# Exhibit D

# Baseline Report
# East Plum Creek Conservation Bank, Douglas County, Colorado

## I. Statement of Purpose

This document describes baseline conditions for various ecological receptors in the East Plum Creek Conservation Bank (EPCCB). Data are provided on groundwater, vegetation, and Preble's meadow jumping mouse populations and distribution.

Baseline data are reported for receptors prior to or shortly after installation of several check dams in the bank area. Installation occurred in winter-spring 2001 and winter-spring 2002. Baseline data reported here vary both temporally and spatially, depending on where and when data were sampled in relation to check dam location.

## II. Project Description

CDOT has several proposed or completed projects within or adjacent to the bank area. The Fifth Street bridge was completed near check dam 1 in the spring of 2001. This bridge spans East Plum Creek and project construction disturbed 1.22 acres of Preble's habitat, including the installation of check dams 1-3 (Ensight 1999a, Ensight 2000a).

The Wolfensberger Bridge project also affected 0.57 acres of Preble's habitat, and repairs to the existing structure and construction of a new bridge were completed in summer 2002 (Ensight 1999a).

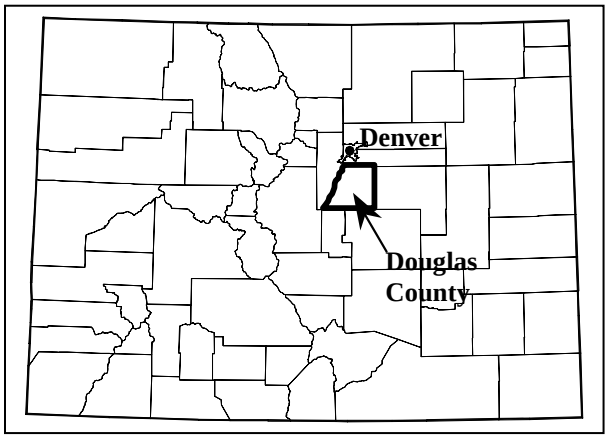
Future projects include the widening of I-25, and this will affect lands adjacent to much of the eastern boundary of the bank. Approximately 5.65 acres of habitat will be affected, and this area will not be included within the bank boundary (Ensight 2000b). Check dams 4-9 were permitted under an amendment to the I-25 biological assessment (Ensight 2001).

Details on the location and nature of the disturbances, as well as the mitigation for these projects are contained in the biological assessments referenced above, and the associated biological opinions, as well as the permit issued by the U.S. Army Corps of Engineers (USACE) and the Colorado Division of Wildlife's (CDOW) approval under SB40 (see USACE 2001a, b, and CDOW 2001 a, b). The CDOW was also consulted on potential effects from the dams on native fish (there were no threatened, endangered, or species of special concern in the bank area), and they provided comments on how to improve fish habitat through dam design modifications.

## III. Project Location

The location of the EPCCB is given in Figures 1 and 2; the bank has an area of 25.3 acres.

**Figure 1. Map of the State of Colorado showing the project location in Douglas County**




## IV. Environmental Setting

### Surrounding Landscape

The landscape surrounding the EPCCB consists of rolling hills with elevation increasing from north to south. Bank elevation is approximately 6,150 feet above mean sea level. The Castle Rock area occurs at the interface between two ecoregional provinces, the Great-Plains-Palouse Dry Steppe to the East and the Southern Rocky Mountain Steppe–Open Woodland-Coniferous Forest–Alpine Meadow Province to the west (Bailey 1995). As such, grasslands, Gambel oak shrublands, and Ponderosa pine woodlands are the dominant vegetation types found within the East Plum Creek watershed.

### Land Use Prior to Check Dams

This property has been owned by CDOT since 1959, when Interstate 25 (I-25) was constructed. Past conditions in the area were determined from aerial photographs from 1955 and 1962. The general bank area during that period had a number of various anthropogenic influences, including construction activities from I-25, commercial or residential structures in the Sellers Gulch area, and agricultural fields south of Sellers Gulch and west of I-25 near the current trailer park, and near the north end of the bank. The stream channel south of Sellers Gulch meandered and was well-vegetated with the exception of the area near Plum Creek Parkway (which was not constructed at that time). The Sellers Gulch confluence with East Plum Creek in the 1962 photos was much less vegetated than present day, with considerable bare ground, possibly caused by flooding.

The stream on the west side of I-25 had a wide, braided, open channel. There appeared to be open areas in the floodplain that could have resulted from past flooding, construction from I-25, or other disturbance factors. There were few structures in surrounding upland areas, and a significant portion of these areas were used for hay fields. There was a small, unnamed drainage that flowed east into East Plum Creek that was more distinct and better vegetated than it is today (this drainage is located approximately at the 5th Street Bridge).

**Current Land Use**

The area surrounding the bank has become increasingly developed in the past 30-40 years. The agricultural fields mentioned above are almost entirely gone. I-25 is directly adjacent or very close to much of the bank boundary. There are commercial businesses in upland areas on both the east and west sides of the bank, in areas that were formerly hay fields. A paved bicycle path, constructed in 1995, runs through much of the north and middle bank areas. A trailer park is on the west side of the bank, near the newly constructed 5th Street Bridge. The Wolfensberger, Plum Creek Parkway, and Wilcox Street Bridges also span the Creek. See Figures 3a-c for bank features.

**Off-Site Influences**

There is a 3-acre CDOT maintenance area northeast of Wolfensberger Road on the east side of I-25 on Wilcox Street (Figure 3a). It is not within the bank area and approximately 500 feet east of East Plum Creek.

At least four underground storage tanks containing gasoline and diesel fuel were at the site, and during removal between 1989 and 1994, two of them were found to be visibly leaking. One-thousand cubic yards of contaminated soil (clay and silty sand) were removed to a depth of 28 feet below ground surface after this discovery (Arcadis Geraghty & Miller 2001 a,b,c). Groundwater occurred at the contaminated site from 19 to 25 feet below ground surface or deeper, with a west to northwest flow direction. Hydraulic conductivity of the soils for groundwater was found to be low (2-10 feet year) and consistent with permeability values for these types of soil (Arcadis Geraghty & Miller 2001 a).

Soil and groundwater (primarily near the locations of the underground storage tanks) were found to be contaminated with benzene, toluene, ethylbenzene, xylenes, total volatile petroleum hydrocarbons, and total extractable petroleum hydrocarbons. Both soil and groundwater contamination levels were highest at the former tank locations, and decreased markedly with distance from the tanks. These contaminants were not detected at two monitoring wells on the west side of I-25 between I-25 and the southbound off-ramp to Wolfensberger (just east of the bank). Methyl-tertiary-butyl-ether (MTBE) was found in groundwater here, but the source appears to be from the Amoco station at Wolfensberger and Wilcox on the east side of I-25 (MTBE was not found in groundwater at the maintenance yard).

Site remediation was conducted in May 2000 by injecting an Oxygen Release Compound (ORC) in the vicinity of the underground storage tanks, through a series of temporary boreholes. ORC is a formula of magnesium peroxide that release $O_2$ when it contacts water, enhancing aerobic microbe activity after an increase in dissolved $O_2$ in groundwater. Aerobic microbes are known to biodegrade all of the organic contaminants found.

Subsequent groundwater sampling and analysis has shown benzene concentrations to be declining or stable in the plume area. Benzene was the primary contaminant of concern, and post-remediation concentrations of other contaminants were not available.

A human health risk assessment was performed for several potential flow pathways (Cite). One potential pathway included contamination of groundwater wells on the west side of I-25 just west of the bank area (there are four wells north of Wolfensberger). Contamination of these wells was evaluated but dismissed because of the low groundwater hydraulic conductivity and the hydraulic barrier of East Plum Creek to groundwater transport. Both of these factors would limit contaminant migration. There were two potential exposure pathways that were identified for further analysis: groundwater migration-ingestion, and groundwater-volatilization to indoor air. The former pathway merited further analysis (Tier 2 evaluation) through a modeling process (BP RISC software). Modeling indicated that maximum allowable? concentration levels will not be exceeded in the future at downgradient exposure sites, even if site contamination levels remain constant, due to natural attenuation processes. The consultant recommended site closure based on current and anticipated future industrial/commercial land use at the site and surrounding properties.

This risk analysis process did not include an ecological risk assessment, which might analyze the potential pathways, contaminant exposure, and subsequent risk to the Preble's meadow jumping mouse. There is not enough information provided in the background materials to conduct such an assessment, but potential risk could be assessed using reasonable assumptions regarding pathways and potential exposure.

It is almost certain that Preble's would not be exposed to contaminated soil; this soil was confined to the maintenance yard on the east side of I-25, approximately 500 feet from East Plum Creek. The yard is separated from the bank by both north and southbound I-25 lanes and ramps, a median, and extensive rip-rapping on the west side of I-25. There is no dispersal pathway for Preble's between the bank area and the contaminated maintenance yard. Soil contaminant concentrations also decrease with distance from the former locations of the underground storage tanks, and most of this contaminated soil was removed and replaced.

Preble's could be exposed to organic contaminants through groundwater exposure. Groundwater does flow west from the contaminated maintenance yard and Amoco station to the area of the bank north of Wolfensberger. Preble's could be potentially exposed if this groundwater emerged to the surface and was ingested, through direct contact with soil contaminated by groundwater, through inhalation of volatilized contaminants in

burrows or hibernacula, or through ingestion of vegetation or invertebrates where groundwater uptake or ingestion had occurred. In all of these hypothetical cases, the risk to Preble's would depend on completion of the pathway (exposure), duration of exposure, and effect of a particular contaminant on Preble's.

Based on the presence of methyl-tertiary-butyl-ether (MTBE) in the groundwater well west of the I-25 southbound main lanes, it is possible that this organic contaminant may reach groundwater within the bank. The effect of this contaminant on Preble's is unknown. Petroleum volotile organic compounds (VOCs) are teratogenic to birds and fish and mutagenic to mammals, birds, fish, reptiles, invertebrates, and plants. Other organic contaminants that originated at the CDOT maintenance yard were not found at this sampling location and probably have not contaminated bank groundwater.

However, based on hydraulic conductivity data and the hydraulic pressure from East Plum Creek, contaminant groundwater migration from east to west here is very slow. Contaminant concentrations would be expected to decrease from the contaminant source on the east side of I-25. Also, Preble's exposure to organic contaminants in this area might be limited based on the relatively short average lifespan of a Preble's (the average annual survival for Preble's in the bank is approximately 12%, or 88% of animals do not survive a one-year period). It is also thought that Preble's do not burrow into or hibernate in periodically wet or saturated soils. Areas that are subjected to fluctuating groundwater levels would put hibernating or nesting animals at risk from drowning or seasonal displacement. Most known or suspected hibernation sites are found in dry soils that are not subject to such groundwater fluctuations.

Although there may be exposure risks from organic contaminants in groundwater to Preble's within the bank area, these risks are probably limited, based on data that indicate limited contaminant migration to the bank, and life-history traits of Preble's that would minimize exposure to contaminants in groundwater.

In recognition of the potential hazards to Preble's represented by these contaminants, CDOT will sample groundwater under the bank lands in the vicinity of the Wolfensberger Bridge to determine the presence of any contaminants of concern. In addition, in cooperation with FWS, CDOT will develop a groundwater monitoring plan to sample for contaminants during the life of the Bank. Should sampling identify the presence of contaminants at levels that might constitute a threat to Preble's, CDOT will take necessary steps to remove this threat. The groundwater monitoring plan will be included in the Final Management Plan, to be completed within six months from the signing of the Bank Agreement.

## Soils

Soils in the East Plum Creek floodplain are classified as Sandy Wet Alluvial Land (USDA-SCS 1974). This soil classification is typified as light colored, stratified sand, loamy sand, sandy loam, and gravel (USDA-SCS 1974, SAIC 2000). Sandy Wet Alluvial Land soils are poorly drained, have rapid permeability/slow runoff, and have a low water capacity (USDA-SCS 1974).

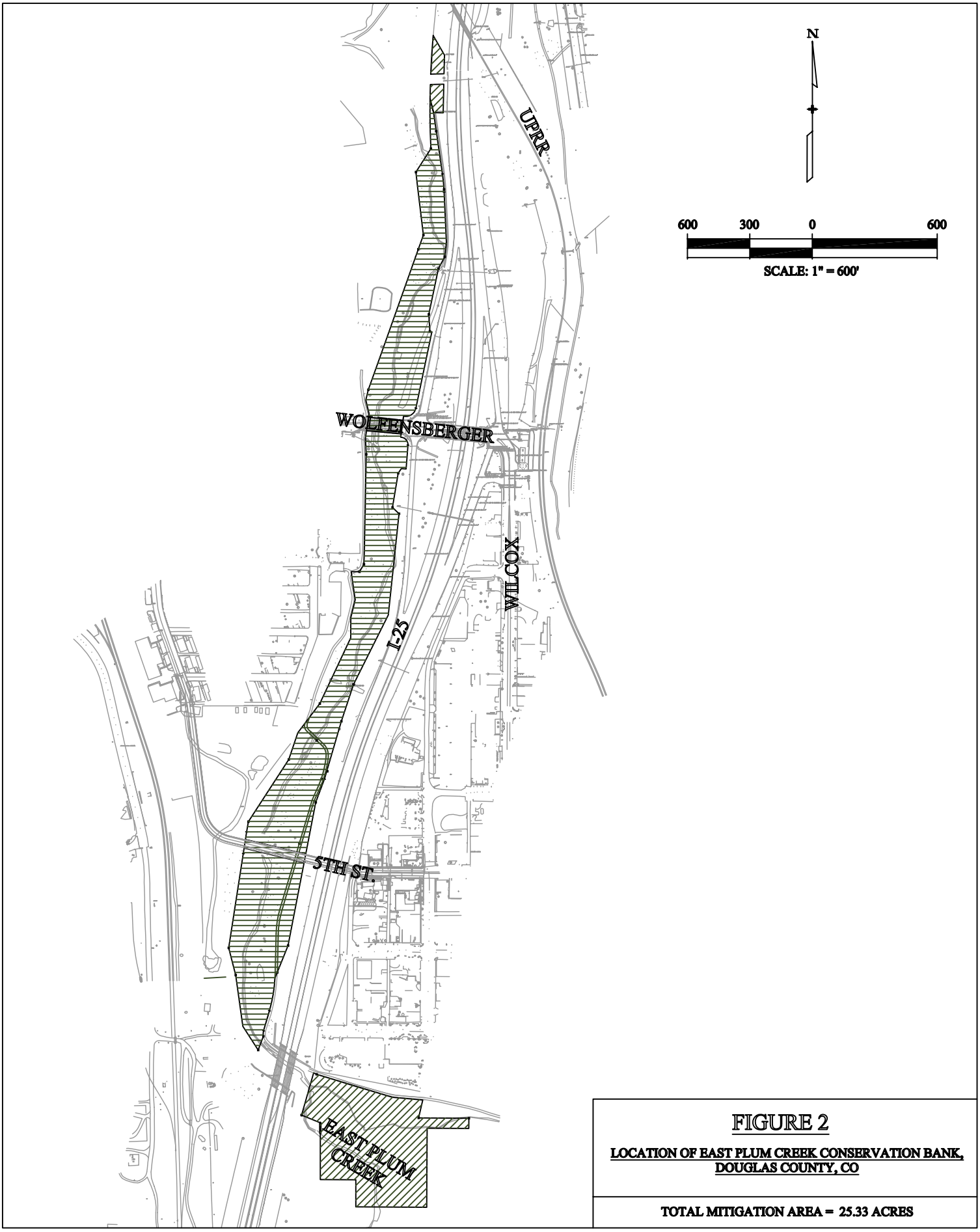
## East Plum Creek

East Plum Creek is a perennial, sand/gravel bed, third order stream, flowing north and northwest within the project area. The headwaters of East Plum Creek are south of Castle Rock along the Palmer Divide. The creek largely flows through rural areas and open space between the Palmer Divide and Castle Rock. Once in Castle Rock, East Plum Creek flow is augmented by stormwater runoff from development along the I-25 corridor and other urbanized areas in Castle Rock. Northwest of Castle Rock, East Plum Creek joins with West Plum Creek in Sedalia, to form Plum Creek, which flows northwest to Chatfield Reservoir.

East Plum Creek morphology through the study area has changed from a meandering alluvial stream to one with a regular, incised channel. The current incised morphology is a result of three interdependent factors: 1) the straightening of East Plum Creek through Castle Rock in the early 1950's, 2) the catastrophic flood of 1965, and 3) the more recent urbanization of the watershed. Flow from the catastrophic flood of July 16, 1965 was estimated at 154,000 cubic feet per second (cfs) (USGS 2000) at the Plum Creek gaging station near Louviers (located downstream of the current project area). This event radically altered the floodplains of all the streams in the area, including East Plum Creek. Friedman et al. (1996) state that this flood 'removed most of the bottomland vegetation and transformed the single-thalweg stream (Plum Creek) into a wider, braided channel.'

Channel incision has lowered the channel bottom and adjacent groundwater table, causing adjacent riparian vegetation to go into decline as groundwater depth dropped below the root zone. Channel cross-sections were surveyed at twelve locations between the Wolfensberger Bridge and Sellers Gulch (see Appendix 1 for cross-sections and location). Some of these locations will be resurveyed to determine the amount of channel filling that has occurred after dam installation.

Bankfull discharge of East Plum Creek is estimated to be approximately 140 cfs. Bankfull discharge is the dominant channel forming flow, and is usually considered to occur once every 1.67 years. Between 1999 and 2001 the highest average daily flow of 410 cfs was measured on April 30, 1999, and the minimum measured flow was 0.86 cfs on August 11, 2000 as measured at the USGS Gauging Station No. 06708800 (East Plum Creek below Haskins Gulch).




# FIGURE 2

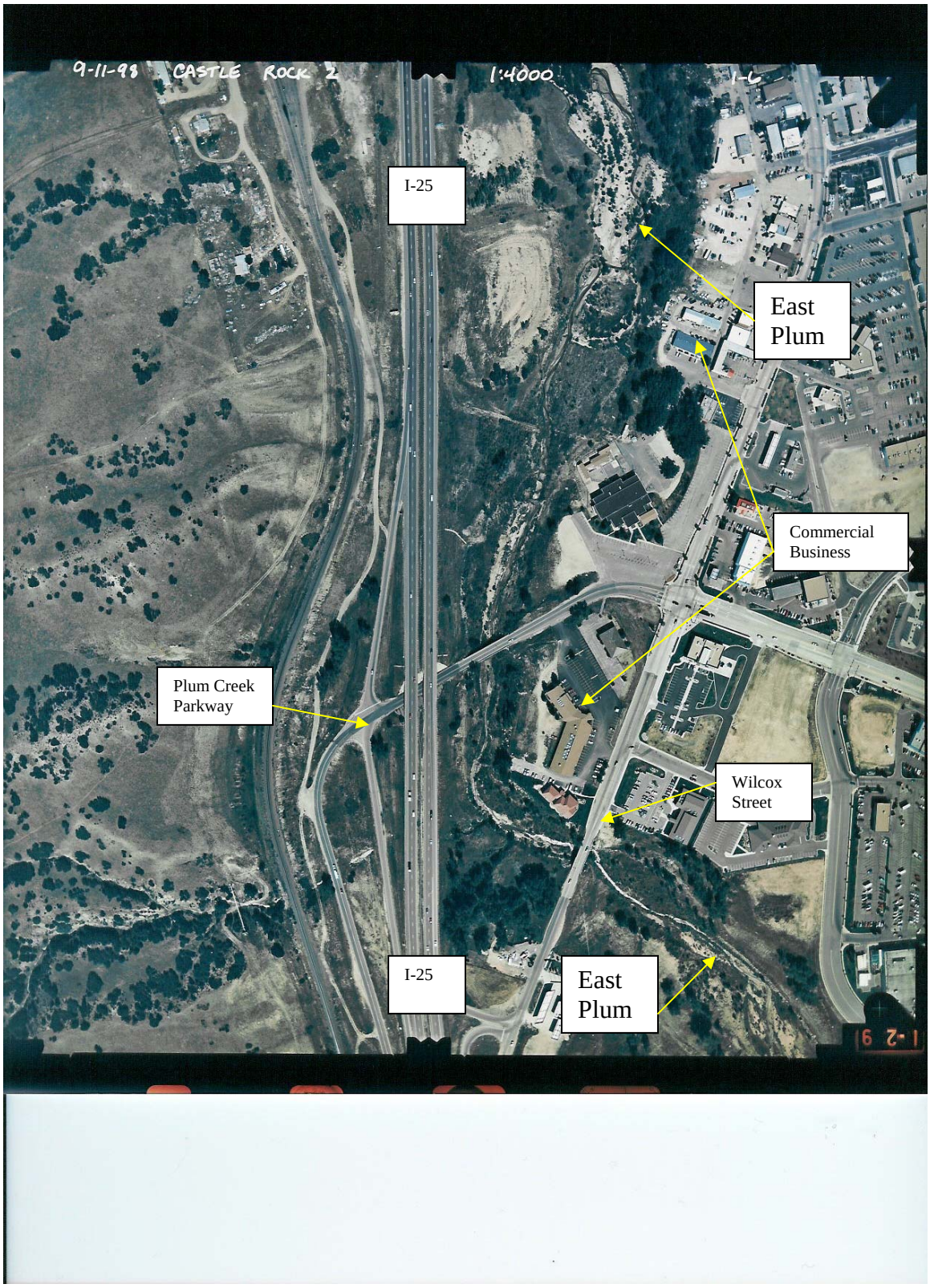
**LOCATION OF EAST PLUM CREEK CONSERVATION BANK, DOUGLAS COUNTY, CO**

**TOTAL MITIGATION AREA = 25.33 ACRES**

**Figure 3a. 1998 Aerial Photograph of East Plum Creek Bank, North Section, Douglas County CO.**

**Figure 3b. 1998 Aerial Photograph of East Plum Creek Bank, Middle Section, Douglas County CO.**

**Figure 3c. 1998 Aerial Photograph of East Plum Creek Bank, Middle Section, Douglas County CO.**



## V. Ecological Receptors

## A. Groundwater

### Groundwater Methods

Two sets of shallow groundwater monitoring wells, constructed from 2-inch diameter PVC, were installed in the project area. The first set of 37 shallow groundwater monitoring wells ('MW' wells) were initially installed in the study area on March 24th and 25th, 1999 to aid in determining wetland hydrology within the East Plum Creek floodplain. The total length of each MW well was approximately 40 inches. Wells MW14 and MW20 were lost to high flows in spring 1999 and were not replaced.

A second set of deeper groundwater wells were installed in 2001 ('CD' wells) to augment the existing monitoring well network, and thereby better document changes in alluvial groundwater elevations associated with the installation of three check dams. The total length of each CD well was approximately 60 inches. These wells penetrate deeper into the floodplain alluvium and associated groundwater. Because the groundwater elevations were typically below the shallower MW wells, the CD wells provided a more complete picture of the alluvial groundwater elevations prior to installation of the initial three check dams. A total of 23 CD wells were installed in the spring of 2001, 19 of which were installed prior to the installation of the check dams, and contributed to establishing baseline groundwater conditions. Figure 4 shows the locations of the two different types of monitoring wells.

Water levels in the MW and CD wells were monitored with a Solinst-Mini water level indicator. Prior to sampling, the meter's battery was tested, and the probe's sensitivity to free water was tested in the creek. The monitoring period of MW wells was March 29, 1999 through March 29, 2001; monitoring of the CD wells was February 15, 2001 through March 29, 2001.

### Groundwater Results

Many of the MW well sites exhibited hydrophytic vegetation and soils, but the incising stream channel made wetland hydrology questionable, and a determination of wetland hydrology difficult. Well monitoring results showed that only four (MW 30, MW35, MW36; and MW37) of the 37 wells met the criteria for wetland hydrology. The wetland hydrology requirement was considered fulfilled if the depth to the water table was continuously within 12 inches of the soil surface for at least 5% of the growing season (May 9th through October 2nd)—147 days for Castle Rock, Colorado (USDA-NRCS 1995, 1996). Consequently, the number of consecutive days required to fulfill the wetland hydrology requirement is 7.35 days, or 7 days. This determination was based primarily on monitoring during May and June of the 1999 growing season.

Table 1 provides a summary of groundwater data collected from the MW wells between March 29, 1999 and March 29, 2001, and the CD wells between February 15, 2001 and

March 29, 2001. A total of 57 monitoring events were performed for MW wells containing water between March 29 and August 18, 1999. Because the majority of monitoring events for 'MW' wells occurred in spring and summer of 1999, when precipitation and water levels in East Plum Creek were above average, the median depth to water calculation is skewed higher than it might be during 'average' water years.

**Groundwater Discussion**

As expected, alluvial groundwater levels were found to rise in April and May during spring runoff and to return to base levels during the summer, fall and winter months.

Of the wells installed in 1999, water was detected most frequently in MW12, MW13, MW17, MW20, MW25, MW26, MW27, MW29, MW30, MW31, MW35, MW36 and MW37. Specific conditions that attribute to a greater frequency of observed water at specific MW well locations are:

- Monitoring wells MW17, MW27, MW30, MW36, MW37 were sited in obvious secondary flow channels.
- Monitoring wells MW12, MW13, MW26, and MW29 were sited at the toe of a slope. Field measurements for these wells reflect drainage from the adjacent slope in addition to changes in the water table related to East Plum Creek stage.
- Monitoring wells MW20, MW25, MW26, MW27, MW35, and MW37 were sited in areas prone to overbank flooding.
- The bottom elevation of MW35 was deeper than the bottom of the adjacent East Plum Creek channel.

The deeper CD wells show that alluvial groundwater base levels ranged from 34 inches to greater than 55 inches in depth, depending on monitoring well location. Of the CD wells containing water, the average depth to groundwater was 44 inches below the soil surface during the winter and early spring of 2001.

**Table 1. Summary Data for Shallow and Deep Groundwater Monitoring Wells, East Plum Creek, Douglas County, Colorado**

| Well No.[1] | No. of Days Sampled[2] | No. of Sampled Days with Water Detected | Percentage of Days with Water Detected | Median Depth to Water [3] (inches) |
|---|---|---|---|---|
| **MW1** | 62 | 5 | 8.1 | >27 |
| **MW2** | 62 | 7 | 11.3 | >26 |
| **MW3** | 62 | 5 | 8.1 | >28 |
| **MW4** | 62 | 4 | 6.5 | >28 |
| **MW5** | 60 | 1 | 1.7 | >24 |
| **MW6** | 61 | 2 | 3.3 | >27 |
| **MW7** | 58 | 0 | 0.0 | >28 |
| **MW8** | 62 | 1 | 1.6 | >27 |
| **MW9** | 62 | 2 | 3.2 | >28 |
| **MW10** | 61 | 0 | 0.0 | >26 |
| **MW11** | 65 | 8 | 12.3 | >30 |
| **MW12** | 66 | 22 | 33.3 | >25 |
| **MW13** | 75 | 39 | 52.0 | >24 |
| **MW14** | 7 | 0 | 0.0 | >30 |
| **MW15** | 63 | 1 | 1.6 | >28 |
| **MW16** | 66 | 6 | 9.1 | >30 |
| **MW17** | 75 | 31 | 41.3 | >21 |
| **MW18** | 64 | 5 | 7.8 | >25 |
| **MW19** | 63 | 2 | 3.2 | >25 |
| **MW20** | 36 | 36 | 100.0 | 19 |
| **MW21** | 65 | 2 | 3.1 | >27 |
| **MW22** | 68 | 5 | 7.4 | >29 |
| **MW23** | 68 | 8 | 11.8 | >28 |
| **MW24** | 66 | 11 | 16.7 | >29 |
| **MW25** | 69 | 27 | 39.1 | >27 |
| **MW26** | 74 | 43 | 58.1 | >21 |
| **MW27** | 79 | 61 | 77.2 | 27 |
| **MW28** | 65 | 6 | 9.2 | >32 |
| **MW29** | 79 | 59 | 74.7 | 19 |
| **MW30** | 79 | 66 | 83.5 | 19 |
| **MW31** | 66 | 20 | 30.3 | >24 |
| **MW32** | 63 | 5 | 7.9 | >31 |
| **MW33** | 63 | 0 | 0.0 | >28 |
| **MW34** | 47 | 0 | 0.0 | >35 |
| **MW35** | 78 | 77 | 98.7 | 22 |
| **MW36** | 79 | 65 | 82.3 | 11 |
| **MW37** | 78 | 47 | 60.3 | 15 |
| **CD01** | 8 | 3 | 37.5 | >55 |

**Table 1 cont'd. Summary Data for Shallow and Deep Groundwater Monitoring Wells, East Plum Creek, Douglas County, Colorado**

| Well No. | No. of Days Sampled[1] | No. of Sampled Days with Water Detected | Percentage of Days with Water Detected | Median Depth to Water (inches) |
|---|---|---|---|---|
| **CD02** | 8 | 3 | 37.5 | >52 |
| **CD03** | 8 | 3 | 37.5 | >37 |
| **CD04** | 8 | 3 | 37.5 | >39 |
| **CD05** | 8 | 3 | 37.5 | >35 |
| **CD06** | 8 | 8 | 100 | >49 |
| **CD07** | 5 | 5 | 62.5 | 46 |
| **CD08** | 8 | 8 | 100 | 41 |
| **CD09** | 8 | 8 | 100 | 41 |
| **CD10** | 8 | 8 | 100 | 43 |
| **CD11** | 8 | 8 | 100 | 42 |
| **CD12** | 8 | 8 | 100 | 39 |
| **CD13** | 8 | 8 | 100 | 45 |
| **CD14** | 8 | 8 | 100 | 46 |
| **CD15** | 8 | 8 | 100 | 54 |
| **CD16** | 8 | 8 | 100 | 34 |
| **CD17** | 8 | 8 | 100 | 52 |
| **CD18** | 8 | 8 | 100 | 48 |
| **CD19** | 8 | 0 | 0 | >51 |

[1]'MW' wells are shallower and typically penetrate 30 inches below the soil surface. 'CD' wells are deeper than the 'MW' wells and typically penetrate > 48 inches below the soil surface.

[2]'MW' well monitoring period 3/29/99 - 3/29/01, 'CD' well monitoring period 2/15/01 – 3/29/01.

[3]For table entries with a greater than symbol ('>'), the exact median depth to water is unknown, however, it is known that the median depth to water is greater than the value given in the table. Majority of monitoring events for 'MW' wells occurred in spring 1999, when precipitation and water levels in East Plum Creek were above average. This affects the median depth to water calculation by skewing it higher than it might be during 'average' water years.

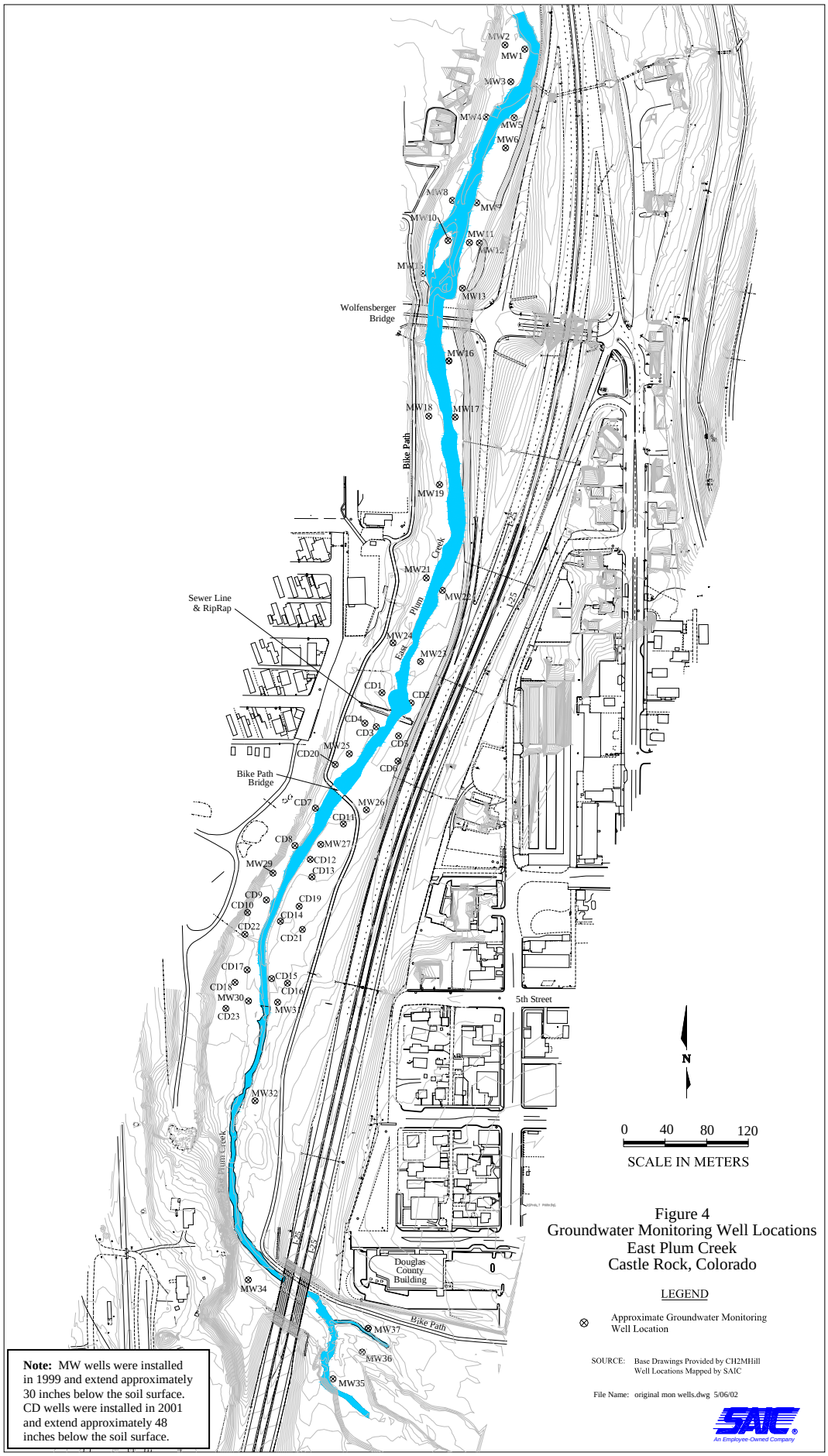



Figure 4
Groundwater Monitoring Well Locations
East Plum Creek
Castle Rock, Colorado

LEGEND

⊗ Approximate Groundwater Monitoring Well Location

SOURCE: Base Drawings Provided by CH2MHill
Well Locations Mapped by SAIC

File Name: original mon wells.dwg 5/06/02

SAIC
An Employee-Owned Company

**Note:** MW wells were installed in 1999 and extend approximately 30 inches below the soil surface. CD wells were installed in 2001 and extend approximately 48 inches below the soil surface.

## B. Vegetation

Data on vegetation within the bank area has been collected for several years. Initial studies were part of the wetland delineation effort in 1999. Subsequent studies have focused on collected species composition and point intercept cover data from areas that will be affected by check dam placement and non-impact locations. A community vegetation map is presented here for much (but not all) of the bank area.

Note that recent vegetation measurements have been collected at two geographic scales. Vegetation mapping data was collected at the landscape scale, where all vegetation within selected bank areas was classified, and areas of each map unit determined. Approximately 77.7% of the bank area has been mapped, which includes all of the check dam areas. More specific point-intercept data was collected at selected sites (site scale), and vegetation hits were classified by plant species, litter, or bare ground. Although there is a relationship between the community/map unit types identified in Table 2 and the point intercept results, the data taken by these contrasting methods does not coincide precisely.

### Community Vegetation Mapping Methods (landscape scale)

Vegetation at check dams 1-3 and at nearby areas on East Plum Creek was mapped using a Trimble GeoExplorer II global positioning system (GPS) receiver unit in June 2001. Three study areas were established, one at each dam. Each area was 100 meters (m) in length, beginning 30 m downstream from the dam and extending 70 m upstream.

A second vegetation mapping effort was conducted in October 2001 in the area where additional check dams were installed in early 2002 (check dams 4-9). This area extends north of check dam 3 to approximately 250 m north of the Wolfensberger Bridge. The plant communities in this area were described and mapped using the same methods and community classification system described above (Figure 5). Note that point intercept measurements that were collected in 2001 are only reported for dams 1-3 (see below). Two reference areas were also selected in 2002. Reference area 1 was located upstream (south) from check dam 1 (Sellers Gulch area); reference area 2 was downstream (north) of check dam 9 at the old sewage treatment plant (Figure 5). Note that reference areas were changed from areas selected in 2001, based on conversations with CDOT and U.S. Fish and Wildlife Service staff, and are not the same as reference areas in the Ensight 2002 report.

The study area was walked with project personnel in June 2001, and preliminary vegetation maps of the area were reviewed. The area was divided into 18 map units (bare ground, bare channel, bike path, dam reinforcement structure (at check dam 9), and 14 plant communities), based on dominant plant species, distinct plant species associations, and environmental and ecological factors. Details on methods are given in Ensight 2002.

**Methods for Sampling Vegetation Composition, Cover, and Community Classification (site scale)**

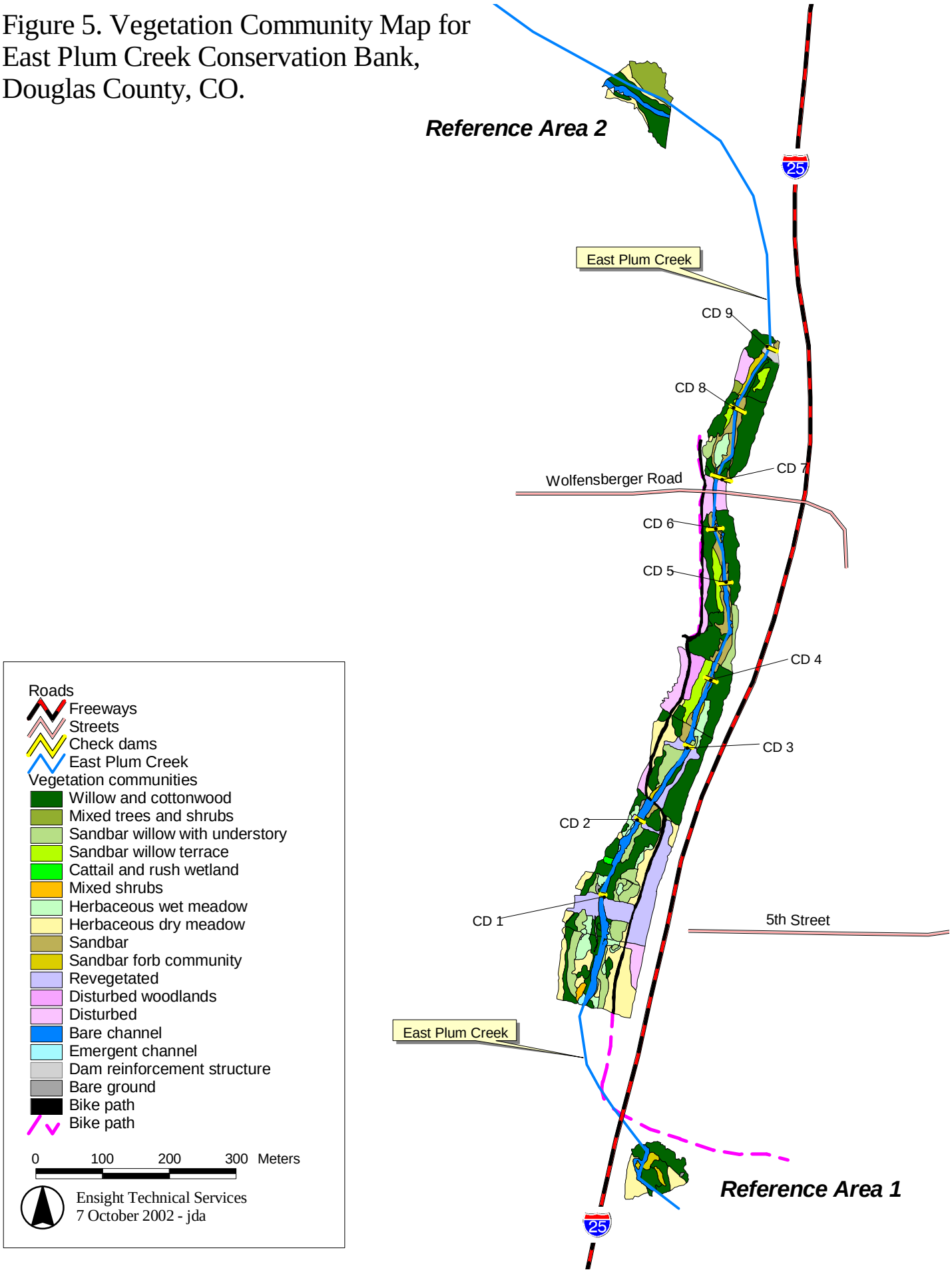
Seven vegetation sampling transects were located within each study site for dams 1-3 in June 2001. Although these measurements were taken after check dams 1-3 were installed, the period from installation to vegetation data collection was approximately six weeks; we believe that vegetation cover and composition did not appreciably change during this period, and the data reported here do represent baseline conditions.

All plant community composition and structure values were derived from species cover data collected with the point intercept method. A 50-meter tape was used to describe each transect. Data were collected at each meter mark along the tape (50 per transect, 350 per dam). A data point was recorded as the species of the first plant intercepted by a sampling rod lowered to the ground from one meter in height.

Plant species with overhead canopy occurring directly above a sample point were also recorded. The appropriate plant community was recorded for each point. If the intercepted plant was a shrub or tree, its height was also noted.

All native plant species that were observed during the exercise are listed in Appendix 2, and non-native species in Appendix 3.

Figure 5. Vegetation Community Map for East Plum Creek Conservation Bank, Douglas County, CO.



## GPS Vegetation Mapping Results for All Areas

Each of the 18 map units (bare ground, bare channel, bike path, dam reinforcement structure, and 14 plant communities) characterized and delineated in selected areas (nine check dam areas, two reference areas) are summarized in Table 2. A map of the 14 plant community (and other) types is shown in Figure 5.

**Table 2. Summary of Plant Communities and Other Map Units at East Plum Creek, Douglas County, CO.**

**Bank Area**

| Map Units | Acres | Percent of Total Mapped Area |
|---|---|---|
| Bare ground | 0.0560 | 0.284973 |
| Bike path | 0.7590 | 3.862399 |
| Cattail and rush wetland | 0.0320 | 0.162842 |
| Bare channel | 1.5460 | 7.867284 |
| Emergent channel | 0.0520 | 0.264618 |
| Disturbed | 1.4630 | 7.444914 |
| Disturbed woodlands | 0.2380 | 1.211134 |
| Herbaceous dry meadow | 2.0470 | 10.41677 |
| Herbaceous wet meadow | 0.9340 | 4.752939 |
| Mixed shrubs | 0.0550 | 0.279884 |
| Mixed trees and shrubs | 0.0500 | 0.25444 |
| Revegetated | 1.9290 | 9.816294 |
| Dam reinforcement structure | 0.0840 | 0.427459 |
| Sandbar willow terrace | 0.6880 | 3.501094 |
| Willow and cottonwood | 6.6510 | 33.84561 |
| Sandbar willow with understory | 1.7950 | 9.134395 |
| Sandbar | 1.1190 | 5.694367 |
| Sandbar forb community | 0.1530 | 0.778586 |
| **Total** | **19.651** | **100** |

**Reference Area 1 (Near Sellers Gulch)**

| Map Units | Acres | Percent of Total Mapped Area |
|---|---|---|
| Bare ground | 0.0070 | 0.48951 |
| Bare channel | 0.1310 | 9.160839 |
| Herbaceous dry meadow | 0.4110 | 28.74126 |
| Willow and cottonwood | 0.7470 | 52.23776 |
| Sandbar forb community | 0.1340 | 9.370629 |
| **Total** | **1.4300** | **100** |

**Table 2 continued. Summary of Plant Communities and Other Map Units at East Plum Creek, Douglas County, CO.**

**Reference Area 2 (at old sewage treatment plant)**

| Map Units | Acres | Percent of Total Mapped Area |
|---|---|---|
| Channel bare | 0.2030 | 12.27328 |
| Herbaceous dry meadow | 0.2420 | 14.6312 |
| Mixed trees and shrubs | 0.5630 | 34.03869 |
| Willow and cottonwood | 0.6460 | 39.05683 |
| **Total** | **1.6540** | **100** |

Aerial Extent of Each Community (acres) Calculated from the ArcView Shapefiles Generated From GPS data.

## Point Intercept Composition and Ground Cover Results for Check Dams 1-3 in 2001

A total of 61 plant species were sampled along the point intercept transects at check dams 1-3 in 2001. Forty-one of these were native species. Native species accounted for 67 percent of total species. Twenty plant species were exotic (33 percent), including introduced reclamation plants and noxious weeds. Native and non-native species lists are given in Appendices 2 and 3.

The most commonly encountered native species along the sampling transects were also the dominant plant species noted in the most common communities. Sandbar willow (coyote willow) contributes an average of almost 20 percent of total cover, all species. Sedges accounted for 7.6 percent of the cover. Rushes and yellow willow each represent 5.5 percent of the vegetation cover along the sampling transects.

Four of the 20 exotic species encountered along the transects are on the State of Colorado noxious weed list. These are cheatgrass, Canada thistle, diffuse knapweed, and field bindweed. The most common exotic plant species is smooth brome, a commonly planted reclamation grass, with 4 percent of the total cover. Diffuse knapweed is the second largest contributor to total cover (1.2 percent). Alfalfa and white sweetclover each contribute almost 1 percent cover.

Non-vegetation hits accounted for a mean of 31.5 percent of the total cover along the point intercept transects. Bare ground contributed 11.8 percent of non-vegetation hits, and litter 19.7 percent.

Slightly more than 16 percent of the recorded intercept points also had overhead cover, contributed by eight woody species. Five of these are native trees. Three are exotic to the Colorado Front Range. The most common canopy species on transects were plains cottonwood (9.5 percent), followed by crack willow (3.9 percent) and Russian-olive (1.1 percent).

## C. Preble's Meadow Jumping Mouse Sampling

Presence/absence surveys for the Preble's meadow jumping mouse were first conducted at several sites in Castle Rock in 1998 (Ensight 1998a, b). Mice were found at most sampling locations on East Plum Creek, from an abandoned sewage treatment plant on the north end of Castle Rock (outside the bank area), to the Wilcox Street bridge over East Plum Creek. Jumping mice were not found in areas near the Wolfensberger Bridge (see Figure 7). Additional work was conducted at eight sites in years 1999-2001 to determine additional mouse distribution information, habitat relationships, and mouse movement patterns. Note that site 8 is not within the bank area.

Site sampling has been consistent from year-to-year with a few changes. Preble's were not captured at Site 4 (an upland grassland) in June 1999, and it has not been trapped since. Construction work at the 5$^{th}$ Street Bridge site in 2001 required reconfiguration of transects 5 and 6, and the new transects were labeled 9 and 10 (see Figure 1 for sampling locations). Three of the sampled transects in 2001 were in construction disturbed areas (transects 7, 9, 10), either from 5$^{th}$ Street or check dam locations (check dams 1-3). Although there were disturbances to some sample sites in 2001, impacts were relatively minor in terms of both area affected and duration of impact before sampling. We have therefore determined that the period for Preble's baseline data is 1999-2001. Real improvements to habitat as a result of the first three check dams occurred after Preble's sampling in 2001.

### Methods for Sampling Preble's Meadow Jumping Mouse

Jumping mouse population estimates and movement patterns were determined by live-trapping mark/re-capture techniques. Captured jumping mice were permanently marked with passive integrated transponder (PIT) tags, which were implanted in the scapular area under the skin. Each tag has a unique identification number that is recorded by a reader. PIT-tagged (marked) mice can be recorded in subsequent years by staff with the proper reader (Mini Portable Reader, Destron-Fearing, Model HS5900L).

Species of small mammals other than meadow jumping mice were sexed, aged, and reproductive condition determined before release. Individual meadow jumping mice were weighed, sexed, aged, permanently marked, and released. Animals were also hair-clipped to ensure recapture status before handling. Each implanted PIT tag had a unique identification number that was entered into the database, and captured mice were subsequently referred to by their PIT tag number. All data were recorded on standardized data sheets and entered into an electronic database, usually on the same day of capture.

Trapping efforts have been conducted in June of each year (1999-2001), with an additional September trapping in 1999 (see Table 3 for trapping effort summaries).

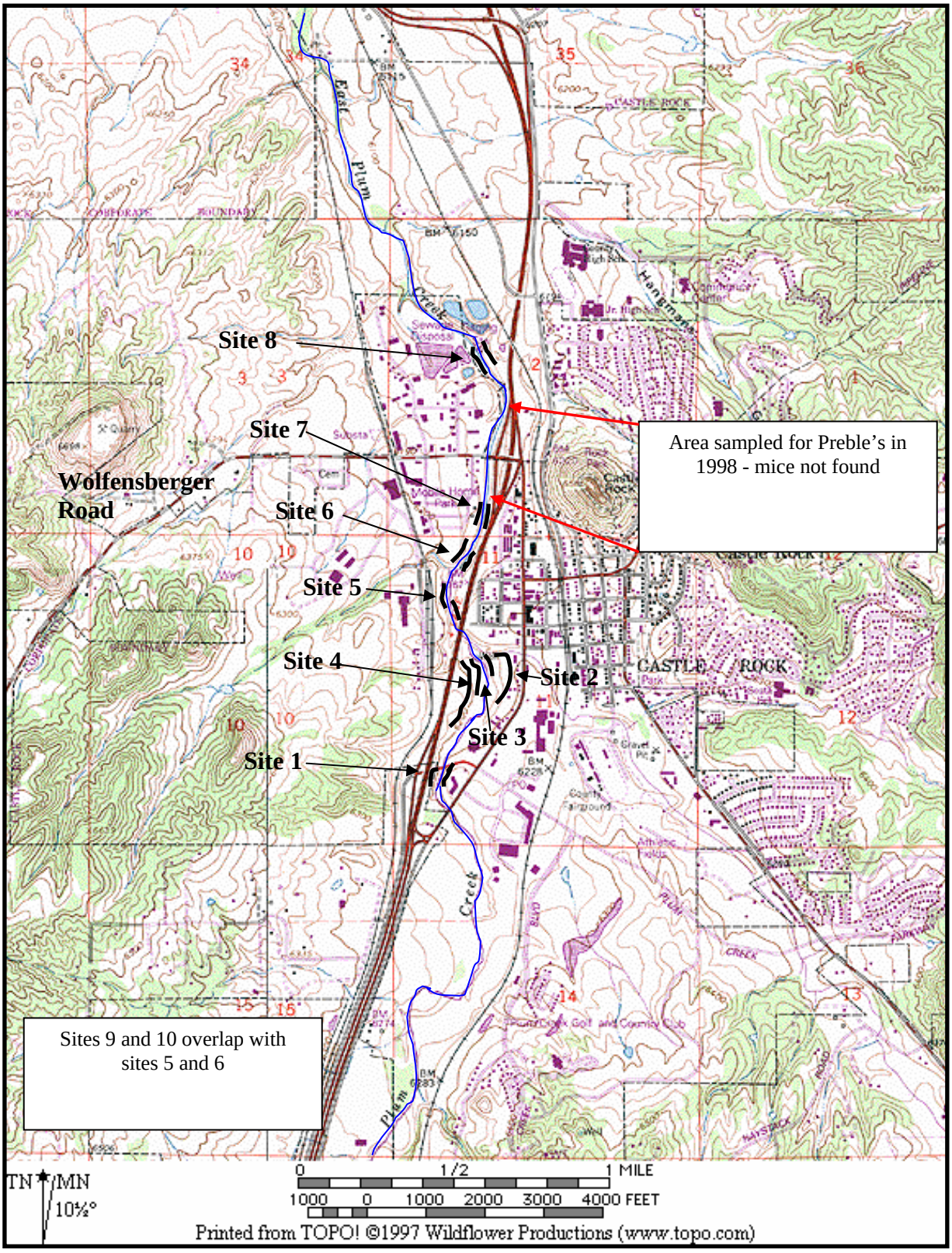
Preble's capture and recapture data were analyzed in population model MARK, robust design (see Ensight 2000). Site population abundance (N-hat values), capture and recapture rates, and survival rates were estimated. All of these estimates are reconfigured each year with the addition of new data. The N-hat values, variances, transect lengths, and a residency correction factor (White and Shenk 2001) were used to determine site and average bank Preble's linear densities (mice $km^{-1}$ stream).

**Table 3. Summary of Preble's Live-Trapping efforts at Castle Rock, Douglas County, CO**

| | **Site 1** | **Site 2** | **Site 3** | **Site 4** | **Site 5** | **Site 6** | **Site 7** | **Site 8** | **Site 9** | **Site 10** | **Total Trap-Nights** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **1999 6/12-6/18** | 50 traps | 50 traps | 50 traps | 50 traps | 50 traps | 50 traps | 50 traps | 50 traps | NS | NS | 2800 |
| **1999 9/4-9/10** | 50 traps | 50 traps | 50 traps | NS | 50 traps | 50 traps | 50 traps | 50 traps | NS | NS | 2450 |
| **2000 6/24-28 and 6/30** | 50 traps | 50 traps | 50 traps | NS | 50 traps | 50 traps | 50 traps | 50 traps | NS | NS | 2100 |
| **2001 6/9-6/15** | 50 traps | 50 traps | 50 traps | NS | NS | NS | 50 traps | 50 traps | 50 traps | 50 traps | 2100 |

NS: not sampled

**Figure 6. Preble's Meadow Jumping Mouse Sampling Sites at East Plum Creek Conservation Bank, Douglas County, CO.**



**Preble's Results**

Preble's were captured at all sampled sites with the exception of Site 4, an upland grassland (see Table 4). Preble's have been captured during June sampling at sites 3,5, and 6 in all years (sites 5 and 6 overlap with sites 9 and 10). Site 8 has unusually high numbers of animals.

Seven individual Preble's were found in 2001 at the sites that had recently been disturbed from 5th Street or check dam construction actions. Fourteen of the sixteen female Preble's captured in that session were reproductive (all sites).

**Table 4. Preble's Model Population Estimates (N-hat values) from Several Sites in East Plum Creek Conservation Bank, Douglas County, CO.**

| | Estimated Population (N-hat values) | | | |
|---|---|---|---|---|
| | Session | | | |
| Site | Jun-99 | Sep-99 | Jun-00 | Jun-01 |
| 1 | 4.0 | 0 | 4.1 | 0 |
| 2 | 4.0 | 0 | 0 | 0 |
| 3 | 3.0 | 1 | 1 | 4 |
| 4 | 0 | | | |
| 5 | 6.4 | 0 | 2.0 | |
| 6 | 3.0 | 1 | 3.0 | |
| 7 | 2 | 0 | 1 | 3 |
| 8 (outside bank) | 39.4 | 11.76018 | 27.16444 | 16.41864 |
| 9 | | | | 2 |
| 10 | | | | 2 |
| TOTAL | 61.8717334 | 13.76018 | 38.28056 | 27.41864 |
| Mean | 7.733966675 | 1.96574 | 5.468651 | 3.916948 |
| SE(Mean) | 4.576197111 | 1.642102 | 3.653134 | 2.155692 |

N-hat values are model population estimates. Sites with shading were not sampled in that year.

Capture, recapture, and survival rates are given in Table 5. Average study area linear density values for sample sites are given in Table 6. Note that the population values given in Table 4 are not standardized for transect lengths (some sites have longer or shorter transects than other sites). The translation process from population values to linear density standardizes transects length; density values are based on mice $km^{-1}$ stream.

**Table 5. Preble's Meadow Jumping Mouse Capture, Recapture, and Survival Rates Determined from Capture/Recapture Data Collected from 1999-2001, Castle Rock, Douglas County, CO.**

| Rate Type | Rate (%) | Standard Error |
|---|---|---|
| Capture Rate (all sessions, sites and sexes) | 24.5 | 0.28 |
| Recapture Rate | 21.0 | 0.21 |
| Survival Summer 1999 | 2.76 | 0.701 |
| Winter 1999-2000 | 9.67 | 0.39 |
| Annual 2000-2001 | 11.51 | 0.31 |

**Table 6. Average Preble's Linear Density for Castle Rock Study Sites, 1999-2001.**

| Year | Linear Density mice $km^{-1}$ stream | Standard Error |
|---|---|---|
| 1999 | 38.027 | 24.065 |
| 2000 | 27.779 | 19.140 |
| 2001 | 18.764 | 11.408 |

**Preble's Discussion**

Population sampling from 1999-2001 show that there is a persistent population of jumping mice on East Plum Creek within the bank area and at one site (site 8) northwest of the bank. Site 8 has very high levels of mice, and although not within the bank area, should be considered as a potential future addition to the bank.

Estimated population size is variable, as reflected at two geographical scales. The site, or smaller scale values, vary considerably year-to-year (Site 8 varied from 39.4 to 16.4 animals captured from 1999 to 2001); average linear density values (larger geographical scale) also vary, but less than site values.

Many investigators have found considerable within-study site variability in Preble's captures (personal communication, Preble's Research Group). This high variability may be partially attributed to the high dispersal capability of the mouse; Preble's can move upwards of 1.6 km within suitable habitat areas that do not have barriers or significant movement filters. Average density of several sites is considered a better measure of population dynamics than single site density values, because average density integrates within study area movement and shows less variation.

When the Castle Rock Preble's population is compared to other long-term study sites, it appears that the variation in density is within the range found at other sites (see Ensight 2002 for more data). The 2001 Preble's density of 18.76 mice $km^{-1}$ is similar to the Maytag 2001 estimate of 20.62 mice $km^{-1}$; Maytag is also on East Plum Creek, upstream of Castle Rock.

There are areas within the bank where Preble's have not been captured, primarily the areas 100-150 meters north and south of the Wolfensberger Bridge, and an area just north of the Plum Creek Parkway Bridge (opposite the old Justice Center, not sampled since 1998). Jumping mice have been found at Sites 1 and 2 in some years and not in others.

Jumping mouse movement has been primarily within-site. There are a few documented movements of animals between sites 2 and 3, between the East Plum Creek floodplain and an upland grassland along Sellers Gulch. However, live-trapping is not a particularly effective way of documenting movement, and we would expect additional movements between sites that have not been recorded by the trapping exercises.

Preble's jumping mouse populations found within the bank area are part of a larger East Plum Creek population. Preble's have been captured upstream of the bank area (most notably the Maytag property, Shenk and Sivert 1999) and also downstream near site 8. The Preble's population within the bank area (approximately 2.1 km of stream) has varied from 11 animals (2002) to 76 animals (1999), based on linear density estimates. It is unknown if the habitat in the bank is sufficient to support a self-sustaining Preble's population. However, it is clear that habitat within the bank serves to connect the upstream and downstream populations. If this bank habitat linkage was removed, the remaining populations would be at an increased risk of extinction because of increased habitat (and population) fragmentation.

Survival rates were calculated for one summer session (summer 1999), one winter session (winter 1999-2000) and for the annual period between summer 2000 and summer 2001. Summer survival was lower than the other two periods (2.76%); low summer survival has also been found at some study sites in El Paso and Boulder Counties (personal communication, Rob Schorr and Carron Meaney). Dirty Woman Creek in El Paso County had a higher summer survival value of 23.3% for summer 1998, but has a lower annual survival of 2.2% (compared to 11.5%, East Plum Creek). Survival is determined from recapture rates, and most researchers agree that live-trapping efforts do not allow for recapture of all animals in the study area. Despite the errors associated with determining survival, it does appear that Preble's summer survival is relatively low, with mice likely succumbing to a variety of predation and environmental factors.

A potential threat to Preble's in the study area is the invasion of Preble's habitat by other small mammals that can act as competitors or predators, primarily the house mouse (*Mus musculus*) and the Norway rat (*Rattus norvegicus*). Over the three years of survey work here, a few house mice have been captured each year, primarily in the Sellers Gulch area. No Norway rats have been found in the study area, despite the proximity of many urban influences.

Other potential threats include predation by the introduced bullfrog (*Rana catesbeiana*), which are known to feed on Preble's at the Maytag property (Shenk and Sivert, 1999). Bullfrogs have been seen occasionally in East Plum Creek at the study area, also near Sellers Gulch. Bullfrogs prefer the slower moving waters of ponds, reservoirs and marshes, but can inhabit streams if the current is not excessive (Hammerson 1999). The

new check dams on the creek will create potential bullfrog habitat, and bullfrog presence will be monitored in future sampling efforts.

## VI. References


Arcadis Geraghty & Miller. 2001a. Risk Assessment. Colorado Department of Transportation Maintenance Facility, 1000 North Wilcox Street, Castle Rock Colorado. Prepared for Colorado Department of Transportation.

Arcadis Geraghty & Miller. 2001b. Letter Report to Colorado Department of Transportation Office of Environmental Services regarding Monitoring Well Installation and Repair and Groundwater Sampling.

Arcadis Geraghty & Miller. 2001c. Soil Assessment Report. Colorado Department of Transportation Castle Rock Maintenance Facility. Prepared for Colorado Department of Transportation.

Bailey, R.G. 1995. *Description of the Ecoregions of the United States*. 2nd ed. rev. and expanded (1st ed. 1980). Miscellaneous Pub. 1391(rev.). USDA Forest Service. 108 p. with separate map at 1:7,500,000.

Colorado Division of Wildlife. 2001 a. Letter from CDOW to CDOT dated February 1, 2001, issuing SB40 certification for first three check dams.

Colorado Division of Wildlife. 2001 a. Letter from CDOW to CDOT dated December 7, 2001, issuing SB40 certification for remaining check dams.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United States*. FWS/OBS-79/31. U.S. Fish and Wildlife Service. Washington, DC.

Ensight Technical Services, Inc. 2002. Monitoring report on East Plum Creek Conservation Bank. Preble's Meadow Jumping Mouse and Vegetation Baseline Conditions Determined in Year 2001. Submitted to PBS&J for Colorado Department of Transportation.

Ensight Technical Services, Inc. 2001. Amendment to Preble's Meadow Jumping Mouse Biological Assessment for South I-25 Corridor and U.S. 85 Corridor Environmental Impact Statement, Douglas County, Colorado. Submitted to Colorado Department of Transportation.

Ensight Technical Services. 2000a. Addendum to Preble's Meadow Jumping Mouse Biological Assessment at 5th Street Site, Town of Castle Rock, Douglas County, CO. Submitted to Colorado Department of Transportation.

Ensight Technical Services, Inc. 2000b. Preble's Meadow Jumping Mouse Biological Assessment for South I-25 Corridor and U.S. 85 Corridor Environmental Impact Statement, Douglas County, Colorado. Submitted to Colorado Department of Transportation.

Ensight Technical Services. 1999a. Preble's Meadow Jumping Mouse Biological Assessment at 5th Street Site, Town of Castle Rock, Douglas County, CO. Submitted to Colorado Department of Transportation.

Ensight Technical Services. 1999a. Wolfensberger Bridge Biological Assessment, Town of Castle Rock, Douglas County, CO. Submitted to Colorado Department of Transportation.

Ensight Technical Services. 2000. Addendum to Preble's Meadow Jumping Mouse Biological Assessment at 5th Street Site, Town of Castle Rock, Douglas County, CO. Submitted to Colorado Department of Transportation.

Ensight Technical Services, Inc. 1998a. Presence or Absence Survey for Preble's Meadow Jumping Mouse at Castle Rock, Douglas County, Colorado. Prepared for Colorado Department of Transportation.

Ensight Technical Services, Inc. 1998b. Presence or Absence Survey for Preble's Meadow Jumping Mouse at North Castle Rock, Douglas County, Colorado. Prepared for Colorado Department of Transportation.

Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual*. Technical Report Y-87-1 (on-line edition). US Army Corps of Engineers. Waterways Experiment Sta. Vicksburg, Miss.

Friedman, J.M., W.R. Osterkamp, and W. M. Lewis, Jr. 1996. *The role of vegetation and bed-level fluctuations in the process of channel narrowing.* Geomorphology 14:341-351.

Great Plains Flora Association. 1986. T.M. Barkley, Ed. Flora of the Great Plains. University Press of Kansas. Lawrence, Kansas.

Hammerson, G.A. 1999. Amphibians and Reptiles in Colorado. Second Edition. University Press of Colorado and Colorado Division of Wildlife. 484 p.

Kollmorgen Corporation. 1994. (revised). *Munsell Soil Color Charts*. Macbeth division of Kollmorgen Instruments Corporation. New Windsor, NY.

Reed, P.B., Jr. 1988. *Edited Copy of National List of Plant Species that Occur in Wetlands: 1988 for Colorado*. NERC-88/18.06. National Wetlands Inventory. St. Petersburg, Fla.

Science Applications International Corporation (SAIC). 2000. Wetland Technical Report. South I-25 and US 85 Corridor EIS. Submitted to PBS&J Consulting. May 2000. Denver, Colorado.

United States Army Corps of Engineers. 2001 a. Letter dated January 8, 2001 from USACE to CDOT permitting first three check dams under exiting Nationwide Permit 23 (reference File No 200080358).

United States Army Corps of Engineers. 2001 a. Letter dated November 8, 2001 from USACE to CDOT permitting remaining check dams under exiting Nationwide Permit 23 (reference File No 200180421).

United States Geological Survey (USGS). 2000. Online data for Peak Flows for the Gaging Station at Plum Creek Near Louviers, Colorado (Sta.# 06709500). *http://waterdata.usgs.gov/ nwis-w/CO/data.components/peak.cgi?statnum=06709500& bdate_year=1948&edate_year= 1989&peaktype=all&mode=data&dateformat=0* (accessed August 14, 2000).
United States Department of Agriculture, Natural Resources Conservation Service (USDA-NRCS). 1995. *WETS Table Documentation.* Water and Climate Center. Portland, Oregon. May 15, 1995.

United States Department of Agriculture, Natural Resources Conservation Service (USDA-NRCS). 1996. Climate data from WETS Station: Castle Rock, CO 1401. Creation date 6/24/1996. Start year 1961 – End year 1990. Data available online at: htt*p://ftp.wcc.nrcs.usda.gov/support/climate/wetlands/ co/08035.txt*. Accessed June 14, 1999.

United States Department of Agriculture, Natural Resources Conservation Service (USDA-NRCS). 1999. Hydric soils of the United States. *www.statlab.iastate.edu/soils/hydric/ intro.html#DEF*. Accessed Nov. 4, 1999.

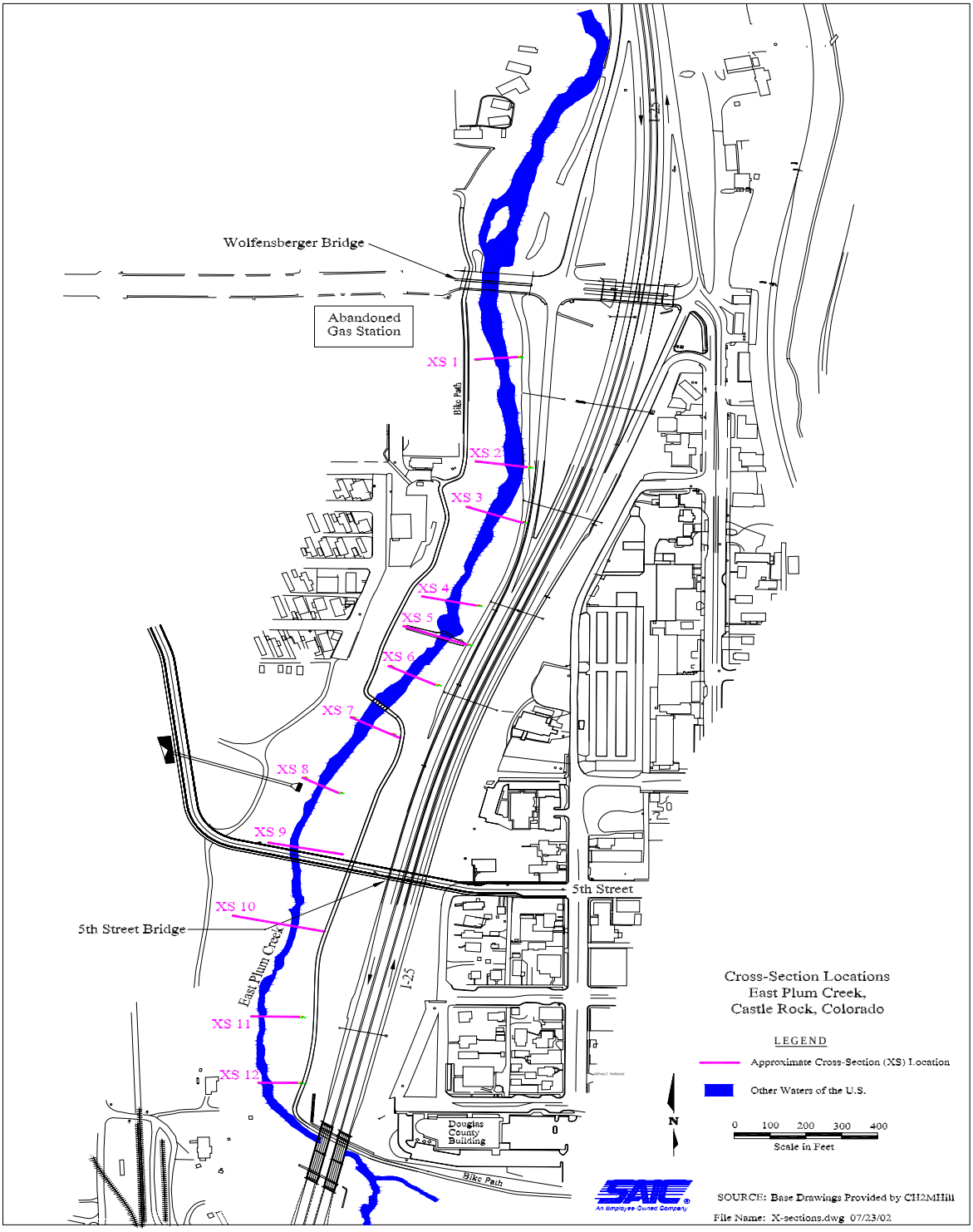
United States Department of Agriculture, Soil Conservation Service (USDA-SCS). 1991. *National Soils Handbook*. USDA Soil Conservation Service. Washington, DC.

United States Department of Agriculture, Soil Conservation Service (USDA-SCS). 1974. *Soil Survey of Castle Rock Area, Colorado*. USDA Soil Conservation Service in cooperation with Colorado Agricultural Experiment Station. Washington, DC.

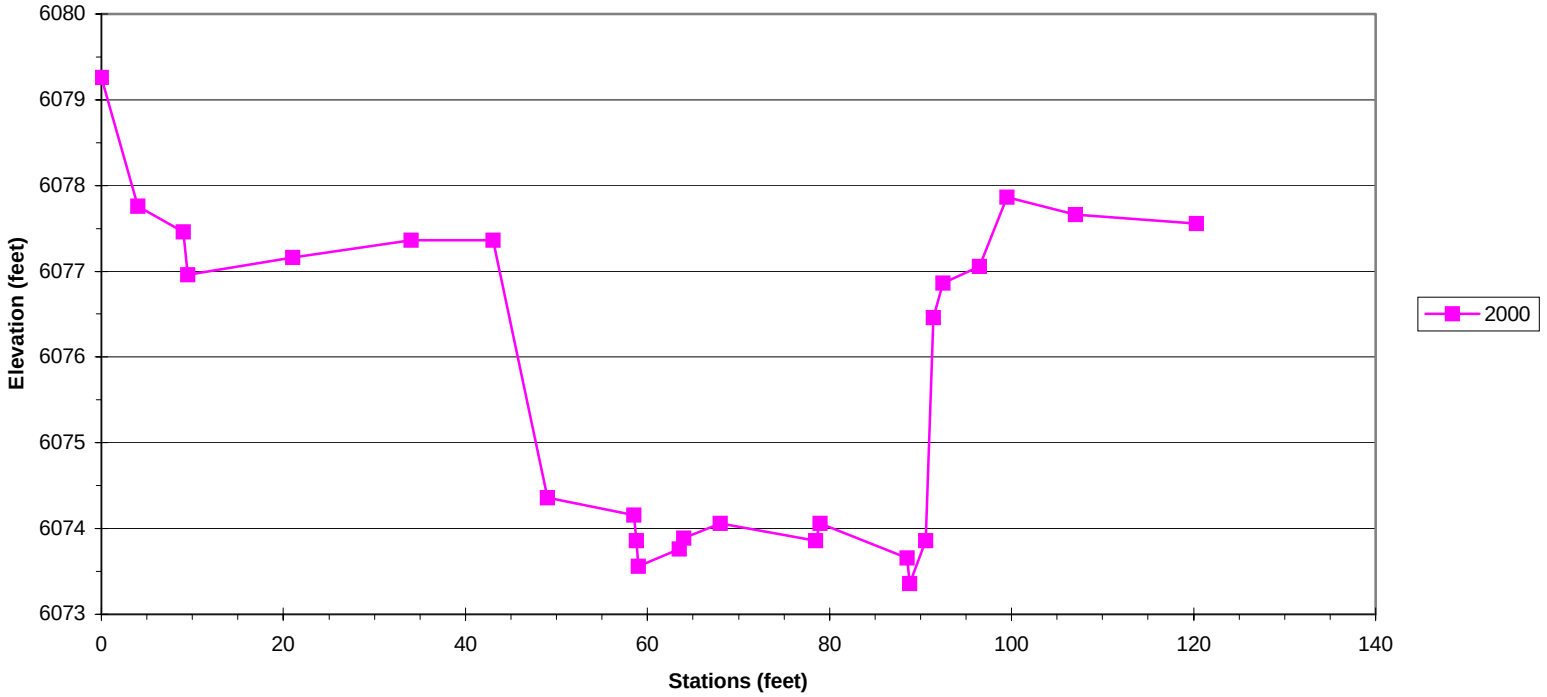
Weber, W. A. and R.C. Whittmann. 2001. Colorado Flora: Eastern Slope. University Press of Colorado. Boulder, Colorado.

## Appendix 1. Cross-Sections of East Plum Creek, Douglas County, CO

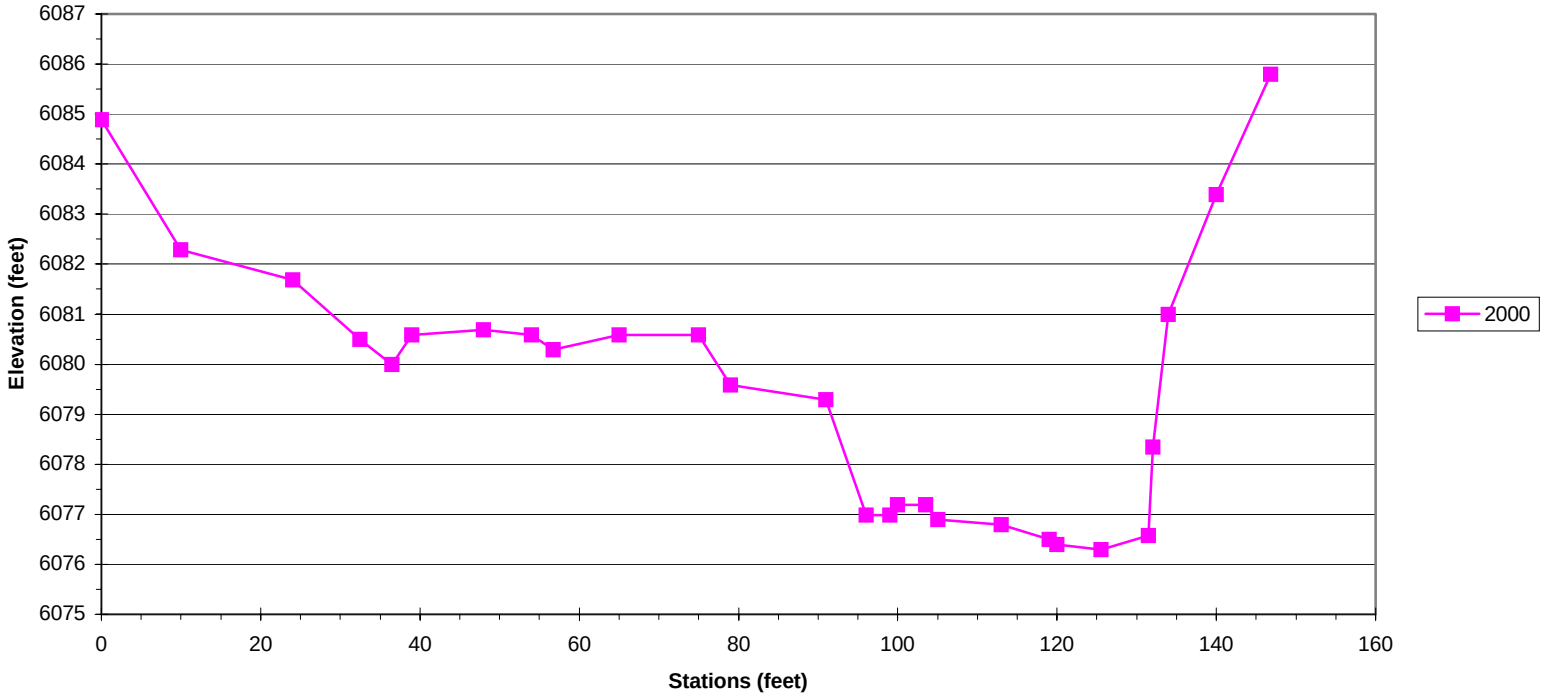
## Locations of Cross-Sections on East Plum Creek



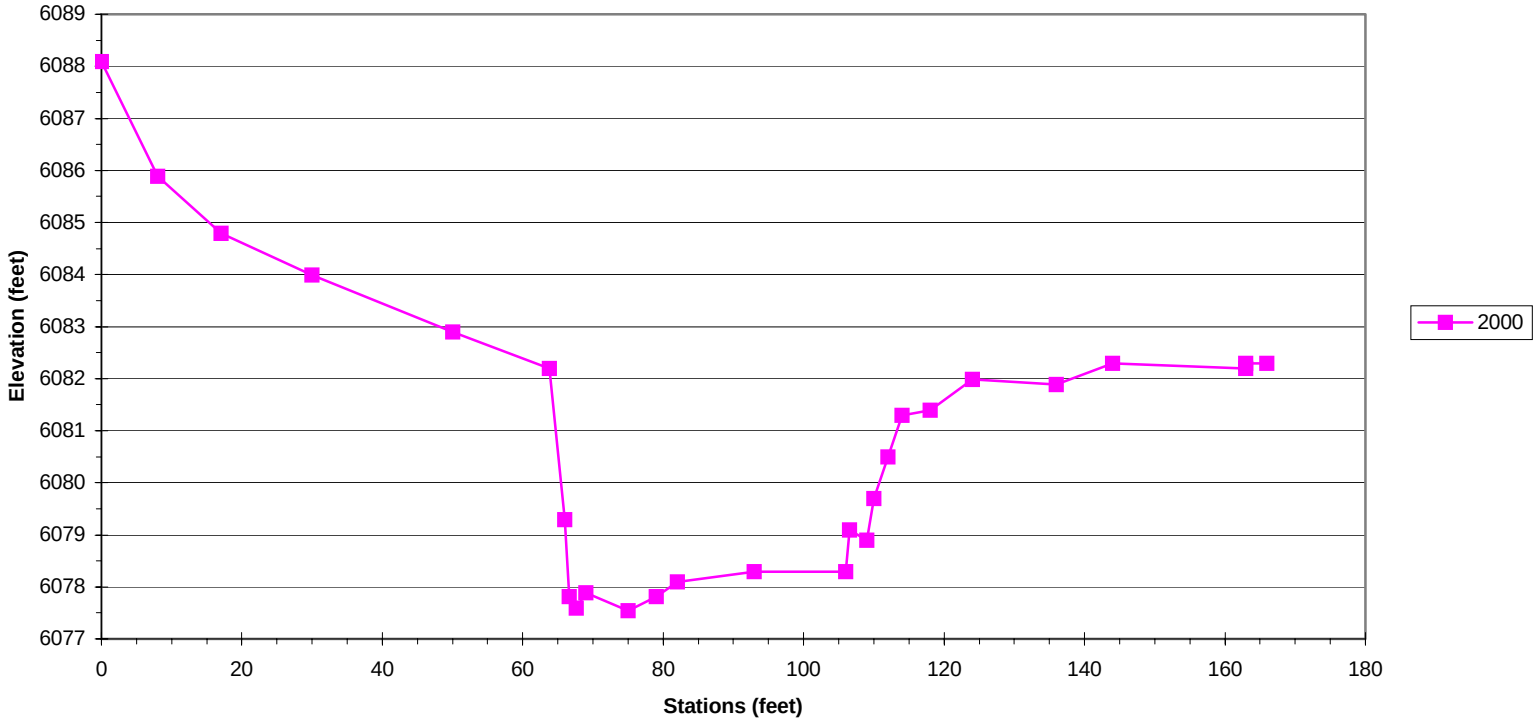
**Appendix 1. East Plum Creek - Castle Rock, Colorado**
**Cross-Section 1**



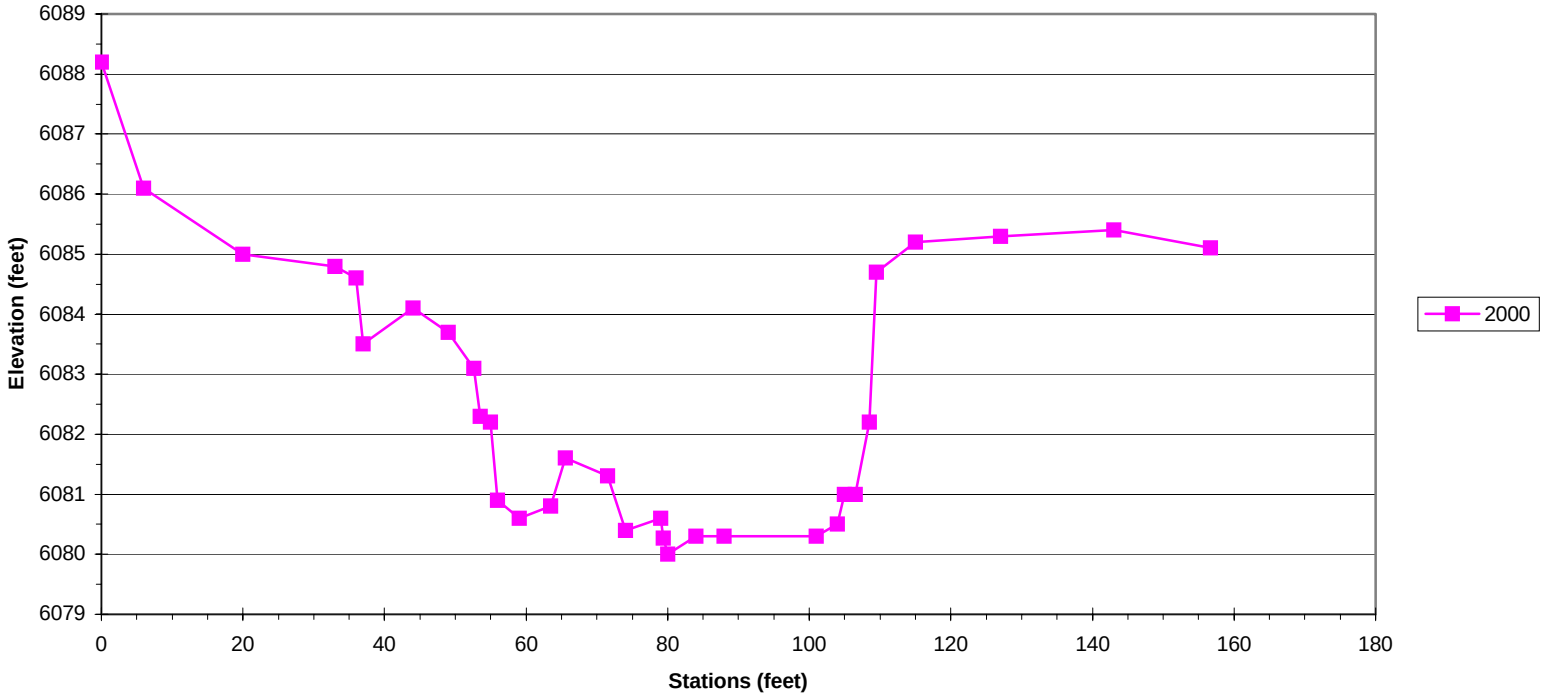
**Appendix 1. East Plum Creek - Castle Rock, Colorado**
**Cross-Section 2**



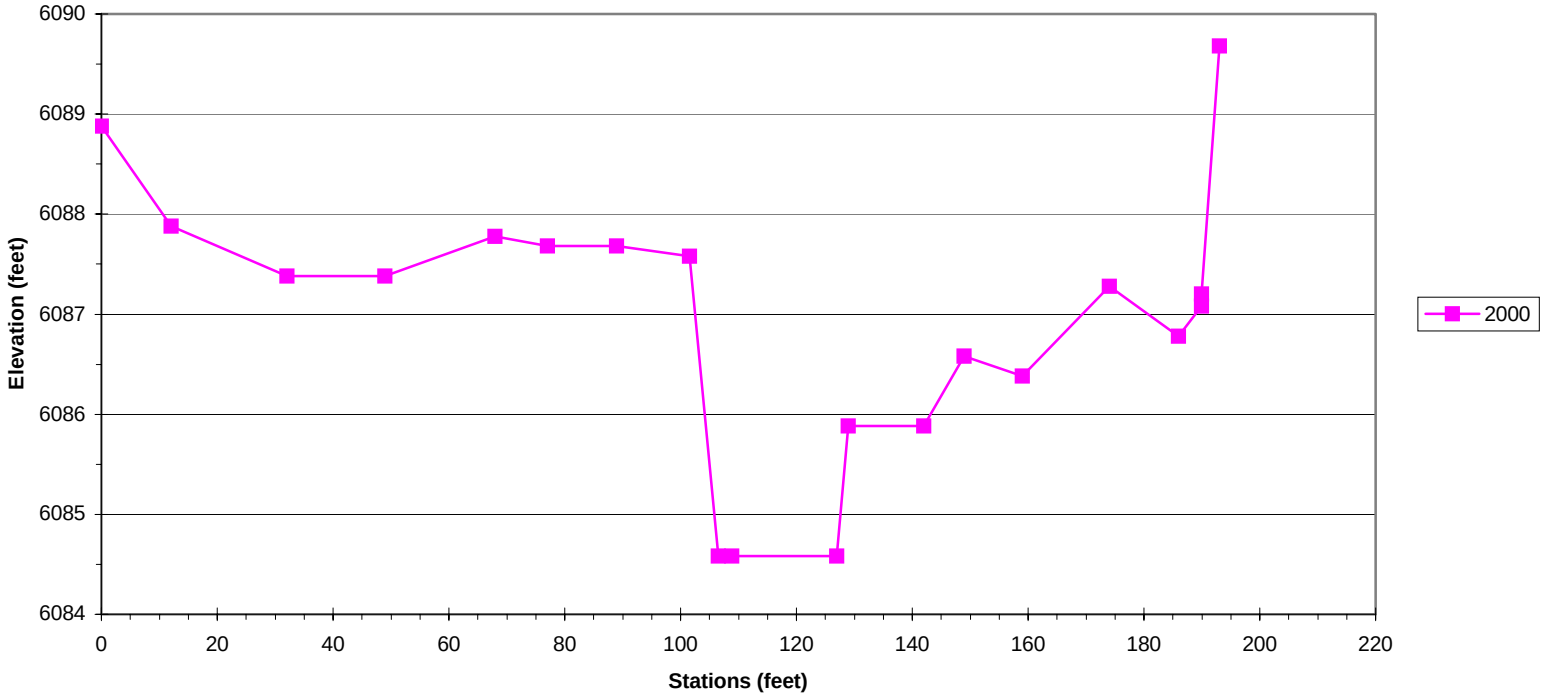
**Appendix 1. East Plum Creek - Castle Rock, Colorado**
**Cross-Section 3**



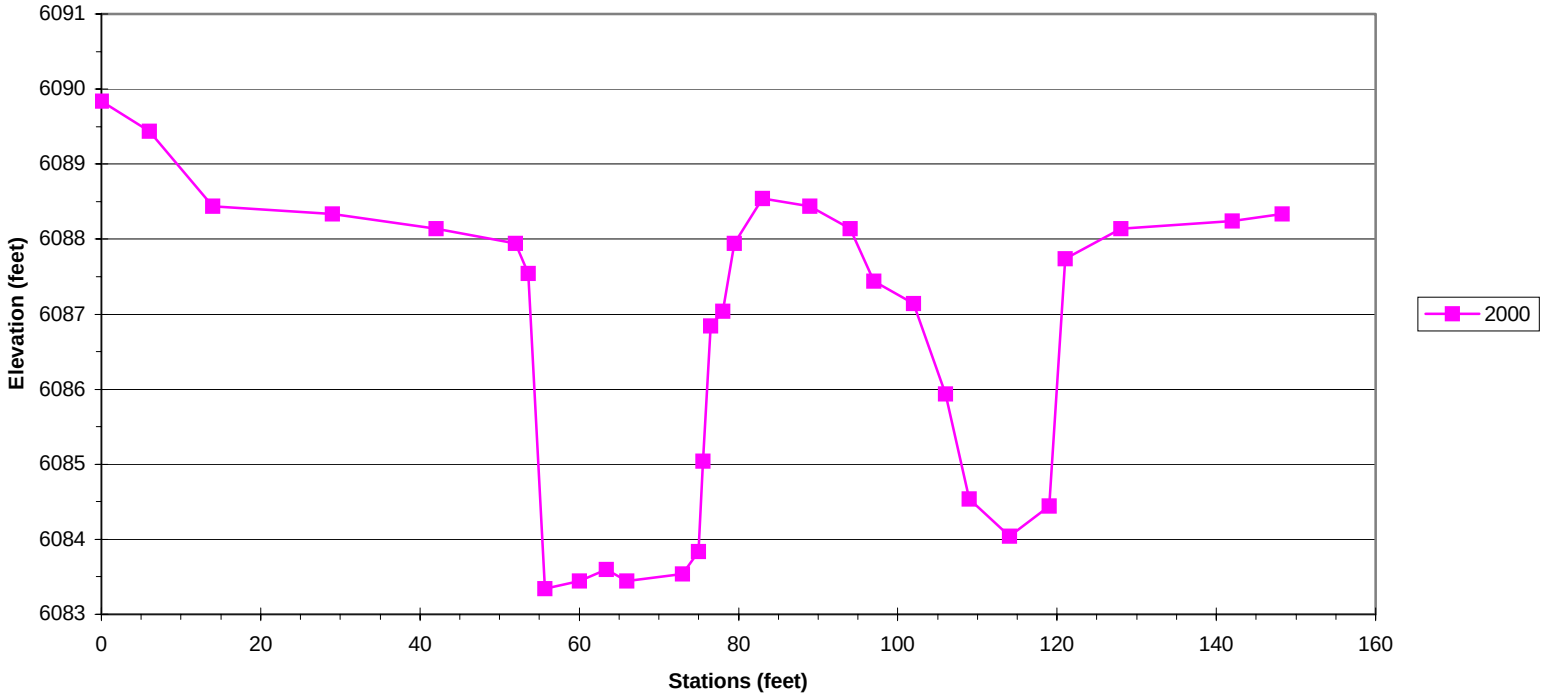
**Appendix 1. East Plum Creek - Castle Rock, Colorado**
**Cross-Section 4**



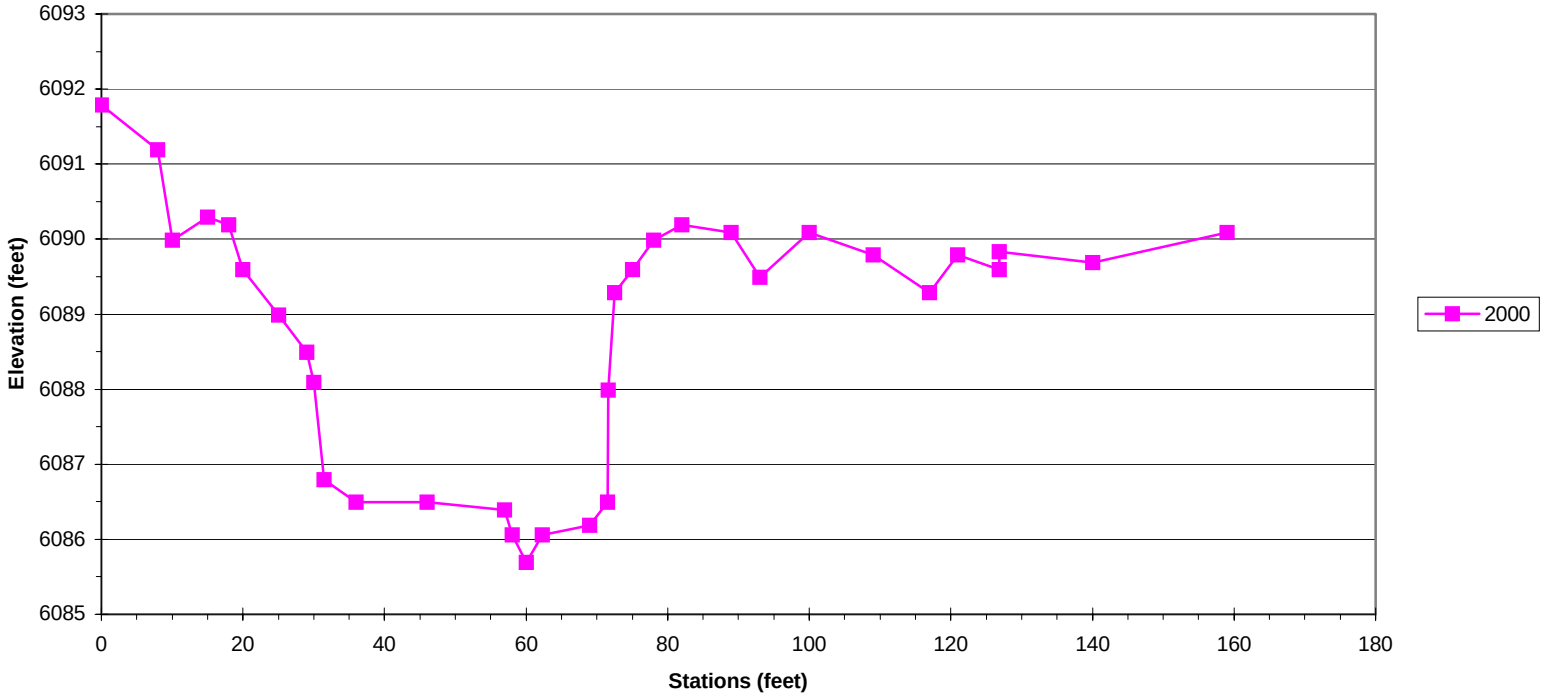
**East Plum Creek - Castle Rock, Colorado**
**Cross-Section 5**



**Appendix 1. East Plum Creek - Castle Rock, Colorado**
**Cross-Section 6**



**Appendix 1. East Plum Creek - Castle Rock, Colorado**
**Cross-Section 7**



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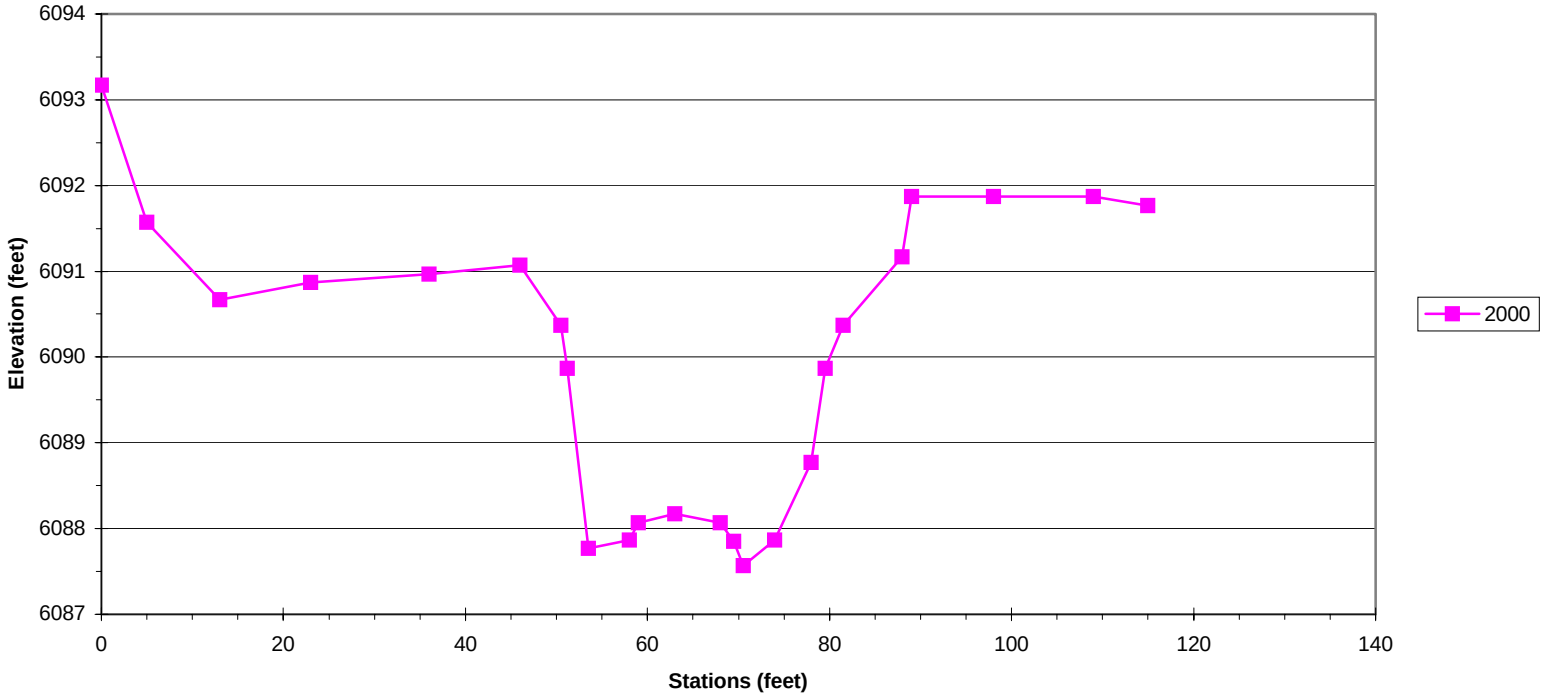
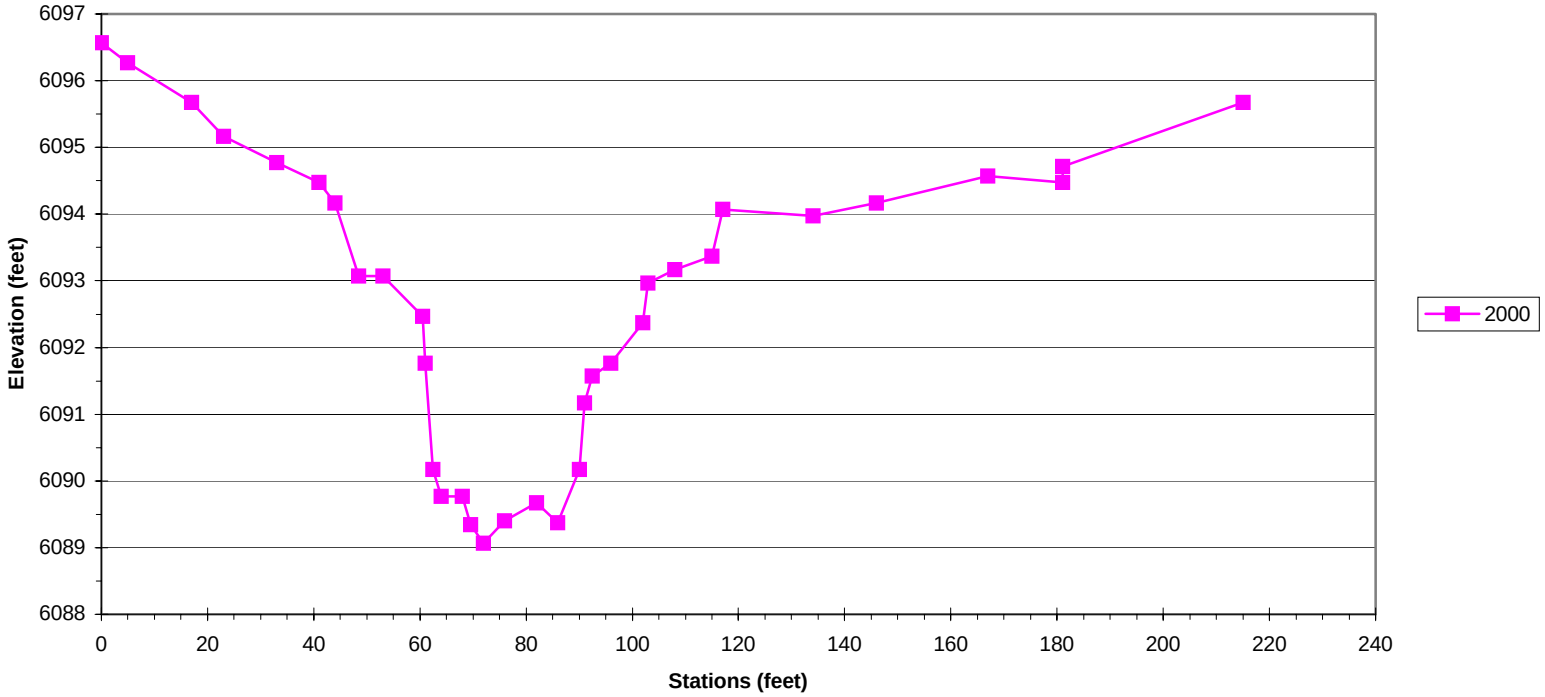
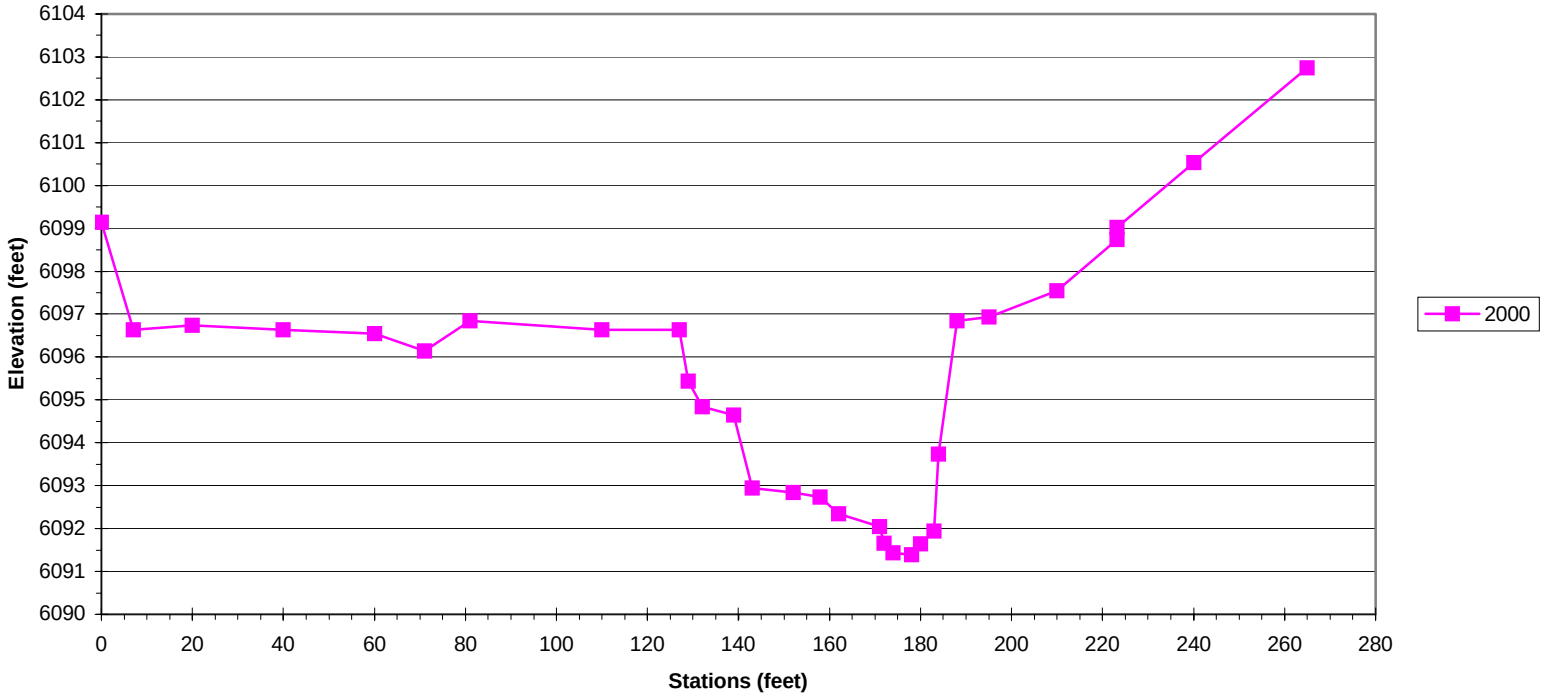
**Cross-Section 8**



**Appendix 1. East Plum Creek - Castle Rock, Colorado**
**Cross-Section 9**



**Appendix 1. East Plum Creek - Castle Rock, Colorado**
**Cross-Section 10**



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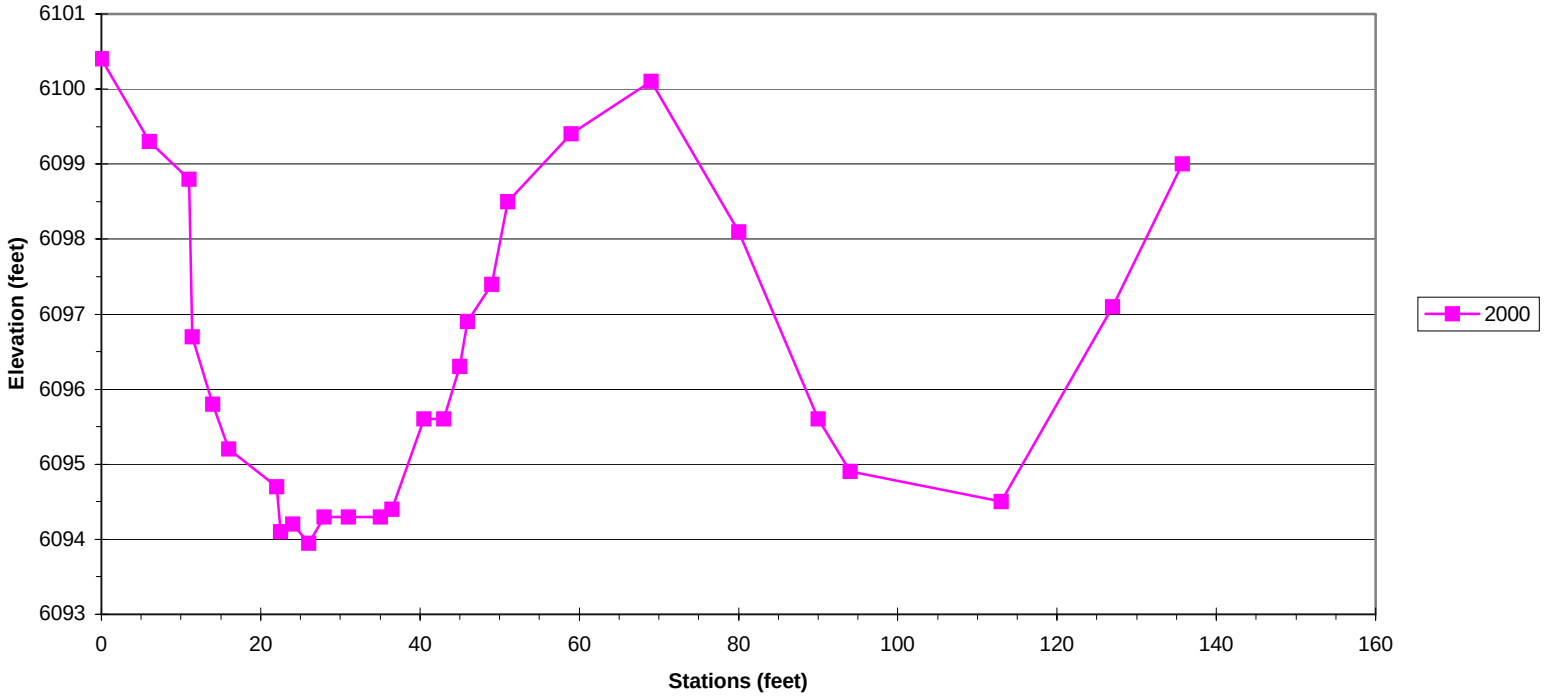
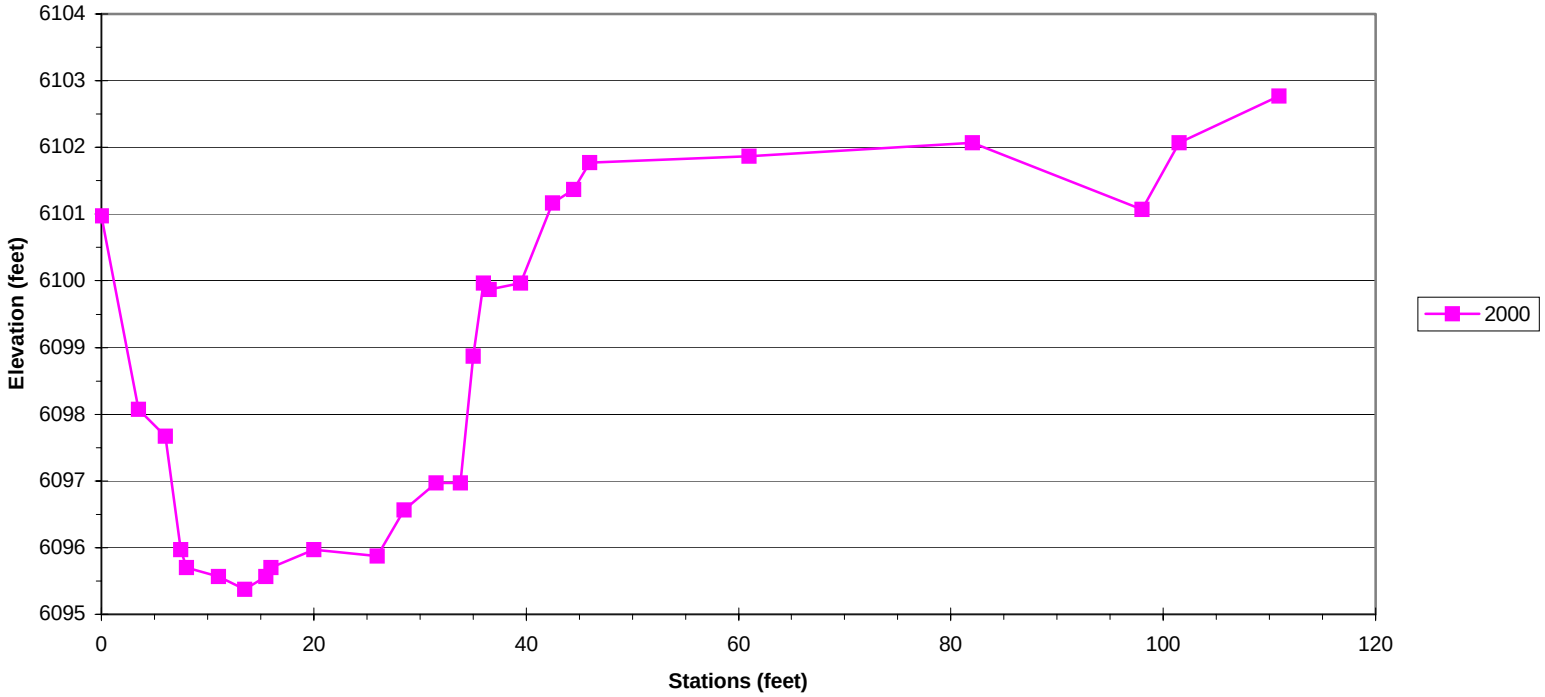
**Cross-Section 11**



**Appendix 1. East Plum Creek - Castle Rock, Colorado**
**Cross-Section 12**



**Appendix 2. List of Native Plant Species and Mean Percent Cover from Check Dam Areas 1-3, 2001, Castle Rock, Douglas County, CO**

| Count | Scientific Binomial | Common Name | Family | Mean Percent cover |
|---|---|---|---|---|
| 1 | *Salix exigua* | Sandbar willow | Salicaceae - Willow Family | 19.9 |
| 2 | *Carex* sp. | Sedge | Cyperaceae - Sedge Family | 7.6 |
| 3 | *Juncus* sp. | Rush | Juncaceae - Rush Family | 5.5 |
| 4 | *Salix lutea* | Yellow willow | Salicaceae - Willow Family | 5.5 |
| 5 | *Phalaris arundinacea* | Reed canarygrass | Poaceae - Grass Family | 3.1 |
| 6 | *Juncus interior* | Rush | Juncaceae - Rush Family | 2.1 |
| 7 | *Elymus canadensis* | Canada wild rye | Poaceae - Grass Family | 1.2 |
| 8 | *Ambrosia psilostachya* | Western ragweed | Asteraceae - Sunflower Family | 1.1 |
| 9 | *Thermopsis rhombifolia* | Prairie goldenpea | Fabaceae - Pea Family | 0.9 |
| 10 | *Conyza canadensis* | Horseweed | Asteraceae - Sunflower Family | 0.8 |
| 11 | *Elymus lanceolatus* subsp. *psammophilus* | Streambank wheatgrass | Poaceae - Grass Family | 0.5 |
| 12 | *Pascopyrum smithii* | Western wheatgrass | Poaceae - Grass Family | 0.5 |
| 13 | *Asclepias speciosa* | Showy milkweed | Asclepiadaceae - Milkweed Family | 0.4 |
| 14 | *Chondrosum gracile* | Blue grama | Poaceae - Grass Family | 0.4 |
| 15 | *Festuca* sp. | Fescue | Poaceae - Grass Family | 0.4 |
| 16 | *Hippochaete variegata* | Scouring-rush | Equisetaceae - Horsetail Family | 0.4 |
| 17 | *Rhus aromatica var. trilobata* | Skunkbrush | Anacardiaceae - Sumac Family | 0.4 |
| 18 | *Solidago canadensis* | Canada goldenrod | Asteraceae - Sunflower Family | 0.4 |
| 19 | *Symphoricarpos occidentalis* | Western snowberry | Caprifoliaceae - Honeysuckle Family | 0.4 |
| 20 | *Apocynum cannabinum* | Indian hemp | Apocynaceae - Dogbane Family | 0.3 |
| 21 | *Bouteloua curtipendula* | Side-oats grama | Poaceae - Grass Family | 0.3 |
| 22 | *Epilobium cilatum* | Willow herb | Onagraceae - Evening-primrose Family | 0.3 |
| 23 | *Panicum capillare* | Witchgrass | Poaceae - Grass Family | 0.3 |
| 24 | *Poa* sp. | Blue grass | Poaceae - Grass Family | 0.3 |
| 25 | *Populus x acuminata* | Cottonwood hybrid | Salicaceae - Willow Family | 0.3 |

**Appendix 2. List of Native Plant Species and Mean Percent Cover from Check Dam Areas 1-3, 2001, Castle Rock, Douglas County, CO**

| *Count* | **Scientific Binomial** | **Common Name** | **Family** | **Mean Percent cover** |
|---|---|---|---|---|
| 26 | *Stachys palustris subsp.pilosa* | Hedge-nettle | Lamiaceae - Mint Family | 0.3 |
| 27 | *Artemisia absinthium* | Wormwood | Asteraceae - Sunflower Family | 0.1 |
| 28 | *Artemisia dracunculus* | Dragon sagewort | Asteraceae - Sunflower Family | 0.1 |
| 29 | *Artemisia frigida* | Fringed sagebrush | Asteraceae - Sunflower Family | 0.1 |
| 30 | *Crataegus macracantha* var. *occidentalis* | Western hawthorn | Rosaceae - Rose Family | 0.1 |
| 31 | *Equisetum arvense* | Horsetail | Equisetaceae - Horsetail Family | 0.1 |
| 32 | *Erigeron* sp. | Fleabane | Asteraceae - Sunflower Family | 0.1 |
| 33 | *Chamaesyce glyptosperma* | Ridgeseed spurge | Euphorbiaceae - Spurge Family | 0.1 |
| 34 | *Helianthus annuus* | Common sunflower | Asteraceae - Sunflower Family | 0.1 |
| 35 | *Heterotheca villosa* | Hairy golden aster | Asteraceae - Sunflower Family | 0.1 |
| 36 | *Lepidium* sp. | Peppergrass | Brassicaceae - Mustard Family | 0.1 |
| 37 | *Padus virginiana subsp. melanocarpa* | Chokecherry | Rosaceae - Rose Family | 0.1 |
| 38 | *Populus angustifolia* | Narrowleaf cottonwood | Salicaceae – Willow Family | 0.1 |
| 39 | *Populus deltoides* | Plains cottonwood | Salicaceae – Willow Family | 0.1 |
| 40 | *Potentilla rivalis* | Brook cinquefoil | Rosaceae - Rose Family | 0.1 |
| 41 | *Solidago* sp. | Goldenrod | Asteraceae - Sunflower Family | 0.1 |

**Appendix 3. List of Exotic Plant Species and Mean Percent Cover from Check Dam Areas 1-3, 2001, Castle Rock, Douglas County, CO**

| Count | Scientific Binomial | Common Name | Family | Mean Percent cover |
|---|---|---|---|---|
| 1 | *Bromopis inermis* | Smooth bromegrass | Poaceae - Grass Family | 4.0 |
| 2 | *Centaurea diffusa* | Diffuse knapweed | Asteraceae - Sunflower Family | 1.2 |
| 3 | *Medicago sativa* | Alfalfa | Fabaceae - Pea Family | 0.9 |
| 4 | *Melilotus albus* | White sweetclover | Fabaceae - Pea Family | 0.9 |
| 5 | *Poa compressa* | Canada bluegrass | Poaceae - Grass Family | 0.7 |
| 6 | *Salix fragilis* | Crack willow | Salicaceae - Willow Family | 0.7 |
| 7 | *Ulmus pumila* | Chinese elm | Ulmaceae - Elm Family | 0.5 |
| 8 | *Agrostis* sp. | Bentgrass | Poaceae - Grass Family | 0.4 |
| 9 | *Anisantha tectorum* | Cheatgrass | Poaceae - Grass Family | 0.4 |
| 10 | *Agropyron cristatum* | Crested wheatgrass | Poaceae - Grass Family | 0.3 |
| 11 | *Alyssum parviflorum* | Alyssum | Brassicaceae - Mustard Family | 0.3 |
| 12 | *Breea arvensis* | Canada thistle | Asteraceae - Sunflower Family | 0.3 |
| 13 | *Convolvulus arvensis* | Field bindweed | Convolvulaceae - Morning Glory Family | 0.3 |
| 14 | *Medicago lupulina* | Black medic | Fabaceae - Pea Family | 0.3 |
| 15 | *Poa pratensis* | Kentucky bluegrass | Poaceae - Grass Family | 0.3 |
| 16 | *Prunus* sp. | Flowering plum | Rosaceae - Rose Family | 0.3 |
| 17 | *Trifolium* sp. | Clover | Fabaceae - Pea Family | 0.3 |
| 18 | *Chenopodium album* | Common lambsquarters | Chenopodiaceae - Goosefoot Family | 0.1 |
| 19 | *Persicaria maculata* | Lady's thumb | Polygonaceae - Buckwheat Family | 0.1 |
| 20 | *Triticum aestivum* | Wheat | Poaceae - Grass Family | 0.1 |