substrates, riffles and pools, wood snags and undercut banks, water quality, and biotic interactions. microorganisms and benthic invertebrates facilitate the breakdown of organic material (e.g., leaf litter) that enters the stream from external sources. The general rule is that the more diverse the microhabitats provided in the riparian corridor, the more diverse the species. Aquatic invertebrates utilize all vertical strata, and are found in numerous microhabitats including plants, woody debris, rocks, interstitial spaces of hard substrates, and soft substrates.

Stream corridors also serve as barriers or filters to reduce water pollution, minimize sediment transport. Connectivity and corridor width also affect barrier and filter functions. Vegetation structure can physically affect the amount of runoff entering a stream system through uptake, absorption, and interruption. A wider corridor provides more effective filtering, and a continuous corridor functions as a filter along its entire length. Gaps in contiguous vegetation can impede the filter function, leading to erosion and the free flow of sediments and nutrients into the stream.

PREVIOUS REPORTS/RESEARCH

1.0 Zuellig Thesis

A 2-mile section of lower Goose Creek (south channel) was evaluated by Zuellig using a modification of EPA's Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish (Barbour et al 1999). Habitat characteristics measured include stream width, riparian width, percent run, riffle, pool, glide, area of root wad, undercut bank, and woody debris. A 2-mile length of lower Goose Creek (south channel) was evaluated. This reach is from the cattail marsh at the junction of the north and south Goose Creek channels upstream to about 47th St.

Table 1 shows the results of the habitat basement method of the evaluated Lower Goose Creek segment (using original 1 – 20 attribute score scale).

Table 1. Lower Goose Creek (LGC1) 6-June-00

Channel Flow Status	15
Channel Sinuosity	0
Riffle Frequency	5
Substrate Embeddedness	5
Habitat	0
Pool Substrate	5
Pool Variability	5
Left Bank Stability	10
Right Bank Stability	10
Left Bank Vegetative Protection	0
Right Bank Vegetative Protection	0
Left Bank Vegetative Width	5

Right Bank Vegetative Width	5
Total	65

2.0 City of Boulder Comprehensive Wetland Remapping Project

Prepared by Alan T. Carpenter, Ph.D. & Steve Perce, John Sanderson, Claudia Browne, Land Stewardship Consulting, Inc. and subcontractors, Boulder, Colorado, Oct 2004

The City of Boulder conducted a mapping and evaluation of the city's wetlands in 2004. In addition to size, an assessment was conducted for 13 functions performed by the wetlands. The intensity of the function as it is or could be performed by the wetland in it current condition is indicated by the rank of 1-5, with 1 being "low" and 5 being "very high). The wetland functions evaluated included recharge and discharge of groundwater, flood storage or alteration, sediment trapping, shoreline anchoring (erosion control), short- and long-term nutrient retention, food chain support, aquatic and wildlife habitat, and recreational values.

Current threats to wetlands include invasion of noxious weeds and other alien plant species, more paved surfaces, channel downcutting, changes in flood hydrographs, and increasing human and pet use. Paving promotes stormwater runoff, which tends to downcut channels and dry out wetlands. Human use of public trails and fishing results in trampling which promotes weeds. Mowing and landscaping are also a threat.

Recommendations of the report include increased aggressiveness on weed management, developing a comprehensive strategy for controlling downcutting, increased set backs of greenway trails to reduce impacts to riparian areas, changes in landscape practices for wetland buffer areas, and increased public involvement and education regarding weed control, vegetation diversity, and reducing impacts associated with stormwater management problems.

The survey mapped 4 wetlands in the project area. One of these is Wetland No. 40404 - Goose Creek west of Foothills Parkway and east of railroad tracks. This portion of Goose Creek flows through a broad cattail marsh in a commercial/industrial area which was apparently modified as part of an urban drainage project. The entire segment is estimated at 1.5 acres in size. It is a seasonally flooded natural wetland whose primary water source is urban/industrial runoff. Although the wetland has been heavily manipulated , it performs many wetland functions very well, including flood attenuation, sediment trapping, and nutrient retention. Other functions are not provided, including active recreation, groundwater discharge and recharge, and shoreline stabilization (it has retaining walls rather than vegetation), food chain support (no leaf litter; immobile cattail debris; export restricted because outlet is partially dammed). Fish habitat and aquatic diversity is low because small fish and aquatic insects are found at the east end only, and there is no adjoining habitat to function well for wildlife. This wetland was one of 11

wetlands in the city that was listed as an "exemplary wetland" in terms of "functions, size, and vegetation quality (multiple vegetation strata, dominance by native vegetation, unusual plant communities, and small amounts of noxious weeds.)" Table 2 summarizes the functional assessment:

Table 2. Summary of Functional Assessment for Wetlands in Study Area

	Wetland Number/Ranking			
Function	**40404***	**40405**	**40406**	**40407**
Size (acres)	1.5	3.2	1.1	1.7
Groundwater Recharge	2	4	1	1
Groundwater Discharge	1	1	1	3
Floodflow Alteration	4	4	3	4
Streambank Anchoring	2	1	1	3
Sediment Retention	4	2	2	4
Long-Term Nutrient Retention	4	1	2	4
Short-Term Nutrient Retention	4	2	2	4
Food Chain Support Downstream	2	1	2	3
Foot Chain Support In-basin	3	2	2	4
Fish/Aquatic Habitat	2	1	1	3
Wildlife Habitat	2	1	1	3
Active Recreation	1	1	1	2
Passive Recreation	2	2	2	4

* Just outside of Project Area, but is a model wetland.

5 Very High

4 High

3 Moderate

2 Low

1 Very low

Highly ranked (4 or 5) functions are highlighted in blue, and lower ranked are in red.

3.0 City of Boulder Tributary Greenways Program

Riparian Habitat Assessment Vegetation Evaluation Final Report, November 12, 1999 prepared for: Ann Noble City of Boulder Tributary-Greenways Coordinator prepared by: Mark Gershman, Consulting Naturalist

The city of Boulder conducted a vegetation assessment of the riparian habitat along several creeks in Boulder (Gershman 1999). Lower Goose Creek below Foothills Parkway was one of the reaches evaluated. Lower Goose Creek was investigated in the summer of 1999 and information regarding the following was recorded: (a) canopy cover; (b) ground cover; (c) location, extent and density of weed infestations; (d) number, species and condition of snags; and (e)vegetation height. In addition, an evaluation of each reach was made to determine if it had the potential to serve as habitat for the Ute ladies tresses orchid or Preble's meadow jumping mouse.

4.0 Wildlife Inventory & Evaluation for Goose Creek Section 206 Project Area, Boulder, Colorado. December 20, 2007

The follow report summarizes the wildlife inventory and evaluation project which Biohabitats, Inc. conducted as part of USACE (US Army Corps of Engineers) requirements for the Goose Creek restoration project in Boulder, CO (Figure 1). The purpose of the project was to assist the USACE in considering wildlife resources in the formulation and evaluation of alternative restoration plans.

4.1 SCOPE OF WORK

In accordance with the agreed upon Scope of Work authorized September 21, 2007, Biohabitats has completed the following tasks which focused on describing current habitat type and condition, potential wildlife species, and potential restoration benefits for habitat.

Task 1. Habitat Type & Condition. We reviewed and summarized previous

habitat assessments and have summarized physical characteristics and conditions based on available information from the aquatic habitat assessment, riparian vegetation assessment, and PIF scores. We visited the site to observe general habitat conditions including plant communities, channel conditions, and invasive plant species.

Task 2. Potential Current Species. We reviewed the Natural Diversity Information Source (NDIS) wildlife species list for Boulder County and wildlife species range maps to prepare tables of potential mammals, birds, reptiles, and amphibians with the potential for breeding in the project area. We included information on species habitat requirements and noted federally listed threatened and endangered species (T&E).

Task 3. Potential Restoration Benefits. We conducted phone interviews and consulted with key contacts regarding how various species may benefit from the stream and habitat restoration. We evaluated which new species or uses may occur in the project area after restoration, and identified design criteria needed to achieve benefits for key species.

Due to the small size of the project, the scope of work did not include detailed field work or an assessment of aquatic habitat for fish. Although a field review was conducted during the 2007 growing season, detailed inventory, characterization, and mapping was outside the scope of this project.

4.2 HABITAT TYPES AND CONDITIONS

The USACE has designated six reaches within the Goose Creek Section 206 project area (Figure 1). We visited the reaches on two occasions between June and December 2007 to observe current native plant communities, stream banks, and hydrologic conditions as indicators of habitat characteristics such as cover, connectivity and obstructions, and food sources.

4.2.1 Habitat Types

Currently, most of the stream reaches within the restoration project area lack native riparian plant communities. The dominant vegetation, especially in Reaches 1 through 4, is bluegrass lawn with only very minor areas of wetland vegetation mainly between the large rocks lining the channel or around the small ponded area of Reach 2. Reach 5a is vegetated with a cattail marsh with minor areas of willow and scattered volunteer plains cottonwood saplings. Reach 5b contains a small pond with adjacent willow areas. Reach 6 is the Cottonwood Pond area. Very minor areas of emergent vegetation are present adjacent to the pond and are most concentrated in the area of the pond outlet. Woody vegetation is mainly Russian-olive (State of Colorado B List Noxious Weed) although several small plains cottonwoods are present.

The abiotic elements of the study area include a concrete-lined channel bordered by large boulders, large areas of riprap, and three concrete box culverts (CBCs). Additionally, a bridge crossing Boulder Creek is present just east of the study area and confluence of Goose Creek and Boulder Creek.

Based on our experience in the Boulder area, the range of native habitat types for this portion of Goose Creek could potentially include: prairie grassland, marsh, riparian willows and shrubs, and deciduous riparian forest dominated by plains cottonwood with a native shrub and grass understory. Table 1 summarizes which of these habitat types are present in each of the Goose Creek project reaches. It is evident from the table that native vegetation suitable for wildlife habitat is almost entirely absent from Reaches 1-4. Additionally, while minor riparian shrub land is present in reaches 5-7, there is essentially no tree canopy present throughout the entire project area.

Table 1. Goose Creek Section 206 Existing Habitat by Project Reach

Section 206 Project Reach #	Stream	Pond	Prairie Grassland	Marsh	Riparian Willows, Shrubs	Deciduous Riparian Forest, Cottonwoods	Concrete box culverts, Bridges
1	Yes	No	No	No	Very minor willows, tree-of-heave	No	CBC

2	Yes	No	No, Prairie dog colony	No	No	Small cottonwood grove developing	No
3	Short reach	Yes – Cotton-wood Pond	Some weedy upland grass areas, Prairie dog colony	Yes – at pond outlet, very minor marsh patches along shoreline	Several willow patches, dense Russian-olive along north shore line	No, small cottonwood area and crack willow area northwest of pond	Bridge to northeast

Note: Riprap which is present in all of the reaches provides minor rocky habitat, but also limits wildlife movement.

4.2.2. Habitat Conditions

Multiple habitat assessments have been conducted for the City of Boulder between 1995 and 2004 and have included the project area. Summaries of the physical characteristics and information from these previous reports that relate to the project area are provided below. More detail is provided in the Attachments.

Riparian Habitat Assessment -- Vegetation. The City of Boulder Tributary Greenways Program conducted a Riparian Habitat Assessment, Vegetation Evaluation in 1999 which included field data collection for canopy cover, ground cover, weeds, snags, and vegetation height. The reaches were also assessed for potential habitat for T&E species (Ute ladies tresses orchid or Preble's meadow jumping mouse). Goose Creek was not listed as a possible location for T&E species at the time of the assessment. The reaches were also ranked for native plant habitat and vegetative structure using a weighted method (described in detail in Gershman 1999). A summary table of the vegetation scores and cross references to corresponding USACE project reaches is shown in Table 2. As shown in the table, most of the project reaches scored very low (poor) for total structure and in the mid-range for native plant habitat, with the exception of GC15 (near pond) which scored fairly well for native plant habitat.

Table 2. Summary of Riparian Habitat Assessment Vegetation Evaluation for Goose Creek Reaches within Project Area

Section 206 Project Reach ID	*Riparian Habitat Assessment Reach ID*	*Total Structure Scores (range from 2.5-17)*	*Native Plant Habitat (0-21)*	*Riparian Width (meters)*
1	GC13	4.5	9	2
2	GC14	5.0	14	2
2	GC15	5.0	17	2
3	GC16	2.5	9	25

Riparian Habitat Assessment -- Birds. A bird inventory was also conducted as part of the City of Boulder Tributary Greenways Program Riparian Habitat Assessment (Stone, 1999). The inventory measured bird diversity within major reaches of stream corridors to assess priorities for habitat protection and improvement. Species richness (SR) was measured by counting the number of species at each point location and then weighting the species based on Partners in Flight (PIF) species values which account for criteria such as population trends. Count locations are from a very similar drainage located approximately ¼ mile north of the Goose Creek and can be considered generally representative of conditions in the project area. The results characterized Goose Creek as a "cold spot" in the City based on its very low bird biodiversity scores (Table 3).

Table 3. Summary of Bird Diversity Information For Nearby Goose Creek Reaches

Stone 1999 Site ID	*SR*	*PIF*	*Overall value for city-wide ranking of riparian areas*
GCRH03	7.338	86	Average
GCRH04	6	65.667	Average
GCRH05	3.667	43	Lowest, Average
GCRH06	3	41.5	Average

See Appendix C in Stone's 1999 report for details on locations and statistics.

Aquatic Habitat. In 1995, a stream habitat assessment study was conducted (Laninga, T. 1995) using a modified rapid assessment field data collection approach (see attached example data form). The method scored habitat conditions based on the following categories of poor (0-3), marginal (4-6), suboptimal (7-9), and optimal (0-12). The aquatic habitat scores for each of the project reaches are presented below in Table 4.

Table 4. Summary of Riparian Habitat Assessment Vegetation Evaluation for Goose Creek reaches within Project Area

		Primary				Secondary			Tertiary			Total Points (overall range of 17-129)
Section 206 Project Reach #	Riparian Habitat Assessment Reach	Instream Cover	Epifaunal Substrate	Embeddednes	Channel Flow Status	Channel Alteration	Sediment Deposition	Riffles Frequency	Bank Veg Avg	Avg Bank Stability	Avg Riparian Width	
Reach 1	GC13	6	0	0	3	2	7	0	3.0	8.0	3.0	46
Reach 2	GC14	2	0	0	3	2	7	0	2.0	8.0	3.0	39
Reach 2	GC15	3	0	6	3	2	7	0	2.0	9.0	2.0	49
Reach 3	GC16	1	0	0	3	1	10	0	2.0	9.0	2.0	40

As the above table shows, the tertiary parameters describe terrestrial habitat conditions in the study area. The project reach scores were categorized as “poor” for riparian width, “poor” bank vegetation, and “suboptimal” for bank stability.

4.2.3 Habitat Constraints

Based on our observations of channel morphology throughout the City of Boulder, the project area of Goose Creek is located in the portion of the city which typically has streams with low gradients, well defined floodplains, gentle meanders, and sandy streambeds. Viability of these systems is affected by the hydrologic regime and the interrelationship between groundwater and surface water, which affect baseflow, flooding, and depth to groundwater beneath adjoining or nearby wetlands and other

riparian areas.

As the available habitat assessment information show, the condition of wildlife habitat in the project reaches is relatively poor. The limited habitat is due to a number of reasons including narrow riparian width, low flows, riprap, concrete stream bed, fragmentation, and low cover by native plants, and lack of vegetation structure. The existing reach lacks diverse and abundant wildlife species because of a lack of protection from predators, lack of shelter areas, very limited food resources, and certain water quality conditions (e.g., appropriate temperature), which are in turn functions of the streambed (instream cover, epifaunal substrate, embeddedness), flow characteristics, channel morphology (channel alteration, riffle frequency, and sediment deposition) and bank stability (bank vegetation, bank stability, and riparian width).

4.3 WILDLIFE SPECIES WITH CURRENT OR POTENTIAL HABITAT

We used the Colorado Division of Wildlife county wildlife lists based on the National Diversity Information System (NDIS), Colorado Natural Heritage Program (CNHP) threatened and endangered species list (Niwot, CO topographic quadrangles), and available range data from the literature to prepare lists of potential amphibians, reptiles, mammals, and birds for the project area. Species which are not native to Colorado or have only peripheral habitat, or are very unlikely to occur even following restoration activities were removed from the initial listings to develop the summary species tables presented in the Attachments.

4.3.1 ***Potential Wildlife Species***

There are 5 amphibian, 45 bird, 34 mammal, and 16 reptile species identified with current or potential habitat in the Goose Creek project area. Of these 100 species, 6 are Federal and/or State Threatened or State Special Concern (northern leopard frog, burrowing owl, black-tailed prairie dog, northern pocket gopher, Preble's meadow jumping mouse, and common garter snake). Brief discussions of each wildlife group are provided below.

Amphibians. Colorado native amphibians which are potential in the Goose Creek project area are generally species associated with streams or ponds with adjacent wet meadows or marshes. Threats to amphibians include loss of wetland and riparian habitat and, for the northern leopard frog, the introduction of bull frog from the eastern US.

Birds. While there are many birds that could potentially visit Goose Creek, obligate riparian birds would be drawn to the restored area for abundant supply of food, notably insects, and nesting and protection opportunities provided by riparian vegetation and deciduous forest. Key bird species found in Boulder's riparian areas include neotropical migrants such as Bullock's oriole, common yellowthroat, and western wood-pewee; short-distant migrants such as the song sparrow; and permanent residents such as the American dipper and white-breasted nuthatch.

Mammals. Although the narrow width of the project area makes habitat for larger

mammals such as mule deer unlikely, improvement of cover, connectivity, and food supply will benefit numerous smaller mammals such as bats, voles, and fox.

Reptiles. Grasslands and riparian areas are the preferred habitat of many of the native reptiles which could inhabit a restored Goose Creek. The ponds could support turtles such as painted turtle, snapping turtle, and spiny softshell as well as northern water snake. Riparian areas would provide habitat for snakes including common garter snake, gopher snake and racer.

4.3.2 Wildlife Species Likely Present Based on Current Habitat

We cross-checked the preferred habitats for the list of potential species with the currently available habitat types. Although most of the species listed in the attachments could have a minor presence in the Goose Creek corridor, the very small areas of suitable habitat are likely to severely limit actual species presence. Species noted during Goose Creek reconnaissance surveys include red fox, rabbit, mallard, Canada goose, raven, and flicker. Mink is also recently reported. It appears that obligate riparian species such as American beaver, big brown bat, prairie vole, silver-haired bat, belted kingfisher, killdeeer, and western wood-Peewee are unlikely to be present due to the absence of appropriate conditions. Most of the current wildlife habitat is in project reaches 5a, 5B, and 6, the sites in the most natural condition where at least some open water, wetlands, and/or mature trees are present. The major habitat limitations are lack of structural diversity, trees and shrubs for shelter, food, and breeding site as well as the presence of adjacent businesses, high traffic roadway, and human presence along the pedestrian and bicycle trail. Marginal habitat for Federally threatened Preble's meadow jumping mouse is present in the riparian areas of Reaches 5a and 5b, although often-associated adjacent tallgrass prairie is not present.

4.4. HABITAT IMPROVEMENT RECOMMENDATIONS

A restoration project which creates a mosaic of prairie grassland, streams and ponds, riparian willows and shrubs, and deciduous riparian forests with cottonwoods of varying age class has the potential to support high diversity of wildlife in each class of species, in particular those impacted by loss of habitat. According to Jeremy Siemers, zoologist with the Colorado Natural Heritage Program, and William Keeley, wildlife ecologist with City of Boulder Open Space and Mountain Parks Department, restoration of native plant communities will by itself attract wildlife to the Goose Creek area. Especially important is the expansion and reestablishment of native willow and cottonwood. Control of invasive species currently in the project area such as such as Russian-olive, Chinese elm, and tree-of-heaven as well as species with the potential to infest streams and streambanks such as New Zealand mud snail, Eurasian water milfoil, purple loosestrife, is important in all project phases to prevent introduction and spread.

Amphibians. Important habitat improvements for amphibians include increase of stream length by addition of meanders and increase of native wet meadow, marsh, riparian willows, and grasslands. Limiting non-native bullfrog would potentially benefit the northern leopard frog, a species of State Special Concern.

Birds. Habitat improvements for birds are based on improvement and expansion of existing native habitats. Recommendations include:

- Creation of more shallow-water marshy areas and possibly nesting islands in Cottonwood Pond.
- Creation of streambank marshes vegetated with sedges, bulrush, cattail as well as restoration of stream meanders.
- Native willow planting of sandbar willow, Geyer's willow, and peach-leaved willow adjacent to the stream.
- Riparian shrub plantings in as much of the floodplain as possible to provide nesting sites and food sources as well as to provide screening from the human presence on Pearl Parkway and the bicycle/pedestrian path. Potential species include hawthorn, wild rose, skunkbrush, wild plum, chokecherry, and mountain maple.
- Establishment of a plains cottonwood grove with an understory of native shrubs and grasses. Once mature, this grove could potentially serve as a heronry for great blue heron.
- Creation of prairie grassland on above the riparian shrub zone.
- Removal of noxious weeds such as Russian-olive and Canada thistle as well as invasive tree-of-heaven and Siberian elm followed by replanting with native species.

Mammals. Mammal habitat improvement recommendations include:

- Native shrub and tree plantings with caging during plant establishment.
- Establish prairie grassland vegetation in Reaches 1 and 2 upslope of the riparian zone.
- As much as possible, establish native prairie grassland vegetation in the prairie dog towns.
- Removal of noxious weeds such as Russian-olive and Canada thistle as well as invasive tree-of-heaven and Siberian elm followed by replanting with native species.
- Removal of wide bands of riprap which impede use of the creek area as a wildlife movement zone.
- Although bat boxes can work under bridges, addition of rock or brush piles should not be necessary to reestablish other species.

Reptiles. Habitat improvements to benefit reptiles include:

- Provide a mosaic of ponds, stream, and native marshes and grasslands.
- Discourage pesticide use.
- Discourage killing of reptiles through education.

4.5 POSSIBLE FOLLOW-UP TASKS

According to Mark Gershman, Environmental Planner with the City of Boulder Open Space & Mountain Parks, the City is in the process of writing an Urban Wildlife Management Plan. As stated in the Prairie Dog Component of the Plan, the purpose is to: "1) establish policies and procedures for managing wildlife within the city on both public

and private land, and 2) outline a set of actions for long-term management of wildlife in the city." The Plan will manage wildlife species on an ecosystem level with the vision of providing for, "diverse self-sustaining, native wildlife populations in numbers compatible with basic human needs, social and economic values, and long-term ecological sustainability. . ." (City of Boulder, 2006) We recommend that the USACE review the existing and future Urban Wildlife Management Plan components to integrate relevant habitat management goals into the restoration project.

An evaluation of future habitat improvements will most likely need to be based on qualitative criteria and areas of habitat type rather than on individual species. This is in keeping with the City's approach of managing habitat on an ecosystem level. Therefore, a detailed map of existing habitat types could enable the USACE to quantify habitat areas before and after restoration for purposes of monitoring restoration effectiveness.

4.6 SUMMARY

Previous habitat assessments along the Goose Creek project reaches document the poor quality of the existing habitat conditions. Although most of the species listed in the attachments could have a minor presence in the Goose Creek corridor, the very small areas of suitable habitat are likely to severely limit actual species presence. The creation of a mosaic of natural plant communities would attract a much higher diversity of wildlife to the area by providing food, shelter, and breeding sites. Several design considerations which would achieve habitat benefits for multiple species include:

- Increasing the width of the riparian area to the maximum extent possible in the floodplain by removing riprap, regrading stream banks, and planting native riparian vegetation
- Establishment a hydrologic regime that supports marshes with sedge meadows, bulrush, and cattails adjacent to Cottonwood Pond and where ever possible along Goose Creek
- Removal of Russian-olive, Canada thistle, tree-of-heaven, Siberian elm, and other weed species.
- Removal of wide areas of riprap which limit habitat connectivity for wildlife.

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US Army Corps of Engineers ®
Omaha District

GOOSE CREEK
BOULDER, COLORADO

SECTION 206
ECOSYSTEM RESTORATION REPORT

APPENDIX A-2-B
COTTONWOOD POND
WATER QUALITY REPORT

JUNE 2011

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STL Denver
4955 Yarrow Street
Arvada, CO 80002

Tel: 303 736 0100 Fax: 303 431 7171
www.stl-inc.com

ANALYTICAL REPORT

USACE Goose Creek Project

Lot #: D7G200355

Ms. Betty Solek

City of Boulder/WQES
4049 N. 75th Street
Boulder, CO 80301

TestAmerica Denver
(formerly STL)

Dee Kettula
for **Donna Rydberg**
Project Manager

August 2, 2007

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Standard Deliverables

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Standard Deliverables *The **Cover Letter** and the **Report Cover** page are considered integral parts of this Standard Deliverable package. This report is incomplete unless all pages indicated in this Table of Contents are included.*	

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- **Executive Summary – Detection Highlights**
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Case Narrative

Enclosed is the report for five samples received at TestAmerica Denver on July 20, 2007. The results included in this report have been reviewed for compliance with TestAmerica's Laboratory Quality Manual. The test results shown in this report meet all requirements of NELAC and any exceptions are noted below. TestAmerica is NELAP approved for all parameters reported.

This report includes data with reporting limits (RLs) less than TestAmerica's standard reporting limits. These data and reporting limits are being used specifically to meet the needs of this project. Note that, data are not customarily reported to these levels without qualifiers, because they are inherently less reliable and potentially less defensible than the latest industry standards require. Please contact TestAmerica Denver for more details.

Dilution factors and footnotes have been provided to assist in the interpretation of the results. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at concentrations above the linear calibration curve, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

TestAmerica utilizes USEPA approved methods in all analytical work. The samples presented in this report were analyzed for the parameters listed on the analytical methods summary page in accordance with the methods indicated. A summary of quality control parameters is provided below.

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Quality Control Summary for Lot D7G200355

Sample Receiving

The cooler temperature upon receipt at the Denver laboratory was 4.8°C. All sample containers were received in acceptable condition.

Sample aliquots for the Grain Size analysis were subcontracted to TestAmerica Burlington located at 55 South Park Drive, Colchester, Vermont 05446. Please reference the laboratory at Burlington for the Grain Size report which is reported under separate cover.

Holding Times

All holding times were within established control limits.

Organochlorine Pesticides - Method SW846 8141A

During the extraction process, it was noted that samples D7G200355-001 through -005 were observed to contain two layers and an excess amount of water, requiring large amounts of Sodium Sulfate added as a drying agent. The analyst noted that sample D7G200355-003 was black and had a tar like consistency.

Each sample is analyzed to achieve the lowest possible reporting limits within the constraints of the methods. Sample D7G200355-003 was analyzed at a dilution due to matrix effect that resulted in failures in the closing Continuing Calibration Verification (CCV) standard. The reporting limits have been adjusted relative to the dilution required.

The surrogate recoveries for sample D7G200355-003 could not be calculated because the extracts were diluted beyond the ability to quantitate recoveries.

Matrix spike analyses were performed on sample D7G200355-002. The MS and/or MSD associated with batch 7206449 exhibited spike compound recoveries below the QC limits for Phorate and o,o,o-Triethylphosphorothioate. The acceptable LCS analysis data indicated that the analytical system was operating within control; therefore, corrective action is deemed unnecessary.

The Continuing Calibration Verification (CCV) standards associated with samples D7G200355-001 through -005 exhibited %Difference (%D) values out of range for Dichlorvos and Naled. The overall mean %D is within control limits; therefore, method criteria have been met and corrective action is deemed unnecessary.

No other anomalies were observed.

Total Metals – Method SW846 6010B & 7471A

Percent recoveries and RPD data could not be calculated for the laboratory generated 6010B MS/MSD due to the sample concentration reading greater than four times the spike amount for Iron.

No anomalies were observed.

General Chemistry – Methods MCAWW 350.1 & SW846 9060

A low level of Ammonia is present in the method blank associated with batch 7206323. Because the concentration in the method blank is not present at a level greater than the reporting limit, corrective action is deemed unnecessary. Associated results in the analytical report have been flagged with a "J".

No other anomalies were observed.

EXECUTIVE SUMMARY - Detection Highlights

D7G200355

PARAMETER	RESULT	REPORTING LIMIT	UNITS	ANALYTICAL METHOD
CWP#1 07/19/07 02:55 001				
Mercury	37	33	ug/kg	SW846 7471A
Arsenic	2.1	2.0	mg/kg	SW846 6010B
Copper	8.0	2.0	mg/kg	SW846 6010B
Iron	9400	15	mg/kg	SW846 6010B
Lead	7.5	0.80	mg/kg	SW846 6010B
Zinc	27	3.0	mg/kg	SW846 6010B
Total Organic Carbon	4.7	2.0	g/kg	SW846 9060
Ammonia as N	0.63 B,J	1.0	mg/kg	MCAWW 350.1
CWP#2 07/19/07 03:15 002				
Mercury	6.1 B	33	ug/kg	SW846 7471A
Arsenic	2.4	2.0	mg/kg	SW846 6010B
Copper	4.1	2.0	mg/kg	SW846 6010B
Iron	7000	15	mg/kg	SW846 6010B
Lead	4.2	0.80	mg/kg	SW846 6010B
Zinc	16	3.0	mg/kg	SW846 6010B
CWP#3 07/19/07 03:25 003				
Mercury	26 B	33	ug/kg	SW846 7471A
Arsenic	1.6 B	2.0	mg/kg	SW846 6010B
Copper	15	2.0	mg/kg	SW846 6010B
Iron	7900	15	mg/kg	SW846 6010B
Lead	14	0.80	mg/kg	SW846 6010B
Zinc	84	3.0	mg/kg	SW846 6010B
Total Organic Carbon	43	2.0	g/kg	SW846 9060
Ammonia as N	5.3 J	1.0	mg/kg	MCAWW 350.1
WL#1 07/19/07 03:45 004				
Mercury	23 B	33	ug/kg	SW846 7471A
Arsenic	5.4	2.0	mg/kg	SW846 6010B
Copper	14	2.0	mg/kg	SW846 6010B
Iron	16000	15	mg/kg	SW846 6010B
Lead	10	0.80	mg/kg	SW846 6010B
Zinc	55	3.0	mg/kg	SW846 6010B
CWP#4 07/19/07 04:00 005				
Mercury	32 B	33	ug/kg	SW846 7471A
Arsenic	5.3	2.0	mg/kg	SW846 6010B
Copper	17	2.0	mg/kg	SW846 6010B

(Continued on next page)

EXECUTIVE SUMMARY - Detection Highlights

D7G200355

PARAMETER	RESULT	REPORTING LIMIT	UNITS	ANALYTICAL METHOD
CWP#4 07/19/07 04:00 005				
Iron	19000	15	mg/kg	SW846 6010B
Lead	13	0.80	mg/kg	SW846 6010B
Zinc	67	3.0	mg/kg	SW846 6010B

METHODS SUMMARY

D7G200355

PARAMETER	ANALYTICAL METHOD	PREPARATION METHOD
Inductively Coupled Plasma (ICP) Metals	SW846 6010B	SW846 3050B
Mercury in Solid Waste (Manual Cold-Vapor)	SW846 7471A	SW846 7471A
Nitrogen, Ammonia	MCAWW 350.1	MCAWW 350.1
Organophosphorous Compounds by GC	SW846 8141A	
Total Organic Carbon	SW846 9060	SW846 9060

References:

MCAWW "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, March 1983 and subsequent revisions.

SW846 "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 and its updates.

METHOD / ANALYST SUMMARY

D7G200355

ANALYTICAL METHOD	ANALYST	ANALYST ID
MCAWW 350.1	Roxanne K. Sullivan	001200
SW846 6010B	Lynn-Anne Trudell	6645
SW846 7471A	David Wells	005099
SW846 8141A	Teresa L. Williams	002510
SW846 9060	Eva Jonska-Muteba	004988

References:

MCAWW "Methods for Chemical Analysis of Water and Wastes", EPA-600/4-79-020, March 1983 and subsequent revisions.

SW846 "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 and its updates.

SAMPLE SUMMARY

D7G200355

WO #	SAMPLE#	CLIENT SAMPLE ID	SAMPLED DATE	SAMP TIME
J3AMJ	001	CWP#1	07/19/07	02:55
J3AMM	002	CWP#2	07/19/07	03:15
J3AMN	003	CWP#3	07/19/07	03:25
J3AMQ	004	WL#1	07/19/07	03:45
J3AM1	005	CWP#4	07/19/07	04:00

NOTE(S):

- The analytical results of the samples listed above are presented on the following pages.
- All calculations are performed before rounding to avoid round-off errors in calculated results.
- Results noted as "ND" were not detected at or above the stated limit.
- This report must not be reproduced, except in full, without the written approval of the laboratory.
- Results for the following parameters are never reported on a dry weight basis: color, corrosivity, density, flashpoint, ignitability, layers, odor, paint filter test, pH, porosity pressure, reactivity, redox potential, specific gravity, spot tests, solids, solubility, temperature, viscosity, and weight.

Cash in Advance / Prepaid Sales

Client Sample ID: CWP#1

GC Semivolatiles

Lot-Sample #...: D7G200355-001 **Work Order #...:** J3AMJ2AJ **Matrix.....:** SOLID
Date Sampled...: 07/19/07 02:55 **Date Received..:** 07/20/07
Prep Date.....: 07/25/07 **Analysis Date..:** 08/01/07
Prep Batch #...: 7206449 **Analysis Time..:** 01:20
Dilution Factor: 1

Method.....: SW846 8141A

PARAMETER	RESULT	REPORTING LIMIT	UNITS
Atrazine	ND	67	ug/kg

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Chlormefos	46	(42 - 132)
Triphenyl phosphate	98	(47 - 161)

Cash in Advance / Prepaid Sales

Client Sample ID: CWP#2

GC Semivolatiles

Lot-Sample #...: D7G200355-002 **Work Order #...:** J3AMM2AG **Matrix.....:** SOLID
Date Sampled...: 07/19/07 03:15 **Date Received..:** 07/20/07
Prep Date.....: 07/25/07 **Analysis Date..:** 08/01/07
Prep Batch #...: 7206449 **Analysis Time..:** 02:35
Dilution Factor: 1

Method.....: SW846 8141A

PARAMETER	RESULT	REPORTING LIMIT	UNITS
Atrazine	ND	67	ug/kg

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Chlormefos	52	(42 - 132)
Triphenyl phosphate	97	(47 - 161)

Cash in Advance / Prepaid Sales

Client Sample ID: CWP#3

GC Semivolatiles

Lot-Sample #...: D7G200355-003 **Work Order #...:** J3AMN2AJ **Matrix.....:** SOLID
Date Sampled...: 07/19/07 03:25 **Date Received..:** 07/20/07
Prep Date.....: 07/25/07 **Analysis Date..:** 08/01/07
Prep Batch #...: 7206449 **Analysis Time..:** 03:00
Dilution Factor: 10

Method.....: SW846 8141A

PARAMETER	RESULT	REPORTING LIMIT	UNITS
Atrazine	ND	670	ug/kg

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Chlormefos	NC,DIL	(42 - 132)
Triphenyl phosphate	NC,DIL	(47 - 161)

NOTE(S):

NC The recovery and/or RPD were not calculated.

DIL The concentration is estimated or not reported due to dilution or the presence of interfering analytes.

Cash in Advance / Prepaid Sales

Client Sample ID: WL#1

GC Semivolatiles

Lot-Sample #...: D7G200355-004 **Work Order #...:** J3AMQ2AG **Matrix.....:** SOLID
Date Sampled...: 07/19/07 03:45 **Date Received..:** 07/20/07
Prep Date.....: 07/25/07 **Analysis Date..:** 08/01/07
Prep Batch #...: 7206449 **Analysis Time..:** 03:50
Dilution Factor: 1

Method.....: SW846 8141A

PARAMETER	RESULT	REPORTING LIMIT	UNITS
Atrazine	ND	67	ug/kg

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Chlormefos	55	(42 - 132)
Triphenyl phosphate	108	(47 - 161)

Cash in Advance / Prepaid Sales

Client Sample ID: CWP#4

GC Semivolatiles

Lot-Sample #...: D7G200355-005 **Work Order #...:** J3AM12AG **Matrix.....:** SOLID
Date Sampled...: 07/19/07 04:00 **Date Received..:** 07/20/07
Prep Date.....: 07/25/07 **Analysis Date..:** 08/01/07
Prep Batch #...: 7206449 **Analysis Time..:** 04:15
Dilution Factor: 1

Method.....: SW846 8141A

PARAMETER	RESULT	REPORTING LIMIT	UNITS
Atrazine	ND	67	ug/kg

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Chlormefos	52	(42 - 132)
Triphenyl phosphate	104	(47 - 161)

Cash in Advance / Prepaid Sales

Client Sample ID: CWP#1

TOTAL Metals

Lot-Sample #...: D7G200355-001 Matrix.....: SOLID
Date Sampled...: 07/19/07 02:55 Date Received..: 07/20/07

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD	PREPARATION-ANALYSIS DATE	WORK ORDER #
Prep Batch #...: 7205124						
Arsenic	2.1	2.0	mg/kg	SW846 6010B	07/24-07/25/07	J3AMJ1AD
		Dilution Factor: 1		Analysis Time..: 14:38		
Copper	8.0	2.0	mg/kg	SW846 6010B	07/24-07/25/07	J3AMJ1AE
		Dilution Factor: 1		Analysis Time..: 14:38		
Iron	9400	15	mg/kg	SW846 6010B	07/24-07/25/07	J3AMJ1AF
		Dilution Factor: 1		Analysis Time..: 14:38		
Lead	7.5	0.80	mg/kg	SW846 6010B	07/24-07/25/07	J3AMJ1AG
		Dilution Factor: 1		Analysis Time..: 14:38		
Zinc	27	3.0	mg/kg	SW846 6010B	07/24-07/25/07	J3AMJ1AH
		Dilution Factor: 1		Analysis Time..: 14:38		
Prep Batch #...: 7207200						
Mercury	37	33	ug/kg	SW846 7471A	07/30/07	J3AMJ1AL
		Dilution Factor: 1		Analysis Time..: 17:47		

Cash in Advance / Prepaid Sales

Client Sample ID: CWP#2

TOTAL Metals

Lot-Sample #...: D7G200355-002 **Matrix.....:** SOLID
Date Sampled...: 07/19/07 03:15 **Date Received..:** 07/20/07

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD	PREPARATION-ANALYSIS DATE	WORK ORDER #
Prep Batch #...: 7205124						
Arsenic	2.4	2.0	mg/kg	SW846 6010B	07/24-07/25/07	J3AMM1AA
		Dilution Factor: 1		Analysis Time..: 14:43		
Copper	4.1	2.0	mg/kg	SW846 6010B	07/24-07/25/07	J3AMM1AC
		Dilution Factor: 1		Analysis Time..: 14:43		
Iron	7000	15	mg/kg	SW846 6010B	07/24-07/25/07	J3AMM1AD
		Dilution Factor: 1		Analysis Time..: 14:43		
Lead	4.2	0.80	mg/kg	SW846 6010B	07/24-07/25/07	J3AMM1AE
		Dilution Factor: 1		Analysis Time..: 14:43		
Zinc	16	3.0	mg/kg	SW846 6010B	07/24-07/25/07	J3AMM1AF
		Dilution Factor: 1		Analysis Time..: 14:43		
Prep Batch #...: 7207200						
Mercury	6.1 B	33	ug/kg	SW846 7471A	07/30/07	J3AMM1AL
		Dilution Factor: 1		Analysis Time..: 17:50		

NOTE(S):

B Estimated result. Result is less than RL.

Cash in Advance / Prepaid Sales

Client Sample ID: CWP#3

TOTAL Metals

Lot-Sample #...: D7G200355-003 **Matrix.....:** SOLID
Date Sampled...: 07/19/07 03:25 **Date Received..:** 07/20/07

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD	PREPARATION-ANALYSIS DATE	WORK ORDER #
Prep Batch #...: 7205124						
Arsenic	1.6 B	2.0	mg/kg	SW846 6010B	07/24-07/25/07	J3AMN1AD
		Dilution Factor: 1		Analysis Time..: 14:48		
Copper	15	2.0	mg/kg	SW846 6010B	07/24-07/25/07	J3AMN1AE
		Dilution Factor: 1		Analysis Time..: 14:48		
Iron	7900	15	mg/kg	SW846 6010B	07/24-07/25/07	J3AMN1AF
		Dilution Factor: 1		Analysis Time..: 14:48		
Lead	14	0.80	mg/kg	SW846 6010B	07/24-07/25/07	J3AMN1AG
		Dilution Factor: 1		Analysis Time..: 14:48		
Zinc	84	3.0	mg/kg	SW846 6010B	07/24-07/25/07	J3AMN1AH
		Dilution Factor: 1		Analysis Time..: 14:48		
Prep Batch #...: 7207200						
Mercury	26 B	33	ug/kg	SW846 7471A	07/30/07	J3AMN1AL
		Dilution Factor: 1		Analysis Time..: 17:52		

NOTE(S):

B Estimated result. Result is less than RL.

Cash in Advance / Prepaid Sales

Client Sample ID: WL#1

TOTAL Metals

Lot-Sample #...: D7G200355-004 **Matrix.....:** SOLID
Date Sampled...: 07/19/07 03:45 **Date Received..:** 07/20/07

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD	PREPARATION-ANALYSIS DATE	WORK ORDER #
Prep Batch #...: 7205124						
Arsenic	5.4	2.0	mg/kg	SW846 6010B	07/24-07/25/07	J3AMQ1AA
		Dilution Factor: 1		Analysis Time..: 14:53		
Copper	14	2.0	mg/kg	SW846 6010B	07/24-07/25/07	J3AMQ1AC
		Dilution Factor: 1		Analysis Time..: 14:53		
Iron	16000	15	mg/kg	SW846 6010B	07/24-07/25/07	J3AMQ1AD
		Dilution Factor: 1		Analysis Time..: 14:53		
Lead	10	0.80	mg/kg	SW846 6010B	07/24-07/25/07	J3AMQ1AE
		Dilution Factor: 1		Analysis Time..: 14:53		
Zinc	55	3.0	mg/kg	SW846 6010B	07/24-07/25/07	J3AMQ1AF
		Dilution Factor: 1		Analysis Time..: 14:53		
Prep Batch #...: 7207200						
Mercury	23 B	33	ug/kg	SW846 7471A	07/30/07	J3AMQ1AH
		Dilution Factor: 1		Analysis Time..: 17:54		

NOTE(S):

B Estimated result. Result is less than RL.

Cash in Advance / Prepaid Sales

Client Sample ID: CWP#4

TOTAL Metals

Lot-Sample #...: D7G200355-005 **Matrix.....:** SOLID
Date Sampled...: 07/19/07 04:00 **Date Received..:** 07/20/07

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD	PREPARATION-ANALYSIS DATE	WORK ORDER #
Prep Batch #...: 7205124						
Arsenic	5.3	2.0	mg/kg	SW846 6010B	07/24-07/25/07	J3AM11AA
		Dilution Factor: 1		Analysis Time..: 14:58		
Copper	17	2.0	mg/kg	SW846 6010B	07/24-07/25/07	J3AM11AC
		Dilution Factor: 1		Analysis Time..: 14:58		
Iron	19000	15	mg/kg	SW846 6010B	07/24-07/25/07	J3AM11AD
		Dilution Factor: 1		Analysis Time..: 14:58		
Lead	13	0.80	mg/kg	SW846 6010B	07/24-07/25/07	J3AM11AE
		Dilution Factor: 1		Analysis Time..: 14:58		
Zinc	67	3.0	mg/kg	SW846 6010B	07/24-07/25/07	J3AM11AF
		Dilution Factor: 1		Analysis Time..: 14:58		
Prep Batch #...: 7207200						
Mercury	32 B	33	ug/kg	SW846 7471A	07/30/07	J3AM11AJ
		Dilution Factor: 1		Analysis Time..: 17:56		

NOTE(S):

B Estimated result. Result is less than RL.

Cash in Advance / Prepaid Sales

Client Sample ID: CWP#1

General Chemistry

Lot-Sample #...: D7G200355-001 **Work Order #...:** J3AMJ **Matrix.....:** SOLID
Date Sampled...: 07/19/07 02:55 **Date Received..:** 07/20/07

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION-ANALYSIS DATE	PREP BATCH #
Ammonia as N	0.63 B,J	1.0	mg/kg	MCAWW 350.1	07/24/07	7206323
		Dilution Factor: 1		Analysis Time..: 09:00		
Total Organic Carbon	4.7	2.0	g/kg	SW846 9060	07/26-07/27/07	7207484
		Dilution Factor: 1		Analysis Time..: 10:30		

NOTE(S):

RL Reporting Limit

B Estimated result. Result is less than RL.

J Method blank contamination. The associated method blank contains the target analyte at a reportable level.

Cash in Advance / Prepaid Sales

Client Sample ID: CWP#3

General Chemistry

Lot-Sample #...: D7G200355-003 **Work Order #...:** J3AMN **Matrix.....:** SOLID
Date Sampled...: 07/19/07 03:25 **Date Received..:** 07/20/07

PARAMETER	RESULT	RL	UNITS	METHOD	PREPARATION-ANALYSIS DATE	PREP BATCH #
Ammonia as N	5.3 J	1.0	mg/kg	MCAWW 350.1	07/24/07	7206323
		Dilution Factor: 1		Analysis Time..: 09:00		
Total Organic Carbon	43	2.0	g/kg	SW846 9060	07/26-07/27/07	7207484
		Dilution Factor: 1		Analysis Time..: 10:30		

NOTE(S):

RL Reporting Limit

J Method blank contamination. The associated method blank contains the target analyte at a reportable level.

QC DATA ASSOCIATION SUMMARY

D7G200355

Sample Preparation and Analysis Control Numbers

SAMPLE#	MATRIX	ANALYTICAL METHOD	LEACH BATCH #	PREP BATCH #	MS RUN#
001	SOLID	SW846 9060		7207484	7208267
	SOLID	SW846 7471A		7207200	7207096
	SOLID	SW846 8141A		7206449	7206279
	SOLID	SW846 6010B		7205124	7205080
	SOLID	MCAWW 350.1		7206323	7206189
002	SOLID	SW846 7471A		7207200	7207096
	SOLID	SW846 8141A		7206449	7206279
	SOLID	SW846 6010B		7205124	7205080
003	SOLID	SW846 9060		7207484	7208267
	SOLID	SW846 7471A		7207200	7207096
	SOLID	SW846 8141A		7206449	7206279
	SOLID	SW846 6010B		7205124	7205080
	SOLID	MCAWW 350.1		7206323	7206189
004	SOLID	SW846 7471A		7207200	7207096
	SOLID	SW846 8141A		7206449	7206279
	SOLID	SW846 6010B		7205124	7205080
005	SOLID	SW846 7471A		7207200	7207096
	SOLID	SW846 8141A		7206449	7206279
	SOLID	SW846 6010B		7205124	7205080

METHOD BLANK REPORT

GC Semivolatiles

Client Lot #...: D7G200355
MB Lot-Sample #: D7G250000-449
Work Order #...: J3JLN1AA
Matrix.....: SOLID
Prep Date.....: 07/25/07
Analysis Time..: 00:30
Analysis Date..: 08/01/07
Prep Batch #...: 7206449
Dilution Factor: 1

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD
Atrazine	ND	67	ug/kg	SW846 8141A

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Chlormefos	49	(42 - 132)
Triphenyl phosphate	87	(47 - 161)

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

LABORATORY CONTROL SAMPLE EVALUATION REPORT

GC Semivolatiles

Client Lot #...: D7G200355 Work Order #...: J3JLN1AC Matrix.....: SOLID
LCS Lot-Sample#: D7G250000-449
Prep Date.....: 07/25/07 Analysis Date..: 08/01/07
Prep Batch #...: 7206449 Analysis Time..: 00:55
Dilution Factor: 1

PARAMETER	PERCENT RECOVERY	RECOVERY LIMITS	METHOD
Demeton (total)	46	(10 - 123)	SW846 8141A
Diazinon	61	(49 - 122)	SW846 8141A
Malathion	76	(49 - 124)	SW846 8141A
Phorate	53	(45 - 115)	SW846 8141A
Methyl parathion	74	(51 - 115)	SW846 8141A
Azinphos-methyl	89	(21 - 145)	SW846 8141A
Chlorpyrifos	68	(57 - 115)	SW846 8141A
Coumaphos	84	(42 - 129)	SW846 8141A
Dichlorvos	66	(25 - 147)	SW846 8141A
Dimethoate	73	(10 - 156)	SW846 8141A
Disulfoton	49	(10 - 133)	SW846 8141A
Ethoprop	61	(51 - 119)	SW846 8141A
Famphur	88	(33 - 144)	SW846 8141A
Fensulfothion	91	(47 - 123)	SW846 8141A
Fenthion	72	(52 - 115)	SW846 8141A
Mevinphos	64	(15 - 143)	SW846 8141A
Tetrachlorvinphos	79	(30 - 130)	SW846 8141A
Thionazin	63	(50 - 124)	SW846 8141A
Ronnel	61	(46 - 115)	SW846 8141A
Sulfotepp	55	(41 - 123)	SW846 8141A
Trichloronate	63	(50 - 115)	SW846 8141A
Ethyl parathion	77	(38 - 134)	SW846 8141A
Simazine	92	(11 - 162)	SW846 8141A
O,O,O-Triethylphosphorothioate	55	(50 - 150)	SW846 8141A
Parathion	77	(38 - 134)	SW846 8141A
Atrazine	84	(50 - 150)	SW846 8141A

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Chlormefos	53	(42 - 132)
Triphenyl phosphate	105	(47 - 161)

(Continued on next page)

LABORATORY CONTROL SAMPLE EVALUATION REPORT

GC Semivolatiles

Client Lot #...: D7G200355 **Work Order #...:** J3JLN1AC **Matrix.....:** SOLID
LCS Lot-Sample#: D7G250000-449

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

Bold print denotes control parameters

LABORATORY CONTROL SAMPLE DATA REPORT

GC Semivolatiles

Client Lot #...: D7G200355 Work Order #...: J3JLN1AC Matrix.....: SOLID
LCS Lot-Sample#: D7G250000-449
Prep Date.....: 07/25/07 Analysis Date..: 08/01/07
Prep Batch #...: 7206449 Analysis Time..: 00:55
Dilution Factor: 1

PARAMETER	SPIKE AMOUNT	MEASURED AMOUNT	UNITS	PERCENT RECOVERY	METHOD
Demeton (total)	130	60.0	ug/kg	46	SW846 8141A
Diazinon	130	79.7	ug/kg	61	SW846 8141A
Malathion	130	98.8	ug/kg	76	SW846 8141A
Phorate	130	69.3	ug/kg	53	SW846 8141A
Methyl parathion	130	95.6	ug/kg	74	SW846 8141A
Azinphos-methyl	130	116	ug/kg	89	SW846 8141A
Chlorpyrifos	130	88.5	ug/kg	68	SW846 8141A
Coumaphos	130	109	ug/kg	84	SW846 8141A
Dichlorvos	130	85.9	ug/kg	66	SW846 8141A
Dimethoate	130	95.0	ug/kg	73	SW846 8141A
Disulfoton	130	63.9	ug/kg	49	SW846 8141A
Ethoprop	130	79.1	ug/kg	61	SW846 8141A
Famphur	260	229	ug/kg	88	SW846 8141A
Fensulfothion	130	118	ug/kg	91	SW846 8141A
Fenthion	130	93.6	ug/kg	72	SW846 8141A
Mevinphos	130	82.8	ug/kg	64	SW846 8141A
Tetrachlorvinphos	130	102	ug/kg	79	SW846 8141A
Thionazin	130	82.0	ug/kg	63	SW846 8141A
Ronnel	130	79.1	ug/kg	61	SW846 8141A
Sulfotepp	130	71.4	ug/kg	55	SW846 8141A
Trichloronate	130	82.2	ug/kg	63	SW846 8141A
Ethyl parathion	130	100	ug/kg	77	SW846 8141A
Simazine	130	119	ug/kg	92	SW846 8141A
O,O,O-Triethylphosphorothioate	130	71.8	ug/kg	55	SW846 8141A
Parathion	130	100	ug/kg	77	SW846 8141A
Atrazine	130	108	ug/kg	84	SW846 8141A

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Chlormefos	53	(42 - 132)
Triphenyl phosphate	105	(47 - 161)

(Continued on next page)

LABORATORY CONTROL SAMPLE DATA REPORT

GC Semivolatiles

Client Lot #...: D7G200355 **Work Order #...:** J3JLN1AC **Matrix.....:** SOLID
LCS Lot-Sample#: D7G250000-449

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

Bold print denotes control parameters

MATRIX SPIKE SAMPLE EVALUATION REPORT

GC Semivolatiles

Client Lot #...: D7G200355 Work Order #...: J3AMM1AM-MS Matrix.....: SOLID
MS Lot-Sample #: D7G200355-002 J3AMM1AN-MSD
Date Sampled...: 07/19/07 03:15 Date Received..: 07/20/07
Prep Date.....: 07/25/07 Analysis Date..: 08/01/07
Prep Batch #...: 7206449 Analysis Time..: 01:45
Dilution Factor: 1

PARAMETER	PERCENT RECOVERY	RECOVERY LIMITS	RPD	RPD LIMITS	METHOD
Demeton (total)	53	(10 - 123)			SW846 8141A
	42	(10 - 123)	16	(0-47)	SW846 8141A
Diazinon	71	(49 - 122)			SW846 8141A
	68	(49 - 122)	2.2	(0-40)	SW846 8141A
Malathion	70	(49 - 124)			SW846 8141A
	66	(49 - 124)	0.93	(0-53)	SW846 8141A
Phorate	45	(45 - 115)			SW846 8141A
	33 a	(45 - 115)	23	(0-40)	SW846 8141A
Methyl parathion	73	(51 - 115)			SW846 8141A
	70	(51 - 115)	2.1	(0-53)	SW846 8141A
Azinphos-methyl	67	(21 - 145)			SW846 8141A
	63	(21 - 145)	0.94	(0-43)	SW846 8141A
Chlorpyrifos	75	(57 - 115)			SW846 8141A
	71	(57 - 115)	1.3	(0-37)	SW846 8141A
Coumaphos	67	(42 - 129)			SW846 8141A
	61	(42 - 129)	3.9	(0-27)	SW846 8141A
Dichlorvos	52	(25 - 147)			SW846 8141A
	45	(25 - 147)	7.9	(0-77)	SW846 8141A
Dimethoate	59	(10 - 156)			SW846 8141A
	54	(10 - 156)	2.5	(0-98)	SW846 8141A
Disulfoton	57	(10 - 133)			SW846 8141A
	48	(10 - 133)	11	(0-40)	SW846 8141A
Ethoprop	66	(51 - 119)			SW846 8141A
	60	(51 - 119)	3.6	(0-54)	SW846 8141A
Famphur	91	(33 - 144)			SW846 8141A
	86	(33 - 144)	0.82	(0-31)	SW846 8141A
Fensulfothion	82	(47 - 123)			SW846 8141A
	76	(47 - 123)	1.1	(0-49)	SW846 8141A
Fenthion	72	(52 - 115)			SW846 8141A
	69	(52 - 115)	1.6	(0-43)	SW846 8141A
Mevinphos	58	(15 - 143)			SW846 8141A
	51	(15 - 143)	7.1	(0-78)	SW846 8141A
Tetrachlorvinphos	71	(30 - 130)			SW846 8141A
	68	(30 - 130)	1.8	(0-24)	SW846 8141A
Thionazin	67	(50 - 124)			SW846 8141A
	58	(50 - 124)	8.0	(0-40)	SW846 8141A
Ronnel	68	(46 - 115)			SW846 8141A
	64	(46 - 115)	1.0	(0-41)	SW846 8141A
Sulfotepp	62	(41 - 123)			SW846 8141A
	55	(41 - 123)	5.4	(0-40)	SW846 8141A

(Continued on next page)

MATRIX SPIKE SAMPLE EVALUATION REPORT

GC Semivolatiles

Client Lot #...: D7G200355 **Work Order #...:** J3AMM1AM-MS **Matrix.....:** SOLID
MS Lot-Sample #: D7G200355-002 J3AMM1AN-MSD

PARAMETER	PERCENT RECOVERY	RECOVERY LIMITS	RPD	RPD LIMITS	METHOD
Trichloronate	**88**	**(50 - 115)**			**SW846 8141A**
	87	**(50 - 115)**	**5.5**	**(0-43)**	**SW846 8141A**
Ethyl parathion	**78**	**(38 - 134)**			**SW846 8141A**
	75	**(38 - 134)**	**2.7**	**(0-47)**	**SW846 8141A**
Simazine	**82**	**(11 - 162)**			**SW846 8141A**
	73	**(11 - 162)**	**4.8**	**(0-58)**	**SW846 8141A**
O,O,O-Triethylphosphorothioate	**26 a**	**(50 - 150)**			**SW846 8141A**
	32 a	**(50 - 150)**	**27**	**(0-50)**	**SW846 8141A**
Parathion	**78**	**(38 - 134)**			**SW846 8141A**
	75	**(38 - 134)**	**2.7**	**(0-47)**	**SW846 8141A**
Atrazine	**72**	**(50 - 150)**			**SW846 8141A**
	69	**(50 - 150)**	**2.0**	**(0-50)**	**SW846 8141A**

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Chlormefos	50	(42 - 132)
	42	(42 - 132)
Triphenyl phosphate	99	(47 - 161)
	93	(47 - 161)

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

Bold print denotes control parameters

a Spiked analyte recovery is outside stated control limits.

MATRIX SPIKE SAMPLE DATA REPORT

GC Semivolatiles

Client Lot #...: D7G200355 Work Order #...: J3AMM1AM-MS Matrix.....: SOLID
MS Lot-Sample #: D7G200355-002 J3AMM1AN-MSD
Date Sampled...: 07/19/07 03:15 Date Received..: 07/20/07
Prep Date.....: 07/25/07 Analysis Date..: 08/01/07
Prep Batch #...: 7206449 Analysis Time..: 01:45
Dilution Factor: 1

PARAMETER	SAMPLE AMOUNT	SPIKE AMT	MEASRD AMOUNT	UNITS	PERCNT RECVRY	RPD	METHOD
Demeton (total)	ND	133	69.9	ug/kg	53		SW846 8141A
	ND	142	59.2	ug/kg	42	16	SW846 8141A
Diazinon	ND	133	94.1	ug/kg	71		SW846 8141A
	ND	142	96.3	ug/kg	68	2.2	SW846 8141A
Malathion	ND	133	92.5	ug/kg	70		SW846 8141A
	ND	142	93.3	ug/kg	66	0.93	SW846 8141A
Phorate	ND	133	59.8	ug/kg	45		SW846 8141A
	ND	142	47.5	ug/kg	33 a	23	SW846 8141A
Methyl parathion	ND	133	97.1	ug/kg	73		SW846 8141A
	ND	142	99.2	ug/kg	70	2.1	SW846 8141A
Azinphos-methyl	ND	133	88.6	ug/kg	67		SW846 8141A
	ND	142	89.4	ug/kg	63	0.94	SW846 8141A
Chlorpyrifos	ND	133	99.5	ug/kg	75		SW846 8141A
	ND	142	101	ug/kg	71	1.3	SW846 8141A
Coumaphos	ND	133	89.4	ug/kg	67		SW846 8141A
	ND	142	86.0	ug/kg	61	3.9	SW846 8141A
Dichlorvos	ND	133	69.0	ug/kg	52		SW846 8141A
	ND	142	63.8	ug/kg	45	7.9	SW846 8141A
Dimethoate	ND	133	77.9	ug/kg	59		SW846 8141A
	ND	142	76.0	ug/kg	54	2.5	SW846 8141A
Disulfoton	ND	133	76.2	ug/kg	57		SW846 8141A
	ND	142	68.1	ug/kg	48	11	SW846 8141A
Ethoprop	ND	133	88.2	ug/kg	66		SW846 8141A
	ND	142	85.2	ug/kg	60	3.6	SW846 8141A
Famphur	ND	266	242	ug/kg	91		SW846 8141A
	ND	284	244	ug/kg	86	0.82	SW846 8141A
Fensulfothion	ND	133	109	ug/kg	82		SW846 8141A
	ND	142	108	ug/kg	76	1.1	SW846 8141A
Fenthion	ND	133	95.7	ug/kg	72		SW846 8141A
	ND	142	97.3	ug/kg	69	1.6	SW846 8141A
Mevinphos	ND	133	77.5	ug/kg	58		SW846 8141A
	ND	142	72.2	ug/kg	51	7.1	SW846 8141A
Tetrachlorvinphos	ND	133	94.3	ug/kg	71		SW846 8141A
	ND	142	96.0	ug/kg	68	1.8	SW846 8141A
Thionazin	ND	133	88.9	ug/kg	67		SW846 8141A
	ND	142	82.0	ug/kg	58	8.0	SW846 8141A
Ronnel	ND	133	90.1	ug/kg	68		SW846 8141A
	ND	142	91.0	ug/kg	64	1.0	SW846 8141A
Sulfotepp	ND	133	82.3	ug/kg	62		SW846 8141A
	ND	142	77.9	ug/kg	55	5.4	SW846 8141A

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MATRIX SPIKE SAMPLE DATA REPORT

GC Semivolatiles

Client Lot #...: D7G200355 **Work Order #...:** J3AMM1AM-MS **Matrix.....:** SOLID
MS Lot-Sample #: D7G200355-002 J3AMM1AN-MSD

PARAMETER	SAMPLE AMOUNT	SPIKE AMT	MEASRD AMOUNT	UNITS	PERCNT RECVRY	RPD	METHOD
Trichloronate	**ND**	**133**	**117**	**ug/kg**	**88**		**SW846 8141A**
	ND	**142**	**124**	**ug/kg**	**87**	**5.5**	**SW846 8141A**
Ethyl parathion	**ND**	**133**	**103**	**ug/kg**	**78**		**SW846 8141A**
	ND	**142**	**106**	**ug/kg**	**75**	**2.7**	**SW846 8141A**
Simazine	**ND**	**133**	**108**	**ug/kg**	**82**		**SW846 8141A**
	ND	**142**	**103**	**ug/kg**	**73**	**4.8**	**SW846 8141A**
O,O,O-Triethylphosphoro-thioate	**ND**	**133**	**35.1**	**ug/kg**	**26 a**		**SW846 8141A**
	ND	**142**	**45.9**	**ug/kg**	**32 a**	**27**	**SW846 8141A**
Parathion	**ND**	**133**	**103**	**ug/kg**	**78**		**SW846 8141A**
	ND	**142**	**106**	**ug/kg**	**75**	**2.7**	**SW846 8141A**
Atrazine	**ND**	**133**	**95.7**	**ug/kg**	**72**		**SW846 8141A**
	ND	**142**	**97.7**	**ug/kg**	**69**	**2.0**	**SW846 8141A**

SURROGATE	PERCENT RECOVERY	RECOVERY LIMITS
Chlormefos	50	(42 - 132)
	42	(42 - 132)
Triphenyl phosphate	99	(47 - 161)
	93	(47 - 161)

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

Bold print denotes control parameters

a Spiked analyte recovery is outside stated control limits.

METHOD BLANK REPORT

TOTAL Metals

Client Lot #...: D7G200355 **Matrix.....:** SOLID

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD	PREPARATION-ANALYSIS DATE	WORK ORDER #
MB Lot-Sample #: D7G240000-124 **Prep Batch #...:** 7205124						
Arsenic	ND	2.0	mg/kg	SW846 6010B	07/24-07/25/07	J3FDT1AD
		Dilution Factor: 1				
		Analysis Time..: 14:29				
Copper	ND	2.0	mg/kg	SW846 6010B	07/24-07/25/07	J3FDT1AL
		Dilution Factor: 1				
		Analysis Time..: 14:29				
Iron	ND	15	mg/kg	SW846 6010B	07/24-07/25/07	J3FDT1AM
		Dilution Factor: 1				
		Analysis Time..: 14:29				
Lead	ND	0.80	mg/kg	SW846 6010B	07/24-07/25/07	J3FDT1AU
		Dilution Factor: 1				
		Analysis Time..: 14:29				
Zinc	ND	3.0	mg/kg	SW846 6010B	07/24-07/25/07	J3FDT1A1
		Dilution Factor: 1				
		Analysis Time..: 14:29				
MB Lot-Sample #: D7G260000-200 **Prep Batch #...:** 7207200						
Mercury	ND	33	ug/kg	SW846 7471A	07/30/07	J3K3V1AA
		Dilution Factor: 1				
		Analysis Time..: 17:43				

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

LABORATORY CONTROL SAMPLE EVALUATION REPORT

TOTAL Metals

Client Lot #...: D7G200355 **Matrix.....:** SOLID

PARAMETER	PERCENT RECOVERY	RECOVERY LIMITS	METHOD	PREPARATION-ANALYSIS DATE	WORK ORDER #
LCS Lot-Sample#: D7G240000-124 **Prep Batch #...:** 7205124					
Arsenic	94	(85 - 110)	SW846 6010B	07/24-07/25/07	J3FDT1A4
		Dilution Factor: 1	Analysis Time..: 14:34		
Copper	99	(88 - 110)	SW846 6010B	07/24-07/25/07	J3FDT1CC
		Dilution Factor: 1	Analysis Time..: 14:34		
Iron	97	(87 - 120)	SW846 6010B	07/24-07/25/07	J3FDT1CD
		Dilution Factor: 1	Analysis Time..: 14:34		
Lead	93	(86 - 110)	SW846 6010B	07/24-07/25/07	J3FDT1CK
		Dilution Factor: 1	Analysis Time..: 14:34		
Zinc	97	(76 - 114)	SW846 6010B	07/24-07/25/07	J3FDT1CQ
		Dilution Factor: 1	Analysis Time..: 14:34		
LCS Lot-Sample#: D7G260000-200 **Prep Batch #...:** 7207200					
Mercury	97	(87 - 111)	SW846 7471A	07/30/07	J3K3V1AC
		Dilution Factor: 1	Analysis Time..: 17:45		

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

LABORATORY CONTROL SAMPLE DATA REPORT

TOTAL Metals

Client Lot #...: D7G200355 **Matrix.....:** SOLID

PARAMETER	SPIKE AMOUNT	MEASURED AMOUNT	UNITS	PERCNT RECVRY	METHOD	PREPARATION-ANALYSIS DATE	WORK ORDER #
LCS Lot-Sample#: D7G240000-124 **Prep Batch #...:** 7205124							
Arsenic	100	93.8	mg/kg	94	SW846 6010B	07/24-07/25/07	J3FDT1A4
			Dilution Factor: 1		Analysis Time..: 14:34		
Copper	25.0	24.6	mg/kg	99	SW846 6010B	07/24-07/25/07	J3FDT1CC
			Dilution Factor: 1		Analysis Time..: 14:34		
Iron	100	97.1	mg/kg	97	SW846 6010B	07/24-07/25/07	J3FDT1CD
			Dilution Factor: 1		Analysis Time..: 14:34		
Lead	50.0	46.7	mg/kg	93	SW846 6010B	07/24-07/25/07	J3FDT1CK
			Dilution Factor: 1		Analysis Time..: 14:34		
Zinc	50.0	48.5	mg/kg	97	SW846 6010B	07/24-07/25/07	J3FDT1CQ
			Dilution Factor: 1		Analysis Time..: 14:34		
LCS Lot-Sample#: D7G260000-200 **Prep Batch #...:** 7207200							
Mercury	833	811	ug/kg	97	SW846 7471A	07/30/07	J3K3V1AC
			Dilution Factor: 1		Analysis Time..: 17:45		

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE SAMPLE EVALUATION REPORT

TOTAL Metals

Client Lot #...: D7G200355 **Matrix.....:** SOLID
Date Sampled...: 07/19/07 15:30 **Date Received..:** 07/21/07

PARAMETER	PERCENT RECOVERY	RECOVERY LIMITS	RPD	RPD LIMITS	METHOD	PREPARATION-ANALYSIS DATE	WORK ORDER #
MS Lot-Sample #: D7G210163-008 **Prep Batch #...:** 7205124							
Arsenic	98	(76 - 111)			SW846 6010B	07/24-07/25/07	J3C0T1DU
	96	(76 - 111)	1.3	(0-30)	SW846 6010B	07/24-07/25/07	J3C0T1DV
		Dilution Factor: 1					
		Analysis Time..: 16:02					
Copper	98	(37 - 187)			SW846 6010B	07/24-07/25/07	J3C0T1CF
	97	(37 - 187)	0.47	(0-30)	SW846 6010B	07/24-07/25/07	J3C0T1CG
		Dilution Factor: 1					
		Analysis Time..: 16:02					
Iron	NC,MSB	(70 - 200)			SW846 6010B	07/24-07/25/07	J3C0T1CH
	NC,MSB	(70 - 200)		(0-40)	SW846 6010B	07/24-07/25/07	J3C0T1CJ
		Dilution Factor: 1					
		Analysis Time..: 16:02					
Lead	87	(70 - 200)			SW846 6010B	07/24-07/25/07	J3C0T1CW
	85	(70 - 200)	1.4	(0-40)	SW846 6010B	07/24-07/25/07	J3C0T1CX
		Dilution Factor: 1					
		Analysis Time..: 16:02					
Zinc	88	(70 - 200)			SW846 6010B	07/24-07/25/07	J3C0T1C8
	90	(70 - 200)	1.5	(0-40)	SW846 6010B	07/24-07/25/07	J3C0T1C9
		Dilution Factor: 1					
		Analysis Time..: 16:02					

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

Results and reporting limits have been adjusted for dry weight.

NC The recovery and/or RPD were not calculated.

MSB The recovery and RPD were not calculated because the sample amount was greater than four times the spike amount.

MATRIX SPIKE SAMPLE DATA REPORT

TOTAL Metals

Client Lot #...: D7G200355 **Matrix.....:** SOLID
Date Sampled...: 07/19/07 15:30 **Date Received..:** 07/21/07

PARAMETER	SAMPLE AMOUNT	SPIKE AMT	MEASRD AMOUNT	UNITS	PERCNT RECVRY	RPD	METHOD	PREPARATION-ANALYSIS DATE	WORK ORDER #
MS Lot-Sample #: D7G210163-008 **Prep Batch #...:** 7205124									
Arsenic									
	1.0	137	135	mg/kg	0 98		SW846 6010B	07/24-07/25/07	J3C0T1DU
	1.0	137	133	mg/kg	0 96	1.3	SW846 6010B	07/24-07/25/07	J3C0T1DV
			Dilution Factor: 1						
			Analysis Time..: 16:02						
Copper									
	2.1	34.3	35.7	mg/kg	0 98		SW846 6010B	07/24-07/25/07	J3C0T1CF
	2.1	34.3	35.5	mg/kg	0 97	0.47	SW846 6010B	07/24-07/25/07	J3C0T1CG
			Dilution Factor: 1						
			Analysis Time..: 16:02						
Iron									
	1200	137	1550	mg/kg	0		SW846 6010B	07/24-07/25/07	J3C0T1CH
			Qualifiers: NC,MSB						
	1200	137	1490	mg/kg	0		SW846 6010B	07/24-07/25/07	J3C0T1CJ
			Qualifiers: NC,MSB						
			Dilution Factor: 1						
			Analysis Time..: 16:02						
Lead									
	1.7	68.6	61.1	mg/kg	0 87		SW846 6010B	07/24-07/25/07	J3C0T1CW
	1.7	68.6	60.2	mg/kg	0 85	1.4	SW846 6010B	07/24-07/25/07	J3C0T1CX
			Dilution Factor: 1						
			Analysis Time..: 16:02						
Zinc									
	4.5	68.6	64.9	mg/kg	0 88		SW846 6010B	07/24-07/25/07	J3C0T1C8
	4.5	68.6	65.9	mg/kg	0 90	1.5	SW846 6010B	07/24-07/25/07	J3C0T1C9
			Dilution Factor: 1						
			Analysis Time..: 16:02						

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

Results and reporting limits have been adjusted for dry weight.

NC The recovery and/or RPD were not calculated.

MSB The recovery and RPD were not calculated because the sample amount was greater than four times the spike amount.

MATRIX SPIKE SAMPLE EVALUATION REPORT

TOTAL Metals

Client Lot #...: D7G200355 **Matrix.....:** SOLID
Date Sampled...: 07/18/07 13:50 **Date Received..:** 07/20/07

PARAMETER	PERCENT RECOVERY	RECOVERY LIMITS	RPD	RPD LIMITS	METHOD	PREPARATION-ANALYSIS DATE	WORK ORDER #
MS Lot-Sample #: D7G200178-001 **Prep Batch #...:** 7207200							
Mercury	103	(87 - 111)			SW846 7471A	07/30/07	J29DP1DX
	99	(87 - 111)	3.5	(0-20)	SW846 7471A	07/30/07	J29DP1D0
		Dilution Factor: 1					
		Analysis Time..: 18:01					

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

Results and reporting limits have been adjusted for dry weight.

MATRIX SPIKE SAMPLE DATA REPORT

TOTAL Metals

Client Lot #...: D7G200355 **Matrix.....:** SOLID
Date Sampled...: 07/18/07 13:50 **Date Received..:** 07/20/07

PARAMETER	SAMPLE AMOUNT	SPIKE AMT	MEASRD AMOUNT	UNITS	PERCNT RECVRY	RPD	METHOD	PREPARATION-ANALYSIS DATE	WORK ORDER #
MS Lot-Sample #: D7G200178-001 **Prep Batch #...:** 7207200									
Mercury									
	ND	967	991	ug/kg	0 103		SW846 7471A	07/30/07	J29DP1DX
	ND	967	957	ug/kg	0 99	3.5	SW846 7471A	07/30/07	J29DP1D0

Dilution Factor: 1
Analysis Time..: 18:01

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

Results and reporting limits have been adjusted for dry weight.

METHOD BLANK REPORT

General Chemistry

Client Lot #...: D7G200355 **Matrix.....:** SOLID

PARAMETER	RESULT	REPORTING LIMIT	UNITS	METHOD	PREPARATION-ANALYSIS DATE	PREP BATCH #
Ammonia as N		Work Order #: J3H1R1AA		MB Lot-Sample #:	D7G250000-323	
	0.43 B	**1.0**	**mg/kg**	**MCAWW 350.1**	**07/24/07**	**7206323**
		Dilution Factor: 1				
		Analysis Time..: 09:00				
Total Organic Carbon		Work Order #: J3QRR1AA		MB Lot-Sample #:	D7G260000-484	
	ND	2.0	g/kg	SW846 9060	07/26-07/27/07	7207484
		Dilution Factor: 1				
		Analysis Time..: 10:30				

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

B Estimated result. Result is less than RL.

LABORATORY CONTROL SAMPLE EVALUATION REPORT

General Chemistry

Lot-Sample #...: D7G200355 **Matrix.....:** SOLID

PARAMETER	PERCENT RECOVERY	RECOVERY LIMITS	RPD	RPD LIMITS	METHOD	PREPARATION-ANALYSIS DATE	PREP BATCH #
Ammonia as N		WO#:J3H1R1AC-LCS/J3H1R1AD-LCSD				LCS Lot-Sample#: D7G250000-323	
	107	(90 - 110)			MCAWW 350.1	07/24/07	7206323
	107	(90 - 110)	0.11	(0-10)	MCAWW 350.1	07/24/07	7206323
		Dilution Factor: 1			Analysis Time..: 09:00		
Total Organic Carbon		WO#:J3QRR1AC-LCS/J3QRR1AD-LCSD				LCS Lot-Sample#: D7G260000-484	
	98	(90 - 110)			SW846 9060	07/26-07/27/07	7207484
	101	(90 - 110)	3.5	(0-10)	SW846 9060	07/26-07/27/07	7207484
		Dilution Factor: 1			Analysis Time..: 10:30		

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

LABORATORY CONTROL SAMPLE DATA REPORT

General Chemistry

Lot-Sample #...: D7G200355 **Matrix.....:** SOLID

PARAMETER	SPIKE AMOUNT	MEASURED AMOUNT	UNITS	PERCNT RECVRY	RPD	METHOD	PREPARATION-ANALYSIS DATE	PREP BATCH #
Ammonia as N		WO#:J3H1R1AC-LCS/J3H1R1AD-LCSD				LCS Lot-Sample#: D7G250000-323		
	40.0	42.7	mg/kg	107		MCAWW 350.1	07/24/07	7206323
	40.0	42.8	mg/kg	107	0.11	MCAWW 350.1	07/24/07	7206323
		Dilution Factor: 1				Analysis Time..: 09:00		
Total Organic Carbon		WO#:J3QRR1AC-LCS/J3QRR1AD-LCSD				LCS Lot-Sample#: D7G260000-484		
	120	117	g/kg	98		SW846 9060	07/26-07/27/07	7207484
	120	121	g/kg	101	3.5	SW846 9060	07/26-07/27/07	7207484
		Dilution Factor: 1				Analysis Time..: 10:30		

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE SAMPLE EVALUATION REPORT

General Chemistry

Client Lot #...: D7G200355 **Matrix.....:** SOLID
Date Sampled...: 07/11/07 12:30 **Date Received..:** 07/12/07

PARAMETER	PERCENT RECOVERY	RECOVERY LIMITS	RPD	RPD LIMITS	METHOD	PREPARATION-ANALYSIS DATE	PREP BATCH #
Ammonia as N		WO#: J3AMJ1AM-MS/J3AMJ1AN-MSD				MS Lot-Sample #: D7G200355-001	
	93	(70 - 124)			MCAWW 350.1	07/24/07	7206323
	92	(70 - 124)	0.70	(0-10)	MCAWW 350.1	07/24/07	7206323
		Dilution Factor: 1					
		Analysis Time..: 09:00					
Total Organic Carbon		WO#: J2Q1L1D8-MS/J2Q1L1D9-MSD				MS Lot-Sample #: D7G120272-004	
	98	(90 - 110)			SW846 9060	07/26-07/27/07	7207486
	99	(90 - 110)	0.40	(0-10)	SW846 9060	07/26-07/27/07	7207486
		Dilution Factor: 1					
		Analysis Time..: 10:30					

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

MATRIX SPIKE SAMPLE DATA REPORT

General Chemistry

Client Lot #...: D7G200355 **Matrix.....:** SOLID
Date Sampled...: 07/11/07 12:30 **Date Received..:** 07/12/07

PARAMETER	SAMPLE AMOUNT	SPIKE AMT	MEASRD AMOUNT	UNITS		PERCNT RECVRY	RPD	METHOD	PREPARATION-ANALYSIS DATE	PREP BATCH #
Ammonia as N			WO#: J3AMJ1AM-MS/J3AMJ1AN-MSD					MS Lot-Sample #: D7G200355-001		
	0.63	34.5	32.7	mg/kg	A	93		MCAWW 350.1	07/24/07	7206323
	0.63	34.5	32.4	mg/kg	A	92	0.70	MCAWW 350.1	07/24/07	7206323
			Dilution Factor: 1							
			Analysis Time..: 09:00							
Total Organic Carbon			WO#: J2Q1L1D8-MS/J2Q1L1D9-MSD					MS Lot-Sample #: D7G120272-004		
	6.7	120	125	g/kg	L	98		SW846 9060	07/26-07/27/07	7207486
	6.7	120	125	g/kg	L	99	0.40	SW846 9060	07/26-07/27/07	7207486
			Dilution Factor: 1							
			Analysis Time..: 10:30							

NOTE(S):

Calculations are performed before rounding to avoid round-off errors in calculated results.

[redacted]

Chain of Custody Record

4.8c

STL-4124 (0901) CENWO-PM-AE

PICKED UP BY STL COURIER

SEVERN TRENT **STL**

Severn Trent Laboratories, Inc.

Quote 75664 DK 7/20/07

Client: Corps of Engineers	Project Manager: Katy Reed	Date: 7/19/07	Chain of Custody Number: 354158
Address: 106 S. 15th St 68102	Telephone Number (Area Code)/Fax Number: 402 221 4604 / 221 4886	Lab Number	Page 1 of 1
City: Omaha; State: NE; Zip Code: 68102	Site Contact	Lab Contact	
Project Name and Location (State): Goose Creek Project	Carrier/Waybill Number		
Contract/Purchase Order/Quote No.			

Sample I.D. No. and Description (Containers for each sample may be combined on one line)	Date	Time	Air	Aqueous	Sed.	Soil	Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/NaOH	N (Ammonia)	Pesticide	Metals		Grainsize		TOC							Special Instructions/ Conditions of Receipt
✓ CWP #1	7/19	2:55			✓		✓						✓						✓							
✓ CWP #1	7/19	2:55			✓		✓							✓	✓											
✓ CWP #2	7/19	3:15			✓		✓							✓	✓											
✓ CWP #2	7/19	3:15			✓		✓										✓									
✓ CWP #3	7/19	3:25			✓		✓						✓						✓							
✓ CWP #3	7/19	3:35			✓		✓							✓	✓											
✓ WL #1	7/19	3:45			✓		✓							✓	✓											
✓ CWP #4	7/19	4:00			✓		✓								✓	✓										
✓ CWP #4	7/19	4:00			✓		✓										✓									

Possible Hazard Identification: ☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal: ☐ Return To Client ☐ Disposal By Lab ☐ Archive For _____ Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required: ☐ 24 Hours ☐ 48 Hours ☐ 7 Days ☐ 14 Days ☐ 21 Days ☒ Other Std

QC Requirements (Specify)

	Date	Time		Date	Time
1. Relinquished By			1. Received By	7/20/07	0830
2. Relinquished By	7/20/07	940	2. Received By	7/20/07	0940
3. Relinquished By			3. Received By		

Comments

DISTRIBUTION: WHITE - Returned to Client with Report; CANARY - Stays with the Sample; PINK - Field Copy

STL Burlington
South Burlington, VT

Extended Data Package

SDG: 7G200355

Case Narrative 1
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Sample Handling 10
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SEVERN TRENT STL

Case Narrative

STL

STL Burlington
30 Community Drive, Suite 11
South Burlington, VT 05403

Tel: 802 660 1990 Fax: 802 660 1919
www.stl-inc.com

August 15, 2007

Ms. Donna Rydberg
TestAmerica
4955 Yarrow Street
Arvada, CO 80002

Re: Laboratory Project No. 27013
Case: BOLDER; SDG: 7G200355

Dear Ms. Rydberg:

Enclosed are the analytical results for the samples that were received by STL Burlington on July 23rd, 2007. Laboratory identification numbers were assigned, and designated as follows:

Lab ID	Client Sample ID	Sample Date	Sample Matrix
	Received: 07/23/07 ETR No: 121009		
718404	CWP#2	07/19/07	SOIL
718405	CWP#4	07/19/07	SOIL

Documentation of the condition of the samples at the time of their receipt and any exception to the laboratory's Sample Acceptance Policy is documented in the Sample Handling section of this submittal.

Particle Size Analysis by ASTM D422
There were no exceptions to the method quality control criteria during the analyses of these samples.

The analytical results associated with the samples presented in this test report were generated under a quality system that adheres to requirements specified in the NELAC standard. Release of the data in this test report and any associated electronic deliverables is authorized by the Laboratory Director's designee as verified by the following signature.

If there are any questions regarding this submittal, please contact me at 802 660-1990.

Sincerely,

Kristine Dusablon

Kristine A. Dusablon
Project Manager

Enclosure

Leaders in Environmental Testing

SEVERN TRENT STL

Chain of Custody

Severn Trent Laboratories, Inc.

SAMPLE ANALYSIS REQUISITION

Lab Request SR094557

Need Analytical Report

Report Package: **STL Standard Report**

2007-07-30

aboratory **TestAmerica Burlington**
55 South Park Drive

Colchester, VT 05446

Client Code: 367970

Project Manager:

Sample I.D.	Work Order Number	Client Sample ID	Sampling Date	Analysis Required
D7G200355-2	J3AMM	CWP#2	2007-07-19 6:15	SOLID, Grain Size TestAmerica Bulington
D7G200355-5	J3AM1	CWP#4	2007-07-19 4:00	SOLID, Grain Size TestAmerica Bulington

Please use Client Sample ID for report

Call with questions at 303-736-0100

Shipping Method:

Need detection limit and analysis date included in report.

Please send a signed copy of this form with the report at completion of analysis.

Relinquished by: [signature] Date/Time: 7/20/07 1600

Relinquished by: _____ Date/Time: _____

Received for lab by: Jessica Bittfeld Date/Time: ~~7/24/07~~ JB 7-23-07 0945

PLEASE RETURN ORIGINAL SAMPLE ANALYSIS REQUISITION

3

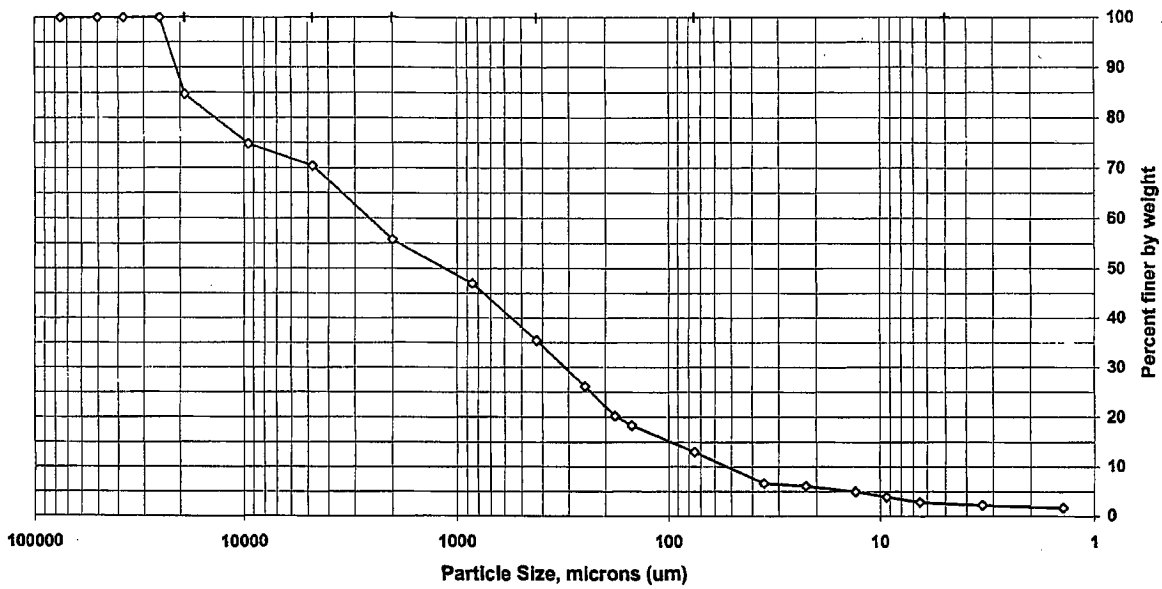
SEVERN TRENT STL

Particle Size Results

Particle Size of Soils by ASTM D422

Client Code:	STLCOD	**SDG:**	7G200355	**Date Received:**	7/24/2007
Sample ID:	CWP#2	**ETR(s):**	121009	**Start Date:**	7/24/2007
Lab ID:	718404			**End Date:**	8/14/2007

Percent Solids:	77.3%	**Non-soil material:**	plant
Specific Gravity:	2.650	**Shape (> #10):**	subrounded
Maximum Particle Size:	25 mm	**Hardness (> #10):**	hard



Sieve size	Particle size, um	Percent finer	Incremental percent
3 inch	75000	100.0	0.0
2 inch	50000	100.0	0.0
1.5 inch	37500	100.0	0.0
1 inch	25000	100.0	0.0
3/4 inch	19000	84.7	15.3
3/8 inch	9500	74.8	9.9
#4	4750	70.4	4.4
#10	2000	55.8	14.6
#20	850	47.0	8.8
#40	425	35.4	11.6
#60	250	26.2	9.2
#80	180	20.2	5.9
#100	150	18.4	1.8
#200	75	13.0	5.3
Hydrometer	35.2	6.7	6.4
I	22.4	6.1	0.5
I	13.1	5.0	1.2
I	9.4	3.9	1.1
I	6.5	2.8	1.1
I	3.4	2.2	0.6
V	1.4	1.7	0.5

Soil Classification	Percent of Total Sample
Gravel	29.6
Sand	57.4
Coarse Sand	14.6
Medium Sand	20.4
Fine Sand	22.3
Silt	10.2
Clay	2.8

Preparation Method: **D2217**
Dispersion Device: Mechanical mixer with a metal paddle.
Dispersion Period: 1 minute

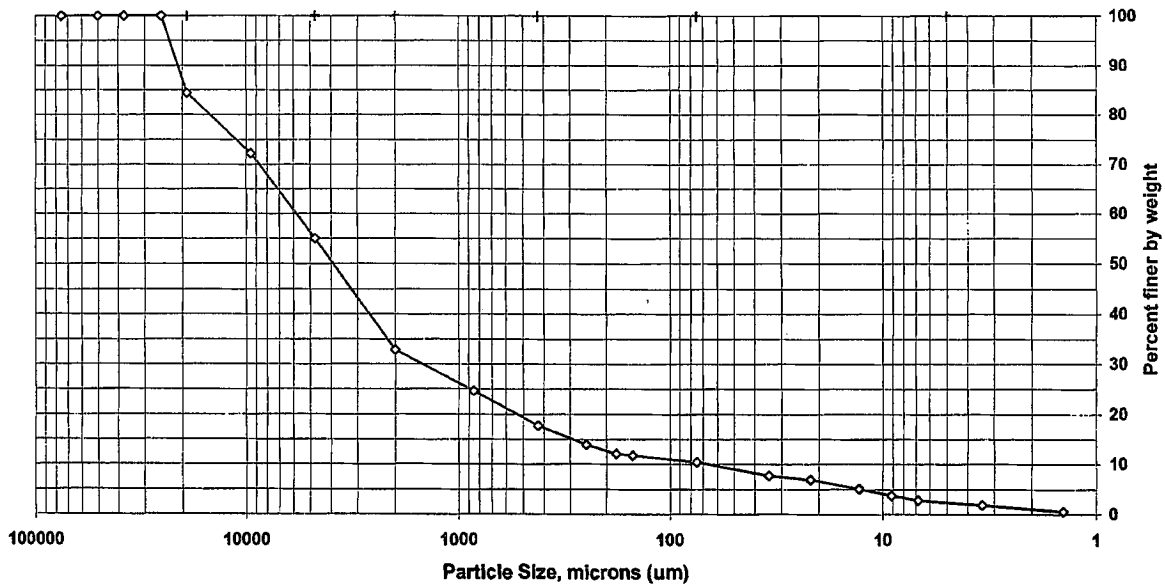
FSL024:07.29.05:0
STL Burlington

7G200355PS 8/15/2007

Particle Size of Soils by ASTM D422

Client Code:	STLCOD	**SDG:**	7G200355	**Date Received:**	7/24/2007
Sample ID:	CWP#4	**ETR(s):**	121009	**Start Date:**	7/24/2007
Lab ID:	718405			**End Date:**	8/14/2007

Percent Solids:	76.1%	**Non-soil material:**	plant,shell
Specific Gravity:	2.650	**Shape (> #10):**	subrounded
Maximum Particle Size:	25 mm	**Hardness (> #10):**	hard



Sieve size	Particle size, um	Percent finer	Incremental percent
3 inch	75000	100.0	0.0
2 inch	50000	100.0	0.0
1.5 inch	37500	100.0	0.0
1 inch	25000	100.0	0.0
3/4 inch	19000	84.4	15.6
3/8 inch	9500	72.3	12.1
#4	4750	55.0	17.3
#10	2000	32.8	22.2
#20	850	24.7	8.1
#40	425	17.7	6.9
#60	250	14.0	3.8
#80	180	12.1	1.8
#100	150	11.7	0.4
#200	75	10.4	1.3
Hydrometer	34.3	7.8	2.7
|	21.9	6.9	0.9
|	12.9	5.1	1.8
|	9.1	3.8	1.3
|	6.8	2.8	1.0
|	3.4	1.8	1.0
V	1.4	0.5	1.3

Soil Classification	Percent of Total Sample
Gravel	45.0
Sand	44.6
Coarse Sand	22.2
Medium Sand	15.1
Fine Sand	7.3
Silt	7.6
Clay	2.8

Preparation Method: **D2217**
Dispersion Device: Mechanical mixer with a metal paddle.
Dispersion Period: 1 minute

Particle Size Analysis of Soils
By ASTM D422
Hydrometer Data

Set Number: 7G200355

Client Code: STLCOD
SDG: 7G200355
ETR(s): 121009

Date Received: 24-Jul-07
Start Date: 24-Jul-07
End Date: 14-Aug-07

Date and Analyst

Percent Solids	Weighed	Mixed	Hydrometer	Large sieves	Small sieves
MAP 8/7/07	MAP 8/7/07	MAP 8/8/07	MAP 8/8/07	MAP 8/8/07	MAP 8/9/07
DJP 8/8/07			MAP 8/9/07	CT 8/9/07	SED 8/14/07

Test number	1	2	3	4	5	6	7	8	9	10	11	12
Lab number											718404	718405
Time, min. (2)	2	2	2	2	2	2	2	2	2	2	2	2
Reading											1.0095	1.0120
Temperature, C											21.5	21.5
Time, min. (5)	5	5	5	5	5	5	5	5	5	5	5	5
Reading											1.0090	1.0110
Temperature, C											21.5	21.5
Time, min. (15)	15	15	15	15	15	15	15	15	15	15	15	15
Reading											1.0080	1.0090
Temperature, C											21.0	21.5
Time, min. (30)	30	30	29	29	31	31	31	32	30	30	30	31
Reading											1.0070	1.0075
Temperature, C											21.0	21.5
Time, min. (60)	59	58	58	63	60	59	59	60	63	57	63	57
Reading											1.0060	1.0065
Temperature, C											21.0	21.0
Time, min. (250)	256	256	250	250	240	234	265	259	253	247	241	235
Reading											1.0055	1.0055
Temperature, C											20.5	20.5
Time, min. (1440)	1440	1440	1434	1434	1424	1418	1412	1406	1400	1394	1388	1382
Reading											1.0050	1.0040
Temperature, C											20.5	20.5

Hydrometer used: 705151 **Model #:** ASTM 151H **Manufacturer:** HB Instrument **Hydrometer start time:** 16:34

Calibrations:

L temp, C	L read	H Temp, C	H read
17.0	1.0040	23.0	1.0030

Cal. Date: 10/19/06 **Hydrometer data entered:** MAP 8/9/07

FSL024:07.29.05:0
STL Burlington

Particle Size Analysis of Soils
By ASTM D422
Hydrometer Data

Set Number: 7G200355

Client Code: STLCOD
SDG: 7G200355
ETR(s): 121009

Date Received: 24-Jul-07
Start Date: 24-Jul-07
End Date: 14-Aug-07

Date and Analyst

Percent Solids	Weighed	Mixed	Hydrometer	Large sieves	Small sieves
MAP 8-7-07	MAP 8-7-07	MAP 8-8-07	MAP 8-8-07	MAP 8-8-07	MAP 8-9-07
DJP 8-8-07			MAP 8-9-07	GT 08-09/07	SEP 8/14/07

Test number	1	2	3	4	5	6	7	8	9	10	11	12
Lab number											718404	718405
Time, min. (2)	2	2	2	2	2	2	2	2	2	2	2	2
Reading											1.0095	1.0120
Temperature, C											21.5	21.5
Time, min. (5)	5	5	5	5	5	5	5	5	5	5	5	5
Reading											1.0090	1.0110
Temperature, C											21.5	21.5
Time, min. (15)	15	15	15	15	15	15	15	15	15	15	15	15
Reading											1.0080	1.0090
Temperature, C											21.0	21.5
Time, min. (30)	30	30	29	29	31	31	31	32	30	30	30	31
Reading											1.0070	1.0075
Temperature, C											21.0	21.5
Time, min. (60)	59	58	58	63	60	59	59	60	63	57	63	57
Reading											1.0060	1.0065
Temperature, C											21.0	21.0
Time, min. (250)	256	256	250	250	240	234	265	259	253	247	241	235
Reading											1.0055	1.0055
Temperature, C											20.5	20.5
Time, min. (1440)	1440	1440	1434	1434	1424	1418	1412	1406	1400	1394	1388	1382
Reading											1.0050	1.0040
Temperature, C											20.5	20.5

Hydrometer used: 70515 **Model #:** ASTM 151H **Manufacturer:**
Cal. Date:
Hydrometer start time: 1634
Hydrometer data entered: MAP 8-9-07

Calibrations:

L temp, C	L read	H Temp, C	H read
17.0		23.0	

FSL024:07.29.05:0
STL Burlington

Particle Size Analysis of Soils By ASTM D422
Sieve Data

Client Code: STLCOD ETR(s): 121009 SDG: 7G200355 Date Rec: 24-Jul-07 Start Date: 24-Jul-07 End Date: 14-Aug-07

SET: 7G200355

Test	1	2	3	4	5	6	7	8	9	10	11	12
Laboratory No											718404	718405
Sample ID											CWP#2	CWP#4
Sample Prep											D2217	D2217
Pan, g												
Pan/sample, g											194.86	237.91
Pan/dry sample, g												
Hygroscopic Moisture correction factor (HMCF) for dry prep / Percent Solids for dry and wet prep												
Pan, g											4.14	4.16
Pan/sample, g											186.37	150.00
Pan/dry sample, g											145.02	115.11
HMCF											100.0%	100.0%
Description of >#10 particles												
Non-soil material											plant	plant,shell
Shape											subrounded	subrounded
Hardness											hard	hard
Sample % Solids											77.3%	76.1%
Dry sample wt, g											150.64	180.99
Sieve + Sample Weights												
Size	Mass, g	Mass, g	Mass, g	Mass, g	Mass, g	Mass, g	Mass, g	Mass, g	Mass, g	Mass, g	Mass, g	Mass, g
3 inch												
2 inch												
1.5 inch												
1 inch												
3/4 inch											481.11	486.27
3/8 inch											462.65	469.71
#4											449.46	474.09
#10											481.26	499.47
#20											397.94	399.40
#40											363.76	358.79
#60											353.60	346.54
#80											314.39	308.72
#100											337.19	335.16
#200											334.41	328.71
Maximum Particle size											25 mm	25 mm
Specific gravity											2.650	2.650
Sample Mass Parameters												
Sample Mass >#10, g	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	66.57	121.63
Sample mass <#10, g	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	#VALUE!	84.07	59.36

Dry prep = D421
Wet prep = D2217

Standard Values	
Sieve	Opening, um
3 inch	75000
2 inch	50000
1.5 inch	37500
1 inch	25000
3/4 inch	19000
3/8 inch	9500
#4	4750
#10	2000
#20	850
#40	425
#60	250
#80	180
#100	150
#200	75

Sieve (tares)		
Size	Mass, g	
3 inch		
2 inch		
1.5 inch		
1 inch		
3/4 inch	458.04	
3/8 inch	447.75	
#4	442.85	
#10	459.27	
#20	384.70	C
#40	346.22	C
#60	339.70	C
#80	305.44	C
#100	334.42	C
#200	326.38	C

Default SG 2.65

FSL024: 07.29.05:0
STL Burlington

7G200355PS 8/15/2007

SEVERN TRENT STL

Sample Handling

ORIGIN ID: WHHA (303) 421-6611
SAMPLE CUSTODIAN
TEST AMERICA
4956 YARROW ST

ARVADA, CO 80002
UNITED STATES US

Ship Date: 20JUL07
ActWgt: 8.1 LB
System#: 0025761/CAFE2349
Account: S 195536767

TO SAMPLE RECEIVING
STL BURLINGTON
30 COMMUNITY DRIVE
SUITE 11
SOUTH BURLINGTON, VT 05403

(802) 660-1990

FedEx Express

CLS05L07/22/23

Delivery Address Barcode

BILL SENDER

PRIORITY OVERNIGHT

MON
Deliver By:
23JUL07

TRK# 9021 9189 3438 Form 0201

BTV AA

05403 -VT-US XH BTVA

Part # 156148-434 NRIT 01-07

RECEIVED
7-23-07
0945
Jessica Bettfell

STL BURLINGTON
SAMPLE RECEIPT & LOG IN CHECKLIST

Client: STLCOD	Date Received: 07/23/07	Log In Date: 7-24-07
ETR: 121009	Time Received: 0945	By: JB
SDG: 7G200355	Received By: JB	Signature: Jessica Butterfield
Project: 27013	# Coolers Received: 1	PM Signature: Kristen Hurtado
Samples Delivered By: X Shipping Service ☐ Courier ☐ Hand ☐ Other (specify)		Date: 7/25/07
List Air bill Number(s) or Attach a photocopy of the Air Bill:		

COOLER SCREEN	YES	NO	NA	COMMENTS
There is *no* evidence to indicate tampering	X			
Custody seals are present and intact	X			
Custody seal numbers are present	X			
If yes, list custody seal numbers: 011476				

Thermal Preservation Type: ☐ Wet Ice ☐ Blue Ice X None ☐ Other (specify)

IR Gun ID: 62	Correction Factor (CF) = 0 °C		
Cooler 1: 23.6 °C	Cooler 6 °C	Cooler 11 °C	Cooler 16 °C
Cooler 2: °C	Cooler 7 °C	Cooler 12 °C	Cooler 17 °C
Cooler 3: °C	Cooler 8 °C	Cooler 13 °C	Cooler 18 °C
Cooler 4: °C	Cooler 9 °C	Cooler 14 °C	Cooler 19 °C
Cooler 5 °C	Cooler 10 °C	Cooler 15 °C	Cooler 20 °C

Unless otherwise documented, the recorded temperature readings are adjusted readings to account for the CF of the IR Gun

EPA Criteria: 0-6°C, except for air and geo samples which should be at ambient temperature and tissue samples, which may be frozen.

Some clients require thermal preservation criteria of 2-4°C or other such criteria. The PM must notify SM when alternate criteria is specified.

SAMPLE CONDITION	YES	NO	NA	COMMENTS
Sample containers were received intact	X			
Legible sample labels are affixed to each container	X			

CHAIN OF CUSTODY (COC)	YES	NO	NA	COMMENTS
COC is present and includes the following information for each container:				
• Sample ID / Sample Description	X			
• Date of Sample Collection	X			
• Time of Sample Collection	X			
• Identification of the Sampler		X		
• Preservation Type		X		
• Requested Tests Method(s)	X			
• Necessary Signatures	X			
Internal Chain of Custody (ICOC) Required		X		
If yes to above, ICOC Record initiated for every Worksheet			X	

SAMPLE INTEGRITY/USABILITY	YES	NO	NA	COMMENTS
The sample container matches the COC	X			
Appropriate sample containers were received for the tests requested	X			
Samples were received within holding time	X			
Sufficient amount of sample is provided for requested analyses	X			
VOA vials do not have headspace or a bubble >6mm (1/4" diameter)			X	
Appropriate preservatives were used for the tests requested			X	
pH of inorganic samples checked and is within method specification			X	
If no, attach Inorganic Sample pH Adjustment Form				

ANOMALY/NCR SUMMARY

FSM002:10.26.05:2
STL Burlington

SEVERN TRENT STL

Last Page of this Document

US Army Corps of Engineers ®
Omaha District

GOOSE CREEK
BOULDER, COLORADO

SECTION 206
ECOSYSTEM RESTORATION REPORT

APPENDIX A-3
COMPLIANCE WITH ENVIRONMENTAL STATUTES

JUNE 2011

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COMPLIANCE WITH ENVIRONMENTAL STATUTES
GOOSE CREEK
BOULDER COUNTY, COLORADO

Bald and Golden Eagle Protection Act, 16 U.S.C. Sec. 668, 668 note, 669a-668d.
In compliance. This Act prohibits the taking or possession of and commerce in bald and golden eagles, with limited exceptions for the scientific or exhibition purposes, for religious purposes of Indian tribes, or for the protection of wildlife, agriculture or preservation of the species. In the project area, the nesting season runs from November 1, to July 31. During this period, the National Bald Eagle Management Guidelines (NBEMG) recommend avoiding active nests by a maximum distance of 660 feet if the activity will be visible from the nest. The Corps has, and will continue to, coordinate with the USFWS and the appropriate state agencies to avoid taking the species during construction activities, and will follow the USFWS's guidelines regarding eagle nests.

Clean Air Act, as amended, 42 U.S.C. 1857h-7, et seq.
In compliance. Air quality is not expected to be impacted to any measurable degree by construction activities associated with this stream restoration project. Some temporary emission releases are expected during construction activities; however air quality is not expected to be impacted to any measurable degree.

Clean Water Act, as amended, (Federal Water Pollution Control Act) 33 U.S.C. 1251, et seq.
In compliance. The objective of this Act is to restore and maintain the chemical, physical and biological integrity of the Nation's waters (33 U.S.C. 1251). Section 404 requires authorization to place dredged or fill material into water bodies or wetlands. The proposed Goose Creek Project could be authorized under a type of General Permit for stream and wetland restoration. According to Colorado Water Quality Control Act, under Part 3, Administration, "General or nationwide permits under section 404 of the federal act shall be certified for use in Colorado without the imposition of any additional state conditions"; therefore, the Colorado Department of Public Health and Environment (CDPHE) would not be required to issue a water quality certification.

National Pollutant Discharge Elimination System (NJPDES) permits (Section 402) must also be obtained from the applicable state, and would be applied for by the contractor during the construction phase of the project.

Endangered Species Act, as amended, 16 U.S.C. 1531, et seq.
In compliance. In accordance with Section 7 of the Endangered Species Act of 1973, as amended, the Corps requested in a letter dated June 21, 2008, that the USFWS provide a list of Federally listed threatened and endangered species that may be found in the proposed project area. The USFWS responded with a letter dated August 12, 2008. The Preble's meadow jumping mouse, *Zapus hudsonius preblei*, and the Ute ladies'-tresses orchid, *Spiranthes diluvialis*, are known to occur upstream within the Boulder Creek drainage. In addition, the site is within the Platte River drainage, and the USFWS has requested that any action on the project site that could result impact listed species or critical habitat in the central Platte River in

Nebraska also be addressed. However no adverse impacts to the Platte River are anticipated. This Environmental Assessment (EA) has analyzed the potential effects of project implementation and the resulting environmental changes from the project, and determined that this project is not likely to adversely impact T&E species. The USFWS concurred with this determination in a letter dated May 25, 2011.

Environmental Justice (E.O. 12898).
In compliance. Federal agencies shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States. The project does not disproportionately impact minority or low-income populations.

Farmland Protection Policy Act, 7 U.S.C. 4201, et seq.
In compliance. This Act instructs the Department of Agriculture, in cooperation with other departments, agencies, independent commissions and other units of the Federal government, to develop criteria for identifying the effects of Federal programs on the conversion of farmland to nonagricultural uses. No farmland is located on or surrounds the project area. The NRCS confirmed in a May 19, 2011 communication that the project area is in a previously identified urbanized area, and that no Prime Farm Land is recognized. There are no FPPA significant concerns.

Fish and Wildlife Coordination Act, as amended, 16 U.S.C. 661, et seq.
In compliance. In accordance with Section 7 of the Endangered Species Act of 1973, as amended, the Corps requested in a letter dated July 21, 2008, that the USFWS provide a list of Federally listed threatened and endangered species that may be found in the proposed project area. The USFWS responded with a letter dated August 12, 2008, which serves as the PAL. In an letter dated May 25, 2011, after the USFWS reviewed the Draft DPR/EA, the USFWS noted the benefits to resources of Federal interest, including wetlands, migratory birds and aquatic life.

Flood Plain Management (E.O. 11988) 42 CFR 26951.
Compliance to be achieved during design phase. Omaha District's Flood Risk and Floodplain Management Section completed a review of the proposed project. The footprint of much of the project construction lies within the flood fringe and floodway boundaries of the effective Flood Insurance Rate Maps (panel 415 of 595, dated June 2, 1995). As such, Omaha District acknowledges the requirements of E.O. 11988 as well as any State and local floodplain ordinances. The proposed project consists primarily of channel modifications to restore more natural meanders, floodplain connectivity, and diversity of habitat in close proximity to the channel, as well as reconstructing an existing small pond (Cottonwood Pond) to an emergent wetland complex with a meandering channel. In general, the proposed channel modifications typically result in slightly increased conveyance within the channel but also introduce some changes in channel roughness due to increased meanders and changes in vegetation. Hydraulic modeling to date has demonstrated that the proposed changes result in very slight increases in water surface elevations at a few cross sections. Since the modeling is preliminary at this juncture and is subject to revision during the final design process, the PDT proposes to address optimization of the final design model during the design phase with an absolute requirement that the final model must demonstrate no rise (0.00 ft) floodway throughout the project area. The

changes to the design that would result from modifying the modeling is not anticipated to significantly affect project alignment, quantities, or costs and should have no effect on the project outputs in terms of habitat benefits.

Migratory Bird Treaty Act of 1918 (16 U.S.C. 703-712) as amended.
*In compliance***.** The Migratory Bird Treaty Act (MBTA) of 1918 is the domestic law that affirms, or implements, the United States' commitment to four international conventions with Canada, Japan, Mexico, and Russia for the protection of shared migratory bird resources. The MBTA governs the taking, killing, possessing, transporting, and importing of migratory birds, their eggs, parts, and nests. The take of all migratory birds is governed by the MBTA's regulation of taking migratory birds for educational, scientific, and recreational purposes and requiring harvest to be limited to levels that prevent over-utilization. Executive Order 13186 (2001) directs executive agencies to take certain actions to implement the Act. The Corps will perform surveys for migratory birds and nests prior to construction, and will be in consultation with the USFWS, and the states with regard to impact on migratory birds.

National Environmental Policy Act, as amended, 42 U.S.C. 4321, et seq.
In compliance. A Detailed Project Report and Environmental Assessment (EA) have been prepared for the proposed action. The Draft report is currently undergoing agency and public review, and the public involvement process.

National Historic Preservation Act, as amended, 16 U.S.C. 470a, et seq.
In compliance. The Corps reviewed the National Register of Historic Places (NRHP) and found no NRHP properties listed within or near the project area. The State of Colorado Historic Preservation Officer provided the opinion that the potential of locating archaeological sites within the Area of Potential Effects (APE) is low; therefore, an archaeological survey is not needed. A Detailed Project Report and Environmental Assessment (EA) have been prepared. The report is pending public and agency review to complete the NEPA process. If any historic or archaeological resources are found, the contractor would be explicitly instructed that he or she should stop work and contact the Corps Omaha District Office immediately.

Noise Control Act of 1972, 42 U.S.C. Sec. 4901 to 4918.
In compliance. Noise emission levels at the project site will increase above current levels temporarily due to construction of the ponds and wet areas; however, appropriate measures will be taken to keep the noise level within the compliance levels.

Protection of Wetlands (E.O. 11990). *In compliance*. Federal agencies shall take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agencies responsibilities. Each agency, to the extent permitted by law, shall avoid undertaking or providing assistance for new construction located in wetlands unless the head of the agency finds (1) that there is no practicable alternative to such construction, and (2) that the proposed action includes all practicable measures to minimize harm to wetlands, which may result from such use. In making this finding, the head of the agency may take into account economic, environmental and other pertinent factors. Each agency shall also provide opportunity for early public review of any plans or proposals for new construction in wetlands. Construction could impact a small amount

of existing stream-side or pond wetlands, estimated to be under 0.1 acre total. Because the 10-13 acres of wetland that could be restored by the project offset any construction impacts to wetlands, no significant impact or net loss of wetlands is anticipated.

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US Army Corps of Engineers ®
Omaha District

GOOSE CREEK
BOULDER, COLORADO

SECTION 206
ECOSYSTEM RESTORATION REPORT

APPENDIX A-4
HABITAT ASSESSMENT RESULTS

JUNE 2011

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Attachment 2 – Results of Existing Wetland Analysis (not included as a stand-alone reach)

Attachment 3 – Panel of Experts

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1.0 INTRODUCTION

The current and future quality of wildlife habitat in stream, wetland and riparian areas in the Goose Creek Section 206 Project Area were assessed using a modified version of EPA's Rapid Bioassessment Protocols (RBPs) (Barbour, 1999) (see Section 2.2). According to the EPA document EPA 941-B-99-002, the RBPs were established in the mid-1980s due to the need for cost-effective biological survey techniques. Among the goals of the protocols were that they be environmentally benign, cost-effective, yet scientifically valid assessment techniques which could be easily translated in scientific reports for use by management and the public. Protocols for three aquatic assemblages (periphyton, benthic macroinvertebrates and fish) and a habitat assessment (Habitat Quality Index - HQI) are presented. It has been found that the RBPs can be applied to other program areas, such as characterizing reference conditions, characterizing the existence and severity of impairment to the water resource, helping identify sources and causes of impairment, and evaluating the effectiveness of restoration activities. Additionally, the methodology provided a vehicle to meet the goals outlined in Appendix E of ER 1105-2-100, as it pertains to "evaluating the larger context of community and ecosystem frameworks" for this smaller project in an urban setting.

The methodology has gained wide acceptance in the past 25 years, and had been employed in earlier studies in the Boulder area including evaluations of Goose Creek in Boulder. One such study, the Zuellig Thesis "Macroinvertebrate and Fish Communities along the Front Range of Colorado and their Relationship to Habitat in the Urban Environment," is considered foundational to this ecosystem restoration project (Zuellig, 2001). Zuellig used a modified version of EPA's RBPs, and studied a portion of Goose Creek. Among the habitat characteristics measured were stream width, riparian width, percent run, riffle pool, glide, area of root wad, undercut banks and woody debris. The output of an evaluation of a riparian ecosystem was expressed in terms of "Habitat Attributes."

During the formulation of the Section 206 ecosystem restoration effort, application of this methodology to evaluate outputs from the Goose Creek ecosystem restoration effort was discussed with the City of Boulder, Colorado Division of Wildlife (CDOW) and Fish and Wildlife Service (USFWS) during initial meetings and correspondence in the spring of 2006, with Northwestern Division (NWD) in November of 2006 and with the Panel of Experts, which was convened in May 2008 (see Section 2.l). These discussions were also coordinated with the Corps' Ecosystem Restoration Planning Center of Expertise (ECO-PCX) located in the Mississippi Valley Division (MVR). Recommendations forwarded by NWD included documenting any modifications of the methodology, articulating the measurable and quantifiable outputs and qualifying results according to the relatively small scale of the project area. An additional phone conference was held with Northwestern Division and the ECO-PCX in February 2010. The guidance provided included having an expert on the ATR who was familiar with the EPA Rapid Bioassessment.

Three reaches have been designated by the project delivery team within the Goose Creek Project Area (Figure 1). Reach delineation was based on unique features and potential restoration opportunities. The reaches are identified as:

- Reach 1 – Upper Riparian Corridor;
- Reach 2 – Lower Riparian Complex, and
- Reach 3 – Cottonwood Pond.

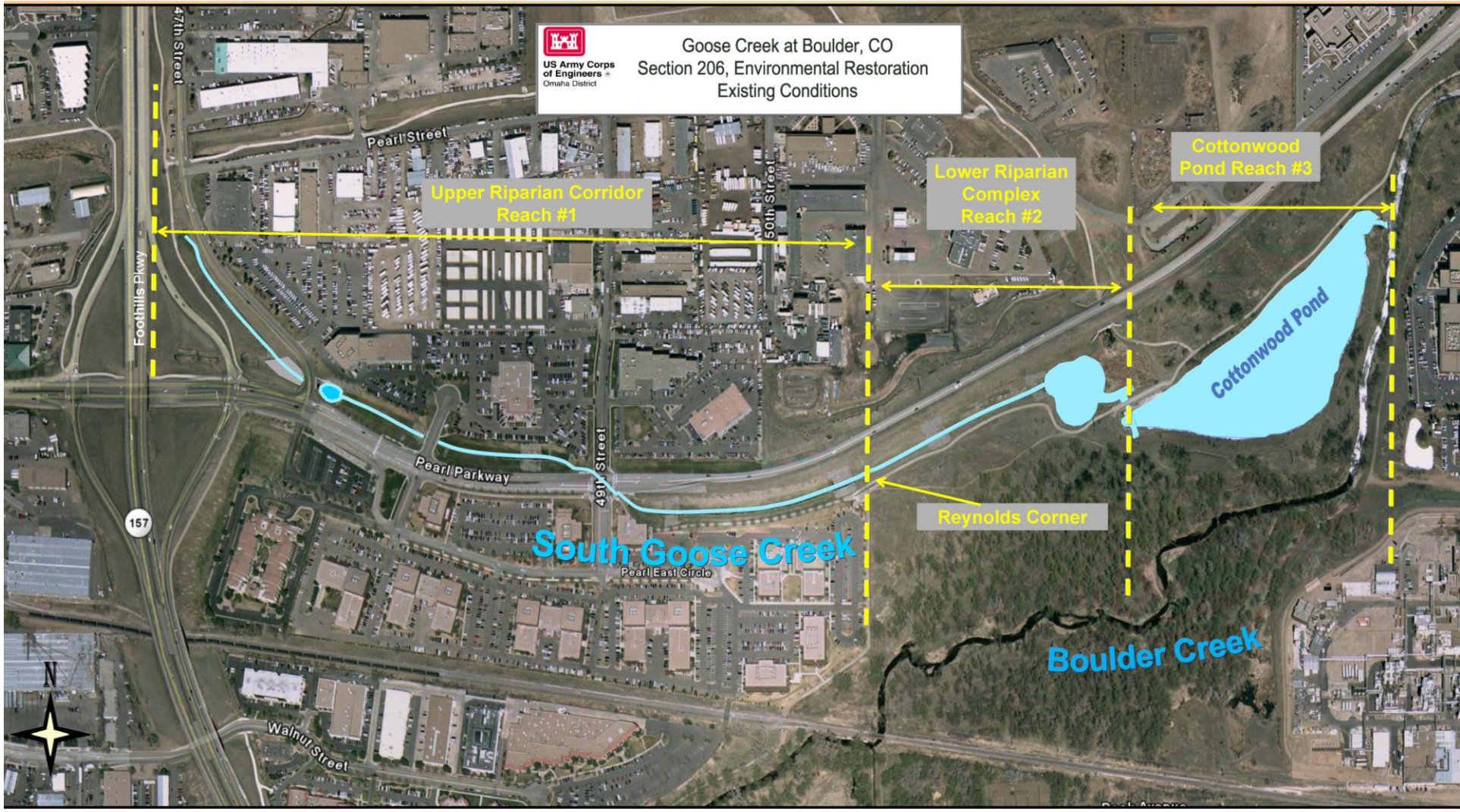

Figure 1: Goose Creek Project Area.

2.0 METHODS

2.1 Panel of Experts

On May 8, 2008, a panel of experts met on site to assess the existing conditions of the Goose Creek project site (Attachment 3). Members included representatives from the U.S. Army Corps of Engineers, the City of Boulder, Boulder County Parks and Open Space, U.S. Fish and Wildlife Service (USFWS), Colorado Division of Wildlife (CDOW), U.S. Corps of Engineers Engineering and Research Development Center (ERDC), the U.S. Environmental Protection Agency (EPA), the U.S. Geological Service and the USDA Natural Resources Conservation Service (NRCS). The meeting was conducted on-site and involved individual scoring in the field followed by a collaboration session to ascertain appropriate and accurate assignment of values. On August 17, 2010, members of the panel reconvened via phone conference and email to discuss a newly proposed alternative for Reach 3, Cottonwood Pond. Using the modified version of EPA's Rapid Bioassessment Protocol (Barbour, 1999), each reaches' habitat characteristics were described including aquatic attributes, plant communities, stream banks, and hydrologic conditions based primarily on professional judgment and local expertise (see Section 2.2., model modification details).

The panel of experts assigned an index score to each habitat attribute based on restoration literature (Appendix A-1), past restoration projects (both successes and failures), site visits/knowledge of the site and professional judgment. Existing and Future without-project conditions were assessed, as were Future with-project conditions (maximum score achievable for the project site among the various alternatives). Expert panel member scores for each attribute were averaged to provide an individual attribute score. The individual attribute scores are averaged to provide an HQI score for each alternative. This score was then multiplied by the available acres within each reach to produce a Habitat Unit (HU) value for each Alternative.

2.2 Model Modification

The EPA RBA scores various habitat attributes (e.g. epifaunal substrate cover, frequency of riffles, vegetative protection) on a scale of 1 – 20. The modification used for this study re-valued the scale from 0 – 1 (0 = no value; 1 = optimum value). The scale is represented in Table 1 below. In addition, the Zeullig thesis took 4 categories (optimal, good/suboptimal, marginal and poor) and added a "not present" category with a score of zero in order to adjust the scale of the "poor" category representative of a value starting at 0.1, and to add the distinction that an attribute may not be currently present in the system. The modification for Goose Creek also utilized these 5 categories (see the habitat assessment sheets in Attachment 1).

Table 1. Habitat Quality Index Scale.

Habitat Quality Index	Verbal Equivalent
0.0 < 0.29	Poor
0.30 < 0.59	Marginal
0.60 < 0.89	Good/Sub-optimal
0.9 < 1.0	Optimal

The RBA provides 10 attributes for low gradient streams, and 10 for high gradient streams (7 overlap, and 3 are distinct between the gradients, equaling 13 possible attributes). Zeullig's thesis (Zeullig 2001) utilized attributes from the RBAs high and low gradient stream attribute tables to create an assessment sheet of 10 attributes. The Goose Creek panel of experts also utilized attributes from the RBAs high and low gradient attribute tables (9 of the 13 attributes) and customized 7 others that were representative of specific characteristics in the Front Range region or of an urbanized stream. Table 2 shows the list of attributes from the RBA and those utilized by the panel. Samples of the RBA assessment sheets, Zeullig's modified assessment sheet and the panels 'modified assessment sheet are in Attachment 1, and include a description of each attribute and the scale utilized.

Table 2. Comparison of Habitat Attributes Utilized from EPA Rapid Bioassessment

Attribute	EPA-RBA	Zeullig	Goose Creek
Frequency of Riffles	X (H)	X	X
Velocity/Depth Comb.	X (H)	X	X
Pool/Pond Substrate Characteristics	X (L)	X	X
Epifuanal Substrate & Available Cover	X	X	X
Embeddedness	X (H)	X	X
Channel Sinuosity	X (L)	X	X
Shoreline/Bank Stability	X	X	X
Riparian Vegetative Zone Width	X	X	X
Vegetative Protection	X	X	X
Sediment Deposition	X		
Channel Flow Status	X		
Channel Alteration	X		
Pool Variability	X (L)	X	
Water Quality			X
Floodplain Connectivity			X
Riparian Corridor			X
Vegetated Buffer			X
Riparian Vegetative Quality			X
Exotic Species			X
Threatened & Endangered Species			X

From the RBA, four attributes were removed for the Goose Creek analysis, including channel flow status, channel alteration, sediment deposition and pool variability. Channel flow status was removed from consideration due to the regulated flow and sometimes low or dewatered status of the stream, and the existence of the concrete lined

channel. Channel alteration was removed due to the existence of the concrete lined channel and that channelization or strict hardpointing is a factor throughout the entire project to protect nearby development and Pearl Parkway. Even potential meanders in Reach 2 Alternative 2 would be subject to these restrictions. Sediment deposition and pool variability were eliminated because of the nature of the channelized stream and its inability to create all but minute pools or islands.

Bank stabilization was removed from consideration in the stream reaches because of the channelized nature of this urban reach and its proximity to Pearl Parkway and a business park that must remain protected. Both banks obviously scored a 10 (optimum) and any activities to remove such structure would be detrimental to the designed channel integrity. This attribute did remain in the Cottonwood pond analysis.

Attributes utilized from the RBA (frequency of riffles, velocity/depth combinations, pool/pond substrate, epifaunal substrate, embeddedness, channel sinuosity, shoreline/bank stability, riparian vegetative zone width and vegetative protection) and those added by the panel (water quality, floodplain connectivity, riparian corridor, vegetated buffer, riparian vegetative quality, exotic species and threatened and endangered species) are summarized below, and the scale is available in the attribute scoring sheets in Attachment 1.

Frequency of Riffles

Frequency of riffles evaluates the heterogeneity of a stream by calculating the distance between riffles divided by stream width (Barbour, 1999, pg 5-13). Riffles are often the source of the most diverse macroinvertebrate fauna within a stream (Resh and Jackson 1993); therefore, an increased frequency in the occurrence of riffles can greatly enhance the diversity of the stream community by providing more living space.

Velocity/Depth Combinations

A diversity of depths and velocities protects the stream from excessive erosion during flooding, and provides refugia for benthic invertebrates and fish (Barbour, 1999, pg 5-15).

Pool Substrate Characterization

Pool substrate characterization evaluates the type and condition of bottom substrates found in pools. Gravel, sand and rooted plants support a wider variety of aquatic organisms than a pool substrate dominated by mud, clay, bedrock or silt (Barbour, 1999, pg 5-14).

Epifaunal Substrate and Available Cover

Epifaunal substrate and available cover describes the relative percent and variety of natural structures in the stream, such as clean cobble or gravel, woody debris, root wads and undercut banks for over head cover and quality of riffles for fish and benthic invertebrates. A wide variety and abundance of these habitat components provides macroinvertebrates and fish with a large number of niches to occupy. Generally, as the variety and abundance of cover decreases, diversity can decrease and the potential for

recovery after disturbance decreases. High quality riffles contain a wide variety of particle sizes, which provide diverse habitat for aquatic organisms (Barbour, 1999, pg 5-11).

Embeddedness

Embeddedness is a result of large-scale sediment movement and deposition caused by stream bank collapse or new construction taking place in or around the stream channel. Embeddedness measures the extent to which bottom substrate in riffle areas are covered by fine sediment. Generally, as riffle substrate becomes embedded interstitial spaces between individual cobbles and gravel disappear, causing the amount of surface area available to benthic macroinvertebrates for living space and available cover and spawning habitat for fish to decrease (Barbour, 1999, pg 5-13).
From Zeullig, 200: Riffle dwelling organisms respond negatively to areas subject to embeddedness (Zeullig, Minshall 1984, Waters 1995).

Channel Sinuosity

Channel sinuosity evaluates the meandering or sinuosity of a stream and the degree of channelization. Meanders can also dissipate energy created during high water events and reduce bank erosion. Pools, undercut banks, and areas of flow separation created by a sinuous channel provide refugia for fish and benthic macroinvertebrates during periods of high water (Barbour, 1999, pg 5-24).
From Zeullig, 2001: A high degree of sinuosity provides conditions suitable to create diverse habitat and fauna associated with undercut banks, pools created by outside bends, and pool riffle sequences (Platts et al. 1983). The process of channelization often destroys pools, riffles, undercut banks and flow separation by cuttings meanders, shortening stream length, deepening the channel, and removing riparian vegetation (Karr and Schosser, 1978). Channelization also causes long-term loss of habitat in a downstream direction, influencing areas of refugia that provide potential sources of recolonization after disturbance (Sedell et al. 1990).

Bank Stability

Bank stability measures the relative percentage of raw and exposed stream bank. Steep, raw exposed stream banks are more likely to collapse and suffer from erosion than gradually sloping stream banks. Eroded banks indicate a problem of mass sediment movement and deposition and suggest a scarcity of cover and organic input into a stream. Each stream bank was evaluated separately and left and right sides were determined facing downstream (Barbour, 1999, pg 5-26).

Vegetative protection

Vegetative protection measures the amount of bank stability generated by vegetative protection. Stream banks protected by root systems of plants help hold soil in place and are less likely to erode. Vegetated banks provide erosion resistance, stream shading and overhead cover for fish, food resources for aquatic organisms, pupation areas, and cover for adult aquatic insects. Banks that have full, natural plant growth are better for fish and benthic invertebrates than banks that are shored up with riprap or concrete. Each stream

bank was evaluated separately and left and right sides were determined facing downstream (Barbour, 1999, pg 5-28).

Riparian Zone Width

Riparian zone width measures the natural stream bank out through the riparian zone. The vegetative zone serves as a buffer to pollutants entering a stream from overland flow (excluding sewer outfalls), controls erosion, and provides habitat and nutrient input into the stream. A relatively undisturbed riparian zone supports a robust stream system, narrow riparian zones occur when roads parking lots, lawns, and buildings are near the stream bank. Common causes of narrow riparian areas include urban centers, golf courses, residential developments, and grazing. Each stream bank was evaluated separately and left and right sides were determined facing downstream (Barbour, 1999, pg 5-30).

Attributes Recommended by the Panel of Experts.

The panel of experts reached consensus on the following attributes as well as the scale used to score the attributes (found in the sheets in Attachment 1). This work took place in 2008 when the panel met and refined these modifications. The use of a panel or committee to define and document metric or attribute development is an acceptable practice (McKay et al, 2010).

Water Quality

Water quality is important to fish, amphibians, invertebrates and plants. In addition to pollutants, dissolved oxygen and extreme temperatures can limit species. Water quality is also an important factor in determining riparian buffer needs (USDA, 2003; Barbour, 1999). This variable added by the panel of experts, including the sponsor (City of Boulder), who considered this an important attribute given the urbanized nature of the reach and local water quality within the Boulder Creek watershed..

Floodplain Connectivity

Floodplain connectivity evaluates the ability of a stream to interact with the floodplain and bank. This interaction supports exchange of sediment and nutrients, provides microhabitat for spawning and nursery, attenuates flood flows and supports a diverse riparian and wetland corridor important to many plant & animal species.

Riparian Corridor

A riparian corridor includes stream banks and associated areas adjacent to a stream. This corridor connects two or more larger patches of vegetation, and is a linear ecosystem that permits species movement and migration with regions upstream and downstream of the project area. Riparian corridors provide food and cover and function to prevent stream warming (USDA, 2003; Fischer, 2000). Protection of riparian corridors is critical to the long-term health of streams and downstream waters, and adds aesthetic and economic value.

Vegetated Buffer
A terrestrial buffer zone begins at top of bank & is needed for some species in addition to the stream and riparian vegetative zone. This vegetated buffer filters nonpoint source pollutants from incoming runoff and provide bank stabilization (USDA, 2003; Fischer, 2000; Welsch, 1991; Dillaha et al 1989)

Riparian Vegetative Quality
Riparian wetlands trap sediment by slowing down the water. Nutrients attached to the sediment or in the water are metabolized by wetland plants and reduce eutrophication of ponds (Gershman, 1999).

Exotic Species
Invasive species crowd out native species and can harm the survival of native T&E species (USDA website, Colorado invasive species; Missouri Department of Conservation website). This attribute measures how a stream restoration project is likely to impact these species.

Threatened and Endangered Species
Includes federally listed Endangered, Threatened and Candidate species. Also includes any State listed species of concern. This attribute measures how a stream restoration project is likely to have effects on these species.

In addition, two other attributes were considered by the panel, but eliminated. One was base flow, which was originally thought relevant to evaluate because of the regulated flow or sometimes dewatered status of the stream, but was eliminated because project actions would not impact this status, and instead this status is considered within the constraints of the project. The other attribute considered but eliminated was sustainability, a measure of self healing, or another way to look at it is the gauge of the intensity of management activities to sustain the restored habitat. This was eliminated because a project objective for the restoration is a self sustaining stream and riparian corridor, and any other management actions (i.e. the intensity of vegetation or invasive management) would not change.

Following a subsequent review of the habitat attributes, stream-specific attributes were removed from the Cottonwood Pond analysis. Table 3 provides the list of which attributes were utilized in the stream and pond reaches.

Table 3. HQI Habitat Attributes Utilized for the Stream vs Pond Reaches

Attribute	Stream	Pond
Water Quality	X	X
Frequency of Riffles	X	
Velocity/Depth Comb.	X	X
Pool/Pond Substrate Characteristics	X	X
Epifuanal Substrate & Available Cover	X	X
Embeddedness	X	
Channel Sinuosity	X	
Floodplain Connectivity	X	
Shoreline Stability		X
Riparian Vegetative Zone Width	X	
Riparian Corridor	X	
Vegetated Buffer	X	X
Vegetative Protection	X	X
Riparian Vegetative Quality	X	X
Exotic Species	X	X
Threatened & Endangered Species	X	X
Total Attributes	**15**	**10**

2.3 Elimination of Existing Wetland Area as a Stand Alone Reach

Panel discussion regarding a potential fourth reach, the existing wetland, led to the determination that restoration efforts implemented to increase the quality of this wetland would not produce significant environmental benefits and could potentially decrease the existing quality. Therefore, wetland restoration efforts as a result of project implementation would focus only on expansion of the existing wetland. The existing wetland is considered the lower portion of Reach 2, and no construction activity is recommended. Results of this discussion are in Attachment 2.

3.0 EXISTING (BASELINE) AND FUTURE WITHOUT-PROJECT HABITAT CONDITION

Several factors have diminished the value of stream and riparian habitat with the Goose Creek Project Area. These include urbanization and commercial development, channelization of Goose Creek, storm water inputs, disruption of the soil structure and floodplain area, and establishment of non-native and invasive plants. These have greatly altered the hydrologic regime resulting in stream system degradation. The stream is now a concrete-lined channel bordered by large boulders, large areas of rip rap and three concrete box culverts. Interaction between the stream and the adjacent floodplain are minimal to non-existent.

The stream reaches within the restoration project area lack sinuosity, diverse channel morphology and native riparian plant communities. The dominant vegetation throughout the project area, particularly Reach 1, consists mainly of bluegrass lawn with minute areas of wetland vegetation between the large rocks lining the channel or around the small ponded area. Reach 2 also lacks vegetation diversity and is the location of a prairie dog colony. Reach 3 is a pond with isolated areas of emergent vegetation, which are mostly concentrated in the area of the pond outlet. Woody vegetation consists primarily of Russian olive (State of Colorado B List Noxious Weed) and crack willow. Overall, native vegetation suitable for wildlife habitat is almost entirely absent from the project area and while some riparian shrubland is present in Reach 3, there is essentially no tree canopy present throughout the entire project area.

Multiple habitat assessments have been conducted for the City of Boulder between 1995 and 2004 and have included the project area. Aquatic and riparian habitat have been described as poor to marginal. Summaries of the physical characteristics and information from these previous reports that relate to the project area are provided in Appendix A-2.

As a result, the only habitat available for wildlife usage includes a high temperature, concrete-lined stream with a narrow/absent riparian width, low flows, riprap, extensive habitat fragmentation, and minimal cover by native plants, and lack of vegetation structure. In sum, the existing reach lacks diverse and abundant wildlife species because of a lack of protection from predators, lack of shelter areas, very limited food resources, and certain water quality conditions (e.g., appropriate temperature). These in turn are functions of the streambed (instream cover, epifaunal substrate, embeddedness), flow characteristics, channel morphology (channel alteration, riffle frequency, and sediment deposition) and bank stability (bank vegetation, bank stability, and riparian width).

3.1 Results – Existing and Future without-project Conditions

For each alternative, existing and future-without conditions for each potential reach were evaluated for 1, 5, 10 and 15 years for comparative purposes with Future with-project expectations (see Section 4.2). Individual attribute scores, HQI and HUs are presented in Table 4.

Reach 1 covers about 7.7 acres, and is estimated to provide poor habitat (HQI = 0.13). This results in 0.975 Habitat Units (HUs). Future without-project conditions are expected to decline, with an HQI of 0.12 and 0.934 HUs.

Reach 2 covers about 1.71 acres, and is estimated to provide poor habitat (HQI = 0.13). This results in 0.222 Habitat Units (HUs). Future without-project conditions are expected to decline, with an HQI of 0.12 and 0.207 HUs.

Reach 3, Cottonwood Pond, covers about 16.65 acres, and is estimated to provide marginal habitat (HQI = 0.36). This results in 5.994 Habitat Units (HUs). Future without-project conditions are expected to decline, with an HQI of 0.35 and 5.744 HUs.

Table 4. Individual Attribute and Reach HQI and Total Habitat Units (HUs)

Reach 1 - 7.7 Acres	Existing Condition Score	FWOP Condition Score
Water Quality	0.300	0.300
Frequency of Riffles	0.200	0.200
Velocity/Depth Combinations	0.200	0.200
Pool Substrate Characterization	0.000	0.000
Embeddedness	0.000	0.000
Epifaunal Substrate/Available Cover	0.100	0.100
Channel Sinuosity	0.250	0.250
Riparian Vegetative Zone Width	0.000	0.000
Riparian Corridor	0.000	0.000
Vegetated Buffer	0.150	0.150
Vegetative Protection	0.150	0.120
Exotic Species	0.150	0.100
Flood Plain Connectivity	0.100	0.100
Riparian Vegetative Quality	0.300	0.300
Threatened & Endangered Species	0.00	0.00
HQI Score (Avg)	0.127	0.121
Habitat Units (HQI Avg * Acres)	0.975	0.934
Reach 2 - 1.71 Acres	Existing Condition Score	FWOP Condition Score
Water Quality	0.300	0.300
Frequency of Riffles	0.200	0.200
Velocity/Depth Combinations	0.200	0.200
Pool Substrate Characterization	0.000	0.000
Embeddedness	0.000	0.000
Epifaunal Substrate/Available Cover	0.100	0.100
Channel Sinuosity	0.250	0.250
Riparian Vegetative Zone Width	0.000	0.000
Riparian Corridor	0.000	0.000
Vegetated Buffer	0.150	0.150
Vegetative Protection	0.150	0.120
Exotic Species	0.400	0.300
Flood Plain Connectivity	0.100	0.100
Riparian Vegetative Quality	0.100	0.100
Threatened & Endangered Species	0.00	0.00
HQI Score (Avg)	0.130	0.121
Habitat Units (HQI Avg * Acres)	0.222	0.207
Reach 3 - Cottonwood Pond = 16.65 Acres (7.13 pond + 9.52 perimeter) Alternative 1	Existing Condition Score	FWOP Condition Score
Water Quality	0.500	0.500
Depth Combinations	0.300	0.300
Pond Substrate	0.500	0.500
Epifaunal Substrate & Cover	0.400	0.400
Shoreline Stability	0.525	0.525
Vegetated Buffer	0.325	0.250
Vegetative Protection	0.425	0.425
Vegetative Quality	0.300	0.300
Exotic Species	0.275	0.200
T&E	0.050	0.050
HQI Score (Avg)	0.360	.0345
Habitat Units (HQI Avg * Acres)	5.994	5.744

3.1.1 Conclusions – Existing and Future without-project Conditions

The value of stream and riparian habitat in the Goose Creek Project Area has been reduced by the channelization of Goose Creek and the establishment of non-native-invasive plants, which has modified riparian habitats by changing the interaction between the stream and the adjacent floodplain. The existence of prairie dogs may exacerbate the current habitat modifications. Overall, Goose Creek stream and riparian areas within the project area are degraded, provide marginal to poor habitat, and are expected to continue to decline in habitat value.

4.0 FUTURE WITH-PROJECT CONDITION

For each alternative, future conditions were evaluated for years when changes would be first apparent (years 1 and 5), as well as points when existing vegetation conditions could reach maturity or a full cycle of vegetative succession could occur (years 10 and 15). The panel then assumed that the maximum benefits achieved by year 15 would extend throughout the life of the project (50 years) (see Tables 5 and 6, years 15-50). Future conditions of the essential habitat variables for each reach are based on anticipated management goals for the site, as well as ecological concepts based on stream hydrology, invasive species biology, and plant-animal interactions.

A total of five restoration alternatives were proposed for the purpose of restoring the project area at Lower Boulder Creek. These entailed:
Reach 1, Alternative 1, the upper riparian corridor
Reach 2, Alternative 1, lower riparian complex
Reach 2, Alternative 2, lower riparian complex, move bike trail, increase riparian area, meander channel
Reach 3, Alternative 1, Cottonwood Pond
Reach 3, Alternative 2, Cottonwood Pond wetland

4.1 Results – Future with-project Conditions

The Future without-project scores are compared to Future with-project scores at 15 yrs. Individual attribute scores, HQI and HUs are presented in Tables 5 and 6.

4.1.1 Reach 1, Alternative 1

Goose Creek is classified as "Poor" with regard to habitat quality. The lack of sinuosity and diverse channel morphology, and habitat fragmentation greatly limit the habitat quality within this area and therefore restrict wildlife usage. The lack of a continuous riparian corridor, lack of vegetation diversity, and the presence of non-native species further limit wildlife usage within Reach 1. Removing invasive species and re-planting the riparian corridor with diverse, native species provides improvements in riparian vegetation width, corridor and quality, vegetative buffer and protection, presence of exotic species, epifaunal substrate and cover and water quality. The potential to remove selected boulders and provide microhabitats improves frequency of riffles, depth combinations, embeddedness and substrate attributes. Furthermore, modifications made to the existing box culverts could significantly increase connectivity between Goose Creek and Boulder Creek for small mammals, reptiles and amphibians

By year 15, these improvements are estimated to improve Reach 1 (7.7 acres) habitat from poor (HQI = 0.12) to marginal (0.49), and results in improving HUs from 0.934 to 3.79, an increase in 2.86 HUs (see Table 5)

4.1.2 Reach 2, Alternative 1

Goose Creek is classified as "Poor" with regard to habitat quality. The lack of sinuosity and diverse channel morphology, and habitat fragmentation greatly limit the habitat quality within this area and therefore restrict wildlife usage. The lack of a continuous riparian corridor, lack of vegetation diversity, and the presence of non-native species further limit wildlife usage within Reach 2. Removing invasive species and re-planting the riparian corridor with diverse, native species provides improvements in riparian vegetation width, corridor and quality, vegetative buffer and protection, presence of exotic species, epifaunal substrate and cover and water quality. The potential to remove selected boulders and provide microhabitats improves frequency of riffles, depth combinations, embeddedness and substrate attributes.

By year 15, these improvements are estimated to improve Reach 2 (1.71 acres) habitat from poor (HQI = 0.13) to marginal (0.492), and results in improving HUs from 0.21 to 0.84, an increase in 0.63 HUs (see Table 5).

4.1.3 Reach 2, Alternative 2

There is much greater opportunity to increase riparian corridor width and diversity, increase stream length by reintroducing sinuosity back into the channel, particularly in Reach 2 where the bike trail could be relocated and more space is available to implement additional habitat features. Moving the existing bike trail to the south (further from the right bank of South Goose Creek) and excavating a new, meandering channel with a hydrologically-connected wide right-bank terraced floodplain bench to the south comprises an expanded area of approximately 4.14 acres (from 1.71 acres future without-project). The meander would increase the low-water channel stream length by adding sinuosity. Removing invasive species and re-planting the riparian corridor with diverse, native species provides improvements in riparian vegetation width, corridor and quality, vegetative buffer and protection, presence of exotic species, epifaunal substrate and cover and water quality. The potential to remove selected boulders and provide microhabitats improves frequency of riffles, depth combinations, embeddedness and substrate attributes.

By year 15, these improvements are estimated to improve Reach 2, Alternative 2 (4.14 acres) habitat from poor (HQI = 0.12) to good/suboptimal (0.60), and results in improving HUs from 0.21 to 2.49, an increase in 2.28 HUs (see Table 5).

4.1.4 Reach 3, Cottonwood Pond, Alternative 1

Overall, Cottonwood Pond can be classified as "Marginal" with regard to quality habitat available for local native species. The presence of exotic/invasive species, primarily Eurasian Milfoil, Russian olive, and Brome greatly reduces the habitat quality within this area, limiting wildlife usage. Other items that marginally limit wildlife usages are limited depth and shoreline variation, and overall vegetation protection. The vegetation that is present on site provides some shoreline protect and wildlife value, however, this value is limited due to lack of diversity. Numerous benefits could be realized at a significantly

lower cost than what is typically associated with a project of this type, primarily because of fill placement, rather than excavation. These benefits include increased biodiversity, more efficient water purification, recreational opportunities and outdoor classroom potential.

Removing invasive species and re-planting the riparian corridor with diverse, native species provides improvements in riparian vegetation width, corridor and quality, vegetative buffer and protection, presence of exotic species, epifaunal substrate and cover and water quality.

By year 15, these improvements are estimated to improve Cottonwood Pond, Reach 3, Alternative 1 (16.65 acres) habitat within the marginal range, from HQI = 0.35 to 0.53, and results in improving HUs from 5.744 to 8.87, an increase in 3.12 HUs (see table 6).

4.1.5 Reach 3, Cottonwood Pond, Alternative 2

For this alternative, fill would be used to create a forest wetland similar to much of the area's historical planform. The entire pond would be filled, and a new meandering channel, which mimics the pattern/amplitude of the historical channel, would be excavated. Other features include a shallower remnant channel opposing the stream pattern, and deeper remnant oxbows. In addition, large stands of cottonwood and willows would be planted to re-establish cottonwood wetland areas similar to historic conditions.

Returning the area to a more historic wetland and riparian pattern, removing invasive species and re-planting the riparian corridor with diverse, native species provides improvements in riparian vegetation width, corridor and quality, vegetative buffer and protection, presence of exotic species, epifaunal substrate and cover and water quality.

By year 15, these improvements are estimated to improve Cottonwood Pond, Reach 3, Alternative 2 (16.65 acres) habitat from marginal (HQI = 0.35) to good/suboptimal (0.76), and results in improving HUs from 5.74 to 12.72, an increase in 6.98 HUs (see Table 6).

4.1.6 Conclusions – Future with-project Conditions

The value of stream and riparian habitat in the Goose Creek Project Area has been reduced by the channelization of Goose Creek and the establishment of non-native-invasive plants. The Goose Creek project area, based on existing literature and local expertise could potentially support a range of native habitat types prairie grassland, marsh, riparian willows and shrubs, and deciduous riparian forest dominated by plains cottonwood with a native shrub and grass understory. Based on the habitat assessments, restoration opportunities exist within the identified project area for Reaches 1, 2 and 3. Based on HQI scores and corresponding HUs, establishing a riparian corridor, replacing non-native vegetation with native vegetation, and the potential to excavate a meandering

channel downstream of Reynolds Corner and return Cottonwood Pond to a historic wetland condition, would produce significant differences in habitat suitability and Habitat units within the project area. Figure 2 summarizes the increase in Habitat Units achievable by the different alternatives.

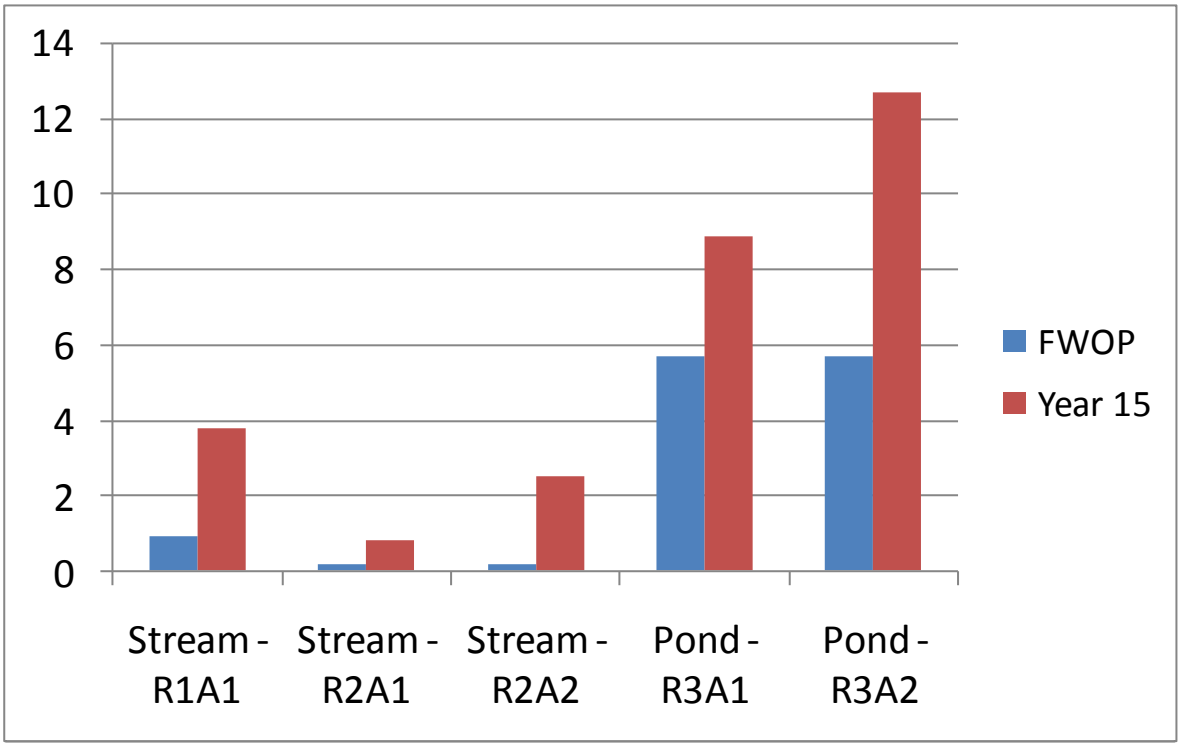

Figure 2: Goose Creek – Habitat Units Future Without Project & Future With Project (Year 15)

Utilization of HQI Scores in the Economic Analysis

The HQI scores from this analysis are utilized in the Cost Effectiveness / Incremental Cost Analysis (CE/ICA) used for determination of the cost effective restoration and "best buy" alternatives (see the Economics Appendix). The calculations of average annual equivalent habitat units (AAHUs) over 50 years are displayed in Exhibit 1 of the Economics Appendix for each reach and alternative. These analyses together form the basis for selection of the National Economic Restoration (NER) plan and selection of the preferred alternative detailed in the main report.

Table 5: Goose Creek HQI Scores and Habitat Units (HUs) for Existing, Future Without-Project and Future With-project Conditions for the Goose Creek Project area.

REACH 1 - ALTERNATIVE 1

			Post Construction					Year 5					Year 10						15 -50 Years Post Construction	
Reach 1 - 7.7 Acres	Existing Condition Score	FWOP Condition Score	FWP Condition Score	Score Change (FWP Score - FWOP Score)	Reach 1 - 7.7 Acres	Existing Condition	FWOP Condition Score	FWP Condition Score	Score Change (FWP Score - FWOP Score)	Reach 1 - 7.7 Acres	Existing Condition	FWOP Condition Score	FWP Condition Score	Score Change (FWP Score - FWOP Score)	Reach 1 - 7.7 Acres	Existing Condition	FWOP Condition Score	FWP Condition Score	Score Change (FWP Score - FWOP Score)
Water Quality	0.300	0.300	0.400	0.100	Water Quality	0.300	0.300	0.467	0.167	Water Quality	0.300	0.300	0.533	0.233	Water Quality	0.300	0.300	0.533	0.233
Frequency of Riffles	0.200	0.200	0.467	0.267	Frequency of Riffles	0.200	0.200	0.533	0.333	Frequency of Riffles	0.200	0.200	0.533	0.333	Frequency of Riffles	0.200	0.200	0.533	0.333
Velocity/Depth Combinations	0.200	0.200	0.467	0.267	Velocity/Depth Combinations	0.200	0.200	0.533	0.333	Velocity/Depth Combinations	0.200	0.200	0.533	0.333	Velocity/Depth Combinations	0.200	0.200	0.533	0.333
Pool Substrate Characterization	0.000	0.000	0.400	0.400	Pool Substrate Characterization	0.000	0.000	0.567	0.567	Pool Substrate Characterization	0.000	0.000	0.567	0.567	Pool Substrate Characterization	0.000	0.000	0.633	0.633
Embeddedness	0.000	0.000	0.233	0.233	Embeddedness	0.000	0.000	0.433	0.433	Embeddedness	0.000	0.000	0.500	0.500	Embeddedness	0.000	0.000	0.567	0.567
Epifaunal Substrate & Available Cover	0.100	0.100	0.467	0.367	Epifaunal Substrate & Available Cover	0.100	0.100	0.500	0.400	Epifaunal Substrate & Available Cover	0.100	0.100	0.567	0.467	Epifaunal Substrate & Available Cover	0.100	0.100	0.567	0.467
Channel Sinuosity	0.250	0.250	0.250	0.000	Channel Sinuosity	0.250	0.250	0.250	0.000	Channel Sinuosity	0.250	0.250	0.250	0.000	Channel Sinuosity	0.250	0.250	0.250	0.000
Riparian Vegetative Zone Width	0.000	0.000	0.300	0.300	Riparian Vegetative Zone Width	0.000	0.000	0.375	0.375	Riparian Vegetative Zone Width	0.000	0.000	0.400	0.400	Riparian Vegetative Zone Width	0.000	0.000	0.400	0.400
Riparian Corridor	0.000	0.000	0.175	0.175	Riparian Corridor	0.000	0.000	0.325	0.325	Riparian Corridor	0.000	0.000	0.425	0.425	Riparian Corridor	0.000	0.000	0.450	0.450
Vegetated Buffer	0.150	0.150	0.325	0.175	Vegetated Buffer	0.150	0.150	0.400	0.250	Vegetated Buffer	0.150	0.150	0.475	0.325	Vegetated Buffer	0.150	0.150	0.475	0.325
Vegetative Protection	0.150	0.120	0.425	0.305	Vegetative Protection	0.150	0.120	0.525	0.405	Vegetative Protection	0.150	0.120	0.675	0.555	Vegetative Protection	0.150	0.120	0.775	0.655
Exotic Species	0.150	0.100	0.600	0.500	Exotic Species	0.150	0.100	0.600	0.500	Exotic Species	0.150	0.100	0.600	0.500	Exotic Species	0.150	0.100	0.600	0.500
Flood Plain Connectivity	0.100	0.100	0.100	0.000	Flood Plain Connectivity	0.100	0.100	0.100	0.000	Flood Plain Connectivity	0.100	0.100	0.100	0.000	Flood Plain Connectivity	0.100	0.100	0.100	0.000
Riparian Vegetative Quality	0.300	0.300	0.425	0.125	Riparian Vegetative Quality	0.300	0.300	0.575	0.275	Riparian Vegetative Quality	0.300	0.300	0.700	0.400	Riparian Vegetative Quality	0.300	0.300	0.800	0.500
Threatened & Endangered Species	0.00	0.00	0.10	0.100	Threatened & Endangered Species	0.00	0.00	0.13	0.133	Threatened & Endangered Species	0.00	0.00	0.17	0.167	Threatened & Endangered Species	0.00	0.00	0.17	0.167
HQI Score (Avg)	0.127	0.121	0.342		HQI Score (Avg)	0.127	0.121	0.421		HQI Score (Avg)	0.127	0.121	0.468		HQI Score (Avg)	0.127	0.121	0.492	
Habitat Units (HQI Avg * Acres)	0.975	0.934	2.635	1.701	Habitat Units (HQI Avg * Acres)	0.975	0.934	3.243	2.308	Habitat Units (HQI Avg * Acres)	0.975	0.934	3.606	2.672	Habitat Units (HQI Avg * Acres)	0.975	0.934	3.790	2.856

REACH 2 - ALTERNATIVE 1

			Post Construction					Year 5					Year 10						15 -50 Years Post Construction	
Reach 2 - Alternative 1 - 1.71 Acres	Existing Condition	FWOP Condition Score	FWP Condition Score	Score Change (FWP Score - FWOP Score)	Reach 2 - Alternative 1 - 1.71 Acres	Existing Condition	FWOP Condition Score	FWP Condition Score	Score Change (FWP Score - FWOP Score)	Reach 2 - Alternative 1 - 1.71 Acres	Existing Condition	FWOP Condition Score	FWP Condition Score	Score Change (FWP Score - FWOP Score)	Reach 2 - Alternative 1 - 1.71 Acres	Existing Condition	FWOP Condition Score	FWP Condition Score	Score Change (FWP Score - FWOP Score)
Water Quality	0.300	0.300	0.400	0.100	Water Quality	0.300	0.300	0.467	0.167	Water Quality	0.300	0.300	0.533	0.233	Water Quality	0.300	0.300	0.533	0.233
Frequency of Riffles	0.200	0.200	0.467	0.267	Frequency of Riffles	0.200	0.200	0.533	0.333	Frequency of Riffles	0.200	0.200	0.533	0.333	Frequency of Riffles	0.200	0.200	0.533	0.333
Velocity/Depth Combinations	0.200	0.200	0.467	0.267	Velocity/Depth Combinations	0.200	0.200	0.533	0.333	Velocity/Depth Combinations	0.200	0.200	0.533	0.333	Velocity/Depth Combinations	0.200	0.200	0.533	0.333
Pool Substrate Characterization	0.000	0.000	0.400	0.400	Pool Substrate Characterization	0.000	0.000	0.567	0.567	Pool Substrate Characterization	0.000	0.000	0.567	0.567	Pool Substrate Characterization	0.000	0.000	0.633	0.633
Embeddedness	0.000	0.000	0.233	0.233	Embeddedness	0.000	0.000	0.433	0.433	Embeddedness	0.000	0.000	0.500	0.500	Embeddedness	0.000	0.000	0.567	0.567
Epifaunal Substrate & Available Cover	0.100	0.100	0.467	0.367	Epifaunal Substrate & Available Cover	0.100	0.100	0.500	0.400	Epifaunal Substrate & Available Cover	0.100	0.100	0.567	0.467	Epifaunal Substrate & Available Cover	0.100	0.100	0.567	0.467
Channel Sinuosity	0.250	0.250	0.250	0.000	Channel Sinuosity	0.250	0.250	0.250	0.000	Channel Sinuosity	0.250	0.250	0.250	0.000	Channel Sinuosity	0.250	0.250	0.250	0.000
Riparian Vegetative Zone Width	0.000	0.000	0.300	0.300	Riparian Vegetative Zone Width	0.000	0.000	0.375	0.375	Riparian Vegetative Zone Width	0.000	0.000	0.400	0.400	Riparian Vegetative Zone Width	0.000	0.000	0.400	0.400
Riparian Corridor	0.000	0.000	0.175	0.175	Riparian Corridor	0.000	0.000	0.325	0.325	Riparian Corridor	0.000	0.000	0.425	0.425	Riparian Corridor	0.000	0.000	0.450	0.450
Vegetated Buffer	0.150	0.150	0.325	0.175	Vegetated Buffer	0.150	0.150	0.400	0.250	Vegetated Buffer	0.150	0.150	0.475	0.325	Vegetated Buffer	0.150	0.150	0.475	0.325
Vegetative Protection	0.150	0.120	0.425	0.305	Vegetative Protection	0.150	0.120	0.525	0.405	Vegetative Protection	0.150	0.120	0.675	0.555	Vegetative Protection	0.150	0.120	0.775	0.655
Exotic Species	0.400	0.300	0.600	0.300	Exotic Species	0.400	0.300	0.600	0.300	Exotic Species	0.400	0.300	0.600	0.300	Exotic Species	0.400	0.300	0.600	0.300
Flood Plain Connectivity	0.100	0.100	0.100	0.000	Flood Plain Connectivity	0.100	0.100	0.100	0.000	Flood Plain Connectivity	0.100	0.100	0.100	0.000	Flood Plain Connectivity	0.100	0.100	0.100	0.000
Riparian Vegetative Quality	0.100	0.100	0.425	0.325	Riparian Vegetative Quality	0.100	0.100	0.575	0.475	Riparian Vegetative Quality	0.100	0.100	0.700	0.600	Riparian Vegetative Quality	0.100	0.100	0.800	0.700
Threatened & Endangered Species	0.00	0.00	0.10	0.100	Threatened & Endangered Species	0.00	0.00	0.13	0.133	Threatened & Endangered Species	0.00	0.00	0.17	0.167	Threatened & Endangered Species	0.00	0.00	0.17	0.167
HQI Score (Avg)	0.130	0.121	0.342		HQI Score (Avg)	0.130	0.121	0.421		HQI Score (Avg)	0.130	0.121	0.468		HQI Score (Avg)	0.130	0.121	0.492	
Habitat Units (HQI Avg * Acres)	0.222	0.207	0.585	0.378	Habitat Units (HQI Avg * Acres)	0.222	0.207	0.720	0.513	Habitat Units (HQI Avg * Acres)	0.222	0.207	0.801	0.593	Habitat Units (HQI Avg * Acres)	0.222	0.207	0.842	0.634

REACH 2 - ALTERNATIVE 2

			Post Construction					Year 5					Year 10						15 -50 Years Post Construction	
Reach 2 - Alternative 2 - Future With Project 4.14 Acres	Existing Condition	FWOP Condition Score	FWP Condition Score	Score Change (FWP Score - FWOP Score)	Reach 2 - Alternative 2 - Future With Project 4.14 Acres	Existing Condition	FWOP Condition Score	FWP Condition Score	Score Change (FWP Score - FWOP Score)	Reach 2 - Alternative 2 - Future With Project 4.14 Acres	Existing Condition	FWOP Condition Score	FWP Condition Score	Score Change (FWP Score - FWOP Score)	Reach 2 - Alternative 2 - Future With Project 4.14 Acres	Existing Condition	FWOP Condition Score	FWP Condition Score	Score Change (FWP Score - FWOP Score)
Water Quality	0.300	0.300	0.400	0.100	Water Quality	0.300	0.300	0.467	0.167	Water Quality	0.300	0.300	0.533	0.233	Water Quality	0.300	0.300	0.533	0.233
Frequency of Riffles	0.200	0.200	0.467	0.267	Frequency of Riffles	0.200	0.200	0.533	0.333	Frequency of Riffles	0.200	0.200	0.533	0.333	Frequency of Riffles	0.200	0.200	0.533	0.333
Velocity/Depth Combinations	0.200	0.200	0.467	0.267	Velocity/Depth Combinations	0.200	0.200	0.533	0.333	Velocity/Depth Combinations	0.200	0.200	0.533	0.333	Velocity/Depth Combinations	0.200	0.200	0.533	0.333
Pool Substrate Characterization	0.000	0.000	0.400	0.400	Pool Substrate Characterization	0.000	0.000	0.567	0.567	Pool Substrate Characterization	0.000	0.000	0.567	0.567	Pool Substrate Characterization	0.000	0.000	0.633	0.633
Embeddedness	0.000	0.000	0.233	0.233	Embeddedness	0.000	0.000	0.433	0.433	Embeddedness	0.000	0.000	0.500	0.500	Embeddedness	0.000	0.000	0.567	0.567
Epifaunal Substrate & Available Cover	0.100	0.100	0.467	0.367	Epifaunal Substrate & Available Cover	0.100	0.100	0.500	0.400	Epifaunal Substrate & Available Cover	0.100	0.100	0.567	0.467	Epifaunal Substrate & Available Cover	0.100	0.100	0.567	0.467
Channel Sinuosity	0.250	0.250	0.533	0.283	Channel Sinuosity	0.250	0.250	0.533	0.283	Channel Sinuosity	0.250	0.250	0.533	0.283	Channel Sinuosity	0.250	0.250	0.533	0.283
Riparian Vegetative Zone Width	0.000	0.000	0.475	0.475	Riparian Vegetative Zone Width	0.000	0.000	0.475	0.475	Riparian Vegetative Zone Width	0.000	0.000	0.575	0.575	Riparian Vegetative Zone Width	0.000	0.000	0.725	0.725
Riparian Corridor	0.000	0.000	0.175	0.175	Riparian Corridor	0.000	0.000	0.325	0.325	Riparian Corridor	0.000	0.000	0.425	0.425	Riparian Corridor	0.000	0.000	0.525	0.525
Vegetated Buffer	0.150	0.150	0.375	0.225	Vegetated Buffer	0.150	0.150	0.550	0.400	Vegetated Buffer	0.150	0.150	0.575	0.425	Vegetated Buffer	0.150	0.150	0.675	0.525
Vegetative Protection	0.150	0.120	0.425	0.305	Vegetative Protection	0.150	0.120	0.525	0.405	Vegetative Protection	0.150	0.120	0.675	0.555	Vegetative Protection	0.150	0.120	0.825	0.705
Exotic Species	0.400	0.300	0.600	0.300	Exotic Species	0.400	0.300	0.600	0.300	Exotic Species	0.400	0.300	0.600	0.300	Exotic Species	0.400	0.300	0.650	0.350
Flood Plain Connectivity	0.100	0.100	0.525	0.425	Flood Plain Connectivity	0.100	0.100	0.500	0.400	Flood Plain Connectivity	0.100	0.100	0.650	0.550	Flood Plain Connectivity	0.100	0.100	0.725	0.625
Riparian Vegetative Quality	0.100	0.100	0.425	0.325	Riparian Vegetative Quality	0.100	0.100	0.575	0.475	Riparian Vegetative Quality	0.100	0.100	0.700	0.600	Riparian Vegetative Quality	0.100	0.100	0.825	0.725
Threatened & Endangered Species	0.00	0.00	0.10	0.100	Threatened & Endangered Species	0.00	0.00	0.13	0.133	Threatened & Endangered Species	0.00	0.00	0.17	0.167	Threatened & Endangered Species	0.00	0.00	0.17	0.167
HQI Score (Avg)	0.130	0.121	0.404		HQI Score (Avg)	0.130	0.121	0.483		HQI Score (Avg)	0.130	0.121	0.542		HQI Score (Avg)	0.130	0.121	0.601	
Habitat Units (HQI Avg * Acres)	0.222	0.207	1.674	1.467	Habitat Units (HQI Avg * Acres)	0.222	0.207	2.001	1.794	Habitat Units (HQI Avg * Acres)	0.222	0.207	2.245	2.037	Habitat Units (HQI Avg * Acres)	0.222	0.207	2.489	2.281

Goose Creek, Section 206 Boulder, Colorado

Table 6: Cottonwood Pond HQI Scores and Habitat Units (HUs) for Existing, Future Without-Project and Future With-project Conditions for the Goose Creek Project area.

COTTONWOOD POND - ALTERNATIVE 1

			Post Construction	
Reach 3 - Cottonwood Pond = 16.65 Acres (7.13 pond + 9.52 perimeter) Alternative 1	Existing Condtion	FWOP Condition Score	FWP Condition Score	Score Change (FWP Score - FWOP Score)
Water Quality	0.500	0.500	0.425	-0.075
Depth Combinations	0.300	0.300	0.467	0.167
Pond Substrate	0.500	0.500	0.650	0.150
Epifaunal Substrate & Cover	0.400	0.400	0.533	0.133
Shoreline Stability	0.525	0.525	0.450	-0.075
Vegetated Buffer	0.325	0.250	0.375	0.125
Vegetative Protection	0.425	0.425	0.350	-0.075
Vegetative Quality	0.300	0.300	0.500	0.200
Exotic Species	0.275	0.200	0.475	0.275
T&E	0.050	0.050	0.100	0.050
HQI Score (Avg)	0.360	0.345	0.433	
Habitat Units (HQI Avg * Acres)	5.994	5.744	7.201	1.457

			Year 5	
Reach 3 - Cottonwood Pond (7.13 acres + 9.52 acre perimeter) Alternative 1	Existing Condtion	FWOP Condition Score	FWP Condition Score	Score Change (FWP Score - FWOP Score)
Water Quality	0.500	0.500	0.625	0.125
Depth Combinations	0.300	0.300	0.467	0.167
Pond Substrate	0.500	0.500	0.675	0.175
Epifaunal Substrate & Cover	0.400	0.400	0.533	0.133
Shoreline Stability	0.525	0.525	0.650	0.125
Vegetated Buffer	0.325	0.250	0.525	0.275
Vegetative Protection	0.425	0.425	0.600	0.175
Vegetative Quality	0.300	0.300	0.500	0.200
Exotic Species	0.275	0.200	0.500	0.300
T&E	0.050	0.050	0.125	0.075
HQI Score (Avg)	0.360	0.345	0.520	
Habitat Units (HQI Avg * Acres)	5.994	5.744	8.658	2.914

			Year 10	
Reach 3 - Cottonwood Pond (7.13 acres + 9.52 acre perimeter) Alternative 1	Existing Condtion	FWOP Condition Score	FWP Condition Score	Score Change (FWP Score - FWOP Score)
Water Quality	0.500	0.500	0.650	0.150
Depth Combinations	0.300	0.300	0.467	0.167
Pond Substrate	0.500	0.500	0.675	0.175
Epifaunal Substrate & Cover	0.400	0.400	0.533	0.133
Shoreline Stability	0.525	0.525	0.650	0.125
Vegetated Buffer	0.325	0.250	0.575	0.325
Vegetative Protection	0.425	0.425	0.650	0.225
Vegetative Quality	0.300	0.300	0.500	0.200
Exotic Species	0.275	0.200	0.500	0.300
T&E	0.050	0.050	0.125	0.075
HQI Score (Avg)	0.360	0.345	0.533	
Habitat Units (HQI Avg * Acres)	5.994	5.744	8.866	3.122

			Years 15-50	
Reach 3 - Cottonwood Pond (7.13 acres + 9.52 acre perimeter) Alternative 1	Existing Condtion	FWOP Condition Score	FWP Condition Score	Score Change (FWP Score - FWOP Score)
Water Quality	0.500	0.500	0.675	0.175
Depth Combinations	0.300	0.300	0.467	0.167
Pond Substrate	0.500	0.500	0.625	0.125
Epifaunal Substrate & Cover	0.400	0.400	0.533	0.133
Shoreline Stability	0.525	0.525	0.650	0.125
Vegetated Buffer	0.325	0.250	0.575	0.325
Vegetative Protection	0.425	0.425	0.675	0.250
Vegetative Quality	0.300	0.300	0.500	0.200
Exotic Species	0.275	0.200	0.500	0.300
T&E	0.050	0.050	0.125	0.075
HQI Score (Avg)	0.360	0.345	0.533	
Habitat Units (HQI Avg * Acres)	5.994	5.744	8.866	3.122

COTTONWOOD POND - ALTERNATIVE 2

			Post Construction	
Reach 3 - Cottonwood Pond = 16.65 Acres (7.13 pond + 9.52 perimeter) Alternative 2	Existing Condtion	FWOP Condition Score	FWP Condition Score	Score Change (FWP Score - FWOP Score)
Water Quality	0.500	0.500	0.425	-0.075
Depth Combinations	0.300	0.300	0.767	0.467
Pond Substrate	0.500	0.500	0.725	0.225
Epifaunal Substrate & Cover	0.400	0.400	0.767	0.367
Shoreline Stability	0.525	0.525	0.525	0.000
Vegetated Buffer	0.325	0.250	0.475	0.225
Vegetative Protection	0.425	0.425	0.550	0.125
Vegetative Quality	0.300	0.300	0.300	0.000
Exotic Species	0.275	0.200	0.650	0.450
T&E	0.050	0.050	0.150	0.100
HQI Score (Avg)	0.360	0.345	0.533	
Habitat Units (HQI Avg * Acres)	5.994	5.744	8.880	3.136

			Year 5	
Reach 3 - Cottonwood Pond (7.13 acres + 9.52 acre perimeter) Alternative 2	Existing Condtion	FWOP Condition Score	FWP Condition Score	Score Change (FWP Score - FWOP Score)
Water Quality	0.500	0.500	0.675	0.175
Depth Combinations	0.300	0.300	0.900	0.600
Pond Substrate	0.500	0.500	0.775	0.275
Epifaunal Substrate & Cover	0.400	0.400	0.800	0.400
Shoreline Stability	0.525	0.525	0.800	0.275
Vegetated Buffer	0.325	0.250	0.700	0.450
Vegetative Protection	0.425	0.425	0.800	0.375
Vegetative Quality	0.300	0.300	0.600	0.300
Exotic Species	0.275	0.200	0.700	0.500
T&E	0.050	0.050	0.250	0.200
HQI Score (Avg)	0.360	0.345	0.700	
Habitat Units (HQI Avg * Acres)	5.994	5.744	11.655	5.911

			Year 10	
Reach 3 - Cottonwood Pond (7.13 acres + 9.52 acre perimeter) Alternative 2	Existing Condtion	FWOP Condition Score	FWP Condition Score	Score Change (FWP Score - FWOP Score)
Water Quality	0.500	0.500	0.700	0.200
Depth Combinations	0.300	0.300	0.900	0.600
Pond Substrate	0.500	0.500	0.775	0.275
Epifaunal Substrate & Cover	0.400	0.400	0.800	0.400
Shoreline Stability	0.525	0.525	0.850	0.325
Vegetated Buffer	0.325	0.250	0.775	0.525
Vegetative Protection	0.425	0.425	0.825	0.400
Vegetative Quality	0.300	0.300	0.700	0.400
Exotic Species	0.275	0.200	0.700	0.500
T&E	0.050	0.050	0.275	0.225
HQI Score (Avg)	0.360	0.345	0.730	
Habitat Units (HQI Avg * Acres)	5.994	5.744	12.155	6.410

			Years 15-50	
Reach 3 - Cottonwood Pond (7.13 acres + 9.52 acre perimeter) Alternative 2	Existing Condtion	FWOP Condition Score	FWP Condition Score	Score Change (FWP Score - FWOP Score)
Water Quality	0.500	0.500	0.725	0.225
Depth Combinations	0.300	0.300	0.933	0.633
Pond Substrate	0.500	0.500	0.725	0.225
Epifaunal Substrate & Cover	0.400	0.400	0.833	0.433
Shoreline Stability	0.525	0.525	0.875	0.350
Vegetated Buffer	0.325	0.250	0.800	0.550
Vegetative Protection	0.425	0.425	0.825	0.400
Vegetative Quality	0.300	0.300	0.900	0.600
Exotic Species	0.275	0.200	0.725	0.525
T&E	0.050	0.050	0.300	0.250
HQI Score (Avg)	0.360	0.345	0.764	
Habitat Units (HQI Avg * Acres)	5.994	5.744	12.723	6.979

Goose Creek, Section 206 Boulder, Colorado

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ATTACHMENT 1

Original and Modified Assessment Sheets

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION	
STATION #_____ RIVERMILE_____	STREAM CLASS	
LAT _____ LONG _____	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE _____ TIME _____ AM PM	REASON FOR SURVEY

Parameters to be evaluated in sampling reach	Habitat Parameter	Condition Category			
		Optimal	Suboptimal	Marginal	Poor
	1. Epifaunal Substrate/ Available Cover	Greater than 50% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	30-50% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	10-30% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 10% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	2. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud or clay or sand bottom; little or no root mat; no submerged vegetation.	Hard-pan clay or bedrock; no root mat or vegetation.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	3. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	4. Sediment Deposition	Little or no enlargement of islands or point bars and less than <20% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 20-50% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 50-80% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 80% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition - Form 3 A-9

HABITAT ASSESSMENT FIELD DATA SHEET—LOW GRADIENT STREAMS (BACK)

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Channel Sinuosity	The bends in the stream increase the stream length 3 to 4 times longer than if it was in a straight line. (Note - channel braiding is considered normal in coastal plains and other low-lying areas. This parameter is not easily rated in these areas.)	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	The bends in the stream increase the stream length 1 to 2 times longer than if it was in a straight line.	Channel straight; waterway has been channelized for a long distance.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank)	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Parameters to be evaluated broader than sampling reach

Total Score _____

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION	
STATION #_____ RIVERMILE_____	STREAM CLASS	
LAT _____ LONG _____	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE _____ TIME _____ AM PM	REASON FOR SURVEY

	Habitat Parameter	Condition Category			
		Optimal	Suboptimal	Marginal	Poor
Parameters to be evaluated in sampling reach	1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
	5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
	SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition - Form 2 A-7

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score _____

Modified Assessment Utilized in the Zeullig Thesis
The following information has been taken and modified from Barbour et al. (1999).

Habitat Assessment Field Data Sheet		
Stream name	**Location**	**Date**
Station number	**GPS**	**Time am pm**
Investigators	**Storm water basin**	**Pic #**

Habitat Attribute	**Category**				
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Zero Score**
1. Channel flow status	Water reaches base of both lower banks and minimal amount of channel substrate is exposed.	Water fills > 75% of the available channel; or < 25% of channel substrate exposed.	Water fills 25-75% of the available channel. Riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.	Character not present.
Score	**20**	**15**	**10**	**5**	**0**
2. Channel sinuosity	Bends in the stream increase the stream length 3-4 times.	Bends in the stream increase the stream length 2-3times.	Bends in the stream increase the stream length 1-2 times.	Channel straight; waterway has been channelized for a long distance.	Character not present.
Score	**20**	**15**	**10**	**5**	**0**
3. Frequency of riffles	Occurrences of riffles relatively frequent; ratio of the distance between riffles divided by stream width is between 5 and 7.	Occurrences of riffles infrequent; the distance between riffles divided by stream width is between 7 and 15.	Occasional riffle; bottom contours provide some habitat; the distance between riffles divided by stream width is between 15 and 25.	Generally all flat water or shallow riffles; poor habitat; the distance between riffles divided by stream width is > 25.	Character not present.
Score	**20**	**15**	**10**	**5**	**0**
4. Embeddedness	Gravel, cobble and boulder particles are 0-25% surrounded by fine sediment.	Gravel, cobble and boulder particles 25-50% surrounded by fine sediment.	Gravel, cobble and boulder particles 50-75% surrounded by fine sediment.	Gravel, cobble and boulder particles are more than 75% surrounded by fine sediment.	Character not present.
Score	**20**	**15**	**10**	**5**	**0**

Habitat Attribute	Category				
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Zero Score**
5. Epifaunal substrate and available cover	Greater than 50% favorable habitat for fish; most favorable is a mix of snags, submerged logs, undercut banks, refugia and clean cobble and gravel within riffles.	30-50% mix of favorable habitat; adequate habitat for maintenance of populations.	10-30% mix of favorable habitat; habitat availability less than desirable.	Less than 10% favorable habitat; lack of habitat is obvious.	Character not present.
Score	**20**	**15**	**10**	**5**	**0**
6. Pool substrate characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud, clay or sand bottom; little or no root mats; no submerged vegetation.	Hardpan clay or bedrock; no root mat or submerged vegetation.	Character not present.
Score	**20**	**15**	**10**	**5**	**0**
7. Pool variability	Even mix of large- shallow, large-deep and small-shallow small-deep pools present.	Majority of pools large-deep; very few shallow.	Shallow pools much more prevalent than deep pools.	Majority of pools small-shallow or pools absent.	Character not present.
Score	**20**	**15**	**10**	**5**	**0**
8. Bank stability **Note:** ***determine right and left side facing downstream.***	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems; < 5% of bank affected.	Banks moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Banks moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Banks unstable; many eroded areas; raw areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosion scars.	Character not present.
Score LB	**Left bank 10**	**7.5**	**5**	**2.5**	**0**
Score RB	**Right bank 10**	**7.5**	**5**	**2.5**	**0**

Habitat Attribute	Category				
	Optimal	**Suboptimal**	**Marginal**	**Poor**	**Zero Score**
9. Vegetative protection **Note:** ***determine right and left side facing downstream.***	More than 90% of the stream bank surfaces and immediate riparian zone covered by native vegetation, including trees, under story shrubs or non-woody macrophytes; vegetative disruption through grazing or mowing minimal or not evident.	70-90% of the stream bank surfaces covered by native vegetation, but one class of plants is not well represented; distribution evident but not affecting full plant growth potential to great extent.	50-70% of the stream bank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common.	Less than 50% of the stream bank surfaces covered by vegetation; disruptions of stream bank vegetation very high.	Character not present.
Score LB	**Left bank 10**	**7.5**	**5**	**2.5**	**0**
Score RB	**Right bank 10**	**7.5**	**5**	**2.5**	**0**
10. Riparian vegetative zone width **Note:** ***determine right and left side facing downstream.***	Width of riparian zone > 18 meters; human activities (i.e., parking lots, roadbeds, lawns or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities (i.e., parking lots, roadbeds, lawns or crops) have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities (i.e., parking lots, roadbeds, lawns or crops) have impacted zone great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.	Character not present.
Score LB	**Left bank 10**	**7.5**	**5**	**2.5**	**0**
Score RB	**Right bank 10**	**7.5**	**5**	**2.5**	**0**
Total Score:					

Goose Creek Modified Assessment Sheet – Stream Reaches – pg 1
Scale of 0 – 1

Habitat Parameters		Category				
		Optimal	Suboptimal	Marginal	Poor	Not present
		1.0 0.9	0.8 0.7 0.6	0.5 0.4 0.3	0.2 0.1	0
Water Quality	Water quality is important to fish, amphibians, invertebrates and plants. In addition to pollutants, dissolved oxygen and extreme temperatures can limit species.	Water quality is absent biological or chemical pollutants and has good temperature range & adequate dissolved oxygen content	Water periodically contains undesirable material, lower dissolved oxygen or poor temperature characteristics, but is not life threatening to native species.	Deficiencies in water quality, dissolved oxygen or temperature limit native species reproduction. Native Species are surviving, but not thriving.	Native species severely limited by water quality problems with the stream at the limits of the tolerance range for organisms	Stream channel frequently experiences lethal pollutants, hypoxia and thermal ranges for native species.
	Overall score					
		Optimal	Suboptimal	Marginal	Poor	Not present
		1.0 0.9	0.8 0.7 0.6	0.5 0.4 0.3	0.2 0.1	0
Frequency of Riffles	Critical for maintaining variety & abundance of insects in most high-gradient streams. Riffles & runs offer diversity of habitat thru variety of particle size and in many small high-gradient streams, provide the most stable habitat.	Occurrences of riffles relatively frequent; ratio of the distance between riffles divided by stream width is between 5 and 7.	Occurrences of riffles infrequent; distance between riffles divided by stream width is between 7 and 15.	Occasional riffle; bottom controls provide some habitat; distance between riffles divided by stream width is between 15 and 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by stream width is >25.	Character not present
	Overall score					
		Optimal	Suboptimal	Marginal	Poor	Not present
		1.0 0.9	0.8 0.7 0.6	0.5 0.4 0.3	0.2 0.1	0
Velocity/Depth Combinations	A diversity of depths & velocities protects the stream from excessive erosion during flooding; provides refugia for ben-thic invertebrates/fish.	All 4 velocity/depth regimes are present (slow-deep, slow-shallow, fast-deep, fast-shallow) (slow is <3 m/s, deep is >0.5 m)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes	Only 2 of the 4 regimes present (if fast-shallow or slow-shallow are missing, score lower)	Dominated by 1 velocity/depth regime (usually slow-deep)	Character not present
	Overall score					
		Optimal	Suboptimal	Marginal	Poor	Not present
		1.0 0.9	0.8 0.7 0.6	0.5 0.4 0.3	0.2 0.1	0
Pool Substrate Characterization	Firmer sediment types (gravel, sand) and rooted aquatic plants support wider variety of organ-isms than pool substrate dominated by mud or bedrock and no plants. Stream with uniform substrate in pools support fewer organisms.	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud, clay or sand bottom; little or no root mats; no submerged vegetation.	Hardpan clay or bedrock; no root mat or submerged vegetation.	Character not present
	Overall score					
		Optimal	Suboptimal	Marginal	Poor	Not present
		1.0 0.9	0.8 0.7 0.6	0.5 0.4 0.3	0.2 0.1	0
Embeddedness	The less embeddedness, the greater the surface area available to macro-invertebrates. Layering provides diversity of niche space.	Gravel, cobble and boulder particles are 0-25% surrounded by fine sediment.	Gravel, cobble and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble and boulder particles are >75% surrounded by fine sediment.	Character not present
	Overall score					

Epifaunal Substrate and Available Cover		**Optimal**	**Suboptimal**	**Marginal**	**Poor**	**Not present**
		1.0 0.9	0.8 0.7 0.6	0.5 0.4 0.3	0.2 0.1	0
	Relative quantity and variety of natural structures (riffles, rocks, fallen woody debris). Provides macroinverte-brates with niches, increasing habitat diversity and increases potential for recovery following disturbance.	>50% favorable habitat for fish; favorable is mix is snags, submerged logs, undercut banks, refugia and clean cobble and gravel within riffles.	30-50% mix of favorable habitat; adequate habitat for maintenance of populations.	10-30% mix of favorable habitat; habitat availability less than desirable.	Less than 10% favorable habitat; lack of habitat is obvious.	Character not present
	Overall score					
Channel Sinuosity		**Optimal**	**Suboptimal**	**Marginal**	**Poor**	**Not present**
		1.0 0.9	0.8 0.7 0.6	0.5 0.4 0.3	0.2 0.1	0
	High degree of sinuosity provides for diverse habitat and fauna. Stream is better able to handle surges when the stream fluctuates as a result of storms. Protects from excessive erosion & flooding; provides refugia for invertebrates & fish.	Bends in the stream increase the stream length 3-4 times	Bends in the stream increase the stream length 2-3 times	Bends in the stream increase the stream length 1-2 times	Channel straight; waterway has been channelized for long distance	Character not present
	Overall score					
Riparian Vegetative Zone Width		**Optimal**	**Suboptimal**	**Marginal**	**Poor**	**Not present**
		1.0 0.9	0.8 0.7 0.6	0.5 0.4 0.3	0.2 0.1	0
	Buffers pollutans entering stream from runoff. Controls erosion, provides habitat and nutrient input.	Width of riparian zone >18 meters; human activities (parking lots, roads, lawns, crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters; little or no riparian vegetation due to human activities.	Character not present
	Left Bank Score					0
	Right Bank Score					0
						0
Riparian Corridor		**Optimal**	**Suboptimal**	**Marginal**	**Poor**	**Not present**
		1.0 0.9	0.8 0.7 0.6	0.5 0.4 0.3	0.2 0.1	0
	A riparian corridor is a linear ecosystem that permits species to range and interact with regions upstream and downstream of the project area.	Excellent habitat is continuous along a bank permitting the move-ment of both larger and smaller native species to adjacent ecosystems upstream and down-stream	Excellent habitat is continuous along a bank permitting the movement of small and medium sized native species to at least 1 adjacent ecosystem.	Fair habitat is available for at least small native animals along a bank and there is connectivity to at least 1 adjacent ecosystem.	Minimal habitat is available for only the smallest native animals and there is connectivity between at least 2 riparian habitat patches within the reach.	Character not present or corridor permits the movement of dangerous and invasive species.
	Left Bank Score					
	Right Bank Score					
	Overall Score					
Vegetated Buffer		**Optimal**	**Suboptimal**	**Marginal**	**Poor**	**Not present**
		1.0 0.9	0.8 0.7 0.6	0.5 0.4 0.3	0.2 0.1	0
	A terrestrial buffer zone begins at top of bank & is needed for some species in addition to the stream and riparian vegetative zone.	Width of terrestrial buffer zone >30 meters; human activities (parking lots, roads, lawns, crops) have not impacted zone.	Width of terrestrial buffer zone 12-18 meters; human activities have impacted zone only minimally.	Width of terrestrial buffer zone 6-12 meters; human activities have impacted zone a great deal.	Width of terrestrial buffer zone <6 meters; Vegetation quality is poor due to human activities.	Character not present.
	Left Bank Score					
	Right Bank Score					
	Overall Score					

Vegetative protection	Root systems hold soil in place, allow uptake or nutrients by plants, con-trol instream scouring and shad the stream. Banks with full, natural plant growth is better for fish and macroinverte-brates than those without vegetation or those shored up with riprap	**Optimal**	**Suboptimal**	**Marginal**	**Poor**	**Not present**
		1.0 0.9	0.8 0.7 0.6	0.5 0.4 0.3	0.2 0.1	0
		>90% of stream bank surfaces & immediate riparian zone covered by native vegetation, including trees, under-story shrubs or non-woody macro-phytes; vegetative disruption through grazing or mowing minimal or not evident.	70-90% of stream bank surfaces covered by native vegetation, but one class of plants is not well represented; distribution evident but not affecting full plant growth potential to great extent.	50-70% of stream bank surfaces covered by native vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common.	Less than 50% of the stream bank surfaces covered by native vegetation; disruptions of stream bank vegetation very high.	Character not present
	Left Bank Score					
	Right Bank Score					
	Overall Score					
Flood Plain Connectivity	The ability of a stream to interact with the flood plain and bank flood terraces is important to many plant & animal species..	**Optimal**	**Suboptimal**	**Marginal**	**Poor**	**Not present**
		1.0 0.9	0.8 0.7 0.6	0.5 0.4 0.3	0.2 0.1	0
		Water can overflow into old meander channels and vernal pools as frequently as the mean annual flood.	Water will overflow on a well defined terrace containing old channels & topographic diversity as often as the mean annual flood.	Water will overflow on a broken flood terrace as often as the mean annual flood.	Channel incised with minimal amounts of remnant flood terrace.	Channel deeply incised, no flood terraces and frequency of flood plain overflow > 5-year event
	Overall Score					
Riparian Vegetative Quality	Riparian wetlands trap sediment by slowing down the water. Nutrients attached to the sediment or in the water are metabolized by wetland plants & reduce eutrofication of ponds	**Optimal**	**Suboptimal**	**Marginal**	**Poor**	**Not present**
		1.0 0.9	0.8 0.7 0.6	0.5 0.4 0.3	0.2 0.1	0
		Dense native wetland vegetation removes considerable sediments, Nitrogen and Phosphorous from storm runoff.	Wetland vegetation causes some sediments and nutrients to be removed.	Intermittent stands of wetland vegetation remove minor amounts of sediment and nutrients.	Thin stands of wetland vegetation may remove a small amount of sediment and associated nutrients.	Not present
	Score left bank					
	Score right bank					
	Overall Score					
Exotic Species	Invasive species crowd out native species and can harm the survival of native T&E Species.	**Optimal**	**Suboptimal**	**Marginal**	**Poor**	**Not present**
		1.0 0.9	0.8 0.7 0.6	0.5 0.4 0.3	0.2 0.1	0
		No non-native species exist within the study area and the threat of entry is low.	Exotic species have been found in the study area but can be controlled by light maintenance.	Exotic species are a problem in the study area and require extensive maintenance to prevent damage to native species.	Exotic species limit native species and difficult maintenance is required to reverse the trend.	Exotic species have driven out the native species.
	Overall Score					
Threatened & Endangered Species	Includes Federally listed Endangered, Threatened, and Candidate species. Also includes any State listed species of concern.	**Optimal**	**Suboptimal**	**Marginal**	**Poor**	**Not present**
		1.0 0.9	0.8 0.7 0.6	0.5 0.4 0.3	0.2 0.1	0
		Threatened and endan-gered species are com-monly found in the study area and are thriv-ing due in part to the excellent riparian habitat.	Threatened and endangered species have been period-ically noted in the study area and the riparian hab-itat is helpful in the survi-val of at least one species.	Threatened and endangered species have been seen in the study area in the past and exist in similar riparian habitat elsewhere in the general area.	The survival of threatened and endangered species would only be marginally helped by the riparian habitat in its present condition.	The survival of threatened and endangered species would not be helped by the riparian habitat in its present condition.
	Overall Score					

Goose Creek Modified Assessment Sheet – Cottonwood Pond – Page 1 Scale of 0 – 1

	Habitat Parameters	Category				
		Optimal	**Suboptimal**	**Marginal**	**Poor**	**Not present**
Water Quality		1.0 0.9	0.8 0.7 0.6	0.5 0.4 0.3	0.2 0.1	0
	Water quality is important to fish, amphibians, invertebrates and plants. In addition to pollutants, dissolved oxygen and extreme temperatures can limit species.	Water quality is absent biological or chemical pollutants and has good temperature range & adequate dissolved oxygen content	Water periodically contains undesirable material, lower dissolved oxygen or poor temperature characteristics, but is not life	Deficiencies in water quality, dissolved oxygen or temperature limit native species reproduction.	Native species severely limited by water quality problems with the stream at the limits	Stream channel frequently experiences lethal pollutants, hypoxia and thermal ranges for
	Score					
Depth Combinations		**Optimal**	**Suboptimal**	**Marginal**	**Poor**	**Not present**
		1.0 0.9	0.8 0.7 0.6	0.5 0.4 0.3	0.2 0.1	0
	A diversity of depths provides refugia for invertebrates/fish.	Excellent mix of shallow, moderate and deeper depths & variable distribution of deeper water relative to shoreline.	Some deep and moderate holes, fairly concentrated in one or two areas.	Small amount of deep water in an otherwise shallow pond.	Essentially a single relatively shallow depth across the lakebed.	Suboptimal: Some deep and moderate holes, fairly concentrated in one or two areas.
	Score					
Pond Substrate Characterization		**Optimal**	**Suboptimal**	**Marginal**	**Poor**	**Not present**
		1.0 0.9	0.8 0.7 0.6	0.5 0.4 0.3	0.2 0.1	0
	Firmer sediment types (gravel, sand) and rooted aquatic plants support wider variety of organ-isms than pool substrate dominated by mud or bedrock and no plants. Stream with uniform substrate in pools support fewer organisms.	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common.	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present.	All mud, clay or sand bottom; little or no root mats; no submerged vegetation.	Hardpan clay or bedrock; no root mat or submerged vegetation.	Character not present
	Score					
Epifaunal Substrate and Available Cover		**Optimal**	**Suboptimal**	**Marginal**	**Poor**	**Not present**
		1.0 0.9	0.8 0.7 0.6	0.5 0.4 0.3	0.2 0.1	0
	Relative quantity and variety of natural structures (rocks and fallen woody debris). Provides macroinverte-brates with niches, increasing habitat diversity and increases potential for recovery following disturbance.	>50% favorable habitat for fish; favorable is mix is snags, submerged logs, undercut banks, and refugia	30-50% mix of favorable habitat; adequate habitat for maintenance of populations.	10-30% mix of favorable habitat; habitat availability less than desirable.	Less than 10% favorable habitat; lack of habitat is obvious.	Character not present
	Score		0.7			
Shoreline Stability		**Optimal**	**Suboptimal**	**Marginal**	**Poor**	**Not present**
		1.0 0.9	0.8 0.7 0.6	0.5 0.4 0.3	0.2 0.1	0
	Measures whether the shoreline is eroded or has the potential for erosion. Steep banks more likely to suffer from erosion and are considered unstable. Signs include crumbling, unvegetated banks, exposed tree roots, exposed soil	Natural high banks stable or successfully stabilized using biological stabilization methods.	Natural high banks moderately stable; infrequent, small areas of erosion controlled by bio-stabilization techniques.	Natural high banks moderately unstable; much of bank in reach has areas of erosion or would erode if not artificially stabilized. Mixture of biological and	Natural high banks unstable; many eroded areas; raw areas frequent along straight sections and bends, with extensive	Natural high banks throughout the reach largely eroding or completely stabilized by artificial means, such as riprap or concrete lining.
	Score					

Vegetated Buffer	A terrestrial buffer zone begins at top of bank & is needed for some species in addition to the stream and riparian vegetative zone.	**Optimal**	**Suboptimal**	**Marginal**	**Poor**	**Not present**
		1.0 0.9	0.8 0.7 0.6	0.5 0.4 0.3	0.2 0.1	0
		Width of terrestrial buffer zone >30 meters; human activities (parking lots, roads, lawns, crops) have not impacted zone.	Width of terrestrial buffer zone 12-18 meters; human activities have impacted zone only minimally.	Width of terrestrial buffer zone 6-12 meters; human activities have impacted zone a great deal.	Width of terrestrial buffer zone <6 meters; Vegetation quality is poor due to human activities.	Character not present.
	Score					
Vegetative protection	Root systems hold soil in place, allow uptake or nutrients by plants, con-trol instream scouring and shad the stream. Banks with full, natural plant growth is better for fish and macroinverte-brates than those without vegetation or those shored up with ri	**Optimal**	**Suboptimal**	**Marginal**	**Poor**	**Not present**
		1.0 0.9	0.8 0.7 0.6	0.5 0.4 0.3	0.2 0.1	0
		>90% of bank surfaces & immediate lakeside zone covered by native vegetation, including trees, understory shrubs or nonwoody macro-phytes; vegetative disruption through grazing or mowing minimal or not evident.	70-90% of bank surfaces covered by native vegetation, but one class of plants is not well represented; distribution evident but not affecting full plant growth potential to great extent.	50-70% of bank surfaces covered by native vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common.	Less than 50% of the bank surfaces covered by native vegetation; disruptions of bank vegetation very high.	Much less than 50% of the bank surfaces covered by native vegetation; disruptions of bank vegetation very high.
	Score					
Riparian Vegetative Quality	Riparian wetlands trap sediment by slowing down the water. Nutrients attached to the sediment or in the water are metabolized by wetland plants & reduce eutrofication of ponds	**Optimal**	**Suboptimal**	**Marginal**	**Poor**	**Not present**
		1.0 0.9	0.8 0.7 0.6	0.5 0.4 0.3	0.2 0.1	0
		Dense native wetland vegetation removes considerable sediments, Nitrogen and Phosphorous from storm runoff.	Wetland vegetation causes some sediments and nutrients to be removed.	Intermittent stands of wetland vegetation remove minor amounts of sediment and nutrients.	Thin stands of wetland vegetation may remove a small amount of sediment and associated nutrients.	Not present
	Score left bank					
	Score right bank					
	Overall Score					
Exotic Species	Invasive species crowd out native species and can harm the survival of native T&E Species.	**Optimal**	**Suboptimal**	**Marginal**	**Poor**	**Not present**
		1.0 0.9	0.8 0.7 0.6	0.5 0.4 0.3	0.2 0.1	0
		No non-native species exist within the study area and the threat of entry is low.	Exotic species have been found in the study area but can be controlled by light maintenance.	Exotic species are a problem in the study area and require extensive maintenance to prevent damage to native species.	Exotic species limit native species and difficult maintenance is required to reverse the trend.	Exotic species have driven out the native species.
	Score					
Threatened & Endangered Species	Includes Federally listed Endangered, Threatened, and Candidate species. Also includes any State listed species of concern.	**Optimal**	**Suboptimal**	**Marginal**	**Poor**	**Not present**
		1.0 0.9	0.8 0.7 0.6	0.5 0.4 0.3	0.2 0.1	0
		Threatened and endan-gered species are com-monly found in the study area and are thriv-ing due in part to the excellent riparian habitat.	Threatened and endangered species have been period-ically noted in the study area and the riparian hab-itat is helpful in the survi-val of at least one species.	Threatened and endangered species have been seen in the study area in the past and exist in similar riparian habitat elsewhere in the general area.	The survival of threatened and endangered species would only be marginally helped by the riparian habitat in its present condition.	The survival of threatened and endangered species would not be helped by the riparian habitat in its present condition.
	Score					

ATTACHMENT 2

Results of Existing Wetland Analysis

The wetland adjacent to Cottonwood Pond was classified as “Marginal/Suboptimal”. The area is dominated with cattails with some willow. It currently supports some wildlife species such as American goldfinch, mallards, Canada geese, great blue heron, red-wing blackbird, common muskrat, mink, raccoon, and western chorus frogs. Discussions among panel experts on the condition of the wetland led to the determination that restoration efforts implemented to increase the quality of this wetland would not produce significant environmental benefits and could potentially decrease the existing quality (potential increase of only 2.5 HUs). Therefore, wetland restoration efforts as a result of project implementation would focus only on managing the existing wetland as part of Reach 2. No construction activity is recommended. The panel results are presented in Table 1.

Table 1: Goose Creek Existing Conditions, Panel of Experts Results, Wetland.

U.S. Army Corps of Engineers, Omaha District

City of Boulder, Colorado

Goose Creek Existing Conditions Assessment
Wetland
Panel Results From 8 May 2008

Assessment Protocol		Panel Results	Future With Project Condition	Difference in Available Units
Habitat Attributes	**Habitat Parameters**	Wetland + Open Water (2.27 acres)	Wetland + Open Water (2.27 acres)	
Water Quality	Water quality is important to fish, amphibians, invertebrates and plants. In addition to pollutants, dissolved oxygen and extreme temperatures can limit species.			
	Overall score	0.60	0.70	
	Functional Units	**1.36**	**1.59**	**0.23**
Depth Combinations	A diversity of depths provides refugia for benthic invertebrates/fish.			
	Overall score	0.70	0.80	
	Functional Units	**1.59**	**1.82**	**0.23**
Pool Substrate Characterization	Firmer substrate types (gravel, sand) and rooted aquatic plants support wider variety of organisms than pool substrate dominated by mud or bedrock and no plants. Uniform substrate in pools support fewer organisms.			
	Overall score	0.70	0.80	
	Functional Units	**1.59**	**1.82**	**0.23**
Epifaunal Substrate & Available Cover	Relative quantity and variety of natural structures (riffles, rocks, fallen woody debris). Provides macroinvertebrates with niches, increasing habitat diversity and increases potential for recovery following disturbance.			
	Overall score	0.60	0.80	
	Functional Units	**1.36**	**1.82**	**0.45**
Vegetated Buffer	A terrestrial buffer zone begins at top of bank & is needed for some species in addition to the stream and riparian vegetative zone.			
	Overall Score	0.50	0.70	
	Functional Units	**1.14**	**1.59**	**0.45**
Vegetative Protection	Root systems hold soil in place, allow uptake or nutrients by plants, control instream scouring and shad the stream. Banks with full, natural plant growth is better for fish and macroinvertebrates than those without vegetation or those shored up with riprap.			
	Overall Score	0.60	0.80	
	Functional Units	**1.36**	**1.82**	**0.45**

June 2008 1

U.S. Army Corps
of Engineers, Omaha District

Goose Creek Existing Conditions Assessment
Wetland
Panel Results From 8 May 2008

City of Boulder, Colorado

Exotic/Invasive Species	Exotic/Invasive species crowd out native species and can harm the survival of native T&E Species.			
	Overall score	0.50	0.70	
	Functional Units	**1.14**	**1.59**	**0.45**
Threatened & Endangered Species	Includes Federally listed Endangered, Threatened, and Candidate species. Also includes any State listed species of concern.			
	Overall score	0.00	0.00	
	Functional Units	**0.00**	**0.00**	**0.00**
Total Functional Units		**9.53**	**12.03**	**2.50**

ATTACHMENT 3

Panel of Experts

GOOSE CREEK AT BOULDER, CO SEC. 206 STUDY
PANEL OF EXPERTS PLAN FORMULATION
0800 – 1500 8 May 2008 Summary

I. OVERVIEW

The central purpose of the Panel of Experts Working Session was to define the "existing conditions" for the South Goose Creek and Cottonwood Pond Ecosystem. Since defining the quality of a riparian ecosystem has both qualitative and quantitative aspects, the panel of expert's methodology was selected to bring together those with the most experience in evaluating similar ecosystems. Other goals included establishing an actual or theoretical reference reach, for a high plains urban stream and to discuss the value of measures

II. MEETING ATTENDANCE

NAME	ORGANIZATION	PHONE NO
Mark Nelson	USACE Plan Formulation / PM	402-995-2703
Katie Reed	USACE Biologist	402-995-2687
Sasha Charney	Boulder CO Parks / Open Space	303-678-6230
Chris Svendsen	USACE Channel Stabilization	402-995-2352
Steve Rothe	USACE Plan Formulation / PM	402-995-2705
Becky Shipman	USACE Plan Formulation / PM	402-995-2704
Terry Skadeland	Natural Resources Conservation S	720-544-2813
Dave Hoerath	Boulder CO Parks / Open Space	303-678-6204
Ben Swigle	CO Division of Wildlife	970-472-4376
Ernst Strenge	Boulder CO Parks / Open Space	303-678-6269
Claire Solohub	CO Division of Wildlife	303-903-8292
Rich Fischer	USACE – ERDC	502-454-4658
Betty Solek	City of Boulder	303-673-9116
Clare Deleo	Boulder CO Parks / Open Space	303-678-6205
Eric Fairlee	Boulder CO Parks / Open Space	303-413-7647
Pete Plage	U.S. Fish & Wildlife Service	303-236-7563
Sarah Fowler	EPA Wetlands	303-312-6192

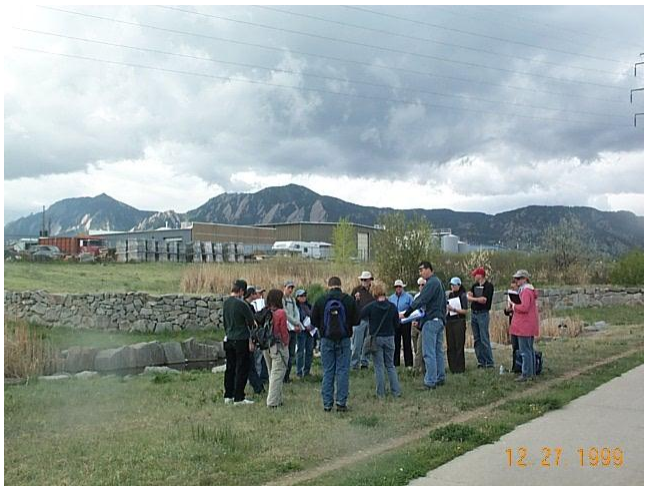
** The small panel convened in August 2010 included Cindy Upah, USACE Biologist, Eric Fairlee, Pete Plage and Rich Fischer.

III. ACTIVITIES AND TOPICS

A. EVALUATION OF REACH UPSTREAM OF FOOTHILLS PARKWAY

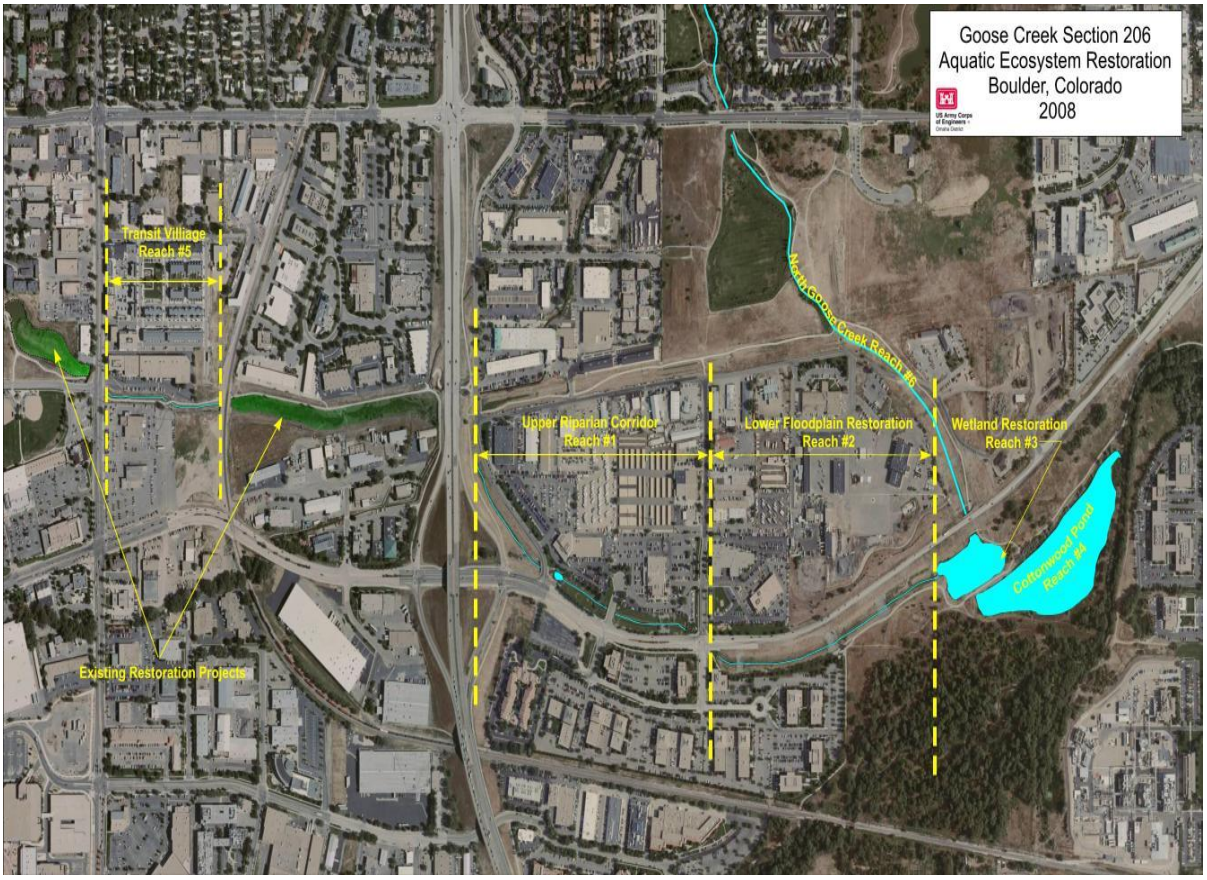
After considerable discussion among the group (Goose Creek and Lower Boulder teams), it was determined that there probably was no reference reach in the area that fit the most likely best result of an ecosystem restoration effort on this highly unnatural urbanized stream reach. The Goose Creek team decided to use an already restored reach (with good and bad features) as a quasi-reference reach in order to stimulate team discussion. It was also convenient to the project and minimized time lost to travel.

Some on the panel thought the reach was not a good choice for the discussion of a reference reach and recommended that we keep looking in the Boulder area. The reach was located upstream of Foothills Parkway. Among the good features were the wetlands created by moving the boulders outward from the central channel and the transition between wetland and terrestrial vegetation. Among the not so good features was the waterfall that blocks aquatic animal migration and the monoculture of cattails in the created riparian wetland.



B. EVALUATION OF SOUTH GOOSE CREEK

The Goose Creek evaluation of existing conditions by the panel of experts went very well. The entire team, consisting of the Panel of Experts, Corps, Boulder City and County personnel and others began at the upstream end of Reach 1, just below Foothills Parkway and worked our way downstream. Considerable discussion was generated by the group over the riparian features that exist and what might be done to improve the functionality of the stream.



C. EVALUATION OF WETLAND

Following the evaluation of the stream, the group examined the wetland. Wildlife is already present in and around the wetland. Ducks and muskrat were using the open water during the visit. Prairie dog towns continue to cover the uplands, particularly on the Right bank.

D. EVALUATION OF COTTONWOOD POND

The last part of the field investigation was focused on Cottonwood Pond and also included a short trip over to adjacent Boulder Creek. The team was treated to a few glimpses of the mink which had been seen by some on earlier visits to Cottonwood Pond.

The group had a good look at Boulder Creek and discussed the Goose Creek tributary in connection with Boulder Creek. Discussion topics included implications of Eurasian Milfoil in Boulder Creek on eradication efforts in Cottonwood Pond and how to handle water during construction.

E. AFTERNOON EVALUATION OF FIELD INFORMATION.

1. Reference Reach

The consensus of the Panel of Experts was that we did not have a very good reference reach. Within the team, there was discussion as to whether it would be worth searching for an actual reference reach on another field trip, or creating a "synthetic reference reach" based upon an optimization of what

2. Scoring South Goose Creek

We had a round table discussion of how everyone scored the Habitat Parameters for South Goose Creek. On some parameters there was quite a bit of spread and some discussion resulted before a consensus was reached. On others, there was surprisingly little variability.

3. Scoring the Wetland
4. Scoring Cottonwood Pond

F. OTHER DISCUSSION, SIDEBARS, ETC.

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GOOSE CREEK
BOULDER, COLORADO

SECTION 206
ECOSYSTEM RESTORATION REPORT

APPENDIX A-5
HISTORIC WETLAND
DELINEATION METHODOLOGY

JUNE 2011

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Utilization of Historic Aerial Photos for the Interpretation of Historic Wetlands within the Proposed Goose Creek Restoration Project Area

There is a wide variety of forms of historical wetland information that come from a wide variety of sources. Historical scientific information is available in journals and is extremely important in wetland determination; however, non-scientific information can be equally useful. Old maps, aerial photographs, and survey records can illustrate changes to wetlands and related catchment areas. These provide information to identify issues and areas of concern, and can help develop an environmental history of wetlands and the relevant catchment areas. One issue with this historical data is ancillary sources of relevant information needed to make a more precise prediction are varied and may not be in an easily accessible form.

On-site ground-truthing by experienced ecologists can be useful to assess the historical development, current state, and restoration potential of a wetland. These visits may include assessments of existing hydrology, vegetation and wildlife surveys, and determination of any wetland remnants. These can provide an understanding of the current functioning and condition of a potential restoration site. This understanding can vary and depends on the expertise available. Ground-truthing exercises can be very difficult during historical delineation especially in areas of extensive anthropogenic disturbance.

Photo-interpretation relies on the interpreter's experience, knowledge of wetland geomorphology and delineation, and current signature keys available for specific areas. In addition to using historical photos (stereo photos would be best), ancillary data such as the National Wetlands Inventory, topography, hydric soil surveys, precipitation records and flood data can be used by the interpreter to determine historic wetlands. This ancillary data is used to aid in the determination, not as a determining factor because most of the data that would be used does not coincide with the time frame of the aerial. However, with every level of information there is an increased level of accuracy.

During the Goose Creek Wetland Restoration Project historic aerial photos from 1937, 58, 72, and 82 were utilized to provide project personnel an estimate of historic wetlands. Much of the ancillary data described above was not available or of insufficient quality or relevance for this project, e.g. a search for the historic 7.5 min topographic map of the general vicinity was conducted. The only information available was a scanned map from the 1950's in black and

white. Ground-truthing, was not utilized mainly due to the lack of personnel and time required to conduct an adequate ground-truthing exercise. There is no set photo-interpretation standard for the Goose Creek area for delineation of historic wetlands, however there are certain techniques that can be used, even without ancillary data. For the determination of these wetlands the techniques that were used;

- Geo-referenced all photos in ESRI ArcGIS 9.3 to current aerial photo base map as to maintain consistency of area and scale.

- Looked for wetland signatures for available years on the Goose Creek site - these years do not have to be consecutive, in fact it is very difficult to find any one area with consecutive yearly photos

- Looked at areas of hydric soils in county soil surveys and NWI wetlands. The National Technical Committee for Hydric Soils defines a hydric soil as a soil that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part of the soil. Knowing these areas have the potential for saturation is an aid for the interpretation of wetlands.

- Looked for areas that resemble depressions, swales, oxbows, old stream channel cut-offs, areas noted on soil maps as river-wash, levees, flowage easement areas, etc. If it was agricultural land, looked for differences in crop patterns that maybe due to different planting dates, e.g. isolated areas not being farmed with the rest of a field

- Utilized signature development criteria for photo interpretation:

    1. **Shape -** The general outline of the object can help you determine what it is. Some objects have a very distinct shape, while others may have a non-distinct shape.

Figure 1. Goose Creek Wetland Shape Criteria shown with red arrow indicating historic channel sinuosity.

2. **Size -** The size of the object needs to be considered in relation to the scale of the aerial photo. For example, perhaps you know that you are looking at a body of water, but is it a small pond, or a large lake?
3. **Tone (or Hue) –** The brightness of the object can assist you in identifying it. For example, in black and white or infrared photos, wetlands can appear darker or lighter than surrounding vegetated areas.

Figure 2. Goose Creek Wetland Tone Criteria shown with red arrow indicating water as having darker tone.

4. **Texture -** The visual smoothness or coarseness of the image creates its texture. The smoothness or coarseness is caused by features that are usually too small to discern as individuals e.g. potential sand areas.
5. **Shadow -** Shadows can both help and hinder the interpretation process. A shadow allows you to see the profile of an object, potentially making the object easier to identify. Large dark areas may be stands of trees that may be confused with small bodies of water. However, objects within shadows may be difficult to identify because they reflect little light.

Figure 3. Goose Creek Wetland Shadow Criteria shown with red arrow indicating shadows cast by trees.

6. **Site -** Consider geographic/geologic location of the photo, e.g. is it in a flood plain or what types of soils are in the area?

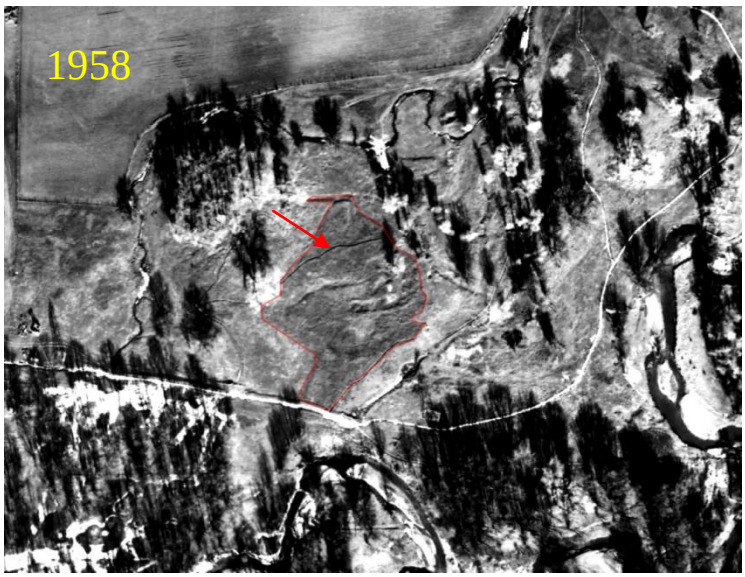

Figure 4. Goose Creek Wetland Site Criteria shown with red arrow indicating potential depression located in footprint of Cottonwood Pond.

The catchment area used exceeds the project footprint to include potential evapotranspiration and water resources that may have been available to the Goose Creek catchment. Current and remnant channel, apparent in aerial photos, allow for movement and retention of water resources for the benefit of wetlands and wetland habitat creation. In the year of 1982 evidence of these channels and wetland areas are still visible. Research of subsequent photo year provided (1999) indicated the majority of these areas not present due to anthropogenic impacts.

The interpretation of the aerial photos resulted in apparent wetlands ranging from 8 to 24 acres in project area depending on the year of photo. In 1937, approximately 19 wetland acres are apparent with old channels maintaining backwater characteristics. In 1958 the river channel appears to have become more forested and contain approximately 14 wetland acres. Roads in the area have become more developed and to the north of the project, an animal confinement area and central pivots appear. By 1972 anthropogenic impacts are even more prevalent and wetland potential was interpreted to be approximately 24 acres. It is unclear the cause of the apparent increase in wetland acres during this year. Photo quality during this timeframe was poor which could have led to the misinterpretation of certain wetland signatures. In 1982, the majority of the historic channel meanders in project area have been removed as municipal development increased. A small number of meanders still remain and during that time approximately 8 potential wetland acres were present.

This project posed several difficulties due to the limited amount of ancillary data available at the time of determination and the unfamiliarity of general geology/geography of the project area. The wetland identification was performed using experience of interpreter, familiarity of techniques of photo interpretation and knowledge of wetland characteristics. Greater precision of wetland delineation for this project could be gained by adding ground-truthing methods; historic data including topographic maps, soils data, precipitation data and flood data.

Prepared by:

Scott A. Flash
Environmental Resource Specialist
US Army Corps of Engineers - Omaha District
Office: (402) 995-2748
scott.a.flash@usace.army.mil

References used to aid in historic wetland interpretation.

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GOOSE CREEK
BOULDER, COLORADO

SECTION 206
ECOSYSTEM RESTORATION REPORT

APPENDIX B
COST ENGINEERING

JUNE 2011

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GOOSE CREEK AT BOULDER, COLORADO
SECTION 206 FEASIBILITY STUDY
APPENDIX B – COST ENGINEERING

1. OVERVIEW OF APPENDIX

The purpose of the Cost Engineering Appendix is to link the M-CACES Cost Estimate to the main report. This appendix provides a summary explanation of the project, critical assumptions, major alternatives considered, Total Project Cost Summary (TPCS) and other aspects of the Feasibility Study. Greater detail on many topics can be found in the Feasibility Report itself and in the other technical appendices related to the specific topic.

2. OVERVIEW OF PROJECT

This Feasibility Study/Environmental Assessment (FS/EA) is submitted under the authority of Section 206 of the Water Resources Development Act of 1996, as amended (33 U.S.C. 2201). The purpose of this study is to identify potential riparian ecosystem restoration alternatives for South Goose Creek, located in the City of Boulder, Boulder County, Colorado. The goal of the FS/EA is to evaluate each proposed alternative and, through coordination between the U.S. Army Corps of Engineers (USACE), the non-Federal, Local Sponsor, and participating agencies, develop a recommended National Ecosystem Restoration (NER) plan for the proposed study site. The study area is in Congressional District 2, which is represented by Congressman Jared Polis. Senator Michael Bennet and Senator Mark Udall also represent the study area. The study area covers approximately 17 acres and includes South Goose Creek and Cottonwood Pond in the city of Boulder, Colorado.

Goose Creek is a tributary of Boulder Creek, which in turn is a tributary of the South Platte River. The study area extends from immediately upstream of Foothills Parkway to the confluence with Boulder Creek and encompasses approximately 4,000 feet of South Goose Creek and Cottonwood Pond. The purpose of the study is to determine if the proposed restoration of the aquatic ecosystem of Goose Creek and the associated wetlands and Cottonwood Pond are feasible, given National Ecosystem Restoration goals and the economic cost.

South Goose Creek and Cottonwood Pond are included in the Aquatic Ecosystem Restoration program due to their degraded condition, and the potential to restore wetland habitat, migratory bird habitat, and stream aquatic habitat, all in proximity to current populations of endangered animal and plant species. The potential project area also offers unique opportunities to connect restored riparian reaches and restore some of the scarce riparian ecosystem in the semi-arid high plains adjacent to the Front Range of the Rocky Mountains. Quality riparian habitat is relatively rare on the high plains of Colorado, yet it is vital to many native and migratory species. Restoration of this impaired ecosystem will offer an opportunity to rid the Boulder Creek watershed of an invasive plant “hot spot” and replace it with native aquatic and riparian species. Together with Cottonwood Pond, South Goose Creek offers an opportunity to increase the amount, quality and connectivity of scarce habitat and potentially expand the range of endangered species that dwell nearby. Cottonwood Pond, in particular, offers an opportunity to

restore pre-development riparian and wetland conditions in the floodplain adjacent to Boulder Creek.

3. RECOMMENDED PLAN

3.1 OVERVIEW

The recommended plan (R11R22R32) is to restore the Reach 1 channel, move the bike trail and develop a channel with meander bends and floodplain with multiple terraces in Reach 2 and to convert Cottonwood Pond to habitat similar to its predevelopment state as a wooded wetland. This plan was selected from the array of "best buy" plans based upon its: efficiency (the increase in output for the second and third best buy plan selected were about two times the percent increase in incremental cost per additional unit of output);completeness (restoring all three reaches, greatly enhancing connectivity, both lateral (stream-floodplain) and longitudinal (between Goose Creek reaches and with reaches upstream and downstream from South Goose Creek); effectiveness (providing the greatest output of all plans, and meeting the overall aquatic ecosystem restoration objectives for the Boulder Creek watershed); and acceptability (having the support of the Sponsor, as well as being technically feasible).

Implementation of the recommended plan would provide for a continuous restored reach of South Goose Creek and Cottonwood Pond that would link the previously restored reach of Goose Creek west of Foothills Parkway with the riparian habitat along Boulder Creek. This would provide connectivity for species movement into the upper reaches of this tributary by the development of sustainable ecosystem restoration where a flood control channel and gravel pit pond now exists.

The restoration plan for Reach 1 involves the aquatic habitat improvement of 7.70 acres of South Goose Creek flood control channel. The primary measures include riparian zone improvement, construction of wetlands at storm sewer outfalls, modification of rock structures (including some of those bounding the low flow channel), removal of exotic trees, and installation of wildlife migration structures under four road crossings.

The restoration plan for Reach 2 consists of the aquatic restoration of 4.14 acres of flood control channel and adjacent perched floodplain. The central restoration theme for this reach entails moving the existing bike trail to the south (further from the right bank of South Goose Creek), and excavating a new, meandering channel with a wide right bank floodplain bench with multiple terraces to the south. The excavation plan would also increase the low water channel stream length by adding sinuosity. Additional restoration features include riparian zone improvement, construction of wetlands at storm sewer outfalls, modification of rock structures (including those bounding the low flow channel) and the removal of exotic plant species.

The restoration plan for Reach 3 (Cottonwood Pond) involves decreasing the pond depth to restore historical wetland habitat. The wetland restoration effort would involve the 7.13-acre pond and adjacent land within the overall 16.65 acre zone. The primary restoration feature for this alternative is to restore this former gravel pit to the riparian ecosystem that existed through most of the 20th century. The wooded aquatic ecosystem

would connect and greatly expand the riparian habitat of Boulder Creek by recreating the wetland at the confluence of the two streams. Restoration of the ecosystem would be accomplished by dewatering the pond and filling much of its basin, excavating a meandering channel, establishing wetland and transitional plantings, and the removal of exotic and invasive species. The M-CACES design and implementation cost for the Recommended Plan is $1,156,078.69.

3.2 M-CACES COSTS BY REACH

The costs noted as follows are from the latest M-CACES output which is summarized in Section 5 of this Appendix.

3.2.1 Reach 1

The M-CACES cost estimate to implement Reach#1, Alternative #1 is $88,915.08.

3.2.2 Reach 2

The M-CACES cost estimate to implement Reach #2, Alternative #2 is $422,739.99.

3.2.3 Reach 3 (Cottonwood Pond)

The M-CACES cost estimate to implement Reach #3, Alternative #2, the revised wetland concept is $644,423.62.

4. PLAN FORMULATION SUMMARY

4.1 RISK ANALYSIS

In the formulation of a project, potential risks to proper or expected performance of the project are evaluated. Most of the risks to this project can be addressed within the context of OMRR&R. There are some areas of uncertainty which could impact the performance and value of the project once completed.

4.1.1 Risk to Construction Cost Formulation

Primary risks to cost formulation include unforeseen site issues, construction inflation and the adequacy of the feasibility-level design and related data. Additionally, the decision as to whether to move from feasibility to “design build” had not been made when the Cost Estimate was prepared. As considerable design effort was performed by Geotechnical Engineering and the project schedule for moving from feasibility into design is rapid, this helped to moderate the risks that grow over time. Risk was computed using the workbook provided by the Cost DX.

4.1.2 Risk During Construction

While the project is a relatively simple “dirt job”, there are some risks during construction, that are chiefly weather related. A very wet year or untimely heavy rains that would cause above average surface and groundwater flow would impact the construction timing and costs. Prairie Dogs are on the site and will need to be removed before construction according to local ordinance. Additionally, the site will need to be evaluated for raptor nesting, which, if found, would preclude tree removal during the

months of the year that the birds fledge. Fluctuations of fuel prices, if on the high side, are also a risk to cost control.

4.1.3 General Project Risk after Construction (Assumptions and Concerns)

4.1.3.1 EROSION

The erosion control and hydraulic structures built in the Goose Creek and South Goose Creek channels by the Denver Urban Drainage and Flood Control District have kept the stream from eroding the banks and endangering nearby property and Pearl Parkway. On South Goose Creek, the potential for erosion is limited by discharge control and structural grade and lateral erosion controls. The flood discharge entering South Goose Creek is effectively controlled by the box culverts upstream of Foothills Parkway, with larger flood flows diverted to the North Goose Creek overflow channel, bypassing Reach 2. There should be no impact to peak discharges carried by the South Goose channel due to the project. Flooding on the small urbanized watershed is infrequent and of short duration. The extremely short duration of these major floods also helps deter severe erosion within the channel. It is accepted that minor bank erosion and deposition would be anticipated due to planned meander development in Reach 2, however the short duration of high flows combined with the anticipated vegetative growth are not conducive to severe planform shifting.

The grade control features installed by Denver Urban Drainage in the 1980s have proven effective through several subsequent larger floods. The majority of those structures on South Goose Creek will remain as they are, with the only significant modification being at the most downstream weir section where the channel would be allowed to meander to the south with more natural riparian conditions in force, including erosion. Given that during larger flows, this area would be within the backwater of the wetland and bike trail, resulting in slower velocities, it is considered unlikely that sufficient scour would be attained to erode that area once vegetation has become established. The greatest risk at that site, as well as elsewhere in the project is that a major flood would take place before the vegetation has become established. If this were to occur, repair, rehabilitation and replacement costs could be larger than anticipated in the first year or two.

4.1.3.2 CLIMATE CHANGE

The impact of climate change on the project was discussed in the Future Without-Project section. While the evidence of considerable climate fluctuation has been documented historically through the post ice age period in the high plains region and evidence of ongoing climate change can be found today, the ecosystem restoration project by its very nature would tend to minimize the impact of climate change. This is because the project would favor an ecosystem that has adapted to the harsh high-plains environment over time and has demonstrated that it can thrive despite wide swings in temperature and precipitation. The greatest risk to the project would be a very hot and dry year following project completion, which would inhibit plant growth needed to resist erosion when large rains returned. In the event of a drought immediately after project completion, a watering plan for newly planted and seeded native species may be worthy of consideration, but would add to initial OMRR&R costs.

4.1.3.3 EURASIAN WATER MILFOIL

This aquatic plant has been a major problem in Cottonwood Pond, and elsewhere within the Boulder Creek Basin, due to crowding out of native species, inhibiting fish forage and water quality impacts. The inability to easily eradicate this invasive water weed was central in the need to formulate an alternative plan for Cottonwood Pond involving its conversion to a wetland. It is anticipated that the wetland as currently designed will largely eliminate the competitive advantages that have been enjoyed by the milfoil to date. Best Management Practices (BMPs) will be followed to reduce the risk of spreading milfoil during dewatering of the pond. Since the aquatic weed requires moderate pond depths and sunshine, the conversion of the pond to a forested wetland would remove both favorable water depths and lighting conditions that have allowed it to thrive. If wet years were to immediately follow project completion, resulting in sustained larger than normal inflows (and greater water depths) in Cottonwood Wetland, milfoil could reestablish itself within the water plant community. Excavating the outflow channel from the wetland to Boulder Creek could provide a solution to the reestablishment of the milfoil by reducing the depth in the wetland to a level that would be unfavorable to the weed.

4.2 PROJECT SCHEDULE

Table B-1 Project Schedule

MILESTONE	DATE
Detailed Project Report Approval	May-11
Receipt of Design and Implementation Funds	June-11
Project Management Plan Agreed	June-11
PPA Executed	June-11
Real Estate Interests Certified	July- 11
Plans and Specifications	September-11
Advertisement, Award and Notice to Proceed	September-11
Initiate Construction	September-11
Construction Complete	May-13
OMRR&R Manual	June-13
Project Turnover to Sponsor	August-13
Monitoring Complete	August-18

4.3 PROJECT COSTS AS A SNAPSHOT IN TIME

A final total project cost was developed for the Feasibility Phase using costs as of January 2011. In addition to the M-CACES cost estimate; the final Real Estate Gross Appraisal used costs gathered during that time as well. The Project Economist also used interest rates, the project schedule and other factors appropriate to January 2011 in the development of the Total Project Cost Summary. The total project cost, for the Feasibility Study, is thus a “snapshot” in time.

It is understood that costs may change a little prior the completion of the Feasibility Phase, but completion of the Feasibility Phase is expected within the same Fiscal

Year (FY11). The next estimate of cost will occur prior to preparation of the Bid Package and will be the "Government Estimate" for that purpose. A Tract Appraisal will also occur during the Design and Construction Phase. Economic factors, such as the Government Interest Rate will also be updated for that effort.

4.4 TOTAL PROJECT COST SUMMARY (TPCS)

The Total Project Cost Summary is jointly prepared by Cost Engineering, Real Estate, Programs and the Project Economist. The TPCS Cost Summary for this project is listed as follows in Table B-2:

Table B-2 Total Project Cost Summary (TPCS)

Economic Data – January 2011 Price Levels; 50 Year Project Life; Interest Rate =	0.04125
(Excludes Feasibility Study Costs)	
Construction Cost including Trail Relocation	$833,823
Engineering and Design	$95,456
Supervision and Administration	$50,029
Contingency	$176,770
Non-Federal Real Estate Acquisition Costs	$1,248,480
Federal Real Estate Admin. & Legal Costs	$46,328
Omaha District Construction Management / QC	$80,000
Interest During Construction (1 year, 4.125%)	$71,940
Total First (Investment) Costs	$2,602,827
Annualized Costs (50 years, 4.125% interest)	$123,764
Annual Non-Fed OMRR&R Costs	$41,818
Annualized Monitoring Costs	$1,178
Annualized Costs to Prepare O&M Manual	$877
Total Annual Costs	$167,637
Average Annual Equivalent Benefits	11.41 AAHUs
Net Average Annual Equivalent Ecosystem Habitat Functional Units (Net AAHUs)	11.41 AAHUs
Cost / Net AAHU	$14,692

5. M-CACES (TRACES MII VERSION 4.1) SUMMARY VERSION RTF OUTPUT OF (22 April 2011) Using Cost Database of January 2011

5.1 PROJECT NOTES

All boulders removed from stream banks will be reused or stockpiled on the project site.

Excess material will be disposed of within the project site or within 5 miles of the project at a location designated by the sponsor with no dumping fees.

Concrete channel lining and sidewalk will be broken up and reused as riprap to control erosion, placed in the lake as fish habitat or stockpiled on the project site for future reuse.

Assume the pallets used for the stacked pallet fish habitat structures will be provided at no cost to the project.

5.2 PROJECT MARKUPS

Engineering & Design (E&D) - 9%
Supervision & Admin (S&A) - 6%
Contingency - 20%

5.3 SUMMARY OF SELECTED ALTERNATIVES FOR EACH REACH

The following table provides a cost "roll-up" for all three reaches that comprise the Goose Creek at Boulder ecosystem restoration project.

Totals for All Reaches	**834,030.93**	**95,479.85**	**50,041.86**	**176,814.56**	**1,156,367.21**
Stream Reach #1					
(Rch1Alt1) Reach #1, Alternative #1	**64,140.93**	**7,342.85**	**3,848.46**	**13,597.88**	**88,930.12**
Stream Reach #2					
(Rch2Alt2) Reach #2, Alternative #2	**304,982.74**	**34,914.42**	**18,298.96**	**64,656.34**	**422,852.47**
Cottonwood Pond, Reach #3					
(Rch2Alt2) Reach #3, Alternative #2	**464,907.26**	**53,222.58**	**27,894.44**	**98,560.34**	**644,584.62**

5.4 STREAM REACH #1, ALT #1

This Selected Alternative was a compilation of the best feasible measures that will improve that reach and allow it to provide connectivity with restore reaches upstream and downstream. Due to real estate and erosion control constraints, this level of restoration was deemed the maximum possible improvement for this portion of South Goose Creek.

DESCRIPTION	CONTRACT COST	E&D 9%	S&A 6%	CONTING. 20%	PROJECT COST
(Rch1Alt1) Reach #1, Alternative #1	64140.93	7342.85	3848.46	13597.88	88930.12
CW WBS 06 03 Wildlife Facilities and Sanctuaries	64140.93	7342.85	3848.46	13597.88	88930.12
01 Riparian Zone Improvements	26507.72	3034.6	1590.46	5619.64	36752.42
02 Construct Wetlands at Outfalls	1312.41	150.25	78.74	278.23	1819.63
03 Modify Rock Structures	7429.15	850.49	445.75	1574.98	10300.36
04 Selectively Remove Existing Boulders	2607.97	298.56	156.48	552.89	3615.9
05 Facilitate Wildlife Travel	13797.99	1579.59	827.88	2925.17	19130.64
06 Remove Exotic Trees & Plant Native	12485.69	1429.36	749.14	2646.97	17311.17

5.5 STREAM REACH #2, ALT #2

For this Selected Alternative, additional public land adjacent to the existing channel would be graded to expand the riparian wetland, provide channel meanders for aquatic restoration and create wetland buffers. A bike trail will be moved as part of the project.

DESCRIPTION	CONTRACT COST	E&D 9%	S&A 6%	CONTING. 20%	PROJECT COST
(Rch2Alt2) Reach #2, Alternative #2	304,982.74	34,914.42	18,298.96	64,656.34	422,852.47
CW WBS 02 01 Relocations, Roads	40,651.09	4,653.74	2,439.07	8,618.03	56,361.93
01 Concrete Bike Trail	40,651.09	4,653.74	2,439.07	8,618.03	56,361.93
CW WBS 06 03 Wildlife Facilities and Sanctuaries	264,331.64	30,260.69	15,859.90	56,038.31	366,490.54
01 Water Diversion	23,511.53	2,691.60	1,410.69	4,984.44	32,598.26
02 Riparian Zone Improvements	54,000.85	6,182.02	3,240.05	11,448.18	74,871.10
03 Construct Wetlands at Outfalls	302.86	34.67	18.17	64.21	419.92
04 Modify Rock Structures	20,697.18	2,369.41	1,241.83	4,387.80	28,696.23
05 Excavate Meanders	150,906.63	17,275.79	9,054.40	31,992.21	209,229.02
06 Riprap Meander Banks	489.79	56.07	29.39	103.84	679.09
07 Weirs, Cut Concrete Lining	4,611.94	527.97	276.72	977.73	6,394.36
08 Channel Block	7,708.37	882.45	462.5	1,634.17	10,687.50
09 Backfill	2,102.49	240.69	126.15	445.73	2,915.07

5.6 COTTONWOOD POND, REACH #3, ALT #2 WETLAND DESIGN

This **Selected Alternative** was formulated in order to kill the Eurasian Water Milfoil and to comply with Colorado Water Law, which precluded impounding water as an adaptive management tool. This plan featured much higher habitat unit outputs than did the pond restoration alternative.

DESCRIPTION	CONTRACT COST	E&D 9%	S&A 6%	CONTING. 20%	PROJECT COST
(Rch2Alt2) Reach #3, Alternative #2	464,907.26	53,222.58	27,894.44	98,560.34	644,584.62
CW WBS 06 03 Wildlife Facilities and Sanctuaries	464,907.26	53,222.58	27,894.44	98,560.34	644,584.62
01 Water Diversion	94,134.18	10,776.48	5,648.05	19,956.45	130,515.16
02 Backfill Pond	185,920.25	21,284.15	11,155.22	39,415.09	257,774.71
03 Seeding & Plantings	101,733.78	11,646.48	6,104.03	21,567.56	141,051.85
04 Remove Trees & Plant Native	17,510.96	2,004.66	1,050.66	3,712.32	24,278.60
05 Excavate Wetland Channel Bank	30,630.10	3,506.53	1,837.81	6,493.58	42,468.02
06 Overflow Knotch	12,999.30	1,488.16	779.96	2,755.85	18,023.27
07 Fence	21,978.69	2,516.12	1,318.72	4,659.48	30,473.01

US Army Corps of Engineers ®
Omaha District

GOOSE CREEK
BOULDER, COLORADO

SECTION 206
ECOSYSTEM RESTORATION REPORT

APPENDIX C -
CULTURAL RESOURCES

JUNE 2011

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
106 SOUTH 15TH STREET
OMAHA NE 68102-1618

REPLY TO ATTENTION OF

August 7, 2007

Planning, Programs, and Project Management Division

Georgianna Contiguglia
State Historic Preservation Officer
The Colorado History Museum
1300 Broadway
Denver, Colorado 80203

Dear Ms. Contiguglia:

The U.S. Army Corps of Engineers, Omaha District (Corps) is planning a Section 206 ecosystem restoration feasibility study in the City of Boulder, Colorado. The proposed project would be undertaken with a combination of Federal and local funding. This letter initiates Section 106 consultation for the proposed project.

The proposed project area extends from immediately upstream of Foothills Parkway to the confluence with Boulder Creek and encompasses approximately 4000 feet of South Goose Creek (Figures 1, 2, and 3). The present Goose Creek area was modified for floodflow conveyance with South Goose Creek being the main channel and North Goose Creek serving as an overflow channel. The South Goose Creek channel is designed to Urban Drainage Flood Control District (UDFCD) specifications and is trapezoidal in cross section with a number of drop structures. The land surrounding the study area is highly urbanized. The channel is confined by property lines, roadways, vehicle crossings, and utilities. The banks have been stripped of native vegetation and replanted with exotic grasses.

Specific project plans have not been developed, however, potential project goals and components have been compiled. In general, proposed project components would include stream restoration, wetland development and re-vegetation. The work would also re-establish native species; preserve, restore, and create functional wetlands, plant communities, and wildlife habitats; and increase recreational opportunities. The project may also relocate the existing bicycle trail southward to the vicinity of the social trail to further enhance riparian development. A specific list of potential goals is listed in the attached preliminary restoration plan.

The Corps has reviewed the National Register of Historic Places (NRHP) and found no NRHP properties listed within or near the proposed project area. A review of archeological sites has not yet been undertaken with your office and it is not known whether all or a portion of the area has been previously surveyed or whether or not there are previously identified cultural resource sites situated within the study area. No standing structures are present within the proposed project area.

At this time we are requesting information from your office on previously recorded sites, if any. Also, given the large amount of previous urban related disturbance within the project area, we also request your comment on the need for archeological survey for the future development.

Thank you for your attention to this matter. If you have any questions about the work performed at these sites, please contact Timothy Meade, Corps' Archeologist at (816) 389-3138 or timothy.m.meade@nwk02.usace.army.mil.

Sincerely,

Larry D. Janis, Chief
Environmental, Economics and
Cultural Resources Section
Planning Branch

Enclosures

Figure 1 Proposed Goose Creek project area.

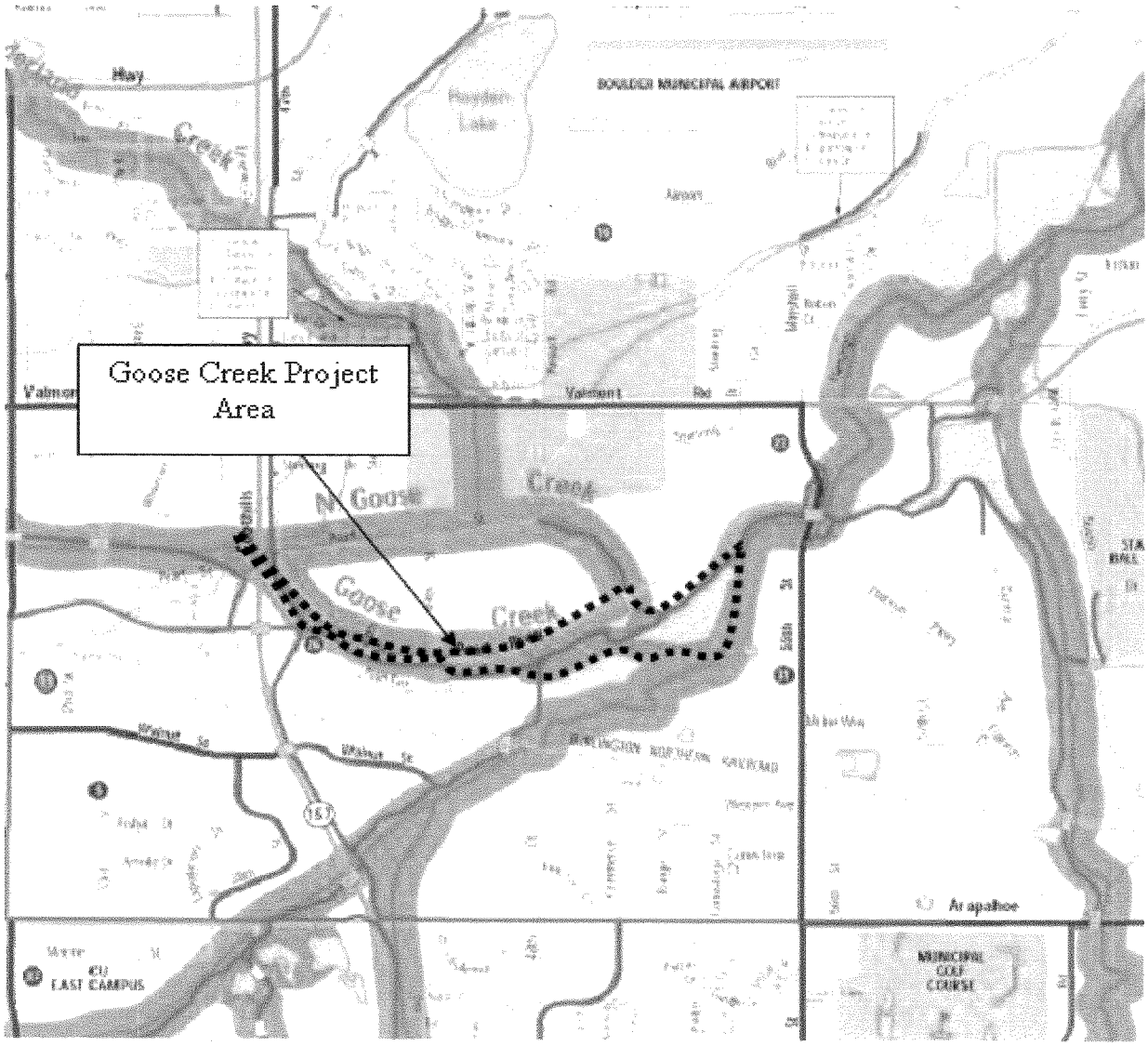


Figure 2 Proposed Goose Creek project location on a topographic map (Boulder 7.5-minute topographic map). Note: There has been a large amount of development in the area since the topographic map was made.

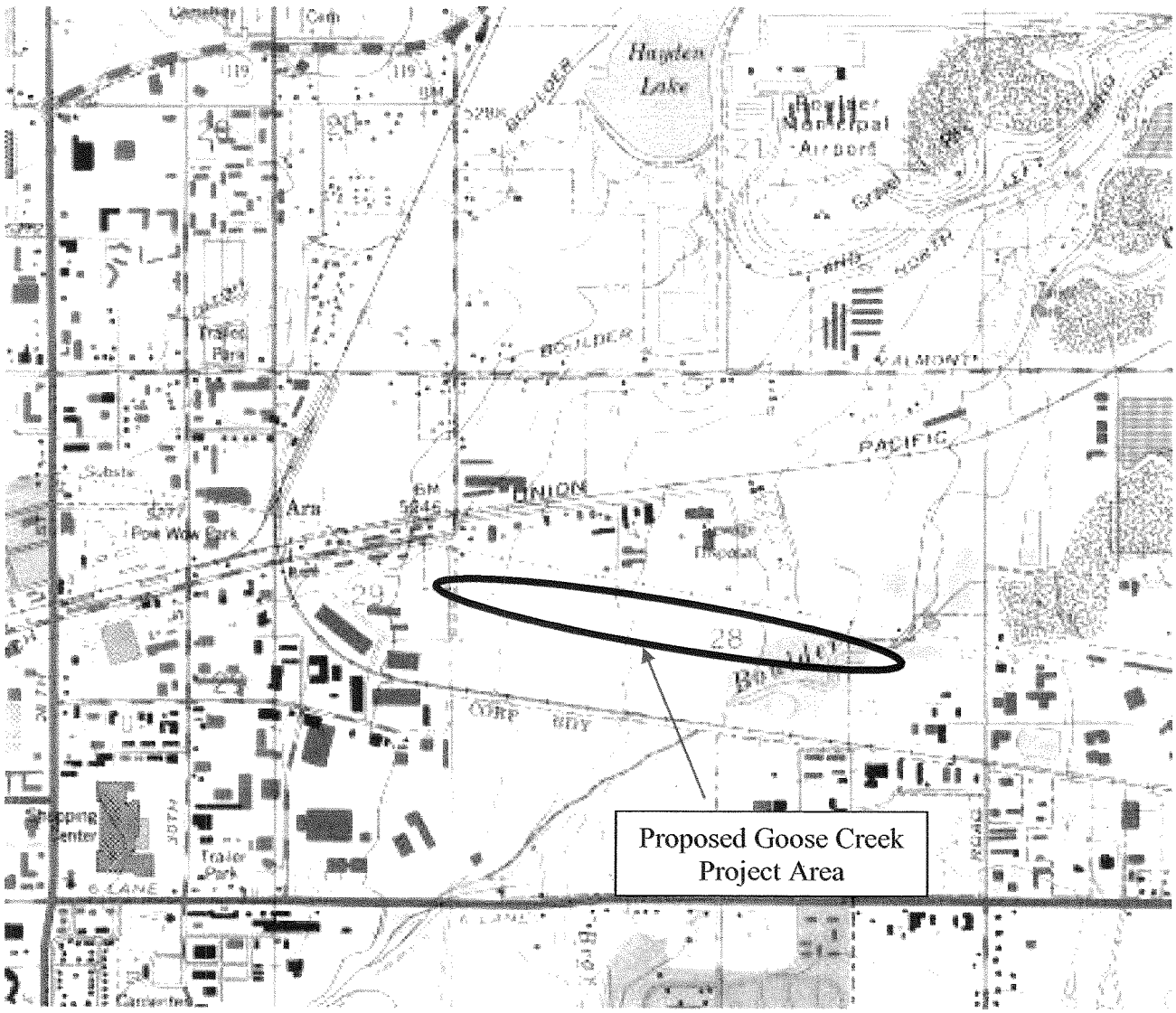
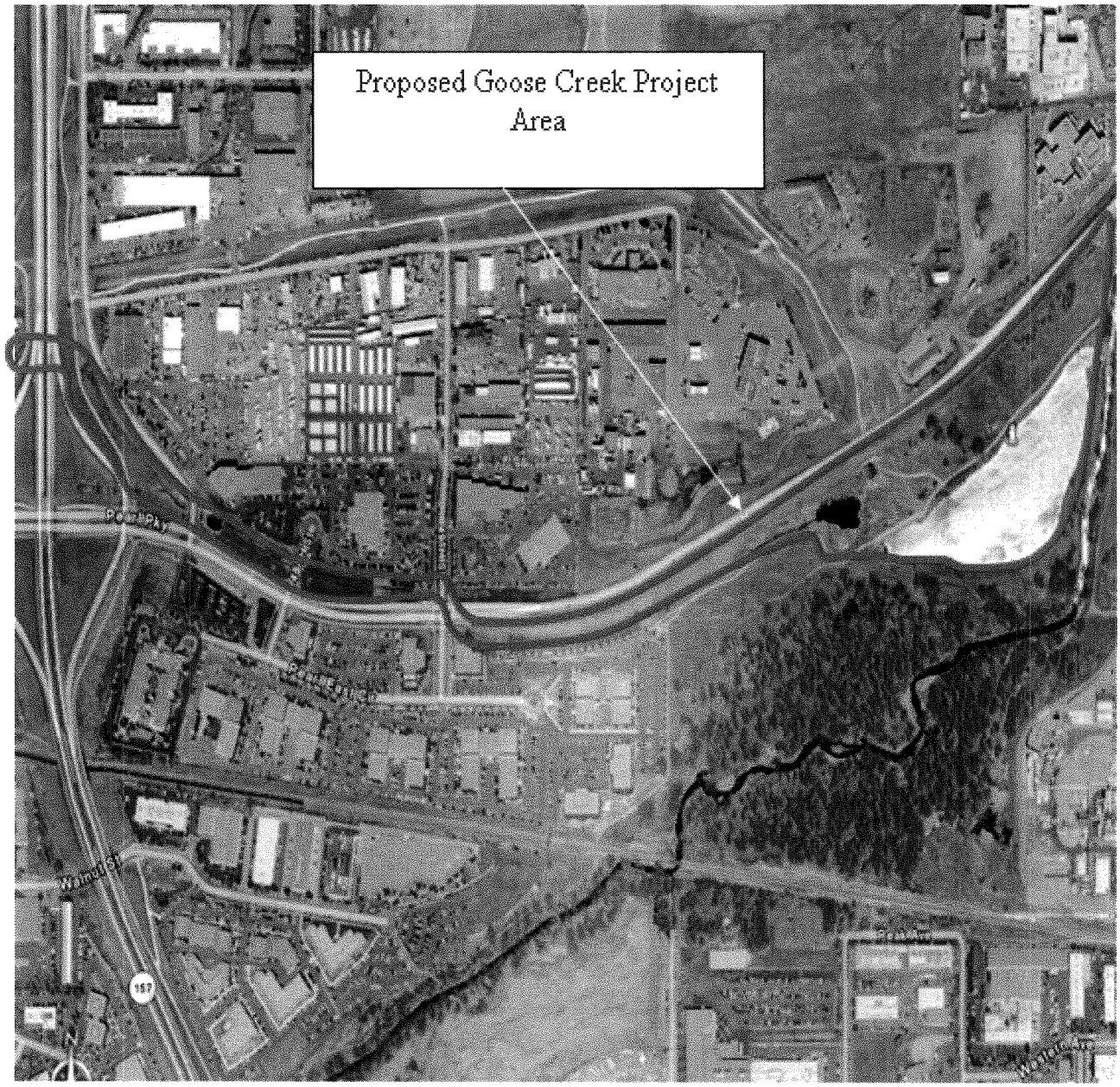


Figure 3 Aerial photo of proposed Goose Creek project area.



US Army Corps of Engineers®

Northwestern Division
Omaha District
Date: 22 July 2004

PRELIMINARY RESTORATION PLAN
SECTION 206
GOOSE CREEK RESTORATION, BOULDER, COLORADO

1. PROJECT: Goose Creek Restoration, Section 206 Project, Boulder, Colorado. Congressional District CO-2.

2. LOCATION: The project is located in the City of Boulder, Colorado. The study area extends from immediately upstream of Foothills Parkway to the confluence with Boulder Creek and encompasses approximately 4000 feet of South Goose Creek.

Goose Creek was modified for flood flow conveyance with South Goose Creek being the main channel and North Goose Creek serving as an overflow channel. The South Goose Creek channel is designed to Urban Drainage Flood Control District (UDFCD) specifications and is trapezoidal in cross section with a number of drop structures. The land surrounding the study area is highly urbanized. The channel is confined by property lines, roadways, vehicle crossings, and utilities. The banks have been stripped of native vegetation and replanted with exotic grasses.

3. DESCRIPTION OF PROPOSED PROJECT:

(A) What is Being Proposed?

i) Project Goals:

a) Re-establish self-sustaining native riparian ecosystems.
b) Preserve, restore, and create diverse, functional wetland communities.
c) Preserve, restore, and create a diversity of native plant communities and wildlife habitats throughout the project area.
d) Preserve existing prairie dog colony and associated habitat in the project area.
e) Enhance stream morphology, shading, oxygenation, wetland filtering, and sediment control to improve water quality for habitat value.
f) Enhance aquatic habitat.
g) Restore upland habitat.
h) Reduce the number and extent of non-native plant species.
i) Increase recreational opportunities including trail improvements, resting areas, drinking fountains, fishing opportunities, and interpretive facilities.

ii) Related Sponsor Goals:

The Greenways Master Plan (City of Boulder, 2001) integrates six different objectives along Boulder Creek and six of its tributaries. These objectives include:

a) Protect and restore riparian, floodplain, and wetland habitat.
b) Enhance water quality.
c) Facilitate storm drainage and mitigate floods.
d) Provide alternative transportation routes or trails for pedestrians and bicycles
e) Provide recreation opportunities.
f) Protect cultural resources.

The Open Space and Mountain Parks Department preserves and protects the natural environment and land resources that characterize Boulder, fostering appreciation and uses that sustain the natural values of the land.

iii) Key components:

a) Restore and implement features that mimic natural features normally created through migration processes of a geomorphically functioning ecosystem.
b) Restore natural stream gradient in some locations.
c) Enhance low-flow channels with aquatic cover and increased sinuosity.
d) If determined to be appropriate, desirable, and feasible, enhance fish passage by modifying existing drop structures and the confluences between Goose Creek and Cottonwood Pond and Boulder Creek. This project component requires further evaluation and may or may not be included in the final project.
e) Plant and seed native riparian vegetation.
f) Plant and seed native upland vegetation.
g) Create functional wetland habitats.

Stream restoration
The project would involve existing hard structures reconfiguration, low-flow channel reconstruction, stream gradient restoration, and bio-stabilization. The channel would be configured to incorporate fish and aquatic invertebrate habitat. An intrinsic goal of river restoration is to allow the stream to meander as naturally as possible. The existing constraints of infrastructure, utilities, and neighboring properties in this highly urbanized area and the need to maintain flood conveyance will make major planform changes and realignments of the channels cost prohibitive in the project area. However, the low-flow channel can be allowed to meander within the confines of the larger flood channel.

Wetland development
The Greenways Master Plan (2001) created for the City of Boulder envisions water quality improvements and wetland and stream restoration. This will be accomplished with wetland areas constructed at storm sewer outfalls. Some of the South Goose Creek channel will also be restored as functional wetlands with native vegetation, although this will be limited to areas outside the existing prairie dog colony.

Re-vegetation
Currently, non-native plant species dominate the riparian areas and surrounding Cottonwood pond. These non-native plants would be removed and appropriate native plant species would be planted along the stream, wetlands, overbank areas, and uplands to improve habitat diversity. A

landscaping plan would be designed to create a relatively continuous riparian corridor. Although most of the resources in the area would benefit greatly from restoration efforts, some high quality communities and habitats may exist and would be preserved or enhanced, most notably the marshlands at the confluence of North and South Goose Creeks. These preservations areas include mature riparian woodland with high quality bird habitat, in-channel marshlands with bird habitat, the wetland at the confluence of North and South Goose Creeks, riparian zones, bird nesting habitat in the channel, and the existing prairie dog colony. The project area is part of a riparian corridor system that, with restoration, would provide habitat linkage for wildlife between the Boulder Creek Corridor and Valmont City Park (Jones, 2001).

Conceptual Alternative

The Greenways Master Plan (City of Boulder, 2001) establishes a listing of potential alternative measures including restoration of aquatic habitat to improve quality, evaluating the removal of fish movement barriers (this project component may or may not be included in the final project), revegetation, restoration and improvement of wetlands within the trapezoidal channel, augmentation of water, and best management practices at storm sewer outfalls. These measures would be incorporated into a comprehensive conceptual alternative for the entire project area. Locations along and within the trapezoidal channel would be revegetated with appropriate native vegetation considering the elevations of the locations to be planted relative to water levels within the channel, and the presence of prairie dogs. Intermediate drop structures of the channel would be removed, and the channel would be filled with appropriate-sized alluvium to maintain a thalweg through the sections of restored gradient. Other drop structures would be reshaped and augmented with fabric-encapsulated soil lifts that would provide an area for revegetation of willows and other native species along the channel. Areas near storm sewer outfalls would be excavated and wetland areas would be constructed there. Boulder edging and concrete lining would be removed from the low-flow channel along South Goose Creek.

At the downstream end of the project area are Cottonwood Pond and the confluence with Boulder Creek. The shoreline of the pond contains invasive vegetation such as Russian olive trees that would be removed, and the shoreline would be planted with native riparian species. It is possible that fish passage upstream into Goose Creek channel could be improved during low-flow periods, although impacts to existing wetlands would need to be avoided. This project component would require an evaluation to determine if it is appropriate, desirable, and feasible, and may or may not be included in the final project. If not colonized by prairie dogs, two high, denuded benches near the confluence of North and South Goose Creek would be shaped to elevations closer to groundwater and revegetated with native riparian vegetation. Recreational improvements such as access trails, boardwalks, benches, and increased access to the pond for fishing would be included in the project.

(B) Why is it Being Proposed?

South Goose Creek channel and associated floodplain has been dramatically altered in the study area in terms of hydrologic regime, natural channel form, and native vegetation communities. The channel is completely artificial and is not functioning under natural geomorphic processes. Riparian and floodplain zones associated with the channel are very limited and disconnected from channel interaction.

In the late 1980s Goose Creek was modified for flood flow conveyance. The current design of the study area was developed in cooperation with Colorado's Urban Drainage and Flood Control District (UDFCD), an organization developed for the purpose of assisting local governments in the Denver metropolitan area with multi-jurisdictional drainage and flood control problems.

Presently, UDFCD is responsible for the maintenance of the Goose Creek channels to continue flood conveyance. North Goose Creek was constructed as an overflow channel for the south and main channel. Both channels were channelized between property lines, roadways, and encroaching utilities. The cross sections of the channels were made trapezoidal to convey flows through the channels as quickly as possible. All native vegetation was removed from the channels, and the banks were planted with grasses. A number of vehicle crossings and boulder edging of the low-flow channel were constructed (the boulder edging has recently been removed from the north channel). The south channel also had a concrete lining installed for the low-flow channel. The profiles of the channels were altered to have a very flat gradient for stretches with boulder and concrete drop structures at intervals to dissipate the hydraulic energy of flood flows. The channel does not maintain a continuous open-water low-flow channel due to a barrier at the inlet to Cottonwood Pond.

The Boulder and White Rocks Ditch was constructed near the start of the 20th century. Until recently, Goose Creek itself was cut off and routed through the Boulder and White Rocks (BWR) ditch. The ditch diverted all of the native Goose Creek flows at the present Folsom Street location, and the creeks were likely dry for extended periods of the growing season. Currently, the first 26 cfs of water flowing in Goose Creek is diverted into the BWR ditch before any additional flows are passed downstream into the project reach. The BWR is lined with concrete, thus reducing the potential for return flows from the ditch to the creek channels.

The creek is in very urbanized areas and storm discharges run directly into the channel. This is likely increasing the flooding frequency and peak flows compared with expected natural flow regime.

As a result of urbanization and irrigation demand, the current channel function is primarily flood conveyance, and it has been channelized to efficiently perform this function. To prevent down-cutting, or incision associated with channelization, grade controls have been placed in the channel bed. To prevent the bank erosion associated with the incision process, the banks have been artificially hardened. South Goose Creek lacks a significant base flow, active floodplain connection, riparian zone, and provides limited support for aquatic life.

Fish Habitat

The riprap structure separating Cottonwood Pond and Goose Creek is a barrier to fish movement except during flood events when sufficient water passes over the structure and through a box culvert. This barrier is located between the North and South Goose Creek confluence and Cottonwood Pond.

South Goose Creek currently maintains some base water flow during runoff. A large portion of the channel contains a flat concrete bottom lined by boulders, which lacks sufficient habitat diversity to support abundant aquatic life. There are some small pools that contain small fish. Fish have been observed moving up and down the downstream half of the channel although water depths are not typically deeper than a few inches.

Cottonwood Pond contains lacustrine fish habitat including submerged vegetation and a combination of deep and shallow water habitats. However, there is a barrier to fish passage at the outlet of the pond where it reaches Boulder Creek; during low-flow periods, fish are prevented from passing between the pond and the creek. Much of the shoreline lacks shaded habitats with the exception of some non-native Russian olive trees.

Vegetation
The City of Boulder Tributary Greenways Program Riparian Habitat Assessment Vegetation Evaluation Report provided a vegetation assessment (Gershman, 1999). The assessment identified plant species composition for the entire Greenways Program and provided a general characterization of the project area. Vegetation along South Goose Creek is predominantly herbaceous non-native species at the upstream end, which parallels Foothills Parkway. A large portion of South Goose Creek runs along several automobile dealerships, which maintain the channel as a landscaped grass and shrub area. Along the uppermost portion of the channel adjacent to Pearl Parkway, there are several landscape trees. Sprinkler systems have been installed at several locations along the channel to maintain the grass and ornamental vegetation.

Wildlife
Wildlife species found in the project area consist of species tolerant of human presence including coyote (*Canis latrans*), black-tail prairie dog (*Cynomys ludovicianus*), and various bird species. There is a prairie dog colony located within the project area, which is protected by state and local regulations and policies. One of the project goals is to preserve the existing prairie dog colony and its habitat. Native wetland habitats and vegetation restoration areas will need to be designed to avoid impacts to prairie dog colonies. Also, the potential for prairie dogs to forage on installed plant materials will need to be considered.

Threatened and Endangered Species
Two federally listed species are known to occur in riparian habitats in the Boulder, Colorado, area and may potentially occur in the project area. These are the Preble's meadow jumping mouse (*Zapus hudsonius preblei)* and Ute ladies' tresses orchid (*Spiranthes divuvialis*). Both are threatened species under the provisions of the US Endangered Species Act. Although a recent vegetation study (Gershman, 1999) observed no suitable habitat for either species within the project area, detailed species surveys would likely be required to satisfy US Fish and Wildlife Service (USFWS) requirements.

Water Quality
A number of storm water discharges into Goose Creek have degraded water quality. The water quality of Goose Creek and downstream water bodies would benefit from wetland enhancement and creation proposed as part of this ecosystem restoration.

This Section 206 proposal is not directed toward addressing water quality compliance issues or human use constraints. Section 206 restoration and enhancement proposed on this site would be directed toward habitat improvements for fish and wildlife benefits; however, water quality improvements may be incidental benefits of the implemented habitat features.

(C) The Expected Outputs and How They Will be Measured.

The restoration of degraded wildlife habitat would directly benefit the environment by improving biodiversity and carrying capacity to resident fish, wildlife, and migratory birds. The proposed project would improve, restore, or enhance approximately 1 mile of South Goose Creek, associated riparian zones, and Cottonwood Pond. Restoration actions may also improve geomorphic function through removal of grade controls, establishment of more natural gradients, and interaction with vegetation. A survey and analysis for vegetation structure, native plant habitat, bird habitat, and aquatic habitat was included in the Greenways Master Plan, December 2001, for each stream reach included in the Greenways Program. The analysis found that habitats along Goose Creek were generally poor or non-existent. Cottonwood Pond and its surrounding shoreline were not included in this survey. Current conditions for Cottonwood Pond were

estimated based on a field visit May 27, 2003. Due to the prevalence of herbaceous weeds, it is likely that conditions would continue to degrade over time.

Output from restoration would strive to bring the ratings to good based on the detailed rating analysis developed to prioritize projects for the Greenways Master Plan. In summary, this system assigned numerical ranges for very poor, poor, good, very good, and excellent ratings of habitat quality. The bird survey data yielded a single numerical score for each reach based on the Partner's in Flight (PIF) database and methodology. The vegetation assessment data provided two numerical scores (total diversity and structure) which were left separate for rating purposes. The aquatic habitat assessment involved an array of numerical scores which were combined to obtain a single rating score. The comparison between pre- and post-project conditions would be based on the same survey methodology to achieve numerical scores, and would be rated using the same numerical ranges as the previous study.

The following table summarizes these outputs.

Table 1. Restoration Outputs

10 acs total	Riparian and Upland Habitat	Aquatic Habitat
Current (1997)	6-8 acs Poor	2-4 acs Poor
Future without project	6-8 acs Poor	2-4 acs Poor
Future with project	5-7 acs Good	3-5 acs Good

Note: Rating descriptors based on analysis conducted for Greenways Master Plan 2001.

In addition to the improved rating, a goal for the corridor would be to increase the acreage of native tree communities and wetland habitat. About two acres of wetlands within the floodplain would be improved or created and about four acres of riparian floodplain would be planted with riparian vegetation, including cottonwood, willow, and herbaceous (e.g., sedge [*Carex* spp.] and rush [*Juncus* spp.]) communities. Appropriate tree species would be selected to meet the requirement of maintaining flood conveyance and the spatial limitation of the trapezoidal channel. Controlling existing weed populations would be implemented using a two-level approach: (1) elimination of small populations of the most invasive non-natives in the near future, and (2) long-term, integrated management of the other weed populations. In areas where relatively large-scale soil excavation is necessary, the area would be planted with native species following soil-disturbing activities.

Restoration of in-stream aquatic habitat by providing low-flow, in-stream and streamside cover as well as potentially improving fish passage at existing barriers could benefit the native aquatic species. This may be accomplished by the redesign of the channel to create a stream profile that will contribute to a productive fishery habitat. Depths, flow, temperatures, shade, structure, and open water habitat ratios (pools, riffles, runs) should all improve or increase relative to fish needs. Water quality should also improve with increased riparian and wetland filtering capability. Reconnecting the creek to Cottonwood Pond and Boulder Creek could provide for passage of

native fish species into Goose Creek, although this project component requires further evaluation and may or may not be included in the final project. Overall, the improved fish habitat would consist of shallow water habitats with some pools, in-stream vegetative cover, and a natural substrate.

(D) The Importance of the Proposed Outputs.

A number of wildlife species could benefit from enhancement of the riparian vegetation. The creation of a riparian corridor composed of cottonwoods, willows, and wetland vegetation would provide valuable wildlife habitat and allow wildlife migration along the corridor. Productivity, conductivity between patches, quality, and actual acreage (quantity) of wildlife habitat should increase as the vegetation is changed from predominantly exotic grasses and weed species to wetland and willow vegetation with a transition to native upland plant species. Bird species potentially benefiting from cottonwood establishment would include several Boulder County species of special concern including great blue heron (*Ardea herodias*), great egret (*Casmerodius albus*), and yellow warbler (*Dendroica petechia*).

The federally listed threatened Preble's meadow jumping mouse requires well-developed riparian vegetation along creeks and ditches. Although this species in not believed to occur in the project area under current conditions, restoration of the riparian area could create suitable habitat.

(E) Lands, Easements, Relocations, Rights-of-Way, and Disposal Areas (LERRD).

The sponsor (City of Boulder) manages much of the project site for greenways and adopted the Greenways Master Plan in December 2001, which outlines land management decisions and maintenance responsibilities. Sponsor holdings in the study area encompass almost the entire project area consisting of drainage way easements and urbanized lands used for City maintenance facilities. Colorado State Highways owns a portion of the land within a right-of-way (ROW) easement for Highway 157 (Foothills Parkway). Approximately 10 acres of channel and riparian zone would be restored for this Section 206 project. It is anticipated that, due to high land values, the sponsor may voluntarily agree to limit LERRD's credit values. Work on Open Space property may require approval of the Open Space Board of Trustees.

Water Rights

The creation of any new open water surfaces from ponds or wetlands with standing water would require an augmentation plan to replace depletions through evaporative losses. Similarly, water used for the temporary irrigation of any new plantings would need to be drawn from existing water rights. Under current Colorado State law, practices such as increasing total stream channel length or the introduction of wetland plants have not historically required augmentation of water rights, so long as native water is not impounded. The conceptual restoration design does not require impoundment of native water. The creation of any new wetlands within the project area would presumably utilize water from augmentation sources. The sponsor is aware that they would be required to provide any water rights for augmentation as a result of this project necessary to meet state requirements.

It is proposed to utilize existing water rights to establish and maintain some of the riparian and wetland plantings, and to intermittently provide open channel low flows to the confluence of the channels with Cottonwood Pond. There are various sources of water that may be utilized for augmentation purposes. The availability and feasibility of any specific water source would need to be evaluated based upon the eventual project design in consultation with the State Engineer. Because there are various sources of water available, it is not anticipated that augmentation

requirements will be a hindrance to restoring Goose Creek, although there will be costs associated with such augmentation.

The City of Boulder's Utilities Department owns approximately 53 shares in the Boulder and White Rocks Ditch. Each share is equivalent to 1.2 acre-feet and is valued at approximately $2,000 a share. The average seasonal flow in the BWR ditch is from May 1 to July 10, or approximately 70 days. If all 53 shares were transferred to supply water for Goose Creek, approximately 0.5 cfs, or 0.9 acre-feet, per day of water would flow in Goose Creek for the BWR season. The cost of the shares from utilities to the project would be approximately $100,000 for the shares.

(F) Relationship of the Proposed Project to Other Projects or Plans.

- The City of Boulder's Greenways Program, designed to protect and restore riparian areas along the tributaries of Boulder Creek, has identified over 60 reaches for potential restoration under the Greenways Master Plan.
- Valmont City Park, located adjacent to and north of North Goose Creek, is currently undergoing various phases of construction and park improvements.
- Wonderland Creek, flowing through the Valmont City Park and tributary to North Goose Creek, was restored in 2001 and may have more plantings as part of future phases of improving the Park.
- A pedestrian underpass located at Foothills and Pearl Parkway, along Goose Creek, has also been planned and is to be constructed in the near future.
- The Goose Creek channel is currently maintained by UDFCD for flood conveyance.

(G) Study Methodologies.

Sediment/Hydraulics/Geomorphology: Existing information includes stream segment evaluations, preliminary geomorphology, hydrologic evaluations, and preliminary restoration proposals. Proposed work to be performed includes a detailed geomorphic evaluation, hydraulic modeling, sediment transport modeling and analysis, engineering design, and cost estimating.

Site visits, data searches, and bed and bank material analyses will be used with sediment transport equations to estimate the sediment yield and geomorphic characteristics of the basin. Existing topography data as well as future cross-section surveys will be used to construct flood plain hydraulic models (HEC-2/HEC-RAS), and stable channel models (SAM, etc.) These models will be used to develop the data necessary to compare alternatives and to develop the detailed design of the selected alternative.

Geotechnical Evaluation: Proposed work to be performed includes sampling and analyzing bed and bank material samples as well as borings from proposed wetland creation sites. In addition, installation and monitoring of groundwater wells and levels will be required. Evaluation of water draining along buried utility bedding will also be required.

Surveys: Surveys to be performed include cross section surveys of the channel and overbank areas for use in the hydraulic model of the system. Detailed information on any infrastructure such as culverts, bridges, and grade controls will need to be obtained. The stormwater discharge locations and other utilities will need to be located and surveyed. Topographic surveys will be necessary in areas of proposed wetland creation for development of plans and determination of quantities of materials for construction.

Environmental: A preliminary inventory of flora and fauna was conducted in 1999 (Gershman, 1999). More specific investigations of existing floral and fauna, wildlife, and aquatic species will be required.

Proposed work to be performed includes a review of the original data collected during the Vegetation Evaluation (Gershman, 1999). An additional field survey would be conducted to assess areas not included in the 1999 survey and document changes in vegetation composition. Surveys would be conducted for the federally listed threatened Ute ladies' tresses orchid and the federally listed threatened Preble's meadow jumping mouse as necessary. An evaluation will be required to determine the appropriateness, desirability, and feasibility of removing the fish passage barriers along Goose Creek. Prairie dog surveys would be conducted to determine the extent of the active colony in order to ensure preservation of the colony and its habitat.

In addition to the rating system described above, an environmental output evaluation methodology would be developed and applied to quantify expected environmental outputs for future without project conditions and the future conditions with different restoration alternatives. The outputs from this methodology would be applicable for incorporation into a cost effectiveness and incremental cost analysis.

The city has also evaluated aquatic habitat in the stream reaches included in the Greenways Program. The habitat survey used the US Environmental Protection Agency's (EPA) Rapid Bio Assessment method during the summer and fall of 1995. Data are available in spreadsheet and GIS compatible electronic forms for analysis. The data characterize existing conditions for streambed (primary), channel morphology (secondary), and bank stability (tertiary) characteristics, as well as vegetative bank stability (City of Boulder Stream Habitat Assessment Report , 1995). This aquatic habitat survey data was used to identify opportunities for aquatic habitat preservation and enhancement through Greenways Projects.

In conjunction with the habitat survey, a macro invertebrate bi-annual sampling program continues to be implemented to study trends at various locations on Boulder Creek. A survey site is located at 55th & Valmont which has been sampled for approximately 10 years.

A recent investigation of stream habitat associated with benthic macroinvertebrate and fish communities was completed for streams within the cities of Fort Collins and Boulder, Colorado, including 9 sites along Goose Creek (Relationships between aquatic communities and habitat in urban streams, 2001, Zuellig, R.E., Master's Thesis Graduate Degree Program in Ecology, Department of Fishery and Wildlife Biology, Colorado State University, Fort Collins). The specific focus of this study was to determine habitat-based relationships of macroinvertebrate and fish communities to aid the design and enhancement of aquatic habitats during future stormwater management activities.

Water Rights: The many issues of augmentation and the drainage rights adjacent to the project area will require an evaluation of water rights and possible court filings.

Economic: Cost estimates and environmental output estimates of each alternative will be evaluated and compared through cost effectiveness and incremental cost analyses to support the identification of a recommended plan.

4. VIEWS OF THE SPONSOR: The sponsor is the City of Boulder. The City of Boulder has long been committed to stewardship of natural areas and open space lands within its jurisdiction.

In its letter of intent, dated July 22, 2004, the sponsor indicated its willingness and ability to sponsor the project conceived herein. A copy of that letter is attached. Work on Open Space property may require approval of the Open Space Board of Trustees.

5. VIEWS OF FEDERAL, STATE, AND REGIONAL AGENCIES: The USFWS has not yet been contacted. Colorado Division of Wildlife (DOW) has not been contacted yet.

The UDFCD was contacted to inquire about potential issues with restoration of natural features in Goose Creek, which would inevitably modify the current maintenance program. The UDFCD is familiar with and supportive of the Section 206 program and considers naturalized drainageways a possible benefit in reduction of regular maintenance. The UDFCD would like to be kept informed of the types of designs being considered and would like to review any proposed modifications to ensure compliance with local and federal regulations. The maintenance agreements with UDFCD may need to be reviewed with implementation of the project.

6. STATUS OF ENVIRONMENTAL COMPLIANCE: An environmental assessment would be incorporated into the feasibility study and would likely result in a Finding of No Significant Impact (FONSI).

7. IMPLEMENTATION COSTS AND BENEFITS: Costs estimated for the completion of the project presented herein include Feasibility Study; Plans and Specifications; Construction; Supervision and Administration; Monitoring; and Lands, Easements, Relocations, Rights-of-Way, and Disposals (LERRDs). The cost estimate for construction of the conceptual alternative is $2.6 million based on generalized quantity estimates and a 25 percent contingency.

	Total	Corps	BOULDER		
			Cash	LERRD Credit	Total
Project Total	$ 2,563,288	$ 1,635,200	$ -	928,088	$ 928,088
Ecosystem	$ 1,428,950	$ 1,532,075			$ 824,963
Feasibility study	333,000	333,000			
Plans & Specs	222,500	222,500			
Construction	873,450	1,079,700			
Construction contracts	639,500				
contract suprv/adm	63,950				
Constr. Phase non-S&A Labor, monitoring	170,000				
Real Estate LERRD value (voluntarily limited to sponsor share)	$ 928,088			928,088	
Recreation including study & design	206,250	103,125			103,125

Information from cost effectiveness and incremental cost analyses would support plan selection by identifying best buy plans or those plans that provide the greatest increase in environmental output for the least increase in cost. Benefits would include increased habitat density and diversity for both aquatic and wildlife species.

Note that the feasibility phase and the planning, design and analysis phase are initially Federally funded, and then at the time of signing Project Cooperation Agreement (PCA), the costs are retroactively cost-shared by the sponsor.

8. IMPLEMENTATION SCHEDULE:

Product/milestone	Months	Estimated Dates
Feasibility Studies	12	Jan 2005 through Dec 2005

COE Approval & Funding	3	Jan 2006 through March 2006
Final Design, Plans and Specification	6	April 2006 through Sept 2006
Real Estate	6	April 2006 through Sept 2006
Advertise and Award	3	Oct 2006 through Dec 2006
Construction	12	Jan 2007 through Dec 2007

9. SUPPLEMENTAL INFORMATION:

Recreational features such as trail improvements, resting areas, drinking fountains, fishing opportunities, and interpretive facilities are included in this project. Also included is construction of a multi-use path along the channel, on the north side of Pearl, from the existing path at 47th street to where the creek crosses Pearl at 49th

The revegetation areas would be managed to maximize establishment of native plants in the first five years by removing invasive species, controlling wildlife, replacing non-survivors, and possibly irrigating. The channels would have to be managed for unforeseen damages. Monitoring would be done to determine the project's achievement of objectives.

Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) activities will be required. Maintenance activities may include debris removal, repair of any damaged structures, and maintenance of the vegetated areas. Other OMRR&R costs will be associated with any augmentation water and delivery system. OMRR&R costs are entirely the Sponsor's responsibility.

10. FINANCIAL DATA: (all costs in thousands of dollars)

	costs in thousands			Federal Funding Needs				
Phase	Total	Non-Fed	Federal	FY05	FY06	FY07	FY08	Bal
Feasibility	333	0	333	290	43	0	0	0
Plans & Specs	223	0	223	0	190	33	0	0
Construction	2,008	928	1,080	0		700	330	50
restoration	1,802	825	1,532					
rec	206	103	103					
Total	2,563	928	1,635	290	233	733	330	50

Non-Federal Requirements:			
	LERRD		$ 928,088
	Cash		$ -
	Work-In-kind		$ -
	Annual OMRR&R		$ 10,000

11. FEDERAL ALLOCATIONS TO DATE:

Preliminary Restoration Plan:	$10,000
Feasibility Plan and Report:	$0
Plans and Specifications:	$0
Implementation (Construction)	$0

12. MAPS (attached)

REFERENCES

City of Boulder. 2001. Greenways Master Plan, December 2001. http://www.ci.boulder.co.us

Ellinghouse, C. 2003. Personal Communications. May 23, 3003. City of Boulder. 303-441-3266.

Gershman, M. 1999. City of Boulder Tributary Greenways Program Riparian Habitat Assessment, Vegetation Evaluation Final Report. November 12, 1999.

Jones, S. R., 2001. Wildlife Habitat Assessment Valmont City Park Site. Prepared for the City of Boulder.

November 2, 2007

Larry Janis
Chief
US Corps of Engineers
Omaha District
Environmental, Economics and
Cultural Resources Section
Planning Branch
106 South 15th Street
Omaha, NE 68102-1618

Re: Section 206 ecosystem restoration feasibility study in the City of Boulder. (CHS #50809)

Dear Mr. Janis:

Thank you for your correspondence dated August 7, 2007 and received by our office on August 15, 2007 regarding the review of the above-mentioned project under Section 106 of the National Historic Preservation Act (Section 106).

After review of our database, no archaeological or historic surveys have occurred in the Area of Potential Effects (APE) (see attached map). In our opinion, the potential of locating archaeological sites within the APE is low; therefore, an archaeological survey is not needed.

However, if unidentified archaeological resources are discovered during construction, work must be interrupted until the resources have been evaluated in terms of the National Register criteria, 36 CRF 60.4, in consultation with this office.

We request being involved in the consultation process with the local government, which as stipulated in 36 CFR 800.3 is required to be notified of the undertaking, and with other consulting parties. Additional information provided by the local government or consulting parties might cause our office to re-evaluate our eligibility and potential effect findings.

Please note that our compliance letter does not end the 30-day review period provided to other consulting parties.

If we may be of further assistance, please contact Amy Pallante, our Section 106 Compliance Coordinator, at (303) 866-4678.

Sincerely,

For Mark Wolfe

Georgianna Contiguglia
State Historic Preservation Officer

cc: Timothy Mead/CORPS

US Army Corps of Engineers ®
Omaha District

GOOSE CREEK
BOULDER, COLORADO

SECTION 206
ECOSYSTEM RESTORATION REPORT

APPENDIX D -
ECONOMICS APPENDIX

JUNE 2011

GOOSE CREEK SECTION 206 ECOSYSTEM RESTORATION REPORT
ECONOMICS APPENDIX

The purpose of this economic appendix is to present the cost effectiveness and incremental cost analyses (CE/ICA) that were prepared in conjunction with the Goose Creek at Boulder, Colorado ecosystem restoration study.

WITHOUT PROJECT CONDITION

The future without project condition represents the baseline condition for the Goose Creek study area. It serves as the basis of comparison for alternative with-project conditions. The future without project condition for all three reaches represents a slight deterioration from existing conditions.

WITH PROJECT CONDITION

The following paragraphs provide a brief summary of the improvements being analyzed in this study. (For more detailed descriptions, see the Detailed Project Report.)

Various alternative management measures for three adjoining reaches of Goose Creek were formulated and evaluated for ecosystem restoration. The Detailed Project Report discusses the alternatives that were considered and screened out on the basis of completeness, effectiveness, efficiency, and/or acceptability prior to formulation of the set of alternatives on which the CE/ICA was conducted.

Each plan that is input into the CE/ICA includes an alternative measure (including no action) for each of three different reaches of Goose Creek. These measures are mutually exclusive within a reach, but all measures within a reach are mutually compatible with any alternative measures analyzed for the other reaches within the segment of Goose Creek proposed for ecosystem restoration. The measures considered for each reach are described below.

- Reach 1, Alternative 1 contains 7.7 acres. This alternative includes replacing exotic trees with native trees and shrubs and replacing the ornamental/lawn grasses with native grasses. The quantity and quality of small wetlands and their connectivity with the stream would be increased; this would include development of wetlands at culvert outfalls. Some boulders and riprap would be removed for use elsewhere on the project, and instream rock erosion control structures would be covered with soil and planted to wet prairie vegetation. Four culvert wildlife travel structures would be installed, including under Foothills Parkway.
- Reach 2, Alternative 1 contains 1.71 acres. The existing alignment of the channel and bicycle trail would be retained. Exotic trees and shrubs would be replaced with native shrubs or small trees, and the rest of the riparian area would be planted with prairie vegetation, including wet prairie species near the channel. The quantity and quality of small wetlands and their connectivity with the stream would be increased; this would include development of wetlands at culvert outfalls and emergent wetland construction in the channel. Much riprap would be removed from the channel for use elsewhere on the project, and many boulders along the channel would be covered with topsoil and wet prairie grass plantings.

- Reach 2, Alternative 2 contains 4.14 acres. The existing concrete hiking-bicycling trail along the south bank of the channel would be relocated farther south. The riparian floodplain south of the channel would be widened by excavation to create a low bench with some terraces. Boulders and riprap would be removed from the southern portion of the last weir structure, and meander bends would be excavated to allow flows into the existing cattail wetland and the low floodplain terrace. The excavated soil would be used elsewhere on the project. Low terraces would be seeded with emergent wetland, wet prairie, and prairie transition species; higher terraces would be seeded with prairie species and native riparian shrub and tree species. Exotic plant species would be removed, and wetlands would be created below three storm sewer outfalls.
- Reach 3, Alternative 1 contains 16.65 acres (7.13 acres of open water and 9.52 riparian acres). Many large non-native trees in the riparian area would be cut down, and the riparian area would be replanted with native tree, shrub, and grass species. Cottonwood Pond would be restored. It would be dewatered by pumping to Boulder Creek; Goose Creek inflows would also be diverted to Boulder Creek by a pump and up to 500 feet of pipe. Deep holes would then be excavated in the bed and small islands, some submerged, would be created in shallow portions of the pond using boulders and other rock material removed from the creek channel. Aquatic habitat would be improved by re-grading to provide more shoreline irregularity, placing root wads (from non-native trees that were cut down) in the bank, and placing pallet cribs of riprap material on the pond bed. Eurasian water milfoil (EWM) would be controlled by treatments with the chemical ClearCast for the first 2 years and every 2 or 3 years afterward, with the need for treatment determined by monitoring.
- Reach 3, Alternative 2 contains 16.65 acres (palustrine wetland and adjacent wooded riparian area). Cottonwood Pond would be converted to a palustrine wetland. It would be dewatered by pumping to Boulder Creek; Goose Creek inflows would also be diverted to Boulder Creek by a pump and up to 500 feet of pipe. The bed of the pond would be backfilled with boulders, riprap, and excavated dirt salvaged from the Goose Creek channel and covered with topsoil to form the wetland surface, which would include a sculpted and excavated meandering channel that historically traversed this area. This fill would eliminate the existing EWM, and it is expected that the shallowness of most of the water in the restored wetlands would allow native wetland species to out-compete EWM. An overflow berm, with a design crest above moderate stages in Cottonwood Wetland, would also be excavated in the existing bank of Cottonwood Pond adjacent to Boulder Creek. The existing opening from Cottonwood Wetland to Boulder Creek, which has a base elevation near the normal Boulder Creek water surface elevation, would not be altered.

Each of the potential combinations of alternative measures (including no action) for the three reaches were considered, resulting in the following list of 18 alternative plans on which CE/ICA was conducted:

- R10R20R30 – No Action;
- R11R20R30 – Reach 1;
- R10R21R30 – Reach 2, Alternative 1;
- R10R22R30 – Reach 2, Alternative 2;
- R10R20R31 – Reach 3, Alternative 1;
- R10R20R32 – Reach 3, Alternative 2;
- R11R21R30 – Reach 1 and Reach 2, Alternative 1;

- R11R22R30 – Reach 1 and Reach 2, Alternative 2;
- R11R20R31 – Reach 1 and Reach 3, Alternative 1;
- R11R20R32 – Reach 1 and Reach 3, Alternative 2;
- R10R21R31 – Reach 2, Alternative 1 and Reach 3, Alternative 1;
- R10R21R32 – Reach 2, Alternative 1 and Reach 3, Alternative 2;
- R10R22R31 – Reach 2, Alternative 2 and Reach 3, Alternative 1;
- R10R22R32 – Reach 2, Alternative 2 and Reach 3, Alternative 2;
- R11R21R31 – Reach 1, Reach 2, Alternative 1 and Reach 3, Alternative 1;
- R11R21R32 – Reach 1, Reach 2, Alternative 1 and Reach 3, Alternative 2;
- R11R22R31 – Reach 1, Reach 2, Alternative 2 and Reach 3, Alternative 1;and
- R11R22R32 – Reach 1, Reach 2, Alternative 2 and Reach 3, Alternative 2.

AVERAGE ANNUAL EQUIVALENT ENVIRONMENTAL OUTPUTS

The non-monetary benefits of the environmental restoration alternatives are measured in average annual equivalent environmental outputs. The environmental outputs for the Goose Creek study are measured as average annual equivalent habitat units (AAHUs). AAHUs were determined for each alternative using Rapid Bioassessment Protocols (RBPs) developed by the U.S. Environmental Protection Agency (USEPA). Through this approach, key features are rated or scored to provide a useful assessment of the quality of the instream and riparian habitat, which influences community structure and function (Barbour et al., 1999, p. 5-1). This methodology provides a vehicle to meet the goals outlined in Appendix E of Engineer Regulation 1105-2-100, as it pertains to "evaluating the larger context of community and ecosystem frameworks" for this smaller project in an urban setting. A modified version of the RBPs was developed for use in smaller streams, including Goose Creek, which ranked various "Habitat Attributes" on a scale of 1 to 20 (Zuellig, 2001). For this Goose Creek feasibility study, the scale was changed to 0 to 1. The panel of experts scored the Habitat Attributes for each reach and alternative (including no action) for six target years: (year 0, or future without-project condition at the expected time of project construction; and 1, 5, 10, 15, and 50 years after completion of the ecosystem restoration project). For each reach, alternative, and time period, the average score assigned by the experts for each Habitat Attribute was calculated, and these average scores were themselves averaged to obtain a Habitat Quality Index (HQI) score. For each reach, alternative, and time period, the HQI was multiplied by the number of acres in that reach to obtain Habitat Units (HUs). Additional details regarding the modified RBP methodology and results are included in Appendix A.

The HQI scores for each reach, alternative, and time period were used in the CE/ICA. The HQI scores were multiplied by the number of acres of total pond and riparian acres in each reach to determine Habitat Units (HUs). The following calculations were performed separately for each of the two alternatives in reach 1, each of the three alternatives in reach 2, and each of the three alternatives in reach 3. The HUs were calculated for each time interval (0-1, 1-5, 5-10, 10-15, and 15-50 years) using formulas developed by the U.S. Fish and Wildlife Service (USFWS) for Habitat Evaluation Procedures (HEP) analyses (USFWS, 1980). These interval-based riparian HUs were summed to form 50-year cumulative HUs. The 50-year cumulative HUs were divided by 50 to obtain the Average Annual equivalent Habitat Units (AAHUs). The AAHUs of the no-action plan were then subtracted from the AAHUs of each of the 18 alternative plans (including no action). Therefore, the AAHUs of each plan represent its net increase in AAHUs compared to the without-

project condition (no action), which by definition has 0 AAHUs for comparison purposes. The calculations of the net AAHUs for each reach-based alternative are provided in Exhibit 1 of this Economics Appendix.

CALCULATING AVERAGE ANNUAL EQUIVALENT COSTS

The costs of implementation for each of the project alternatives include all post-feasibility study costs associated with the project. These costs were estimated at January 2011 price levels. In order to compare costs with average annual equivalent environmental outputs, it is necessary to convert all project costs to average annual equivalent costs. The stream of costs associated with each alternative that were expected to vary on a year-to-year basis were present-valued to the beginning of the 50-year period of analysis; then they were amortized at the FY11 discount rate of 4.125 percent over 50 years to annualize them. These annualized costs included all "first costs" expended during the construction period, which were estimated using M-CACES (MII, TRACES) software; the cost of initially eradicating Cottonwood Pond of EWM at the end of construction; interest during construction (IDC); cost of preparing the O&M Manual in year 2; and monitoring costs during years 2 and 5.

The construction costs include the full value of land interests required by the project, even if greater than the maximum value eligible for crediting to the non-Federal sponsor. The Corps real estate specialist on the Project Delivery Team provided these values from the Gross Appraisal and also provided an estimate of the Federal and non-Federal administrative and legal costs involved in acquiring real estate interests, determining their fair market value, etc. The construction costs also include the following: excavations; invasive plant removal; restoration plantings, including watering and weed control; engineering and design; construction management (supervision and administration); and contingencies. In preparing the cost estimate used in the CE/ICA, it was assumed that no water rights will need to be acquired for the Goose Creek project; however, coordination with the City of Boulder and the Colorado State Engineer is ongoing regarding any need for water rights acquisition. Planting costs were determined through research of alternative sources and methods. Details of the cost estimate are provided in Appendix B.

For determining the economic cost of the project and its various components, the cost of IDC was calculated using the FY11 discount rate of 4.125 percent. Construction was assumed to occur over one year, with all real estate costs included in the first quarter and the cost of the initial EWM treatment occurring in the fourth quarter. Except for EWM treatment, it was estimated that 15 percent of construction costs would occur in the first quarter-year; 35 percent of construction costs would occur in each of the second and third quarters; and 15 percent of construction costs would occur in the fourth quarter. IDC was included as part of the economic "first costs" (or investment costs) of the project that were annualized, but it is not included as a financial cost.

Preparation of an O&M manual was expected to occur 2 years after completion of construction; the Corps Section 206 program manager estimated the cost to be $20,000 based on the cost of O&M manuals prepared recently for ecosystem restoration projects. Monitoring was expected to occur 2 and 5 years after completion of construction. The project biologist estimated expenditures for monitoring for each project alternative. O&M manual preparation and monitoring costs were present-valued and amortized over 50 years based on the FY11 discount rate of 4.125 percent. The

annualized costs for O&M manual preparation and monitoring were added to the annualized "first costs" and the annual cost of operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) for each alternative plan to form the average annual equivalent cost of that alternative. The OMRR&R for each alternative also included costs per riparian acre for beaver and deer protection and costs per riparian acre for management of noxious weeds and invasive species. The OMRR&R of the Reach 3 alternatives included the annualized cost of the present value in year 1 of replacing the fencing 30 years after project construction; the non-Federal sponsor estimated the installation and material costs of replacement wood post-and-rail fencing appropriate for installation in the FEMA regulatory floodway in the vicinity of Cottonwood Pond/Wetland at FY11 price levels. The average annual equivalent cost of the without-project (no action) alternative is $0. The components of the costs for each alternative plan are itemized in Table 1.

COST EFFECTIVENESS AND INCREMENTAL COST ANALYSES

In conjunction with the environmental analysis of potential projects, cost effectiveness and incremental cost analyses (CE/ICA) of potential alternatives are required. The following explanations clarify the difference between cost effectiveness and incremental cost analyses, and the purpose for each analysis.

- *Cost effectiveness analysis* is conducted to ensure that the least cost solution is identified for each level of environmental output. Its purpose is to eliminate inefficient alternatives, based on comparing alternatives regarding each alternative's total environmental output and its total average annual equivalent cost.

- *Incremental cost analysis* is conducted on the cost-effective alternatives to show changes in costs as levels of environmental outputs are increased. It provides data for decision-makers to address the question "Is the next level worth it?". It measures the incremental or additional cost of the next additional level of environmental output. IWR Planning Suite identifies the subset of cost-effective plans that are superior economic investments as "best buys". Best buys are the plans that are the most efficient at producing outputs; they provide the greatest increase in output levels for the least increase in cost. The no-action alternative is by definition a best buy plan. Other than this, the first best buy plan is the most efficient plan, producing incremental output at the lowest incremental cost per unit compared to the no-action plan. Incremental cost per unit is defined as the plan's incremental cost divided by its incremental output. If a higher level of output is desired than that provided by the first best buy plan, the second best buy plan is the plan that produces additional output at the lowest incremental cost per unit of output compared to the first best buy plan, and so on.

TABLE 1

TOTAL IMPLEMENTATION COSTS ($) AND ANNUALIZED COSTS ($) BY PLAN (Jan 2011 prices, 4.125%, 50 years)

Alternative Plan	Con-struction Cost	Engin-eering & Design	Super-vision & Ad-minis-tration	Contin-gency	Year 1 EWM Treat-ment	Real Estate incl Admin/Le-gal Costs for Fed & Non-Fed	IDC for 1 Yr at 4.125 %	Total First Costs (incl $80K PM/ PDT labor in Constr. Phase)	Annu-alized Cost at 4.125% 50 Yrs	Annu-alized O&M Manual Monitor Cost	Annual Cost of OMR R&R	Total Annual Costs
No Action	0	0	0	0	0	0	0	0	0	0	0	0
Rch (R) 1	64,130	7,342	3,848	13,596	0	496,750	21,350	687,015	32,668	1,196	11,217	45,081
Rch 2 Alt 1	71,335	8,166	4,280	15,123	0	311,866	14,900	505,670	24,045	948	2,491	27,484
Rch 2 Alt 2	304,902	34,905	18,294	64,639	0	311,866	21,530	836,136	39,758	1,048	6,031	46,837
Rch 3 Alt1	188,792	21,613	11,328	40,024	4,765	552,492	26,920	925,933	44,028	1,271	17,400	62,699
Rch 3 Alt 2	464,791	53,209	27,887	98,536	0	552,492	34,730	1,311,646	62,369	1,566	24,569	88,504
R1 + R2, A1	135,465	15,508	8,128	28,718	0	808,616	34,610	1,111,045	52,830	1,266	13,708	67,805
R1 + R2, A2	369,032	42,247	22,142	78,235	0	808,616	41,240	1,441,511	68,544	1,367	17,249	87,159
R1 + R3, A1	252,922	28,955	15,175	53,619	4,765	1,049,242	46,630	1,531,308	72,814	1,589	28,618	103,021
R1 + R3, A2	528,921	60,551	31,735	112,131	0	1,049,242	54,440	1,917,021	91,154	1,884	35,787	128,825
Rch 2, Alt 1+ Rch 3, Alt 1	260,126	29,779	15,608	55,147	4,765	798,058	37,790	1,281,273	60,925	1,342	19,892	82,158
Rch 2, Alt 1+ Rch 3, Alt 2	536,126	61,376	32,168	113,659	0	798,058	45,600	1,666,985	79,265	1,636	27,060	107,962
Rch 2, Alt 2+ Rch 3, Alt 1	493,694	56,518	29,622	104,663	4,765	798,058	44,420	1,611,739	76,638	1,442	23,432	101,512
Rch 2, Alt 2+ Rch 3, Alt 2	769,693	88,114	46,182	163,175	0	798,058	52,230	1,997,452	94,979	1,737	30,600	127,316
R1 +R2 Alt 1 +Rch 3, Alt 1	324,256	37,121	19,455	68,742	4,765	1,294,808	57,500	1,886,648	89,710	1,660	31,109	122,479
R1 +R2 Alt 1 +Rch 3, Alt 2	600,256	68,717	36,015	127,254	0	1,294,808	65,310	2,272,361	108051	1,955	38,278	148,284
R1 +R2 Alt 2 +Rch 3, Alt 1	557,824	63,860	33,469	118,259	4,765	1,294,808	64,130	2,217,114	105424	1,760	34,649	141,833
R1 +R2 Alt 2 +Rch 3, Alt 2	833,823	95,456	50,029	176,770	0	1,294,808	71,940	2,602,827	123764	2,055	41,818	167,637

Table 2 identifies the net gains (compared to the "no action" alternative) in average annual equivalent environmental outputs (average annual equivalent habitat units, or AAHUs). Table 2 also shows, for each alternative, the average annual equivalent costs, which are based on January 2011 price levels, the FY11 discount rate of 4.125 percent, and a 50-year period of analysis. Both the net AAHUs and average annual equivalent costs for each alternative were input into the CE/ICA. The CE/ICA was accomplished using Institute for Water Resources (IWR) Planning Suite (2.0.1.0 Beta – 26 February 2009, USACE certified) decision support software. Table 2 also shows the average annual equivalent cost per AAHU, which is calculated during the CE/ICA.

TABLE 2
NET AVERAGE ANNUAL EQUIVALENT HABITAT UNITS (AAHUs), AVERAGE ANNUAL EQUIVALENT COSTS & AVERAGE ANNUAL EQUIVALENT COST PER AAHU

ALTERNATIVE PLANS	AAHUs	AVERAGE ANNUAL EQUIVALENT COSTS	AVG. ANNUAL EQUIVALENT COST / AAHU
No Action	0.00	$ 0	$0
Reach 1	2.70	$45,081	$16,697
Reach 2, Alternative 1	0.60	$27,484	$45,807
Reach 2, Alternative 2	2.15	$46,837	$21,785
Reach 3, Alternative 1	3.00	$62,699	$20,900
Reach 3, Alternative 2	6.56	$88,504	$13,491
Reach 1 + Reach 2, Alt. 1	3.30	$67,805	$20,547
Reach 1 + Reach 2, Alt. 2	4.85	$87,159	$17,971
Reach 1 + Reach 3, Alt. 1	5.70	$103,021	$18,074
Reach 1 + Reach 3, Alt. 2	9.26	$128,825	$13,912
Rch 2, Alt. 1 + Rch 3, Alt. 1	3.60	$82,158	$22,822
Rch 2, Alt. 1 + Rch 3, Alt. 2	7.16	$107,962	$15,078
Rch 2, Alt. 2 + Rch 3, Alt. 1	5.15	$101,512	$19,711
Rch 2, Alt. 2 + Rch 3, Alt. 2	8.71	$127,316	$14,617
R1 + R2, Alt. 1 + R3, Alt. 1	6.30	$122,479	$19,441
R1 + R2, Alt. 1 + R3, Alt. 2	9.86	$148,284	$15,039
R1 + R2, Alt. 2 + R3, Alt. 1	7.85	$141,833	$18,068
R1 + R2, Alt. 2 + R3, Alt. 2	11.41	$167,637	$14,692

Figure 1 displays all plan alternatives differentiated by cost effectiveness. Cost effectiveness analysis eliminated inefficient alternatives by comparing total environmental outputs among the alternatives with each alternative's total average annual equivalent cost. A plan is not considered cost effective if:

- the same output level could be produced by another plan at less cost;
- a larger output level could be produced by another plan at the same cost; or
- a larger output level could be produced by another plan at less cost.

In Figure 1, costs are average annual equivalent costs, in thousands of dollars; outputs are net average annual equivalent habitat units (AAHUs).

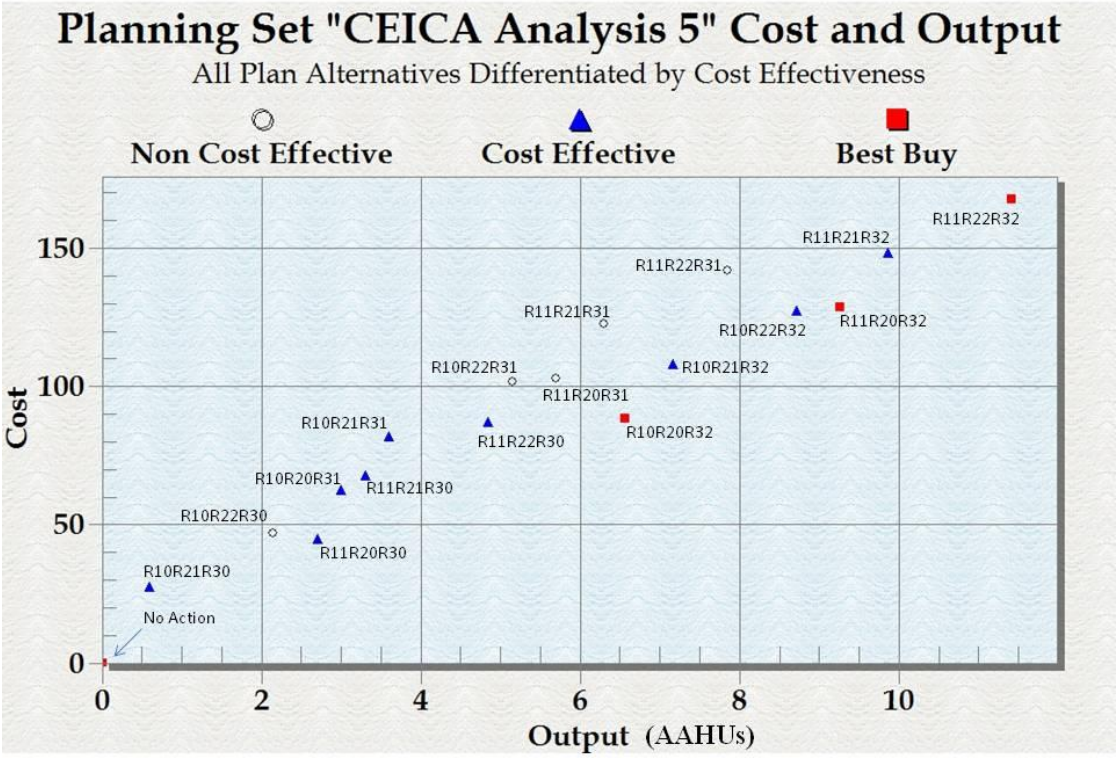


Figure 1. Cost-Effectiveness of Alternative Plans, Goose Creek Ecosystem Restoration.

Figure 1 shows that five alternative plans were not cost effective because they had a higher cost for a given level of environmental outputs. The five alternatives were eliminated from further consideration.

Table 3 displays the 13 cost-effective alternatives, listed in ascending order of average annual equivalent environmental outputs. Average annual equivalent costs are based on January 2011 price levels, the FY11 discount rate of 4.125 percent, and a 50-year period of analysis.

TABLE 3
COST-EFFECTIVE ALTERNATIVES, WITH AAHUs, AVERAGE ANNUAL EQUIVALENT COSTS, AND AVERAGE ANNUAL EQUIVALENT COST PER AAHU

ALTERNATIVE PLANS	AAHUs	AVERAGE ANNUAL EQUIVALENT COSTS	AVG. ANNUAL EQUIVALENT COST / AAHU
No Action	0.00	$ 0	$0
Reach 2, Alt. 1	0.60	$27,484	$45,807
Reach 1	2.70	$45,081	$16,697
Reach 3, Alternative 1	3.00	$62.699	$20,900
Reach 1 + Reach 2, Alt. 1	3.30	$67,805	$20,547
Rch 2, Alt. 1 + Rch 3, Alt. 1	3.60	$82,158	$22,822
Reach 1 + Reach 2, Alt. 2	4.85	$87,159	$17,971
Reach 3, Alt. 2	6.56	$88,504	$13,491
Rch 2, Alt.1 + Rch 3, Alt. 2	7.16	$107,962	$15,078
Rch 2, Alt. 2 + Rch 3, Alt. 2	8.71	$127,316	$14,617
Reach 1 + Reach 2, Alt. 2	9.26	$128,825	$13,912
R1 + R2, Alt. 1 + R3, Alt. 2	9.86	$148,284	$15,039
R1 + R2, Alt. 2 + R3, Alt. 2	11.41	$167,637	$14,692

Table 3 displays the supply schedule of the average annual equivalent cost for each level of output of cost-effective plans. This serves as the basis for the incremental cost analysis. Incremental cost analysis is required to inform a decision regarding whether the incremental or additional cost (in dollars) of the next level of environmental output (measured in non-monetary units) is worth it. To derive the final incremental cost table, the IWR Planning Suite model performed a series of calculations on cost-effective plans to determine, in sequence, the plan (termed a "best buy") with the lowest incremental cost per unit of incremental (or additional) output. The first calculation compares the incremental costs per unit of incremental output of each cost-effective action alternative to the no action alternative (which is by definition a best buy plan). The plan with the lowest incremental cost per unit of incremental output is the first selected best buy plan. The first selected best buy plan's total outputs and total annual equivalent costs are set as the new "base" for determining the next round of incremental costs and incremental outputs. In sequence, subsequent best buys are selected from the remaining plans that have outputs greater than the most recently selected best buy, based on the lowest incremental cost per unit of incremental output. The step is repeated until all best buy plans have been identified. (For further details on this process, please refer to "Evaluation of Environmental Investments Procedures Manual – Interim: Cost Effectiveness and Incremental Cost Analyses, IWR Report 95-R-1, May 1995.)

Figure 2 summarizes the results of the final incremental cost analysis. Only the best buy plans are displayed. The total output of a best buy plan is the sum of its increments back to the origin of the graph. The origin is the no action plan, which is a best buy plan. A plan's annual cost is the area of the rectangles for that best buy plan and any best buy plan(s) to its left. The greater the vertical "step" between plans, the greater the difference in incremental cost per unit of additional output.

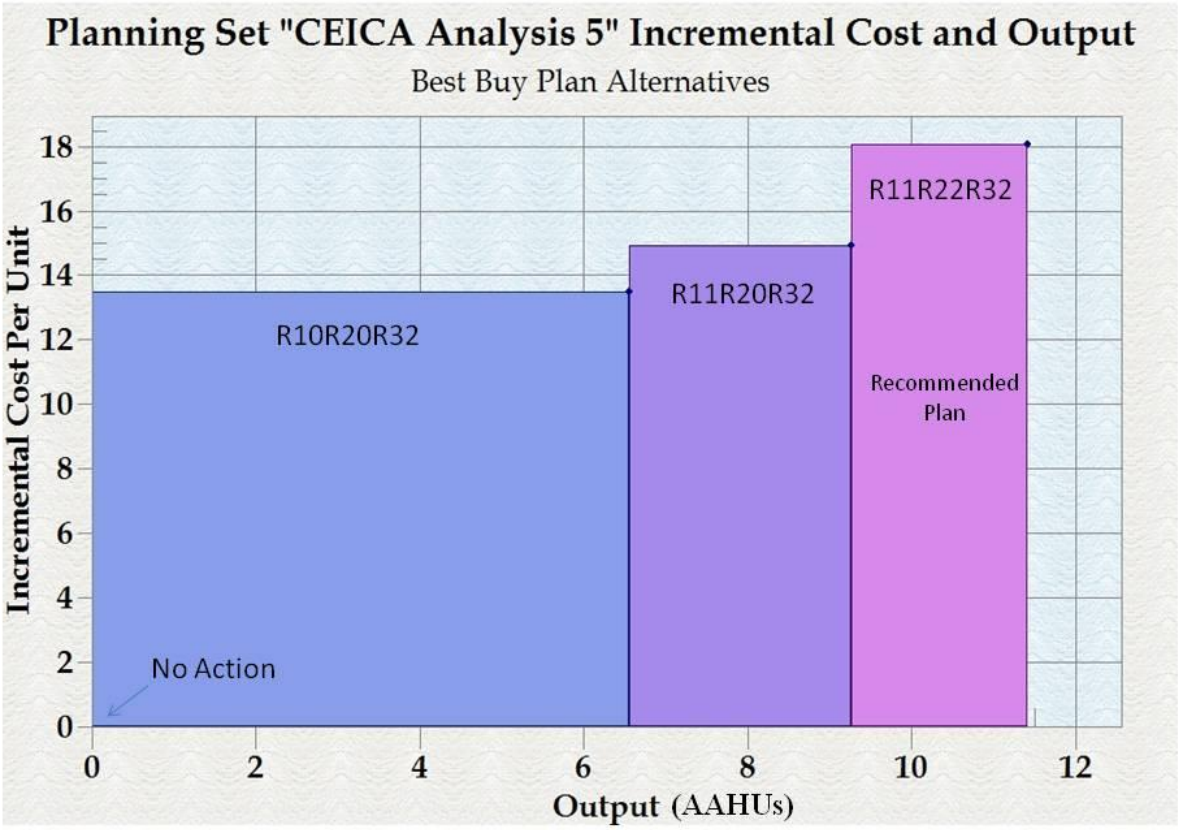


Figure 2. Comparison of Best Buy Plans for Goose Creek Ecosystem Restoration.

Note: Incremental costs per unit are average annual equivalent costs in thousands of dollars; outputs are net average annual equivalent habitat units (AAHUs).

Table 4 displays the results of the final incremental cost analysis. Costs are average annual equivalent costs and are based on January 2011 price levels, the FY11 discount rate of 4.125 percent, and a 50-year period of analysis.

TABLE 4
SUMMARY OF FINAL INCREMENTAL COST ANALYSIS

ALTERNATIVE	AAHUs	ANNUAL COST	INCREMEN-TAL COST	INCREMEN-TAL AAHUs	INCREMENTAL COST / AAHU
No Action	0.00	$ 0	not applicable	not applicable	not applicable
Reach 3, Alt. 2	6.56	$ 88,504	$ 88,504	6.56	$ 13,491
Rch 1 + Rch 3 Alt 2	9.26	$ 128,825	$ 40,321	2.70	$ 14,934
R1 +R2 A2 +R3 A2	11.41	$ 167,637	$ 38,812	2.15	$ 18,052

Table 4 shows the change from one combination to the next. For instance, moving from ecosystem restoration for only Reach 3, Alternative 2 (Cottonwood Wetland) to adding ecosystem restoration in Reach 1, Alternative 1 results in 2.70 *additional AAHUs* (9.26 AAHUs for Reach 1 and Reach 3, Alternative 2 minus 6.56 AAHUs for Reach 3, Alternative 2); *an additional average annual equivalent cost of* $40,321 ($128,825 total average annual equivalent cost for Reach 1 and Reach 3, Alternative 2 minus $88,504 total average annual equivalent cost for Reach 3, Alternative 2; and, an *additional or incremental* $14,934 *average annual equivalent cost per AAHU* ($40,321 additional or incremental cost divided by 2.70 additional or incremental AAHUs).

In Table 4, the column on the right summarizes the incremental average annual equivalent cost per output; its purpose is to show potential breakpoints where gaining the next level of output shows a significant increase in costs. In comparing the "best buy" alternatives, the incremental costs per unit of incremental output increases by approximately 23 percent when Reach 1, Alternative 1 is added to the plan that previously contained only Reach 3, Alternative 2. When Reach 2, Alternative 2 is added to this combined plan, the increase in incremental costs per incremental AAHU is nearly 13 percent. The presence of a breakpoint when Reach 1 is added to the Reach 3, Alternative 2 plan, and when Reach 2, Alternative 2 is added to the combined plan indicates that a detailed rationale may be needed to justify selection of either one of the combined plans. On the other hand, all three plans would meet the criteria of being cost-effective and incrementally justified.

CONCLUSIONS

The Recommended Plan consists of Reach 1, Alternative 1; Reach 2, Alternative 2; and Reach 3, Alternative 2. The three reach-based alternative sets of measures that comprise the Recommended Plan are summarized on pages 1 and 2 of this Economics Appendix. The importance of measures in each reach-based alternative are discussed in the following paragraphs in the same order that each reach-based alternative was identified as a best buy plan or as part of a combined best buy plan.

Based on the results of the cost effectiveness and incremental cost analyses, the Reach 3, Alternative 2 plan appears to be the most cost-effective single-reach plan. Eliminating and/or controlling non-native species such as crack willow and Russian olive, and invasive species such as Eurasian water milfoil, and replacing them with native species such as cottonwoods, native willows, and native wetland plants will increase the quality of fish and wildlife habitat near the confluence of South Goose Creek with Boulder Creek. Ecosystem restoration to wooded wetlands at the existing Cottonwood Pond area would be expected to greatly increase connectivity between the downstream end of South Goose Creek and Boulder Creek from the standpoints of lateral connectivity between Boulder Creek and its floodplain; wildlife travel corridors would also be enhanced by development of palustrine wetlands, which can provide excellent rearing habitat for fish, reptiles, amphibians, shorebirds, some varieties of songbirds, and some mammals (such as the resident mink). Populations of the Federally Listed Ute ladies'-tresses orchid and Preble's meadow jumping mouse are found along South Boulder Creek, which enters Boulder Creek about a mile downstream from the South Goose Creek confluence. Restoration of Cottonwood Pond to a wooded wetland could provide habitat suitable for these two species and the Colorado butterfly plant (another Federally Listed species), as well as a number of State-Listed species and State Species of Concern. The

creation of palustrine wetlands to replace the Eurasian water milfoil-infested pond and enhancement of other riparian areas is very important for fish, migratory birds, and other wildlife species; 75% of the wildlife species in Colorado are dependent on riparian areas during all or a portion of their life cycle, yet riparian areas make up less than 3% of the land mass in Colorado (USFWS, 2008).

When ecosystem restoration in Reach 1 is combined with the Reach 3, Alternative 2 plan, the incremental cost per incremental AAHU increases by approximately 11 percent; however, the net AAHUs increase by over 41 percent. The rise in the HQI in Reach 1 after restoration indicates improvement in riparian habitat quality for a variety of wildlife due to replacing non-native species such as exotic lawn grasses with native prairie, wetland, and (on the upper terrace) shrub species, which in turn reduces habitat fragmentation of native plant communities. Establishing several small wetlands near the stream and at storm sewer outfalls in Reach 1 would provide additional filtering capacity and cover to aid water quality and improve fish and wildlife habitat (Ellis 2008a, 2008b, 2008c). Four wildlife travel structures will be placed at culverts, including the one under Foothills Parkway; these will greatly increase connectivity between the stream segments within Reach 1 as well as increase connectivity between South Goose Creek and the previously restored reach of Upper Goose Creek, immediately upstream of Foothills Parkway.

When ecosystem restoration in Reach 2, Alternative 2 is added to the Reach 1 and Reach 3, Alternative 2 combined plan, the incremental cost per incremental AAHU increases by nearly 21 percent, but the number of net AAHUs increases by over 23 percent. Adding ecosystem restoration in Reach 2, Alternative 2 appears to be worth the additional cost for several reasons. First, longitudinal connectivity would be greatly increased by formation of a continuous restored wildlife corridor encompassing the restored reach of Upper Goose Creek, all three reaches of South Goose Creek, and Boulder Creek. Second, lateral connectivity of South Goose Creek with its riparian floodplain would also be established in Reach 2 by relocation of the bicycle trail farther south, away from the existing south bank, and excavating to form floodplain benches and terraces as well as modifying rock structures in the stream to enhance aquatic habitat and allow the stream to meander. In addition, habitat fragmentation would be further reduced and habitat quality would be improved for a variety of wildlife species by replacing non-native species with a diversity of native species on the terraces. This includes planting native cottonwoods and willows on the upper terraces of the excavated riparian floodplain; the U.S. Fish and Wildlife Service's (USFWS) Mountain-Prairie Region considers riparian cottonwood-willow associations to be a critical wildlife resource (USFWS, 2001).

Ecosystem restoration in all three reaches may be justified as the National Ecosystem Restoration (NER) plan for several reasons. First, removal of exotic woody species and replacing them with native tree and shrub species, especially cottonwoods and/or willows, would be accomplished in all three reaches. Second, ecosystem restoration in all three reaches would enhance connectivity within the South Goose Creek wildlife corridor and extend the wildlife corridor downstream to Boulder Creek; it would result in a continuous corridor of improved wildlife habitat between the upstream end of the restored Upper Goose Creek reach all the way to Boulder Creek. "Riverine corridors often serve as critical wildlife connection and dispersal corridors. They frequently involve a high diversity of vegetation, providing nourishment, shade, cover, breeding grounds, and critical wintering grounds for a number of wildlife species" (USFWS, 2003, pp. 15-16), including Colorado State Species of Concern.

Overall, the recommended plan provides the following benefits:

- Replacement of exotic species and fragmented habitat with a continuous riparian corridor of native species in each reach increases sustainability, enhances wildlife habitat quality in the project area and increases connectivity between the South Goose Creek reaches and (for birds) connectivity between South Goose Creek and the restored Upper Goose Creek reach.
- Establishment of a wildlife travel corridor under Foothills Parkway and at three other culverts in Reach 1 increases connectivity within South Goose Creek as well as between South Goose Creek and the restored reach of Upper Goose Creek for reptiles, amphibians, and small mammals, including Preble's meadow jumping mouse.
- Replanting of diverse native species, including wetland and wet prairie species, along South Goose Creek provides epifaunal substrate and cover; it also improves water quality, including temperature modification due to plant shading.
- Removal of selected boulders and riprap in the channel and provision of microhabitats improves frequency of riffles, depth combinations, embeddedness, and substrate diversity.
- Increase in riparian corridor width and diversity with establishment of some low and higher terraces in Reach 2 will increase quality and quantity of riparian ecosystem functions that improve water quality and provide for aquatic and wildlife habitat.
- Benefits of riparian buffers increase with width; for example, the wider the riparian buffer, the greater the benefits to water quality due to the additional filtering capability of the vegetative community.
- Increase in floodplain width and diversity, establishment of channel sinuosity and some low terraces, and removal/modification of rock structures in Reach 2 will increase lateral connectivity of the stream with its riparian floodplain as well as increase diversity of in-channel microhabitats and quality, quantity, and diversity of riparian habitat and wildlife.
- Meanders provide opportunities for complex and diverse aquatic and riparian features to form over time.
- Restoring the Cottonwood Pond area as a wooded, palustrine wetland with a new meandering channel mimics the pattern and amplitude of the historical channel and the area's planform.
- The shallowness of most of the Cottonwood Wetland would enable native species to out-compete Eurasian water milfoil, making chemical treatments for Eurasian water milfoil eradication unnecessary.
- The restored area would have habitat attributes, including cottonwood and willow plantings, wetlands, and wet meadow/prairie areas that could possibly support populations of Federally Listed species. These include the Preble's meadow jumping mouse and Ute ladies'-tresses orchid, both of which occur nearby in the South Boulder Creek watershed; and the Colorado butterfly plant, which could possibly be transplanted to a site in the Goose Creek project.
- The restored area would have habitat attributes, including cottonwood and willow plantings, wetlands, wet prairie, and prairie species that would attract migratory birds, including some Birds of Conservation Concern species in USFWS Region 6 (Mountain-Prairie Region), and also benefit other bird species consistent with goals of the U.S. Shorebird Conservation Plan, the North American Waterbird Conservation Plan, and the North American Waterfowl Management Plan.

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GOOSE CREEK FEASIBILITY STUDY, BOULDER, COLORADO

ECONOMICS APPENDIX, EXHIBIT 1

CALCULATIONS OF HABITAT UNITS (HUs) PRODUCED OVER 50 YEARS BY EACH REACH-BASED ALTERNATIVE PLAN TO OBTAIN AVERAGE ANNUAL EQUIVALENT HABITAT UNITS (AAHUs)

Alternative Plan R1A0 - Reach 1, No Action

3/31/11

HABITAT UNIT (HU) CALCULATIONS	Future Without Project - Year 0	Future Without Project - Year 1	Future Without Project - Year 5	Future Without Project - Year 10	Future Without Project - Year 15	Future Without Project - Year 50
Avg HQI Score: 15 Criteria	0.121	0.121	0.121	0.121	0.121	0.121
Acres in Reach 1	7.70	7.70	7.70	7.70	7.70	7.70
Year	0	1	5	10	15	50
Total HUs in Time Interval	0.00	0.93	3.73	4.66	4.66	32.61
					Total HUs over 50 Years	46.59
					Average Annual Equivalent HUs	0.93

Alternative Plan R1A1 - Reach 1, Alternative 1

3/31/11

HABITAT UNIT (HU) CALCULATIONS	Future Without Project (Year 0)	Future w/ Project - Year 1 after con-struction	Future With Project- Year 5	Future With Project- Year 10	Future With Project - Year 15	Future With Project - Year 50
Avg HQI Score: 15 Criteria	0.121	0.342	0.421	0.468	0.492	0.492
Acres in Reach 1	7.70	7.70	7.70	7.70	7.70	7.70
Year	0	1	5	10	15	50
Total HUs in Time Interval	0.00	1.78	11.75	17.11	18.48	132.59
					Total HUs over 50 Years	181.72
					Average Annual Equivalent HUs	3.63
					Minus Average Annual Equivalent HUs if No Action	0.93
					Net Average Annual Equivalent HUs Due to ER	2.70

Alternative Plan R2A0 - Reach 2, No Action

3/31/11

HABITAT UNIT (HU) CALCULATIONS	Future Without Project - Year 0	Future Without Project - Year 1	Future Without Project - Year 5	Future Without Project - Year 10	Future Without Project - Year 15	Future Without Project - Year 50
Avg HQI Score: 15 Criteria	0.121	0.121	0.121	0.121	0.121	0.121
Acres in Reach 2	1.71	1.71	1.71	1.71	1.71	1.71
Year	0	1	5	10	15	50
Total HUs in Time Interval	0.00	0.21	0.83	1.03	1.03	7.24
					Total HUs over 50 Years	10.35
					Average Annual Equivalent HUs	0.21

Alternative Plan R2A1 - Reach 2, Alternative 1

3/31/11

HABITAT UNIT (HU) CALCULATIONS	Future Without Project (Year 0)	Future w/ Project - Year 1 after Con-struction	Future With Project- Year 5	Future With Project - Year 10	Future With Project - Year 15	Future With Project - Year 50
Avg HQI Score: 15 Criteria	0.121	0.342	0.421	0.468	0.492	0.492
Acres in Reach 2	1.71	1.71	1.71	1.71	1.71	1.71
Year	0	1	5	10	15	50
Total HUs in Time Interval	0.00	0.40	2.61	3.80	4.10	29.45
					Total HUs over 50 Years	40.36
					Average Annual Equivalent HUs	0.81
					Minus Average Annual Equivalent HUs if No Action	0.21
					Net Average Annual Equivalent HUs Due to ER	0.60

Alternative Plan R2A2 - Reach 2, Alternative 2

3/31/11

HABITAT UNIT (HU) CALCULATIONS	Future Without Project (Year 0)	Future w/ Project - Year 1 after Con-struction	Future With Project- Year 5	Future With Project - Year 10	Future With Project - Year 15	Future With Project - Year 50
Avg HQI Score: 15 Criteria	0.121	0.404	0.483	0.542	0.601	0.601
Acres in Reach 2	1.71	4.14	4.14	4.14	4.14	4.14
Year	0	1	5	10	15	50
Total HUs in Time Interval	0.00	0.83	7.34	10.61	11.83	87.08
					Total HUs over 50 Years	117.69
					Average Annual Equivalent HUs	2.35
					Minus Average Annual Equivalent HUs if No Action	0.21
					Net Average Annual Equivalent HUs Due to ER	2.15

Alternative Plan R3A0 - Reach 3, No Action (Cottonwood Pond)

3/31/11

HABITAT UNIT (HU) CALCULATIONS	Future Without Project - Year 0	Future Without Project- Year 1	Future Without Project - Year 5	Future Without Project- Year 10	Future Without Project- Year 15	Future Without Project - Year 50
Avg HQI Score: 10 Criteria	0.345	0.345	0.345	0.345	0.345	0.345
Acres in Reach 3	16.65	16.65	16.65	16.65	16.65	16.65
Year	0	1	5	10	15	50
Total HUs in Time Interval	0.00	5.74	22.98	28.72	28.72	201.05
					Total HUs over 50 Years	287.21
					Average Annual Equivalent HUs	5.74

Alternative Plan R3A1 - Reach 3, Alternative 1 (Cottonwood Pond)

3/31/11

HABITAT UNIT (HU) CALCULATIONS	Future Without Project (Year 0)	Future w/ Project - Year 1 after con-struction	Future With Project Year 5	Future With Project- Year 10	Future With Project- Year 15	Future With Project- Year 50
Avg HQI Score: 10 Criteria	0.345	0.433	0.520	0.533	0.533	0.533
Acres in Reach 3	16.65	16.65	16.65	16.65	16.65	16.65
Year	0	1	5	10	15	50
Total HUs in Time Interval	0.00	6.48	31.73	43.83	44.37	310.61
					Total HUs over 50 Years	437.02
					Average Annual Equivalent HUs	8.74
					Minus Average Annual Equivalent HUs if No Action	5.74
					Net Average Annual Equivalent HUs Due to ER	3.00

Alternative Plan R3A2 - Reach 3, Alternative 2 (Cottonwood Wetland)

3/31/11

HABITAT UNIT (HU) CALCULATIONS	Future Without Project (Year 0)	Future w/ Project - Year 1 after con-struction	Future With Project Year 5	Future With Project - Year 10	Future With Project - Year 15	Future With Project- Year 50
Avg HQI Score: 10 Criteria	0.345	0.533	0.700	0.730	0.764	0.764
Acres in Reach 3	16.65	16.65	16.65	16.65	16.65	16.65
Year	0	1	5	10	15	50
Total HUs in Time Interval	0.00	7.31	41.06	59.52	62.19	445.22
					Total HUs over 50 Years	615.30
					Average Annual Equivalent HUs	12.31
					Minus Average Annual Equivalent HUs if No Action	5.74
					Net Average Annual Equivalent HUs Due to ER	6.56

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US Army Corps of Engineers ®
Omaha District

GOOSE CREEK
BOULDER, COLORADO

SECTION 206
ECOSYSTEM RESTORATION REPORT

APPENDIX E -
GEOTECHNICAL ANALYSIS

JUNE 2011

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GOOSE CREEK - BOULDER, COLORADO

ECOSYSTEM RESTORATION REPORT
SECTION 206

APPENDIX E – GEOTECHNICAL ANALYSIS

1. INTRODUCTION.

1.1 Purpose and Scope of Appendix E. The purpose of this appendix is to present the geotechnical and geological studies conducted for restoring the aquatic habitat for lower Goose Creek and Cottonwood Pond in the City of Boulder, Colorado. Appendix E consists of: 1) an introduction, 2) a discussion of regional and site geology, and 3) a detailed discussion of site conditions including an analysis of the existing bank materials and results of available geotechnical investigations of the subsurface soils and bedrock formation,. This geotechnical analysis was prepared by Geotechnical Engineering & Sciences Branch of the U.S. Army Corps of Engineers-Omaha District.

1.2 Project Location. The area of study for ecosystem restoration is the lower portion of Goose Creek (also called South Goose Creek) including Cottonwood Pond in the City of Boulder, Colorado. Goose Creek is a left bank tributary of Boulder Creek, which in turn is a left bank tributary of the South Platte River. Within the Boulder city limits, Goose Creek has a drainage basin of 2.7 square miles and a length of 3 miles. The ecosystem study area extends for a length of approximately 1 mile from immediately upstream of Foothills Parkway to the confluence with Boulder Creek. The study area encompasses South Goose Creek, Cottonwood Pond, and the extreme lower end of North Goose Creek (portion located downstream of Pearl Parkway). North Goose Creek is an overflow flood control channel that is normally dry (the Kline water rights underdrain system dewaters most of the creek in this area). The location of the project is shown on Figure 1 in section 1 of the report.

1.3 Ecosystem Restoration Objective. The objective of the ecosystem restoration of lower Goose Creek and Cottonwood Pond is to restore degraded ecosystem structure and ecosystem function, and to restore the dynamic processes to a less degraded, more natural condition. The goal is to mimic, as closely as possible, conditions that would occur in the area in the absence of human changes to the landscape and hydrology. The ecosystem restoration of lower Goose Creek appears on the City of Boulder's Greenways Environment Projects Top 10 List, as ranked by project scores.

1.4 Ecosystem Restoration Study Phases. The Ecosystem Restoration Study is a multi-phase study consisting in general of the following phases: 1) identify objectives, opportunities, and constraints, 2) discuss existing (before project) conditions including defining problems, 2) forecast future (without project) conditions, 3) formulate alternative plans for the most productive ecosystem improvements, 4) evaluate and compare alternatives for ecosystem restoration, and 5) select the recommended plan based on national ecosystem restoration benefits. The Ecosystem

Restoration Study concludes with the recommendation to proceed to Contract Plans and Specifications for the selected plan.

1.5 Design Criteria. Engineering studies were prepared in accordance with standard engineering practices as prescribed in the following Department of the Army engineering manuals and memorandums.

Engineering Manuals and Memorandums

U.S. Army Corps of Engineers, Engineer Manual EM 1110-2-1205, Environmental Engineering for Local Flood Control Channels, 15 November 1989.

U.S. Army Corps of Engineers, Engineer Manual EM 1110-2-38, Environmental Quality in Design of Civil Works Projects, 3 May 1971.

U.S. Army Corps of Engineers, Engineer Manual EM 1110-1-1804, Geotechnical Investigations, 1 January 2001.

Technical Memorandum No. 3-357 The Unified Soil Classification System

1.6 Study Reaches. The approximately 1-mile-long study area for ecosystem restoration was initially divided into 7 reaches for more detailed studies. Those study areas, which were used in 2006 and 2007 are noted below and on Figure E-1:

Reach 1 – Foothills Parkway. This area includes the reach of South Goose Creek which lies between the frontage road and the on-ramp to Foothills Parkway. Its downstream limit is the frontage road, and its upstream end is the downstream end of the 4-8' x 5' box culvert under Foothills Parkway. Its defining characteristic is the stream's incorporation into the highway drainage system.

Reach 2 Auto Sales. This area includes the reach of South Goose that is sandwiched in between Pearl Parkway on the right high bank and auto dealerships on the left high bank. Its downstream end is the long box culvert under Pearl Parkway and its upstream end is the frontage road along Foothills Parkway. Its defining characteristic is the non-native lawn grasses planted on the channel banks adjacent to the Parkway and the auto dealerships.

Reach 3 – Business Park. This area includes the reach of South Goose Creek with office buildings adjacent to its right high bank. Its downstream end is the Reynold's Corner mini-park near the office buildings and its upstream end is the long box culvert under Pearl Parkway. Its defining characteristic is the extensive prairie dog colony along the left bank near Pearl Parkway.

Reach 4 – Riparian Stream. This area includes the portion of South Goose Creek that lies along Pearl Parkway. Its downstream end is the riparian wetland and its upstream end is the Reynold's Corner mini-park adjacent to the Business Park. The reach is characterized by its greater open space to the south, which could provide ecosystem restoration opportunities.

Reach 5a (Reach 6 at one point) – Lower North Goose Creek. This area includes the extreme lower end of North Goose Creek, downstream of Pearl Parkway. Its downstream end is the existing riparian wetland on South Goose Creek and the bike trail along Cottonwood Pond, and

its upstream end is the outlet of the culvert under Pearl Parkway. Its defining characteristic is that it is a normally dry channel on public land located between a riparian wetland and Cottonwood Pond.

Reach 5b (Reach 5 at one point) – Riparian Wetland. This area includes the existing wetland and a reach of South Goose Creek. This area is bounded on the downstream end by the bike trail along Cottonwood Pond and on the upstream end by the transition from the wetland to the flowing stream. Its defining characteristics are the existing wetlands and the city-owned land adjacent to the right bank of South Goose Creek that could be used in a riparian wetland restoration plan.

Reach 6 – (Reach 7 at one point) Cottonwood Pond. This area includes the pond and the outlet of Goose Creek to Boulder Creek. This area is bounded on the downstream end by Boulder Creek and on the upstream end by the bike trail that separates Cottonwood Pond from the wetland at the lower end of South Goose Creek and from the lower end of North Goose Creek. Its defining characteristic is that it is a pond.

The geotechnical analysis presented in this appendix is based on available documentation and is representative of all reaches, except Reach 6 – Cottonwood Pond.

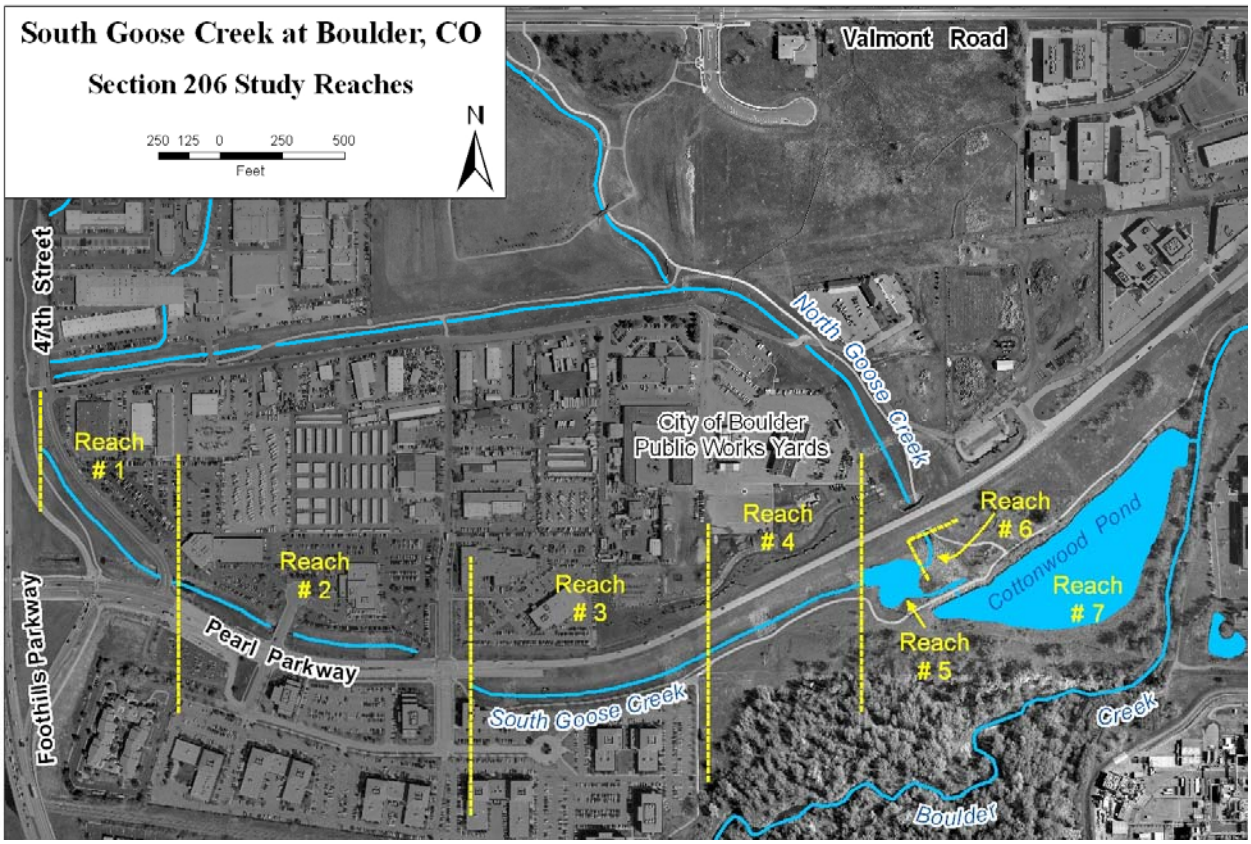


Figure E-1 Initial Goose Creek Study Reaches

As the study progressed, Transit Village was first added and then was removed from consideration in 2008 due to schedule and budget reasons. Figure E-2 shows the Transit Village Reach in conjunction with other reaches.

Figure E-2 Showing the Transit Village Reach relative to South Goose Creek Reaches

Following the departure of the Transit Village Reach, the project study area was reconfigured into 3 reaches as shown in Figure E-3 and discussed below:

Reach 1 (Former Reaches 1, 2 and 3) This area includes the reach of South Goose Creek downstream from Foothills Parkway (including the tunnel under Foothills Parkway) downstream to Reynold's Corner mini-park.

Reach 2 (Former Reaches 4, 5a and 5b) This area includes the reach of South Goose Creek having the greater open space to the south, the tiny portion of North Goose Creek and the existing cattail wetland.

Cottonwood Pond (Also known as Reach 3 and the Former Reach 6) This abandoned gravel mining pit known as Cottonwood Pond, also includes the outlet of Goose Creek to Boulder Creek.

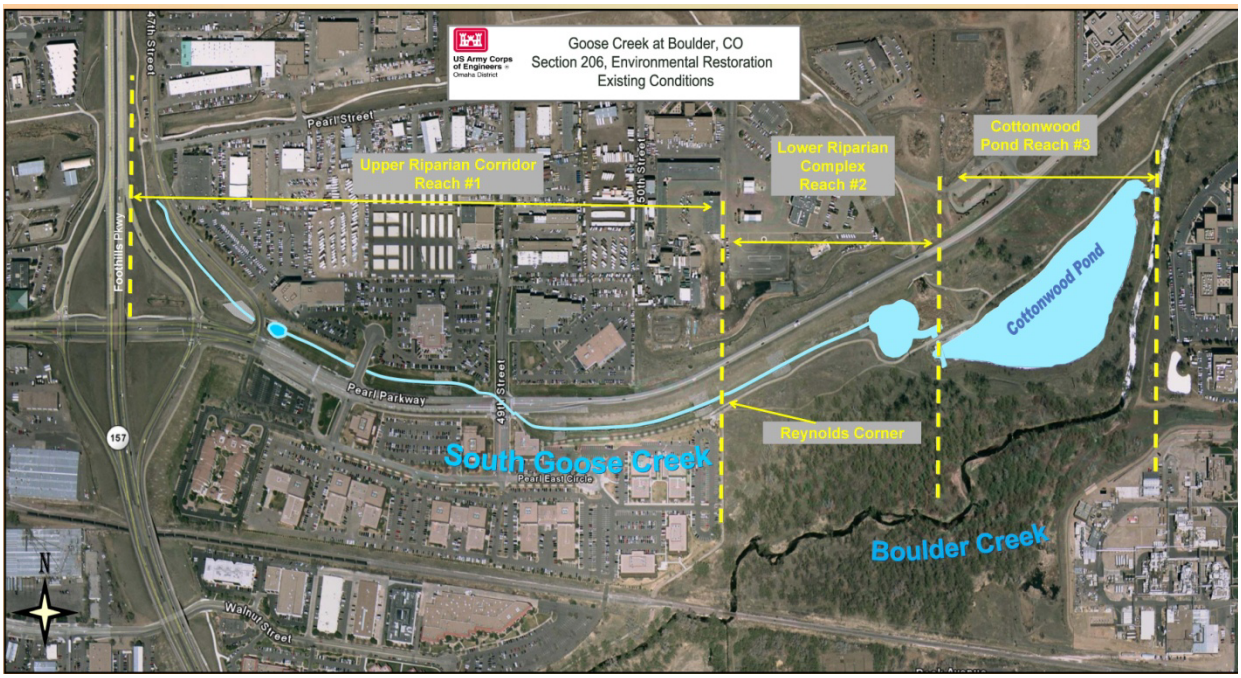


Figure E-3 Current 3 Reach Configuration for Goose Creek Study

2. EXISTING CONDITIONS.

2.1 Site Characteristics and Geology.

2.1.1 Regional Geology.

Physiography

Northeastern Colorado is generally considered as the territory stretching northward from Denver and eastward from the east flank of the Rocky Mountains, a north-south line that divides the State into approximately equal halves. It thus includes a narrow strip of hogback foothills, a large part of the Colorado Piedmont, and a considerable portion of the High Plains (Mather, et al, 1928). The City of Boulder is located in the foothills region.

The foothills are long, narrow hogbacks, or broader and lower asymmetric ridges aligned in a general north-south direction. The east slope of each ridge conforms more or less closely to the dip of a resistant bed; the west slope is generally much steeper. The higher crests of the foothills attain altitudes of 5,700 to 6,600 feet and typically stand 300 to 500 feet above the adjacent valley floors. Ordinarily the more easterly lines of ridges are progressively lower and display more gentle eastward slopes, with the easternmost ones standing only 15 to 30 feet above their surroundings. The mountains rise abruptly above the foothills to the west. The Piedmont boarders the foothills to the east (Mather, et al, 1928).

Geology and Stratigraphy

The regional geology is described in Ground-Water Investigations in the Lower Cache la Poudre River Basin, Colorado (Hershey and Schneider, 1964). Northern Colorado and adjacent parts of the Great Plains are underlain by a broad structural depression referred to as the Denver/Julesburg Basin. Boulder is located on the western edge of the basin. In the foothills, the formations generally dip to the east at 25 ^{o} to 35 ^{o} and shallow to 3 ^{o} to 6 ^{o} toward the Piedmont in the east. A reversal of dip occurs in the area north of Fort Collins, where the formations have been folded into a series of northward-trending anticlines.

The stratigraphy of the region includes pre-Cambrian crystalline rocks to upper Cretaceous sedimentary rocks overlain by Pleistocene to Holocene alluvial, talus and terrace deposits. The stratigraphic sequence for the Boulder area is provided in Table 1. Precambrian rocks exposed in the Boulder region include the Silver Plume Quartz Monzonite and the Boulder Creek Granodiorite. These units are massive and exposed in the hills west of Boulder.

The Fountain Formation of upper Pennsylvanian and Permian age unconformably overlies the Precambrian rocks. It consists of variegated sand-stone and conglomerate and ranges in thickness from a few feet to many hundreds of feet. The Lyons Sandstone unconformably overlies the Fountain Formation and is a fine-grained, bedded sandstone followed by the Triassic and Permian Lykins Formation, consisting of shale and thin-bedded sandstone with a few limestone bands.

The shale and siltstone of the Morrison Formation unconformably overlies the Lykins Formation. Sandstones of the Lower Cretaceous South Platte and Lytle Formations dip steeply eastward from the mountain front and form prominent hogbacks. These formations compose the Dakota Group consisting of shale, siltstone and sandstone. The Greenhorn Limestone, and the Carlile Shale over-lie the Dakota Group. The shale and limestone of these formations are less resistant to erosion than either the Dakota Group or the overlying Niobrara Formation, and thus, their area of outcrop is in valley depressions. The Niobrara Formation consists of shale and limestone. The basal limestone unit forms a persistent low hogback along the eastern margin of the foothills.

Overlying the Niobrara Formation is the Pierre Shale, which consists of a sequence of interbedded sandy shale, mudstone, and massive to lenticular sandstone. Alluvium covers much of the Pierre Shale. The Pierre Shale becomes increasingly sandy in its upper part and grades into the Fox Hills Sandstone, which is rapidly decomposed by weathering and, therefore, is poorly exposed.

The Fox Hills Sandstone is overlain by the silty lenticular sands, varicolored carbonaceous and often gypsiferous shales, and coals of the Laramie Formation. Much of the Laramie Formation is covered by alluvium, slope wash, and pediment deposits.

Groundwater

Water table elevations generally range from 5600 feet mean sea level (msl) at the western edge of Boulder to 5190 feet msl east of the city. Groundwater flow is controlled locally to some extent by several streams in the area, primarily including Boulder Creek and South Boulder

Creek. The bedrock in the area generally yield small amounts of groundwater of varying quality. Table 1 indicates the general groundwater properties of the various rock units of the area. The primary groundwater sources in the area are from the Laramie Formation and unconsolidated deposits of alluvial origin. The Laramie Formation yields low to moderate quantities of water that is generally considered soft. The unconsolidated alluvial deposits yield moderate to large quantities of water. In either event, water quality and quantity generally decreases with depth and distance from the source.

Table E-1
Stratigraphic Sequence and Groundwater Yield

Era	System or Period	Series	Formation	Member	Physical Character	Water Supply
Cenozoic	Quaternary	Recent	Slope Wash		Sand, gravel, and bedrock debris. Forms thin veneer on pediment slopes	Yields small Quantities of water that is generally of poor quality.
			Alluvium		Arkosic gravel and sand with sandy clay. Cemented atbase with calcium carbonate. Flood plain and terrace deposits	Yields mod. To large quantities of water.
		Pleistocene	Terrace Deposits		Arkosic gravel and sand. Zones of calcium carbonate cement, caliche and limonite. 25-50 feet above flood plain of Cache la Poudre.	Yields mod. To large quantities of water of fair to poor quality.
			Pediment Deposits		Arkosic gravel, sand, and red clay with cemented intervals. Occurs in dissected upland above alluvium and terrace deposits.	Yields small to moderate quantities of water of fair to poor quality.
Mesozoic	Cretaceous	Upper Cretaceous	Laramie Formation		Silty to sandy blue to gray shale with carbonaceous sandstone, lignite, coal seams, ironstone and clay. The .Lower part contains fine to med. Sandstone and interbedded sandstone and sandy shale.	Yields low to moderate quantities of soft, alkaline water. Quality may vary with depth.
			Fox Hills Sandstone	Millikin Sandstone	Very fine angular silty yellowish gray sandstone. Massive and fossiliferous.	Yields small quantities of soft alkaline bicarbonate water. Quality varies with depth and distance from recharge area.
					Fine to very fine grained grayish yellow massive sandstone.	
			Pierre Shale		Transition zone. Yellow gray sandstone and sandy shale.	Yields small quantities of soft alkaline bicarbonate water. Quality varies with depth.
				11 separate members	Primarily dark gray shale. Includes members of olive-gray massive fine grained sandstone, yellowish-gray medium grained sandstone and sandy shale to silty sandstone.	Generally yields small quantities of water of poor quality.
			Niobrara Formation	Smokey Hill	Medium to dark gray fossiliferous shale.	
				Fort Hays LS	Massive, chalky fossiliferous limestone.	
			Carlile Shale	Codell SS	Fine to v. fine grained sandstone.	May yield small quantities of water to wells.
					Black to brownish gray micaceous shale.	
			Greenhorn Limestone		Chalky shaley limestone and dark gray shale.	May yield small quantities of water to wells.
		Lower	Dakota Group	South Platte Formation	Gray to black shale, siltstone and sandstone. Locally conglomeratic.	Yields small quantities to wells and springs.
				Lytle Formation	Light gray to white sandstone. Locally conglomeratic.	
	Jurassic		Morrison Formation		Varigated shale and siltstone. Contains massive interbedded limestone	
	Triassic					
Paleozoic	Permian	Upper	Lykins Formation		Thin bedded dark red sandstone and sandy shale. Massive at the top.	Yields limited amount of water.
			Lyons Sandstone		Quartzose light-gray to yellowish- gray cross-bedded sandstone.	
	Pennsylvanian	Upper	Fountain Formation		Sandstone, Arkosic conglomerate, and sandy limestone interbedded with sandy red shale. Becomes more conglomeratic in the basal section.	
Precambrian			Silver Plume		Yellowish-orange to reddish-gray, fine to medium grained, biotite-muscovite quartz monzonite.	
			Boulder Creek		Light to dark gray medium to coarse grained gneissic granodiorite.	

(Adapted from: Hershey and Schneider, 1964, and Colton 1978)

2.1.2 Site Geology.

Topography and Drainage

The major streams in the area of Boulder flow predominantly eastward. Steams originate in the mountains to the west and cross the ridges at right angles to their strike in narrow gaps, which serve as gate-ways to the mountain valleys (Mather, et al, 1928). Many of the smaller streams are subsequent and flow in strike valleys between the successive ridges (Mather, et al, 1928). The eastern margin of the foothills has low rounded hills, longer undulating ridges, and irregular or oval basins. Many of the basins are shallow undrained depressions, some occupied by lakes and ponds. Others have been artificially formed or enlarged by the construction of low earth dams to serve as reservoirs for irrigation (Mather, et al, 1928). The major streams in the Boulder area are Boulder Creek, South Boulder Creek and Fourmile Canyon Creek. Boulder Creek and its tributaries Goose Creek and North Goose Creek are the main drainages at the site.

The topography at the site is relatively flat with an overall dip to the east which mimics the bedrock surface. The bedrock surface indicates an erosional valley that has been filled by alluvium to some extent. The site is located within this valley.

Overburden and Bedrock

Bedrock surface exposures in the Boulder area are represented on the geologic map provided as Figure 1. The stratigraphic sequence, ages and rock descriptions are provided in Table 1. In the vicinity of Goose Creek, the surficial geology is primarily Holocene Piney Creek Alluvium and Broadway Alluvium (USGS, 2005). The Piney Creek Alluvium consists of dark gray, humic sandy to gravelly alluvium containing organic matter such as roots. It typically underlies terraces whose surfaces are 10 to 20 feet above the flood plain. The upper part is characterized by weakly developed brown soil that grades into colluvium upslope and are not usually covered by flood waters (Colton, 1978). The Pleistocene Broadway Alluvium is typically 50% sand, 25% granules and 25% pebbles deposited by streams and may locally contain gravels (Colton, 1978). Below the alluvium lies the Upper Shale Member of the Pierre Shale, which is evident by several outcrops in the area. This rock is typically a gray, concretionary silty shale.

The alluvium is estimated to be 10 to 15 feet thick above the Pierre Shale bedrock. The thickness of the Pierre Shale in the region has been measured at 2,800 feet; however it is unknown under the study area.

Groundwater

Groundwater near the site has been measured from approximately 3 to 12 feet below ground surface (Syntex, 1997). The water table is contained in the alluvium above the Pierre Shale. Natural groundwater flow is to the east-southeast and generally follows the eastern surface slope of the bedrock. Groundwater gradient near the site is approximately .009 as calculated from groundwater contours (USGS, 2005). Gradients are comparably steeper to the

west and flatter to the east. Groundwater elevation is also controlled by Boulder Creek which exits the elevated topography west of Boulder, flows to the east and turns northeast at the east side of Boulder. Boulder Creek is considered effluent, or gaining, stream and appears to act as an overall discharge point for groundwater based on groundwater contour lines (USGS, 2005). The creek likely recharges to the alluvium during periods of high surface water flow. Groundwater elevations near the site approximately range from 5215 feet msl to 5195 feet msl based on USGS groundwater contours (USGS 2005).

Seismicity

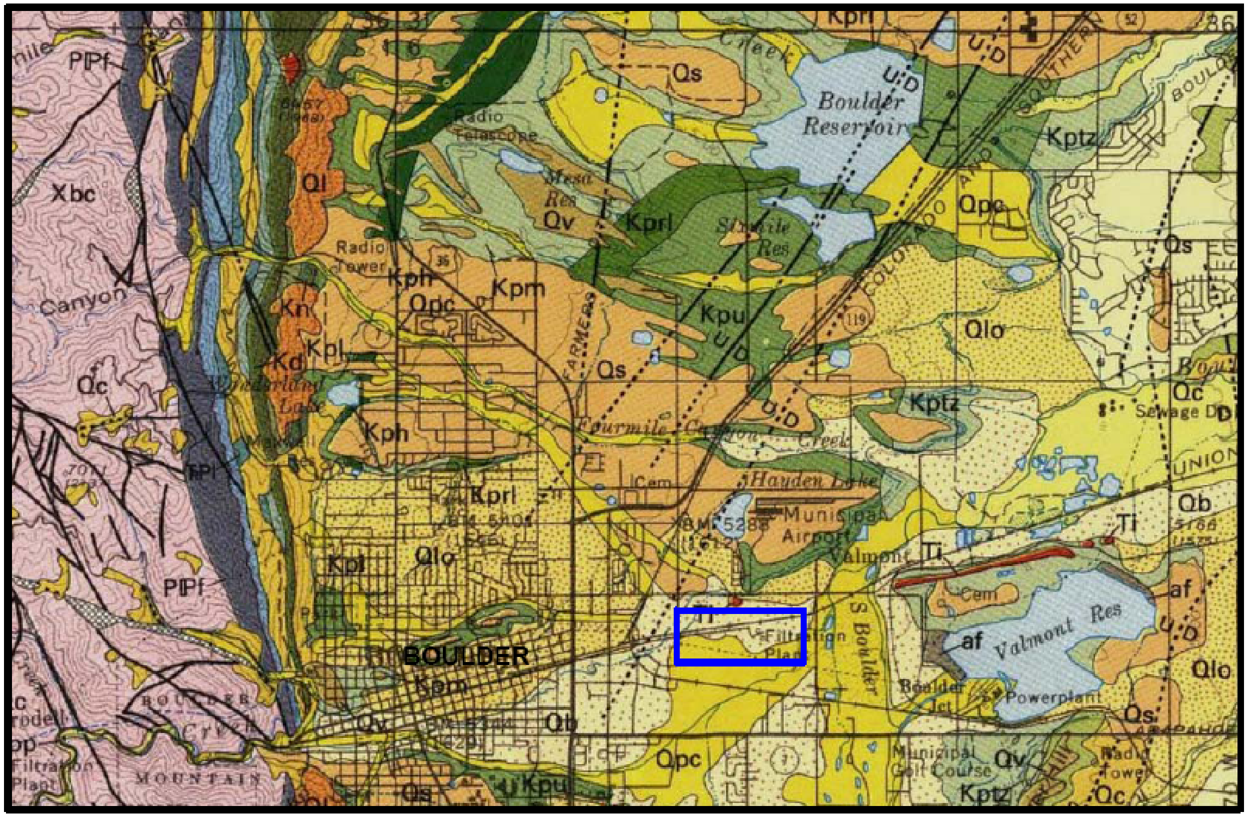
In reference to the U.S. Army Corps of Engineers ER1110-2-1806 "Earthquake Design and Evaluation for Civil Works Projects," dated 31 July 1995, and the United States Geological Society (USGS) Earthquake Hazards Program, the ground motions associated with the Maximum Design Earthquake (MDE) for the Goose Creek project at Boulder, Colorado, are: a Peak Ground Acceleration (PGA) of 0.12 g (12.11% g), a 0.2 second Spectral Acceleration (SA) of approximately 0.23 g (23.42% g), and a one second SA of approximately 0.058 g (5.80% g). These accelerations were taken from the Interpolated Probabilistic Ground Motion for the Conterminous 48 States by Latitude and Longitude, 2002 Data feature provided in the USGS Earthquake Hazards Program. This tool calculates a PGA, a 0.2 second period SA, and a one second period SA for 10% and 2% probability of exceedance (PE) in 50 years. The tool provided the following values.

LOCATION: 40.05 Lat. -105.2 Long.

The interpolated Probabilistic ground motion values, in % g, at the requested point are:

	10% PE in 50 yr.	2% PE in 50 yr.
PGA	3.77	12.11
0.2 sec SA	8.36	23.42
1.0 sec SA	2.21	5.80

ER 1110-2-1806 (paragraph 6.b.) discusses the selection of the MDE for features not considered critical, and states "the MDE shall be selected as a lesser earthquake than the maximum credible earthquake (MCE) which provides economical designs meeting appropriate safety standards. The MDE can be characterized as a deterministic or probabilistic event." EM1110-2-2100 "Stability Analysis of Concrete Structures" (December 2005) defines the MDE for non-critical structures as an event that has a 10% chance of being exceeded in a 100-year period (or a 950-year return period). Even though the definition of the MDE for non-critical structures is defined as an event with a 950-year return period, the 2% probability of exceedance in 50 year (approximately 2,500-year return period) values as presented in the USGS Earthquake Hazards Program are selected. The rationale being that although this provides higher values, they are readily available and provide a degree of conservatism. If these values negatively impact an economical design, the smaller ground motions associated with the 950-year event should be determined during final design.



1 0 1 2 3 4 5 Miles

CONTOUR INTERVAL 100 FEET
DOTTED LINES REPRESENT 50-FOOT CONTOURS
DATUM IS MEAN SEA LEVEL

PROJECT AREA

GEOLOGIC DESCRIPTIONS

Qpp	POST-PINEY CREEK ALLUVIUM (UPPER HOLOCENE)
Qt	TALUS (HOLOCENE TO PLEISTOCENE)
Qc	COLLUVIUM (HOLOCENE TO PLEISTOCENE)
Ql	COLLUVIUM (HOLOCENE TO PLEISTOCENE)
Qpc	PINEY CREEK ALLUVIUM (UPPER HOLOCENE)
Qb	BROADWAY ALLUVIUM (PINEDALE GLACIATION, PLEISTOCENE)
Qlo	LOUVIERS ALLUVIUM (BULL LAKE GLACIATION, PLEISTOCENE)
Qv	VERDOS ALLUVIUM (YARMOUTH INTERGLACIATION OR KANSAN GLACIATION, PLEISTOCENE)
Qprf	ROCKY FLATS ALLUVIUM (NEBRASKAN GLACIATION, PLEISTOCENE)
Kl	LARAMIE FORMATION (UPPER CRETACEOUS)
Kfh	FOX HILLS SANDSTONE (UPPER CRETACEOUS)
Kptz	PIERRE SHALE TRANSITION MEMBER (UPPER CRETACEOUS)
Kpu	PIERRE SHALE-UPPER SHALE MEMBER (UPPER CRETACEOUS)
Kprl	PIERRE SHALE (FIVE MEMBERS-UPPER CRETACEOUS)
Kpm	PIERRE SHALE-MIDDLE SHALE MEMBER (UPPER CRETACEOUS)
Kph	PIERRE SHALE-HYGIENE SANDSTONE MEMBER (UPPER CRETACEOUS)
Kpl	PIERRE SHALE-LOWER SHALE MEMBER (UPPER CRETACEOUS)
Kn	NIOBRARA FORMATION (UPPER CRETACEOUS)
Kcg	CARLILE SH, GREENHORN LS, GRANEROS SH (UPPER CRETACEOUS)
Kd	DAKOTA GROUP (UPPER CRETACEOUS)
J ₮mj	MORRISON FORMATION (UPPER JURASSIC TO UPPER TRIASSIC)
₮Pl	LYKINS FORMATION (TRIASSIC AND PERMIAN)
Ply	LYONS SANDSTONE (PERMIAN)
PIPf	FOUNTAIN FORMATION (PERMIAN & PENSYLVANIAN)
Ysp	SILVER PLUME QUARTZ MONZONITE (PRECAMBRIAN)
Xbc	BOULDER CREEK GRANODIORITE (PRECAMBRIAN)

U/D FAULT OR LINEAR FEATURE (Inferred where dotted) U-upthrown side. D-downthrown side

Map compiled from Geologic Map of the Boulder-Fort Collins-Greely Area, Colorado.
Miscellaneous Investigations Series, Boulder-Fort Collins-Greeley Area, Colorado, Map I-855-G
U.S. Geological Survey

FIGURE 1
GEOLOGIC MAP BOULDER, COLORADO AND VICINITY

2.2 Upper Surface Soils of the Study Area – Soil Types, Qualities, and Physical Properties

2.2.1 Soil Classification. The USDA Natural Resources Conservation Service's (NRCS) Web Soil Survey web site (http://websoilsurvey.nrcs.usda.gov/app/) provides soil types and characteristics for the upper surface soils (soils to a depth of 5 ft.). In the study area, the upper soils are classified by the NRCS as Niwot soils, with the exception of the northern 1/3 of the Cottonwood Pond north shoreline area and the northern corner of the riparian wetland were the upper soils are classified as Loveland soils.

Niwot soils are defined as loam (clay, silt, and sand) for the upper 14 inches and gravelly sand from 14 to 60 inches below ground surface. Loveland soils are defined as clay loam for the upper 11 inches; clay loam, silty clay loam, and loam from 11 to 30 inches; and very gravelly sand, gravelly sand, and gravelly coarse sand from 30 to 60 inches below ground surface.

2.2.2 Excavation Constraints and Finished Slopes. In general, the depth and slope of an excavation, as well as groundwater conditions, control the overall stability and movements of open excavations. For granular soils, instability typically does not extend significantly below the excavation if groundwater seepage forces are controlled. For rock, stability is controlled by the depth and slopes of the excavation, joint patterns in the rock, in situ stresses, and groundwater conditions. For cohesive soils, instability typically includes side slopes but may also involve materials well below the base of the excavation. Instability at the base or below the base of the excavation (often referred to as bottom heave) is influenced by soil type and strength, depth of cut, side slope and/or berm geometry, groundwater conditions, and construction procedures. Cohesive soils are not present in significant quantities in the study area.

The NRCS's Web Soil Survey web site rates both the Niowot and Loveland soils as being "very limited" in terms of completing shallow excavations because of caving cutbanks. This rating is primarily a result of the typical shallow depth to the water table in the study area. For areas adjacent to the Goose Creek channel it is anticipated that an underdrain system and/or other groundwater control methods, such as sumps and pumps, will be required for excavation depths greater than approximately 2' to 5' below channel invert elevations. These types dewatering systems are required in contrast to well point or deep well dewatering systems because of the shallowness of the bedrock in the study area. The existing 6" to 8" diameter twin underdrain system constructed as part of Urban Drainage and Flood Control District's (UDFCD) flood conveyance project (see paragraph 2.4) should sufficiently control groundwater for shallow excavations located adjacent to Goose Creek. Because of the presence of the underdrain system, temporary excavations with slopes 1 vertical (V) on 1.5 horizontal (H) and permanent slopes in the range of 1V on 3H to 1V on 4H or flatter should be easily obtained for shallow excavations. Conventional excavation equipment should be adequate for completing all excavations. If an excavation intercepts poorly graded sand material (SP material) the side slopes could potentially "run" due to low or no cohesion of the material. Only small amounts of SP material are anticipated to be encountered during excavation in the study area based on available subsurface soils information. For temporary excavations, where excavation to the full cross section would

extend beyond desirable limits, temporary excavation support (sheeted and braced excavation) would be required.

The slopes of finished grades will depend on the degree of surface runoff erosion protection provided by vegetation, erosion control matting, etc. because of the high erosional susceptibility of the granular soils in the study area. Typically in the study area finished grades are constructed at 1V on 4H with only grass cover for surface runoff erosion protection.

It is anticipated that conventional rock excavation equipment should be adequate if rock excavation is required. No blasting of the rock will be needed. In general, depth to Siltstone bedrock for the study area is greater than 80 inches (6.67 feet). More specifically, as indicated in part 2.3 below, boring logs in Reaches 1-4 show that the depth to bedrock in the vicinity of the Goose Creek channel varies from 10 ft. or greater below the trickle channel invert in Reach 1 to 0.5 ft. below the trickle channel invert in Reach 4 (UDFCD Goose Creek as-built drawings). It is anticipated that the Siltstone bedrock is relatively firm; however, alternating hard and soft lenses may be encountered in the bedrock stratum.

2.2.3 Embankment Construction. The construction of embankments, dikes, and levees from surface soils (surface layer to a depth of 5 ft.) in the study area is rated "somewhat limited" by the NRCS's Web Soil Survey web site. Embankments, dikes, and levees are defined as raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. Embankments that have zoned construction materials (core and shell materials) are not considered for the rating. The soils are rated as a source of fill material for embankment construction. The rating is given for soil layers assumed to be uniformly mixed and compacted during construction. In general, soil material for embankments must limit seepage, be resistant to piping and erosion, and have favorable compaction properties. The upper soils in the study area being primarily coarse grain materials (sands and gravels), except for the approximately 12-in.-thick surface layer which has some fine grain materials (clays), are limited in regards to these soil characteristics.

2.2.4 Water Table. Data from the NRCS Web Soil Survey web site indicates that the depth to the water table in the study area generally varies from 18 to 36 inches. As indicated in paragraph 2.3 below, for Reaches 1-4 along the channel centerline the water table is estimated to be at the top of the channel underdrain system (6" or 8" perforated polyvinyl tubing), which varies at a depth of approximately 2 ft. to 5 ft. below the trickle channel invert. The elevation of the top of the 6" underdrain varies from approximately El. 5234 at the upstream end of Reach 1 to El. 5199 at the downstream end of Reach 4. See paragraph 2.2.2 Excavation Constraints and Finished Slopes for dewatering requirements for excavations completed in the study area.

2.2.5 Topsoil Availability. In general, topsoil is used to cover an area so that vegetation can be established and maintained. The NRCS's Web Soil Survey web site evaluates the upper 40 inches of a soil for use as topsoil. The soils in the study area have a NRCS rating of "poor" in terms of being a potential source for topsoil. The "poor" rating is generally because the soils are too sandy, have rock fragments, are hard to reclaim, and have a shallow wetness depth. The soil components of the topsoil in the study area are in general- sand, silt, and clay, with minimal

organics. Representative percentages of the various components for the upper 12 inches of soil are, for the Niwot soils: 41.6% sand, 37.4% silt, and 21.0% clays. For Loveland soils, representative percentages are 33.4% sand, 32.1% silt, and 34.4% clay. For the upper 12 inches of soil, a representative value for percent organics for the Niwots soils is 3.50 % and for the Loveland soils is 1.97%. The percent organic matter is the content of plant and animal residue in the soil at various stages of decomposition, and is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. Two millimeters in diameter is the upper particle size for soil material defined as being sand. Silt and clay particles, by definition, are smaller in size than sand particles. It is presumed that the topsoil in the study area is predominantly sandy clay material.

The NRCS classifies the surface layer of both the Niwot and Loveland soils based on the Unified Soil Classification System as CL material. The Unified Soil Classification System classifies soil based on various characteristics of the soil that indicate how it will behave as an engineering construction material. For CL materials, the symbol C stands for clay, with L denoting low liquid limit. CL soils are primarily inorganic clays. Low plasticity CL materials are usually lean clays, sandy clays, and silty clays. The amount and kind of clay (clay mineral type) affect the fertility and physical condition of the soils and the ability of the soil to adsorb cations to retain moisture. The clay content also influences shrink-swell potential, saturated hydraulic conductivity (Ksat), plasticity, the ease of soil dispersion, and earth-moving operations. (NRCS)

Due to the low organic content of the upper 12 inches of the surface soils, it is recommended that native vegetation be used throughout the project area as much as practicable. If non-native species are required to meet project needs, then it is recommended that topsoil material with a high organic content be imported to the job site.

2.3 Description of Subsurface Soils and Groundwater Levels – Reaches 1-6. The subsurface soils and groundwater level descriptions presented below for Reaches 1-4 were based on boring logs from the UDFCD's as-built drawing set for the flood conveyance project on South Goose Creek. This drawing set is titled "As Built, Goose Creek Channels, Foothills Parkway to Boulder Creek", and was completed by Simons, Li & Associates, Inc. Final as-built changes were incorporated into the drawings on June 1, 1987. The subsurface soils and groundwater level descriptions presented below for Reaches 5a, 5b, and 6 were taken from the NRCS's Web Soil Survey web site (http://websoilsurvey.nrcs.usda.gov/app/). The Web Soil Survey data is limited to the upper 60 inches (5 feet) of the surface soils. Paragraph 2.2 above gives general soil properties and qualities for the upper soils in the study areas. Additional subsurface data in the vicinity of Reach 6 – Cottonwood Pond was provided in the preliminary geotechnical investigation for the proposed Valmont City Park completed by CTL/Thompson, Inc. Consulting Engineers, December 1999.

Reach 1 – Foothills Parkway. Two borings (borings T.H. 21 - 15' depth & T.H. 22 – 15' depth) were used to describe the subsurface soils in Reach 1. In general, these borings indicate approximately 13 ft. of sand, gravel and cobbles overlain by 1.5 ft. of fill material at the upstream end of reach 1 and approximately 13.25 ft. of sand gravel & cobbles material overlain by an approximately 12-in. to 15-in. layer of topsoil. Bedrock was not encountered in these 2 borings.

Based on boring T.H. 19 located downstream in Reach 2, it is estimated that Siltstone bedrock in Reach 1 is at a depth of 10 ft. or greater below the trickle channel invert elevation, which varies upstream to downstream along the reach from El. 5236 to El. 5232.

The groundwater level in Reach 1 along the channel centerline is estimated to be at the top of the channel underdrain system (6" perforated polyvinyl tubing), which is at a depth of approximately 2 ft. to 3 ft. below the trickle channel invert. The elevation of the top of the 6" underdrain varies from EL. 5234.25 at the upstream end of Reach 1 to El. 5229 at the downstream end of Reach 1.

Reach 2 - Auto Sales. Three borings (borings T.H. 18 – 14' depth, T.H. 19 – 14.5' depth & T.H. 20 – 15-depth) were used to describe the subsurface soils in Reach 2. These borings indicate approximately 4.5 ft. to 8.5 ft. of sand gravel & cobbles material overlain by an approximately 6-in. to 12-in. layer of topsoil. Siltstone bedrock was encountered in the 2 downstream borings (borings T.H. 18 and T.H. 19) in Reach 2 at a depth of approximately 2.5 ft. to 4.5 ft. below the trickle channel invert, which varies upstream to downstream along the reach from El. 5226.3 to El. 5217.7. Weathered bedrock with a thickness of approximately 0.5 ft. overlies the Siltstone bedrock.

The groundwater level along the channel centerline is estimated to be at the top of the channel 6" underdrain system, which varies in Reach 2 from a depth of approximately 2.5 ft. to 5 ft. below the trickle channel invert. The elevation of the top of the 6" underdrain varies from El. 5222 at the upstream end of Reach 2 to El. 5215.5 at the downstream end of Reach 2.

Reach 3 – Business Park. Two borings (borings T.H. 16 -14.2' depth & T.H. 17 – 14' depth) were used to describe the subsurface soils in Reach 3. These borings indicate approximately 4.5 ft. to 5 ft. of sand, gravel and cobble material overlain by an approximately 6-in. to 12-in. layer of topsoil. Siltstone bedrock was encountered in the borings at a depth of approximately 3.5 ft. to 4.5 ft. below the trickle channel invert, which varies upstream to downstream along the reach from El. 5215.7 to El. 5208. Weathered bedrock with a thickness of approximately 0.5 ft. to 1 ft. overlies the Siltstone bedrock.

The groundwater level along the channel centerline is estimated to be at the top of the channel 6" and 8" underdrain system, which varies in Reach 3 from a depth of approximately 2.5 ft. to 3 ft. below the trickle channel invert. The elevation of the top of the 6" and 8" underdrain varies from El. 5215.5 at the upstream end of Reach 3 to El. 5206 at the downstream end of Reach 3.

Reach 4 – Riparian Stream. A total of 2 borings (T.H. 14 – 14.5' depth & T.H. 15 – 15' depth) were used to describe the subsurface soils in Reach 4. These borings indicate approximately 1 ft. to 4.5 ft. of sand, gravel and cobble material overlain by an approximately 6-in. to 12-in. layer of topsoil. Siltstone bedrock was encountered in the borings at a depth of approximately 0.5 ft. to 4 ft. below the trickle channel invert, which varies upstream to downstream along the reach from El. 5208 to El. 5201.3.

The groundwater level along the channel centerline is estimated to be at the top of the channel 6" and 8" underdrain system, which varies in Reach 4 from a depth of approximately 2 ft. to 2.5 ft. below the trickle channel invert. The elevation of the top of the 6" and 8" underdrain varies from El. 5206 at the upstream end of Reach 4 to El. 5198.75 at the downstream end of Reach 4.

Reach 5a - Lower North Goose Creek. The surface soils in Reach 5a are categorized as Niwot soils. See paragraph 2.2.1 above for a description of soil types. The groundwater level in this reach is estimated to be at a level similar to the level of the water in the adjacent wetland.

Reach 5b - Riparian Wetland. The surface soils in Reach 5b are categorized as Niwot soils, except for the northern corner of the wetland which is categorized as Loveland soils. See paragraph 2.2.1 above for a description of soil types. The groundwater level in the vicinity of riparian wetland is estimated to be at a level similar to the level of the water in the wetland.

Reach 6 - Cottonwood Pond. The surface soils in Reach 6 are categorized as Niwot soils, with the exception of the northern 1/3 of the Cottonwood Pond north shoreline area which are Loveland soils. Two subsurface exploratory borings (TH-16 -15' depth & TH-17 – 10' depth) were drilled across Pearl Parkway from Cottonwood Pond as part of the geotechnical investigation for the proposed Valmont City Park Boring TH-16 indicates approximately 7 ft of loose to medium dense clayey sand with some silt (SC) overlying approximately 8 ft of very dense silty sand to poorly graded sand (SM, SP-SM). Boring TH-17 indicates 10 ft of very dense silty sand to poorly graded sand (SM, SP-SM). Topsoil or sandy clay surface soils were not shown in either boring log.

The groundwater level in the vicinity of Cottonwood Pond is estimated to be at a level similar to the level of the water in the pond. Groundwater level in borings TH-16 & TH-17 was approximately 9.7 ft and 6.8 ft below ground surface, respectively.

2.4 Urban Drainage and Flood Control District Flood Conveyance Project. In the mid 1980's, the UDFCD, an organization developed for the purpose of assisting local governments in the Denver metropolitan area with multi-jurisdictional drainage and flood control problems, constructed a flood conveyance project on both North and South Goose Creek between Foothills Parkway and Cottonwood Pond. Details of the channel configuration and design features for the South Goose Creek portion of the project are given in the Existing Conditions Hydraulic Analysis.

2.4.1 Underdrain System. Included in the design of the South Goose Creek flood conveyance project was the construction of an underdrain system beneath the uniform channel slopes. The underdrain system consists of twin 6" or 8" perforated polyvinyl tubing spaced at various distances apart, and buried approximately 2-5 ft below the invert elevation of the concrete-lined trickle channel. The lateral spacing of the tubing is 28.1' apart from Sta. 1+59-5+50, 52.6' apart from Sta. 9+10-17+50, and 55.4' apart from Sta. 22+66-37+60. The purpose of the South Goose Creek underdrain system was investigated as part of this study. Based on the recollection of one of the project's designers, the underdrain system was installed to lower the water table for

construction and future maintenance of the project. The South Goose Creek project was constructed through a wetland area, and the wetlands were to be eliminated as part of the project construction. The depth of the underdrain system for each designated project reach is given in section 2.3. Underdrain system in Reach 1 ends or "daylights" in the channel drop structure located immediately downstream of the Frontage Road. The second length of underdrain system is within Reaches 2, 3 and the upstream ½ of Reach 4, and ends or "daylights" in the channel drop structure located in the middle of Reach 4. The last segment of underdrain system is located in the downstream ½ of Reach 4, and ends or "daylights" in the channel drop structure located at the downstream end of Reach 4. Any flow from the underdrain system ultimately drains into the Reach 5b wetland. It is believed based on the purpose of the South Creek underdrain that water rights are not associated with its installation.

As stated in paragraph 2.2.2 above, the depth and slope of an excavation, as well as groundwater conditions, control the overall stability and movements of open excavations. The presence of the underdrain system most likely would aid in the construction of proposed ecosystem restoration features. The underdrain system, if in good working condition, will essentially act as a dewatering system, and allow excavations to be completed "in the dry" to depths that are within approximately 2-3 feet above the invert elevation of the underdrain system.

3. PROBLEM IDENTIFICATION AND FUTURE WITHOUT PROJECT CONDITIONS.

In the study area, South Goose Creek and adjacent lands have been dramatically altered overtime, including construction of the UDFCD flood conveyance channel. The channel no longer functions under natural geomorphic processes. Its purpose is primarily flood conveyance. In general, native riparian ecosystems, wetland and native plant communities, wildlife habitats are in a degraded state in the study area. Without the proposed ecosystem restoration of Goose Creek, the degraded condition will continue and possibly worsen.

4. DETERMINATION OF FEASIBLE INITIAL RESTORATION PLAN, DEVELOPMENT OF ALTERNATIVE PLANS, AND SELECTION OF THE RECOMMENDED ECOSYSTEM RESTORATION PLAN.

Stage 1 of the Ecosystem Restoration Study emphasizes the determination of the initial restoration plan, with enough detailed developed to complete a rough cost estimate and to solicit input from the local sponsor and public. Stage 2 of the Ecosystem Restoration Study consists of the completion of the plan formulation process. During this stage alternative restoration plans will be evaluated including comparing their costs, a recommended plan will be selected, and preparations will be completed to enter the Preconstruction Engineering and Design (PED) Phase. PED is the phase during which the design is finalized, plans and specifications are completed, and the construction contract is prepared for advertising. Specific ecosystem restoration features that may be included in the plan are: tree plantings, large woody debris placed within Cottonwood Pond, native prairie vegetation, stream meandering, vegetated rock outfall, wetland expansion, riparian buffer area, and a prairie dog management buffer area. In addition to ecosystem restoration, it is planned to include recreational features as part of the overall project.

Recreational features that may be included include interpretive signs, benches, picnic tables, bike racks, Cottonwood Pond access trails from the main trail, and fishing rocks.

5. FURTHER STUDIES, TESTING, AND ANALYSES AFTER FEASIBILITY STUDY PHASE (DURING PRECONSTRUCTION ENGINEERING AND DESIGN)

5.1 Subsurface Explorations and Laboratory Testing. Final design of the ecosystem restoration will occur during the PED Phase of the project. Depending on the selected recommended plan, and in order to complete the final design, subsurface explorations (borings) will likely be needed at various locations along the proposed project. The borings are used to define soil profiles, determine borrow material properties, and to determine foundation material parameters for seepage control and/or slope stability design, if needed. Laboratory testing, if required, will be performed on disturbed and undisturbed soil samples in accordance with American Society of Testing and Materials (ASTM) standards.

5.2 Final Design Analyses. As part of completing the final design for the recommended ecosystem restoration plan, final design studies will be performed as needed. The following types of analyses may need to be completed: 1) evaluation of foundation seepage, 2) slope stability investigations, 3) settlement analysis if structures are proposed as part of the recommended plan, and 4) the evaluation of various methods to control erosion on the project.

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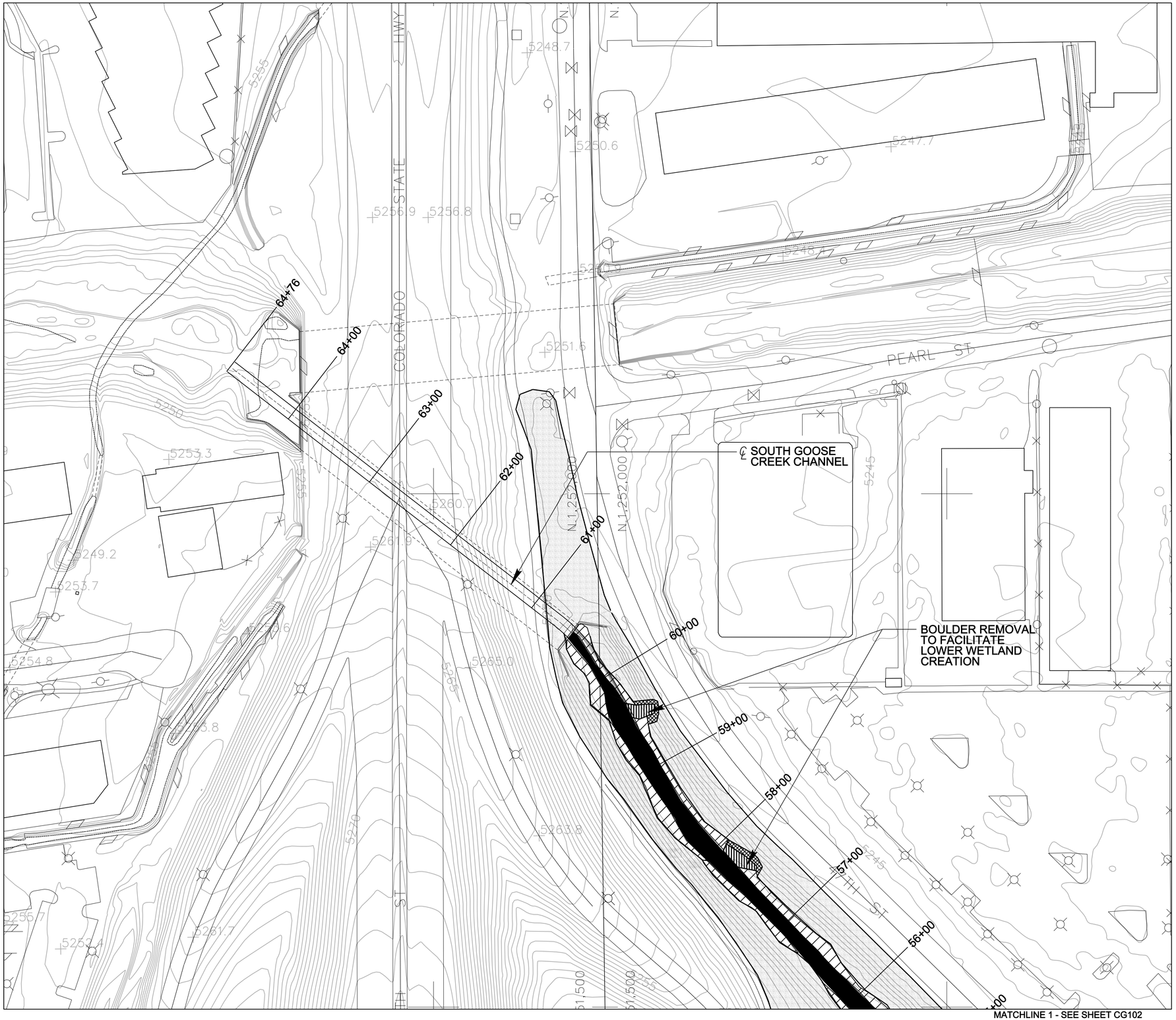
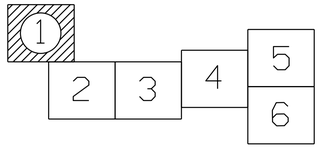


MATCHLINE 1 - SEE SHEET CG102

LEGEND

- 5250 — MAJOR CONTOUR
- MINOR CONTOUR
- CENTERLINE ALIGNMENT
- PRAIRIE (UPLAND BUFFER)
- TRANSITION / WETLAND EDGE (0"-18" DEPTH)
- WET PRAIRIE / TRANSITION MIX (0"-6" DEPTH)
- RIPARIAN SHRUBS / TREES
- EMERGENT WETLAND (18"-36" DEPTH)



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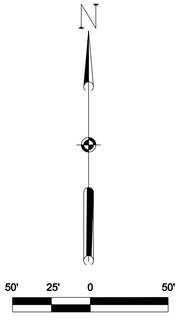

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US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT

MARK	DESCRIPTION	DATE	APPR.

MARK	DESCRIPTION	DATE	APPR.

U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

DESIGNED BY: DSG
DATE: JANUARY 2010
DWN BY: DSG
CKD BY:
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SUBMITTED BY:
CONTRACT NO.: W912BF-10-C-0XXX
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FILE NUMBER: CC1-170
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PLOT SCALE: 0.0833 ft / in.
PLOT DATE: 11/23/2010

GOOSE CREEK
ENVIRONMENTAL RESTORATION PROJECT
BOULDER, COLORADO

SITE PLAN
SHEET 1 OF 6

SHEET IDENTIFICATION NUMBER
CG101

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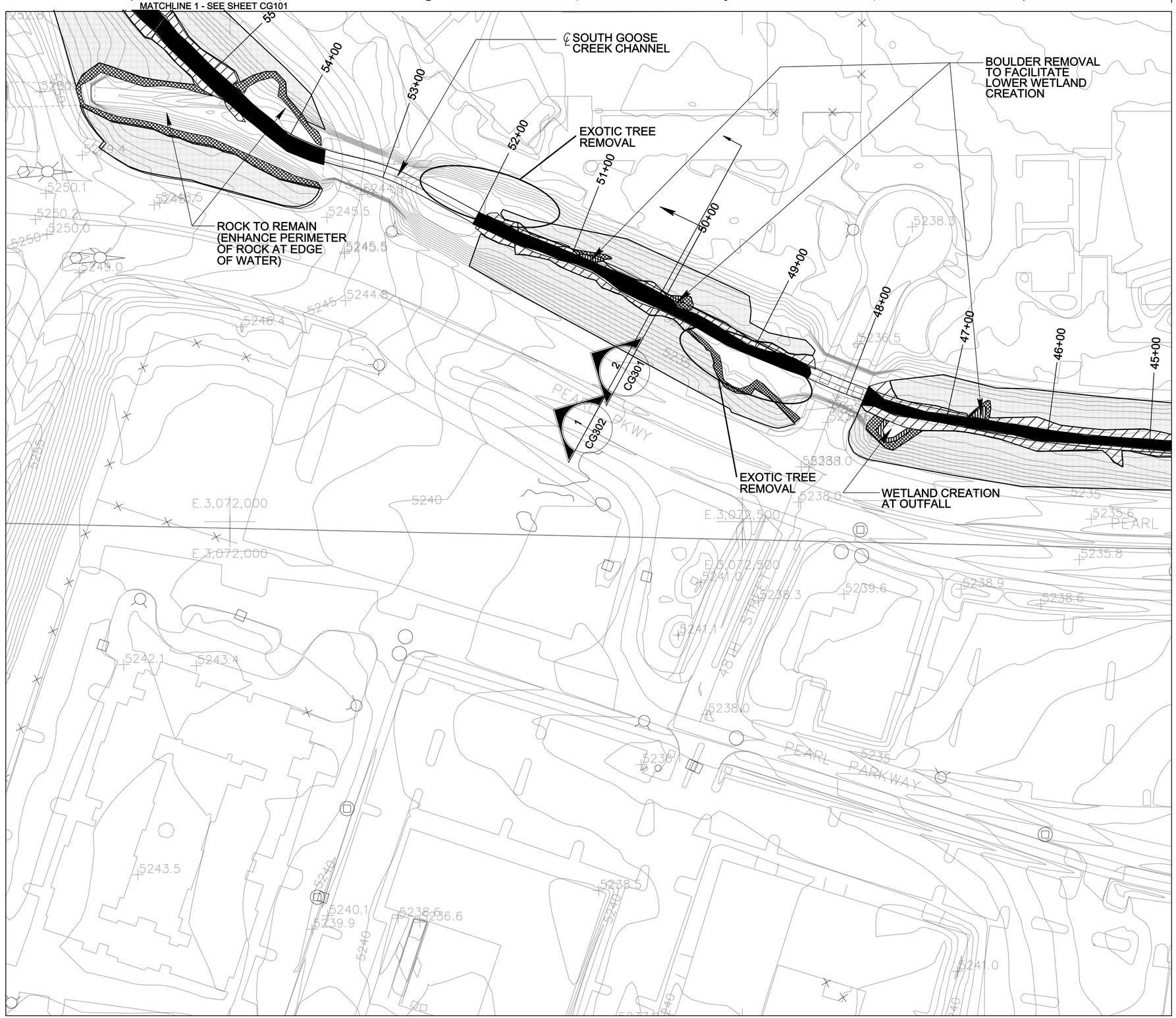

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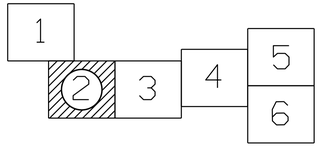

SHEET KEYPLAN

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SCALE: 1" = 50'-0"

US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT

MARK	DESCRIPTION	DATE	APPR.

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U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

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GOOSE CREEK
ENVIRONMENTAL RESTORATION PROJECT
BOULDER, COLORADO

SITE PLAN
SHEET 2 OF 6

SHEET IDENTIFICATION NUMBER
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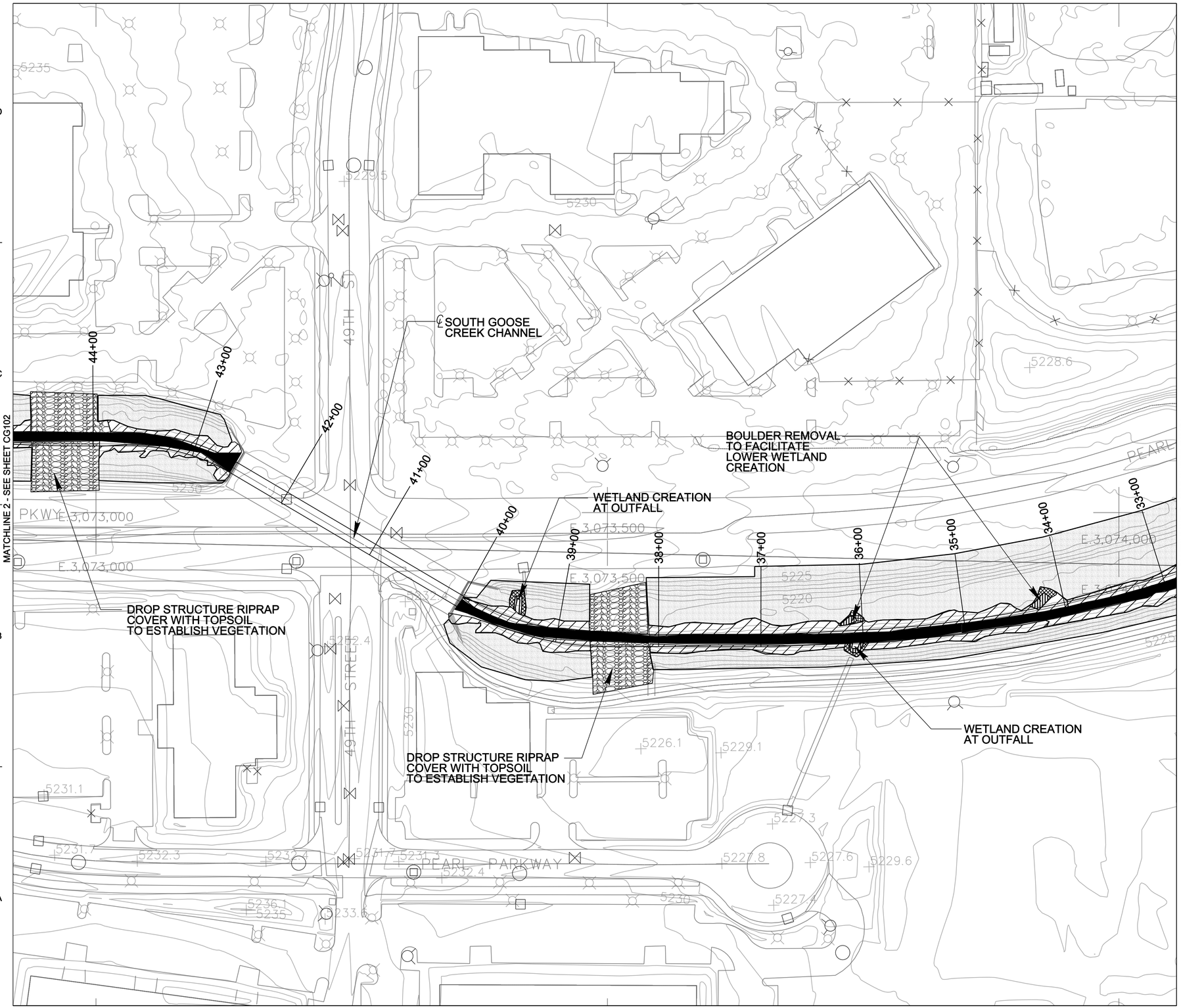

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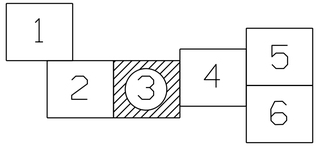

SHEET KEYPLAN

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SCALE: 1" = 50'-0"

US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT

MARK	DESCRIPTION	DATE	APPR.

MARK	DESCRIPTION	DATE	APPR.

U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

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FILE NUMBER: CC-170
PLOT DATE: 1/12/2010

GOOSE CREEK
ENVIRONMENTAL RESTORATION PROJECT
BOULDER, COLORADO

SITE PLAN
SHEET 3 OF 6

SHEET IDENTIFICATION NUMBER
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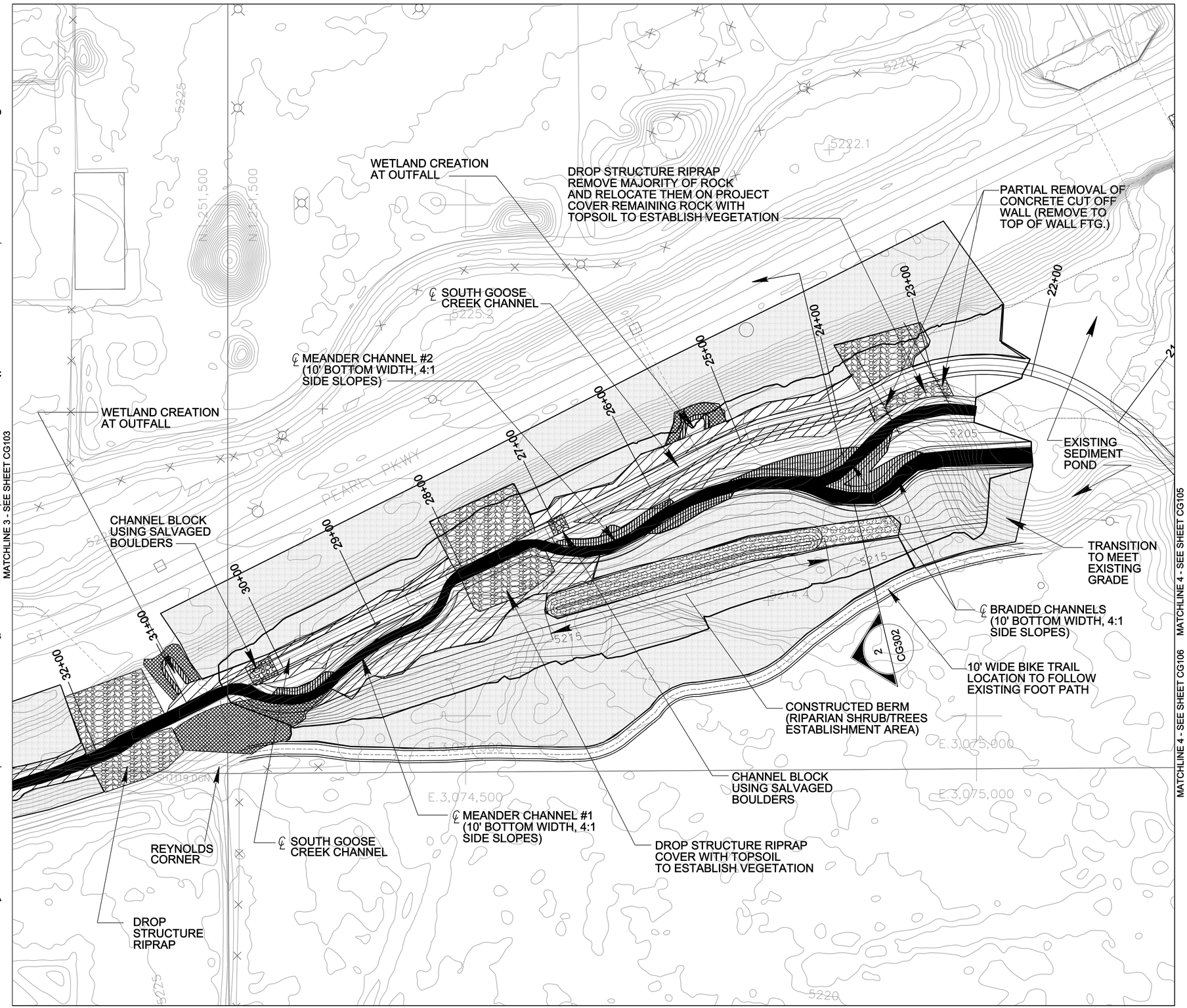

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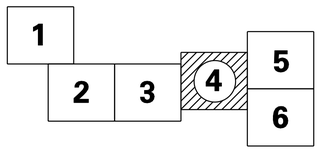
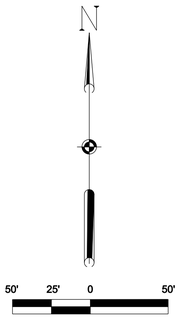


SHEET KEYPLAN



SCALE: 1" = 50'-0"

US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT

MARK	DESCRIPTION	DATE	APPR.

MARK	DESCRIPTION	DATE	APPR.

U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

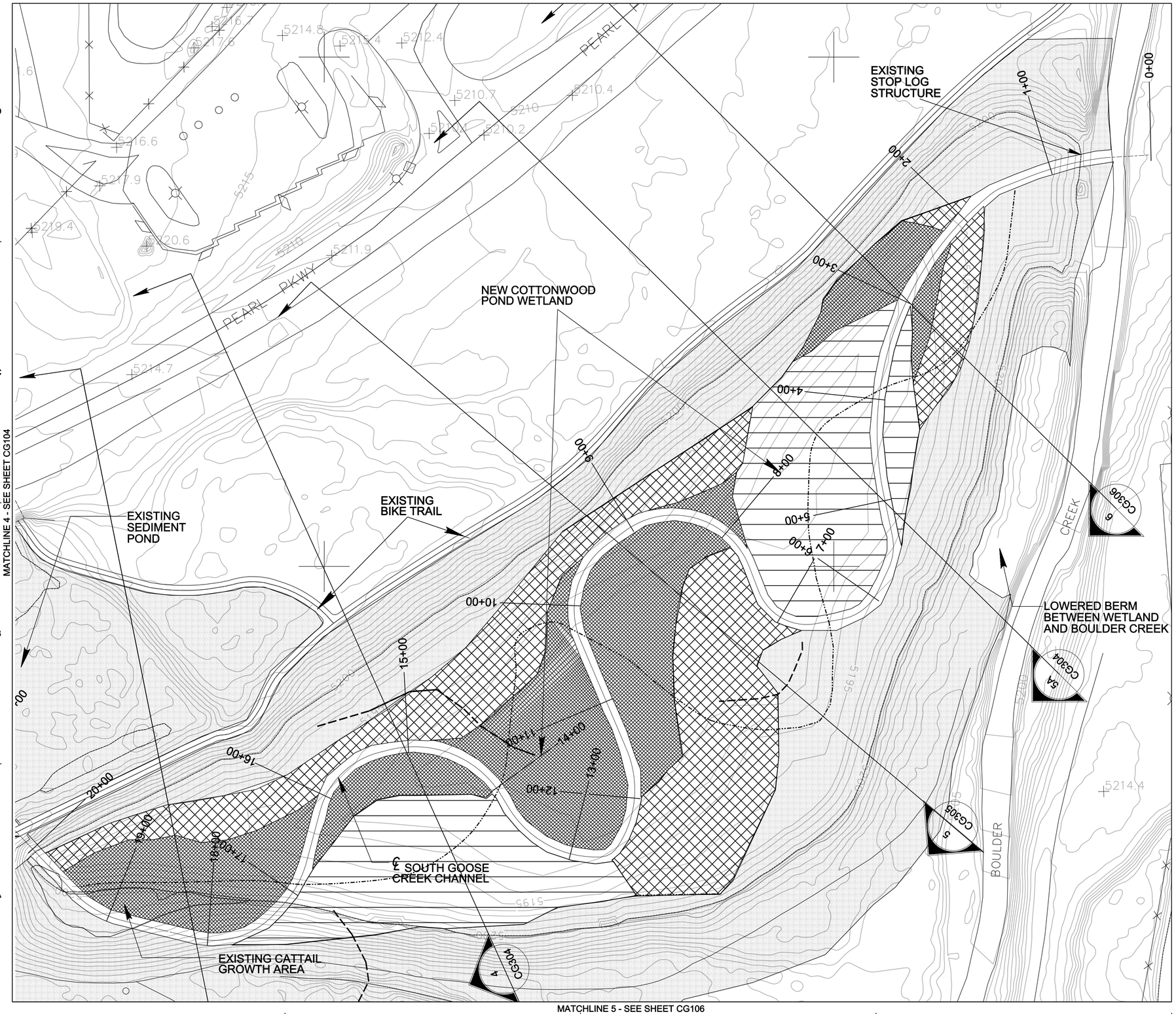
DESIGNED BY: DSG | DATE: JANUARY 2010
DWN BY: DSG | CKD BY: | SOLICITATION NO.: W912BF-0X-B-00XX
SUBMITTED BY: | CONTRACT NO.: W912BF-0X-C-00XX
FILE NAME: C00JCG104.dgn | FILE NUMBER: CC1-170
SIZE: 33.1Kx22 | PLOT SCALE: 0.0833 ft / in. | PLOT DATE: 1/13/2011

GOOSE CREEK
ENVIRONMENTAL RESTORATION PROJECT
BOULDER, COLORADO

SITE PLAN
SHEET 4 OF 6

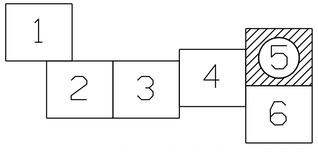
SHEET IDENTIFICATION NUMBER
CG104

I:\dwgs\geotech\C00JCG104.dgn
g6epdxdsg

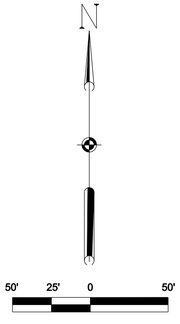


LEGEND

- 5250 — MAJOR CONTOUR
- MINOR CONTOUR
- CENTERLINE ALIGNMENT
- REMNANT OXBOW CHANNEL (12"-36" DEPTH)
- REMNANT STREAM CHANNEL (0"-12" DEPTH)
- PRAIRIE (UPLAND BUFFER)
- WET PRAIRIE / TRANSITION MIX (0"-6" DEPTH TO 24" ABOVE WATER SURFACE)
- TRANSITION / WETLAND EDGE (6"-18" DEPTH)
- COTTONWOOD / WILLOW RIPARIAN ZONE (6"-24" ABOVE WATER SURFACE)



SHEET KEYPLAN



SCALE: 1" = 50'-0"

US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT

MARK	DESCRIPTION	DATE	APPR.

MARK	DESCRIPTION	DATE	APPR.

U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

DESIGNED BY: DSC
DATE: JANUARY 2010
DWN BY: DSC
CKD BY:
SOLICITATION NO.: W912BF-07-B-0007
SUBMITTED BY: RECOMMENDED:
CONTRACT NO.: W912BF-07-C-0007
FILE NAME: C003CG105.dgn
FILE NUMBER: CG-170
SIZE: 33.1X22
PLOT SCALE: 0.0833 ft / in.
PLOT DATE: 11/23/2010

GOOSE CREEK
ENVIRONMENTAL RESTORATION PROJECT
BOULDER, COLORADO

SITE PLAN
SHEET 5 OF 6

SHEET IDENTIFICATION NUMBER
CG105

I:\dwgs\geotech\C003CG105.dgn
g6edxcmc

MATCHLINE 5 - SEE SHEET CG105

MATCHLINE 4 - SEE SHEET CG104

CRACK WILLOW TREE REMOVAL ZONE

CG303 3

E.3,075,500

E.3,076,000

5215

APPROX. PROJECT BOUNDARY LINE

BOULDER CREEK

BOULDER CREEK

WATER EL. 5206.6

LEGEND

5250	MAJOR CONTOUR
	MINOR CONTOUR
	CENTERLINE ALIGNMENT
	REMNANT OXBOW CHANNEL (12"-36" DEPTH)
	REMNANT STREAM CHANNEL (0"-12" DEPTH)
	PRAIRIE (UPLAND BUFFER)
	WET PRAIRIE / TRANSITION MIX (0"-6" DEPTH TO 24" ABOVE WATER SURFACE)
	TRANSITION / WETLAND EDGE (6"-18" DEPTH)
	COTTONWOOD / WILLOW RIPARIAN ZONE (6"-24" ABOVE WATER SURFACE)

1 2 3 4 5 6

SHEET KEYPLAN

N

50' 25' 0 50'

SCALE: 1" = 50'-0"

US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT

MARK	DESCRIPTION	DATE	APPR.

MARK	DESCRIPTION	DATE	APPR.

U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

DESIGNED BY: DSG
DWN BY: DSG
CKD BY:
SUBMITTED BY:
FILE NAME: C003CG106.dgn
SIZE: 33.1X22
PLOT SCALE: 0.0833 ft / in.
DATE: JANUARY 2010
SOLICITATION NO.: W912BF-10-X-B-0XXX
CONTRACT NO.: W912BF-10-C-0XXX
FILE NUMBER: CC1-170
PLOT DATE: 11/23/2010

GOOSE CREEK
ENVIRONMENTAL RESTORATION PROJECT
BOULDER, COLORADO

SITE PLAN
SHEET 6 OF 6

SHEET IDENTIFICATION NUMBER
CG106

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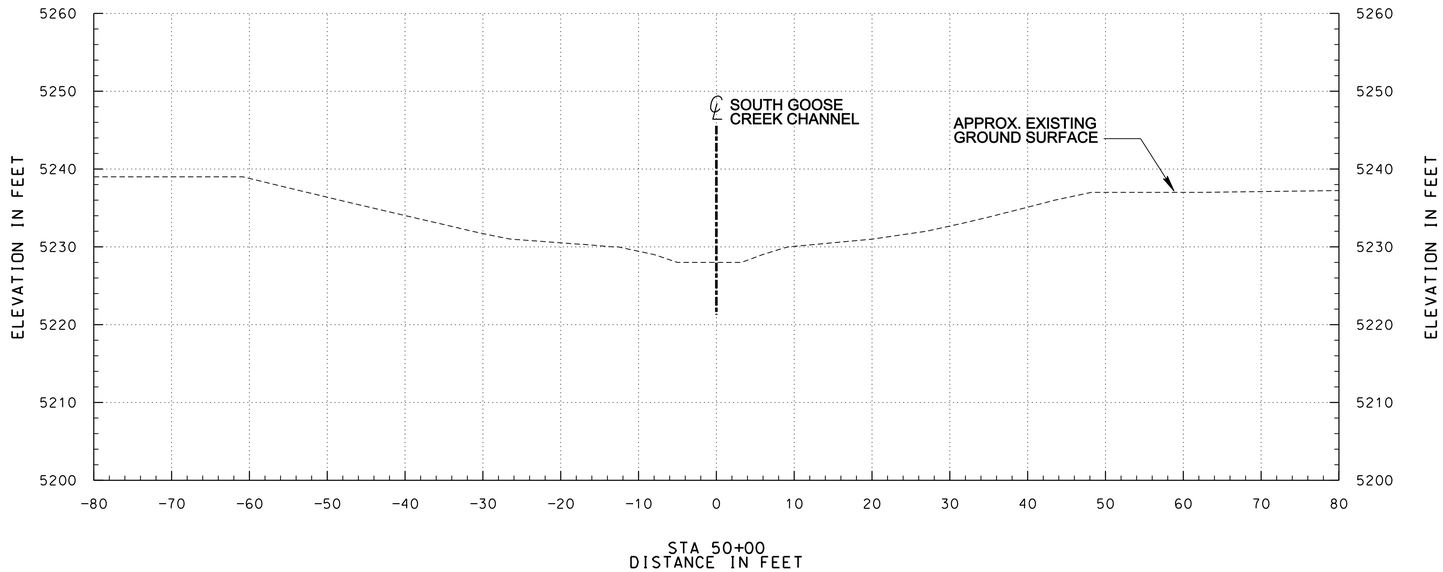
g6ed3xcmc



TYPICAL CROSS SECTION - REACH 1

1
CG102 | CG301

(NO CHANNEL GRADING IN THIS REACH)

10' 5' 0 10'

SCALE: 1" = 10'-0"

US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT

MARK	DESCRIPTION	DATE	APPR.

MARK	DESCRIPTION	DATE	APPR.

U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

DESIGNED BY: DSC
DATE: JANUARY 2010
DWN BY: DSC
CKD BY:
SOLICITATION NO.: W912BF-07-B-0007
SUBMITTED BY: SHEET 1 OF 1
CONTRACT NO.: W912BF-07-C-0007
FILE NAME: C003CG301.dgn
FILE NUMBER: CG1-170
SIZE: 33.1X22
PLOT SCALE: 0.0833 ft / in.
PLOT DATE: 11/17/2010

GOOSE CREEK
ENVIRONMENTAL RESTORATION PROJECT
BOULDER, COLORADO

CROSS SECTIONS
SHEET 1 OF 8

SHEET IDENTIFICATION NUMBER
CG301

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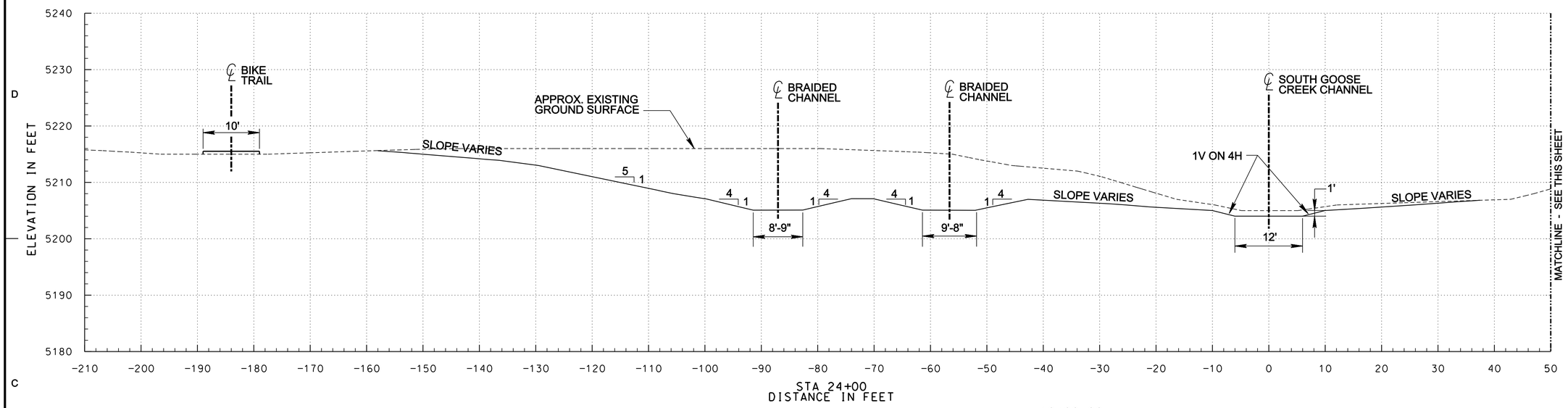
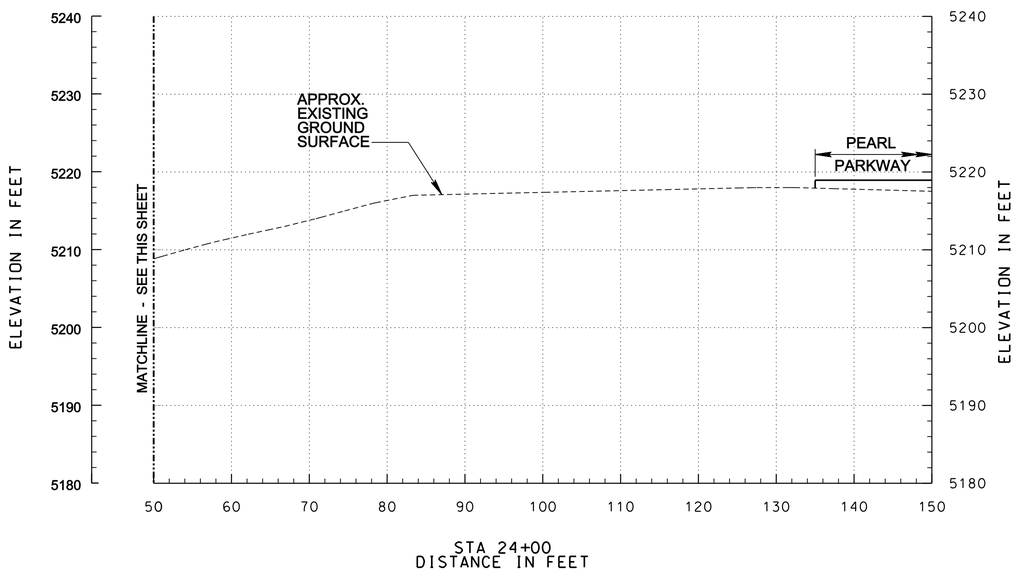


CROSS SECTION - REACH 2 DOWNSTREAM OF REYNOLD'S CORNER

2
CG104 | CG302

LOWER FLOOD PLAIN RESTORATION



10' 5' 0 10'
SCALE: 1" = 10'-0"

US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT

MARK	DESCRIPTION	DATE	APPR.

MARK	DESCRIPTION	DATE	APPR.

U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

DESIGNED BY: DSC
DATE: JANUARY 2010
DWN BY: DSC
CKD BY:
SOLICITATION NO.: W912BF-07-B-0007
SUBMITTED BY: SHEET MANAGER
CONTRACT NO.: W912BF-07-C-0007
FILE NAME: C003CG302.dgn
FILE NUMBER: CG-170
SIZE: 33.1X22
PLOT SCALE: 0.0833 ft / in.
PLOT DATE: 11/17/2010

GOOSE CREEK
ENVIRONMENTAL RESTORATION PROJECT
BOULDER, COLORADO

CROSS SECTIONS
SHEET 2 OF 8

SHEET IDENTIFICATION NUMBER
CG302

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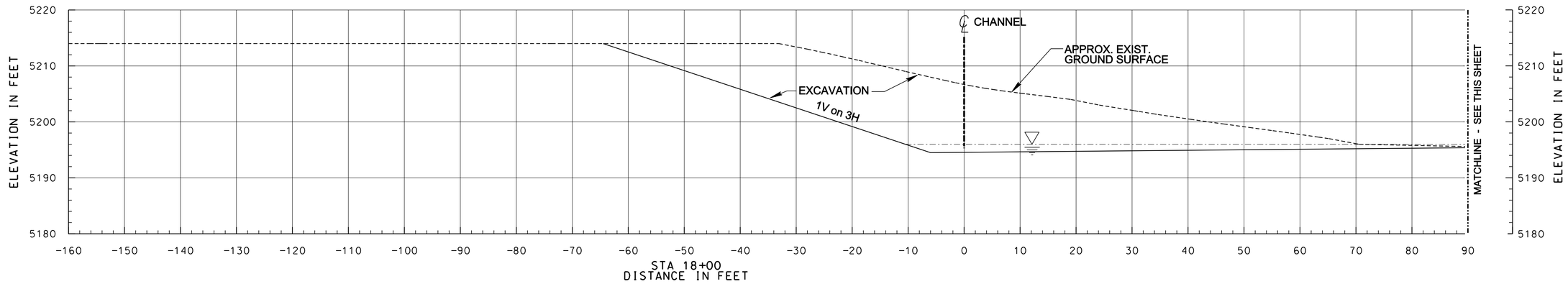
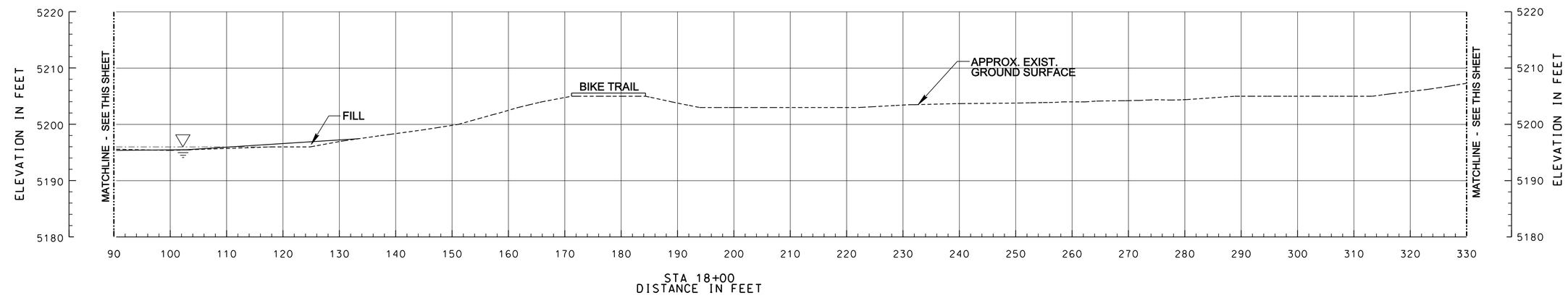
g6edxcmc



CROSS SECTION REACH 3 - COTTONWOOD POND WETLAND

3
CG105 | CG303

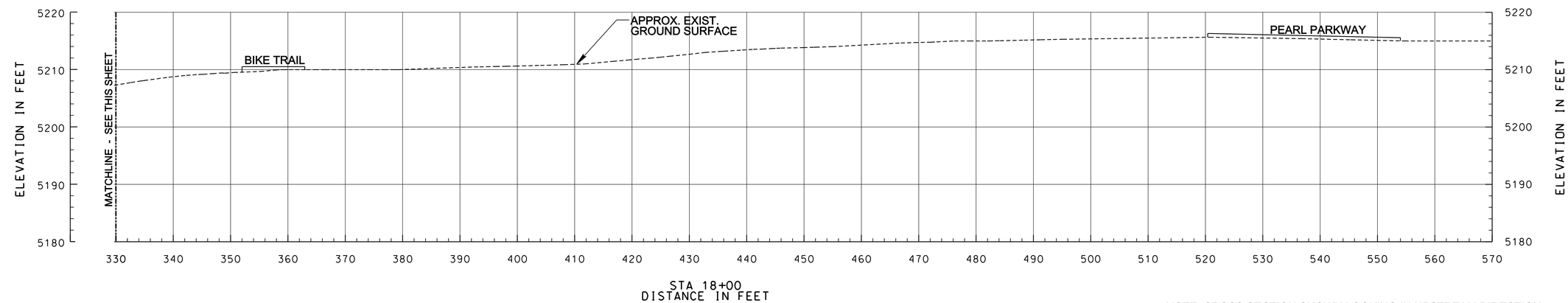
(NO POND GRADING THIS CROSS SECTION)



CROSS SECTION REACH 3 - COTTONWOOD POND WETLAND

3
CG105 | CG303

(NO POND GRADING THIS CROSS SECTION)



CROSS SECTION REACH 3 - COTTONWOOD POND WETLAND

3
CG105 | CG303

(NO POND GRADING THIS CROSS SECTION)

NOTE: CROSS SECTION SHOWN LOOKING IN UPSTREAM DIRECTION.

10' 5' 0 10'

SCALE: 1" = 10'-0"

US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT

MARK	DESCRIPTION	DATE	APPR.

MARK	DESCRIPTION	DATE	APPR.

U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

DESIGNED BY: DSG | DATE: JANUARY 2010
DWN BY: DSG | CKD BY: | SOLICITATION NO.: W912EF-10-X-B-003X
SUBMITTED BY: | CONTRACT NO.: W912EF-10-C-0XXX
FILE NAME: C003CG303.dgn | FILE NUMBER: CC-170
SIZE: 33.1X22 | PLOT SCALE: 0.0833 ft / in. | PLOT DATE: 1/13/2011

GOOSE CREEK
ENVIRONMENTAL RESTORATION PROJECT
BOULDER, COLORADO

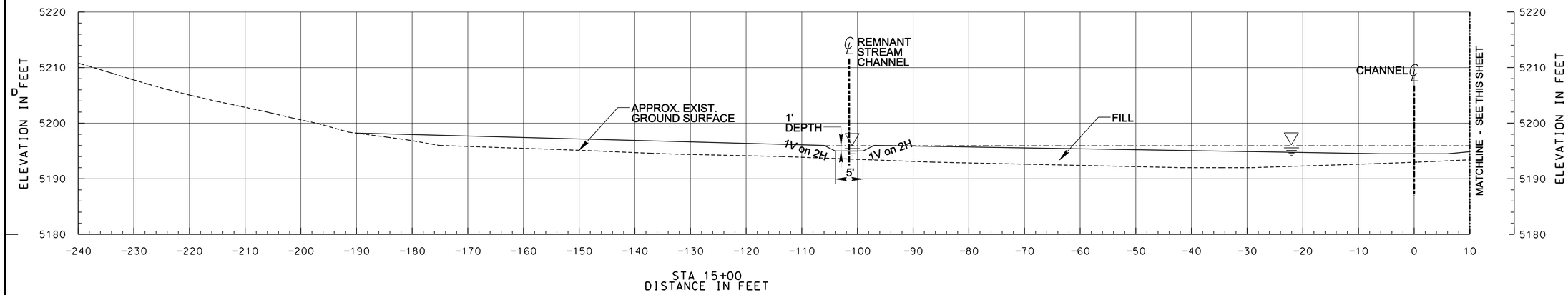
CROSS SECTIONS
SHEET 3 OF 8

SHEET IDENTIFICATION NUMBER
CG303

I:\dwgs\geotech\C003CG303.dgn

g6edxdsg

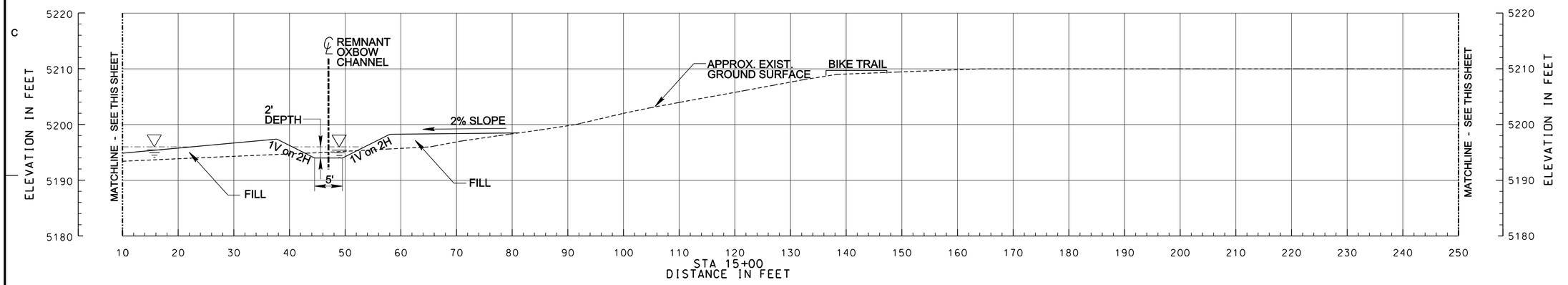
D



CROSS SECTION REACH 3 - COTTONWOOD POND WETLAND

4
CG105 | CG304

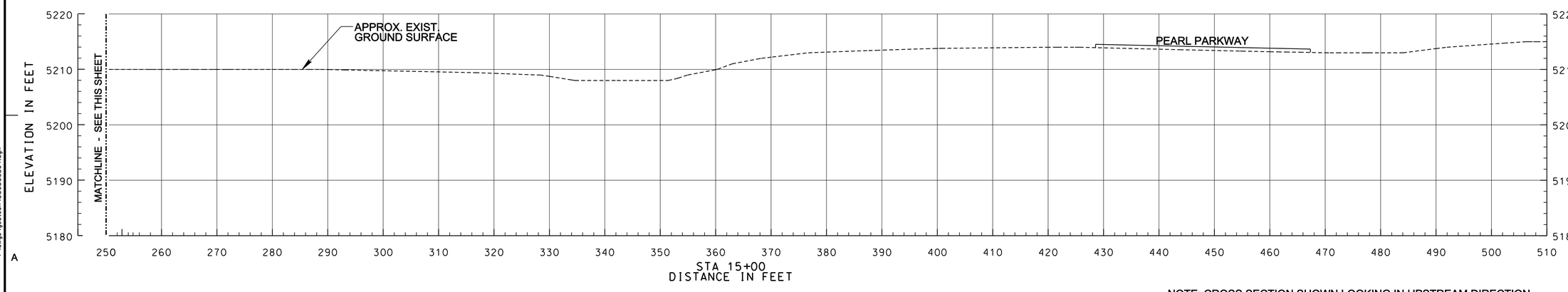
C



CROSS SECTION REACH 3 - COTTONWOOD POND WETLAND

4
CG105 | CG304

B



CROSS SECTION REACH 3 - COTTONWOOD POND WETLAND

4
CG105 | CG304

A

NOTE: CROSS SECTION SHOWN LOOKING IN UPSTREAM DIRECTION.

10' 5' 0 10'

SCALE: 1" = 10'-0"

US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT

MARK	DESCRIPTION	DATE	APPR.

MARK	DESCRIPTION	DATE	APPR.

DESIGNED BY: DSG
DWN BY: DSG
CKD BY:
SUBMITTED BY:
FILE NAME: C003CG304.dgn
SIZE: 33.1X22
PLOT SCALE: 0.0833 ft / in.
DATE: JANUARY 2010
SOLICITATION NO.: W912BF-10-X-B-0011
CONTRACT NO.: W912BF-10-C-0011
FILE NUMBER: CC1-170
PLOT DATE: 1/13/2011

U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

GOOSE CREEK
ENVIRONMENTAL RESTORATION PROJECT
BOULDER, COLORADO

CROSS SECTIONS
SHEET 4 OF 8

SHEET IDENTIFICATION NUMBER
CG304

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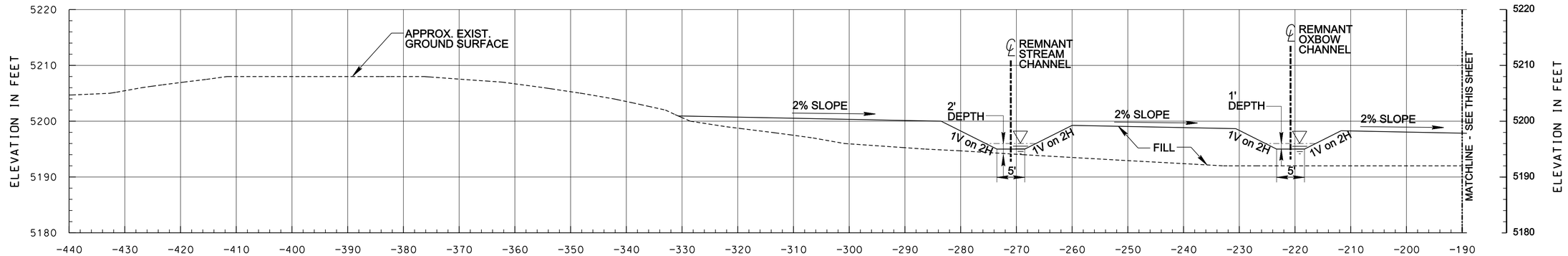
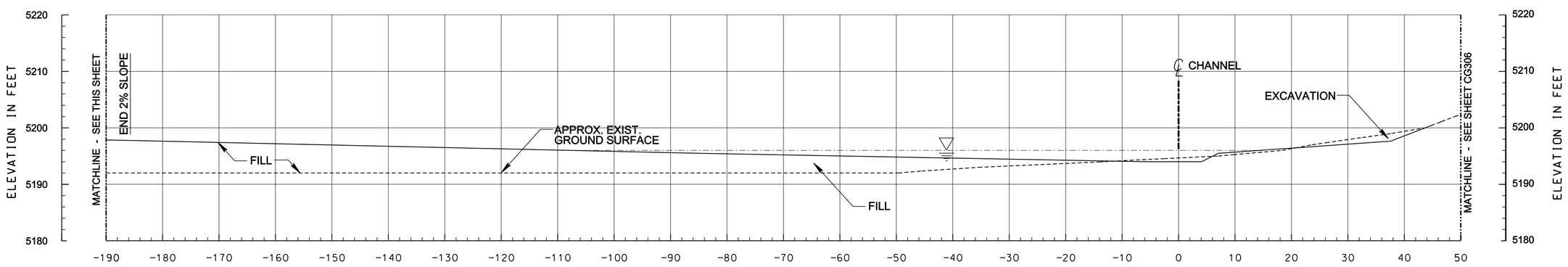


STA 9+20
DISTANCE IN FEET

CROSS SECTION - REACH 3 - COTTONWOOD POND WETLAND

5
CG105 | CG305



STA 9+20
DISTANCE IN FEET

CROSS SECTION - REACH 3 - COTTONWOOD POND WETLAND

5
CG105 | CG305

NOTE: CROSS SECTION SHOWN LOOKING IN UPSTREAM DIRECTION.

10' 5' 0 10'
SCALE: 1" = 10'-0"

US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT

MARK	DESCRIPTION	DATE	APPR.

MARK	DESCRIPTION	DATE	APPR.

U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

DESIGNED BY: DSC
DWN BY: DSC
CKD BY:
SUBMITTED BY:
FILE NAME: C003CG305.dgn
DATE: JANUARY 2010
SOLICITATION NO.: W912BF-07-B-0007
CONTRACT NO.: W912BF-07-C-0007
FILE NUMBER: CC-170
PLOT DATE: 1/13/2011
SIZE: 33.1X22
PLOT SCALE: 0.0833 ft / in.

GOOSE CREEK
ENVIRONMENTAL RESTORATION PROJECT
BOULDER, COLORADO

CROSS SECTIONS
SHEET 5 OF 8

SHEET IDENTIFICATION NUMBER
CG305

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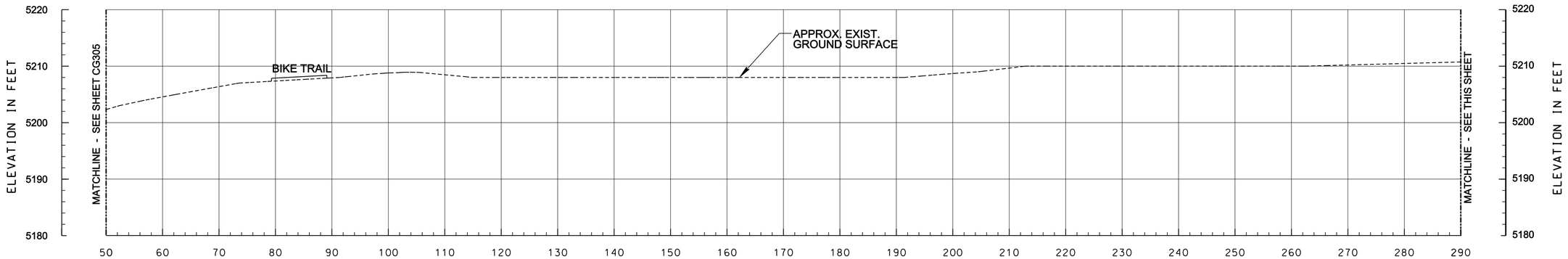
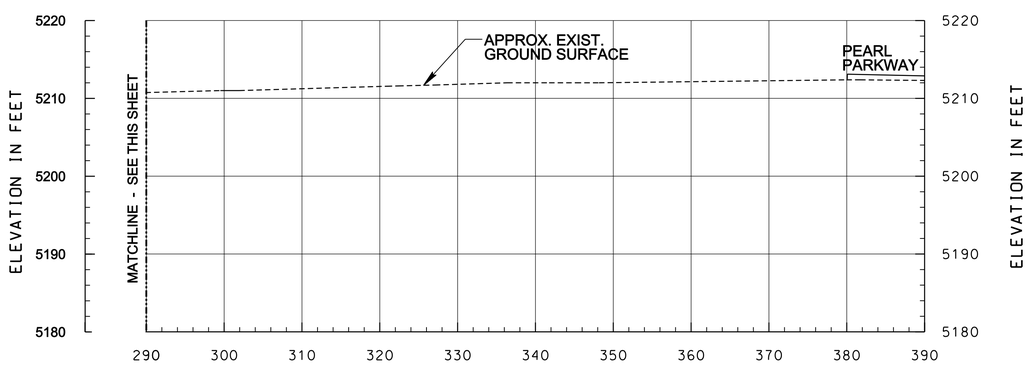


STA 9+20
DISTANCE IN FEET

CROSS SECTION - REACH 3 - COTTONWOOD POND WETLAND

5
CG105 | CG306



STA 9+20
DISTANCE IN FEET

CROSS SECTION - REACH 3 - COTTONWOOD POND WETLAND

5
CG105 | CG306

NOTE: CROSS SECTION SHOWN LOOKING IN UPSTREAM DIRECTION.

10' 5' 0 10'
SCALE: 1" = 10'-0"

US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT

MARK	DESCRIPTION	DATE	APPR.

MARK	DESCRIPTION	DATE	APPR.

U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

DESIGNED BY: DSC
DATE: JANUARY 2010
DWN BY: DSC
CKD BY:
SOLICITATION NO.: W912BF-07-B-0007
SUBMITTED BY: SENIOR PROJECT ENGINEER
CONTRACT NO.: W912BF-07-C-0007
FILE NAME: C003CG306.dgn
FILE NUMBER: CG1-170
SIZE: 33.1X22
PLOT SCALE: 0.0833 ft / in.
PLOT DATE: 1/13/2011

GOOSE CREEK
ENVIRONMENTAL RESTORATION PROJECT
BOULDER, COLORADO

CROSS SECTIONS
SHEET 6 OF 8

SHEET IDENTIFICATION NUMBER
CG306

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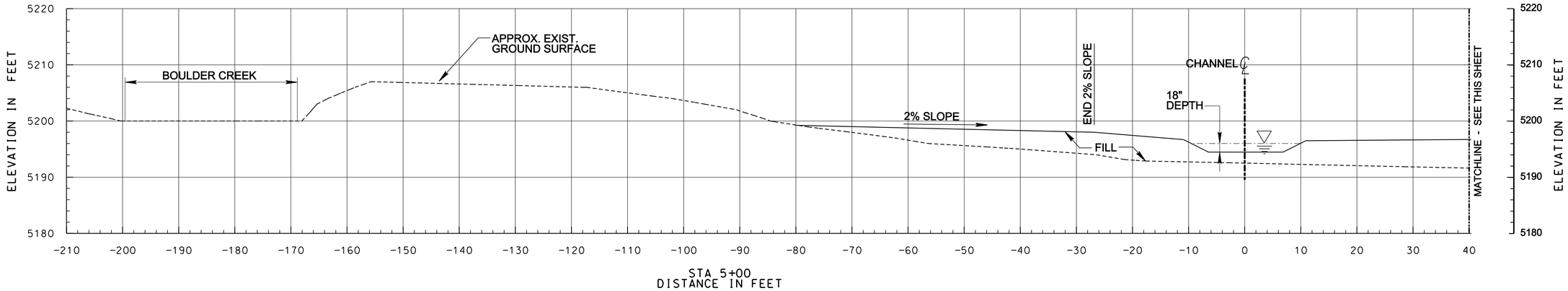
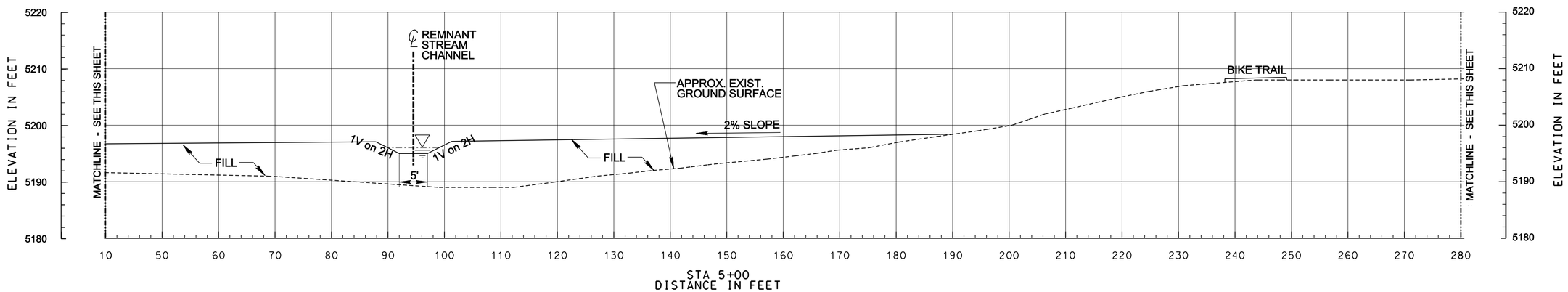


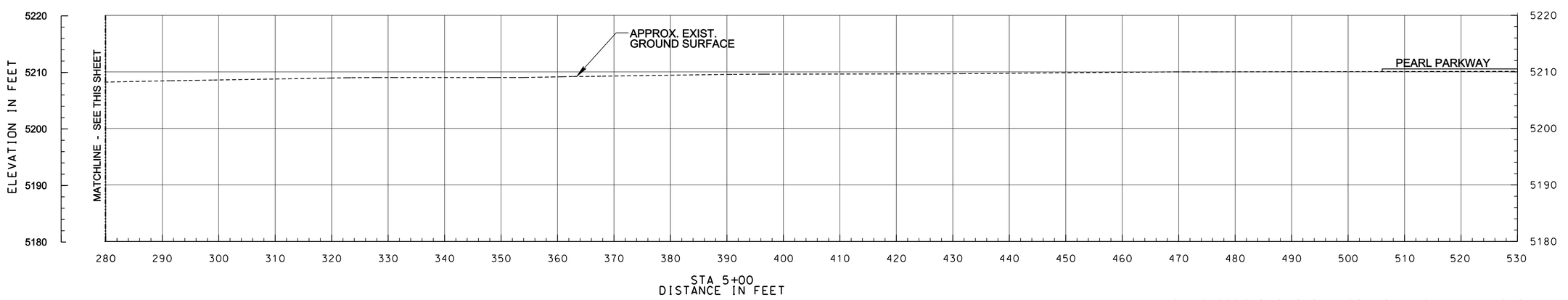
CROSS SECTION REACH 3 - COTTONWOOD POND WETLAND

5A
CG105 | CG307



CROSS SECTION REACH 3 - COTTONWOOD POND WETLAND

5A
CG105 | CG307



CROSS SECTION REACH 3 - COTTONWOOD POND WETLAND

5A
CG105 | CG307

NOTE: CROSS SECTION SHOWN LOOKING IN UPSTREAM DIRECTION.

10' 5' 0 10'
SCALE: 1" = 10'-0"

US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT

MARK	DESCRIPTION	DATE	APPR.	MARK	DESCRIPTION	DATE	APPR.

DESIGNED BY: DSG
DWN BY: DSG
CKD BY:
SUBMITTED BY:
FILE NAME: C003CG307.dgn
SIZE: 33.1X22
PLOT SCALE: 0.0833 1 / 1 in.
DATE: JANUARY 2010
SOLICITATION NO.: W912SF-10-X-B-003X
CONTRACT NO.: W912SF-10-C-0030X
FILE NUMBER: CC-170
PLOT DATE: 1/13/2011

U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

GOOSE CREEK
ENVIRONMENTAL RESTORATION PROJECT
BOULDER, COLORADO

CROSS SECTIONS
SHEET 7 OF 8

SHEET IDENTIFICATION NUMBER
CG307

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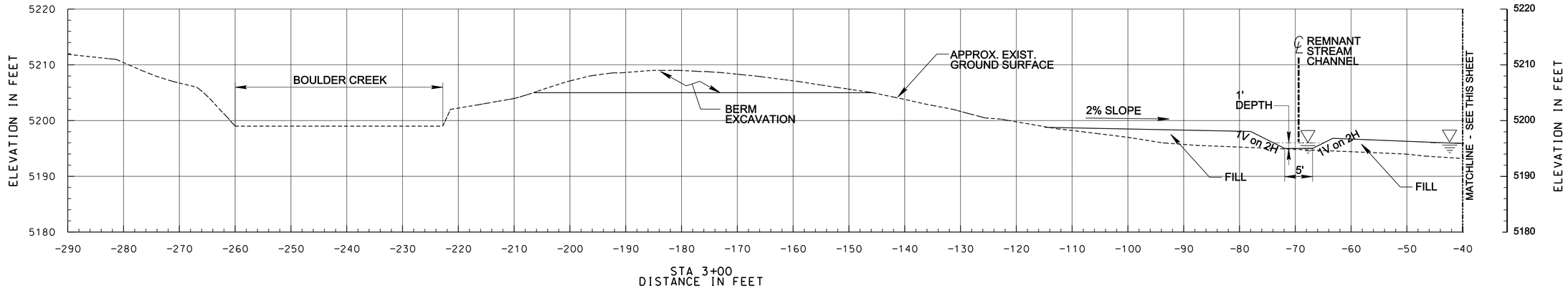
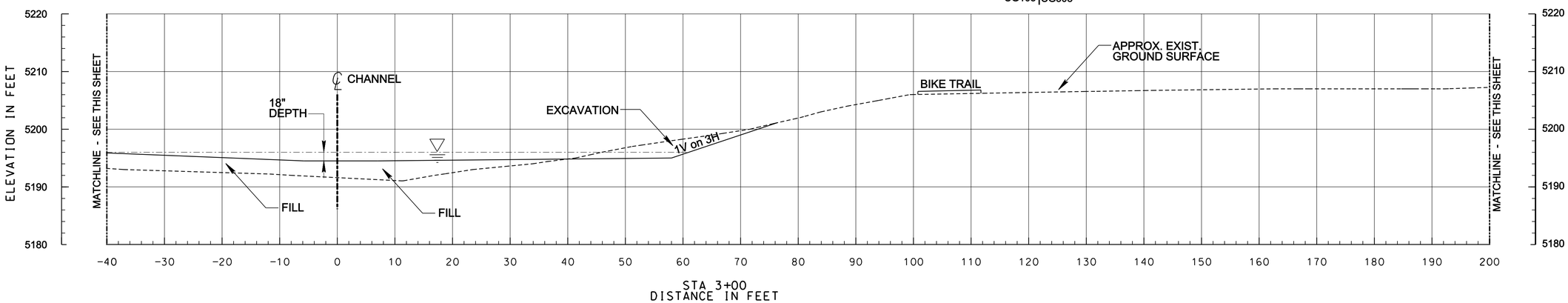


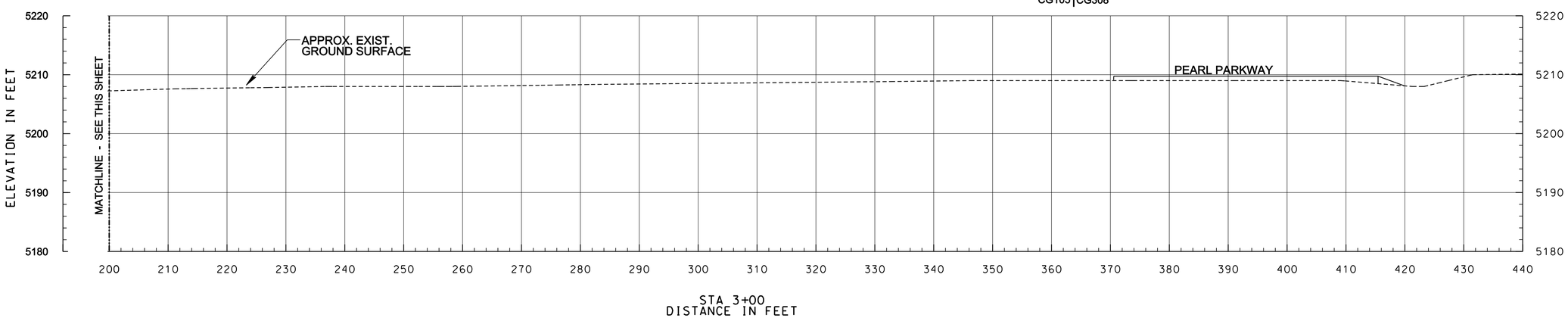
CROSS SECTION - REACH 3 - COTTONWOOD POND WETLAND

6
CG105 | CG308



CROSS SECTION - REACH 3 - COTTONWOOD POND WETLAND

6
CG105 | CG308



CROSS SECTION - REACH 3 - COTTONWOOD POND WETLAND

6
CG105 | CG308

NOTE: CROSS SECTION SHOWN LOOKING IN UPSTREAM DIRECTION.

10' 5' 0 10'
SCALE: 1" = 10'-0"

US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT

MARK	DESCRIPTION	DATE	APPR.

MARK	DESCRIPTION	DATE	APPR.

DESIGNED BY: DSG
DWN BY: DSG
CKD BY:
SUBMITTED BY:
FILE NAME: C003CG308.dgn
SIZE: 33.1x22
PLOT SCALE: 0.0833 ft / in.
DATE: JANUARY 2010
SOLICITATION NO.: W912BF-10-X-B-003XX
CONTRACT NO.: W912BF-10-C-003XX
FILE NUMBER: CC1-170
PLOT DATE: 1/13/2011

U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA, NEBRASKA

GOOSE CREEK
ENVIRONMENTAL RESTORATION PROJECT
BOULDER, COLORADO

CROSS SECTIONS
SHEET 8 OF 8

SHEET IDENTIFICATION NUMBER
CG308

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g6edxdsg

US Army Corps of Engineers ®
Omaha District

GOOSE CREEK
BOULDER, COLORADO

SECTION 206
ECOSYSTEM RESTORATION REPORT

APPENDIX F -
GIS

JUNE 2011

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Goose Creek at Boulder, CO
Section 206 Study

Geospatial Data Holdings
as of
January 2008

This image demonstrates the detail typical of 0.5' pixel resolution photography.
Imagery is from the '2003 black and white' dataset.

Area shown is the northeast portion of Cottonwood Pond, where overflow enters Boulder Creek.
Note the detail of tree limb shadows on the trail and prairie dog villages to the northwest.
Scale is 1:700

GOOSE CREEK AT BOULDER, CO
SEC. 206 STUDY

Geospatial Data Holdings
January 9, 2008

Introduction

Geographic Information Systems (GIS) utilize geospatial data for a wide variety of analysis and visual display. The USACE uses the ESRI suite of GIS software, with ArcMap being the basic program. Geospatial data falls into two broad categories; raster and vector. The raster format is used for imagery such as aerial photography and consists of rows and columns of cells. Resolution is a product of cell, or pixel, size maintained throughout image acquisition, processing, and product delivery. The smaller the cell size the higher the resolution, which yields a 'sharper' image. As cell size decreases file size of course increases. A balance is pursued between what we need to visualize compared to manageable file size. You may notice imagery files with an extension of .sid., denoting the image has been transformed by a product (MrSID) that reduces file size while maintaining visual sharpness The 2003 imagery has cell dimensions of 0.5' X 0.5', considered "high resolution" imagery compared to typical unclassified imagery. Vector is the other broad format for geospatial data and consists of lines, polygons and points. Examples of vector data associated with this project include: lines, as centers of roads; polygons, as ponds or parcel boundaries; and points, often used for well locations. Vector data has been attributed with road names, parcel information etc., which allows us to start using the power of GIS. Another file extension you may notice is .mdb which signifies a Microsoft Access file. ESRI treats these files as geo-databases. They have grown in popularity because they offer a way to organize related data into one package allowing data to be managed and updated more accurately and efficiently. Another heavily used ESRI software file format is the "shape" file with the extension of .shp. Shapefiles are sometimes referred to as "themes", a grouping of related data like road centerlines. Attribute, projection and display information is related to the shape file by using the same "root" file name with four to five different extensions. While not technically true, it can be thought that a geo-database consists of multiple shape files. No matter what the format of geospatial data, to be useful for analysis and visualization the data has to be projected, or placed correctly in earth coordinates.

Project Datums and Projections

Unless otherwise noted please assume the following information applies to all data listed:
Projected Coordinate System: NAD_1983_HARN_StatePlane_Colorado_North_FIPS_0501
Projection: Lambert_Conformal_Conic
False_Easting: 3000000.00031608
False_Northing: 999999.99999600
Central_Meridian: -105.50000000
Standard_Parallel_1: 39.71666667
Standard_Parallel_2: 40.78333333
Latitude_Of_Origin: 39.33333333
Linear Unit: Foot_US

continued on next page…

Geographic Coordinate System: GCS_North_American_1983_HARN
Datum: D_North_American_1983_HARN
Prime Meridian: 0
Angular Unit: Degree

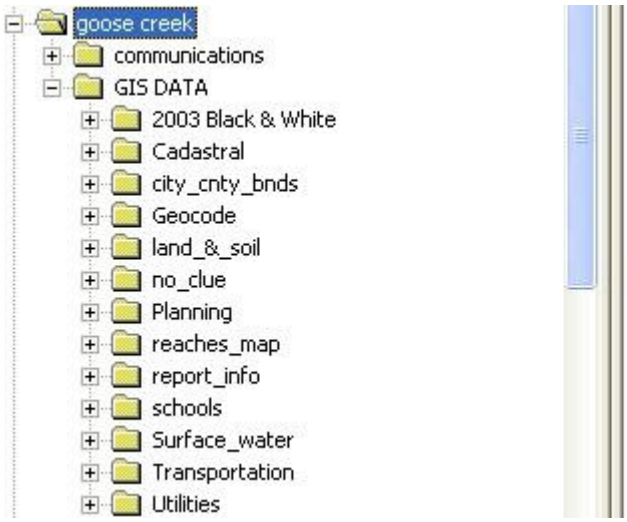
If you are interested in datums and projections visit: http://www.ngs.noaa.gov/faq.shtml; or http://geodesy.noaa.gov/; or http://geodesy.noaa.gov/faq.shtml#HorzDiff.

The geospatial data discussed in this report can be found on the branch drive under /goose creek/ GIS DATA

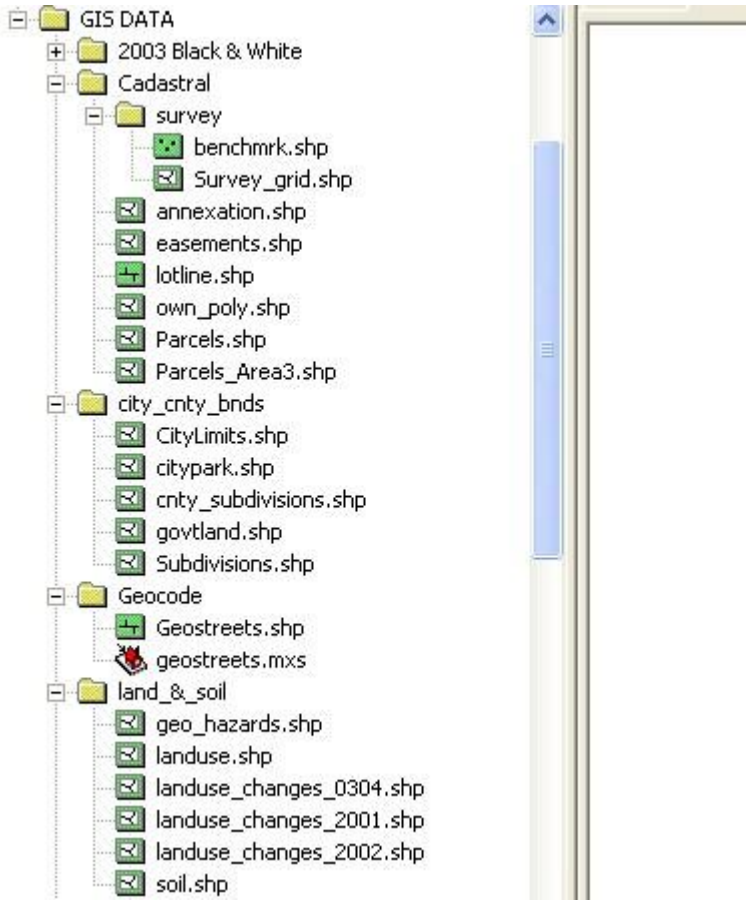
The entire dataset is ~1.04 gigabytes and includes:
-approximately 240 black and white aerial photos in jpeg format totaling ~700 megabytes.
-the "Stormwater" folder contains two MS Office Access geodatabases totaling ~43 megabytes.
-The remaining ~297 megabytes consists of vector datasets.

File Structure:
Every shape file or dataset was reviewed to determine a logical folder assignment. Determination of data type and relevancy was at times not possible. The file structure is presented as a series of increasingly specific ArcCatalogue screen captures.

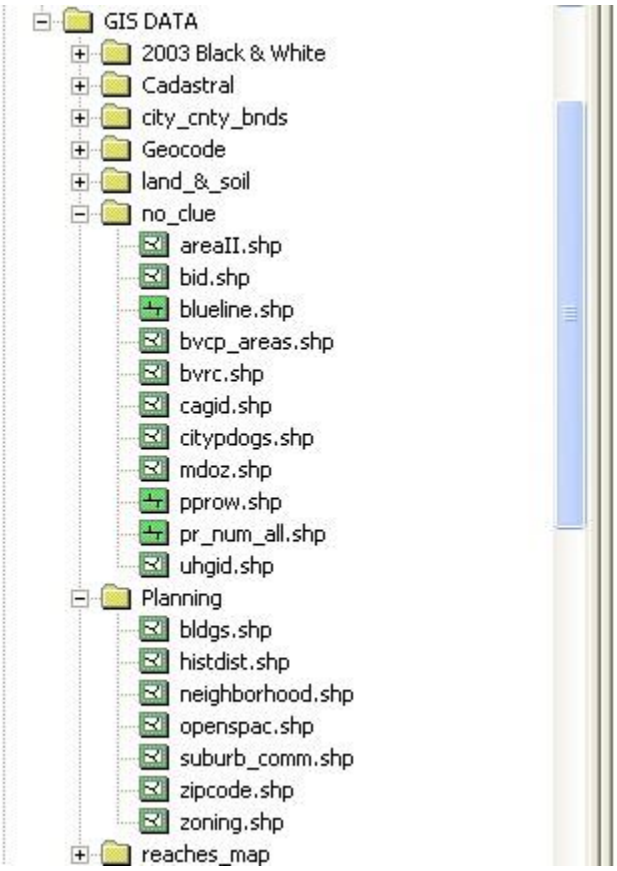
Screen 1: Overall dataset structure-



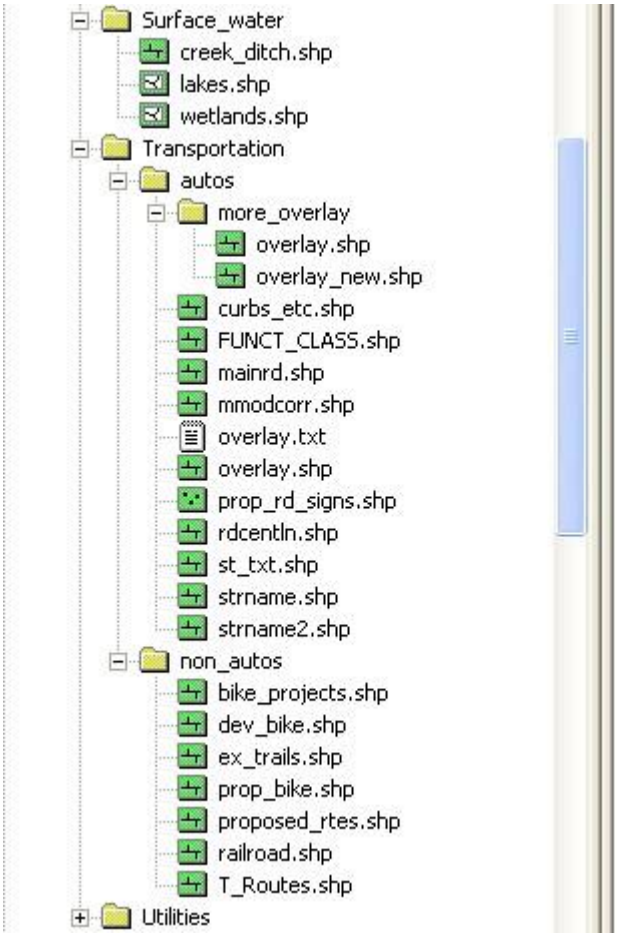
Screen 2: An expansion of the first few data folders. Notice the *.shp extensions on the majority of the data.
Also the pattern in the rectangle preceding the shapefile name indicates the type of vector data within the shapefile. The 3 dots, or points, represents a point shapefile; the horizontal line with vertical spikes indicates a line shapefile; finally, the box being divided into three areas is a polygon shapefile.



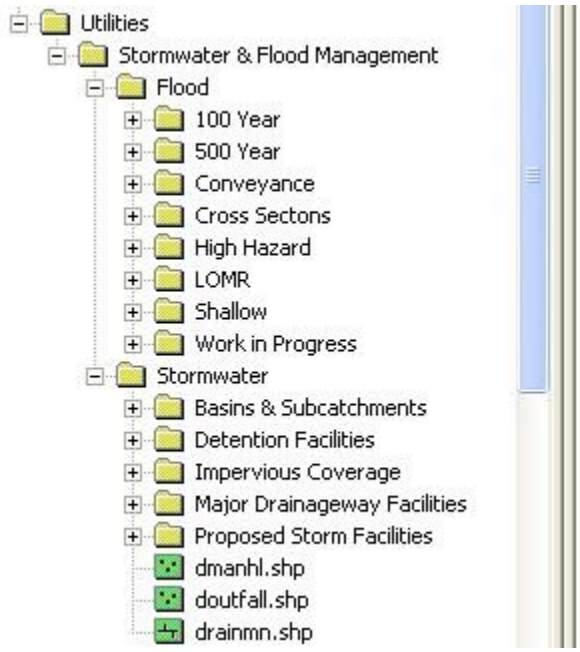
Screen 3: Note that the previous screen ended with an expansion of 'land_&_soil', so this screen begins with the expansion of 'no_clue'. As the name may indicate, 'no_clue' contains shapefiles for which I couldn't determine any meaningful content.



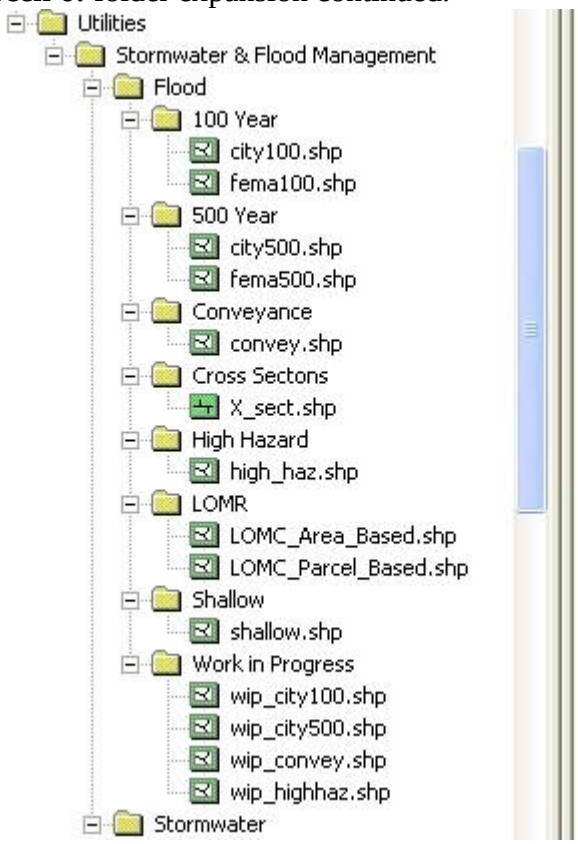
Screen 4: folder expansion continued.



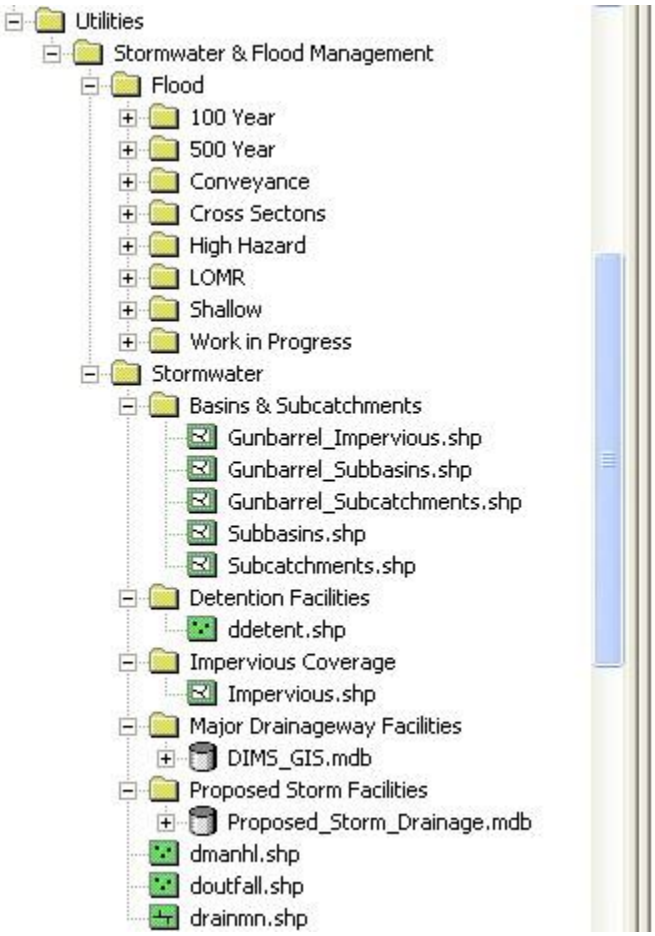
Screen 5: The ‘Utilities’ folder and subordinate folders were left intact, and include:



Screen 6: folder expansion continued.



Screen 7: Notice the *.mdb geodatabase under 'Major Drainageway Facilities' and another under 'Proposed Storm Facilities'.



This concludes the discussion and presentation of geospatial data holdings. If you have questions or would like to have products derived from this database, please let me know.

Ty Sabin
x4202

US Army Corps of Engineers ®
Omaha District

GOOSE CREEK
BOULDER, COLORADO

SECTION 206
ECOSYSTEM RESTORATION REPORT

APPENDIX G -
HYDRAULICS

JUNE 2011

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Goose Creek - Boulder, CO - Existing Conditions Hydraulic Analysis

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Goose Creek - Boulder, Colorado
Existing and Project Condition Hydraulic Analysis

1. Introduction

A hydraulic study was conducted of Goose Creek within Boulder, Colorado. The study reach begins near Foothills Parkway and follows along Pearl Parkway to the confluence with Boulder Creek, a distance of approximately 1.5 miles. This portion of the stream is surrounded by commercial development and has been channelized its entire length to accommodate storm water flows. Computations were performed to evaluate stages and define flood potential for the existing reach conditions and then modified to reflect the final proposed project design. Flow rates and water surface profiles for the study reach were computed using a model from the standard step backwater program HEC-RAS.

Computations were performed for a range of flow events. The major design consideration for the existing channel of Goose Creek was to contain the 100-year flood (0.01 annual chance of exceedance). event within the channel. A split flow analysis was previously performed to determine flow splits between the North and South Goose Creek channels extending downstream to Cottonwood Pond and the confluence with Boulder Creek. A general location map illustrating project location and layout is shown in Figure 1.

Figure 1. Project Location Map

2. Historical Information

The primary cause of flooding on Goose Creek and other small streams along the Boulder Front Range area are heavy localized thunderstorms. Significant flooding is known to have occurred in August 1951 and again in July 1954. Damage from the 1954 storm included flooding to an addition under construction at the Community Hospital at the intersection of Broadway Street and Alpine Avenue. Headwaters for Goose Creek are entirely located below 9,000 feet. As a result, snowmelt does not significantly impact peak discharges as occurs on Boulder Creek and other larger streams in the region.

3. Geomorphologic Data and Soils Information

Little is known about the natural condition of bed materials in and around the Boulder area. All local streams in Boulder have been modified for flood protection or grade control purposes, including the current study reach. The existing channel is concrete lined with full lateral movement controlled by a constructed row of large boulders. Almost no channel evolution has occurred since the previous project was completed in 1988.

Slight sediment deposition along the sides of the concrete lining indicates the optimal width of the low-flow stream channel may be slightly narrower than the existing 8-foot wide path. The typical bend radius for smaller streams of this variety has been documented to be 2.5 times the channel width. This suggests a stable meander pattern for a stream this size may be achieved within approximately a 40 to 50-foot wide base footprint. Any use of grade control structures may induce additional flow pattern requirements to this meander path. Current grade control is provided by a series of drop structures, each about 2 to 3-feet in height. Each of these structures is hardened with a concrete drop and scour protection provided upstream and downstream by a riprap blanket approximately 40-feet in length.

From USGS soil documentation, Goose Creek's headwater soil classification is Type C & D (SCS Classification systems). In those upper reaches, Goose Creek has extensive sections without well-defined channels. Investigation of other small streams along the Foothills Highway corridor in Boulder County were performed to find bed load material sample data. The dominant bed material consisted of medium to coarse graded sands ranging from approximately 2-millimeter grain size diameter layered atop finer alluvial silt material. Along with this some finer sediment depositions and occasional gravel deposits were found sporadically exposed, but not to the extent of sand deposits.

The study reach of Goose Creek is in an urbanized area with occasional open-space and park areas. It is characterized by mild slopes with topsoils classified as B to C range soils (classified hydrologically placed). Vegetation is primarily urban grasses with uniform channel sections having maintained side slopes. Climate of the region is considered semiarid, with average annual precipitation of 18.3 inches of rainfall, and an average annual snowfall of 83 inches. The bulk of the rainfall comes seasonally around May in the form of brief, strong thunderstorms. Temperature extremes at Boulder have mean maximums of 46.3-degrees (Fahrenheit) in January to 88.3-degrees in July (minimums 21.6, 61.0).

4. Study Area Geometries

Geometry data for the 2002 FIS model was obtained from surveys completed in 1989. This data was used to extract cross sections at an interval ranging from 700 to 1300 feet. This provided only 5 detailed cross sections in the reach from Foothills Parkway to Cottonwood Pond. It was then determined this spacing does not provide sufficient detail for water surface comparisons in the short project reach of South Goose Creek where improvements are being made for this study. Additional cross sections were then added from as-built drawings provided by the Urban Drainage and Flood Control District (UDFCD) of the previously completed project. Further data was utilized to relocate cross sections after detailed contour files were made available from the Boulder FTP site allowing a surface to be used for extracting new cross sections.

Overall channel slope through the Pearl Parkway reach of Goose Creek is approximately 0.01 ft/ft, although with drop structures in place, the typical gradient between them is reduced to 0.0049 ft/ft. Land use within the study reach is urban and developed with a large portion of the upstream reach developed as well. The study reach of Goose Creek is a straightened channel with a trapezoidal cross section. Banks are roughly 10-14 feet in height with vegetation consisting of a solid stand of maintained grasses from the top of the channel to the sides of the 8-foot wide concrete lining at the channel invert. During high flow events, split flow occurs as a result of a flow diversion structure at Foothills Parkway dividing discharges between the North and South Goose Creek Channels. Improvements to the south channel exclusively are under analysis for this study.

5. Model Hydrology - Discharges and Split Flow

Hydrologic analysis for the 2002 FIS report was completed using UDFCD's CUHP-B program and the resulting hydrograph was routed through the study reach using the USACE software HEC-1. The total drainage area for Goose Creek at the confluence with Boulder Creek is 5.46 square miles. Split discharges are accounted for just below Foothills Parkway at the North and South Goose Creek channel diversion structure. All peak discharges for a range of flood events are located in Table 1a below.

Table 1a. Goose Creek Study Reach Discharges (cfs)

GOOSE CREEK AT BOULDER, CO				
RETURN PERIOD	10-YR	50-YR	100-YR	500-YR
ANNUAL EXCEEDANCE PROBABILITY	0.1	0.02	0.01	0.002
LOCATION				
Goose Creek upstream of Foothills Parkway	1050	2100	2680	4300
North Goose Creek Flood Channel (Incl. Valmont Creek)	1510	2855	3865	6075
South Goose Creek	1355	2180	2450	3250
Goose Creek at Confluence with Bolder Creek	2865	5065	6315	9325

For many applications, including ecosystem restoration, more frequent discharges can be useful in designing channel features. Among the discharges to be considered are the 2-year (0.5 annual chance of exceedance), bank-full and mean annual floods. Since there is no stream gage on Goose Creek, the more frequent events were extrapolated from the discharge frequency information included in the Flood Insurance Study. These more common events are shown in Table 1b for South Goose Creek and Goose Creek at its

confluence with Boulder Creek.

Table 1b. Goose Creek Study Reach Discharges (cfs)

GOOSE CREEK AT BOULDER, CO									
RETURN PERIOD	Bankfull	2-YR	M. Ann.	5-YR	10-YR	20-YR	50-YR	100-YR	500-YR
ANNUAL EXCEEDANCE PROBABILITY	0.63	0.5	0.43	0.2	0.1	0.05	0.02	0.01	0.002
LOCATION									
South Goose Creek (Below Foothills Parkway)	520	610	685	1040	1355	1700	2180	2450	3250
Goose Creek at Confluence with Bolder Creek	700	1090	1260	2030	2865	3750	5065	6315	9325

6. HEC-RAS Model Development.

Development of cross sections and geometry layout was first developed using ESRI ArcMap software. Modeling incorporated cross section placement to identify drop structures and culverts through the study reach. The weirs at the entrance and outlet of Cottonwood Pond were modeled using cross sections. Channel roughness was modeled using Manning's' n-value. Roughness coefficients were based on field inspection, typical values for the area, and available reference material for native vegetation. Channel n-values were established as 0.035 based on observed conditions of grass lined uniform slopes. Concrete segments at culverts and channel linings utilized a value of 0.018. Overbank flow areas along the Pearl

Parkway reach did not significantly factor into modeling as design discharges are primarily maintained within the channel. However, these values were set at 0.05 to reflect heavier vegetation.

Contraction and expansion coefficients were set at 0.1 and 0.3 through the typical channel sections. Higher values of 0.3 and 0.5 were used at culvert transitions and weirs to account for anticipated energy losses.

Table 2. Existing Condition Manning's n Values

Channel Description/Roughness Type	n-Value
Overbank Portions of Cross Section	0.05
Grass-Lined Channel	0.035
Concrete Channel Segments & Culverts	0.018

7. Downstream Modeling Boundary Conditions.

Several downstream boundary conditions were considered for the Goose Creek study reach. Initially, a normal depth starting water surface slope was determined as 0.007 to begin the stream analysis. This value correlates to the lower end of the existing Goose Creek channel as it enters Boulder Creek. Additional sensitivity analysis was performed using varying starting water surfaces for Boulder Creek under various flood stages recommended in coincident flooding guidance. The final selected starting water surface elevation for the 100-year (0.01 annual chance of exceedance) profile was selected to correlate the Cottonwood Pond elevation impacted by the 10-year (0.1 annual chance of exceedance) flood event on Boulder Creek. Starting water surfaces for the remaining events were determined by shifting water surfaces on Boulder Creek consistent with those found in the FIS study. More severe downstream impacts are considered unlikely due to the dissimilar flooding sources between Boulder and Goose Creeks providing a low risk of coincident flooding for major flood events.

Table 3. Downstream Computed Water Surface Rating Curve

Flood Event (% chance exceedance)	Elevation (ft NAVD 88)
10-year (10%)	5204.5
50-year (2%)	5205.5
100-year (1%)	5206.1
500-year (0.2%)	5207.9

8. Project Design Model Alterations

Changes to be implemented under the Section 206 environmental restoration study include a slight channel widening from approximately 1,000-ft upstream of the bike path weir at the entrance of Cottonwood Pond to the sediment pond at the confluence of the North and South branches of Goose Creek. Cottonwood Pond is to be partially filled to create wetland habitat.

Modifications for the project were evaluated using alterations to the geometry in the HEC-RAS model. Cross sections in the improved areas were altered to reflect a change in roughness (increased by 60%) and also impacts to station/elevation points in the ground surface accounting for the re-grading of the stream channel. The channel was modeled to expand from its current width of 100-ft to approximately 200-ft in width at the sediment pond. Cottonwood Pond was filled with spoil material between 2 and 8-feet in depth across its length for creation of shallow water habitat and wetlands. Peak flow discharges were kept consistent for all four flood events being investigated, which included the 10, 50, 100 and 500-year (0.1, 0.02, 0.1 and 0.002 annual chance of exceedance) event. Results were evaluated to ensure negligible impacts to water surfaces were caused due to the balance of increased cross sectional flow area with the higher channel roughness values brought by new vegetation that is anticipated being supported.

Table 4. Project Condition Manning's n Values

Channel Vegetation Description/Roughness Type	n-Value
Shrubs and Vegetation Capable of Laying Flat In Flows	0.055
Non-Mowed Reeds and Grasses	0.045
Unchanged Concrete Channel Segments & Culverts	0.018

9. Sensitivity Analysis.

A brief sensitivity analysis was performed to evaluate the impacts of parameters such as Manning's roughness values and the downstream starting water surface elevation on computed results. For the 100-year (0.01 annual chance of exceedance)event, the starting water surface elevation was varied both up and down incrementally by up to 2 feet. Resulting computations determined identical results upstream of the first drop structure despite these changes. This is to be expected in a steep stream system. For this reason, impacts in the lower reach are relatively complex due to the high dependence on the boundary conditions created by Boulder Creek downstream.

Varying the roughness impacted the computed water surface profile significantly. Roughness values were both increased and decreased by 20 percent to assess the impact on computed profiles. Changing the roughness value by 20 percent resulted in an average increase or decrease in the computed water surface elevation of 0.5 to 0.9 feet compared to the normal condition which was derived from previous modeling analysis. Final results represent original conditions and are indicative of the expected conditions with reasonable engineering judgment.

10. Modeling Results and Comparison

Results of this analysis indicate the final grading and vegetation plans as proposed will have minimal stage impacts in the Goose Creek basin. The modified grading plans when modeled were found to reduce the 100-year (0.01 annual chance of exceedance) flood profile at all but one cross section (RAS Station 499) which indicated a 0.1' rise. However, this elevation was still well below the previously determined regulatory water surface elevation determined in the 2002 FIS report. These results indicate the final project condition satisfies the intended modeling check by not increasing flooding risk or damages to other properties along the Pearl Parkway corridor. Full results are available in Plates 1 through 9 at the end of this report.

11. Summary.

A hydraulic study was conducted of existing and project conditions of Goose Creek within the city of Boulder, CO. The study reach is from near Foothills Parkway to the confluence with Boulder Creek. Computations were performed to evaluate stages and confirm flood boundaries for the comparison of existing and with-project conditions. Flow rates and water surface profiles for the study reach were computed using the standard step backwater program HEC-RAS. Computations were performed for a range of flow events. Split flow data from the previous FIS study has been employed to separate flows between the North and South Goose Creek channels. Goose Creek occupies a narrow corridor through the city, and any future

development should have little impact on the Goose Creek peak 100-year (0.01 annual chance of exceedance) flow rate through Boulder. Analysis results are summarized as follows:

- Comparison to the existing FIS data indicates the HEC-RAS model performs satisfactorily and has been used to perform detailed analysis of existing and project alternative impacts.

- Flood boundaries for the 10, 50, 100 and 500-year (0.1, 0.02, 0.1 and 0.002 annual chance of exceedance) events are illustrated in Plates 1 through 4.

- FIS Flood outlines for the 100-year (0.01 annual chance of exceedance) event are compared to the project condition boundary on Plate 5.

- A 100-yr water surface profile comparison between the FIS study results, existing condition model, and project design model can be viewed on Plate 6.

- Full profiles for the 10, 50, 100, and 500-year (0.1, 0.02, 0.1 and 0.002 annual chance of exceedance) events under both existing and project conditions are on Plate 8 and Plate 9.

- For the 100-year (0.01 annual chance of exceedance) event, Goose Creek is designed to maintain all discharges within its banks until its confluence with the Boulder Creek floodplain at Cottonwood Pond. The environmental restoration alternative called for in this Section 206 study maintains this same channel condition.

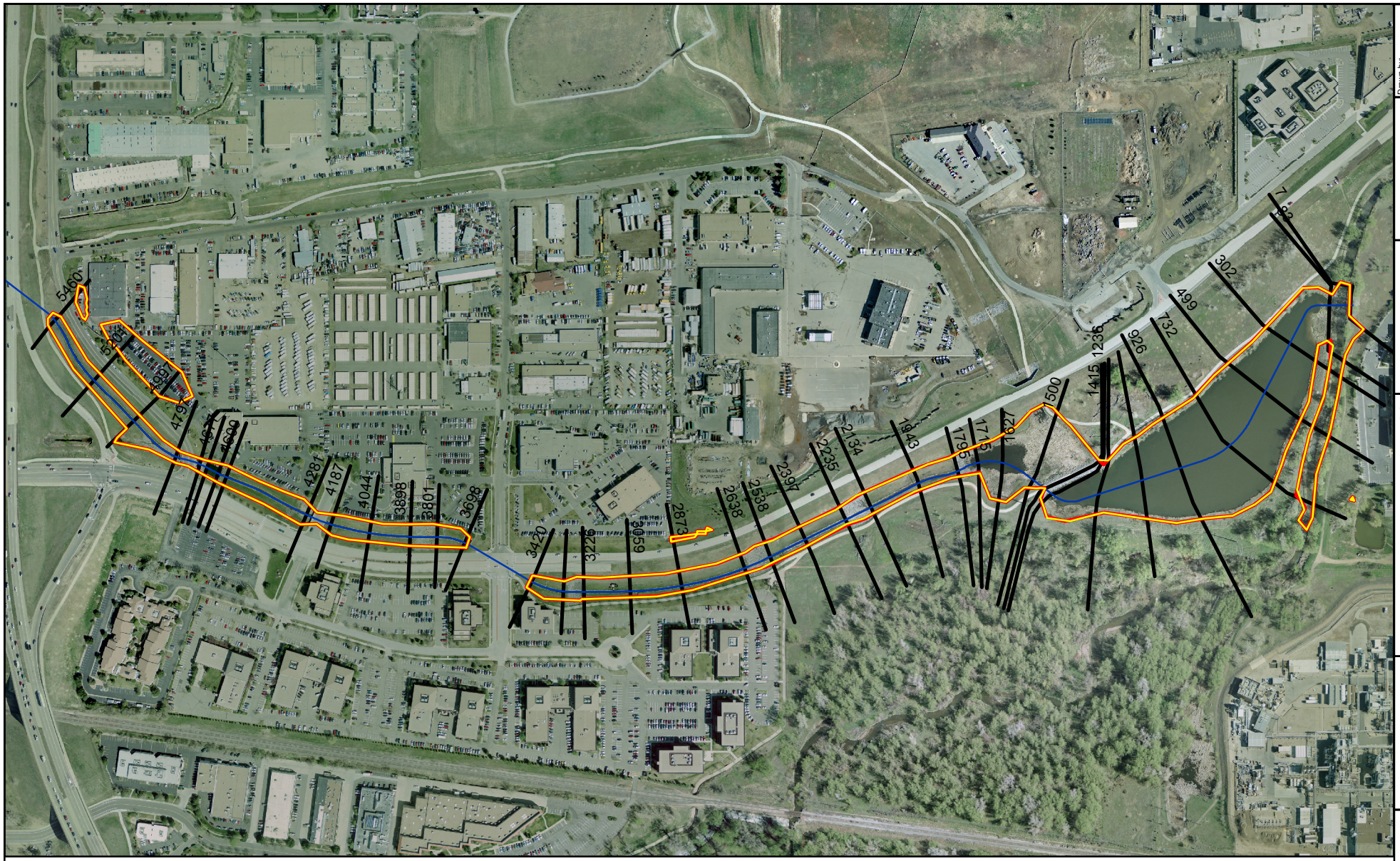
12. References

1.1. EM 1110-2-1601, Hydraulic Design of Flood Control Channels, July 1991.

1.2. HEC-2 Water Surface Profiles, Hydrologic Engineering Center, Davis, CA, September 1990.

1.3. FEMA Flood Insurance Study of Boulder County, CO and Incorporated Areas, October 2002.

1.4 USGS Comprehensive Water Quality of the Boulder Creek Watershed, Colorado, 2003.



10-yr Design
10-yr Existing
Stream Center Line
Cross Sections (RAS)

Note - Flooded reaches of Boulder Creek are not mapped.

N

0 500 1,000 2,000 3,000 4,000 Feet

Drawn by:
Designed by:
Reviewed by:

Submitted by: Hydraulics Section

US Army Corps of Engineers Omaha District

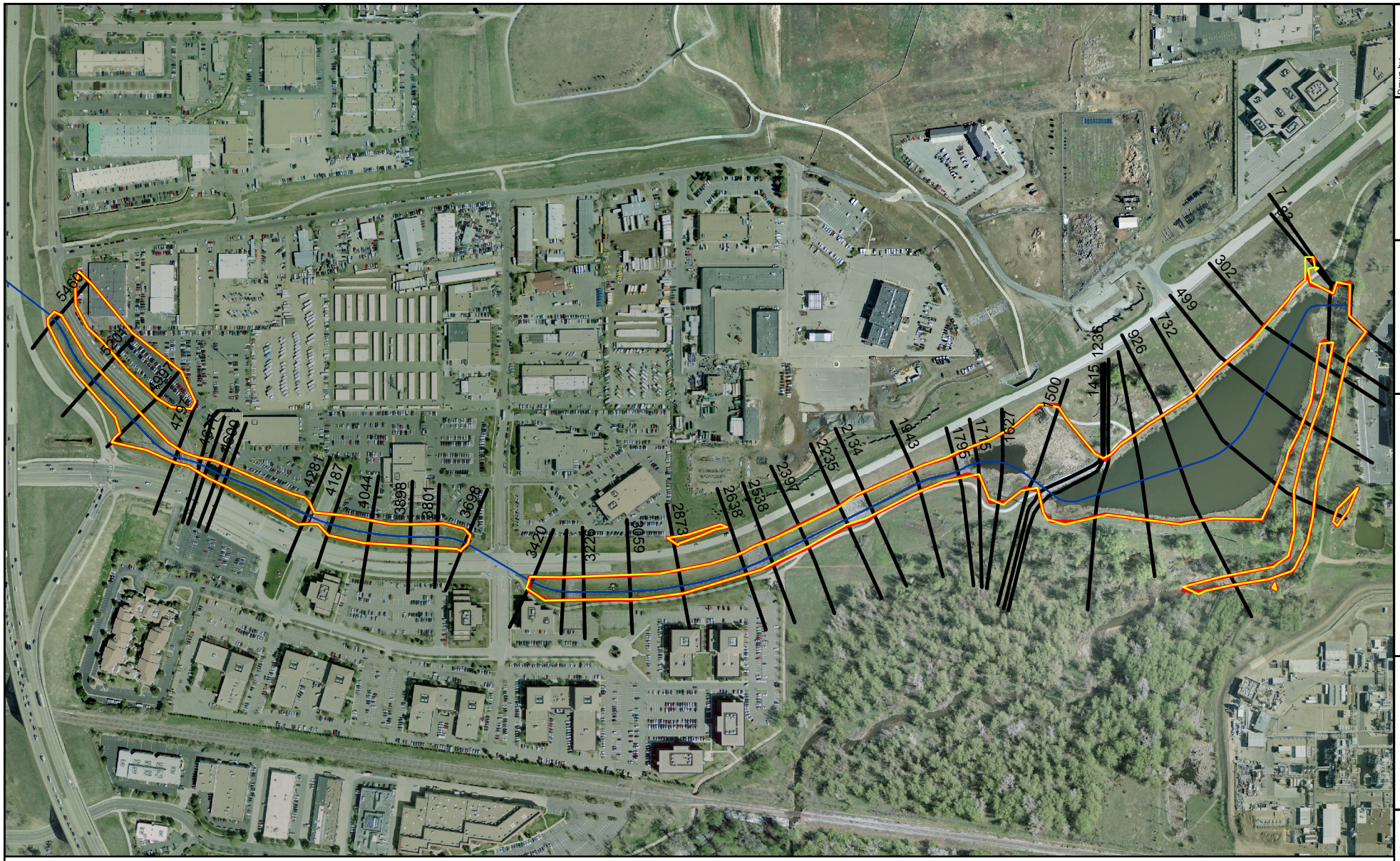
Goose Creek Boulder, CO

Existing & Design Conditions 10-yr Boundaries

Jan 2011

Plot Scale 1:X

Plate



50-yr Design
50-yr Existing
Stream Center Line
Cross Sections (RAS)

Note - Flooded reaches of Boulder Creek are not mapped.

N

0 500 1,000 2,000 3,000 4,000 Feet

Drawn by:
Designed by:
Reviewed by:

Submitted by: Hydraulics Section

US Army Corps of Engineers Omaha District

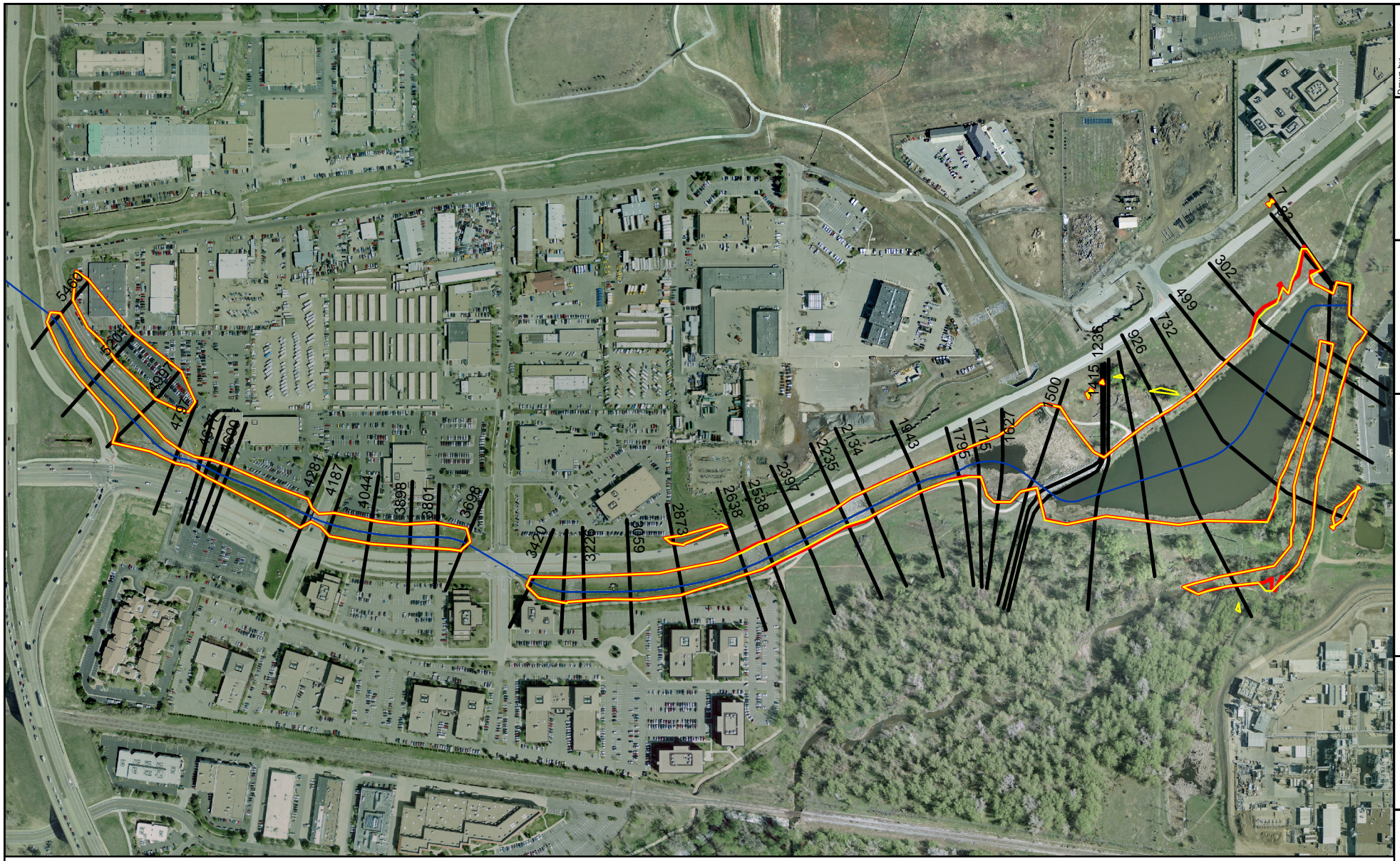
Goose Creek Boulder, CO

Existing & Design Conditions 50-yr Boundaries

Jan 2011

Plot Scale 1:X

Plate



Drawn by:

Designed by:

Reviewed by:

Submitted by: Hydraulics Section

US Army Corps of Engineers Omaha District

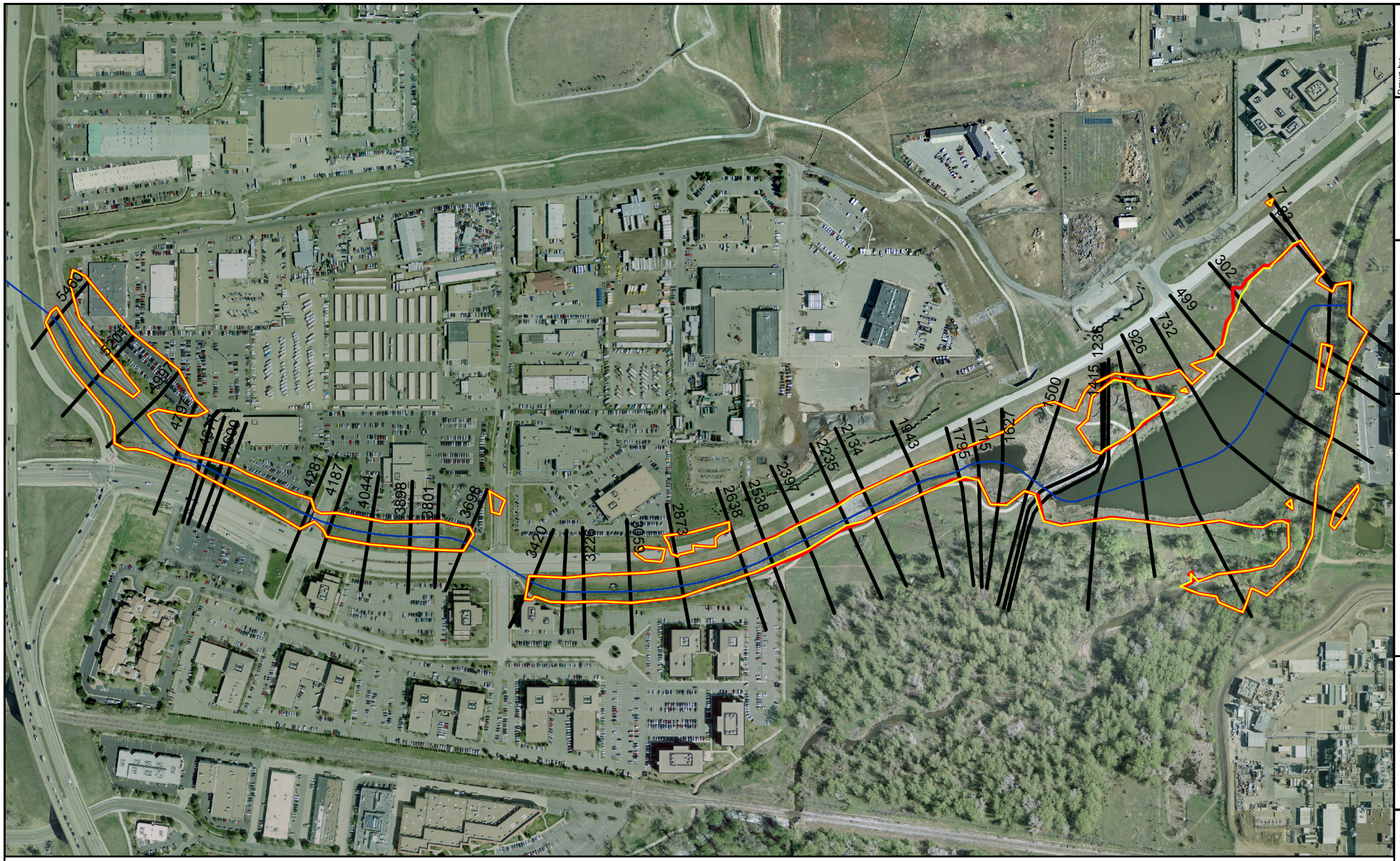
Goose Creek Boulder, CO

Existing & Design Conditions 100-yr Boundaries

Jan 2011

Plot Scale 1:X

Plate



500-yr Design

500-yr Existing

Stream Center Line

Cross Sections (RAS)

Note - Flooded reaches of Boulder Creek are not mapped.

N

0 500 1,000 2,000 3,000 4,000 Feet

Drawn by:

Designed by:

Reviewed by:

Submitted by: Hydraulics Section

US Army Corps of Engineers Omaha District

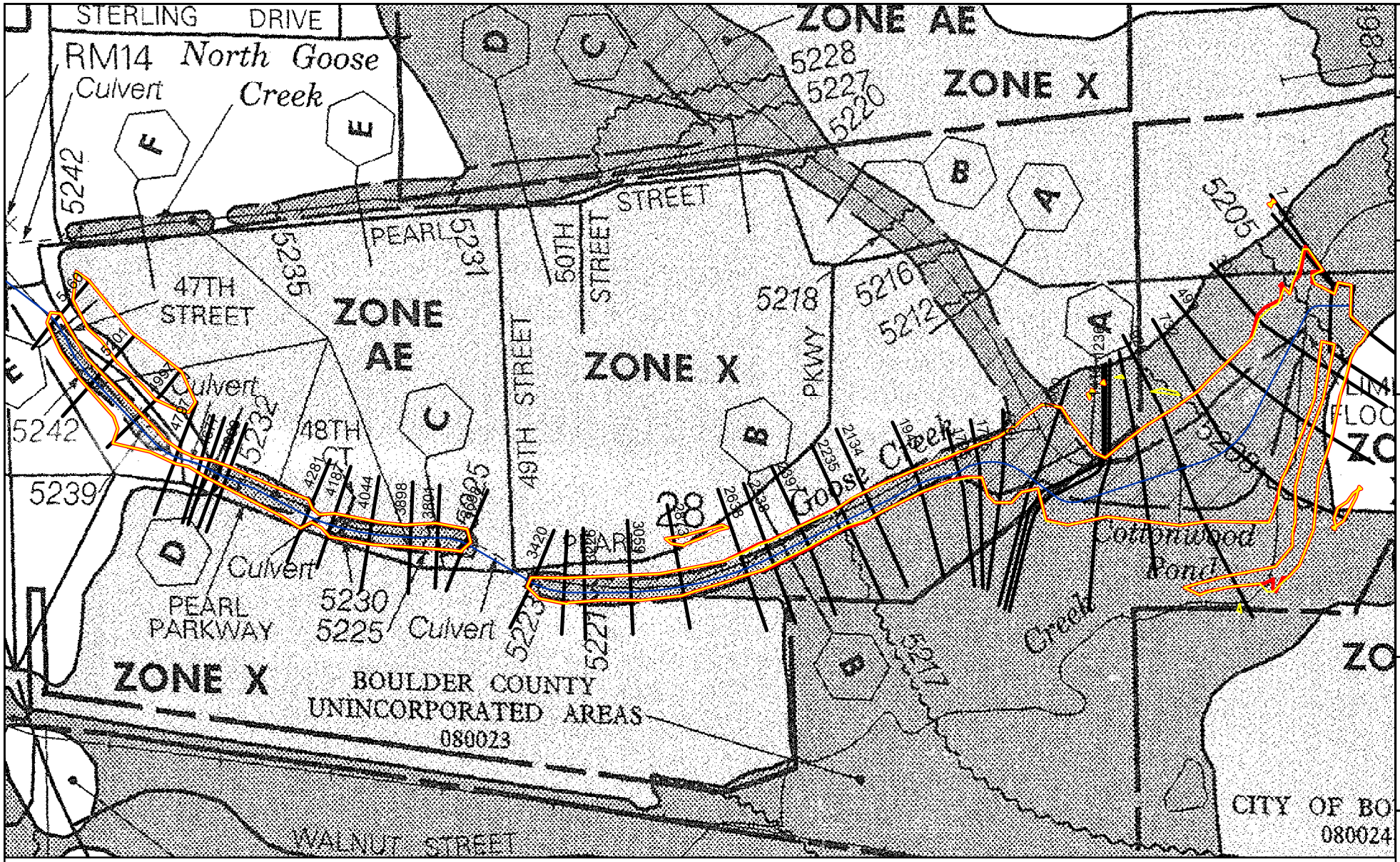
Goose Creek Boulder, CO

Existing & Design Conditions 500-yr Boundaries

Jan 2011

Plot Scale 1:X

Plate



100-yr Existing
100-yr Design
Stream Center Line
Cross Sections (RAS)

Note - Flooded reaches of Boulder Creek are not mapped.

N

0 500 1,000 2,000 3,000 4,000 Feet

Drawn by:
Designed by:
Reviewed by:

Submitted by: Hydraulics Section

US Army Corps of Engineers Omaha District

Boulder, CO

Goose Creek

Existing & Design Conditions 100-yr Boundaries vs. FIRM

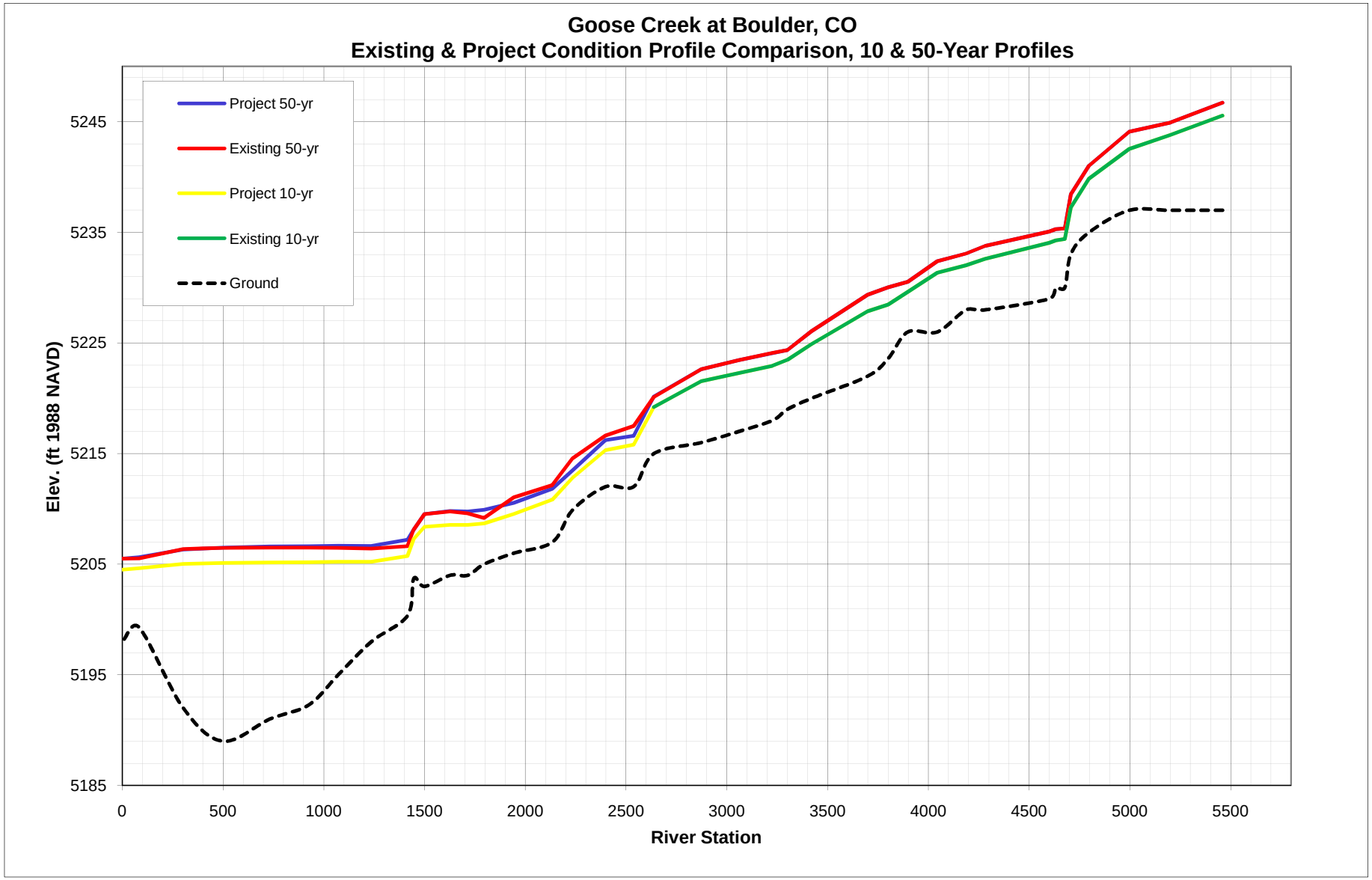
Jan 2011

Plot Scale 1:X

Plate

100-Year Profile Comparison Table - FIS Study, Existing Condition, and Project Design - Known Water Surface Downstream Starting Condition (Elev. 5206.1)						
HEC-RAS Model Channel Station	Feature Description	FIS Regulatory Water Surface Elevation (NAVD 88)	Existing Condition Model 100-yr Water Surface El. (NAVD 88)	Design Condition Model 100-yr Water Surface El. (NAVD88)	FIS Regulatory - Existing Water Surface El. Difference (ft)	Existing - Design Water Surface El. Difference (ft)
5460	Outlet of Foothills Pkwy Culvert	5247.5	5247.1	5247.1	0.5	0.0
5201	FIS Section 'E'	5245.9	5245.2	5245.2	0.7	0.0
4677	Downstream of 47th St Culvert	5237.4	5235.6	5235.6	1.8	0.0
4632	FIS Section 'D'	5237.2	5235.6	5235.6	1.7	0.0
4187	Downstream of 48th Ct Culvert	5233.7	5233.4	5233.4	0.3	0.0
3801	FIS Section 'C'	5230.6	5230.5	5230.5	0.1	0.0
3300	Downstream of Pearl Pkwy Culvert	5226.0	5224.6	5224.6	1.4	0.0
3059		5224.3	5223.8	5223.8	0.6	0.0
2638	FIS Section 'B' - Upstream of Drop Structure #3	5221.5	5220.4	5220.4	1.1	0.0
2538	Downstream of Drop #3/Grading Matches Existing Channel	5220.7	5217.8	5216.8	2.9	1.0
2397		5219.9	5216.9	5216.5	3.0	0.4
2235	Upstream of Drop Structure #2	5218.7	5214.8	5213.7	3.8	1.1
2134	Downstream of Drop Structure #2	5218.2	5212.5	5212.1	5.7	0.3
1943		5216.8	5211.2	5211.0	5.7	0.2
1627	Downstream of Sediment Pond	5215.3	5210.4	5210.4	4.9	0.0
1500		5214.5	5210.1	5210.1	4.5	0.0
1446	FIS Section 'A' - Bike Path Weir (Cottonwood Pond)	5214.2	5208.5	5208.5	5.7	0.0
499		5210.4	5207.2	5207.3	3.2	-0.1
302	Downstream Portion of Cottonwood Pond	5208.4	5207.0	5207.0	1.4	0.0
0	Boulder Creek Center Line	5208.2	5206.1	5206.1	2.1	0.0

100-Year Profile Comparison Table - FIS Study, Existing Condition, and Project Design - Normal Depth Downstream Starting Condition (S=0.007)						
HEC-RAS Model Channel Station	Feature Description	FIS Regulatory Water Surface Elevation (NAVD 88)	Existing Condition Model 100-yr Water Surface El. (NAVD 88)	Design Condition Model 100-yr Water Surface El. (NAVD88)	FIS Regulatory - Existing Water Surface El. Difference (ft)	Existing - Design Water Surface El. Difference (ft)
5460	Outlet of Foothills Pkwy Culvert	5247.5	5247.1	5247.1	0.5	0.0
5201	FIS Section 'E'	5245.9	5245.2	5245.2	0.7	0.0
4677	Downstream of 47th St Culvert	5237.4	5235.6	5235.6	1.8	0.0
4632	FIS Section 'D'	5237.2	5235.6	5235.6	1.7	0.0
4187	Downstream of 48th Ct Culvert	5233.7	5233.4	5233.4	0.3	0.0
3801	FIS Section 'C'	5230.6	5230.5	5230.5	0.1	0.0
3300	Downstream of Pearl Pkwy Culvert	5226.0	5224.6	5224.6	1.4	0.0
3059		5224.3	5223.8	5223.8	0.6	0.0
2638	FIS Section 'B' - Upstream of Drop Structure #3	5221.5	5220.4	5220.4	1.1	0.0
2538	Downstream of Drop #3/Grading Matches Existing Channel	5220.7	5217.8	5216.8	2.9	1.0
2397		5219.9	5216.9	5216.5	3.0	0.4
2235	Upstream of Drop Structure #2	5218.7	5214.8	5213.7	3.8	1.1
2134	Downstream of Drop Structure #2	5218.2	5212.5	5212.1	5.7	0.3
1943		5216.8	5211.2	5211.0	5.7	0.2
1627	Downstream of Sediment Pond	5215.3	5210.4	5210.4	4.9	0.0
1500		5214.5	5210.1	5210.1	4.5	0.0
1446	FIS Section 'A' - Bike Path Weir (Cottonwood Pond)	5214.2	5208.5	5208.5	5.7	0.0
1071		5212.9	5207.0	5207.1	5.9	-0.1
499		5210.4	5207.0	5206.9	3.4	0.1
302	Downstream Portion of Cottonwood Pond	5208.4	5206.8	5206.6	1.6	0.2
0	Boulder Creek Center Line	5208.2	5205.0	5205.0	3.3	0.0


Goose Creek at Boulder, CO
Existing & Project Condition Profile Comparison, 10 & 50-Year Profiles
Project 50-yr
Existing 50-yr
Project 10-yr
Existing 10-yr
Ground
Elev. (ft 1988 NAVD)
5245
5235
5225
5215
5205
5195
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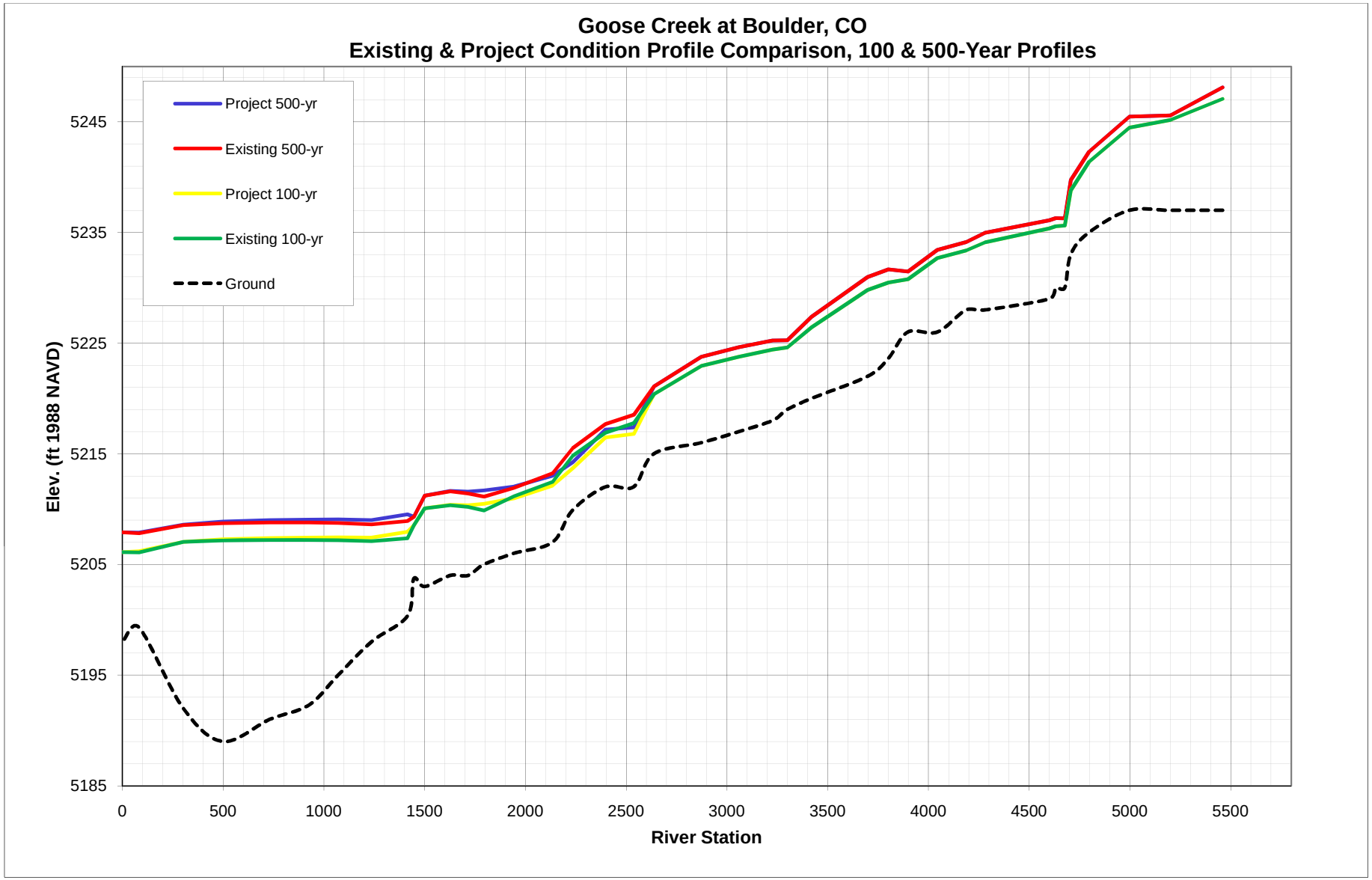
2000
2500
3000
3500
4000
4500
5000
5500
River Station


Goose Creek at Boulder, CO
Existing & Project Condition Profile Comparison, 100 & 500-Year Profiles
Project 500-yr
Existing 500-yr
Project 100-yr
Existing 100-yr
Ground
Elev. (ft 1988 NAVD)
5245
5235
5225
5215
5205
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5185
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2000
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3500
4000
4500
5000
5500
River Station

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Omaha District

GOOSE CREEK
BOULDER, COLORADO

ECOSYSTEM RESTORATION REPORT
SECTION 206

APPENDIX H – RECREATION

JUNE 2011

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RECREATION ANALYSIS
AQUATIC ECOSYSTEM RESTORATION, GOOSE CREEK AT BOULDER, CO,
UPDATED MAY 25, 2011

WITHOUT-PROJECT RECREATION FACILITIES AND ACTIVITIES

Existing Conditions. The Boulder Creek Trail, a concrete bicycle-pedestrian trail approximately 10 feet wide, traverses most of the project area along South Goose Creek and the north side of Cottonwood Pond. The trail links with other trails in the city of Boulder's trail system. It runs generally along Boulder Creek but diverges near the Reynolds Corner mini-park/rest area to also run along South Goose Creek. Reynolds Corner consists of naturalistic, semicircular seating ideal for interpretive presentations to small- and medium-sized groups and a nearby drinking fountain. A two-block-long break in the trail occurs on the north side of Pearl Parkway; in this segment, trail users wishing to remain on a hard surface cross to the south side of the street and use the sidewalk. At Foothills Parkway, the trail intersects other trails that run north (and then east along Pearl Street, near North Goose Creek); south; and west through a lighted tunnel under Foothills Parkway, towards downtown Boulder. A yellow centerline is painted on the trail where needed to minimize user conflicts and increase public safety. Social trails (dirt paths) have been worn by foot traffic from the southwest end of Cottonwood Pond: 1) to the pond's intermittent connection with Boulder Creek; and 2) along the edge of the wooded area to Reynolds Corner. At least two social trail spurs lead to the banks of Boulder Creek, which provide informal fishing access. Shoreline fishing at Cottonwood Pond used to be very popular and still occurs there. Ice skating can occur at Cottonwood Pond in the winter if ice cover conditions are favorable. Due to the effect of Eurasian water milfoil on the fishery in Cottonwood Pond and the reduced chance of fishing success, however, more angling currently takes place on the banks of Boulder Creek near Cottonwood Pond than at Cottonwood Pond itself.

1992 Visitation Data. Based on visitation data collected by the Boulder Open Space Department between June 1, 1992 and May 31, 1993, 1,185,704 user days were estimated for the ten zones of the Open Space system and an additional 269,714 user days for the Boulder Creek path, for a total of 1,485,314 visitors. Open space areas in Zone 3, Cottonwood, where South Goose Creek is located, had visitation of 120,594, or 10.2 percent of the total. Average trail visits in Zone 3 lasted 31.4 minutes, the shortest of the ten zones; the average number of persons per group was 1.2, compared to 1.4 persons system-wide. Approximately 99.5 percent of Open Space system users in Zone 3 were residents of the city of Boulder, due to its location in the middle of the city. Joggers, hikers, pet exercisers, and cyclists were the most frequent users of the concrete trail in 1992-1993; rollerbladers have joined their ranks since then. Other trail uses include wildlife viewing, picnicking, and fishing. When the ten zones are ranked by the percentage of groups engaging in each activity, Zone 3 was the highest for fishing (10.1 percent), which was negligible in all other zones; second-highest for bicycling (32.8 percent); about average for jogging (37.4 percent); below average for exercising pets (14.9 percent); below average for picnicking (0.1 percent); and the lowest for hiking (4.7

percent). The total number of fishing days in 1992 was over 12,000 in Zone 3; much of the fishing activities occurred at Cottonwood Pond, and some shoreline fishing occurred along Boulder Creek.

Estimated Current Annual Visitation on the Boulder Creek Trail along South Goose Creek. Annual trail use in each zone would be expected to vary with the population, trail lengths, the amount of adjacent recreation facilities, and the popularity of trail-based activities in the community. Zone 3 is located in three census block groups (122.03, 127.01, and 127.07) which had a combined population of 10,339 in 1990 and 13,881 in 2000, for a growth rate of 34 percent. If trail use increased by the same percentage, annual visitation in Zone 3 could be 161,908, or an average of 444 users per day.

Trail use appears to have increased faster than the population and was estimated at over 288,000 visitors annually. These visitors include commuters who enjoy recreational exercise and sightseeing as they walk or bicycle to and from work on the Boulder Creek Trail. Boulder Creek trail visitation counts along South Goose Creek were taken for over 3 hours during different time periods on two weekdays, September 6 and 8, 2006. The 9-11 am and 1-4 pm periods averaged 61 visitors per hour; 98 visitors per hour used the trail between 11 am and 1 pm; and 73 visitors per hour used the trail during the 6-9 am and 4-6 pm time periods. Although there may be some duplication of commuters during the morning and afternoon commuting periods, these would be compensated for by the lack of added visitation during the evening hours. The calculated visitation of 866 for a 12-hour day was taken during very warm weather. Based on professional judgment, the daily visitation of 866 was multiplied by 0.9 to obtain 779, the estimate of what visitation would have been during September 21-26, when counts were taken of Boulder Creek Trail users at Arapahoe Road. The proportion of 12-hour weekday visits for the Boulder Creek Trail along South Goose Creek compared to 12-hour weekday visits for the Boulder Creek Trail at Arapahoe Road (779/832, or 93.6 percent) was assumed to hold for weekends in September and for weekdays and weekends in other seasons in which Boulder Creek Trail visits were counted. Using these methods, the Boulder Creek Trail visitation along South Goose Creek was estimated to average 721 per weekday and 964 per weekend day throughout the year, for an annual total of 288,437. Bicycling was by far the most frequent type of trail use. However, the sample size was too small to determine proportions of trail visits accounted for by each type of trail use. The average size of groups using the Boulder Creek Trail along South Goose Creek was 1.3 persons on September 6 and 8, 2006.

Expected Future Visitation on the Boulder Creek Trail along South Goose Creek. Future visitation is expected to increase even without the aquatic ecosystem restoration project. The Boulder Creek Trail intersects with the North Goose Creek Trail on the northwest side of Cottonwood Pond. The city of Boulder plans to expand Valmont Park south to Pearl Parkway, and the North Goose Creek Trail will form its western boundary. Many trail users are expected to access Valmont Park by using the Boulder Creek and North Goose Creek trails. No projections of future visitation at the Boulder Creek Trail along South Goose Creek were available in September 2007 because the public involvement process regarding the specific facilities to be developed in the expanded Valmont Park

had not been completed. Additional trail use is also expected by residents of Transit Village that will be developed along Goose Creek upstream of the North Goose Creek Trail.

WITH-PROJECT RECREATION FACILITIES AND ACTIVITIES

Potential Recreation Facilities Under With-Project Conditions. Under with-project conditions, trail use is expected to be higher than under without-project conditions because of the additional trail-based recreation facilities and opportunities. The following discussion takes all ecosystem restoration alternatives into account. If the Goose Creek project includes elimination of the Eurasian water milfoil and renovation of the fishery at Cottonwood Pond, fishing access points that meet Americans with Disabilities Act (ADA) standards could be developed along the north bank of the pond. Fencing between the trail and the pond could channel anglers to the access points, thereby reducing shoreline erosion and social trails. Stone seating and a flat-topped boulder for use as a small "table" could be provided at the access points. A bicycle rack and one or more stone picnic tables could also possibly be installed along the trail near Cottonwood Pond. Representatives of the Parks and Recreation Department and the Open Space and Mountain Parks Department were concerned that toilet facilities would attract vandalism and other uses that might make them unattractive to recreational users, but restrooms will be available nearby in Valmont Park, which will be expanded south to Pearl Parkway. Trash receptacles can not be provided because emptying the container without road access for a vehicle would be problematic. In the future, there may be administrative support for funding educational signage at Cottonwood Pond relating to reducing the spread of aquatic nuisance species; and possibly also educational and interpretive signs along the trail relating to environmental, cultural, and historical resources.

Potential Relocation of a Trail Segment. In addition to providing new recreation facilities, the Goose Creek ecosystem restoration project could also relocate the portion of the existing trail between Cottonwood Pond and Reynolds Corner closer to the wooded area to the south, to allow room for meanders in the South Goose Creek streambed and adjacent wetlands/riparian vegetation. This relocation would eliminate two sharp curves ("doglegs") from the trail alignment, thereby increasing visitor enjoyment and public safety.

Economic Feasibility of Recreation Facilities. Annual recreation benefits of a project are based on the difference between the annual with-project benefits and the annual without-project benefits. Annual benefits are calculated by the dollar value per day of general recreation multiplied by the annual number of trail users. Recreation facilities are economically justified if the annual recreation benefits they add are equal to or greater than their annual costs. Annual costs consist of the annual operation, maintenance, repair, rehabilitation, and replacement costs plus the annualized construction cost of the facilities (and interest during construction) amortized over the 50-year life of the project.

Estimation of Daily Recreation Benefits. The dollar value per day of general recreation was estimated for without-project (existing) conditions and several alternative with-project recreation facility plans using the Unit Day Value method. Point values were assigned based on visitor enjoyment and willingness to pay using the table "Guidelines for Assigning Points for General Recreation". This is Table 6-29 of Engineer Regulation 1105-2-100, Planning Guidance Notebook, dated December 28, 1990; and Table 1 of the attachment to Economic Guidance Memorandum (EGM) 11-03, Unit Day Values for Recreation, Fiscal Year 2011, dated November 5, 2010. The point values were assigned during conference calls August 17 and 24, 2006, with city of Boulder staff representing the following Departments: Parks and Recreation; Open Space and Mountain Parks; Transportation; and Public Works. The point values were converted to FY11 dollars per day of general recreation based on EGM 11-03. The point values established by consensus for each recreation facility plan and their corresponding dollar values per day are provided in table H-1 below.

Table H-1: Alternative Recreational Facility Plans in the Cottonwood Pond Vicinity and Their FY11 Benefit Values per Day, with No Fishing and with 5% of Visitors Fishing

Recreation Facility Plan	UDV Point Value	$/Day (0% Fish)	$/Day (5% Fish)
Existing Conditions (No Action Alternative)	31	$5.51	na
Fence/ADA access/seating at pond; Remove 2 doglegs in trail	43	$6.99	$7.03
Fence/ADA access/seating at pond; Remove 2 doglegs in trail; Picnic table(s)/bike rack	45	$7.17	$7.21
Fence/ADA access/seating at pond; Remove 2 doglegs in trail; Picnic table(s)/bike rack; Educational and interpretive signage	46 or more	$7.26 +	$7.30 +

ECONOMIC JUSTIFICATION OF RECREATION PLAN

Estimation of Annual Project Recreation Benefits. With an existing annual trail visitation estimated at 288,000, existing recreation benefits at $5.51 per day are estimated at about $1,586,880 annually. If with-project recreation benefits are calculated conservatively based on the assumptions of no additional visitation and the lowest-cost recreation facility plan considered, at $6.99 per day the recreation benefits are estimated at about $2,013,120 annually. The difference, or about $426,240, represents the minimum annual project recreation benefits that would result from the recreation-related portion of the Goose Creek aquatic ecosystem restoration project that includes restoration of Cottonwood Pond as a pond.

Fishing and non-fishing visitation for the future without-project condition and for each recreation facility plan the city desires to be evaluated were expected to be estimated over the 50-year project life with the aid of city of Boulder staff. When these tasks were

completed, the annual recreation benefits without-project and the annual recreation benefits with-project for each recreation facility plan would have been determined.

Estimation of Annual Project Recreation Costs. Costs of construction, operation, routine maintenance, repairs, and replacements were also expected to be estimated for each recreation facility plan; city of Boulder staff would have input regarding design, materials, and siting for the recreation facilities. When these cost estimates were completed, the annual recreation costs could then be calculated.

Economic Justification for Corps Cost-Sharing of Recreation Facilities. Recreation facilities constructed as part of a Section 206 aquatic ecosystem restoration project can be cost-shared by the Corps up to 50 percent if they are included in Exhibit E-3, Checklist of Facilities which may be Cost-Shared in Recreation Developments at Environmental Protection and Ecosystem Restoration Projects, of Engineer Regulation (ER) 1105-2-100. All of the recreation facilities proposed for the Section 206 project along Goose Creek at Boulder, Colorado, are on this checklist; the bicycle rack is included as a "parking" facility. The Federal share of recreation facility costs can not, however, increase the Federal costs of the project without recreation facilities by more than 10 percent. An additional requirement for Corps cost-sharing is that the net annual project recreation benefits (the difference between annual recreation benefits with-project and annual recreation benefits without-project) must be greater than the annual recreation costs. A benefit-cost ratio would need to be calculated for each recreation plan evaluated to ensure that this criterion is met.

RECREATION FACILITY PLAN OPTIONS, BENEFITS, AND ECONOMIC JUSTIFICATION WITH THE SELECTED ECOSYSTEM RESTORATION PLAN

The Selected Plan (which is also the National Ecosystem Restoration Plan) includes restoring Cottonwood Pond to its historic condition, a wooded wetland, rather than a pond. Therefore, a new set of alternative recreation facility plans comprised of previously discussed features were developed. The dollar value per day of general recreation was estimated for several alternative with-project recreation facility plans using the Unit Day Value (UDV) method. Point values were assigned based on visitor enjoyment and willingness to pay using the table "Guidelines for Assigning Points for General Recreation." This is Table 6-29 of Engineer Regulation 1105-2-100, Planning Guidance Notebook, dated December 28, 1990; and Table 1 of the attachment to Economic Guidance Memorandum (EGM) 11-03, Unit Day Values for Recreation, Fiscal Year 2011, dated November 5, 2010. The point values were assigned during conference calls August 17 and 24, 2006, with city of Boulder staff representing the following Departments: Parks and Recreation; Open Space and Mountain Parks; Transportation; and Public Works. The point values were converted to dollars per day of general recreation based on EGM 11-03. The point values for each recreation facility plan and their corresponding dollar values per day are provided in Table H-2.

Table H-2: Recreation Facility Alternative Plans and Their Benefit Values (FY11 $) per Visitor-Day

and Annually, with Cottonwood Pond Restored as a Wetland

Recreation Facility Plan	UDV Points	$/Day/ Visitor	Recreation Benefit/Yr*	Net Recreat. Benefit/Yr**
Remove 2 doglegs in trail; Fence between trail and Cottonwood Wetland	43	$6.99	$2,013,120	$426,240
Remove 2 doglegs in trail; Fence between trail & C. Wetland; 1 educ./interpretive sign	44	$7.08	$2,039,040	$452,160
Remove 2 doglegs in trail; Fence between trail & C. Wetland; 2 educ./interpretive signs	45	$7.17	$2,064,960	$478,080
Remove 2 doglegs in trail; Fence between trail & C. Wetland; 3 educ./interpretive signs	46	$7.26	$2,090,880	$504,000
Remove 2 doglegs in trail; Fence between trail & C. Wetland; 4 educ./interpretive signs	47	$7.35	$2,116,800	$529,920

*Total with-project recreation benefits is based on 288,000 trail visitors per year.
**Net recreation benefits are equal to the annual recreation benefits with-project minus $1,586,880 in annual recreation benefits without-project.

As part of the NER plan, the concrete trail along the south bank of South Goose Creek in Reach 2 would be removed and would be reconstructed along the "social" trail alignment, farther from South Goose Creek. The trail relocation cost is estimated at $56,345 in M-CACES at January 2011 price levels. The trail relocation is part of the ER project, and the cost is part of LERRDs. Fencing between the trail and the Cottonwood Wetland is also considered part of the ER project. The only recreational facilities would be the educational / interpretive signs, which are also considered part of the ER project. A sign with a trail map near Reynolds Corner would cost $4,000 (including installation). Three additional signs made of high-pressure laminate would cost up to $1,500 each, for a total of $4,500 (including installation). Steel pedestals would cost up to $400 for each sign, totaling up to $1,600. City of Boulder staff would design the signs, so total first cost would be $10,100 plus design costs. The signs would be replaced as needed but require no other OMRR&R. Even if trail visitation does not increase, the over $400,000 in net annual recreation benefits easily economically justifies the cost of up to four interpretive signs. If the city of Boulder decides to include any educational / interpretive signs, these costs are small enough to be covered by the contingencies in the Goose Creek ER project cost estimate.

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GOOSE CREEK
BOULDER, COLORADO

SECTION 206
ECOSYSTEM RESTORATION REPORT

APPENDIX I -
REAL ESTATE PLAN

APRIL 2011

REAL ESTATE PLAN
For
FEASIBILITY REPORT
GOOSE CREEK AT BOULDER, COLORADO

PURPOSE	1
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LOCATION	2
DESCRIPTION OF PROJECT SITE	2
PRIOR STUDIES	2
RECOMMENDED ESTATES	3
FEDERALLLY OWNED LANDS	4
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REAL ESTATE PLAN

GOOSE CREEK AT BOULDER, COLORADO

Section 206 – Ecosystem Restoration

INTRODUCTION: This Real Estate Plan, prepared in accordance with ER 405-1-12, 12-16, Real Estate Plan, presents the real estate requirements for a Federally-supported Ecosystem Restoration Project for Goose Creek for the City of Boulder, Colorado. The project purpose is to identify the potential riparian ecosystem restoration of the South Goose Creek in Boulder, Colorado.

PURPOSE: The Real Estate Plan (REP) is prepared in support of the Goose Creek Feasibility Study. The purpose of the REP is to identify and describe the lands, easements, and rights-of-way (LER) required for the construction, operation, and maintenance of a proposed aquatic ecosystem restoration and protection project. Including those lands required for relocations, borrow material and dredged or excavated material disposal. The REP identifies and describes the facility/utility relocations, if any, which are necessary to implement this project. Also included are the estimated administrative and incidental costs attributed to providing project LER, the acquisition process, who acquire, types of ownership's and non-Federal Sponsor's ability to acquire the LER required for the project.

AUTHORITY: The Project is authorized by Section 206, of the Water Resources Development Act (WRDA) of 1996, as amended, Public Law 104-3030, which states:

> *"The Secretary is authorized to carry out an aquatic ecosystem restoration and protection project if the Secretary determines that the project (1) will improve the quality of the environment and is in the public interest, and (2) is cost-effective."*

LOCATION: General Project Maps for reference are included throughout the Feasibility Report. Real Estate Maps are identified as Exhibit "A" and Exhibit "B" of the REP.

South Goose Creek is an urban stream, in the City of Boulder, Boulder County, Colorado. It is a tributary of Boulder Creek, which is a tributary of the South Platte River. The study area extends from immediately upstream of Foothills Parkway to the confluence with Boulder Creek. The project site is in Section 25, Township 1 North, Range 70 West.

Boulder is a very diverse business and employment center with one of the largest concentrations of research laboratories and high-tech industries which include IBM, Sun Microsystems, Ball Aerospace, and The Southwest Research Institute and Lockheed Martin. The University of Colorado (UC) in Boulder hosts the Laboratory for Atmospheric and Space Physics, the Center for Astrophysics and Space Astronomy and the Joint Institute for Laboratory Astrophysics.

UC is the largest employer in the area. The workforce is highly educated with 70% of adults earning a bachelor's degree or higher. The median population age is 29, which is lower than the average population age for other Colorado areas.

2010 Median home prices are at $525,000 with nearby communities at about $347,980. Slightly lower residential housing prices outside of the city may be seen with the current economic slowdown. Median county income is about $61,000 with the median family income fairly high at $81,000 in the city.

DESCRIPTION OF PROJECT SITE: The proposed project area extends from immediately upstream of Foothills Parkway to the confluence with Boulder Creek. A project site map is attached at Exhibit "B". The proposed project site runs approximately 4,000 feet along South Goose Creek and Cottonwood Pond. The site offers opportunities to connect restored riparian reaches and some of the scarce riparian ecosystem in the semi-arid high plains adjacent to the Front Range of the Rocky Mountains. Cottonwood Pond offers an opportunity to recreate pre-development riparian and wetland conditions in the floodplain adjacent to Boulder Creek.

As indicated on Exhibit "B", the Project is identified in three (3) reaches. Reach 1 includes a strip of land which lies between the northbound on-ramp of Foothills Boulevard and 47th Street, (a frontage road running north-south just east of the ramp). The reach continues south and turns east to parallel Pearl Parkway and crosses southeast under 49th Street ending at the west end of the office complex property on the south side adjacent to Pearl Parkway. Reach 1 has 8.03 acres. A temporary work area at the east end of the project will be utilized for the duration of the construction contract. The duration of the temporary work area easement will not exceed 2 years.

Reaches 2 and 3 include part of the Cottonwood Grove Pond area. Reaches 2 and 3 contain 8.61 acres and 17.08 acres respectively. Reaches 2 and 3 continue east from Reach 1 along the south side of Pearl Parkway.

In Reach 1, the highest and best use based on the gross appraisal study is industrial. Reach 1 lands in the footprint include Colorado Department of Transportation (CDOT) Right-of-Way for Foothills Boulevard, Miller Family Real Estate (aka Boulder Toyota) McCaddon Oldsmobile-Cadillac and 2 parcels of Offices in Pearl Business Center.

The highest and best use for the parcels in Reaches 2 and 3, based on the comparable sales study within the gross appraisal, is floodplain. Parcels in these reaches are owned by city of Boulder and Boulder County.

PRIOR STUDIES: "Preliminary Restoration Plan Section 206 Goose Creek Restoration, Boulder, Colorado", August 2004 and the City of Boulder's "Greenways Master Plan", December 2001. For more information on these studies as well as other studies related to this project, see Appendix K of the Feasibility Report.

RECOMMENDED ESTATES: Chapter 12, ER405-1-12, paragraph 12-9b (6) state that generally fee title is required for ecosystem restoration, however an easement may be appropriate based on the requirements of the project. The parcels within Reach 1 are all encumbered by a South Goose Creek easement which is granted to the City of Boulder. The plat map for the area states in part:

"… Do hereby grant to the City of Boulder those portions of said real property designated as 'Utility Easement', 'Drainage Easement' and "South Goose Creek Easement' on the accompanying plat as easements for the construction, installation, operation, maintenance, repair and replacement for all services, including without limiting the generality of the foregoing, telephone and electric lines, works, poles and underground cables, gas pipelines, sanitary sewer lines, street lights, culverts, hydrants, drainage ditches and drains and all appurtenances thereto, it being expressly understood and agreed by the undersigned…".

The land within the footprint of Reaches 1, 2 and 3 are owned in fee by the City of Boulder and Boulder County.

The land within the Project footprint is located entirely within the designated FEMA floodway for South Goose Creek. As a result, it was determined that two standard easement estates are sufficient to secure and preserve the project's footprint: A permanent flowage easement and a temporary work area easement are recommended for the project. The standard estates are as follows:

FLOWAGE EASEMENT- PERMANENT

The perpetual right, power, privilege and easement permanently to overflow, flood and submerge (the land described in Schedule A)(Tracts Nos. _____, _____ and _____), (and to maintain mosquito control) in connection with the operation and maintenance of the project as authorized by the Act of Congress approved _____, and the continuing right to clear and remove and brush, debris and natural obstructions which, in the opinion of the representative of the United States in charge of the project, may be detrimental to the project, together with the right, title and interest in and to the timber, structures and improvements situate on the land (excepting _____) (provided that no structures for human habitation which the District Engineer determines may remain on the land,) provided that no structures for human habitation shall be constructed or maintained on the land, that no other structures shall be constructed or maintained on the land except as may be approved in writing by the representative of the United States in charge of the project, and that no excavation shall be conducted and no landfill placed on the land without such approval as to the location and method of excavation and/or placement of landfill; the above estate is taken subject to existing easements for public roads and highways, public utilities, railroads and pipelines; reserving, however, however to eh landowners, their heirs and assigns all such rights and privileges as may be used and enjoyed without interfering with the use of the project for the purposes authorized by Congress or abridging the rights and easement hereby acquired; provided further that any use of the land shall be subject to Federal and State laws with respect to pollution.

TEMPORARY WORK AREA EASEMENT

A temporary easement and right-of-way in, on, over and across (the land described in Schedule A) (Tracts Nos. ____, ____ and ____),for a period not to exceed _____, beginning with date possession of the land is granted to the United States, for use by the United States, its representatives, agents, and contractors as a (borrow area) (work area), including the right to (borrow and/or deposit fill, spoil and waste material thereon) (move, store and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the _____ Project, together with the right to trim, cut, fell and remove there from all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

The following is a breakdown of the real estate interests required for the project:

	Flowage Easement	Temporary Work Area
	Acres	Acres
Reach 1	8.03	0
Reach 2	8.61	0
Reach 3	17.08	0
Temporary Work Area	0.00	6.93
Total Acres	**33.72**	**6.93**

Note: There are no non-standard estates required for this project.

FEDERAL OWNED LANDS: Lands required for this Project are not within the scope of any other known existing Federal Project.

SPONSORED OWNED LANDS: All lands within the project footprint are publically owned by the City of Boulder or Boulder County, Colorado**.**

NAVIGATIONAL SERVITUDE: The footprint of the proposed Project contains no lands below the Ordinary High Water Mark, or Mean High Water Mark, as the case may be, of a navigable watercourse. Therefore, the rights of the Federal Government by way of Navigational Servitude will not apply for Project.

INDUCED FLOODING: Based on the project's proposed footprint, no induce flooding will occur.

FACILITY/UTILITY RELOCATIONS: The preliminary project design indicates that no facility or utility relocations will be required for this project.

"ANY CONCLUSION OR CATEGORIZATION CONTAINED IN THIS REAL ESTATE PLAN, OR ELSEWHERE IN THIS PROJECT REPORT, THAT AN ITEM IS A UTILITY OR FACILITY RELOCATION TO BE PERFORMED BY THE NON-FEDERAL SPONSOR AS PART OF ITS LERRD RESPONSIBILITIES IS PRELIMINARY ONLY. THE GOVERNMENT WILL MAKE A FINAL DETERMINATION OF THE RELOCATIONS NECESSARY FOR THE CONSTRUCTION, OPERATION, OR MAINTENANCE OF THE PROJECT AFTER FURTHER ANALYSIS AND COMPLETION AND APPROVAL OF FINAL ATTORNEY'S OPINIONS OF COMPENSABILITY FOR EACH OF THE IMPACTED UTILITIES AND FACILITIES."

BASELINE COST ESTIMATE: The following table is a synopsis of the real estate land and damages cost estimate.

	Federal Costs	NFS Costs	TOTAL
Land/Damages	$0.00	$1,124,000.0	$1,124,000.00
Relocation Expenses	$0.00	$0.00	$0.00
Replacement Housing	$0.00	$0.00	$0.00
RE Administrative Costs	$45,420.00	$100,000.00	$145,420.00
Total	$45,420.00	$1,224,000.00	$1,269,420.00
Contingencies (2%) (Rounded)	$908.00	$24,480.00	$25,388.00
Total	$46,328.00	$1,248,480.00	$1,294,808.00

The land costs are identified in a gross appraisal dated February 25, 2011. The total land costs include $62,000.00 for incremental costs.

P.L.91-646 RESIDENCE/BUSINESS RELOCATION: Based on the mapping provided by the Omaha District Design Branch, no residences or businesses need to be relocated or removed.

ENVIROMENTAL CLEARANCE: In accordance with the National Environmental Policy Act, the Omaha District is conducting an assessment of the environmental impacts associated with the project. The completion of the Finding of No Significant Impact (FONSI) is expected in late May 2011.

ATTITUDE OF LANDOWNERS: The residents of Boulder are very proactive in their environmental pursuits on behalf of their community. No negative comments have been voiced in opposition of this Project. The residents and businesses in the area may experience the usual temporary inconveniences inherent in any construction Project including some increased traffic and construction noise. The Sponsor does not generally receive complaints in other areas where they have had various types of construction projects which they attribute to the information they regularly provide to their community.

MINERAL/TIMBER ACTIVITY: There is no present or anticipated mineral activity within the proposed Project limits. There is no timber value impact as a result of this project.

ASSESSMENT OF LOCAL SPONSOR: An Assessment of Non-Federal Sponsor's Real Estate Acquisition Capability" checklist, is attached as Exhibit "C".

ZONING: No application or enactment of zoning ordinances will be required nor utilized for the proposed Project. Parcels within Reach 1 are zoned for industrial/service use. Improvements along this reach include two car dealerships and an office building complex and are in conformity with uses allowable. Parcels in Reach 2 and Reach 3 are zoned Public or noted as Enclave areas. Enclave areas are not zoned and the low elevation and floodway areas are expected to be prohibitive to development. These areas are normally reserved for wetlands. The parcel at the west end is Public Zoned which are severely restricted in the allowable uses. These areas have low elevation and floodplain/floodway that would limit the use of this land.

ACQUISITION SCHEDULE: The Project Manager will develop a schedule upon the approval of the Real Estate Plan and the Feasibility Study. No construction will take place until documentation of the ownership have been provided, reviewed, and confirmed, as stated in the Project Partnership Agreement. The non-Federal Sponsor must provide copies of all deeds and easements on tracts of lands required by the project footprint. Further, they must provide the certification by their attorney that they have met the requirements including compliance with P. L. 91-646 through those acquisitions prior to advertisement of the construction contract where applicable.

The anticipated real estate project activities duration, developed with NFS and the Project Manager, begins upon the approval of the Feasibility Study. The likely schedule is: :

Feasibility Study Approval (NWO)	0 month
NFS and COE execute PPA	within 45-60 days *
Final ROW drawings to NFS with NTP	Within 7 days after PPA Execution
NFS initiates acquisition responsibilities	Within 5 days of receipt of final ROW drawings
Complete acquisition	30 days
Certify Real Estate	Within 10 days of NFS certification
Construction Contract Award	After RE certification
Begin Construction Phase	Anticipate 6 months minimum time required between Feasibility Study approval and start of construction

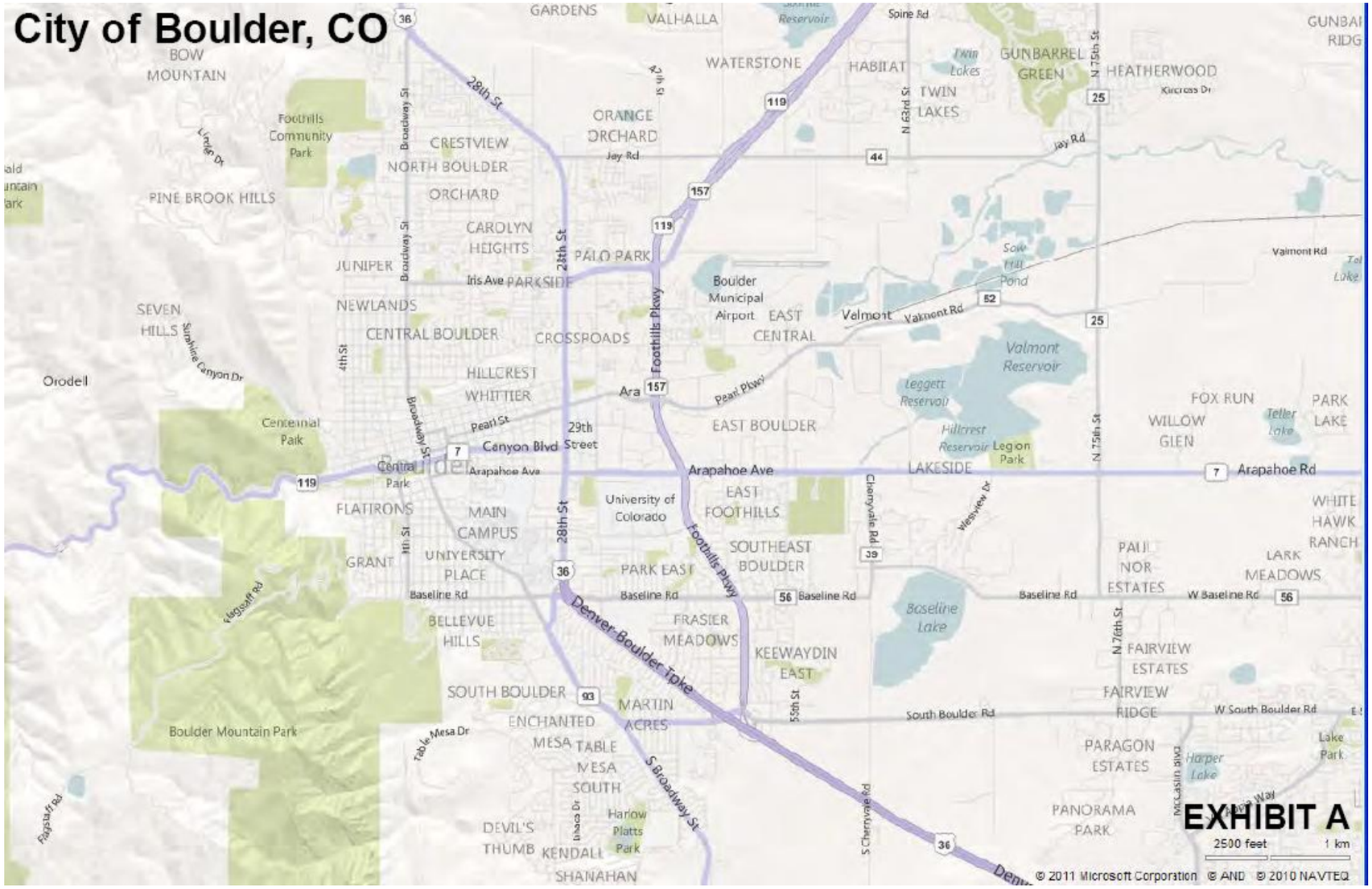
***** Number of days required dependent upon NFS's date for board meeting after the execution of the PPA.

NOTIFICATION TO NON-FEDERAL SPONSOR: The NFS has been notified in writing of the risks associated with acquiring land before the execution of the Project Partnership Agreement (PPA),

RECOMMENDATIONS/COMMENTS: Omaha District's Real Estate Division and the Project Non-Federal Sponsor, the City of Boulder, Colorado, recommend this Project for construction.

Prepared by: Victoria S. French, Realty Specialist

	Federal Costs	NFS Costs	TOTAL
Land/Damages	$0.00	$1,124,000.0	$1,124,000.00
Relocation Expenses	$0.00	$0.00	$0.00
Replacement Housing	$0.00	$0.00	$0.00
RE Administrative Costs	$45,420.00	$100,000.00	$145,420.00
Total	$45,420.00	$1,224,000.00	$1,269,420.00
Contingencies (2%) (Rounded)	$908.00	$24,480.00	$25,388.00
Total	$46,328.00	$1,248,480.00	$1,294,808.00


City of Boulder, CO
BOW MOUNTAIN
Foothills Community Park
PINE BROOK HILLS
SEVEN HILLS
Orodell
Centennial Park
GARDENS
VALHALLA
WATERSTONE
HABITAT
GUNBARREL GREEN
HEATHERWOOD
TWIN LAKES
ORANGE ORCHARD
CRESTVIEW
NORTH BOULDER
ORCHARD
CAROLYN HEIGHTS
PALO PARK
JUNIPER
PARKSIDE
NEWLANDS
CENTRAL BOULDER
CROSSROADS
HILLCREST
WHITTIER
Boulder Municipal Airport
EAST CENTRAL
Valmont Reservoir
Leggett Reservoir
Hillcrest Reservoir
Legion Park
EAST BOULDER
FOX RUN
WILLOW GLEN
PARK LAKE
LAKESIDE
Central Park
FLATIRONS
MAIN CAMPUS
University of Colorado
EAST FOOTHILLS
SOUTHEAST BOULDER
GRANT
UNIVERSITY PLACE
PARK EAST
PALL NOR ESTATES
WHITE HAWK RANCH
LARK MEADOWS
BELLEVUE HILLS
FRASIER MEADOWS
KEEWAYDIN EAST
Baseline Lake
FAIRVIEW ESTATES
FAIRVIEW RIDGE
SOUTH BOULDER
MARTIN ACRES
ENCHANTED MESA
TABLE MESA
SOUTH
PARAGON ESTATES
Harper Lake
Lake Park
Boulder Mountain Park
DEVIL'S THUMB
KENDALL
Harlow Platts Park
SHANAHAN
PANORAMA PARK
Denver-Boulder Tpke
Foothills Pkwy
S Broadway St
28th St
Broadway St
Arapahoe Ave
Arapahoe Rd
Baseline Rd
W Baseline Rd
South Boulder Rd
W South Boulder Rd
Valmont Rd
Jay Rd
Iris Ave
Pearl St
Canyon Blvd
29th Street
Spine Rd
Kincross Dr
Cherryvale Rd
N 75th St
N 76th St
N 63rd St
Lindo Dr
Sunshine Canyon Dr
Flagstaff Rd
Table Mesa Dr
McCaslin Blvd
EXHIBIT A
2500 feet
1 km
© 2011 Microsoft Corporation © AND © 2010 NAVTEQ

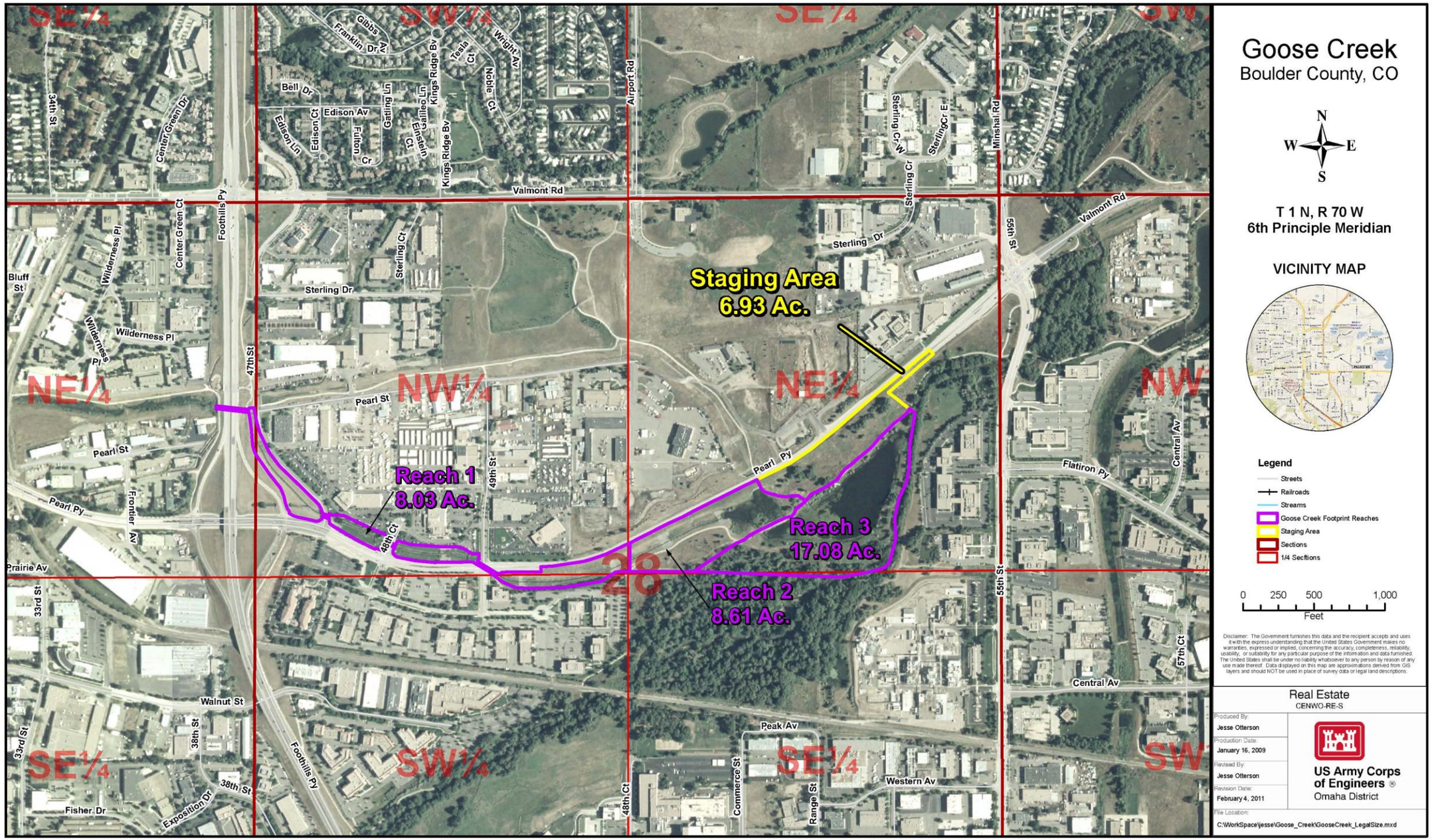

Goose Creek
Boulder County, CO
N
W
E
S
T 1 N, R 70 W
6th Principle Meridian
VICINITY MAP
Legend
Streets
Railroads
Streams
Goose Creek Footprint Reaches
Staging Area
Sections
1/4 Sections
0 250 500 1,000
Feet
Disclaimer: The Government furnishes this data and the recipient accepts and uses it with the express understanding that the United States Government makes no warranties, expressed or implied, concerning the accuracy, completeness, reliability, usability, or suitability for any particular purpose of the information and data furnished. The United States shall be under no liability whatsoever to any person by reason of any use made thereof. Data displayed on this map are approximations derived from GIS layers and should NOT be used in place of survey data or legal land descriptions.
Real Estate
CENWO-RE-S
Produced By:
Jesse Otterson
Production Date:
January 16, 2009
Revised By:
Jesse Otterson
Revision Date:
February 4, 2011
File Location:
C:\WorkSpace\jesse\Goose_Creek\GooseCreek_LegalSize.mxd
US Army Corps of Engineers ®
Omaha District
Staging Area
6.93 Ac.
Reach 1
8.03 Ac.
Reach 2
8.61 Ac.
Reach 3
17.08 Ac.
28
NE¼
NW¼
SE¼
SW¼
Valmont Rd
Airport Rd
Foothills Py
Pearl St
Pearl Py
Sterling Dr
Sterling Cr
Sterling Cr W
Sterling Cr E
Minshall Rd
55th St
Flatiron Py
Central Av
Wilderness Pl
Bluff St
Center Green Dr
Center Green Ct
47th St
48th Ct
49th St
Frontier Av
Prairie Av
33rd St
Walnut St
38th St
Fisher Dr
Exposition Dr
Peak Av
Commerce St
Range St
Western Av
57th Ct
34th St
Bell Dr
Edison Av
Edison Ct
Edison Ln
Fulton Cr
Gatling Ln
Einstein Ct
Galileo Ln
Kings Ridge Bv
Tesla Ct
Nobel Ct
Wright Av
Gibbs Dr
Franklin Dr

EXHIBIT B

Goose Creek Section 206 Project
City of Boulder, Colorado

ASSESSMENT OF NON-FEDERAL SPONSOR'S
REAL ESTATE ACQUISITION CAPABILITY

I. Legal Authority:

a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes? YES
b. Does the sponsor have the power of eminent domain for this project? YES
c. Does the sponsor have "quick-take" authority for this project? YES, VIA EMINANT DOMAIN
d. Are any of the lands/interests in land required for the project located outside the sponsor's political boundary? NO
e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn? NO

II. Human Resource Requirements:

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including P.L. 91-646, as amended? NO
b. If the answer to II a. is "yes," has a reasonable plan been developed to provide such training? N/A
c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project? YES
d. Is the sponsor's projected in-house staffing level sufficient considering its other work load, if any, and the project schedule? YES
e. Can the sponsor obtain contractor support, if required in a timely fashion? YES
f. Will the sponsor likely request USACE assistance in acquiring real estate? NO (If "yes," provide description)

III. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site? YES
b. Has the sponsor approved the project/real estate schedule/milestones? YES

IV. Overall Assessment:

a. Has the sponsor performed satisfactorily on other USACE projects? N/A
b. With regard to this project, the sponsor is anticipated to be: HIGHLY CAPABLE

EXHIBIT "C"

V. Coordination:

a. Has this assessment been coordinated with the sponsor? YES

b. Does the sponsor concur with this assessment? YES

Prepared by:

Melissa M Head Feb 23, 11

Melissa M Head
Assistant District Counsel

Reviewed and approved by:

Lon G. Larson 23 Feb 11

Lon G. Larson
Chief, Real Estate Division

EXHIBIT "C"

US Army Corps of Engineers ®
Omaha District

GOOSE CREEK
BOULDER, COLORADO

SECTION 206
ECOSYSTEM RESTORATION REPORT

APPENDIX J-
Part I: AGENCY COORDINATION
Part II: PUBLIC INVOLVEMENT

JUNE 2011

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US Army Corps
of Engineers ®
Omaha District

APPENDIX J-

Part I: AGENCY COORDINATION

JUNE 2011

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DEPARTMENT OF NATURAL RESOURCES

DIVISION OF WATER RESOURCES

John W. Hickenlooper
Governor

Mike King
Executive Director

Dick Wolfe, P.E.
Director/State Engineer

June 10, 2011

Eric Fairlee
Natural Resource Specialist – IPM Coordinator
City of Boulder Open Space and Mountain Parks
7315 Red Deer Drive
Boulder, CO 80301

Re: Request for Water Rights Policy Guidance - Goose Creek Restoration Project

Dear Mr. Fairlee:

This letter responds to a request from your department and your partnering agency, the US Army Corps of Engineers, Omaha District, regarding water rights policy and administration with respect to the proposed Goose Creek Restoration Project. I have conferred with my staff and reviewed the materials that they received from you during recent discussions of the proposed project. You are proposing restoration of a reach of South Goose Creek extending from Foothills Parkway through Cottonwood Pond to the creek's confluence with Boulder Creek. Elements of the project would include restoring natural stream channel conditions, including channel meanders and floodplain terraces; filling and re-excavating Cottonwood Pond; removing exotic/invasive vegetation species and reestablishing native riparian vegetation; and recreating wetlands, including a wooded wetland area at the current pond site. The objective of the proposed restoration is to reestablish an aquatic and riparian habitat benefitting fish and wildlife resources to resemble historic conditions prior to disturbances of the last 75 years. You would carry out these changes with the understanding that the areas of restored wetlands and stream would be no greater than the areas of historic, or pre-disturbance, wetlands and stream along the project reach.

Under my administrative authority and that of the Division Engineer for Division 1, the Division of Water Resources would allow the stream restoration project under the described conditions on the basis that there would be no more water consumption than occurred during pre-disturbance conditions. Similarly, I can state that native wetland and riparian vegetation within the restored systems, whether intentionally planted or not, would be allowed on the same basis. This position is consistent with our long-held approach to evaluating any efforts to modify a natural stream; that is, the modification is allowed under our administration as long as stream surface area and wetlands area are not greater after the modification than before. Your situation is different from more conventional projects only in that there has been a large amount of time separating the current restoration efforts from the time of pre-disturbance.

However, I cannot state a position that your efforts will not impact existing water rights. As a result of the restoration effort, the owner of a senior vested water right may indeed see an

impact to water rights relative to recent conditions. My position is that your restoration effort is allowable under our administration, but the fact that we will allow the effort does not protect you from a claim of injury by another water user. If you have questions on this matter, please contact Kevin Rein, Assistant State Engineer.

Sincerely,

Dick Wolfe, P.E.
Director/State Engineer

cc: Mark Nelson, US Army Corps of Engineers
Cynthia Upah, US Army Corps of Engineers
Dave Nettles, Division 1 Engineer

STATE OF COLORADO

John W. Hickenlooper, Governor
DEPARTMENT OF NATURAL RESOURCES

DIVISION OF WILDLIFE

AN EQUAL OPPORTUNITY EMPLOYER

Thomas E. Remington, Director
6060 Broadway
Denver, Colorado 80216
Telephone: (303) 297-1192
wildlife.state.co.us

received
JUN 10 2011

For Wildlife-
For People

May 26, 2011

Cindy Upah, CENWO-PM-AC
U.S. Army Corps of Engineers, Omaha District
Planning Branch
1616 Capitol Avenue
Omaha, NE 68102-4901
(402) 995-2672

Dear Ms. Upah:

Thank you for the opportunity to comment on the Draft Detailed Project Report and Environmental Assessment of the U.S. Army Corps of Engineers and City of Boulder's Goose Creek Aquatic Ecosystem Restoration Project. The purpose of the project is to restore historic aquatic and riparian habitat for the benefit of fish and wildlife resources to the section of Goose Creek from Foothills Parkway to the confluence with Boulder Creek including Cottonwood Pond in the City of Boulder.

The proposed project site includes a section of Goose Creek that has been significantly altered. It is surrounded by Pearl Parkway, industry, commercial development, City of Boulder Open Space and Mountain Parks property, and Parks and Recreation property. Cottonwood Lake is an old gravel pit that is currently utilized by wildlife. Beavers, muskrats, coyotes, raccoons, red foxes, and great horned owls all use the lake and surrounding area. There is also a prairie dog colony on site. In the lake are aquatic species including blue gill and carp. There is a heavily used bike path between Cottonwood Lake and Goose Creek and the lake is used by anglers as a public recreational fishery and by wildlife watchers.

This project has been divided into four reaches and different alignments were evaluated for each. The recommended plan includes restoring the channel in the first reach, moving the bike path to develop a channel with meander bends and floodplain with multiple terraces in Reach 2 and converting Cottonwood Pond into a wooded wetland. This recommended plan would provide for a continuous restored reach of Goose Creek and Cottonwood Pond that would link the previously restored reach of Goose Creek west of Foothills Parkway with the riparian habitat along Boulder Creek. Additionally, the project, if implemented, would include the removal of exotic trees and installation of wildlife migration structures under four road crossings.

The project will have a long term benefit to native species of wildlife potentially including threatened species such as the Preble's meadow jumping mouse, brassy minnow and common shiner. Project construction does, however, have the potential to impact wildlife.

The project may require removal of a small colony of black tailed prairie dogs next to the creek, unless project design can be modified to maintain the town. If removal (lethal control or relocation) is required, please be aware that the City of Boulder has specific permit requirements related to prairie dog management. Additionally, relocation requires a permit from the Division of Wildlife. Relocation sites are difficult to find because so much of Colorado's black tailed prairie dog habitat is already occupied. Because of the public concerns about moving

DEPARTMENT OF NATURAL RESOURCES, Mike King, Executive Director
WILDLIFE COMMISSION, Tim Glenn, Chair • Robert Streeter, Vice Chair • Mark Smith, Secretary
Members, David R. Brougham • Dorothea Farris • Allan Jones • Gaspar Perricone • John Singletary • Dean Wingfield
Ex Officio Members, Mike King and John Salazar

prairie dogs, relocation across county boundaries also requires county commissioner approval. We do not recommend leaving the prairie dog town in place to be destroyed by construction.

The Goose Creek plan states that most construction activity will take place outside of the nesting season of most migratory birds. If construction occurs during the nesting season of raptor species that could potentially occur in the study area raptor surveys should be conducted and if nests are detected recommended buffer zones are established in *Recommended Buffer Zones and Seasonal Restrictions for Colorado Raptors*. This guide can be found on the CDOW Website as follows: http://wildlife.state.co.us/NR/rdonlyres/A4BA7B50-A71B-4C1D-§631-ASD321FD73CO/O/CDOWRaptorBufferGuidelines02_2008.pdf .

Mature cottonwood and other trees are critical to quality wildlife habitat. It is recommended that removal of large, mature trees be avoided and other trees removed in construction be replaced at a 3:1 ratio.

One goal of the project is to replace the existing non-native vegetation on the project site with native shrubs, trees, and grasses. To further this goal it will be important to develop a weed management plan with the city of Boulder to be implemented during construction and followed up on after completion.

If heavy equipment to be used for the project has previously been used in another stream, river, lake, reservoir, pond, or wetland, one of the following disinfection practices is necessary prior to construction to prevent the spread of New Zealand mud snails, zebra mussels, quagga mussels, whirling disease, and any other aquatic invasive species into this drainage. These practices are also necessary after project completion, prior to this equipment being used in another stream, river, lake, reservoir, pond, or wetland:

- Remove all mud, plants, and debris from equipment (tracks, turrets, buckets, drags, teeth, etc.) and spray/soak equipment a 1:15 solution of Sparquat institutional cleaner and water. Keep equipment moist for at least 10 minutes **OR**
- Remove all mud, plants and debris from equipment (tracks, turrets, buckets, drags, teeth, etc.) and spray/soak equipment with water greater than 140 degrees F for at least 10 minutes.

Clean hand tools, boots, and any other equipment that will be used in the water with one of the above options as well. Do not move water from one water body to another.

The recommended plan includes draining and converting Cottonwood Pond into wooded wetlands as it was historically. We recommend notifying the local District Wildlife Manager or Area Aquatic Biologist as far in advance as possible of the intended date for onset of construction so that fish currently in the lake may be salvaged and transferred to nearby waters if possible and appropriate. Alternatively CDOW may wish to place an emergency salvage order on the pond prior to construction to allow anglers to remove a substantial portion of the fish population. Cottonwood Pond is currently utilized by anglers and will no longer be available for fishing after the project is complete.

Public angling opportunity especially in and near metropolitan areas is a valuable recreational resource to communities. The President of the United States and the Colorado Congressional delegations have advocated promoting activities that continue to bring citizens outdoors to enjoy angling, hunting and wildlife related activities for the health of our nation. To encourage continued availability of close to home sites for angling we would encourage the project proponent and partners to make a legitimate attempt to offset the loss of pond fishing opportunity that will result from altering Cottonwood Pond through mitigation work at nearby public fisheries. Shore line improvement, vegetation stabilization/enhancement, installation of float tube/non motorized boat pond access points, mobility impaired access, and fish habitat enhancement, should be considered and a fairly planned program for installation conducted in a good faith effort to offset the loss of angling opportunity this project will cause.

As part of the project evaluation a stream survey before the onset of construction and after project completion could help demonstrate any aquatic benefit from the improvements. The Division of Wildlife has the resources and the willingness to conduct such a survey. We would also encourage project planners to design any permanently flowing stream reaches for this project in a manner that will maximize survival for small fish, and to incorporate design elements that preserve, protect and enhance habitat for brassy minnows, northern redbelly dace and or common shiners, all of which are listed or species of concern in Colorado. Our regional small fish biologist can assist with suggesting key habitat elements for these species on request. Of paramount need is to create stream reaches without significant drops that would inhibit or preclude movement by small fish upstream

or downstream. If quality habitat restoration is completed that protects or provides potential suitable habitat as part of the restoration of the creek, we would be interested in stocking this section of creek with brassy minnows, northern redbelly dace, and/or common shiners depending on habitat availability as part of the project completion.

Upon completion of this project we hope that habitat enhancements will result in increased diversity and numbers of wildlife visiting the site. Hopefully this will bring birdwatchers and other outdoor enthusiasts to Goose Creek on a regular basis. However unlimited access to prime wildlife habitat can at times offset the attractiveness of the habitat because of constant human presence. Balancing access for birding with the need for privacy by nesting/roosting wildlife is a dilemma in urban wildlife recreation projects. To this end we would encourage careful consideration be given to designing pathways and observation points that allow free and appropriate access for enjoying the site while protecting crucial habitat for wildlife along Goose Creek. The local CDOW district wildlife manager would be pleased to provide input on crucial habitat deserving protections from human encroachment.

Wetlands comprise less than two percent of Colorado's landscape but provide benefits to over 75% of the species in our state, including waterfowl and several declining species. Since the beginning of major settlement activities, Colorado has lost over half of its wetlands. By virtue of their position in the landscape, wetlands perform several functions valuable to wildlife and society, including feeding, resting and rearing habitat, movement corridors, groundwater recharge, flood flow alteration, stream bank stabilization, recreation and sediment and nutrient removal. The project proposed including the preferred alignment will improve habitat for wildlife in a significantly altered section of Lower Boulder Creek. To this end we support your efforts and are available to assist and advise you in whatever capacity we are capable of, and we look forward to this project moving forward, for the not too distant future when we will be able to see the project completed, and people and wildlife benefitted by the effort. Please feel free to contact District Wildlife Manager Kristin Cannon at 303-877-6094 if we may be of further service.

Sincerely,

Steve Yamashita
Northeast Regional Manager

CC: S. Yamashita, K. Green, L. Rogstad, K. Cannon, K. Kehmeier

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Colorado Field Office
P.O. Box 25486, DFC (65412)
Denver, Colorado 80225-0486

IN REPLY REFER TO:
ES/CO: T&E/Concurrence
TAILS-65412-2011-TA-0488

MAY 25 2011

Cynthia Upah, CENWO-PM-AC
U.S. Army Corps of Engineers, Omaha District
Planning Branch
1616 Capitol Avenue
Omaha, Nebraska 68102-4901

Dear Ms. Upah:

The U.S. Fish and Wildlife Service (Service) received Brad Thompson's letters of May 11, 2011, regarding the Goose Creek Section 206 Aquatic Ecosystems Restoration Project in Boulder County, Colorado. You provided us with "Draft Detailed Project Report and Environmental Assessment" and requested concurrence with your determinations on the project's likely effects to federally-listed threatened or endangered species. The following comments have been prepared based on the authority conferred to the Service by the Endangered Species Act of 1973, as amended (50 CFR §402.14) and the Fish and Wildlife Coordination Act (48 Stat. as amended; 16 U.S.C. 661 et. seq.).

The project consists of restoration of a 4,000-foot long segment of South Goose Creek, from just upstream of Foothills Parkway downstream to the confluence with Boulder Creek. The objective of the project is to restore historic aquatic and riparian habitat for the benefit of fish and wildlife resources. Proposed actions include restoration of the stream channel and floodplain terrace, filling and excavation at the existing Cottonwood Pond, removal of exotic and invasive species, and re-establishment of native vegetation. Based on the information you have provided, the Service concurs that the proposed project is not likely to adversely affect federally-listed threatened or endangered species, including those species and critical habitat downstream on the Platte River in Nebraska. Further, the project may provide beneficial effects to the Preble's meadow jumping mouse, (*Zapus hudsonius preblei*), Ute ladies'-tresses orchid (*Spirantus diluvialus*), and Colorado butterfly plant (*Guara neomexicana* spp. *coloradensis*).

You also requested confirmation that our letter of August 12, 2008, regarding the project suffices as a Planning Aid Letter under the Fish and Wildlife Coordination Act. In that letter we addressed potential presence of listed species and described the Goose Creek Project as a positive project that should enhance fish and wildlife resources in the project area. We agree that our August 12, 2008, letter serves as a Planning Aid Letter under the Fish and Wildlife

Coordination Act. In addition, we have conducted a cursory review of your Draft Detailed Project Report and Environmental Assessment and we are encouraged that the project's selected alternative should, when implemented, result in benefits to resources of Federal interest, including wetlands, migratory birds, and aquatic life.

If the Service can be of further assistance, contact Peter Plage of this office at (303) 236-4750.

Sincerely,

ACTING FOR

Susan C. Linner
Colorado Field Supervisor

pc: Vana-Miller
Plage

Pplage:COEGooseCr:052511

From: Brand, Rena J NWO
Sent: Tuesday, May 24, 2011 12:32 PM
To: Upah, Cynthia S NWO
Subject: RE: Goose Creek - Section 404 CWA Review and Comments (UNCLASSIFIED)

Cindy,

The Corps Omaha District Denver Regulatory office (Regulatory) has reviewed the DPR and EA for the proposed Goose Creek Section 206 Aquatic Ecosystem Restoration project in Boulder County, Colorado to determine compliance under Section 404 of the Clean Water Act.

Regulatory determined that the recommended plan (R11R22R32) as described in the report can be authorized under Nationwide Permit 27 - Aquatic Habitat Restoration, Establishment, and Enhancement activities - found in the March 12, 2007 Federal Register. A full description of the Nationwide 27 Permit, General Conditions, and Colorado Regional Conditions can be found at the following links:

Nationwide Permit General Conditions: http://www.nwo.usace.army.mil/html/od-tl/nwp_nwp.html

Colorado Regional Conditions: http://www.nwo.usace.army.mil/html/od-tl/nwp.colo-regional-conditions.11-30-07.doc

All conditions must be followed to ensure compliance with Section 404 of the Clean Water Act. Please be aware that existing Nationwide Permits and Colorado Regional Conditions are scheduled to be modified, reissued, or revoked by March 18, 2012. If the project commences or is under contract to commence before March 18, 2012, you will have twelve (12) months to complete the restoration project construction under the present terms and conditions. If the project will not be under contract by March 18, 2012, please contact me to determine how to proceed.

Thanks for the opportunity to review the project,
Rena
~~~~~~
Rena Brand
Regulatory Specialist
U S Army Corps of Engineers, Omaha District
Denver Regulatory Office
9307 S. Wadsworth Blvd
Littleton, CO 80128-6901
ph 303.979.4120
fx 303.979.0602
rena.j.brand@usace.army.mil
~~~~~~

http://www.nwo.usace.army.mil/html/od-tl/tri-lakes.html

-----Original Message-----
From: Upah, Cynthia S NWO
Sent: Wednesday, May 11, 2011 1:53 PM
To: Peter_Plage@fws.gov; Sandy_Vana-Miller@fws.gov; Sage, Terri - Lakewood, CO; Christy Pickens @ CDPHE; rzuellig@usgs.gov; fowler.serah@epa.gov; larry.rogstad@state.co.us
Cc: Brand, Rena J NWO; Nelson, Mark E NWO
Subject: Goose Creek Restoration Draft Report being overnighted (UNCLASSIFIED)

Hello,

The U.S. Army Corps of Engineers, Omaha District (Corps) has prepared a Draft Detailed Project Report (DPR) and Environmental Assessment (EA) on the proposed Goose Creek Section 206 Aquatic Ecosystem Restoration Project, Boulder County, Colorado. We are over-nighting each of you a disc tomorrow, and the document is also posted under “Related Documents” at: http://www.nwo.usace.army.mil/html/pd-p/Goose_Creek/index.html.

The Denver Regulatory Office has determined that this project fits under the Nationwide permit program.

The Goose Creek Project is on an expedited schedule. We are requesting your review and comments by Wednesday, May 25, 2011. Thank you for your timely response. Due to the compressed schedule, an email response or a PDF of a written response is acceptable. Please feel free to send these to me at the contact information below, or you may contact Mark Nelson, Project Manager, at 402.995.2703.

Thank you,

Cindy

Cynthia S. Upah
Environmental Resources Specialist
U.S. Army Corps of Engineers
Omaha District
1616 Capitol Avenue
Omaha, NE 68102
(402) 995-2672
cynthia.s.upah@usace.army.mil

From: Shoup, William - Denver, CO [william.shoup@co.usda.gov]
Sent: Thursday, May 19, 2011 11:03 AM
To: Upah, Cynthia S NWO
Cc: Shoup, William - Denver, CO
Attachments: AD1006_Goose_Creek_USACE.pdf

Cynthia,

Here is the document for your records. This area is in a previously identified urbanized area. No Prime Farm Land is recognized.

Thank you,

William Shoup

Assistant State Soil Scientist

Denver, Colorado

USDA - NRCS

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request 5/19/11
Name Of Project Goose Creek at Boulder Colorado	Federal Agency Involved US Army Corps of Engineers
Proposed Land Use Aquatic Ecosystem Restoration	County And State Boulder County - Colorado
PART II *(To be completed by NRCS)*	Date Request Received By NRCS 5/19/11

Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply -- do not complete additional parts of this form).*	Yes ☐	No ☑	Acres Irrigated / Average Farm Size
Major Crop*(s)*	Farmable Land In Govt. Jurisdiction Acres: %		Amount Of Farmland As Defined in FPPA Acres: %
Name Of Land Evaluation System Used	Name Of Local Site Assessment System		Date Land Evaluation Returned By NRCS

PART III *(To be completed by Federal Agency)*	Alternative Site Rating			
	Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly				
B. Total Acres To Be Converted Indirectly				
C. Total Acres In Site	0.0	0.0	0.0	0.0
PART IV *(To be completed by NRCS)* Land Evaluation Information				
A. Total Acres Prime And Unique Farmland				
B. Total Acres Statewide And Local Important Farmland				
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted				
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value				
PART V *(To be completed by NRCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*	0	0	0	0

PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points	Site A	Site B	Site C	Site D
1. Area In Nonurban Use					
2. Perimeter In Nonurban Use					
3. Percent Of Site Being Farmed					
4. Protection Provided By State And Local Government					
5. Distance From Urban Builtup Area					
6. Distance To Urban Support Services					
7. Size Of Present Farm Unit Compared To Average					
8. Creation Of Nonfarmable Farmland					
9. Availability Of Farm Support Services					
10. On-Farm Investments					
11. Effects Of Conversion On Farm Support Services					
12. Compatibility With Existing Agricultural Use					
TOTAL SITE ASSESSMENT POINTS	160	0	0	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	0	0	0	0
Total Site Assessment *(From Part VI above or a local site assessment)*	160	0	0	0	0
TOTAL POINTS *(Total of above 2 lines)*	260	0	0	0	0

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? Yes ☐ No ☐

Reason For Selection:

(See Instructions on reverse side)

This form was electronically produced by National Production Services Staff

Clear Form

Form AD-1006 (10-83)

From: Upah, Cynthia S NWO
Sent: Thursday, May 19, 2011 4:18 PM
To: 'dick.wolfe@state.co.us'; 'kevin.rein@state.co.us'; 'jeff.deatherage@state.co.us'; 'joanna.williams@state.co.us'; Nelson, Mark
E NWO; 'Crifasi, Bob'; 'Gershman, Mark'; 'Fairlee, Eric'; 'Noble, Annie'
Subject: Goose Creek Restoration Project request for guidance (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Dear Mr. Wolfe,

The U.S. Army Corps of Engineers, Omaha District (Corps) has prepared a Draft Detailed Project Report (DPR) and Environmental Assessment (EA) on the proposed Goose Creek Section 206 Aquatic Ecosystem Restoration Project, Boulder County, Colorado. The Corps of Engineers and the city of Boulder, Open Space and Mountain Parks, have partnered on this project for a number of years.

As I indicated in my recent voicemail message, this is a very similar project to one on Lower Boulder Creek, another Section 206 Aquatic Restoration project, for which we coordinated with your office last fall. We would appreciate formal guidance from the Colorado Division of Water Resources - Office of the State Engineer on water right implications of this Goose Creek project. From our understanding on previous coordination, restoration of a natural stream channel and naturally occurring/historically equivalent wetlands would not impact existing water rights, if that restoration of wetlands is no greater than the historic presence of wetlands in the area. We have formulated the proposed project to meet these guidelines. A short summary is below, and the Draft document is posted online under "Related Documents" at: http://www.nwo.usace.army.mil/html/pd-p/Goose_Creek/index.html.

In addition, methodology for the wetland delineation follows the same methodology utilized for the Lower Boulder Creek project, and is available at the end of Appendix A of the document, also posted at the link above.

The Goose Creek Project is on an expedited schedule. The draft document is currently available for public comment through next Wednesday, May 25, and we would like to be able to finalize the report in the first part of June. I was hoping to achieve a similar coordination with your office, with the city of Boulder project managers and our Corps office through a phone call or webinar to take place next week. We would like to check your availability for a 1-2 hour call/webinar Tuesday through Friday next week (May 24-27). I could provide PowerPoint slides or similar support materials as soon as tomorrow if needed.

Thank you for your consideration of this project, particularly on such a quick timeframe. You can contact me at 402.995.2672 or Mark Nelson, Project Manager, at 402.995.2703.

Thank you,

Cindy Upah

Cynthia S. Upah
Environmental Resources Specialist
U.S. Army Corps of Engineers
Omaha District
1616 Capitol Avenue
Omaha, NE 68102
(402) 995-2672
cynthia.s.upah@usace.army.mil

SUMMARY:
The proposed project site includes 17 acres located in Township 1 North, Range 70 West, Section 28. Goose Creek is a left bank tributary of Boulder Creek, which is in turn a left bank tributary of the South Platte River. The study area extends from immediately upstream of Foothills parkway to the confluence with Boulder Creek and encompasses 4,000 feet of South Goose Creek and Cottonwood Pond, plus a small portion of North Goose Creek, downstream of Pearl Parkway. The objective is to restore a historic aquatic and riparian habitat for the benefit of fish and wildlife resources. Efforts are authorized by Section 206 of the Water Resources Development Act and are complementary to the City of Boulder's "Greenways Master Plan." In addition, the proposed project would restore part of an important riparian corridor in the Boulder Creek watershed and provide connectivity for many wildlife species dependent on the riparian corridor.

Proposed activities include removal of exotic/invasive species and re-establishment of native riparian vegetation throughout the project site, excavation of channel meanders and a floodplain terrace in a short reach of the project, and the filling of and re-excavation of Cottonwood Pond. There is an opportunity at the Cottonwood Pond area to restore a wooded wetland area resembling historic conditions. Approximately 3 acres of wetland are to be restored in Reaches 1 and 2, and approximately 7 – 10 acres of wetland are to be restored in the Cottonwood Pond area (this is compared to approximately 19 acres of historic wetlands). Other opportunities include the creation of microhabitat through removal of selected boulders lining the channel, enhancement of outfall areas, and covering of current rock structures with low lying vegetation.

Classification: UNCLASSIFIED
Caveats: NONE

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
1616 CAPITOL AVENUE
OMAHA NE 68102-4901

REPLY TO
ATTENTION OF

May 11, 2011

Planning, Programs, and Project Management Division

Pete Plage
Colorado Ecological Services Office
134 Union Blvd., Suite 670
PO Box 25486 DFC
Denver, CO 80225

Dear Mr. Plage:

The U.S. Army Corps of Engineers, Omaha District (Corps) has prepared a Draft Detailed Project Report (DPR) and Environmental Assessment (EA) on the proposed Goose Creek Section 206 Aquatic Ecosystem Restoration Project, Boulder County, Colorado. Enclosed you will find a copy of the report on disc. The document is also posted under "Related Documents" at: http://www.nwo.usace.army.mil/html/pd-p/Goose_Creek/index.html. We appreciate your continued coordination regarding this project.

The proposed project site includes 17 acres located in Township 1 North, Range 70 West, Section 28. The objective is to restore a historic aquatic and riparian habitat for the benefit of fish and wildlife resources. Efforts are authorized by Section 206 of the Water Resources Development Act and are complementary to the City of Boulder's "Greenways Master Plan." The area is heavily urbanized. Goose Creek is a left bank tributary of Boulder Creek, which is in turn a left bank tributary of the South Platte River. The study area extends from immediately upstream of Foothills parkway to the confluence with Boulder Creek and encompasses 4,000 feet of South Goose Creek and Cottonwood Pond, plus a small portion of North Goose Creek, downstream of Pearl Parkway.

Proposed activities include removal of exotic/invasive species and re-establishment of native riparian vegetation throughout the project site, excavation of channel meanders and a floodplain terrace in a short reach of the project, and the filling of and re-excavation of Cottonwood Pond. There is an opportunity at Cottonwood Pond area to restore a wooded wetland area resembling historic conditions. Approximately 3 acres of wetland are to be restored in Reaches 1 and 2, and approximately 7 – 10 acres of wetland are to be restored in the Cottonwood Pond area (this is compared to approximately 19 acres of historic wetlands). Smaller microhabitat opportunities are also planned through removing selected boulders, enhancement of outfall areas, and covering of current rock structures with biomatting.

In a letter dated August 12, 2008 the USFWS noted that while Preble's meadow jumping mouse and the Ute ladies'-tresses orchid are known to be present in the Boulder Creek drainage on City of Boulder Open Space, but that none are known to occur on the proposed project site. The letter suggested that the project area can support a variety of wildlife, and that care should be

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taken to avoid disturbance to migratory birds, eggs, young or nests. Enclosed is a Biological Assessment summary table with our preliminary determinations. Please review this table and provide your response or edits to these.

In addition, the letter requested that any action on the project site that could impact listed species or critical habitat in the central Platte River in Nebraska also be addressed; however no adverse impacts to the Platte River are anticipated. This Environmental Assessment (EA) has analyzed the potential effects of project implementation and the resulting environmental changes from the project, and determined that this project is not likely to adversely impact T&E species. Ongoing coordination with the USFWS is occurring (with Ms. Sandy Vana-Miller) and a concurrence with our no adverse impacts determination is being pursued. The Denver Regulatory Office has determined that this project fits under the Nationwide permit program.

The Goose Creek Project is on an expedited schedule. We request that you review the enclosed document and provide comments by May 25, 2011. In addition to any comments, please provide confirmation that the letter written during our scoping process, which we received August 12, 2008, provided under the authority of the Fish and Wildlife Coordination Act and the Endangered Species Act, suffices as a Planning Aid letter (as we have noted in the EA), or if communication as a response to this review would meet those needs.

Thank you for your timely response. Due to the compressed schedule, an email response or a PDF of a written response is acceptable. Please submit comments and other correspondence to:

ATTN: Ms. Cynthia Upah, CENWO-PM-AC
U.S. Army Corps of Engineers, Omaha District
Planning Branch
1616 Capitol Avenue
Omaha, NE 68102
Cynthia.s.upah@usace.army.mil

If you have any questions, please contact Ms. Cynthia Upah of my staff at (402) 995-2672.

Sincerely,

Brad Thompson
Chief, Environmental Resources and Missouri River
Recovery Program Plan Formulation Section

Enclosures

Biological Assessment Summary for Federally-listed and Candidate Endangered and Threatened Species

Common Name (Scientific Name)	**Habitat Availability within Project Area/ Rationale**	**Determination**	**Mitigation/Notes**
Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*)	The purpose of this project is to restore the riparian vegetative community and corridor, which could benefit the Preble's Meadow Jumping Mouse.	May affect/ beneficial affect	Restoration of suitable habitat may increase productivity. A qualified biologist would conduct a field survey to determine absence or presence immediately preceding construction.
Ute Ladies'-Tresses *(Spiranthes diluvialis)*	Potential habitats for the Ute ladies'-tresses within the study area included the restored reach of South Goose Creek below Reynolds Corner and in the Cottonwood Pond wetland.	May affect/ beneficial affect	A qualified biologist would conduct a field survey to determine absence or presence immediately preceding construction.
Colorado Butterfly Plant *(Gaura neomexicana spp. Coloradensis)*	Potential habitat for this species exists along the Boulder Creek floodplain in mesic meadows and within the stream channel. Habitat within the study area is not optimal because potential habitat areas have been modified by gravel mining activity and through changes in the stream channel and flow regimes.	May affect/ beneficial affect	A qualified biologist would conduct a field survey to determine absence or presence immediately preceding construction.
Interior least tern (*Sterna antillarum*)	Goose Creek is a left tributary to Boulder Creek. Boulder Creek drains into the South Platte River which is important habitat for the terns. Due to restrictions on storage and use of water, the Goose Creek project is already being formulated to avoid flow depletions to downstream regions of the Platte River Basin, so the project should not contribute to potential depletions of the flow upon which the tern depends.	May affect / Not likely to adversely affect.	The Corps has provided the flow information to the USFWS and has asked for informal consultation regarding a determination that the project would not adversely affect federally listed species and designated critical habitat associated with the Platte River in Nebraska.

Common Name (Scientific Name)	Habitat Availability within Project Area/ Rationale	Determination	Mitigation/Notes
Piping plover (*Charadrius melodus*)	Goose Creek is a left tributary to Boulder Creek. Boulder Creek drains into the South Platte River which is important habitat for the piping plovers. Due to restrictions on storage and use of water, the Goose Creek project is already being formulated to avoid flow depletions to downstream regions of the Platte River Basin, so the project should not contribute to potential depletions of the flow upon which the tern depends.	May affect / Not likely to adversely affect.	The Corps has provided the flow information to the USFWS and has asked for informal consultation regarding a determination that the project would not adversely affect federally listed species and designated critical habitat associated with the Platte River in Nebraska.
Pallid sturgeon (*Scaphirhynchus albus*)	Goose Creek is a left tributary to Boulder Creek. Boulder Creek drains into the South Platte River which is important habitat for the pallid sturgeon. Due to restrictions on storage and use of water, the Goose Creek project is already being formulated to avoid flow depletions to downstream regions of the Platte River Basin, so the project should not contribute to potential depletions of the flow upon which the tern depends.	May affect / Not likely to adversely affect.	The Corps has provided the flow information to the USFWS and has asked for informal consultation regarding a determination that the project would not adversely affect federally listed species and designated critical habitat associated with the Platte River in Nebraska.
Whooping crane (*Grus americana*)	Whooping cranes have not been seen in Colorado since 2002; however, they do pass through the Platte River basin, downstream in Nebraska, which is important habitat for the cranes. Due to restrictions on storage and use of water, the Goose Creek project is already being formulated to avoid flow depletions to downstream regions of the Platte River Basin, so the project should not contribute to potential depletions of the flow upon which the tern depends.	May affect / Not likely to adversely affect.	The Corps has provided the flow information to the USFWS and has asked for informal consultation regarding a determination that the project would not adversely affect federally listed species and designated critical habitat associated with the Platte River in Nebraska. If a whooping crane is sighted, work would stop and the USFWS would be contacted.

Common Name (Scientific Name)	Habitat Availability within Project Area/ Rationale	Determination	Mitigation/Notes
Bald eagle	While previously listed as "threatened" under the ESA, the Bald Eagle was de-listed on June 28, 2007 (effective August 8, 2007). However, this species is still protected under the Bald and Golden Eagle Protection Act as well as the Migratory Bird Treaty Act. These birds tend to construct their nests in mature trees near aquatic habitats, especially in cottonwood trees, and do nest downstream within the South Platte Basin, particularly in adjacent Weld County. Bald Eagle nests are also located in Boulder County, with the closest nest to the project located approximately 4 miles downstream along Boulder Creek.	May affect / Not likely to adversely affect.	In the Goose Creek area, the nesting season runs from November 1 to July 31. Accordingly, during this period, construction would avoid active nests by a maximum distance of 660 feet if the activity would be visible from the nest. A qualified biologist would coordinate with the USFWS Colorado Ecological Services Field Office in Denver, Colorado, to survey the area prior to the clearing and other construction activities and also if a nest is suspected in the project area.

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
1616 capitol avenue
OMAHA NE 68102-4901

REPLY TO
ATTENTION OF

May 11, 2011

Planning, Programs, and Project Management Division

Sandy Vana-Miller
Colorado Ecological Services Office
134 Union Blvd., Suite 670
PO Box 25486 DFC
Denver, CO 80225

Dear Ms. Vana-Miller:

The U.S. Army Corps of Engineers, Omaha District (Corps) has prepared a Draft Detailed Project Report (DPR) and Environmental Assessment (EA) on the proposed Goose Creek Section 206 Aquatic Ecosystem Restoration Project, Boulder County, Colorado. Enclosed you will find a copy of the report on disc. The document is also posted under "Related Documents" at: http://www.nwo.usace.army.mil/html/pd-p/Goose_Creek/index.html. We appreciate your assistance in helping us coordinate our requirements regarding wetland activities and Platte River Basin depletions.

We understand that restoration projects whose objective is to restore natural functions that were formerly provided by a wetland at a location are considered to contribute to the recovery of the federally –listed species in the Platte River basin.

The proposed project site includes 17 acres located in Township 1 North, Range 70 West, Section 28. The objective is to restore a historic aquatic and riparian habitat for the benefit of fish and wildlife resources. Efforts are authorized by Section 206 of the Water Resources Development Act and are complementary to the City of Boulder's "Greenways Master Plan." The area is heavily urbanized. Goose Creek is a left bank tributary of Boulder Creek, which is in turn a left bank tributary of the South Platte River. The study area extends from immediately upstream of Foothills parkway to the confluence with Boulder Creek and encompasses 4,000 feet of South Goose Creek and Cottonwood Pond, plus a small portion of North Goose Creek, downstream of Pearl Parkway.

Proposed activities include removal of exotic/invasive species and re-establishment of native riparian vegetation throughout the project site, excavation of channel meanders and a floodplain terrace in a short reach of the project, and the filling of and re-excavation of Cottonwood Pond. There is an opportunity at Cottonwood Pond area to restore a wooded wetland area resembling historic conditions. Approximately 3 acres of wetland are to be restored in Reaches 1 and 2, and approximately 7 – 10 acres of wetland are to be restored in the Cottonwood Pond area (this is compared to approximately 19 acres of historic wetlands). In the view of the State Engineer, this would be restoration of a lesser acreage of meander wetlands than historically existed in this reach. Smaller microhabitat opportunities are also planned through removing selected boulders,

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enhancement of outfall areas, and covering of current rock structures with biomatting. The Denver Regulatory Office has determined that this project fits under the Nationwide permit program.

South Goose Creek is normally a gaining stream (discharge point for groundwater) at low and average stream flows; thus no stream losses would occur at low and average flows. The stream would be a losing stream (recharges the overburden materials) during periods of sustained, high stream flows - where incremental flow losses are related to the increase in infiltration area and duration. Since Goose Creek is a small urban watershed, flood discharge hydrographs are short and sharp, giving little time for infiltration losses to occur. Since changes in both the base and flood flow discharges of Goose Creek will be negligible following project implementation, this project is not forecast to have any impact on Platte River depletions. Further details are provided in the attached document.

Based on these facts, we request concurrence to our determination that the Goose Creek restoration project would be not likely to adversely affect federally-listed species or critical habitat in the Platte River basin. The Goose Creek Project is on an expedited schedule. We request that you review the enclosed document and provide comments by May 25, 2011. Thank you for your timely response. Due to the compressed schedule, an email response or a PDF of a written response is acceptable. Please submit comments and other correspondence to:

ATTN: Ms. Cynthia Upah, CENWO-PM-AC
U.S. Army Corps of Engineers, Omaha District
Planning Branch
1616 Capitol Avenue
Omaha, NE 68102
Cynthia.s.upah@usace.army.mil

If you have any questions, please contact Ms. Cynthia Upah of my staff at (402) 995-2672.

Sincerely,

Brad Thompson
Chief, Environmental Resources and Missouri River
Recovery Program Plan Formulation Section

Enclosures

Goose Creek Section 206 Aquatic Restoration Project
Boulder Colorado
Water Depletions

South Goose Creek is normally a gaining stream (discharge point for groundwater) at low and average stream flows; thus no stream losses would occur at low and average flows. The stream would be a losing stream (recharges the overburden materials) during periods of sustained, high stream flows - where incremental flow losses are related to the increase in infiltration area and duration. Since Goose Creek is a small urban watershed, flood discharge hydrographs are short and sharp, giving little time for infiltration losses to occur. Additionally, there are no documented floods of long duration, since the larger peak discharges are the result of thunderstorm runoff in this basin. In general, any infiltrated water would likely return to South Goose Creek for a majority of the project length and to Boulder Creek in the vicinity of Cottonwood Pond.

Proposed changes to South Goose Creek would not cause depletions through infiltration losses, at low and average flows, even though the proposed project would slightly increase stream length. Data indicate that groundwater elevation is normally above the elevation of the proposed new channel bed; thus, the new alignment would be a gaining stream reach just as the existing alignment is.

In the upstream portion of the project (Reach 1), the "with-project" South Goose Creek flood behavior will be similar to the existing condition, as the conveyance of the flood channel remains unaltered. Above average flows would escape the new channel slightly less frequently in the middle reach (Reach 2), due to the widened low floodplain bench and greater flood conveyance in that reach resulting from the selected plan. In Cottonwood Pond (Reach 3), the flood behavior will be similar to the existing condition, once it is converted to a wetland. Flood flows will spread out and slow down crossing the wetland in route to Boulder Creek, in similar fashion as they do now crossing Cottonwood Pond. In all cases, the frequency of out of bank flows will be similar to, or less than the current condition. Given the similarity of the pre and post-project channel / floodplain conveyance, and the flashy nature of flood hydrographs moving through South Goose Creek / Cottonwood Wetland, it is anticipated that infiltration losses will be essentially unaltered by this project.

Discharges from this small urban watershed are very small relative to those on the South Platte River and Platte River. Typical base flows on South Goose Creek range from 1 to 2 cubic feet per second. This discharge is small enough to be lost in the rounding of daily discharge computations for most flows measured at the South Platte River Gage at Kersey, CO. During a South Platte Basin-wide flood event, Goose Creek discharges will also be very small relative to the flood discharges measured on the South Platte River. Since changes in both the base and flood flow discharges of Goose Creek will be negligible following project implementation, this project is not forecast to have any impact on Platte River depletions.

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
1616 CAPITOL AVENUE
OMAHA NE 68102-4901

REPLY TO
ATTENTION OF

May 11, 2011

Planning, Programs, and Project Management Division

Larry Rogstad
Lon Hagler State Wildlife Area
Colorado Division of Wildlife
4207 West County Road 16E
Loveland, CO 80537

Dear Mr. Rogstad:

The U.S. Army Corps of Engineers, Omaha District (Corps) has prepared a draft Detailed Project Report (DPR) and Environmental Assessment (EA) on the proposed Goose Creek Section 206 Aquatic Ecosystem Restoration Project, Boulder County, Colorado. Enclosed you will find a copy of the report on disc. The document is also posted under "Related Documents" at: http://www.nwo.usace.army.mil/html/pd-p/Goose_Creek/index.html. Thank you for your continued coordination regarding this project.

The proposed project site includes 17 acres located in Township 1 North, Range 70 West, Section 28. The objective is to restore a historic aquatic and riparian habitat for the benefit of fish and wildlife resources. Efforts are authorized by Section 206 of the Water Resources Development Act and are complementary to the City of Boulder's "Greenways Master Plan." The area is heavily urbanized. Goose Creek is a left bank tributary of Boulder Creek, which is in turn a left bank tributary of the South Platte River. The study area extends from immediately upstream of Foothills parkway to the confluence with Boulder Creek and encompasses 4,000 feet of South Goose Creek and Cottonwood Pond, plus a small portion of North Goose Creek, downstream of Pearl Parkway.

Proposed activities include removal of exotic/invasive species and re-establishment of native riparian vegetation throughout the project site, excavation of channel meanders and a floodplain terrace in a short reach of the project, and the filling of and re-excavation of Cottonwood Pond. There is an opportunity at Cottonwood Pond area to restore a wooded wetland area resembling historic conditions. Approximately 3 acres of wetland are to be restored in Reaches 1 and 2, and approximately 7 – 10 acres of wetland are to be restored in the Cottonwood Pond area (this is compared to approximately 19 acres of historic wetlands). Smaller microhabitat opportunities are also planned through removing selected boulders, enhancement of outfall areas, and covering of current rock structures with biomatting. The Denver Regulatory Office has determined that this project fits under the Nationwide permit program.

The Goose Creek Project is on an expedited schedule. We request that you review the enclosed document and provide comments by May 25, 2011. Thank you for your timely response. Due to the compressed schedule, an email response or a PDF of a written response is acceptable. Please submit comments and other correspondence to:

Printed on Recycled Paper

ATTN: Ms. Cynthia Upah, CENWO-PM-AC
U.S. Army Corps of Engineers, Omaha District
Planning Branch
1616 Capitol Avenue
Omaha, NE 68102

If you have any questions, please contact Ms. Cynthia Upah of my staff at (402) 995-2672.

Sincerely,

Brad Thompson
Chief, Environmental Resources and Missouri River
Recovery Program Plan Formulation Section

Enclosures

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
1616 CAPITOL AVENUE
OMAHA NE 68102-4901

REPLY TO
ATTENTION OF

May 11, 2011

Planning, Programs, and Project Management Division

Christy Pickens
Colorado Department of Public Health and Environment
Water Quality Control Division
WQCS-WSP-EDU-Bi
4300 Cherry Creek Drive South
Denver, CO 80246-3586

Dear Ms. Pickens:

The U.S. Army Corps of Engineers, Omaha District (Corps) has prepared a Draft Detailed Project Report (DPR) and Environmental Assessment (EA) on the proposed Goose Creek Section 206 Aquatic Ecosystem Restoration Project, Boulder County, Colorado. Enclosed you will find a copy of the report on disc. The document is also posted under "Related Documents" at: http://www.nwo.usace.army.mil/html/pd-p/Goose_Creek/index.html.

The Denver Regulatory Office has determined that this project fits under the Nationwide permit program; therefore, it is anticipated that the Colorado Department of Public Health and Environment (CDPHE) would not be required to issue a water quality certification.

The proposed project site includes 17 acres located in Township 1 North, Range 70 West, Section 28. The objective is to restore a historic aquatic and riparian habitat for the benefit of fish and wildlife resources. Efforts are authorized by Section 206 of the Water Resources Development Act and are complementary to the City of Boulder's "Greenways Master Plan." The area is heavily urbanized. Goose Creek is a left bank tributary of Boulder Creek, which is in turn a left bank tributary of the South Platte River. The study area extends from immediately upstream of Foothills parkway to the confluence with Boulder Creek and encompasses 4,000 feet of South Goose Creek and Cottonwood Pond, plus a small portion of North Goose Creek, downstream of Pearl Parkway.

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ATTN: Ms. Cythia Upah, CENWO-PM-AC
U.S. Army Corps of Engineers, Omaha District
Planning Branch
1616 Capitol Avenue
Omaha, NE 68102

If you have any questions, please contact Ms. Cynthia Upah of my staff at (402) 995-2672.

Sincerely,

Brad Thompson
Chief, Environmental Resources and Missouri River
Recovery Program Plan Formulation Section

Enclosures

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
1616 CAPITOL AVENUE
OMAHA NE 68102-4901

REPLY TO
ATTENTION OF

May 11, 2011

Planning, Programs, and Project Management Division

Sarah Fowler, Biologist
Wetlands and Watershed Unit, EPR-EP
EPA Region 8
1595 Wynkoop Street
Denver, CO 80202-1129

Dear Ms. Fowler:

The U.S. Army Corps of Engineers, Omaha District (Corps) has prepared a Draft Detailed Project Report (DPR) and Environmental Assessment (EA) on the proposed Goose Creek Section 206 Aquatic Ecosystem Restoration Project, Boulder County, Colorado. Enclosed you will find a copy of the report on disc. The document is also posted under "Related Documents" at: http://www.nwo.usace.army.mil/html/pd-p/Goose_Creek/index.html. We appreciate your continued coordination regarding this project.

The proposed project site includes 17 acres located in Township 1 North, Range 70 West, Section 28. The objective is to restore a historic aquatic and riparian habitat for the benefit of fish and wildlife resources. Efforts are authorized by Section 206 of the Water Resources Development Act and are complementary to the City of Boulder's "Greenways Master Plan." The area is heavily urbanized. Goose Creek is a left bank tributary of Boulder Creek, which is in turn a left bank tributary of the South Platte River. The study area extends from immediately upstream of Foothills parkway to the confluence with Boulder Creek and encompasses 4,000 feet of South Goose Creek and Cottonwood Pond, plus a small portion of North Goose Creek, downstream of Pearl Parkway.

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The Goose Creek Project is on an expedited schedule. We request that you review the enclosed document and provide comments by May 25, 2011. Thank you for your timely response. Due to the compressed schedule, an email response or a PDF of a written response is acceptable. Please submit comments and other correspondence to:

Printed on Recycled Paper

ATTN: Ms. Cynthia Upah, CENWO-PM-AC
U.S. Army Corps of Engineers, Omaha District
Planning Branch
1616 Capitol Avenue
Omaha, NE 68102
Cynthia.s.upah@usace.army.mil

If you have any questions, please contact Ms. Cynthia Upah of my staff at (402) 995-2672.

Sincerely,

Brad Thompson
Chief, Environmental Resources and Missouri River
Recovery Program Plan Formulation Section

Enclosures

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
1616 CAPITOL AVENUE
OMAHA NE 68102-4901

REPLY TO
ATTENTION OF

May 11, 2011

Planning, Programs, and Project Management Division

Ms. Terri Sage, State Biologist
USDA-NRCS
Denver Federal Center
Building 56, Rm 2604
PO Box 25426
Denver, CO 80225-0426

Dear Ms. Sage:

The U.S. Army Corps of Engineers, Omaha District (Corps) has prepared a Draft Detailed Project Report (DPR) and Environmental Assessment (EA) on the proposed Goose Creek Section 206 Aquatic Ecosystem Restoration Project, Boulder County, Colorado. Enclosed you will find a copy of the report on disc. The document is also posted under "Related Documents" at: http://www.nwo.usace.army.mil/html/pd-p/Goose_Creek/index.html.

The proposed project site includes 17 acres located in Township 1 North, Range 70 West, Section 28. The objective is to restore a historic aquatic and riparian habitat for the benefit of fish and wildlife resources. Efforts are authorized by Section 206 of the Water Resources Development Act and are complementary to the City of Boulder's "Greenways Master Plan." The area is heavily urbanized. Goose Creek is a left bank tributary of Boulder Creek, which is in turn a left bank tributary of the South Platte River. The study area extends from immediately upstream of Foothills parkway to the confluence with Boulder Creek and encompasses 4,000 feet of South Goose Creek and Cottonwood Pond, plus a small portion of North Goose Creek, downstream of Pearl Parkway.

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The Goose Creek Project is on an expedited schedule. We request that you review the enclosed document and provide comments by May 25, 2011. Although this is a very urbanized reach, and it is not anticipated that any "Prime" farmland exists in the project area, please advise regarding Farmland Protection Policy Act (FPPA) clearance. Thank you for your timely response. Due to the compressed schedule, an email response or a PDF of a written response is acceptable. Please submit comments and other correspondence to:

Printed on Recycled Paper

ATTN: Ms. Cynthia Upah, CENWO-PM-AC
U.S. Army Corps of Engineers, Omaha District
Planning Branch
1616 Capitol Avenue
Omaha, NE 68102

If you have any questions, please contact Ms. Cynthia Upah of my staff at (402) 995-2672.

Sincerely,

Brad Thompson
Chief, Environmental Resources and Missouri River
Recovery Program Plan Formulation Section

Enclosures

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
1616 CAPITOL AVENUE
OMAHA NE 68102-4901

REPLY TO
ATTENTION OF

May 11, 2011

Planning, Programs, and Project Management Division

Robert E. Zuellig, Ph.D.
WRD Ecologist
U.S. Geological Survey
Fort Collins Science Center
2150 Centre Ave., Bldg. C
Fort Collins, Colorado 80526-8118

Dear Dr. Zuellig:

The U.S. Army Corps of Engineers, Omaha District (Corps) has prepared a Draft Detailed Project Report (DPR) and Environmental Assessment (EA) on the proposed Goose Creek Section 206 Aquatic Ecosystem Restoration Project, Boulder County, Colorado. Enclosed you will find a copy of the report on disc. The document is also posted under "Related Documents" at: http://www.nwo.usace.army.mil/html/pd-p/Goose_Creek/index.html. Thank you for your participation as a panel member for the habitat analysis of this project, your continued interest in the Goose Creek watershed, and your research, which was foundational to the habitat analysis.

The proposed project site includes 17 acres located in Township 1 North, Range 70 West, Section 28. The objective is to restore a historic aquatic and riparian habitat for the benefit of fish and wildlife resources. Efforts are authorized by Section 206 of the Water Resources Development Act and are complementary to the City of Boulder's "Greenways Master Plan." The area is heavily urbanized. Goose Creek is a left bank tributary of Boulder Creek, which is in turn a left bank tributary of the South Platte River. The study area extends from immediately upstream of Foothills parkway to the confluence with Boulder Creek and encompasses 4,000 feet of South Goose Creek and Cottonwood Pond, plus a small portion of North Goose Creek, downstream of Pearl Parkway.

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The Goose Creek Project is on an expedited schedule. We request that you review the enclosed document and provide comments by May 25, 2011. Thank you for your timely response. Due to the compressed schedule, an email response or a PDF of a written response is acceptable. Please submit comments and other correspondence to:

ATTN: Ms. Cynthia Upah, CENWO-PM-AC
U.S. Army Corps of Engineers, Omaha District
Planning Branch
1616 Capitol Avenue
Omaha, NE 68102
Cynthia.s.upah@usace.army.mil

If you have any questions, please contact Ms. Cynthia Upah of my staff at (402) 995-2672.

Sincerely,

Brad Thompson
Chief, Environmental Resources and Missouri River
Recovery Program Plan Formulation Section

Enclosures

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
106 SOUTH 15TH STREET
OMAHA NE 68102-1618

REPLY TO ATTENTION OF

August 7, 2007

Planning, Programs, and Project Management Division

Georgianna Contiguglia
State Historic Preservation Officer
The Colorado History Museum
1300 Broadway
Denver, Colorado 80203

Dear Ms. Contiguglia:

The U.S. Army Corps of Engineers, Omaha District (Corps) is planning a Section 206 ecosystem restoration feasibility study in the City of Boulder, Colorado. The proposed project would be undertaken with a combination of Federal and local funding. This letter initiates Section 106 consultation for the proposed project.

The proposed project area extends from immediately upstream of Foothills Parkway to the confluence with Boulder Creek and encompasses approximately 4000 feet of South Goose Creek (Figures 1, 2, and 3). The present Goose Creek area was modified for floodflow conveyance with South Goose Creek being the main channel and North Goose Creek serving as an overflow channel. The South Goose Creek channel is designed to Urban Drainage Flood Control District (UDFCD) specifications and is trapezoidal in cross section with a number of drop structures. The land surrounding the study area is highly urbanized. The channel is confined by property lines, roadways, vehicle crossings, and utilities. The banks have been stripped of native vegetation and replanted with exotic grasses.

Specific project plans have not been developed, however, potential project goals and components have been compiled. In general, proposed project components would include stream restoration, wetland development and re-vegetation. The work would also re-establish native species; preserve, restore, and create functional wetlands, plant communities, and wildlife habitats; and increase recreational opportunities. The project may also relocate the existing bicycle trail southward to the vicinity of the social trail to further enhance riparian development. A specific list of potential goals is listed in the attached preliminary restoration plan.

The Corps has reviewed the National Register of Historic Places (NRHP) and found no NRHP properties listed within or near the proposed project area. A review of archeological sites has not yet been undertaken with your office and it is not known whether all or a portion of the area has been previously surveyed or whether or not there are previously identified cultural resource sites situated within the study area. No standing structures are present within the proposed project area.

At this time we are requesting information from your office on previously recorded sites, if any. Also, given the large amount of previous urban related disturbance within the project area, we also request your comment on the need for archeological survey for the future development.

Thank you for your attention to this matter. If you have any questions about the work performed at these sites, please contact Timothy Meade, Corps' Archeologist at (816) 389-3138 or timothy.m.meade@nwk02.usace.army.mil.

Sincerely,

Larry D. Janis, Chief
Environmental, Economics and
Cultural Resources Section
Planning Branch

Enclosures

Figure 1 Proposed Goose Creek project area.

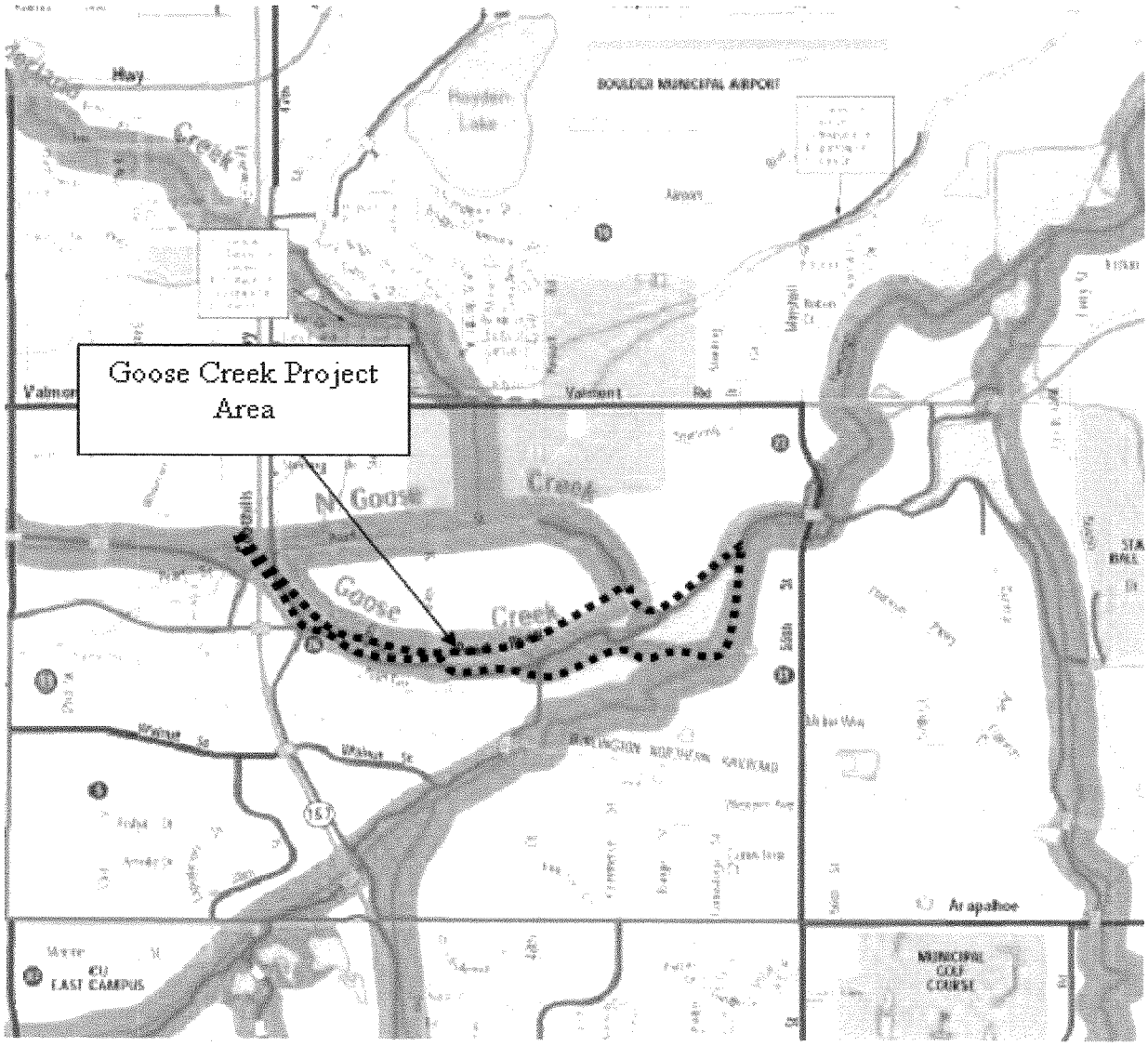


Figure 2 Proposed Goose Creek project location on a topographic map (Boulder 7.5-minute topographic map). Note: There has been a large amount of development in the area since the topographic map was made.

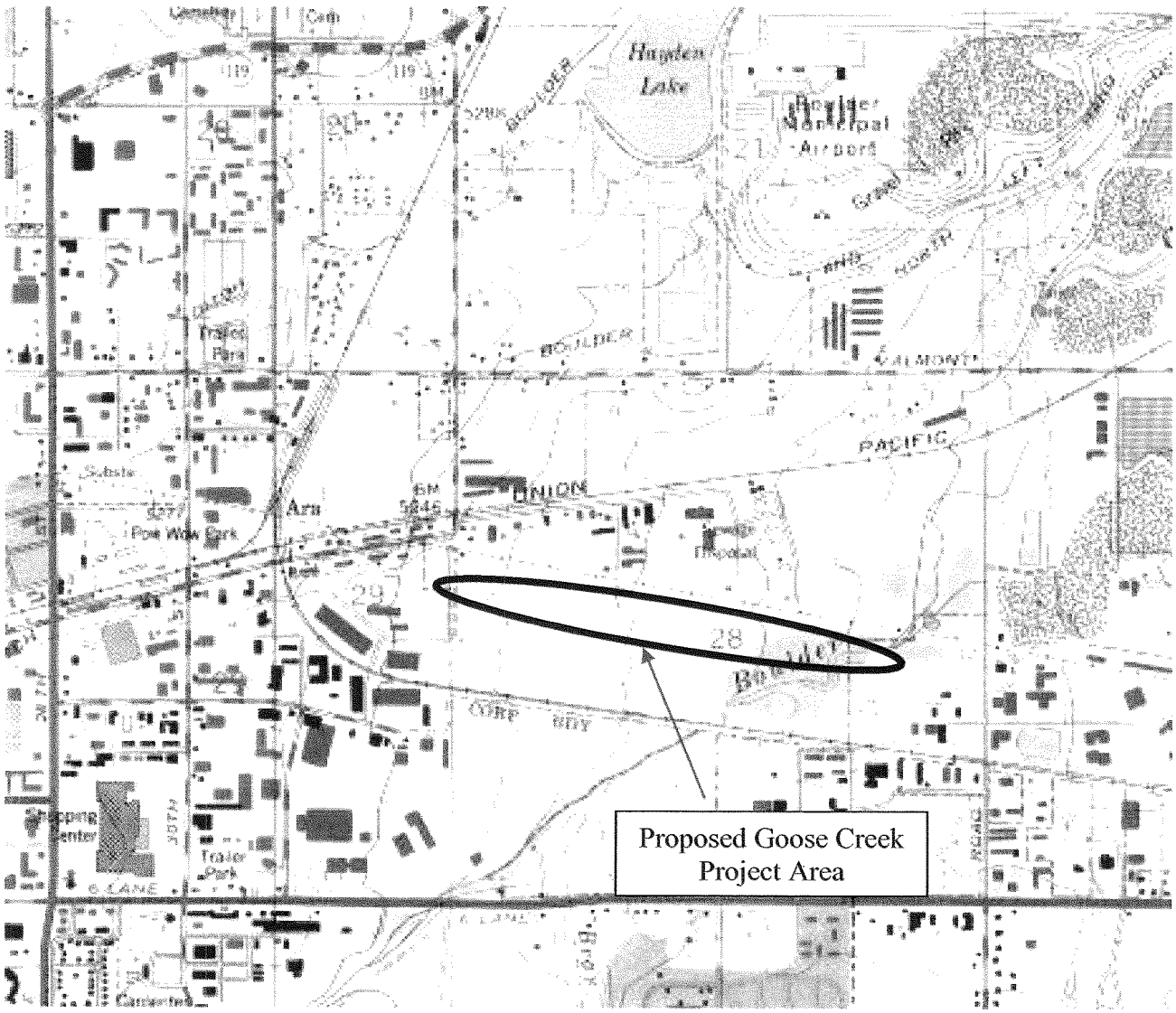
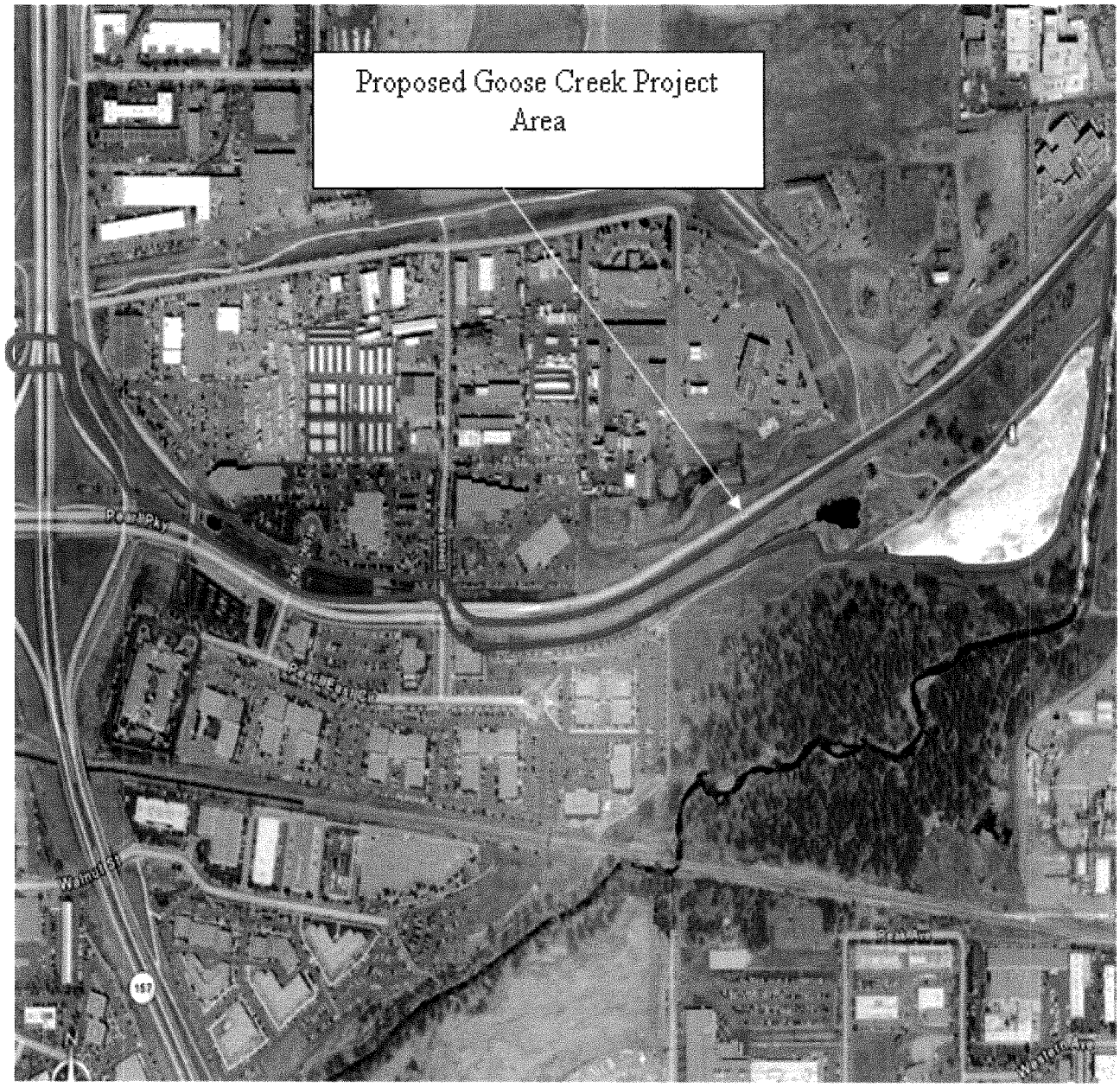


Figure 3 Aerial photo of proposed Goose Creek project area.



November 2, 2007

Larry Janis
Chief
US Corps of Engineers
Omaha District
Environmental, Economics and
Cultural Resources Section
Planning Branch
106 South 15th Street
Omaha, NE 68102-1618

Re: Section 206 ecosystem restoration feasibility study in the City of Boulder. (CHS #50809)

Dear Mr. Janis:

Thank you for your correspondence dated August 7, 2007 and received by our office on August 15, 2007 regarding the review of the above-mentioned project under Section 106 of the National Historic Preservation Act (Section 106).

After review of our database, no archaeological or historic surveys have occurred in the Area of Potential Effects (APE) (see attached map). In our opinion, the potential of locating archaeological sites within the APE is low; therefore, an archaeological survey is not needed.

However, if unidentified archaeological resources are discovered during construction, work must be interrupted until the resources have been evaluated in terms of the National Register criteria, 36 CRF 60.4, in consultation with this office.

We request being involved in the consultation process with the local government, which as stipulated in 36 CFR 800.3 is required to be notified of the undertaking, and with other consulting parties. Additional information provided by the local government or consulting parties might cause our office to re-evaluate our eligibility and potential effect findings.

Please note that our compliance letter does not end the 30-day review period provided to other consulting parties.

If we may be of further assistance, please contact Amy Pallante, our Section 106 Compliance Coordinator, at (303) 866-4678.

Sincerely,

For Mark Wolfe

Georgianna Contiguglia
State Historic Preservation Officer

cc: Timothy Mead/CORPS

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
1616 CAPITOL AVENUE
OMAHA NE 68102-4901

July 24, 2008

Planning, Programs, and Project Management Division

Mr. Larry Rogstad
Lon Hagler State Wildlife Area
Colorado Division of Wildlife
4207 West County Road 16E
Loveland, Colorado 80537

Dear Mr. Rogstad:

The U.S. Army Corps of Engineers, Omaha District (Corps) is in the process of planning a restoration project that includes lower Goose Creek and Cottonwood Pond in the City of Boulder, Colorado. The site includes 17 acres and is located in sec. 25 T. 1 N., R. 70 W. The objective is to restore historic riparian habitat for the benefit of native wildlife resources. This project study is authorized by Section 206 of the Water Resources Development Act and is complementary to the City of Boulder's "Greenways Master Plan."

The area is heavily urbanized. Goose Creek is a left bank tributary of Boulder Creek, which in turn is a left bank tributary of the South Platte River. The study area extends from immediately upstream of Foothills Parkway to the confluence with Boulder Creek and encompasses 4000 feet of South Goose Creek and Cottonwood Pond, plus a small portion of North Goose Creek, downstream of Pearl Parkway.

Specific measures to be evaluated include the reconstruction of a more natural, stable channel, construction of aquatic habitat features, invasive species removal/management, re-vegetation with native species, restoration and improvement of wetlands within the channel and best management practices at storm sewer outfalls. Improvements to Cottonwood Pond include shoreline wetland improvements, shoreline variability and depth diversity and the replacement of invasive species with native vegetation.

Any adverse construction effects would be minimal and temporary. Existing vegetation within the project boundary is mostly non-native and will be removed to restore native vegetation. The proposed project is anticipated to produce positive effects on both terrestrial and aquatic fauna including increased habitat diversity and reconnection of the riparian corridor. The last prairie dog colony located along Pearl Parkway will require special attention to remain in compliance with federal, state and local statutes.

Two federally listed (threatened) species, Preble's meadow jumping mouse and Ute's ladies tresses orchid occur in riparian habitats in the Boulder, Colorado area. A literature review and recent wildlife survey (Biohabitats 2007) did not reveal the presence of Preble's meadow jumping mouse within or near the project area. According to the City of Boulder - Open Spaces historic populations of Ute's ladies tresses occur near the project area: one upstream of the project site on Boulder Creek and one downstream on a reclaimed area (former gravel mine and now open space) east of 61st along Boulder Creek. There are no known sightings around Cottonwood Pond or Goose Creek.

We ask that you provide us with comments you may have on this project regarding state species of concern, information on ongoing projects in the area, applicable permitting requirements and any other relevant data concerning wildlife resources within or near the project area.

Please submit any updates regarding this project to:

U.S. Army Corps of Engineers, Omaha District,
Environmental, Economics, and Cultural Resource Section
ATTN: M. Katie Reed, CENWO-PM-AE
1616 Capitol Avenue
Omaha, NE 68102-4901

If you have any questions, please contact Katie Reed of my staff at (402) 995-2687.

Sincerely,

Julie Price

For Eric A. Laux, Acting Chief
Environmental, Economics and
Cultural Resources Section
Planning Branch

Enclosures

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
1616 CAPITOL AVENUE
OMAHA NE 68102-4901

July 24, 2008

Planning, Programs, and Project Management Division

Ms. Sarah Fowler, Biologist
Wetlands and Watershed Unit, EPR-EP
EPA Region 8
1595 Wynkoop Street
Denver, Colorado 80202-1129

Dear Ms. Fowler:

The U.S. Army Corps of Engineers, Omaha District (Corps) is in the process of planning a restoration project that includes lower Goose Creek and Cottonwood Pond in the City of Boulder, Colorado. The site includes 17 acres and is located in sec. 25 T. 1 N., R. 70 W. The objective is to restore historic riparian habitat for the benefit of native wildlife resources. This project study is authorized by Section 206 of the Water Resources Development Act and is complementary to the City of Boulder's "Greenways Master Plan."

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We ask that you provide us with comments and any other relevant data concerning resources within or near the project area.

Please submit this information to:

U.S. Army Corps of Engineers, Omaha District
Environmental, Economics and Cultural Resource Section
ATTN: M. Katie Reed, CENWO-PM-AE
1616 Capitol Avenue
Omaha, NE 68102-4901

If you have any questions, please contact Katie Reed of my staff at (402) 995-2687.

Sincerely,

Julie Price

For Eric A. Laux, Acting Chief
Environmental, Economics and
Cultural Resources Section
Planning Branch

Enclosures

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
1616 CAPITOL AVENUE
OMAHA NE 68102-4901

July 24, 2008

Planning, Programs, and Project Management Division

Ms. Terri Skadeland
Natural Resource Conservation Service
USDA-NRCS
655 Parfet St.
Lakewood, Colorado 80215
720-544-2813

Dear Ms. Skadeland:

The U.S. Army Corps of Engineers, Omaha District (Corps) is in the process of planning a restoration project that includes lower Goose Creek and Cottonwood Pond in the City of Boulder, Colorado. The site includes 17 acres and is located in sec. 25 T. 1 N., R. 70 W. The objective is to restore historic riparian habitat for the benefit of native wildlife resources. This project study is authorized by Section 206 of the Water Resources Development Act and is complementary to the City of Boulder's "Greenways Master Plan."

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We ask that you provide us with comments and any other relevant data concerning resources within or near the project area.

Please submit this list to:

U.S. Army Corps of Engineers, Omaha District,
Environmental, Economics, and Cultural Resource Section
ATTN: M. Katie Reed, CENWO-PM-AE
1616 Capitol Avenue
Omaha, NE 68102-4901.

If you have any questions, please contact Katie Reed of my staff at (402) 995-2687.

Sincerely,

Julie Price

For Eric A. Laux, Acting Chief
Environmental, Economics and
Cultural Resources Section
Planning Branch

Enclosures

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
1616 CAPITOL AVENUE
OMAHA NE 68102-4901

July 24, 2008

Planning, Programs, and Project Management Division

Susan Linner, Field Supervisor
Colorado Ecological Services Office
134 Union Blvd., Suite 670
PO Box 25486 DFC
Denver, Colorado 80225

Dear Ms. Linner:

The U.S. Army Corps of Engineers, Omaha District (Corps) is in the process of planning a restoration project that includes lower Goose Creek and Cottonwood Pond in the City of Boulder, Colorado. The site includes 17 acres and is located in Township 1 North, Range 70 West, Section 25. The objective is to restore historic riparian habitat for the benefit of native wildlife resources. This project study is authorized by Section 206 of the Water Resources Development Act and is complementary to the City of Boulder's "Greenways Master Plan."

The area is heavily urbanized. Goose Creek is a left bank tributary of Boulder Creek, which in turn is a left bank tributary of the South Platte River. The study area extends from immediately upstream of Foothills Parkway to the confluence with Boulder Creek and encompasses 4000 feet of South Goose Creek and Cottonwood Pond, plus a small portion of North Goose Creek, downstream of Pearl Parkway.

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Any adverse construction effects would be minimal and temporary. Existing vegetation within the project boundary is mostly non-native and will be removed to restore native vegetation. The proposed project is anticipated to produce positive effects on both terrestrial and aquatic fauna including increased habitat diversity and reconnection of the riparian corridor. The last prairie dog colony located along Pearl Parkway will require special attention to remain in compliance with federal, state and local statutes.

We ask that you provide us with comments and any other relevant data concerning resources within or near the project area.

In accordance with Section 7 of the Endangered Species Act of 1973, as amended, the U.S. Army Corps Engineers, Omaha District has requested that the USFWS provide a list of Federally listed threatened and endangered species that may be found in the proposed project area.

Please submit this list to:

ATTN: M. Katie Reed, CENWO-PM-AE
U.S. Army Corps of Engineers, Omaha District
Economics, Environmental, and Cultural Resource Section
1616 Capitol Avenue
Omaha, NE 68102

If you have any questions, please contact Katie Reed of my staff at (402) 995-2687.

Sincerely,

Julie Price

for Eric A. Laux
Chief, Environmental, Economics and
Cultural Resources Section
Planning Branch

Enclosures

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
1616 CAPITOL AVENUE
OMAHA NE 68102-4901

July 24, 2008

Planning, Programs, and Project Management Division

Mr. Robert E. Zuellig, Ph.D.
WRD Ecologist
U.S. Geological Survey
Fort Collins Science Center
2150 Centre Ave., Bldg. C
Fort Collins, Colorado 80526-8118
970 226-9419

Dear Mr. Zuellig:

The U.S. Army Corps of Engineers, Omaha District (Corps) is in the process of planning a restoration project that includes lower Goose Creek and Cottonwood Pond in the City of Boulder, Colorado. The site includes 17 acres and is located in sec. 25 T. 1 N., R. 70 W. The objective is to restore historic riparian habitat for the benefit of native wildlife resources. This project study is authorized by Section 206 of the Water Resources Development Act and is complementary to the City of Boulder's "Greenways Master Plan."

The area is heavily urbanized. Goose Creek is a left bank tributary of Boulder Creek, which in turn is a left bank tributary of the South Platte River. The study area extends from immediately upstream of Foothills Parkway to the confluence with Boulder Creek and encompasses 4000 feet of South Goose Creek and Cottonwood Pond, plus a small portion of North Goose Creek, downstream of Pearl Parkway.

Specific measures to be evaluated include the reconstruction of a more natural, stable channel, construction of aquatic habitat features, invasive species removal/management, re-vegetation with native species, restoration and improvement of wetlands within the channel and best management practices at storm sewer outfalls. Improvements to Cottonwood Pond include shoreline wetland improvements, shoreline variability and depth diversity and the replacement of invasive species with native vegetation.

Any adverse construction effects would be minimal and temporary. Existing vegetation within the project boundary is mostly non-native and will be removed to restore native vegetation. The proposed project is anticipated to produce positive effects on both terrestrial and aquatic fauna including increased habitat diversity and reconnection of the riparian corridor. The last prairie dog colony located along Pearl Parkway will require special attention to remain in compliance with federal, state and local statutes.

We ask that you provide us with comments and any other relevant data concerning resources within or near the project area.

Please submit this list to:

U.S. Army Corps of Engineers, Omaha District,
Environmental, Economics, and Cultural Resource Section
ATTN: M. Katie Reed, CENWO-PM-AE
1616 Capitol Avenue
Omaha, NE 68102-4901.

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
1616 CAPITOL AVENUE
OMAHA NE 68102-4901

July 24, 2008

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We ask that you provide us with comments and any other relevant data concerning resources within or near the project area.

Please submit this list to:

U.S. Army Corps of Engineers, Omaha District,
Environmental, Economics, and Cultural Resource Section
ATTN: M. Katie Reed, CENWO-PM-AE
1616 Capitol Avenue
Omaha, NE 68102-4901.

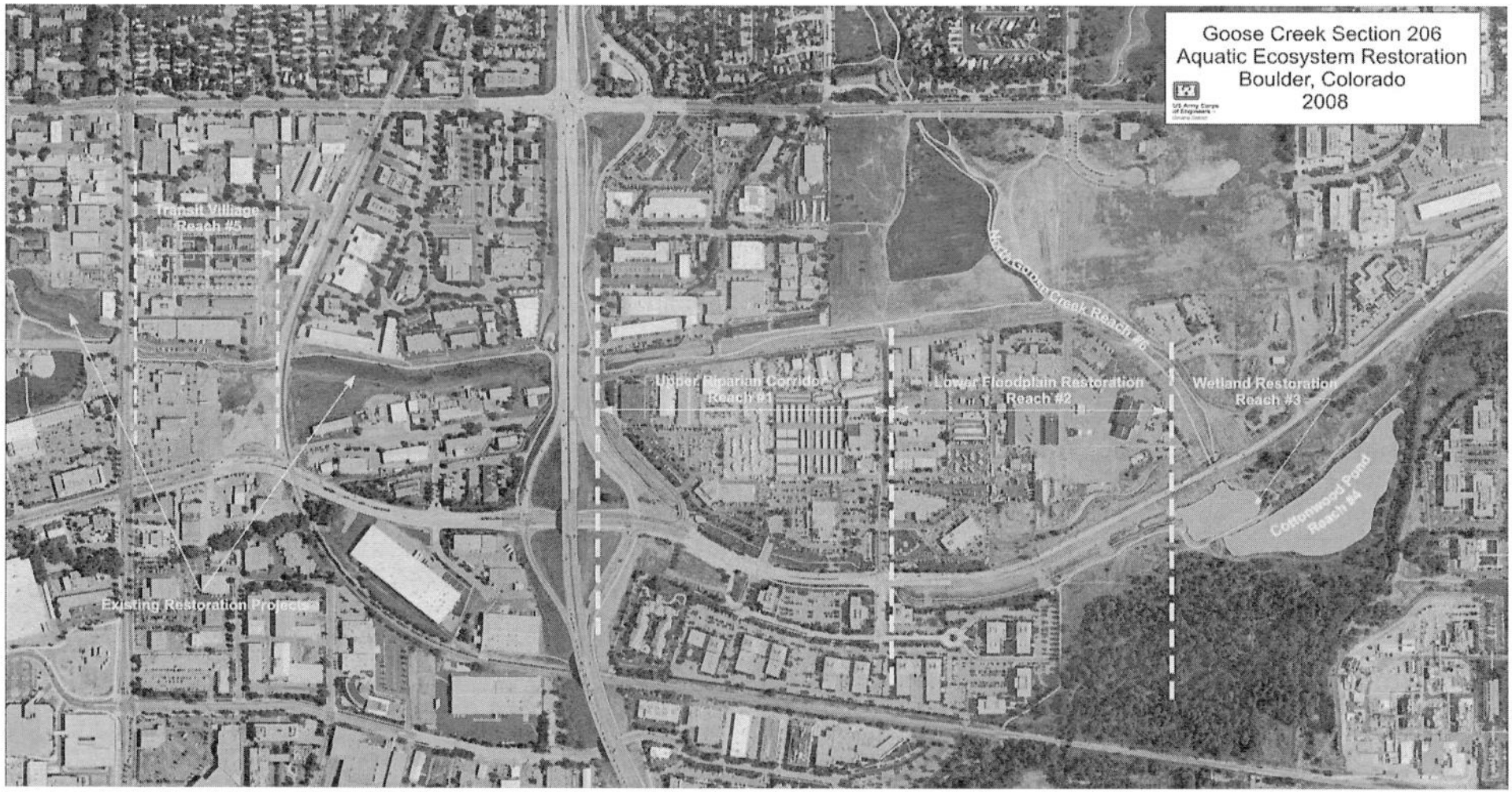
If you have any questions, please contact Katie Reed of my staff at (402) 995-2687.

Sincerely,

Julie Price

for Eric A. Laux,
Acting Chief, Environmental, Economics and
Cultural Resources Section
Planning Branch

Enclosures


Goose Creek Section 206
Aquatic Ecosystem Restoration
Boulder, Colorado
2008
Transit Village
Reach #5
Existing Restoration Projects
Upper Riparian Corridor
Reach #1
Lower Floodplain Restoration
Reach #2
Wetland Restoration
Reach #3
North Goose Creek Reach #6
Cottonwood Pond
Reach #4

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
Colorado Field Office
P.O. Box 25486, DFC (65412)
Denver, Colorado 80225-0486

IN REPLY REFER TO:
ES/CO: COE-Omaha/GooseCreek
TAILS: 65412-2008-TA-0514

AUG 1 2 2008

Eric Laux
U.S. Army Corps of Engineers, Omaha District
1616 Capitol Avenue
Omaha, Nebraska 68102-4901

Dear Mr. Laux

The U.S. Fish and Wildlife Service (Service) received your letter of July 24, 2008, regarding the the U.S. Army, Corps of Engineers' **Goose Creek and Cottonwood Pond restoration project** (Section 25, Township 1 North, Range 70 West) in Boulder County, Colorado. You requested a list of Federally-listed threatened and endangered species that may be found in the proposed project area as well as other relevant data concerning resources within or near the project area. The following comments have been prepared based on the authority conferred to the Service by the Endangered Species Act of 1973, as amended (50 CFR §402.14), and the Migratory Bird Treaty Act (16 U.S.C. 703) (MBTA).

Enclosed is a listing of Federal threatened and endangered species known from Boulder County and others that could be affected by depletions to the South Platte River. The Preble's meadow jumping mouse, *Zapus hudsonius preblei,* and the Ute ladies'-tresses orchid, *Spiranthes diluvialis,* are known to be present in the Boulder Creek drainage on City of Boulder open space. However, based on our knowledge of their distribution and habitat needs, none of these listed species are likely to inhabit the project site.

The project area supports variety of wildlife capable of existing in a human-dominated environment. This includes a variety of migratory birds that are federally-protected under the MBTA. Project activities that would otherwise result in the taking of migratory birds, eggs, young, and/or active nests should be avoided.

We see the Goose Creek restoration as a positive project that should enhance fish and wildlife resources in the project area and anticipate continued coordination with the Corps as project plans are developed.

Should you have questions regarding the content of this letter, please contact Peter Plage of this office at (303) 236-4750.

Sincerely,

Susan C. Linner
Colorado Field Supervisor

Enclosure

pc: Plage

PPlage:COEGooseCr: 080708

United States Department of the Interior

FISH AND WILDLIFE SERVICE
ECOLOGICAL SERVICES
COLORADO FIELD OFFICES

P.O. Box 25486 – DFC
Denver, Colorado 80225
Phone 303-236-4773

764 Horizon Drive, Bld. B
Grand Junction, Colorado 81502
Phone 970-243-2778

THREATENED, ENDANGERED, CANDIDATE, AND PROPOSED SPECIES BY COUNTY
Updated March 2010

Symbols:
* Water depletions in the Upper Colorado River and San Juan River Basins, may affect the species and/or critical habitat in downstream reaches in other states.
▲ Water depletions in the South Platte River may affect the species and/or critical habitat in downstream reaches in other states.
© There is designated critical habitat for the species within the county.
Recent genetic tests identified cutthroat population as GB linage, therefore, consultation is an interim measure until genetic and taxonomic issues are resolved.
§ This applies only to white-tailed or Gunnison's prairie dog habitats. All black-tailed prairie dog habitats within Colorado have been block-cleared from the requirements of ferret surveys.
T Threatened
E Endangered
P Proposed
X Experimental
C Candidate

For additional information contact: U.S. Fish and Wildlife Service, Colorado Field Office, PO Box 25486 DFC (MS 65412), Denver, Colorado 80225-0486, telephone 303-236-4773
U.S. Fish and Wildlife Service, Western Colorado Field Office, 764 Horizon Drive, Building B, Grand Junction, Colorado 81506, telephone 970-243-2778

Species	Scientific Name	Status
ADAMS		
Least tern (interior population)▲	Sternula antillarum	E
Mexican spotted owl	Strix occidentalis lucida	T
Pallid sturgeon▲	Scaphirhynchus albus	E
Piping plover▲	Charadrius melodus	T
Preble's meadow jumping mouse	Zapus hudsonius preblei	T
Ute ladies'-tresses orchid	Spiranthes diluvialis	T
Western prairie fringed orchid▲	Platanthera praeclara	T
Whooping crane▲	Grus americana	E

ALAMOSA		
Black-footed ferret	Mustela nigripes	E
Canada lynx	Lynx canadensis	T
Gunnison's prairie dog	Cynomys gunnisoni	C
Mexican spotted owl	Strix occidentalis lucida	T
Rio Grande cutthroat trout	Oncorhynchus clarki virginalis	C
Southwestern willow flycatcher	Empidonax traillii extimus	E
Yellow-billed cuckoo	Coccyzus americanus	C
ARAPAHOE		
Least tern (interior population)▲	Sternula antillarum	E
Mexican spotted owl	Strix occidentalis lucida	T
Pallid sturgeon▲	Scaphirhynchus albus	E
Piping plover▲	Charadrius melodus	T
Preble's meadow jumping mouse	Zapus hudsonius preblei	T
Ute ladies'-tresses orchid	Spiranthes diluvialis	T
Western prairie fringed orchid▲	Platanthera praeclara	T
Whooping crane▲	Grus americana	E
ARCHULETA		
Black-footed ferret	Mustela nigripes	E
Canada lynx	Lynx canadensis	T
Colorado pikeminnow*	Ptychocheilus lucius	E
Mexican spotted owl	Strix occidentalis lucida	T
New Mexico meadow jumping mouse	Zapus hudsonius luteus	C
Pagosa skyrocket	Ipomopsis polyantha	C
Razorback sucker*	Xyrauchen texanus	E
Rio Grande cutthroat trout	Oncorhynchus clarki virginalis	C
Southwestern willow flycatcher	Empidonax traillii extimus	E
Yellow-billed cuckoo	Coccyzus americanus	C
BACA		
Arkansas darter	Etheostoma cragini	C
Lesser prairie chicken	Tympanuchus pallidicinctus	C
BENT		
Arkansas darter	Etheostoma cragini	C
Least tern (interior population)	Sternula antillarum	E
Lesser prairie chicken	Tympanuchus pallidicinctus	C
Piping plover	Charadrius melodus	T
BOULDER		
Canada lynx	Lynx canadensis	T
Colorado butterfly plant	Gaura neomexicana spp. coloradensis	T

Greenback cutthroat trout	Oncorhynchus clarki stomias	T
Least tern (interior population)▲	Sternula antillarum	E
Mexican spotted owl	Strix occidentalis lucida	T
Pallid sturgeon▲	Scaphirhynchus albus	E
Piping plover▲	Charadrius melodus	T
Preble's meadow jumping mouse	Zapus hudsonius preblei	T
Ute ladies'-tresses	Spiranthes diluvialis	T
Western prairie fringed orchid▲	Platanthera praeclara	T
Whooping crane▲	Grus americana	E
BROOMFIELD		
Colorado butterfly plant	Gaura neomexicana spp. coloradensis	T
Least tern (interior population) ▲	Sternula antillarum	E
Pallid sturgeon▲	Scaphirhynchus albus	E
Piping plover▲	Charadrius melodus	T
Preble's meadow jumping mouse	Zapus hudsonius preblei	T
Ute ladies'-tresses orchid	Spiranthes diluvialis	T
Western prairie fringed orchid▲	Platanthera praeclara	T
Whooping crane▲	Grus americana	E
CHAFFEE		
Canada lynx	Lynx canadensis	T
Gunnison's prairie dog	Cynomys gunnisoni	C
Mexican spotted owl	Strix occidentalis lucida	T
Uncompahgre fritillary butterfly	Boloria acrocnema	E
CHEYENNE		
Arkansas darter	Etheostoma cragini	C
Lesser prairie chicken	Tympanuchus pallidicinctus	C
CLEAR CREEK		
Canada lynx	Lynx canadensis	T
Greenback cutthroat trout	Oncorhynchus clarki stomias	T
Least tern (interior population)▲	Sternula antillarum	E
Mexican spotted owl	Strix occidentalis lucida	T
Pallid sturgeon▲	Scaphirhynchus albus	E
Piping plover▲	Charadrius melodus	T
Western prairie fringed orchid▲	Platanthera praeclara	T
Whooping crane▲	Grus americana	E
CONEJOS		
Black-footed ferret	Mustela nigripes	E
Canada lynx	Lynx canadensis	T
Gunnison's prairie dog	Cynomys gunnisoni	C
Mexican spotted owl	Strix occidentalis lucida	T
New Mexico meadow jumping mouse	Zapus hudsonius luteus	C

Rio Grande cutthroat trout	Oncorhynchus clarki virginalis	C
Southwestern willow flycatcher	Empidonax traillii extimus	E
Yellow-billed cuckoo	Coccyzus americanus	C
COSTILLA		
Black-footed ferret	Mustela nigripes	E
Canada lynx	Lynx canadensis	T
Gunnison's prairie dog	Cynomys gunnisoni	C
Mexican spotted owl	Strix occidentalis lucida	T
New Mexico meadow jumping mouse	Zapus hudsonius luteus	C
Rio Grande cutthroat trout	Oncorhynchus clarki virginalis	C
Southwestern willow flycatcher	Empidonax traillii extimus	E
Yellow-billed cuckoo	Coccyzus americanus	C
CROWLEY		
Arkansas darter	Etheostoma cragini	C
Least tern (interior population)	Sternula antillarum	E
Lesser prairie chicken	Tympanuchus pallidicinctus	C
Piping plover	Charadrius melodus	T
CUSTER		
Canada lynx	Lynx canadensis	T
Greenback cutthroat trout	Oncorhynchus clarki stomias	T
Gunnison's prairie dog	Cynomys gunnisoni	C
Mexican spotted owl	Strix occidentalis lucida	T
DELTA		
Black-footed ferret	Mustela nigripes	E
Bonytail	Gila elegans	E
Canada lynx	Lynx canadensis	T
Clay-loving wild buckwheat©	Eriogonum pelinophilum	E
Colorado Basin hookless cactus	Sclerocactus glaucus	T
Colorado pikeminnow©	Ptychocheilus lucius	E
Greenback cutthroat trout#	Oncorhynchus clarki stomias	T
Humpback chub	Gila cypha	E
Razorback sucker©	Xyrauchen texanus	E
Yellow-billed cuckoo	Coccyzus americanus	C
DENVER		
Least tern (interior population) ▲	Sternula antillarum	E
Pallid sturgeon▲	Scaphirhynchus albus	E
Piping plover▲	Charadrius melodus	T
Preble's meadow jumping mouse	Zapus hudsonius preblei	T
Ute ladies'-tresses orchid	Spiranthes diluvialis	T
Western prairie fringed orchid▲	Platanthera praeclara	T

Whooping crane▲	Grus americana	E
DOLORES		
Bonytail*	Gila elegans	E
Canada lynx	Lynx canadensis	T
Colorado pikeminnow*	Ptychocheilus lucius	E
Humpback chub*	Gila cypha	E
Mexican spotted owl	Strix occidentalis lucida	T
Razorback sucker*	Xyrauchen texanus	E
Southwestern willow flycatcher	Empidonax traillii extimus	E
Uncompahgre fritillary butterfly	Boloria acrocnema	E
Yellow-billed cuckoo	Coccyzus americanus	C
DOUGLAS		
Colorado butterfly plant	Gaura neomexicana spp. coloradensis	T
Greenback cutthroat trout	Oncorhynchus clarki stomias	T
Gunnison's prairie dog	Cynomys gunnisoni	C
Least tern (interior population)▲	Sternula antillarum	E
Mexican spotted owl	Strix occidentalis lucida	T
Pallid sturgeon▲	Scaphirhynchus albus	E
Pawnee montane skipper	Hesperia leonardus montana	T
Piping plover▲	Charadrius melodus	T
Preble's meadow jumping mouse©	Zapus hudsonius preblei	T
Ute ladies'-tresses orchid	Spiranthes diluvialis	T
Western prairie fringed orchid▲	Platanthera praeclara	T
Whooping crane▲	Grus americana	E
EAGLE		
Black-footed ferret	Mustela nigripes	E
Bonytail*	Gila elegans	E
Canada lynx	Lynx canadensis	T
Colorado pikeminnow*	Ptychocheilus lucius	E
Greenback cutthroat trout#	Oncorhynchus clarki stomias	T
Humpback chub*	Gila cypha	E
Mexican spotted owl	Strix occidentalis lucida	T
Razorback sucker*	Xyrauchen texanus	E
Uncompahgre fritillary butterfly	Boloria acrocnema	E
Ute ladies'-tresses orchid	Spiranthes diluvialis	T
Yellow-billed cuckoo	Coccyzus americanus	C
ELBERT		
Arkansas darter	Etheostoma cragini	C
Least tern (interior population) ▲	Sternula antillarum	E
Pallid sturgeon▲	Scaphirhynchus albus	E
Piping plover▲	Charadrius melodus	T

Preble's meadow jumping mouse	Zapus hudsonius preblei	T
Western prairie fringed orchid▲	Platanthera praeclara	T
Whooping crane▲	Grus americana	E
EL PASO		
Arkansas darter	Etheostoma cragini	C
Greenback cutthroat trout	Oncorhynchus clarki stomias	T
Gunnison's prairie dog	Cynomys gunnisoni	C
Least tern (interior population) ▲	Sternula antillarum	E
Mexican spotted owl	Strix occidentalis lucida	T
Pallid sturgeon▲	Scaphirhynchus albus	E
Piping plover▲	Charadrius melodus	T
Preble's meadow jumping mouse	Zapus hudsonius preblei	T
Ute ladies'-tresses orchid	Spiranthes diluvialis	T
Western prairie fringed orchid▲	Platanthera praeclara	T
Whooping crane▲	Grus americana	E
FREMONT		
Arkansas darter	Etheostoma cragini	C
Black-footed ferret §	Mustela nigripes	E
Canada lynx	Lynx canadensis	T
Gunnison's prairie dog	Cynomys gunnisoni	C
Mexican spotted owl	Strix occidentalis lucida	T
GARFIELD		
Bonytail	Gila elegans	E
Canada lynx	Lynx canadensis	T
Colorado Basin hookless cactus	Sclerocactus glaucus	T
Colorado pikeminnow©	Ptychocheilus lucius	E
De Beque phacelia	Phacelia submutica	C
Greenback cutthroat trout#	Oncorhynchus clarki stomias	T
Humpback chub	Gila cypha	E
Mexican spotted owl	Strix occidentalis lucida	T
Parachute beardtongue	Penstemon debilis	C
Razorback sucker©	Xyrauchen texanus	E
Ute ladies'-tresses orchid	Spiranthes diluvialis	T
Yellow-billed cuckoo	Coccyzus americanus	C
GILPIN		
Canada lynx	Lynx canadensis	T
Least tern (interior population) ▲	Sternula antillarum	E
Mexican spotted owl	Strix occidentalis lucida	T
Pallid sturgeon▲	Scaphirhynchus albus	E
Piping plover▲	Charadrius melodus	T
Western prairie fringed orchid▲	Platanthera praeclara	T

Whooping crane▲	Grus americana	E
GRAND		
Bonytail*	Gila elegans	E
Canada lynx	Lynx canadensis	T
Colorado pikeminnow*	Ptychocheilus lucius	E
Greenback cutthroat trout#	Oncorhynchus clarki stomias	T
Humpback chub*	Gila cypha	E
Osterhout milkvetch	Astragalus osterhoutii	E
Penland beardtongue	Penstemon penlandii	E
Razorback sucker*	Xyrauchen texanus	E
Yellow-billed cuckoo	Coccyzus americanus	C
GUNNISON		
Bonytail*	Gila elegans	E
Canada lynx	Lynx canadensis	T
Colorado pikeminnow*	Ptychocheilus lucius	E
Greenback cutthroat trout#	Oncorhynchus clarki stomias	T
Gunnison's prairie dog	Cynomys gunnisoni	C
Humpback chub*	Gila cypha	E
Razorback sucker*	Xyrauchen texanus	E
Uncompahgre fritillary butterfly	Boloria acrocnema	E
Yellow-billed cuckoo	Coccyzus americanus	C
HINSDALE		
Bonytail*	Gila elegans	E
Canada lynx	Lynx canadensis	T
Colorado pikeminnow*	Ptychocheilus lucius	E
Gunnison's prairie dog	Cynomys gunnisoni	C
Humpback chub*	Gila cypha	E
Razorback sucker*	Xyrauchen texanus	E
Rio Grande cutthroat trout	Oncorhynchus clarki virginalis	C
Southwestern willow flycatcher	Empidonax traillii extimus	E
Uncompahgre fritillary butterfly	Boloria acrocnema	E
Yellow-billed cuckoo	Coccyzus americanus	C
HUERFANO		
Arkansas darter	Etheostoma cragini	C
Canada lynx	Lynx canadensis	T
Greenback cutthroat trout	Oncorhynchus clarki stomias	T
Gunnison's prairie dog	Cynomys gunnisoni	C
Mexican spotted owl	Strix occidentalis lucida	T
JACKSON		
Canada lynx	Lynx canadensis	T
Least tern (interior population)▲	Sternula antillarum	E

North Park phacelia	Phacelia formosula	E
Pallid sturgeon▲	Scaphirhynchus albus	E
Piping plover▲	Charadrius melodus	T
Western prairie fringed orchid▲	Platanthera praeclara	T
Whooping crane▲	Grus americana	E
JEFFERSON		
Canada lynx	Lynx canadensis	T
Colorado butterfly plant	Gaura neomexicana spp. coloradensis	T
Gunnison's prairie dog	Cynomys gunnisoni	C
Least tern (interior population)▲	Sternula antillarum	E
Mexican spotted owl	Strix occidentalis lucida	T
Pallid sturgeon▲	Scaphirhynchus albus	E
Pawnee montane skipper	Hesperia leonardus montana	T
Piping plover▲	Charadrius melodus	T
Preble's meadow jumping mouse©	Zapus hudsonius preblei	T
Ute ladies'-tresses orchid	Spiranthes diluvialis	T
Western prairie fringed orchid▲	Platanthera praeclara	T
Whooping crane▲	Grus americana	E
KIOWA		
Arkansas darter	Etheostoma cragini	C
Least tern (interior population)	Sternula antillarum	E
Lesser prairie chicken	Tympanuchus pallidicinctus	C
Piping plover	Charadrius melodus	T
KIT CARSON		
None		
LAKE		
Canada lynx	Lynx canadensis	T
Greenback cutthroat trout	Oncorhynchus clarki stomias	T
Gunnison's prairie dog	Cynomys gunnisoni	C
Penland alpine fen mustard	Eutrema penlandii	T
Uncompahgre fritillary butterfly	Boloria acrocnema	E
LA PLATA		
Black-footed ferret	Mustela nigripes	E
Canada lynx	Lynx canadensis	T
Colorado pikeminnow*	Ptychocheilus lucius	E
Knowlton cactus	Pediocactus knowltonii	E
Mexican spotted owl	Strix occidentalis lucida	T
New Mexico meadow jumping mouse	Zapus hudsonius luteus	C
Razorback sucker*	Xyrauchen texanus	E
Southwestern willow flycatcher	Empidonax traillii extimus	E

Uncompahgre fritillary butterfly	Boloria acrocnema	E
Yellow-billed cuckoo	Coccyzus americanus	C
LARIMER		
Black-footed ferret §	Mustela nigripes	E
Canada lynx	Lynx canadensis	T
Colorado butterfly plant	Gaura neomexicana spp. coloradensis	T
Greenback cutthroat trout	Oncorhynchus clarki stomias	T
Least tern (interior population)▲	Sternula antillarum	E
Mexican spotted owl	Strix occidentalis lucida	T
North Park phacelia	Phacelia formosula	E
Pallid sturgeon▲	Scaphirhynchus albus	E
Piping plover▲	Charadrius melodus	T
Preble's meadow jumping mouse©	Zapus hudsonius preblei	T
Ute ladies'-tresses orchid	Spiranthes diluvialis	T
Western prairie fringed orchid▲	Platanthera praeclara	T
Whooping crane▲	Grus americana	E
LAS ANIMAS		
Arkansas darter	Etheostoma cragini	C
Black-footed ferret §	Mustela nigripes	E
Canada lynx	Lynx canadensis	T
Gunnison's prairie dog	Cynomys gunnisoni	C
Mexican spotted owl	Strix occidentalis lucida	T
New Mexico meadow jumping mouse	Zapus hudsonius luteus	C
LINCOLN		
Arkansas darter	Etheostoma cragini	C
Least tern (interior population)▲	Sternula antillarum	E
Lesser prairie chicken	Tympanuchus pallidicinctus	C
Pallid sturgeon▲	Scaphirhynchus albus	E
Piping plover▲	Charadrius melodus	T
Western prairie fringed orchid▲	Platanthera praeclara	T
Whooping crane▲	Grus americana	E
LOGAN		
Least tern (interior population)▲	Sternula antillarum	E
Pallid sturgeon▲	Scaphirhynchus albus	E
Piping plover	Charadrius melodus	T
Western prairie fringed orchid▲	Platanthera praeclara	T
Whooping crane▲	Grus americana	E
MESA		
Bonytail©	Gila elegans	E

Canada lynx	Lynx canadensis	T
Colorado Basin hookless cactus	Sclerocactus glaucus	T
Colorado pikeminnow©	Ptychocheilus lucius	E
De Beque phacelia	Phacelia submutica	C
Greenback cutthroat trout#	Oncorhynchus clarki stomias	T
Humpback chub©	Gila cypha	E
Razorback sucker©	Xyrauchen texanus	E
Yellow-billed cuckoo	Coccyzus americanus	C
MINERAL		
Canada lynx	Lynx canadensis	T
Colorado pikeminnow*	Ptychocheilus lucius	E
Gunnison's prairie dog	Cynomys gunnisoni	C
Razorback sucker*	Xyrauchen texanus	E
Rio Grande cutthroat trout	Oncorhynchus clarki virginalis	C
Southwestern willow flycatcher	Empidonax traillii extimus	E
Uncompahgre fritillary butterfly	Boloria acrocnema	E
Yellow-billed cuckoo	Coccyzus americanus	C
MOFFAT		
Black-footed ferret	Mustela nigripes	E
Bonytail©	Gila elegans	E
Canada lynx	Lynx canadensis	T
Colorado pikeminnow©	Ptychocheilus lucius	E
Humpback chub©	Gila cypha	E
Mexican spotted owl	Strix occidentalis lucida	T
Razorback sucker©	Xyrauchen texanus	E
Ute ladies'-tresses orchid (Yampa River floodplain)	Spiranthes diluvialis	T
Yellow-billed cuckoo	Coccyzus americanus	C
MONTEZUMA		
Black-footed ferret	Mustela nigripes	E
Canada lynx	Lynx canadensis	T
Colorado pikeminnow*	Ptychocheilus lucius	E
Greenback cutthroat trout#	Oncorhynchus clarki stomias	T
Mancos milkvetch	Astragalus humillimus	E
Mesa Verde cactus	Sclerocactus mesae-verdae	T
Mexican spotted owl	Strix occidentalis lucida	T
New Mexico meadow jumping mouse	Zapus hudsonius luteus	C
Razorback sucker*	Xyrauchen texanus	E
Sleeping Ute milkvetch	Astragalus tortipes	C
Southwestern willow flycatcher	Empidonax traillii extimus	E
Yellow-billed cuckoo	Coccyzus americanus	C

MONTROSE		
Black-footed ferret	Mustela nigripes	E
Bonytail*	Gila elegans	E
Canada lynx	Lynx canadensis	T
Clay-loving wild buckwheat	Eriogonum pelinophilum	E
Colorado Basin hookless cactus	Sclerocactus glaucus	T
Colorado pikeminnow*	Ptychocheilus lucius	E
Gunnison's prairie dog	Cynomys gunnisoni	C
Humpback chub*	Gila cypha	E
Mexican spotted owl	Strix occidentalis lucida	T
Razorback sucker*	Xyrauchen texanus	E
Yellow-billed cuckoo	Coccyzus americanus	C
MORGAN		
Least tern (interior population)	Sternula antillarum	E
Pallid sturgeon▲	Scaphirhynchus albus	E
Piping plover	Charadrius melodus	T
Preble's meadow jumping mouse	Zapus hudsonius preblei	T
Ute ladies'-tresses orchid	Spiranthes diluvialis	T
Western prairie fringed orchid▲	Platanthera praeclara	T
Whooping crane▲	Grus americana	E
OTERO		
Arkansas darter	Etheostoma cragini	C
Least tern (interior population)	Sternula antillarum	E
Piping plover	Charadrius melodus	T
OURAY		
Bonytail*	Gila elegans	E
Canada lynx	Lynx canadensis	T
Colorado pikeminnow*	Ptychocheilus lucius	E
Greenback cutthroat trout#	Oncorhynchus clarki stomias	T
Humpback chub*	Gila cypha	E
Razorback sucker*	Xyrauchen texanus	E
Uncompahgre fritillary butterfly	Boloria acrocnema	E
Yellow-billed cuckoo	Coccyzus americanus	C
PARK		
Canada lynx	Lynx canadensis	T
Greenback cutthroat trout	Oncorhynchus clarki stomias	T
Gunnison's prairie dog	Cynomys gunnisoni	C
Least tern (interior population)▲	Sternula antillarum	E
Mexican spotted owl	Strix occidentalis lucida	T

Pallid sturgeon▲	Scaphirhynchus albus	E
Pawnee montane skipper	Hesperia leonardus montana	T
Penland alpine fen mustard	Eutrema penlandii	T
Piping plover▲	Charadrius melodus	T
Uncompahgre fritillary butterfly	Boloria acrocnema	E
Western prairie fringed orchid▲	Platanthera praeclara	T
Whooping crane▲	Grus americana	E
PHILLIPS		
None		
PITKIN		
Bonytail*	Gila elegans	E
Canada lynx	Lynx canadensis	T
Colorado pikeminnow*	Ptychocheilus lucius	E
Greenback cutthroat trout#	Oncorhynchus clarki stomias	T
Humpback chub*	Gila cypha	E
Mexican spotted owl	Strix occidentalis lucida	T
Razorback sucker*	Xyrauchen texanus	E
Uncompahgre fritillary butterfly	Boloria acrocnema	E
Ute ladies'-tresses orchid	Spiranthes diluvialis	T
Yellow-billed cuckoo	Coccyzus americanus	C
PROWERS		
Arkansas darter	Etheostoma cragini	C
Least tern (interior population)	Sternula antillarum	E
Lesser prairie chicken	Tympanuchus pallidicinctus	C
Piping plover	Charadrius melodus	T
PUEBLO		
Arkansas darter	Etheostoma cragini	C
Black-footed ferret §	Mustela nigripes	E
Canada lynx	Lynx canadensis	T
Greenback cutthroat trout	Oncorhynchus clarki stomias	T
Mexican spotted owl	Strix occidentalis lucida	T
RIO BLANCO		
Black-footed ferret	Mustela nigripes	E
Bonytail*	Gila elegans	E
Canada lynx	Lynx canadensis	T
Colorado pikeminnow©	Ptychocheilus lucius	E
Dudley Bluffs bladderpod	Lesquerella congesta	T
Dudley Bluffs twinpod	Physaria obcordata	T
Humpback chub*	Gila cypha	E
Razorback sucker*	Xyrauchen texanus	E

White River beardtongue	Penstemon scariosus var. albifluvis	C
Yellow-billed cuckoo	Coccyzus americanus	C
RIO GRANDE		
Canada lynx	Lynx canadensis	T
Colorado pikeminnow*	Ptychocheilus lucius	E
Gunnison's prairie dog	Cynomys gunnisoni	C
Mexican spotted owl	Strix occidentalis lucida	T
Razorback sucker*	Xyrauchen texanus	E
Rio Grande cutthroat trout	Oncorhynchus clarki virginalis	C
Southwestern willow flycatcher	Empidonax traillii extimus	E
Uncompahgre fritillary butterfly	Boloria acrocnema	E
Yellow-billed cuckoo	Coccyzus americanus	C
ROUTT		
Bonytail*	Gila elegans	E
Canada lynx	Lynx canadensis	T
Colorado pikeminnow*	Ptychocheilus lucius	E
Greenback cutthroat trout#	Oncorhynchus clarki stomias	T
Humpback chub*	Gila cypha	E
Razorback sucker*	Xyrauchen texanus	E
Yellow-billed cuckoo	Coccyzus americanus	C
SAGUACHE		
Black-footed ferret	Mustela nigripes	E
Bonytail*	Gila elegans	E
Canada lynx	Lynx canadensis	T
Colorado pikeminnow*	Ptychocheilus lucius	E
Greenback cutthroat trout#	Oncorhynchus clarki stomias	T
Gunnison's prairie dog	Cynomys gunnisoni	C
Humpback chub*	Gila cypha	E
Mexican spotted owl	Strix occidentalis lucida	T
Razorback sucker*	Xyrauchen texanus	E
Rio Grande cutthroat trout	Oncorhynchus clarki virginalis	C
Southwestern willow flycatcher	Empidonax traillii extimus	E
Uncompahgre fritillary butterfly	Boloria acrocnema	E
Yellow-billed cuckoo	Coccyzus americanus	C
SAN JUAN		
Canada lynx	Lynx canadensis	T
Colorado pikeminnow*	Ptychocheilus lucius	E
Razorback sucker*	Xyrauchen texanus	E
Rio Grande cutthroat trout	Oncorhynchus clarki virginalis	C
Southwestern willow flycatcher	Empidonax traillii extimus	E
Uncompahgre fritillary butterfly	Boloria acrocnema	E

Yellow-billed cuckoo	Coccyzus americanus	C
SAN MIGUEL		
Black-footed ferret	Mustela nigripes	E
Bonytail*	Gila elegans	E
Canada lynx	Lynx canadensis	T
Colorado pikeminnow*	Ptychocheilus lucius	E
Humpback chub*	Gila cypha	E
Mexican spotted owl	Strix occidentalis lucida	T
Razorback sucker*	Xyrauchen texanus	E
Southwestern willow flycatcher	Empidonax traillii extimus	E
Uncompahgre fritillary butterfly	Boloria acrocnema	E
Yellow-billed cuckoo	Coccyzus americanus	C
SEDGWICK		
Least tern (interior population)	Sternula antillarum	E
Pallid sturgeon▲	Scaphirhynchus albus	E
Piping plover	Charadrius melodus	T
Western prairie fringed orchid▲	Platanthera praeclara	T
Whooping crane▲	Grus americana	E
SUMMIT		
Bonytail*	Gila elegans	E
Canada lynx	Lynx canadensis	T
Colorado pikeminnow*	Ptychocheilus lucius	E
Greenback cutthroat trout#	Oncorhynchus clarki stomias	T
Humpback chub*	Gila cypha	E
Mexican spotted owl	Strix occidentalis lucida	T
Penland alpine fen mustard	Eutrema penlandii	T
Razorback sucker*	Xyrauchen texanus	E
Uncompahgre fritillary butterfly	Boloria acrocnema	E
Yellow-billed cuckoo	Coccyzus americanus	C
TELLER		
Gunnison’s prairie dog	Cynomys gunnisoni	C
Least tern (interior population)▲	Sternula antillarum	E
Mexican spotted owl	Strix occidentalis lucida	T
Pallid sturgeon▲	Scaphirhynchus albus	E
Pawnee montane skipper	Hesperia leonardus montana	T
Piping plover▲	Charadrius melodus	T
Preble’s meadow jumping mouse©	Zapus hudsonius preblei	T
Western prairie fringed orchid▲	Platanthera praeclara	T
Whooping crane▲	Grus americana	E
WASHINGTON		

Least tern (interior population)▲	Sternula antillarum	E
Pallid sturgeon▲	Scaphirhynchus albus	E
Piping plover▲	Charadrius melodus	T
Western prairie fringed orchid▲	Platanthera praeclara	T
Whooping crane▲	Grus americana	E
WELD		
Colorado butterfly plant	Gaura neomexicana spp. coloradensis	T
Least tern (interior population)▲	Sternula antillarum	E
Mexican spotted owl	Strix occidentalis lucida	T
Pallid sturgeon▲	Scaphirhynchus albus	E
Piping plover▲	Charadrius melodus	T
Preble's meadow jumping mouse	Zapus hudsonius preblei	T
Ute ladies'-tresses orchid	Spiranthes diluvialis	T
Western prairie fringed orchid▲	Platanthera praeclara	T
Whooping crane▲	Grus americana	E
YUMA		
None		

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US Army Corps
of Engineers ®
Omaha District

APPENDIX J-

Part II: PUBLIC INVOLVEMENT

JUNE 2011

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From: Fairlee, Eric
To: Tony Carelli
Subject: RE: Cottonwood lake/goose creek project
Date: Monday, June 06, 2011 9:16:21 AM

Tony, good questions. I spoke with Don Damico in my office who is the project sponsor for the Fishing is Fun grant. He provided some answers to your questions.

Email from Don Damico: "We work closely with the local DOW fish biologist, Ben Swigle, on fish management. He regularly samples and stocks some of our "fishing ponds" on a regular basis."

Recent correspondence from the Colorado Department of Wildlife (CDOW) to the US Army Corps of Engineers indicates that they recommend salvaging and transferring fish from Cottonwood Pond to nearby waters, if appropriate, and they support and will assist and advise in whatever appropriate capacity.

I spoke with Open Space and Mountain Parks Rangers concerning changing regulations to allow belly boats and enforcement of regulations if a grant is not awarded. Our Ranger Supervisor said regulations can be changed to allow belly boats, however, the proposed change would have to be reviewed and approved.

Concerning ability to flyfishing from the shore, if the issue is because of the Russian olive that lines the banks of KOA Lake, then I would be willing to remove Russian olive to open up some of the shoreline for better fishing access, if OSMP is not awarded the grant.

I hope this answers your questions.

Thank you again,

Eric W. Fairlee

Natural Resource Specialist - IPM Coordinator
City of Boulder Open Space and Mountain Parks
7315 Red Deer Dr
Boulder, CO 80301

office: 303.413.7647
cell: 303.906.5478
fax: 303.413.7617
email: fairleee@bouldercolorado.gov

-----Original Message-----
From: Tony Carelli [mailto:t_carelli@yahoo.com]
Sent: Tuesday, May 24, 2011 3:38 PM
To: Fairlee, Eric
Subject: Re: Cottonwood lake/goose creek project

So, if KOA is funded that is fine. But what if the grant doesn't get awarded? KOA is nearly impossible to flyfish from shore, one of the main reasons my friends and I fish Cottonwood, would the current regulations at least be changed to allow belly boating? Access to KOA for belly boats is easy, the regulations just don't allow it.
Also, would the fish from Cottonwood be put into KOA? Would current stocking be kept up? KOA has

the potential to be a tremendous fishery, with the bass population and wiper that are there already, if it was opened up to belly boating and stocking kept up with wiper, it would easily mitigate the loss of Cottonwood. But I worry about what happens if the grant is not approved, and also about the enforcement of regulations at KOA, where I have never once seen anyone to enforce regs, even after calling because they are being violated.
So is that also in the plans?
Thanks,
Tony

On May 24, 2011, at 11:46 AM, "Fairlee, Eric" <FairleeE@bouldercolorado.gov> wrote:

> Mr. Carelli,
> Thank you for your comments regarding the proposed plans for Cottonwood Pond. The current plan for Cottonwood Pond is to convert it back to a riparian and wetland system like existed in the area before gravel mining resulted in the pond. Goose Creek will be re-excavated through the filled portion of the pond, however, access to the creek will be minimal. In addition to re-creating a wetland and riparian system, this project will result in the removal of Eurasian watermilfoil, a highly aggressive aquatic noxious weed. This weed is not only abundant in Cottonwood Pond but has created dense colonies in Boulder Creek which alters habitat, slows water flow, and clogs irrigation structures and ditches. Eurasian watermilfoil is documented to significantly degrade fish populations and fishing opportunities when allowed to dominate a water system. It should be noted that Eurasian watermilfoil in Cottonwood Pond has not yet resulted in the loss of the pond's fishery. Cottonwood Pond is a main source of this weed into Boulder Creek and all irrigation ditches that receive water from Boulder Creek.
>
> In order to mitigate the loss of this pond for its fishing values, the city of Boulder Open Space and Mountain Parks Department has applied for a Fishing is Fun grant to enhance fishing opportunities in KOA Lake, located approximately half a mile east of Cottonwood Pond. In general, the objectives of the KOA Lake (if funded) are to increase recreational fishing opportunities and improve fish habitat by:
> 1. Building a handicap accessible fishing pier, trails, and picnic facilities on the western shoreline of KOA Lake.
> 2. Building a belly boat access ramp to allow easy access to the lake from the existing steep shoreline and modifying current regulations to allow belly boat access.
> 3. Planting native trees along the shoreline to provide shade for anglers and fish habitat.
> 4. Improving aquatic habitat in the lake to help support a self-sustaining fishery and catchable species of sport fish.
>
> Again, thank you for your comments and feel free to contact me with further questions.
>
>
> Eric W. Fairlee
>
> Natural Resource Specialist - IPM Coordinator
> City of Boulder Open Space and Mountain Parks
> 7315 Red Deer Dr
> Boulder, CO 80301
>
> office: 303.413.7647
> cell: 303.906.5478
> fax: 303.413.7617
> email: fairleee@bouldercolorado.gov
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> -----Original Message-----

> From: Noble, Annie
> Sent: Monday, May 23, 2011 3:38 PM
> To: Tony Carelli; Fairlee, Eric
> Subject: RE: Cottonwood lake/goose creek project
>
> Tony,
> Thanks for sending us your comments. I am forwarding your comments to our Open Space staff who are partnering in this project and are more familiar with fishing opportunities in Cottonwood Pond.
> Annie
>
> -----Original Message-----
> From: Tony Carelli [mailto:t_carelli@yahoo.com]
> Sent: Monday, May 23, 2011 3:26 PM
> To: Noble, Annie
> Subject: Cottonwood lake/goose creek project
>
> Hello,
> I just wanted to get a little more information regarding the proposed project.
> I've been fishing Cottonwood Lake for years now, and it's been a great spot for fishing. Under the proposed project, would fishing still be allowed? And also, with the plan to remove species of plants, would the species of fish in the lake remain the same?
> Personally I'd hate to see such a good largemouth bass, bluegill, and carp fishery shut down or altered in any way, unless there's a plan to add more bass to the lake.
> My concern would be if the plan is to make this a natural wetland with the creeks that are part of the boulder creek system, that bass and other species would be removed to pace way for more trout fishing, or to keep the fish out of the creek. I understand not wanting them in the creek, but there is an abundance of opportunities for trout in Boulder and Cottonwood pond is one of a much smaller collection of opportunities for bass fishing.
> Thank you,
> Tony Carelli
>
>

From:	Nelson, Mark E NWO
To:	kurt.nordback@bil.konicaminolta.us
Cc:	Upah, Cynthia S NWO; Fairlee, Eric; Peake, Elizabeth B NWO
Subject:	Goose Creek Ecosystem Restoration Project (UNCLASSIFIED)
Date:	Thursday, May 26, 2011 12:35:41 PM

Classification: UNCLASSIFIED
Caveats: NONE

Kurt,

Thank you for your interest in this project and support of the restoration of South Goose Creek and related changes to a difficult portion of the Boulder Creek bike path.

We looked into restoring North Goose Creek at the start of the study. However, we determined that most of North Goose Creek is a flood overflow channel without regular base flow that would support aquatic vegetation. In addition, there is a series of underdrains that parallel the North Goose Creek Channel that supply groundwater to the Cline Trout Farm. Planting of riparian vegetation that could impede inflow to those drains would be restricted by the Cline Trout Farm's water right.

Recreational uses of Cottonwood Pond were considered in making the decision to convert the former gravel mining permit to its original status as a wooded wetland. We had not been aware of the use by ice skaters but had noted the use by fishermen. An edit to the report has been made to note the use of the pond by ice skaters. It was concluded by the City and by the Corps that the fishing at the pond would decline over time unless aggressive measures were taken to combat the Eurasian water milfoil, which would have also killed fish as a result. The spread of the milfoil has adversely impacted the entire Boulder Creek Watershed, and Cottonwood Pond is a hot spot for that invasive plant. I understand that other ponds, and Boulder Creek, provided better fishing opportunities, so the loss of fishing opportunities at Cottonwood Pond, though not insignificant, would be replaceable.

We've made an edit to the report to note the significant use of the path in commuting, and the "passive recreational value" of a natural stream and wetland in passing during daily commutes and errands. Based on the restrictions of our project scope to aquatic restoration, we are not able to improve the tree plantings along Pearl Parkway. Ideas on how future plantings could be used to improved the visual experience of Pearl Parkway, combined with the restored stream and wetland, can be addressed to the City.

Mark Nelson
Project Manager

Classification: UNCLASSIFIED
Caveats: NONE

Classification: UNCLASSIFIED
Caveats: NONE

-----Original Message-----
From: Kurt Nordback [mailto:kurt.nordback@bil.konicaminolta.us]
Sent: Thursday, May 19, 2011 2:44 PM
To: DLL-CENWO-PAGEMASTER-PlanForm
Subject: Goose Creek Section 206 Project

I travel the Goose Creek path daily between home and work. I generally support the goals of this project and the proposed plan, but I'd like to make the following points:

1. The project scope should include restoration of North Goose Creek also. North Goose Creek carries significant amounts of water when flows are high, but the riparian area is very degraded.
2. Cottonwood Pond is a popular skating pond in the winter. It freezes faster and stays frozen longer than KOA pond, since it has lower flow through it. This use should be considered in weighing the alternatives for restoration of the pond.
3. I strongly support the realignment and straightening of the Boulder Creek path west of Cottonwood Pond. This would eliminate two sharp, dangerous corners as well as providing room to restore Goose Creek to a more natural form.
4. The project report seems to assume that all multi-use path usage is for recreation. This is incorrect. Studies have shown that at least 50% of the bicycle traffic on the paths in this area is for transportation (commuting, errands, etc.). A significant portion of the pedestrian traffic is also for transportation.
5. The project should also include tree plantings along the south side of Pearl Parkway, in order to frame this street which currently has an inappropriate, highway-like character.

Thank you.

Kurt Nordback

8-31-10 Greenways Advisory Committee Meeting, Boulder, CO

Andrea City wants to see Russian olives out. Typically remove/plant natives 2 to 1. Russian olive classified as noxious weed.

Boulder Ck has EWM - think can prevent EWM from getting into Cottonwood if use wetlands & meandering stream & riparian area around

for fill, use sediment types that would support veg types we want.

Mark Gershman - gravel ponds around 95th St - City filled ponds to create soccer fields. Sand & gravel are costly, so put in fines as fill.

Mark Nelson - groundwater table high in this area; Cottonwood reach is a gaining reach.

Mark Gershman - will provide piezometer data to Mark Nelson if City still has it.

Andrea - if creating so many wetlands that will have an increase in wetland area compared to current conditions? City would require mitigation 2:1 if this is the case.

Cindy - tried to balance increase in evapotransperation with filling the pond.

Andrea - justification should be easy bc. purpose is to restore the area.

Mark G - beaver activity hasn't been seen here for years. can move fish into creek also.

Boulder

Will be an EA (response to Mark Gershman's Q)

Mark N - so far, Goose Ck is on track to have the entire 35% non-Fed c-s would be provided by LERRDS

Andrea - the flood permit & wetland permit would be published in the newspaper.

City has a 6" floodway ~~not~~ 1' FEMA requirement more restrictive than

Pdf files of Power Point to all City Dept. Boards

Mark N - good to find out if any lg-scale opposition.

Greenways MP - including all tributaries (not just those with trails or likely to have trails) - have been incorporated into MP & now Annie Noble is making revisions to the tables to update them.

COE next mtg w/ Greenways = March

NEWS FROM BOULDER

CITY HALL

Week of Sunday, September 16-22, 2007

All board and commission packets are available at the Main Public Library's reference desk News From City Hall is also available at www.bouldercolorado.gov **(click on News Center)**

It is the City of Boulder's practice to provide more notice than is required by law whenever possible. However, this practice shall not be used to invalidate any action taken with the minimum notice required by state law.

PUBLIC WORKS AND PLANNING & DEVELOPMENT SERVICES MEETINGS

Planning & Development Services:

Landmarks Board Design Review Committee Meeting, Wednesday, Sept. 19 - 8 a.m. to noon, Park Central Building, 1739 Broadway, Olmsted Room, third floor.
Information: James Hewat, (303) 441-3207 or hewatj@bouldercolorado.gov

Planning Board Meeting, Thursday, Sept. 20 - 6 p.m., Council Chambers, 1777 Broadway, second floor.
Agenda: www.boulderplandevelop.net
Information: Juliet Bonnell, (303) 441-4464 or bonnellj@bouldercolorado.gov

Transit Village Area Plan, City Council Meeting, Tuesday, Sept. 18 - 6 p.m., Council Chambers, 1777 Broadway, second floor. (If City Council makes any changes to the draft Area or Implementation Plans, Planning Board will meet on Thursday, Sept. 20, 6 p.m., Council Chambers, 1777 Broadway, second floor.)
Information: Louise Grauer, (303) 441-3134 or grauerl@bouldercolorado.gov

Public Works:

30th Street Transportation Improvements Project Public Meeting, Thursday, Sept. 27 - 5 to 6:30 p.m., Twenty Ninth Street Retail Center, 1710 29th Street, Suite 2036, second floor, next to Border's.

Information: Noreen Walsh, (303) 441-4301 or walshn@bouldercolorado.gov

Fourmile Canyon Creek and Wonderland Creek Open House, Thursday, Sept. 27, 6:30 - 8:30 p.m., Shining Mountain Waldorf School, 999 Violet Ave. in the Festival Hall.
Information: Eric Lessard, (303) 441-4232 or lessarde@bouldercolorado.gov

WATER RESOURCES ADVISORY BOARD

Date/Time: Monday, Sept. 17 - 7 p.m.
Location: Municipal Services Center, 5050 E. Pearl St.
Agenda Highlights:
-Minutes from the Aug. 20 WRAB meeting.
*Public participation and comment period.
-Matters from the Staff.
-Matters from the Board.
-*Discussion and Recommendation about Carter Lake Pipeline Project for the City Council Study Session on Sept. 25.
-Discussion of future meeting.

*Public Comment Item

Information: (303) 441-3229 or www.bouldercolorado.gov, Departments, Public Works, Utilities, Water Resources Advisory Board.

CITY COUNCIL MEETING

Date/Time: Tuesday, Sept. 18 - 6 p.m.
Location: Council Chamber, 1777 Broadway
Agenda:
2. PUBLIC PARTICIPATION and COUNCIL/STAFF RESPONSE (limited to 45 min.) Public may address any city business for which a public hearing is not scheduled later in the meeting (this includes the consent agenda and first readings). After all public hearings have taken place, any remaining speakers will be allowed to address Council. All speakers are limited to three minutes.

3. Potential Call-ups: (Moved from 8A by the Council Agenda Committee)
1. Washington Village Site Review

2. Landmark alteration certificate at 2620 7th St.

3. Landmark alteration certificate to reconstruct a historic dormer at 453 Pine St.

4. Use Review for 1723 Canyon Blvd.

5. Landmark Lofts Phase 1 Utility Easement Vacation.

4. CONSENT AGENDA: (to include first reading of ordinances) Vote to be taken on the motion at this time.
A. Minutes from Aug. 29
B. Minutes from Sept. 4
C. Ordinance No. 7552 supporting a multi-year Intergovernmental Agreement for hazardous materials management between the city of Boulder and Boulder County.
D. First reading of an ordinance to establish a business incentive rebate program to grant tax and fee rebates to promote economic vitality with a sunset date of December 31, 2008.

E. First reading of an ordinance approving an Intergovernmental Agreement between the city and county of Boulder to provide mutual aid and cooperation in the prevention and suppression of Wildland and Prairie Fires.
F. First reading of an ordinance approving supplemental appropriations to the 2007 budget.
G. First reading of an ordinance adding a local violation for failure to pay wages.
H. First reading of an ordinance adopting new regulatory wetlands maps and wetland functional evaluations; and adopting a provision for the transition from the old maps to the new maps.
I. First reading of an ordinance to rezone a portion of the Washington School site located at 1215 Cedar Avenue from low density residential (RL-1) to high density residential (RH-2). The public hearing will be held at second reading on Oct. 2

ORDER OF BUSINESS
5. PUBLIC HEARINGS:
A. Ordinance No. 7551 designating 1936 Mapleton Ave., the Frakes House, as an individual landmark.
B. A motion to adopt the Transit Village Area Plan and Implementation Plan. The public hearing for this item was held on Aug. 29. Input for this meeting will be limited to the Planning Board's deliberation and decision.
C. A motion approving the purchase of a conservation easement on 464 acres west of Highway 93, south of the Boulder County line for $10,000,000 from the Hogan Family.
D. Second reading and of Ordinance No. 7553 requesting an exemption to Wood Roof Covering Materials Prohibited, for three contributing buildings located in the Chautauqua Historic District.

8. MATTERS FROM MAYOR AND MEMBERS OF COUNCIL:
A. Mid-year appointments to Boards and Commissions
B. Council Comments on North West Rail
C. Report on Bike Summit - Councilmember McGrath
D. Report on City Attorney vacancy process - Mayor Ruzzin and Councilmember McGrath
E. Request to schedule a Department of Peace Resolution - Councilmembers Gray and Polk

This agenda and the meetings can be viewed at www.bouldercolorado.gov and click on City Council. Meetings are aired live on Municipal Channel 8 and the city's Web site and are re-cablecast at 6 p.m. Wednesdays and 11 a.m. Fridays in the two weeks following a regular council meeting. DVD's may be checked out at the Main Boulder Public Library. Anyone requiring Braille, large print or tape recorded versions of this agenda or anyone requiring an interpreter may contact the City Clerk's office at (303) 441-3002, 8 a.m. - 5 p.m., Monday through Friday. Preparation of special Council packet information will take 48 hours from the time of request once the material is available.

Information: (303) 441-3002

MEETING OF THE HUMAN RELATIONS COMMISSION

Date/Time: Monday, Sept. 17 - 6 p.m.
Location: Council Chambers, 1777 Broadway, 2nd fl

Agenda:
Interviews with 2008 Cultural Celebrations Fund Applican
Complete agenda can be found at www.bouldercolorado.g
Department of Housing and Human Services

Information: Carmen Atilano, (303) 441-3141, atilanoc@bouldercolorado.gov, www.bouldercolorado.gov

BOULDER ARTS COMMISSION

Date/Time: Wednesday, Sept. 19 - 5:30 p.m.
Location: Boulder Public Library, 1000 Canyon Blvd. Boulder Creek Meeting Room
Information: Donna Gartenmann, (303) 441-4113

GREENWAYS ADVISORY COMMITTEE MEETING

Date/Time: Wednesday, Sept. 19
6 to 7 p.m. - Open house
7 p.m. - Regular meeting
Location: Municipal Building Lobby, 1777 Broad

Agenda Highlights:
Previous meeting minutes for approval.
*Public participation and comment period.
Agenda Items
*Update on the Goose Creek Restoration Project
*Fourmile/ Wonderland Phase A Report
-Matters from Staff and Board.
*Public Comment Item

Information: (303) 441-3229 or www.bouldercolorado

UNIVERSITY HILL GENERAI IMPROVEMENT DISTRICT

Date/Time: Wednesday, Sept. 19 - 9 a.m.
Location: Council Chambers, 1777 Broadway

Agenda:
Public hearing and consideration of a motion to make a r mendation to City Council of the Downtown and Univer Management, Parking Services 2008 budget

Information: Lauie Chestnut, (303) 413-7318 or chestnutl@bouldercolorado.gov

PLANNING BOARD MEETING

Date/Time: Thursday, Sept. 27 - 6 p.m.
Location: Council Chambers, 1777 Broadway

Agenda:
There is no Planning Board meeting scheduled for Thursday, Sept. 27

Information: Juliet Bonnell, (303) 441-4464, bonnellj@bouldercolorado.gov

BOULDER VALLEY COMPREHENS PLAN MID-TERM REVIEW

The city of Boulder Planning and Development Service Department and the Boulder County Land Use Departm beginning the mid-term review of the Boulder Valley Comprehensive Plan for 2007-2008. Property owners a members of the public may submit requests for the foll changes to the plan:

Land Use Map and description changes
Area IIB to Area IIA changes
Minor Service Area boundary changes
Minor additions or clarifications to the policy sec

The deadline for submitting a request is 5 p.m. Friday, Request forms and information is available at the city c Planning Department, 1739 Broadway, third floor, (303 3274, or visit www.bouldervalleycompplan.net

9-19-07 - On-site meeting, Goose Ck. N of Pearl Parkway - 2:30pm - 3:40pm

Betty S - Goose Ck habitat improvement ID in Greenways MP as 1 of top 10 projects

David - folks wanted City to continue trail on N side of Pearl Parkway between Foothills Parkway & bus stop area. No funds to extend trail farther in near-term.

Pat - Want to replace 8 trees along street w/ riparian trees, & put trail along street where trees are now. Steep grade from road towards stream.

Mark N - need to maintain flood conveyance, native veg. preferred, want as little encroachment on stream corridor as possible

Betty S - use boulders for meanders, want trail near road instead of near channel in Auto Dealerships area (like near Cottonwood Pond)

David - can possibly put funding in each year for several years to create enough money to accomplish something.

Mark McC - prefers short vegetation that is relatively attractive. If it's native species that requires little O&M, good. Don't want to hide view of dealerships from motorists - want to maintain visibility.

Nancy Love - proposed trail along 5 existing eastern trees, but fill & short retaining wall, but remove 3 westernmost trees where high land at road elev. is very narrow, & only have trail next to road in that area.

Pat - City has procedures re mitigating root damage. All 8 trees are green ash. These are young to middle-age trees & can lose 30% of roots w/o dying but if lose 40% of roots will die. Cost $3600 per tree to replace.

David - Toyota will sell property. Opportunity for City to purchase for wetlands banking. Meanders can be developed towards ex-Toyota property.

Mark N. - 1' rise is considered a berm, >1' is a levee. policy-wise, COE neutral until sign agreement & these trees are not native species.

David - why are these trees special?

Pat - green ash better than cottonwood & willow for trail shade & thrive higher up from creek. Once established, considered by City as doing well because 30% mortality after planting. Green ash & honeylocust were pushed in 70's & 80's. Have ~~bug~~ insect problems, but can treat them by spraying.

Betty S - what about boardwalk?

David - O&M is problem, liability, & ADA standards would be difficult to meet. ADA involved in original complaint requesting trail connectors.

Betty S - what about modular soft concrete?

David - tree roots would cause surface not to be smooth, as roots grow.

Betty S options: 1) keep 5 trees, remove 3 trees & mitigate by planting wetland riparian species

2) wetlands banking on Toyota property & larger ecosystem restoration

Mark - wants trees to be native, provide shade for pools, riffles, & bends, & not reduce flood conveyance.

Rebecca Baker - says still need HEC-RAS model & other info from Neil Vohl. He created a new existing conditions model & was using HEC-2 as a check. [Mark spoke with Rebecca to get more details. Neil has been ill with West Nile Virus.]

From: Upah, Cynthia S NWO
To: Upah, Cynthia S NWO
Subject: FW: public involvement for appendix (UNCLASSIFIED)
Date: Wednesday, February 02, 2011 11:58:03 AM

Classification: UNCLASSIFIED
Caveats: NONE

-----Original Message-----
From: Nelson, Mark E NWO
Sent: Wednesday, February 02, 2011 11:07 AM
To: Upah, Cynthia S NWO
Cc: Peake, Elizabeth B NWO
Subject: RE: public involvement for appendix (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

I don't believe that we received any formal public comments from the 2007 evening Public Involvement Meeting and we received none from the 2010 meeting that I'm aware of. Betty took very good notes (as always) of the verbal comments offered. I will bring this information over to you as I'm not sure that you have seen this file.

The closest we had to an official public comment was from the Car Dealerships, when we conducted an on-site stakeholder meeting. This meeting was combined in the same afternoon as the Transit Village site visit, and there are some notes in the files relative to this stakeholder outreach. I had comments were verbal from Mark McCaddon, owner of the McCaddon Auto Dealership on the afternoon of September 19, 2007, which can be paraphrased as:

1) We support the project, but would like to be visible from Pearl Parkway, so please do not plant vegetation near the top of the South Goose Creek channel that is tall and would block the view from the street.
2) We do not require that a Kentucky bluegrass lawn be maintained in the channel in front of our properties.

There was also some discussion of the ash trees at the top of the channel on the Pearl Parkway side.

-----Original Message-----
From: Upah, Cynthia S NWO
Sent: Wednesday, February 02, 2011 10:46 AM
To: Nelson, Mark E NWO
Subject: public involvement for appendix (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Hi,
I see the public involvement sign in sheets from 2007, and an ad...were there formal comments received we should also put in there...letters or emails?

Also, we can put ad and sign in sheet from our greenways/public meeting from last January.
Did we get any formal letters or emails from those?

Thanks

cindy

Cynthia S. Upah
Environmental Resources Specialist
U.S. Army Corps of Engineers
Omaha District
1616 Capitol Avenue
Omaha, NE 68102
(402) 995-2672
cynthia.s.upah@usace.army.mil

Classification: UNCLASSIFIED
Caveats: NONE

Classification: UNCLASSIFIED
Caveats: NONE

Classification: UNCLASSIFIED
Caveats: NONE

Questions/Comments & Responses after 9-19-07 Presentation to Greenways Advisory Committee

Mark Gershman – excavated depressions, sprinkled cottonwood seeds, at some level within the depression the conditions were ideal for generation

Katie – reaches 1, 2 & 3 ~~not ideal~~ don't want cottonwoods, because they affect conveyance. willows preferable, ~~plains~~ lay down & don't increase Manning's n. Auto dealers don't want high cottonwood trees bec. restricts visibility to motorists from Pearl Parkway.

Vince – because Goose Ck channel has their narrow width, have to keep main channel relatively straight but low ~~level~~ flow channel can wiggle.

Katie – some boulders will be buried.

Mark N – soften & hide hydraulic structures, but they're still needed.

Susan Iott Env. Advisory Board – Asked it any questions or comments from the general public

Andy Boogler Box 358, Nederland had some comments:
- 3-4000 jobs in new Transit Village & these folks will use trail along Goose Ck, too – Valmont Park expansion not only reason for increased trail use in future.
- COE should work w/ City on Transit Village area – property owners will pay for own floodwater/stormwater treatment. look at outfall areas & create wetlands there.

Mark N – COE just learning about Transit Village & will include it in future w/o project re WQ coming into Goose Ck from U/S
- FEMA doesn't do review unless have 10% Δ in base flood. If have higher base flood from new development Boulder needs to work with hydraulic engineers to document this increase in base flood.

Betty S – Areawide Stormwater ~~Quality~~ Mgt Plan – Transit Village. quality & quantity of stormwater.

Betty S – preference for 1 of the 2 alts?

Susan & Allyn Forsberg (Open Space Advisory Board) said STAC relocated trail alt. was better

Lynn – (Transportation Advisory Board) relocated trail, bec. allows meanders.

Mark G – tail end of Goose Ck before hits Boulder Ck. USGS may be able to suggest enhancements for Cottonwood Pond so pond can do better job of increasing WQ (Boulder Ck water used for drinking by d/s towns)

Larry Barker, Sheila Murphy are POC's

Between weed seedbed & ~~des~~ _____, design challenges for Goose Ck. project has local seed sources he can provide to Katie

Susan – Q re EWM. – why postponed?

Betty – replied couldn't get all pieces in place for Clearcast to be applied in the spring, so postponed until 2008.

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US Army Corps of Engineers ®
Omaha District

GOOSE CREEK
BOULDER, COLORADO

SECTION 206
ECOSYSTEM RESTORATION REPORT

APPENDIX K-
HTRW

JUNE 2011

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FINAL
ENVIRONMENTAL CONDITION OF PROPERTY
GOOSE CREEK
BOULDER, COLORADO

Prepared by Omaha District
U.S. Army Corp of Engineers

September 2009

CERTIFICATION OF THE ENVIRONMENTAL CONDITION OF PROPERTY

No evidence was discovered during the assessment that hazardous substances defined by 42 USC § 9601(14) or petroleum products have been released or disposed on the Goose Creek property. The Goose Creek property is an Environmental Condition of Property (ECP) Area Type 1 in accordance with the classification system American Society for Testing and Materials (ASTM) D5746-98(2002), Standard Classification of Environmental Condition of Property Area Types for Defense Base Closure and Realignment Facilities. It is a geographically contiguous area or parcel of real property where the results of the investigation revealed that no hazardous substances or petroleum products or their derivatives were released, or disposed of on site property. Goose Creek is in a non-hazardous location and contamination is not suspected from past, present or proposed activities.

Certified by: _____ 9/29/09
KALI FREY Date
Chemist, Environmental Sciences Section
Geotechnical Engineering & Sciences Branch

Certified by: _____ 9/29/09
CHERYL GROENJES Date
Chief, Environmental Sciences Section
Geotechnical Engineering & Sciences Branch

EXECUTIVE SUMMARY

An Environmental Condition of Property (ECP) Phase 1 evaluation was performed for south Goose Creek, located in Boulder, Colorado. This ECP supports a habitat assessment covering a total of approximately 23.89 acres, as shown in Figure 1. This due diligence effort is intended to provide the minimum information required to assess potential environmental liabilities associated within the assessment area.

The following activities as part of the ECP were completed:

- Visit the site, including field site inspection and generation of photo log
- Converse with key site personnel
- Query of environmental databases

The purpose of the assessment was to support an ECP type classification of the property in accordance with the American Society for Testing Materials (ASTM) D5746-98(2002), *Standard Classification of Environmental Condition of Property Area Types for Defense Base Closure and Realignment Facilities*. This determines if hazardous substances or petroleum products as defined by 42 USC 9601 (14) were stored, released, or disposed of on this property.

Based on the information contained in this ECP, there appears to be no evidence that hazardous substances or petroleum products as defined by 42 USC § 9601(14) that have been released or disposed on the Goose Creek property. In conjunction with ASTM 5746-98(2002), the Goose Creek property has been characterized a Type 1 property, with little to no potential for environmental contamination from past or present activities or use. Based on the findings in this report, there is no limit or restriction placed on the proposed use of the property.

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2.0 SITE LOCATION AND PHYSICAL DESCRIPTION 2-1
3.0 SITE HISTORY AND CURRENT USE 3-1
4.0 SITE INSPECTION SUMMARY 4-1
5.0 REVIEW OF REGULATORY INFORMATION 5-1
6.0 CONCLUSION 6-1
7.0 REFERENCES 7-1

FIGURES AND PHOTOS

ATTACHMENT 1 – CERCLIS Sites in Boulder, CO
ATTACHMENT 2 – Hazardous Materials Waste Sites
ATTACHMENT 3 – Underground Storage Tanks (USTs)
ATTACHMENT 4 – Leaking Underground Storage Tanks (LUSTs)

1.0 PURPOSE

The U.S. Army Corps of Engineers (USACE), Omaha District, conducted an environmental assessment and site inspection for a habitat assessment of an area of land located in Boulder, CO around Goose Creek, a tributary of Boulder Creek. This Goose Creek ECP supports a habitat assessment covering 23.89 acres of interest. A site inspection of the property was conducted on 13 July 2009 by Kali Frey (USACE Chemist). The purpose of the assessment was to support an Environmental Condition of Property (ECP) area type classification; and to determine if hazardous substances, hazardous materials or petroleum products were stored, released, or disposed of on the property in order to assess health and safety risks and pose potential environmental liabilities. The information gathered and ECP report reduces the uncertainty regarding the historic and current environmental condition and its impact on business decisions related to the transfer or acquisition of proposed properties.

Goose Creek is part of the Greenways Program, the purpose of which is to restore and protect the riparian, floodplain and wetland habitats located along Boulder Creek and its tributaries which flow through Boulder, CO. The program also seeks to enhance water quality, improve storm drainage, and create new recreational trails and areas.

The general requirements established above are fulfilled by application of the industry standards, protocols, and Type (1 to 7) classifications contained within the American Society for Testing Materials (ASTM) D5746-98(2002), *Standard Classification of Environmental Condition of Property Area Types for Defense Base Closure and Realignment Facilities*. ASTM D5746 determines whether hazardous substances or petroleum products as defined by 42 USC 9601 (14) were stored, released, or disposed of on this property and provides a property classification according to the Type 1 to 7 DoD ECP categories. The categories include:

- Type 1 - Where no release or disposal of hazardous substances or petroleum products or their derivatives has occurred (including no migration of these substances from adjacent properties).
- Type 2 - Where only the release or disposal of petroleum products or their derivatives has occurred.
- Type 3 - Where release, disposal, or migration, or some combination thereof, of hazardous substances has occurred, but at concentrations that do not require a removal or remedial action.
- Type 4 - Where release, disposal, or migration, or some combination thereof, of hazardous substances has occurred, and all remedial actions necessary to protect human health and the environment have been taken.
- Type 5 - Where release, disposal, or migration, or some combination thereof, of hazardous substances has occurred and removal or remedial actions, or both, are under way, but all required actions have not yet been taken.

- Type 6 - Where release, disposal, or migration, or some combination thereof, of hazardous substances has occurred, but required response actions have not yet been initiated.
- Type 7 – Where the property is unevaluated or requires additional evaluation.

2.0 SITE LOCATION AND PHYSICAL DESCRIPTION

Goose Creek is located in eastern Boulder, CO, running from Foothills Parkway along Pearl Parkway to 55th Street. Goose Creek is owned by the City of Boulder, Colorado and is found in Township 1 North, Range 70 West, Section 25 (Figure 1).

It flows through an urban area surrounded by offices and industrial buildings and empties into Cottonwood Pond. The western part of the creek runs along several automobile dealerships, which maintain the creek as a landscaped grass and shrub area. The area consists mainly of bluegrass lawn with sparse areas of wetland vegetation. Notable structures in the area include a concrete-lined channel bordered by large boulders, large areas of riprap, three concrete box culverts, and a bike trail that runs alongside the creek.

The climate is typically cool and dry. The summer days are hot and generally include regular daily thundershowers. The mountain areas mostly stay cool. At night, temperatures fall, and freezing temperatures are possible in some mountain locations year-round.

3.0 SITE HISTORY AND CURRENT USE

Goose Creek is owned by the City of Boulder and was originally tailored in the 1980's for flood flow passage. In 1987 the city of Boulder began the Greenways project. This project involves a series of corridors along riparian areas and includes Boulder Creek. The goals of the Aquatic Ecosystem Restoration Projects are to: reconnect old river channels, create wetlands along lakes and reservoirs, improve aquatic habitat in lakes and reservoirs, reduce erosion & sedimentation along streams, improve riparian habitat in & along flowing streams, emphasis on helping survival of endangered species, and restore rare habitats when possible. Previous to the start of the Greenways project, the conditions and benefits from south Goose Creek were minimal. Currently, the area is used for recreational purposes, transportation, as well as flood protection.

4.0 SITE INSPECTION SUMMARY

To conduct this assessment, an aerial photograph of the site from Google Maps was generated to plan and document the site inspection. The primary concern for the visit was to evaluate if impacts resulted from the nearby (approximately .19 miles) Roche Colorado Corporation, a peptide production plant. A visual site inspection was performed with no intrusive work. Kali Frey, a representative from Omaha District USACE, conducted a site inspection on 13 July 2009. The site was traversed by foot and visual observations were made along the interior bike/pedestrian trail. No significant solid waste was observed on the property and no releases were noted. A few distinguished areas of Goose Creek can be seen on the attached photos.

5.0 REVIEW OF REGULATORY INFORMATION

State level environmental databases were searched for possible environmental and cultural contingencies near Goose Creek. The Colorado Department of Public Health: Hazardous Materials and Waste Management Division provides a hazardous Site Location Mapping application. The area around Goose Creek was searched for sites within .25 miles of Goose Creek. Results are listed in Attachment 2. The Colorado Department of Labor and Employment provides a searchable database of underground storage tanks (USTs). The database was searched for USTs within .25 miles of Goose Creek. Results are listed in Attachment 3. The Colorado Division of Oil and Public Safety was also contacted in regards to Leaking Underground Storage Tanks (LUSTs). The LUSTs are listed in Attachment 4, which only includes LUSTs within .25 miles of Goose Creek.

One facility of concern, the Roche Colorado Corporation, exposed some environmental issues in the process of reviewing the regulatory information within a quarter of a mile from Goose Creek. The plant is a peptide production plant located approximately .19 miles from Goose Creek. The plant was found to have 17 hazardous substance USTs as well as several violations of the Clean Air Act in 2007 and 2008. The USTs are now under permit and currently pass all regulation standards. Corrective action was taken for the Clean Air Act violations and they now pose no impact to the project area. No evidence of any environmental hazards was found during the site inspection.

The Federal Superfund Program Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) Database was searched for Boulder, Colorado. The CERCLIS database contains information on hazardous waste sites, potentially hazardous waste sites and remedial activities across the nation. “Active” CERCLIS sites are sites at which site assessment, removal, remedial, enforcement, cost recovery, or oversight activities are being planned or conducted under the Superfund program. “Archive” CERCLIS sites are sites where there is no further interest under the Federal Superfund Program based on available information. EPA may perform a minimal level of assessment work at a site while it is archived if site conditions change and/or new information becomes available. The archive designation is removed and the site is returned to the CERCLIS inventory if more substantive assessment and/or any cleanup work are necessary under the Federal Superfund Program. Six active and twenty-six archived hazardous sites were listed for Boulder, CO (Attachment 1). The only active site still on the Nation Priority List is the Marshall Landfill which is located approximately 4.75 miles southeast of Goose Creek. Due to the distance between the Marshall Landfill and Goose Creek, potential impact is not suspected. The archived sites have also been assessed and are no longer a concern.

In order to determine the possibility of cultural of natural resource issues, the National Register of Historical Places was queried to review if any historic places ever existed on the site. The search found that no NRHP sites exist within the project area. Threatened

and Endangered species of Colorado were also researched, as the purpose of the project is to enhance the habitat along Goose Creek. The results are shown in the table below.

Animals -- 18 listings	
Status	Species/Listing Name
T	Bear, grizzly lower 48 States, except where listed as an experimental population or delisted (Ursus arctos horribilis)
E	Butterfly, Uncompahgre fritillary (Boloria acrocnema)
E	Chub, bonytail entire (Gila elegans)
E	Chub, humpback entire (Gila cypha)
E	Crane, whooping except where EXPN (Grus americana)
E	Curlew, Eskimo (Numenius borealis)
E	Ferret, black-footed entire population, except where EXPN (Mustela nigripes)
E	Flycatcher, southwestern willow (Empidonax traillii extimus)
T	Lynx, Canada lower 48 States DPS (Lynx canadensis)
T	Mouse, Preble's meadow jumping (Zapus hudsonius preblei)
T	Owl, Mexican spotted (Strix occidentalis lucida)
E	Pikeminnow (=squawfish), Colorado except Salt and Verde R. drainages, AZ (Ptychocheilus lucius)
T	Plover, piping except Great Lakes watershed (Charadrius melodus)
T	Skipper, Pawnee montane (Hesperia leonardus montana)
E	Sucker, razorback entire (Xyrauchen texanus)
E	Tern, least interior pop. (Sterna antillarum)
T	Trout, greenback cutthroat (Oncorhynchus clarki stomias)
E	Wolf, gray Lower 48 States, except where delisted and where EXPN. Mexico. (Canis lupus)
Plants -- 13 listings	
Status	Species/Listing Name
E	Beardtongue, Penland (Penstemon penlandii)
T	Bladderpod, Dudley Bluffs (Lesquerella congesta)
T	Butterfly plant, Colorado (Gaura neomexicana var. coloradensis)
E	Cactus, Knowlton (Pediocactus knowltonii)
T	Cactus, Mesa Verde (Sclerocactus mesae-verdae)
T	Cactus, Uinta Basin hookless (Sclerocactus glaucus)
T	Ladies'-tresses, Ute (Spiranthes diluvialis)
E	Milk-vetch, Mancos (Astragalus humillimus)
E	Milk-vetch, Osterhout (Astragalus osterhoutii)
T	Mustard, Penland alpine fen (Eutrema penlandii)
E	Phacelia, North Park (Phacelia formosula)
T	Twinpod, Dudley Bluffs (Physaria obcordata)
E	Wild-buckwheat, clay-loving (Eriogonum pelinophilum)

6.0 CONCLUSION

No evidence was discovered during any portion of the environmental assessment that hazardous substances defined by 42 USC § 9601(14) or petroleum products have been released or disposed on Goose Creek. This area is an ECP Area Type 1 in accordance with the classification system American Society for Testing and Materials (ASTM) D5746-98(2002), *Standard Classification of Environmental Condition of Property Area Types for Defense Base Closure and Realignment Facilities*. It is a geographically contiguous area or parcel of real property where the results of the investigation revealed that no hazardous substances or petroleum products or their derivatives were released, or disposed of.

7.0 REFERENCES

American Society for Testing and Materials (ASTM). D5746-98. Standard Classification of Environmental Condition of Property Area Types for Defense Base Closure and Realignment Facilities. 2002.

Colorado Department of Public Health and Environment (CDPHE). 2009. Surface water quality classifications and standards– Regulation 38– Classification and numeric standards for South Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin: Denver, Colorado Department of Public Health and Environment, accessed August 1, 2009, at http://www.cdphe.state.co.us/ regulations/wqccregs/index.html

Department of the Army, Office of the Chief of Engineers, ENVR-EH (200-1C) Memorandum, "Real Property Transactions and Preliminary Assessment Screenings (PAS)," 1 Nov 1990.

Department of the Army, Headquarters, Army Regulation 200-1 Environmental Protection and Enhancement, 21 February 1997.

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FIGURES

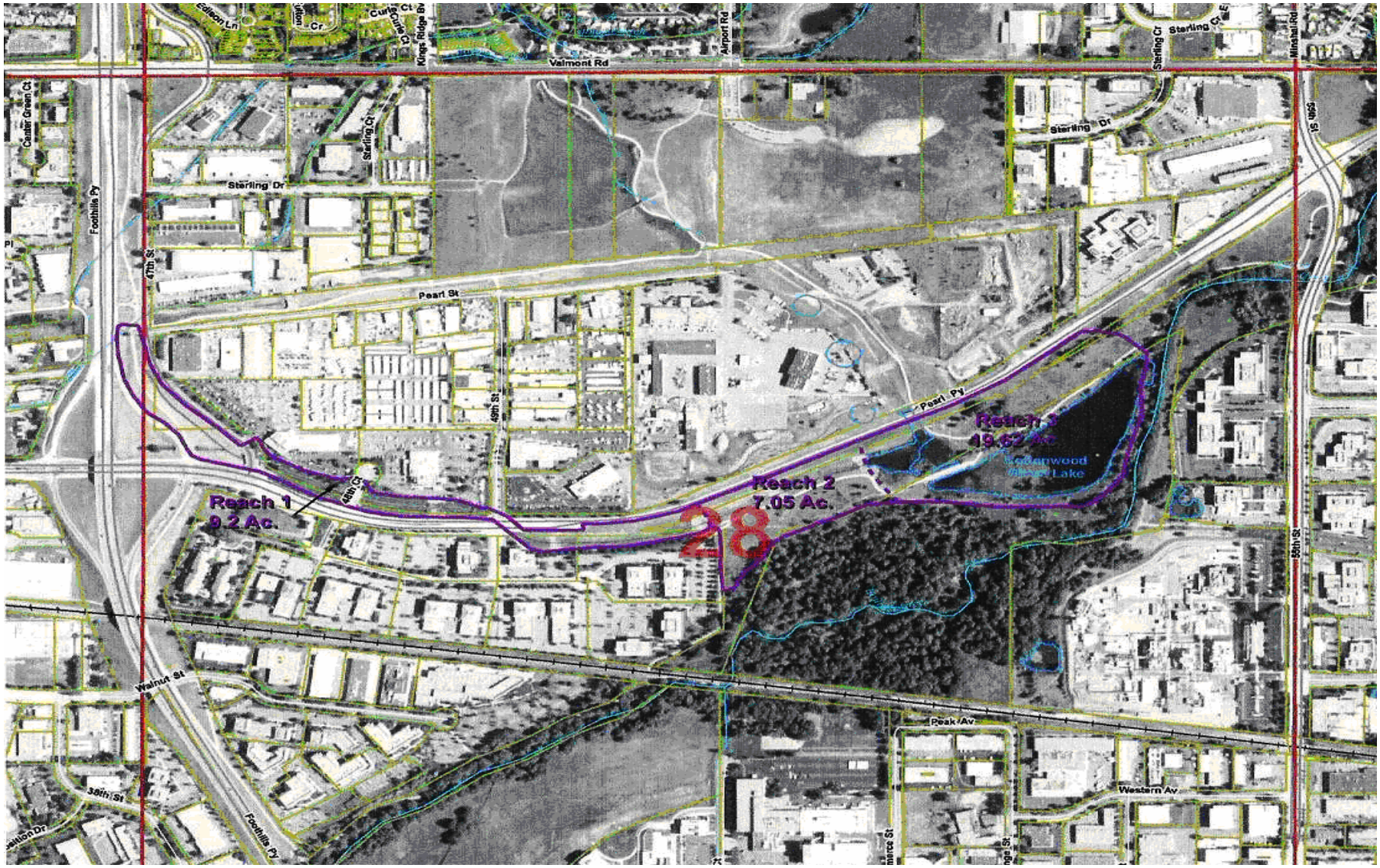

Figure 1. Property Map

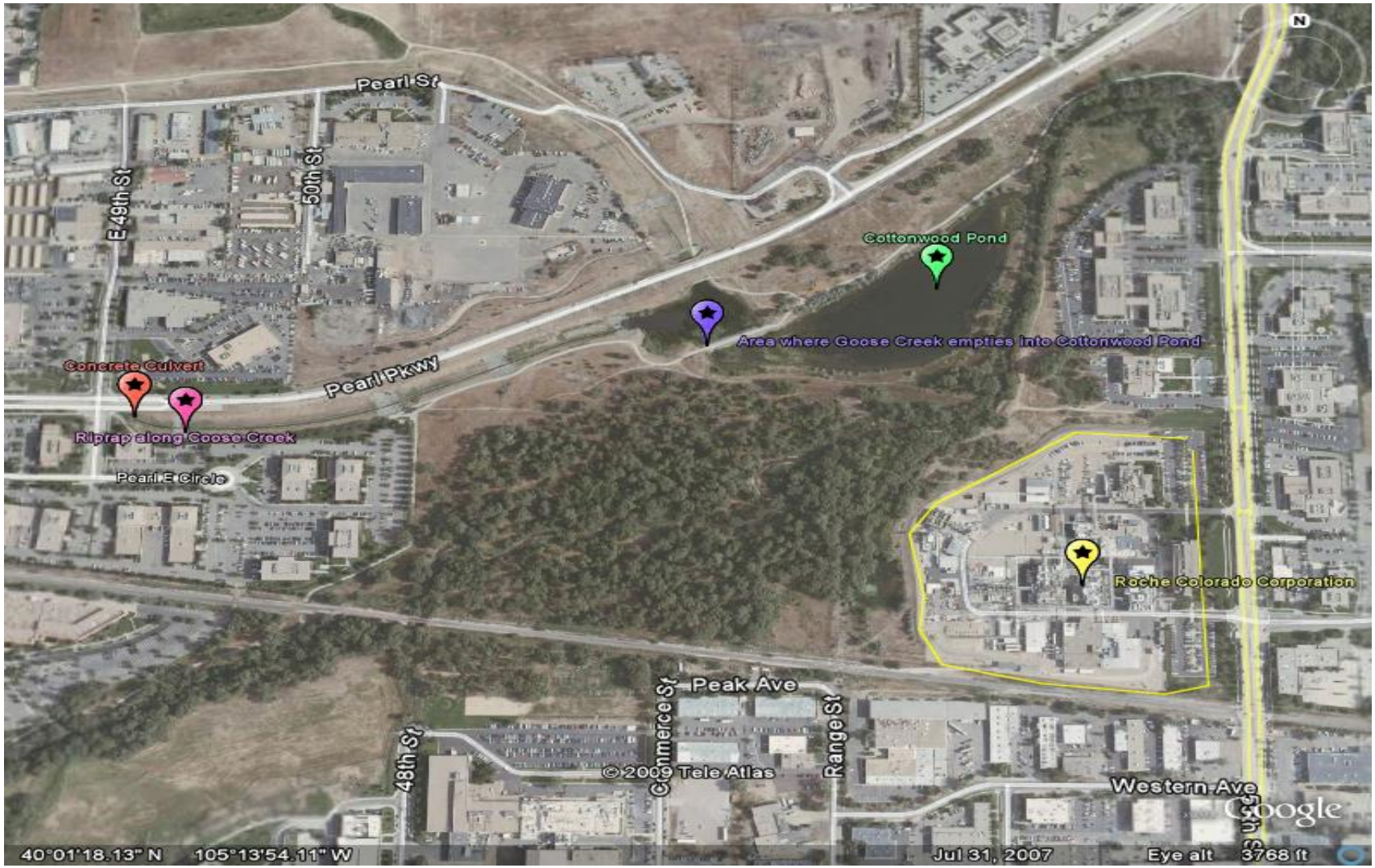

Figure 2. Points of Interest created on Google Earth

PHOTOS

Photo 1 – Concrete culvert where Goose Creek crosses Pearl Parkway, facing northwest.

Photo 2 – Riprap along Goose Creek, facing north.

Photo 3 – View towards Pearl Parkway (from bike trail), facing northeast.

Photo 4 – View from trail towards 49th and Pearl Parkway, facing northwest.

Photo 5 – Roche Corporation, located southeast of Goose Creek.

Photo 6 – Roche Corporation side view, facing northeast.

ATTACHMENTS

Attachment 1 - CERCLIS Sites in Boulder, CO

Active

EPA ID	Site Name	NPL Status
COD078348737	HENDRICKS MINING & MILLING	Not NPL
COD980499255	MARSHALL LANDFILL	Final NPL
CON000802778	NIST PLUTONIUM	Not NPL
CON000802777	ROOM 320 BOULDER SUICIDE	Not NPL
CO0001096791	SWEENEY MILL	Not NPL
COD980666572	UNIVERSITY OF COLORADO BOULDER	Not NPL

Archive

EPA ID	Site Name	NPL Status
COD981548977	AERO PROPELLER	Not NPL
COD076470525	ARAPAHOE CHEM INC	Not NPL
COD980717243	ARAPAHOE CHEMICALS - FORMER PLT SITE	Not NPL
COD980717250	BANK-BOULDER CR (TUNGSTEN PROD CO DUMP)	Not NPL
COD007068646	BEECH AIRCRAFT CORP	Not NPL
COD982591638	CENTERLINE CIRCUITS (FORMER LOCATION)	Not NPL
COD983797457	COBALT SMELTER	Not NPL
CO0001910991	CULBERTSON MILL	Not NPL
CO0000991166	FEDERAL GAS COMPANY	Not NPL
COD980959621	FLATIRONS COMPANIES PROPERTIES.	Not NPL
COD980959639	FOOTHILLS AUTO COMPANY	Not NPL
COD005548037	GUNBARREL INDUSTRIAL PARK	Not NPL
COD001883164	IBM CORP	Not NPL
CON000802609	LEGGETT INLET CANAL	Not NPL
COD980959449	NORTH BOULDER DUMP	Not NPL
COD980962112	OSTERLUND PROPERTY	Not NPL
COD982572315	PEARL AND 3RD STREET	Not NPL
CON000802622	PEARL AND CANYON DRUMS	Not NPL
COD095155156	RALPH'S REPAIR SERVICE	Not NPL
COD980959597	SCOTT CARPENTER PARK	Not NPL
COD000114009	SUPERIOR PAPER PRODUCTS	Not NPL
COD981551542	SYNTEX LANDFILL	Not NPL
COT090010984	T P CLARK INC ROCKY FLATS	Not NPL
COD983776907	WALNUT FIFTEEN PARTNERSHIP	Not NPL
COD982572323	WESTERN AVENUE	Not NPL
COD040714594	WYOMING MINERAL CORP - BOULDER LAB	Not NPL

Attachment 2 - Hazardous Materials Waste Sites near Goose Creek

Hazardous Waste Large Quantity Generators

Rec	ID	FACILITY	STREET ADD	FAC_TYPE	STATUS	LINKS	ID
1	COD076470525	ROCHE COLORADO CORPORATION	2075 55TH ST	LQG	A	http://oaspub.epa.gov/enviro/brs_web.report?pgm_sys_id=COD076470525	58
2	COD983789850	NAPRO BIOTHERAPEUTICS INC	4884 STERLING DR	LQG	A	http://oaspub.epa.gov/enviro/brs_web.report?pgm_sys_id=COD983789850	91
3	COD983794108	RIBOZYME PHARMACEUTICALS INC	2950 WILDERNESS PL	LQG	A	http://oaspub.epa.gov/enviro/brs_web.report?pgm_sys_id=COD983794108	93
4	COD983794132	OSI PHARMACEUTICALS INC	2860 WILDERNESS PL SUITE 200	LQG	A	http://oaspub.epa.gov/enviro/brs_web.report?pgm_sys_id=COD983794132	95
5	COD983801564	AMGEN INC	4765 WALNUT	LQG	A	http://oaspub.epa.gov/enviro/brs_web.report?pgm_sys_id=COD983801564	98

Hazardous Waste Small Quantity Generators

Rec	ID	FACILITY	STREET ADD	FAC_TYPE	STATUS	LINKS	ID
1	CO0000144386	ABRA AUTOBODY & GLASS	4725 STERLING DR	SQG	A	http://www.epa.gov/cgi-bin/get1cReport.cgi?tool=echo&IDNumber=CO0000144386	17
2	COD981544521	BOULDER TOYOTA	2465 48TH CT	SQG	A	http://www.epa.gov/cgi-bin/get1cReport.cgi?tool=echo&IDNumber=COD981544521	532
3	COD982647976	BOULDER BUMP SHOP INC	2480 49TH ST #A	SQG	A	http://www.epa.gov/cgi-bin/get1cReport.cgi?tool=echo&IDNumber=COD982647976	662
4	COD983798711	GOODBYE BLUE MONDAY	2865 WILDERNESS PLACE	SQG	A	http://www.epa.gov/cgi-bin/get1cReport.cgi?tool=echo&IDNumber=COD983798711	831
5	COR000004440	NAPRO BIOTHERAPEUTICS INC	2830 WILDERNESS PL	SQG	A	http://www.epa.gov/cgi-bin/get1cReport.cgi?tool=echo&IDNumber=COR000004440	887
6	COR000202267	RIBOZYME PHARMACEUTICALS INC	2945 WILDERNESS PL	SQG	A	http://www.epa.gov/cgi-bin/get1cReport.cgi?tool=echo&IDNumber=COR000202267	1079

Hazardous Waste Corrective Action

Rec	ID_1	FACILITY	STREET ADD	FAC_TYPE	STATUS	LINKS	ID
1	COD076470525	ROCHE COLORADO CORPORATION	2075 55TH ST	CA	A	http://www.epa.gov/cgi-bin/get1cReport.cgi?tool=echo&IDNumber=COD076470525	60
2	CO0000025791	UNITED PARCEL SERVICE CENTER	3795 FRONTIER AVENUE	CA	H	http://www.epa.gov/cgi-bin/get1cReport.cgi?tool=echo&IDNumber=CO0000025791	112

Hazardous Waste Treatment, Storage and Disposal Facilities

Rec	ID	FACILITY	STREET ADD	FAC_TYPE	STATUS	LINKS	ID
1	COD076470525	ROCHE COLORADO CORPORATION	2075 55TH ST	TSD	H	http://oaspub.epa.gov/enviro/brs_web.report?pgm_sys_id=COD076470525	38

Attachment 3 - Underground Storage Tanks

tankid	facilityid	ownerid	tanktag	capacity	productname	tanktypedesc	facilitynameaddress	facilityowner
1935	621	5053	'621-1	18000	Z Hazardous Substance	UST	ROCHE COLORADO CORP 2075 N 55TH ST BOULDER 80301	ROCHE COLORADO CORP
1936	621	5053	'621-2	10000	Z Hazardous Substance	UST	ROCHE COLORADO CORP 2075 N 55TH ST BOULDER 80301	ROCHE COLORADO CORP
1937	621	5053	'621-3	18000	Z Hazardous Substance	UST	ROCHE COLORADO CORP 2075 N 55TH ST BOULDER 80301	ROCHE COLORADO CORP
1938	621	5053	'621-4	10000	Z Hazardous Substance	UST	ROCHE COLORADO CORP 2075 N 55TH ST BOULDER 80301	ROCHE COLORADO CORP
1939	621	5053	'621-5	18000	Z Hazardous Substance	UST	ROCHE COLORADO CORP 2075 N 55TH ST BOULDER 80301	ROCHE COLORADO CORP
1940	621	5053	'621-6	10000	Z Hazardous Substance	UST	ROCHE COLORADO CORP 2075 N 55TH ST BOULDER 80301	ROCHE COLORADO CORP
1941	621	5053	'621-7	18000	Z Hazardous Substance	UST	ROCHE COLORADO CORP 2075 N 55TH ST BOULDER 80301	ROCHE COLORADO CORP
1942	621	5053	'621-8	10000	Z Hazardous Substance	UST	ROCHE COLORADO CORP 2075 N 55TH ST BOULDER 80301	ROCHE COLORADO CORP
1943	621	5053	'621-9	18000	Z Hazardous Substance	UST	ROCHE COLORADO CORP 2075 N 55TH ST BOULDER 80301	ROCHE COLORADO CORP
1944	621	5053	'621-10	10000	Z Hazardous Substance	UST	ROCHE COLORADO CORP 2075 N 55TH ST BOULDER 80301	ROCHE COLORADO CORP
1945	621	5053	'621-11	18000	Z Hazardous Substance	UST	ROCHE COLORADO CORP 2075 N 55TH ST BOULDER 80301	ROCHE COLORADO CORP
1946	621	5053	'621-12	10000	Z Hazardous Substance	UST	ROCHE COLORADO CORP 2075 N 55TH ST BOULDER 80301	ROCHE COLORADO CORP
1947	621	5053	'621-13	18000	Z Hazardous Substance	UST	ROCHE COLORADO CORP 2075 N 55TH ST BOULDER 80301	ROCHE COLORADO CORP
1948	621	5053	'621-14	10000	Z Hazardous Substance	UST	ROCHE COLORADO CORP 2075 N 55TH ST BOULDER 80301	ROCHE COLORADO CORP
1949	621	5053	'621-16	10000	Z Hazardous Substance	UST	ROCHE COLORADO CORP 2075 N 55TH ST BOULDER 80301	ROCHE COLORADO CORP
1950	621	5053	'621-17	10000	Z Hazardous Substance	UST	ROCHE COLORADO CORP 2075 N 55TH ST BOULDER 80301	ROCHE COLORADO CORP
1951	621	5053	'621-18	11000	Z Hazardous Substance	UST	ROCHE COLORADO CORP 2075 N 55TH ST BOULDER 80301	ROCHE COLORADO CORP
2143	2163	428	'2163-2	560	6 - Used Oil (Waste Oil)	UST	VALVOLINE INSTANT OIL CHANGE 4700 PEARL ST BOULDER 80301	PENNZOIL PRODUCTS CO
2418	808	3029	'808-1	6000	Gasoline	UST	BOULDER AIRPORT-Self Serv 3327 AIRPORT RD BOULDER 80301	CITY OF BOULDER AIRPORT
2419	808	3029	'808-2	6000	Gasoline	UST	BOULDER AIRPORT-Self Serv 3327 AIRPORT RD BOULDER 80301	CITY OF BOULDER AIRPORT
3196	1116	5110	'1116-1	12000	Gasoline	UST	WESTERN AIR OF BOULDER BOULDER MUNICIPAL AIRPORT BOULDER 80301	SHELL OIL PRODUCTS U S
3197	1116	5110	'1116-2	12000	Gasoline	UST	WESTERN AIR OF BOULDER BOULDER MUNICIPAL AIRPORT BOULDER 80301	SHELL OIL PRODUCTS U S
6418	2285	5091	'2285-3	3000	4 - Diesel	UST	RENAISSANCE INVESTMENTS LLC dba Pellman's Auto 2560 49TH ST BOULDER 80301	RENAISSANCE INVESTMENTS LLC dba Pellman's Auto
6419	2285	5091	'2285-4	4000	4 - Diesel	UST	RENAISSANCE INVESTMENTS LLC dba Pellman's Auto 2560 49TH ST BOULDER 80301	RENAISSANCE INVESTMENTS LLC dba Pellman's Auto
6420	2285	5091	'2285-5	8000	4 - Diesel	UST	RENAISSANCE INVESTMENTS LLC dba Pellman's Auto 2560 49TH ST BOULDER 80301	RENAISSANCE INVESTMENTS LLC dba Pellman's Auto
6421	2285	5091	'2285-6	3000	Gasoline	UST	RENAISSANCE INVESTMENTS LLC dba Pellman's Auto 2560 49TH ST BOULDER 80301	RENAISSANCE INVESTMENTS LLC dba Pellman's Auto
6422	2285	5091	'2285-7	4000	Z Unknown	UST	RENAISSANCE INVESTMENTS LLC dba Pellman's Auto 2560 49TH ST BOULDER 80301	RENAISSANCE INVESTMENTS LLC dba Pellman's Auto
9278	3340	471	'3340-11	1000	4 - Diesel	UST	BARTKUS OIL COMPANY 3501 PEARL ST BOULDER 80301	BARTKUS OIL COMPANY
9279	3340	471	'3340-12	1000	Gasoline	UST	BARTKUS OIL COMPANY 3501 PEARL ST BOULDER 80301	BARTKUS OIL COMPANY
9280	3340	471	'3340-13	1000	Gasoline	UST	BARTKUS OIL COMPANY 3501 PEARL ST BOULDER 80301	BARTKUS OIL COMPANY
9281	3340	471	'3340-14	1000	Gasoline	UST	BARTKUS OIL COMPANY 3501 PEARL ST BOULDER 80301	BARTKUS OIL COMPANY
9282	3340	471	'3340-15	1000	Kerosene	UST	BARTKUS OIL COMPANY 3501 PEARL ST BOULDER 80301	BARTKUS OIL COMPANY
12311	4380	2420	'4380-1	4000	Gasoline	UST	CONOCO BULK PLANT 3200 PEARL ST BOULDER 80301	G & S OIL PRODUCTS INC
12350	4395	2420	'4395-1	2000	4 - Diesel	UST	MCPHERSON TRUCKING CO 3200 BLUFF BOULDER 80301	G & S OIL PRODUCTS INC
12351	4395	2420	'4395-2	1500	Gasoline	UST	MCPHERSON TRUCKING CO 3200 BLUFF BOULDER 80301	G & S OIL PRODUCTS INC
13644	4904	2209	'4904-1	1000	Gasoline	UST	BOULDER HYUNDAI 2470 49TH ST BOULDER 80301	BOULDER HYUNDAI
13645	4904	2209	'4904-2	1000	Z Unknown	UST	BOULDER HYUNDAI 2470 49TH ST BOULDER 80301	BOULDER HYUNDAI
13646	4904	2209	'4904-3	550	6 - Used Oil (Waste Oil)	UST	BOULDER HYUNDAI 2470 49TH ST BOULDER 80301	BOULDER HYUNDAI
13647	4904	2209	'4904-4	550	6 - Used Oil (Waste Oil)	UST	BOULDER HYUNDAI 2470 49TH ST BOULDER 80301	BOULDER HYUNDAI
13648	4904	2209	'4904-5	550	6 - Used Oil (Waste Oil)	UST	BOULDER HYUNDAI 2470 49TH ST BOULDER 80301	BOULDER HYUNDAI
13649	4904	2209	'4904-6	550	6 - Used Oil (Waste Oil)	UST	BOULDER HYUNDAI 2470 49TH ST BOULDER 80301	BOULDER HYUNDAI
13650	4904	2209	'4904-7	550	6 - Used Oil (Waste Oil)	UST	BOULDER HYUNDAI 2470 49TH ST BOULDER 80301	BOULDER HYUNDAI
13656	4908	2211	'4908-1	1000	Gasoline	UST	BOULDER TOYOTA 2465 48TH CT BOULDER 80301	BOULDER TOYOTA
13657	4908	2211	'4908-2	1000	Z Unknown	UST	BOULDER TOYOTA 2465 48TH CT BOULDER 80301	BOULDER TOYOTA
13658	4908	2211	'4908-3	550	6 - Used Oil (Waste Oil)	UST	BOULDER TOYOTA 2465 48TH CT BOULDER 80301	BOULDER TOYOTA
13659	4908	2211	'4908-4	550	6 - Used Oil (Waste Oil)	UST	BOULDER TOYOTA 2465 48TH CT BOULDER 80301	BOULDER TOYOTA
13660	4908	2211	'4908-5	550	6 - Used Oil (Waste Oil)	UST	BOULDER TOYOTA 2465 48TH CT BOULDER 80301	BOULDER TOYOTA
13661	4908	2211	'4908-6	550	6 - Used Oil (Waste Oil)	UST	BOULDER TOYOTA 2465 48TH CT BOULDER 80301	BOULDER TOYOTA
13662	4908	2211	'4908-7	550	6 - Used Oil (Waste Oil)	UST	BOULDER TOYOTA 2465 48TH CT BOULDER 80301	BOULDER TOYOTA
14568	5288	2698	'5288-1	1000	Gasoline	UST	PEARL STREET AUTO SALVAGE 4790 PEARL ST BOULDER 80301	HAROLD PELLE
14569	5288	2698	'5288-2	500	4 - Diesel	UST	PEARL STREET AUTO SALVAGE 4790 PEARL ST BOULDER 80301	HAROLD PELLE
14912	5439	2521	'5439-1	1000	Gasoline	UST	MCCADDEN OLDSMOBILE-CADILLAC 2460 48TH ST BOULDER 80301	MCCADDEN OLDSMOBILE CADILLAC
14913	5439	2521	'5439-2	1000	6 - Used Oil (Waste Oil)	UST	MCCADDEN OLDSMOBILE-CADILLAC 2460 48TH ST BOULDER 80301	MCCADDEN OLDSMOBILE CADILLAC
15483	5672	17701	'5672-1	200	6 - Used Oil (Waste Oil)	UST	FLATIRON SERVICE CO 2300 55TH ST BOULDER 80301	UNKNOWN
15627	5735	17930	'5735-1	1000	6 - Used Oil (Waste Oil)	UST	HOLLISTER DODGE 2100 30TH ST BOULDER 80301	EDWARD HOLLISTER
16321	6020	4296	'6020-1	1E+09	Gasoline	UST	WESTLAND REALTY DEVELOPMENT 1990 55TH ST BOULDER 80301	WESTLAND REALTY DEVELOPMENT
16322	6020	4296	'6020-2	1E+09	Gasoline	UST	WESTLAND REALTY DEVELOPMENT 1990 55TH ST BOULDER 80301	WESTLAND REALTY DEVELOPMENT
16544	6146	642	'6146-1	1000	Gasoline	UST	BOULDER EMERGENCY SQUAD 5048 E PEARL ST BOULDER 80301	BOULDER EMERGENCY SQUAD

19880	7551	1196	'7551-1	1E+09	Gasoline	UST	CITY STORAGE & TRANSFER 3625 WALNUT ST BOULDER 80301	CITY STORAGE & TRANSFER
19881	7551	1196	'7551-2	1E+09	Gasoline	UST	CITY STORAGE & TRANSFER 3625 WALNUT ST BOULDER 80301	CITY STORAGE & TRANSFER
19882	7551	1196	'7551-3	1E+09	Gasoline	UST	CITY STORAGE & TRANSFER 3625 WALNUT ST BOULDER 80301	CITY STORAGE & TRANSFER
20343	7735	7744	'7735-1	1500	Z Unknown	UST	ASPEN RV 3200 BLUFF ST BOULDER 80301	ASPEN RV
20344	7735	7744	'7735-2	2000	Z Unknown	UST	ASPEN RV 3200 BLUFF ST BOULDER 80301	ASPEN RV
22025	8449	20429	'8449-1	7280	Gasoline	UST	BOULDER SERVICE CENTER 5050 PEARL ST BOULDER 80301	CITY OF BOULDER - PUBLIC WORKS
22026	8449	20429	'8449-2	7280	4 - Diesel	UST	BOULDER SERVICE CENTER 5050 PEARL ST BOULDER 80301	CITY OF BOULDER - PUBLIC WORKS
22027	8449	20429	'8449-3	10000	Gasoline	UST	BOULDER SERVICE CENTER 5050 PEARL ST BOULDER 80301	CITY OF BOULDER - PUBLIC WORKS
22028	8449	20429	'8449-4	1000	6 - Used Oil (Waste Oil)	UST	BOULDER SERVICE CENTER 5050 PEARL ST BOULDER 80301	CITY OF BOULDER - PUBLIC WORKS
22800	8717	17701	'8717-1	8000	4 - Diesel	UST	FLATIRON PRE-MIX CONCRETE 2300 55TH ST BOULDER 80301	UNKNOWN
22801	8717	17701	'8717-2	4000	Gasoline	UST	FLATIRON PRE-MIX CONCRETE 2300 55TH ST BOULDER 80301	UNKNOWN
22802	8717	17701	'8717-3	4000	Gasoline	UST	FLATIRON PRE-MIX CONCRETE 2300 55TH ST BOULDER 80301	UNKNOWN
23778	9010	1323	'9010-1	1E+09	Gasoline	UST	ALPHA OMEGA IMPORT MOTOR SERVICE 3445 WALNUT ST BOULDER 80301	RMR PROPERTIES LTD
23779	9010	1323	'9010-2	1E+09	Gasoline	UST	ALPHA OMEGA IMPORT MOTOR SERVICE 3445 WALNUT ST BOULDER 80301	RMR PROPERTIES LTD
26548	9895	8025	'9895-1	10000	Gasoline	UST	SCOTT S & ANITA B BAIR 1900 N 57TH CT BOULDER 80301	QWEST SAFETY & ENVIRONMENT
26549	9895	8025	'9895-2	560	Z Unknown	UST	SCOTT S & ANITA B BAIR 1900 N 57TH CT BOULDER 80301	QWEST SAFETY & ENVIRONMENT
32680	14854	18125	'14854-1	560	6 - Used Oil (Waste Oil)	UST	B AND W VENTURES 4732 B PEARL ST BOULDER 80301	B AND W VENTURES

Attachment 4 - Leaking Underground Storage Tanks (LUSTs)

Facility_ID	EventId	SiteName	LocAddr	LocCity	LocCounty	LocZip	ProcessStatusName	ConfirmedReleaseDate
245	3834	PAY N TAKE	3000 VALMONT	BOULDER	BOULDER	80301	Closed	20-Oct-92
288	8390	SHAMROCK 4056	2995 28TH ST	BOULDER	BOULDER	80301	Closed	22-Oct-00
288	9066	SHAMROCK 4056	2995 28TH ST	BOULDER	BOULDER	80301	Implementing CAP	09-May-02
288	9066	SHAMROCK 4056	2995 28TH ST	BOULDER	BOULDER	80301	Implementing CAP	23-Jun-88
288	9106	TOTAL #4056	2995 28TH ST	BOULDER	BOULDER	80301	Closed	03-Sep-00
490	874	BOULDER COUNTY ROAD DISTRICT #1	3897 N 75TH ST	BOULDER	BOULDER	80301	Closed	12-Dec-95
621	3104	SYNTEX CHEMICALS INC	2075 N 55TH ST	BOULDER	BOULDER	80301	Closed	21-Mar-90
736	7001	SINCLAIR	3005 28TH ST	BOULDER	BOULDER	80301	Closed	09-Nov-98
808	6375	FLATIRONS AVIATION	3300 AIRPORT ROAD BLDG F	BOULDER	BOULDER	80301	Closed	29-Feb-92
808	6376	BOULDER AIRPORT	3300 AIRPORT ROAD BLDG F	BOULDER	BOULDER	80301	Closed	17-Nov-93
1614	4754	VALMONT STEAM PLANT	1800 N 63RD ST	BOULDER	BOULDER	80301	Closed	14-May-90
1614	4758	VALMONT STEAM PLANT	1800 N 63RD ST	BOULDER	BOULDER	80301	Closed	26-Apr-89
1614	9375	VALMONT STEAM PLANT	1800 N 63RD ST	BOULDER	BOULDER	80301	Closed	07-Nov-03
1633	869	BOULDER SERVICE CENTER	2655 N 63RD ST	BOULDER	BOULDER	80301	Closed	25-Apr-91
2277	4802	BOULDER STEEL INC	2696 30TH ST	BOULDER	BOULDER	80301	Closed	19-Mar-91
2285	3146	TERMINAL RENTALS	2560 49TH ST	BOULDER	BOULDER	80301	Closed	01-Oct-93
3249	5387	STAMMLER AUDI INC	1799 EXPOSITION DR	BOULDER	BOULDER	80301	Closed	05-Apr-93
3254	610	EXXON CO USA RAS #62311	3000 28TH ST	BOULDER	BOULDER	80301	Closed	01-Jun-90
3254	10481	CONOCOPHILLIPS SITE 6510	3000 28TH ST	BOULDER	BOULDER	80301	Implementing CAP	10-Oct-07
3340	4377	BARTKUS OIL CO	3501 PEARL ST	BOULDER	BOULDER	80301	Closed	29-Jul-93
3340	7181	BARTKUS BULK PLANT	3501 PEARL ST	BOULDER	BOULDER	80301	Implementing CAP	08-Jan-99
3975	9551	TEXACO/JIFFY LUBE	1788 30TH ST	BOULDER	BOULDER	80301	Implementing CAP	13-Jul-04
4082	4444	DIAMOND SHAMROCK #1110	2995 30TH ST	BOULDER	BOULDER	80301	Implementing CAP	15-Dec-89
5262	1441	UNIVERSITY OF COLORADO CREDIT UNION	2625 28TH ST	BOULDER	BOULDER	80301	Closed	04-Feb-91
5301	3357	BOULDER VALLEY SCHOOL DISTRICT EDUCATION CENTER	6500 E ARAPAHOE PO BOX 9011	BOULDER	BOULDER	80301	Closed	12-Feb-90
5672	2266	FLATIRON SERVICE CO	2300 55TH	BOULDER	BOULDER	80301	Closed	06-Sep-91
5836	4986	VALLEY LINCOLN-MERCURY	3200 28TH ST	BOULDER	BOULDER	80301	Closed	12-Aug-91
6146	4634	BOULDER EMERGENCY FACILITY	5048 E PEARL ST	BOULDER	BOULDER	80301	Closed	06-May-94
6694	4712	AMOCO OIL #8634	6500 LOOKOUT RD	BOULDER	BOULDER	80301	Closed	31-May-89
6694	9762	AMOCO #8634	6500 LOOKOUT RD	BOULDER	BOULDER	80301	Closed	28-Mar-05

6694	10114	AMOCO #8634	6500 LOOKOUT RD	BOULDER	BOULDER	80301	Implementing CAP	16-Jun-06
6703	10113	MY MART BOULDER GAS	2900 BASELINE RD	BOULDER	BOULDER	80301	SCR Complete	16-Jun-06
8321	1472	KMART #4181	3325 28TH ST	BOULDER	BOULDER	80301	Closed	03-Mar-92
8449	223	MUNICIPAL SERVICE CENTER	5050 PEARL ST	BOULDER	BOULDER	80301	Closed	16-Jun-93
8551	4616	RENTAL CITY INC	3050 WALNUT ST	BOULDER	BOULDER	80301	Closed	09-Dec-91
8594	4667	FIRESTONE STORE #2838 028851	3396 30TH AVE	BOULDER	BOULDER	80301	Closed	15-Nov-96
8881	326	MICRO MOTION FACILITY	6930 WINCHESTER CIR	BOULDER	BOULDER	80301	Closed	27-Jul-94
9499	1852	RTD - BOULDER	1707 EXPOSITION DR	BOULDER	BOULDER	80301	Closed	27-Oct-95
9499	1892	RTD - BOULDER	1707 EXPOSITION DR	BOULDER	BOULDER	80301	Closed	15-Aug-87
9499	9486	RTD BOULDER	1707 EXPOSTITION DR	BOULDER	BOULDER	80301	Closed	21-Apr-04
9895	3868	US WEST COMMUNICATIONS	1900 N 57TH CT	BOULDER	BOULDER	80301	Closed	19-Oct-94
9899	4166	DC BURNS REALTY & TRUST CO	1860 S FLATIRON CT	BOULDER	BOULDER	80301	Closed	09-Jan-97
10250	19	SAVEWAY #9	3375 28TH ST	BOULDER	BOULDER	80301	Closed	05-Sep-89
10250	30	SAVEWAY #9	3375 28TH ST	BOULDER	BOULDER	80301	Implementing CAP	15-Mar-96
10497	7258	AMOCO 8617	2990 BASELINE	BOULDER	BOULDER	80301	Implementing CAP	31-Aug-90
10567	4827	CHEVRON #70634	2990 DIAGONAL HWY	BOULDER	BOULDER	80301	Closed	09-May-89
10567	6380	AMOCO #3712	2990 DIAGONAL HWY	BOULDER	BOULDER	80301	Closed	29-Jan-98
10879	8874	GUNBARREL TEXACO	6580 LOOKOUT RD	BOULDER	BOULDER	80301	Closed	08-Mar-02
11727	2757	DIAMOND SHAMROCK #621	3445 28TH AVE	BOULDER	BOULDER	80301	Closed	01-Aug-90
11733	5152	NORTH AMERICAN VAN LINES	3625 WALNUT ST	BOULDER	BOULDER	80301	Closed	21-Oct-89
12085	3726	JAMISON PROPERTY	3200 PEARL ST	BOULDER	BOULDER	80301	Closed	15-Mar-93
12125	2442	BOULDER COUNTY CLUB	7350 CLUBHOUSE RD	BOULDER	BOULDER	80301	Closed	18-Apr-91
12265	935	BOULDER TOYOTA	2465 48TH COURT	BOULDER	BOULDER	80301	Closed	09-Jun-93
12407	4298	MARGRET LEICHNER	5690 VALMONT RD	BOULDER	BOULDER	80301	Closed	12-Aug-91
12467	2045	VICKERS AT CROSSROADS MALL	1950 28TH ST	BOULDER	BOULDER	80301	Closed	06-Feb-91
12494	2153	EMPIRE VOLVO	2845 VALMONT RD	BOULDER	BOULDER	80301	Closed	30-Mar-93
12613	4439	MCCADDON OLDSMOBILE CADILLAC INC	2460 48TH ST	BOULDER	BOULDER	80301	Closed	10-Dec-93
12684	1920	BOULDER HYUNDAI	2470 49TH ST	BOULDER	BOULDER	80301	Closed	30-Jun-93
12743	4049	ANTONOFF & CO	2300 30TH ST	BOULDER	BOULDER	80301	Closed	12-Jul-93
12815	492	ALPHA-OMEGA IMPORT AUTO SERVICE	3445 WALNUT ST	BOULDER	BOULDER	80301	Closed	19-Mar-91
12905	4551	PIT PROS	2121 28TH ST	BOULDER	BOULDER	80301	Closed	28-Feb-92
13339	5342	IBM	5992 63RD ST BLDG 13	BOULDER	BOULDER	80301	Closed	10-Feb-95
13694	2659	WESTERN DISPOSAL	6032 VALMONT RD	BOULDER	BOULDER	80301	Closed	31-Oct-96
14371	6248	COLORADO FLIGHT SAFETY	AIRPORT RD BLDG #4	BOULDER	BOULDER	80301	Closed	05-Dec-97
14508	6736	POLLARD FRIENDLY MOTORS	2360 30TH ST	BOULDER	BOULDER	80301	Closed	14-Jul-98

15694	9318	BOULDER COMMUNITY HOSPITAL	4747 ARAPAHOE ST	BOULDER	BOULDER	80301	Closed	13-Aug-03
18067	10067	LYNCH PROPERTY (TOWING LOT)	4898 PEARL	BOULDER	BOULDER	80301	Closed	04-May-06